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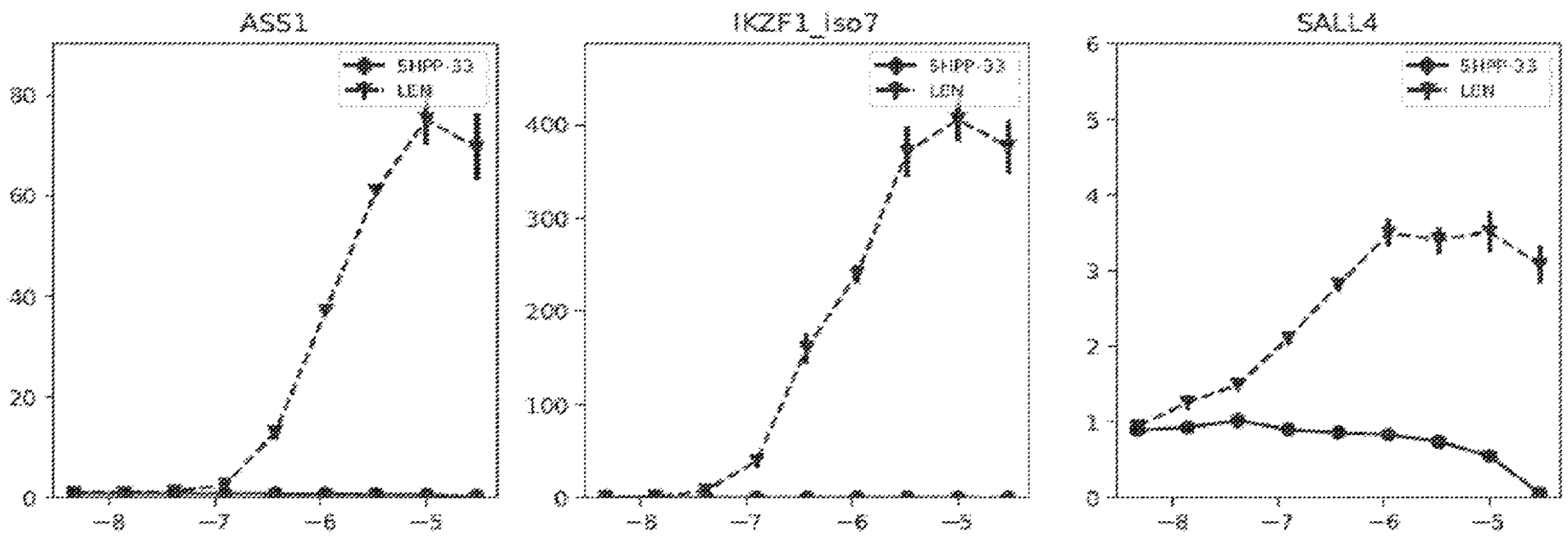


FIG. 1

(57) Abstract: The invention provides cereblon binders for the degradation of proteins by the ubiquitin proteasome pathway for therapeutic applications.

WO 2021/126973 A1

COMPOUNDS MODULATING PROTEIN RECRUITMENT AND/OR DEGRADATION

FIELD OF THE INVENTION

[0001] The invention provides cereblon binders for the degradation of proteins by the ubiquitin proteasome pathway for therapeutic applications as described further herein.

CROSS-REFERENCE TO RELATED APPLICATIONS

[0002] This application claims the benefit of U.S. Provisional Application No. 62/949,027, filed on December 17, 2019, the entire contents of which are incorporated herein.

BACKGROUND OF THE INVENTION

[0003] Protein degradation is a highly regulated and essential process that maintains cellular homeostasis. The selective identification and removal of damaged, misfolded, or excess proteins is achieved via the ubiquitin-proteasome pathway (UPP). The UPP is essential to the regulation of almost all cellular processes.

[0004] Covalent attachment of multiple ubiquitin molecules by an E3 ubiquitin ligase to a terminal lysine residue marks the protein for proteasome degradation, where the protein is digested into small peptides and eventually into its constituent amino acids that serve as building blocks for new proteins.

[0005] Thalidomide and its analogues have been found to bind to the ubiquitin ligase cereblon and redirect its ubiquitination activity (Ito, T. et al., Science, 2010, 327: 1345). Cereblon forms part of an E3 ubiquitin ligase complex which interacts with damaged DNA binding protein, forming an E3 ubiquitin ligase complex with Cullin 4 and the E2-binding protein ROC1 (known as RBX1) where it functions as a substrate receptor to select proteins for ubiquitination. The binding of lenalidomide to cereblon facilitates subsequent binding of cereblon to Ikaros and Aiolos, leading to their ubiquitination and degradation by the proteasome (Lu, G. et al., Science, 2014, 343:305-309; Kronke, J. et al., Science, 2014, 343:301-305).

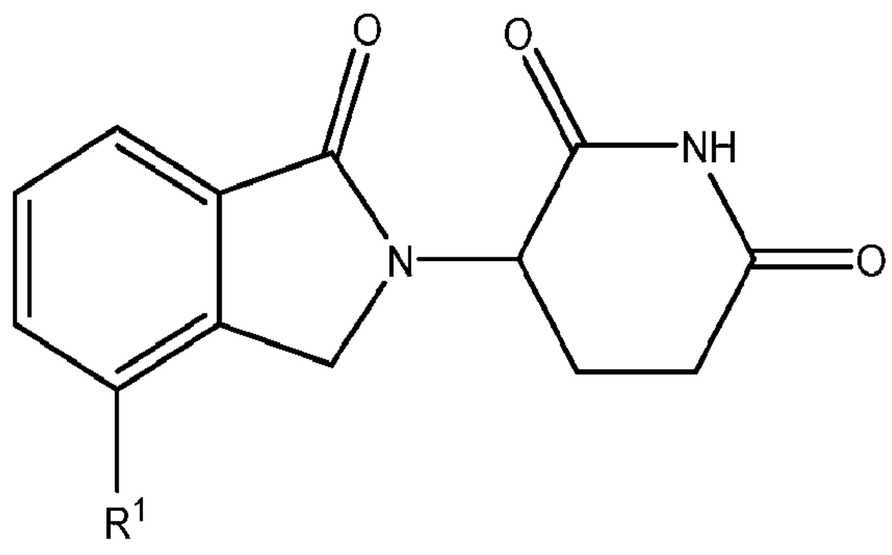
[0006] It is an object of the present invention to provide new compounds binding to cereblon and the use thereof for the treatment of various diseases and disorders, e.g. by modulating protein degradation.

SUMMARY OF THE INVENTION

[0007] New compounds that bind cereblon are provided, along with their uses and manufacture. It is believed, without wishing to be bound by theory, that binding of the disclosed compounds to cereblon results in increased or reduced interactions of cereblon with one or more of IKZF1, SALL4, and ASS1, leading to their subsequent ubiquitination and degradation in the proteasome. The selected compounds are found to be both potent binders of cereblon as well as showing potential therapeutic use. Accordingly, in various embodiments, the compounds are "molecular glues," and therefore can bind protein surfaces or interfaces, *e.g.* on cereblon, and stabilize interaction(s) with another protein, potentially resulting in the activation or suppression of a cellular response (e.g. ubiquitination and degradation in the proteasome).

[0008] Compounds disclosed herein, pharmaceutically acceptable salts thereof, or pharmaceutically acceptable compositions thereof can be used to treat a disorder mediated by cereblon, IKZF1, SALL4, or ASS1, *e.g.* various cancers and autoimmune diseases or disorders.

[0009] In one aspect, the compound of the present invention is selected from Formula I:



I

or a pharmaceutically acceptable salt thereof, wherein:

[0010] R^1 is aryl, $-N(R^5)-X-R^6$, $-SO_2R^5$, or $-O(CH_2)_mR^5$, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0011] R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0012] R^6 at each occurrence is independently OH, $(C_1\text{-}C_3)$alkyl, -$(C_1\text{-}C_3)$alkoxy, $(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, -$(CH_2)_n$-$(C_3\text{-}C_{10})$ cycloalkyl, -$(CH_2)_n$-$(C_3\text{-}C_{10})$heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing $(C_3\text{-}C_{10})$heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

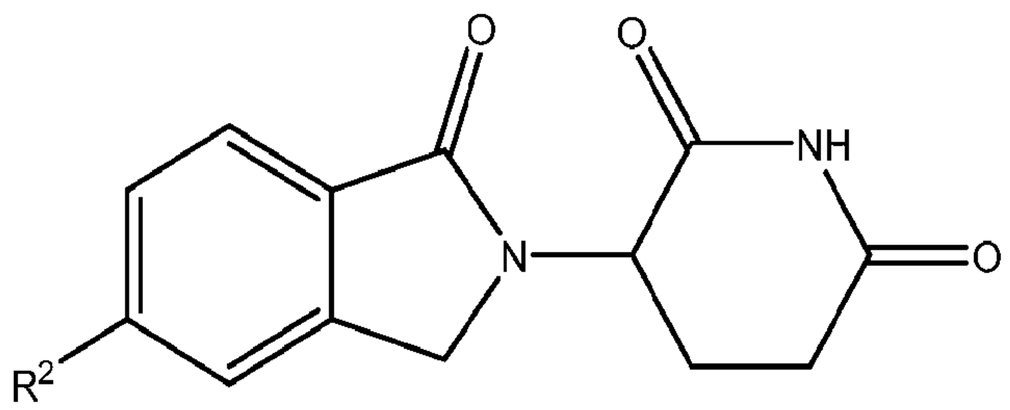
[0013] R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo$(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, -$(CH_2)_n$-$(C_3\text{-}C_{10})$ cycloalkyl, -$(CH_2)_n$-$(C_3\text{-}C_{10})$heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

[0014] X is a bond, -SO_2-, -$(CH_2)_nC(O)(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

[0015] m is 0, 1, 2, 3, or 4;

[0016] n is 0, 1, 2, 3, or 4.

[0017] In one aspect, the compound of the present invention is selected from Formula II:



II

or a pharmaceutically acceptable salt thereof, wherein:

[0018] R^2 is aryl, -NH-$(C_3\text{-}C_{10})$ heteroaryl, or -N(R^5)-$(CH_2)_m$-X-$(CH_2)_n$-R^6, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0019] R^5 at each occurrence is independently H, $(C_1\text{-}C_3)$alkyl, $(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, -$(CH_2)_n$-$(C_3\text{-}C_{10})$ cycloalkyl, -$(CH_2)_n$-$(C_3\text{-}C_{10})$heterocyclo, -$(CH_2)_n$-aryl, -

$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0020] R^6 at each occurrence is independently OH, $(C_1$-$C_3)$alkyl, -$(C_1$-$C_3)$alkoxy, $(C_3$-$C_{10})$heterocyclo, $(C_3$-$C_{10})$cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$ cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing $(C_3$-$C_{10})$heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

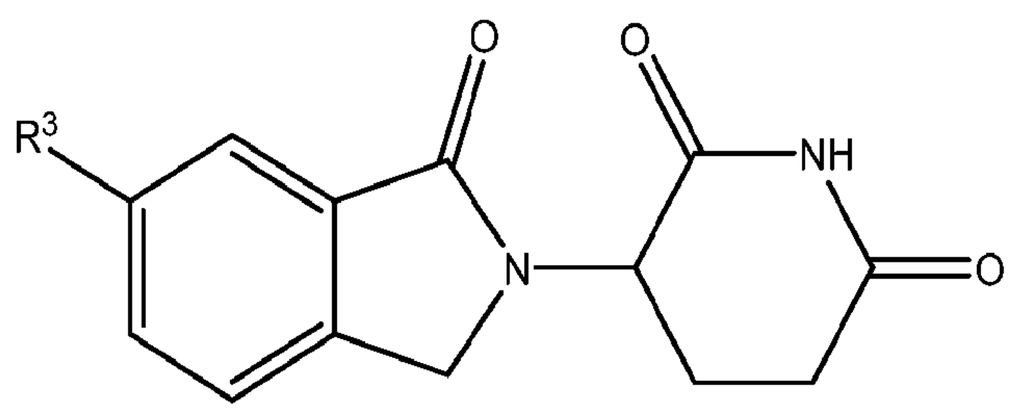
[0021] R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo$(C_3$-$C_{10})$heterocyclo, $(C_3$-$C_{10})$cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$ cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

[0022] X is a bond, -SO_2-, -$(CH_2)_n$C(O)$(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

[0023] m is 0, 1, 2, 3, or 4;

[0024] n is 0, 1, 2, 3, or 4.

[0025] In one aspect, the compound of the present invention is selected from Formula III:



III

or a pharmaceutically acceptable salt thereof, wherein:

[0026] R^3 is cyano, aryl, -NH-$(C_3$-$C_{10})$ heteroaryl, $(C_3$-$C_{10})$heterocyclo, or -N(R^5)-$(CH_2)_m$-X-$(CH_2)_n$-R^6, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0027] R^5 at each occurrence is independently H, $(C_1\text{-}C_3)$alkyl, $(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$ cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0028] R^6 at each occurrence is independently OH, $(C_1\text{-}C_3)$alkyl, $-(C_1\text{-}C_3)$alkoxy, $(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$ cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing $(C_3\text{-}C_{10})$heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

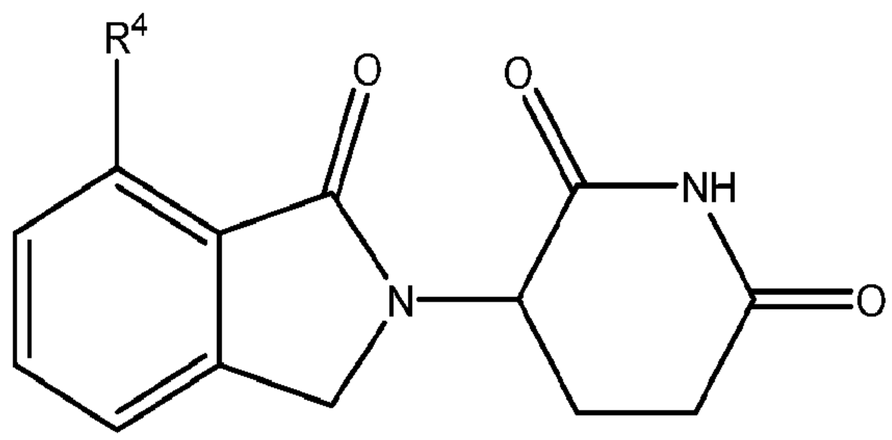
[0029] R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo$(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$ cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

[0030] X is a bond, $-SO_2$-, $-(CH_2)_nC(O)(CH_2)_m$-, -C(O)NH-, $-C(O)N(R^w)$-, -NHC(O)NH-, or $-(CH_2)_n$-;

[0031] m is 0, 1, 2, 3, or 4;

[0032] n is 0, 1, 2, 3, or 4.

[0033] In one aspect, the compound of the present invention is selected from Formula IV:



IV

or a pharmaceutically acceptable salt thereof, wherein:

[0034] R^4 is halo, cyano, aryl, OR^5, or $-N(R^5)-(CH_2)_m-X-(CH_2)_n-R^6$, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0035] R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0036] R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, $-(C_1-C_3)$alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

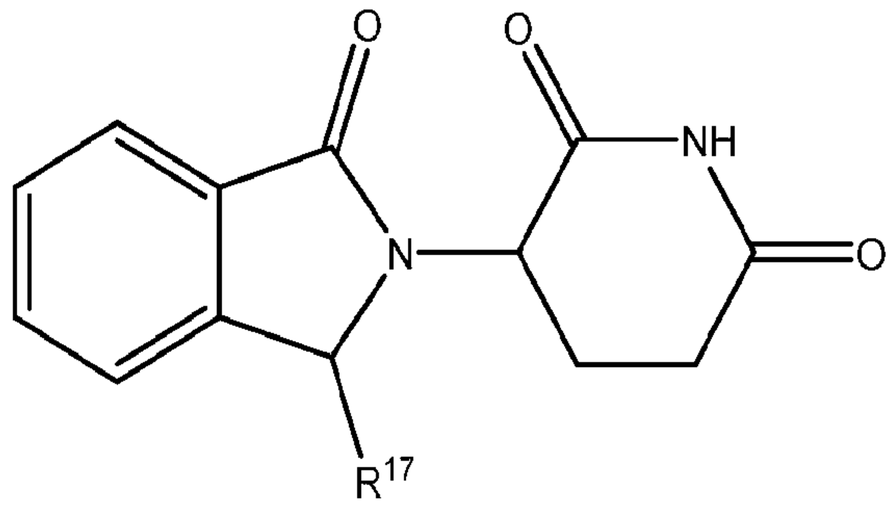
[0037] R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

[0038] X is a bond, $-SO_2-$, $-(CH_2)_nC(O)(CH_2)_m-$, $-C(O)NH-$, $-C(O)N(R^w)-$, $-NHC(O)NH-$, or $-(CH_2)_n-$;

[0039] m is 0, 1, 2, 3, or 4;

[0040] n is 0, 1, 2, 3, or 4.

[0041] In one aspect, the compound of the present invention is selected from Formula V:



V

or a pharmaceutically acceptable salt thereof, wherein:

[0042] R^{17} is cyano, heteroaryl, -$(CH_2)_m$-C(O)O-R^6, or -$N(R^5)$-$(CH_2)_m$-X-$(CH_2)_n$-R^6, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0043] R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0044] R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

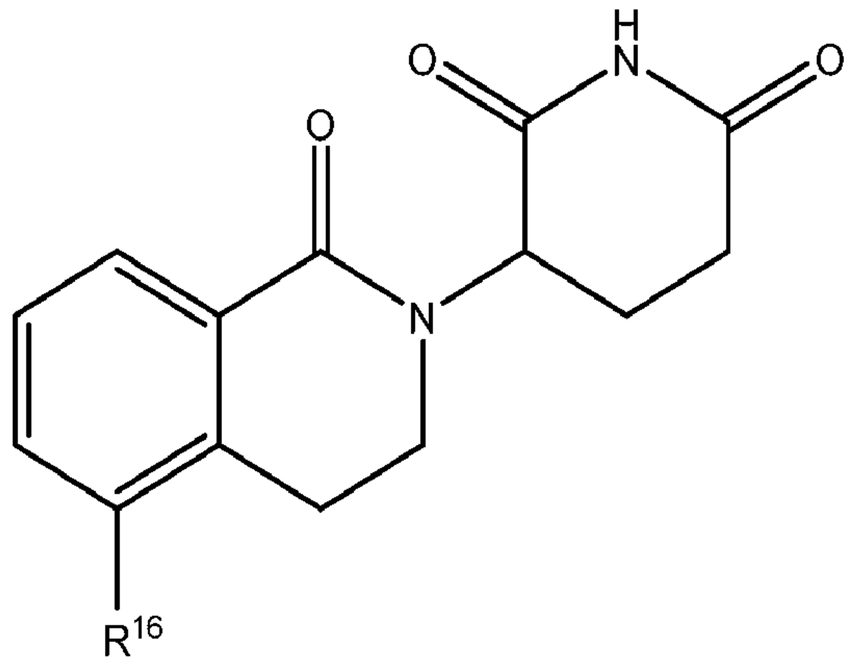
[0045] R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

[0046] X is a bond, -SO_2-, -$(CH_2)_n$C(O)$(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

[0047] m is 0, 1, 2, 3, or 4;

[0048] n is 0, 1, 2, 3, or 4.

[0049] In one aspect, the compound of the present invention is selected from Formula VI:



VI

or a pharmaceutically acceptable salt thereof, wherein:

[0050] R^{16} is NH_2 or $-N(R^5)-(CH_2)_m-X-(CH_2)_n-R^6$, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0051] R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0052] R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, $-(C_1-C_3)$alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

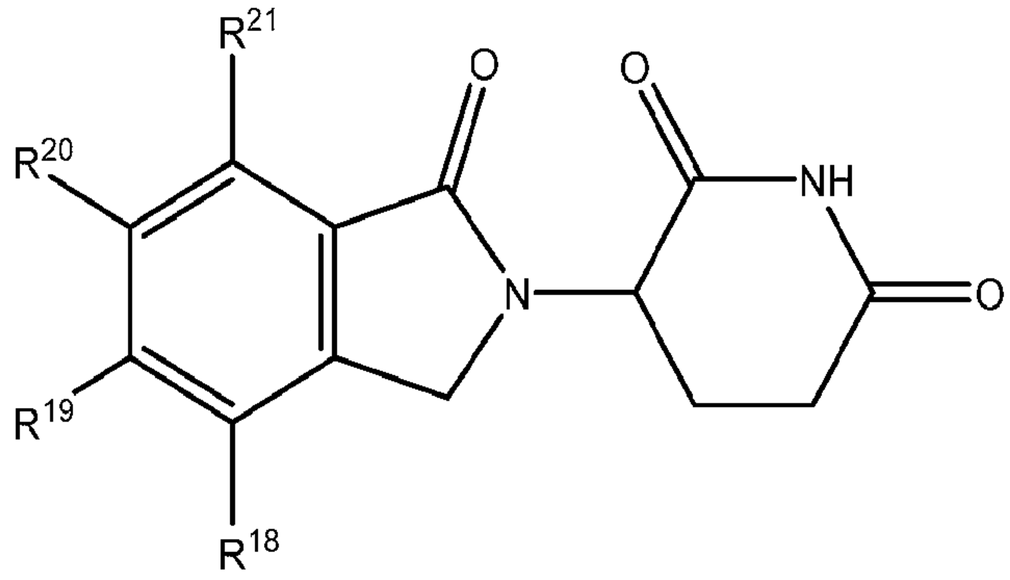
[0053] R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

[0054] X is a bond, $-SO_2-$, $-(CH_2)_nC(O)(CH_2)_m-$, -C(O)NH-, $-C(O)N(R^w)-$, -NHC(O)NH-, or $-(CH_2)_n-$;

[0055] m is 0, 1, 2, 3, or 4;

[0056] n is 0, 1, 2, 3, or 4.

[0057] In one aspect, the compound of the present invention is selected from Formula VII:



VII

or a pharmaceutically acceptable salt thereof, wherein:

[0058] R^{18}, R^{19}, R^{20}, R^{21} each independently is H, halo, (C_1-C_3)alkyl, or $-N(R^5)-X-R^6$, with the proviso that no more than two substituents of R^{18}, R^{19}, R^{20}, R^{21} are H; or

[0059] R^{18}, R^{19} taken together with the carbons they are attached to forming a (C_3-C_{10})cycloalkyl or a (C_3-C_{10})heterocyclo, or R^{19}, R^{20} taken together with the carbons they are attached to forming a (C_3-C_{10})cycloalkyl or a (C_3-C_{10})heterocyclo, or R^{20}, R^{21} taken together with the carbons they are attached to forming a (C_3-C_{10})cycloalkyl or a (C_3-C_{10})heterocyclo, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0060] R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0061] R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, $-(C_1-C_3)$alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

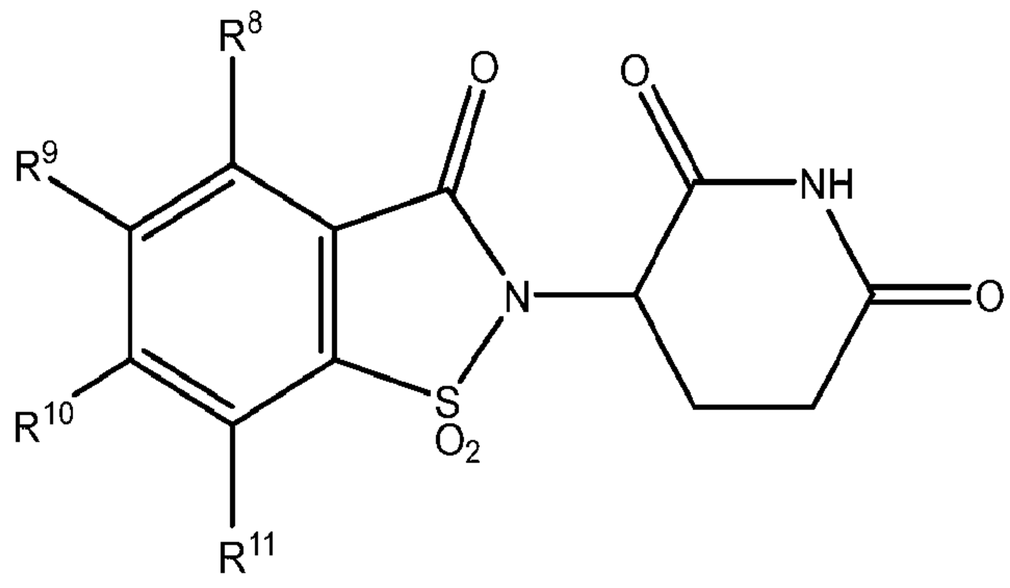
[0062] R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

[0063] X is a bond, -SO_2-, -$(CH_2)_nC(O)(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

[0064] m is 0, 1, 2, 3, or 4;

[0065] n is 0, 1, 2, 3, or 4.

[0066] In one aspect, the compound of the present invention is selected from Formula VIII:



VIII

or a pharmaceutically acceptable salt thereof, wherein:

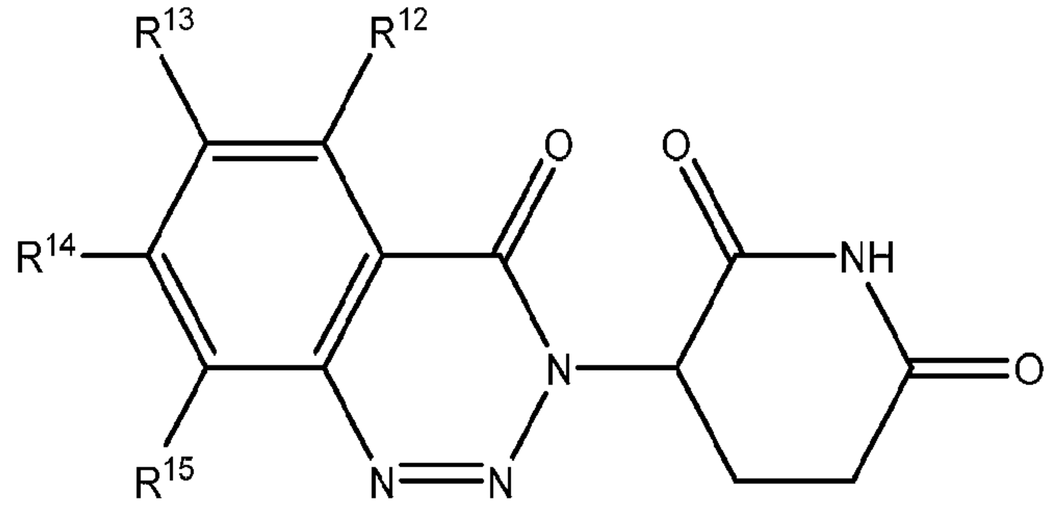
[0067] R^8, R^9, R^{10}, R^{11} each independently is H, halo, OH, cyano, (C_1-C_3)alkyl, (C_1-C_3)alkoxy, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0068] R^w at each occurrence is independently, H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-

C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

[0069] n is 0, 1, 2, 3, or 4.

[0070] In one aspect, the compound of the present invention is selected from Formula IX:



IX

or a pharmaceutically acceptable salt thereof, wherein:

[0071] R^{12}, R^{13}, R^{14}, R^{15} each is independently H, NH_2, (C_1-C_3)alkyl, -$N(R^5)$-(CH_2)m-$N(R^5)$-X-R^6, with proviso that no more than three substituents out of R^{12}, R^{13}, R^{14}, and R^{15} are H, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0072] R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0073] R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0074] R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with

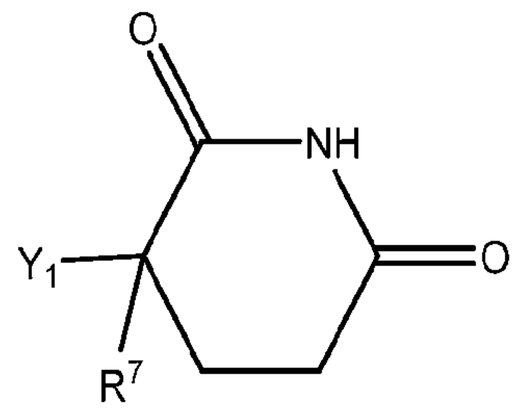
one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

[0075] X is a bond, -SO_2-, -$(CH_2)_nC(O)(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

[0076] m is 0, 1, 2, 3, or 4;

[0077] n is 0, 1, 2, 3, or 4.

[0078] In one aspect, the compound of the present invention is selected from Formula X:



X

or a pharmaceutically acceptable salt thereof, wherein:

[0079] Y is –NHR^{33}, -NHC(O)R^{33}, or –$CHR^{33}R^{34}$;

[0080] R^7 is H, (C_1-C_3)alkyl, or R^7 and R^{34} taken together with the carbons they are attached to forming a carbon carbon double bond;

[0081] R^{33} is aryl, heteroaryl, or (C_3-C_{10})heterocyclo, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

[0082] R^w at each occurrence is independently, H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

[0083] n is 0, 1, 2, 3, or 4.

[0084] In one aspect, the compound of the present invention is selected from the group consisting of:

3-[1-oxo-5-(quinazolin-4-ylamino)isoindolin-2-yl]piperidine-2,6-dione;

3-[5-[(4-aminothieno[2,3-d]pyrimidin-2-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

N-[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]acetamide;

3-[5-[(2-aminopyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

6-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]pyridazine-3-carbonitrile;

3-[[2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]acetyl]amino]benzamide;

2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]acetic acid;

N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]quinoline-2-carboxamide;

3-[6-[[2-(2-methyl-1-piperidyl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[(2-isoindolin-2-yl-2-oxo-ethyl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

N-(cyclopropylmethyl)-2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-methyl-acetamide;

acetic acid;3-[1-oxo-6-(quinazolin-4-ylamino)isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[[2-(3-methyl-1-piperidyl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[(4-methyl-3-oxo-pyrazin-2-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[1-oxo-6-(quinoxalin-2-ylamino)isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[(1-methylpyrazolo[3,4-d]pyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-(5,7-dihydrofuro[3,4-d]pyrimidin-2-ylamino)-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[(6-methylpyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-phenyl-acetamide;

3-[6-[[2-(2,4-dimethylpiperazin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-(dimethylamino)-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-(1-oxo-6-phenyl-isoindolin-2-yl)piperidine-2,6-dione;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N,N-dimethyl-acetamide;

3-[6-[[2-(2-methylmorpholin-4-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-methyl-N-[(1-methylpyrazol-4-yl)methyl]acetamide;

N-benzyl-2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetamide;

6-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]pyridazine-3-carbonitrile;

3-[6-[(6-methylpyrrolo[3,2-d]pyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

2-(dimethylamino)-N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]acetamide;

N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]-5H-pyrrolo[2,3-b]pyridine-4-carboxamide;

N-cyclopropyl-2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetamide;

3-[1-oxo-6-(2-oxoimidazolidin-1-yl)isoindolin-2-yl]piperidine-2,6-dione;

2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-5-carbonitrile;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]propanoic acid;

2-acetamido-N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]acetamide;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetamide;

3-[6-[[2-(3-methyl-5-oxo-piperazin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]acetamide;

3-[6-[[2-(4-methyl-3-oxo-piperazin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]-3H-imidazo[4,5-b]pyridine-6-carboxamide;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-tetrahydropyran-4-yl-acetamide;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetic acid;

3-[1-oxo-6-[[2-oxo-2-(1-piperidyl)ethyl]amino]isoindolin-2-yl]piperidine-2,6-dione;

3-(1-oxo-7-phenyl-isoindolin-2-yl)piperidine-2,6-dione;

2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-4-carbonitrile;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-4-yl]amino]acetic acid;

3-(7-fluoro-1-oxo-isoindolin-2-yl)piperidine-2,6-dione;

3-(5-amino-1-oxo-3,4-dihydroisoquinolin-2-yl)piperidine-2,6-dione;

t-butyl 2-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-1-yl]acetate;

3-[1-(2H-indol-3-yl)-3-oxo-isoindolin-2-yl]piperidine-2,6-dione;

2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-1-carbonitrile;

3-[1-(dimethylamino)-3-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-(2-oxopyrrolidin-1-yl)piperidine-2,6-dione;

3-(quinazolin-2-ylamino)piperidine-2,6-dione;

(3Z)-3-benzylidenepiperidine-2,6-dione;

3-(quinoxalin-2-ylamino)piperidine-2,6-dione;

3-(pyrimidin-2-ylamino)piperidine-2,6-dione;

N-(2,6-dioxo-3-piperidyl)-2-oxo-3H-pyridine-6-carboxamide;

3-(4-methyl-1,1,3-trioxo-1,2-benzothiazol-2-yl)piperidine-2,6-dione;

3-(8-amino-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione;

3-(5-amino-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione;

3-(4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione;

3-(5-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione;

3-(6-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione; and

3-(8-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione.

[0085] In one aspect, the present invention relates to a composition comprising a pharmaceutically effective amount of the compound described herein and a pharmaceutically acceptable carrier.

[0086] In one aspect, the present invention relates to a method of treating a disease comprising administering the composition comprising a pharmaceutically effective amount of the compound described herein and a pharmaceutically acceptable carrier to a subject in need thereof.

[0087] In one aspect, the present invention relates to a method of treating or preventing a cancer comprising administering the composition comprising a pharmaceutically effective amount of the compound described herein and a pharmaceutically acceptable carrier to a subject in need thereof. In an embodiment, the cancer is selected from the group consisting of squamous-cell carcinoma, basal cell carcinoma, adenocarcinoma, hepatocellular carcinomas, renal cell carcinomas, bladder cancer, bowel cancer, breast cancer, cervical cancer, colon cancer, esophageal cancer, head cancer, kidney cancer, liver cancer, lung cancer, neck cancer, ovarian cancer, pancreatic cancer, prostate cancer, stomach cancer, uterine cancer, leukemias,

lymphomas, Burkitt's lymphoma, Non-Hodgkin's lymphoma, melanomas, myeloproliferative diseases, multiple myeloma, sarcomas, including Ewing's sarcoma, hemangiosarcoma, Kaposi's sarcoma, liposarcoma, myosarcomas, peripheral neuroepithelioma, synovial sarcoma, gliomas, astrocytomas, oligodendrogliomas, ependymomas, glioblastomas, neuroblastomas, ganglioneuromas, gangliogliomas, medulloblastomas, pineal cell tumors, meningiomas, meningeal sarcomas, neurofibromas, Schwannomas, testicular cancer, thyroid cancer, astrocytoma, Hodgkin's disease, Wilms' tumor, and teratocarcinomas. In an embodiment, the subject is a human.

[0088] In another aspect, the present invention relates to a method of treating or preventing one or more autoimmune diseases or disorders comprising administering a composition comprising a pharmaceutically effective amount of the compound described herein and a pharmaceutically acceptable carrier to a subject in need thereof. In an embodiment, the autoimmune disease or disorder is selected from, such as multiple sclerosis, diabetes mellitus, lupus, celiac disease, Crohn's disease, ulcerative colitis, Guillain-Barre syndrome, scleroderms, Goodpasture's syndrome, Wegener's granulomatosis, autoimmune epilepsy, Rasmussen's encephalitis, Primary biliary sclerosis, Sclerosing cholangitis, Autoimmune hepatitis, Addison's disease, Hashimoto's thyroiditis, Fibromyalgia, Menier's syndrome; transplantation rejection (*e.g.*, prevention of allograft rejection) pernicious anemia, rheumatoid arthritis, systemic lupus erythematosus, dermatomyositis, Sjogren's syndrome, lupus erythematosus, multiple sclerosis, myasthenia gravis, Reiter's syndrome, Grave's disease, and other autoimmune diseases or disorders.

BRIEF DESCRIPTION OF THE DRAWINGS

[0089] The foregoing summary, as well as the following detailed description of the invention, will be better understood when read in conjunction with the appended drawings. References to various compounds are made with reference to Table 1 in Example 4.

[0090] FIG. 1 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with 5HPP-3 in comparison to lenalidomide (LEN).

[0091] FIG. 2 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C98696 in comparison to LEN. Lenalidomide is the top curve of the right panel.

[0092] FIG. 3 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C36126 in comparison to LEN.

[0093] FIG. 4 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C44292 in comparison to LEN.

[0094] FIG. 5 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C97402 in comparison to LEN.

[0095] FIG. 6 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C51830 in comparison to LEN.

[0096] FIG. 7 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C55468 in comparison to LEN.

[0097] FIG. 8 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C28661 in comparison to LEN.

[0098] FIG. 9 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C29137 in comparison to LEN.

[0099] FIG. 10 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C29408 in comparison to LEN.

[0100] FIG. 11 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C47997 in comparison to LEN.

[0101] FIG. 12 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C48009 in comparison to LEN.

[0102] FIG. 13 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C48020 in comparison to LEN.

[0103] FIG. 14 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C66979 in comparison to LEN.

[0104] FIG. 15 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C68121 in comparison to LEN.

[0105] FIG. 16 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C49708 in comparison to LEN.

[0106] FIG. 17 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C96622 in comparison to LEN.

[0107] FIG. 18 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C45748 in comparison to LEN.

[0108] FIG. 19 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C84961 in comparison to LEN.

[0109] FIG. 20 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C84964 in comparison to LEN.

[0110] FIG. 21 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C84966 in comparison to LEN.

[0111] FIG. 22 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C84971 in comparison to LEN.

[0112] FIG. 23 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C56572 in comparison to LEN.

[0113] FIG. 24 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C64324 in comparison to LEN.

[0114] FIG. 25 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C64376 in comparison to LEN.

[0115] FIG. 26 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80370 in comparison to LEN.

[0116] FIG. 27 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80375 in comparison to LEN.

[0117] FIG. 28 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80382 in comparison to LEN.

[0118] FIG. 29 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80383 in comparison to LEN.

[0119] FIG. 30 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80384 in comparison to LEN.

[0120] FIG. 31 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80386 in comparison to LEN.

[0121] FIG. 32 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80387 in comparison to LEN.

[0122] FIG. 33 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80389 in comparison to LEN.

[0123] FIG. 34 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80392 in comparison to LEN.

[0124] FIG. 35 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C98053 in comparison to LEN.

[0125] FIG. 36 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C49713 in comparison to LEN.

[0126] FIG. 37 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C11892 in comparison to LEN.

[0127] FIG. 38 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12581 in comparison to LEN.

[0128] FIG. 39 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12583 in comparison to LEN.

[0129] FIG. 40 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12584 in comparison to LEN.

[0130] FIG. 41 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12586 in comparison to LEN.

[0131] FIG. 42 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12595 in comparison to LEN.

[0132] FIG. 43 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12597 in comparison to LEN.

[0133] FIG. 44 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12598 in comparison to LEN.

[**0134**] FIG. 45 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C95330 in comparison to LEN.

[**0135**] FIG. 46 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C95333 in comparison to LEN.

[**0136**] FIG. 47 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C95338 in comparison to LEN.

[**0137**] FIG. 48 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C74668 in comparison to LEN.

[**0138**] FIG. 49 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C73349 in comparison to LEN.

[**0139**] FIG. 50 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C35833 in comparison to LEN.

[**0140**] FIG. 51 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with 5'-OH-THL in comparison to LEN.

[**0141**] FIG. 52 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C60651 in comparison to LEN.

[**0142**] FIG. 53 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C58181 in comparison to LEN.

[**0143**] FIG. 54 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with CC-122 in comparison to LEN.

[**0144**] FIG. 55 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with CC-220 in comparison to LEN.

[**0145**] FIG. 56 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with CC-885 in comparison to LEN.

[**0146**] FIG. 57 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C15352 in comparison to LEN.

[**0147**] FIG. 58 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C36124 in comparison to LEN.

[0148] FIG. 59 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C36128 in comparison to LEN.

[0149] FIG. 60 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with glutarimide in comparison to LEN.

[0150] FIG. 61 illustrates LEN's effects on cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding.

[0151] FIG. 62 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C10001 in comparison to LEN.

[0152] FIG. 63 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with POM in comparison to LEN.

[0153] FIG. 64 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with THL in comparison to LEN.

[0154] FIG. 65 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with CC07128 in comparison to LEN.

[0155] FIG. 66 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C38930 in comparison to LEN.

[0156] FIG. 67 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C38935 in comparison to LEN.

[0157] FIG. 68 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C75987 in comparison to LEN.

[0158] FIG. 69 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C87699 in comparison to LEN.

[0159] FIG. 70 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C24031 in comparison to LEN.

[0160] FIG. 71 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C07207 in comparison to LEN.

[0161] FIG. 72 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C89676 in comparison to LEN.

[**0162**] FIG. 73 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C28558 in comparison to LEN.

[**0163**] FIG. 74 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C28577 in comparison to LEN.

[**0164**] FIG. 75 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C28620 in comparison to LEN.

[**0165**] FIG. 76 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C28891 in comparison to LEN.

[**0166**] FIG. 77 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C28928 in comparison to LEN.

[**0167**] FIG. 78 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C28973 in comparison to LEN.

[**0168**] FIG. 79 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C29330 in comparison to LEN.

[**0169**] FIG. 80 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C29361 in comparison to LEN.

[**0170**] FIG. 81 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C29457 in comparison to LEN.

[**0171**] FIG. 82 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C29490 in comparison to LEN.

[**0172**] FIG. 83 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C14950 in comparison to LEN.

[**0173**] FIG. 84 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C24191 in comparison to LEN.

[**0174**] FIG. 85 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C02896 in comparison to LEN.

[**0175**] FIG. 86 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C47927 in comparison to LEN.

[0176] FIG. 87 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C47928 in comparison to LEN.

[0177] FIG. 88 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C47930 in comparison to LEN.

[0178] FIG. 89 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C47932 in comparison to LEN.

[0179] FIG. 90 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C47933 in comparison to LEN.

[0180] FIG. 91 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C47959 in comparison to LEN.

[0181] FIG. 92 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C47995 in comparison to LEN.

[0182] FIG. 93 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C47998 in comparison to LEN.

[0183] FIG. 94 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C48003 in comparison to LEN.

[0184] FIG. 95 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C48005 in comparison to LEN.

[0185] FIG. 96 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C48007 in comparison to LEN.

[0186] FIG. 97 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C48014 in comparison to LEN.

[0187] FIG. 98 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C48016 in comparison to LEN.

[0188] FIG. 99 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C48018 in comparison to LEN.

[0189] FIG. 100 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C22548 in comparison to LEN.

[**0190**] FIG. 101 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C22564 in comparison to LEN.

[**0191**] FIG. 102 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C22586 in comparison to LEN.

[**0192**] FIG. 103 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C22594 in comparison to LEN.

[**0193**] FIG. 104 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C22622 in comparison to LEN.

[**0194**] FIG. 105 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C30231 in comparison to LEN.

[**0195**] FIG. 106 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C29737 in comparison to LEN.

[**0196**] FIG. 107 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C67858 in comparison to LEN.

[**0197**] FIG. 108 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C68126 in comparison to LEN.

[**0198**] FIG. 109 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C55859 in comparison to LEN.

[**0199**] FIG. 110 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C23258 in comparison to LEN.

[**0200**] FIG. 111 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C47935 in comparison to LEN.

[**0201**] FIG. 112 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C05955 in comparison to LEN.

[**0202**] FIG. 113 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C49278 in comparison to LEN.

[**0203**] FIG. 114 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C39453 in comparison to LEN.

[**0204**] FIG. 115 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C51383 in comparison to LEN.

[**0205**] FIG. 116 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C99884 in comparison to LEN.

[**0206**] FIG. 117 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C34491 in comparison to LEN.

[**0207**] FIG. 118 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C98103 in comparison to LEN.

[**0208**] FIG. 119 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C96413 in comparison to LEN.

[**0209**] FIG. 120 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C35745 in comparison to LEN.

[**0210**] FIG. 121 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C35751 in comparison to LEN.

[**0211**] FIG. 122 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C35754 in comparison to LEN.

[**0212**] FIG. 123 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C35797 in comparison to LEN.

[**0213**] FIG. 124 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C35811 in comparison to LEN.

[**0214**] FIG. 125 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C35856 in comparison to LEN.

[**0215**] FIG. 126 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C23066 in comparison to LEN.

[**0216**] FIG. 127 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C39772 in comparison to LEN.

[**0217**] FIG. 128 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C51647 in comparison to LEN.

[**0218**] FIG. 129 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C40531 in comparison to LEN.

[**0219**] FIG. 130 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C84963 in comparison to LEN.

[**0220**] FIG. 131 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C84965 in comparison to LEN.

[**0221**] FIG. 132 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C84967 in comparison to LEN.

[**0222**] FIG. 133 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C84970 in comparison to LEN.

[**0223**] FIG. 134 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C64319 in comparison to LEN.

[**0224**] FIG. 135 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C64329 in comparison to LEN.

[**0225**] FIG. 136 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C64340 in comparison to LEN.

[**0226**] FIG. 137 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C64344 in comparison to LEN.

[**0227**] FIG. 138 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C64348 in comparison to LEN.

[**0228**] FIG. 139 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C64372 in comparison to LEN.

[**0229**] FIG. 140 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C89940 in comparison to LEN.

[**0230**] FIG. 141 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12697 in comparison to LEN.

[**0231**] FIG. 142 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C16899 in comparison to LEN.

[**0232**] FIG. 143 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80369 in comparison to LEN.

[**0233**] FIG. 144 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80373 in comparison to LEN.

[**0234**] FIG. 145 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80374 in comparison to LEN.

[**0235**] FIG. 146 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80376 in comparison to LEN.

[**0236**] FIG. 147 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80378 in comparison to LEN.

[**0237**] FIG. 148 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80379 in comparison to LEN.

[**0238**] FIG. 149 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80380 in comparison to LEN.

[**0239**] FIG. 150 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80385 in comparison to LEN.

[**0240**] FIG. 151 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80390 in comparison to LEN.

[**0241**] FIG. 152 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80391 in comparison to LEN.

[**0242**] FIG. 153 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80393 in comparison to LEN.

[**0243**] FIG. 154 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80394 in comparison to LEN.

[**0244**] FIG. 155 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80395 in comparison to LEN.

[**0245**] FIG. 156 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C80396 in comparison to LEN.

[**0246**] FIG. 157 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C33779 in comparison to LEN.

[**0247**] FIG. 158 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C46003 in comparison to LEN.

[**0248**] FIG. 159 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with CC08493 in comparison to LEN.

[**0249**] FIG. 160 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C09063 in comparison to LEN.

[**0250**] FIG. 161 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C09563 in comparison to LEN.

[**0251**] FIG. 162 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C10239 in comparison to LEN.

[**0252**] FIG. 163 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C10537 in comparison to LEN.

[**0253**] FIG. 164 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C10981 in comparison to LEN.

[**0254**] FIG. 165 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12582 in comparison to LEN.

[**0255**] FIG. 166 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12589 in comparison to LEN.

[**0256**] FIG. 167 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12693 in comparison to LEN.

[**0257**] FIG. 168 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12694 in comparison to LEN.

[**0258**] FIG. 169 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C12695 in comparison to LEN.

[**0259**] FIG. 170 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C95329 in comparison to LEN.

[0260] FIG. 171 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C95334 in comparison to LEN.

[0261] FIG. 172 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C95336 in comparison to LEN.

[0262] FIG. 173 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C59904 in comparison to LEN.

[0263] FIG. 174 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C75688 in comparison to LEN.

[0264] FIG. 175 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C35830 in comparison to LEN.

[0265] FIG. 176 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C13247 in comparison to LEN.

[0266] FIG. 177 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C16463 in comparison to LEN.

[0267] FIG. 178 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C17800 in comparison to LEN.

[0268] FIG. 179 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with C21223 in comparison to LEN.

[0269] FIG. 180 illustrates the change of cereblon's ability to recruit ASS1, IKZF1, and SALL4 after binding with ZE26-0001 in comparison to LEN.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

[0270] The term "H" denotes a single hydrogen atom. This radical may be attached, for example, to an oxygen atom to form a hydroxyl radical.

[0271] "/" indicates the double bond in E or Z configuration.

[0272] Where the term "alkyl" is used, either alone or within other terms such as "haloalkyl" or "alkylamino", it embraces linear or branched radicals having one to about twelve carbon atoms. More preferred alkyl radicals are "lower alkyl" radicals having one to about six carbon atoms. Examples of such radicals include methyl, ethyl, n-propyl, isopropyl,

n-butyl, isobutyl, *sec*-butyl, *tert*-butyl, pentyl, isoamyl, hexyl and the like. Even more preferred are lower alkyl radicals having one or two carbon atoms. The term “alkylenyl” or “alkylene” embraces bridging divalent alkyl radicals such as methylenyl or ethylenyl. The term "lower alkyl substituted with $R^{2"}$ does not include an acetal moiety. The term “alkyl” further includes alkyl radicals wherein one or more carbon atoms in the chain is substituted with a heteroatom selected from oxygen, nitrogen, or sulfur.

[0273] The term "alkenyl" embraces linear or branched radicals having at least one carbon-carbon double bond of two to about twelve carbon atoms. More preferred alkenyl radicals are "lower alkenyl" radicals having two to about six carbon atoms. Most preferred lower alkenyl radicals are radicals having two to about four carbon atoms. Examples of alkenyl radicals include ethenyl, propenyl, allyl, propenyl, butenyl and 4-methylbutenyl. The terms "alkenyl" and "lower alkenyl", embrace radicals having "cis" and "trans" orientations, or alternatively, "E" and "Z" orientations.

[0274] The term "alkynyl" denotes linear or branched radicals having at least one carbon-carbon triple bond and having two to about twelve carbon atoms. More preferred alkynyl radicals are "lower alkynyl" radicals having two to about six carbon atoms. Most preferred are lower alkynyl radicals having two to about four carbon atoms. Examples of such radicals include propargyl, and butynyl, and the like.

[0275] Alkyl, alkylenyl, alkenyl, and alkynyl radicals may be optionally substituted with one or more functional groups such as halo, hydroxy, nitro, amino, cyano, haloalkyl, aryl, heteroaryl, and heterocyclo and the like.

[0276] The term "halo" means halogens such as fluorine, chlorine, bromine or iodine atoms.

[0277] The term "haloalkyl" embraces radicals wherein any one or more of the alkyl carbon atoms is substituted with halo as defined above. Specifically embraced are monohaloalkyl, dihaloalkyl and polyhaloalkyl radicals including perhaloalkyl. A monohaloalkyl radical, for example, may have either an iodo, bromo, chloro or fluoro atom within the radical. Dihalo and polyhaloalkyl radicals may have two or more of the same halo atoms or a combination of different halo radicals. "Lower haloalkyl" embraces radicals having 1 to 6 carbon atoms. Even more preferred are lower haloalkyl radicals having one to three carbon atoms. Examples of haloalkyl radicals include fluoromethyl, difluoromethyl, trifluoromethyl, chloromethyl,

dichloromethyl, trichloromethyl, pentafluoroethyl, heptafluoropropyl, difluorochloromethyl, dichlorofluoromethyl, difluoroethyl, difluoropropyl, dichloroethyl and dichloropropyl.

[0278] The term "perfluoroalkyl" means alkyl radicals having all hydrogen atoms replaced with fluoro atoms. Examples include trifluoromethyl and pentafluoroethyl.

[0279] The term "hydroxyalkyl" embraces linear or branched alkyl radicals having one to about ten carbon atoms any one of which may be substituted with one or more hydroxyl radicals. More preferred hydroxyalkyl radicals are "lower hydroxyalkyl" radicals having one to six carbon atoms and one or more hydroxyl radicals. Examples of such radicals include hydroxymethyl, hydroxyethyl, hydroxypropyl, hydroxybutyl and hydroxyhexyl. Even more preferred are lower hydroxyalkyl radicals having one to three carbon atoms.

[0280] The term "alkoxy" embraces linear or branched oxy-containing radicals each having alkyl portions of one to about ten carbon atoms. More preferred alkoxy radicals are "lower alkoxy" radicals having one to six carbon atoms. Examples of such radicals include methoxy, ethoxy, propoxy, butoxy and *tert*-butoxy. Even more preferred are lower alkoxy radicals having one to three carbon atoms. Alkoxy radicals may be further substituted with one or more halo atoms, such as fluoro, chloro or bromo, to provide "haloalkoxy" radicals. Even more preferred are lower haloalkoxy radicals having one to three carbon atoms. Examples of such radicals include fluoromethoxy, chloromethoxy, trifluoromethoxy, trifluoroethoxy, fluoroethoxy and fluoropropoxy.

[0281] The term "aryl", alone or in combination, means a carbocyclic aromatic system containing one or two rings, wherein such rings may be attached together in a fused manner. The term "aryl" embraces aromatic radicals such as phenyl, naphthyl, indenyl, tetrahydronaphthyl, and indanyl. More preferred aryl is phenyl. An "aryl" group may have 1 or more substituents such as lower alkyl, hydroxyl, halo, haloalkyl, nitro, cyano, alkoxy, and lower alkylamino, and the like. Phenyl substituted with $-O-CH_2-O-$ forms the aryl benzodioxolyl substituent.

[0282] The term "heterocyclyl" (or “heterocyclo”) embraces saturated, partially saturated and unsaturated heteroatom-containing ring radicals, where the heteroatoms may be selected from nitrogen, sulfur and oxygen. It does not include rings containing -O-O-,-O-S- or -S-S- portions. The "heterocyclyl" group may have 1 to 4 substituents such as hydroxyl, Boc, halo, haloalkyl, cyano, lower alkyl, lower aralkyl, oxo, lower alkoxy, amino and lower alkylamino.

[**0283**] Examples of saturated heterocyclic radicals include saturated 3 to 6-membered heteromonocyclic groups containing 1 to 4 nitrogen atoms [e.g., pyrrolidinyl, imidazolidinyl, piperidinyl, pyrrolinyl, piperazinyl]; saturated 3 to 6-membered heteromonocyclic group containing 1 to 2 oxygen atoms and 1 to 3 nitrogen atoms [e.g., morpholinyl]; saturated 3 to 6-membered heteromonocyclic group containing 1 to 2 sulfur atoms and 1 to 3 nitrogen atoms [e.g., thiazolidinyl]. Examples of partially saturated heterocyclyl radicals include dihydrothienyl, dihydropyranyl, dihydrofuryl and dihydrothiazolyl.

[**0284**] Examples of unsaturated heterocyclic radicals, also termed "heteroaryl" radicals, include unsaturated 5 to 6 membered heteromonocyclyl group containing 1 to 4 nitrogen atoms, for example, pyrrolyl, imidazolyl, pyrazolyl, 2-pyridyl, 3-pyridyl, 4-pyridyl, pyrimidyl, pyrazinyl, pyridazinyl, triazolyl [e.g., 4H-1,2,4-triazolyl, 1H-1,2,3-triazolyl, 2H-1,2,3-triazolyl]; unsaturated 5- to 6-membered heteromonocyclic group containing an oxygen atom, for example, pyranyl, 2-furyl, 3-furyl, etc.; unsaturated 5 to 6-membered heteromonocyclic group containing a sulfur atom, for example, 2-thienyl, 3-thienyl, etc.; unsaturated 5- to 6-membered heteromonocyclic group containing 1 to 2 oxygen atoms and 1 to 3 nitrogen atoms, for example, oxazolyl, isoxazolyl, oxadiazolyl [e.g., 1,2,4-oxadiazolyl, 1,3,4-oxadiazolyl, 1,2,5-oxadiazolyl]; unsaturated 5 to 6-membered heteromonocyclic group containing 1 to 2 sulfur atoms and 1 to 3 nitrogen atoms, for example, thiazolyl, thiadiazolyl [e.g., 1,2,4-thiadiazolyl, 1,3,4-thiadiazolyl, 1,2,5-thiadiazolyl].

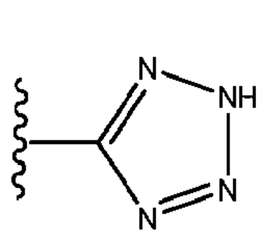
[**0285**] The term heterocyclyl, (or heterocyclo) also embraces radicals where heterocyclic radicals are fused/condensed with aryl radicals: unsaturated condensed heterocyclic group containing 1 to 5 nitrogen atoms, for example, indolyl, isoindolyl, indolizinyl, benzimidazolyl, quinolyl, isoquinolyl, indazolyl, benzotriazolyl, tetrazolopyridazinyl [e.g., tetrazolo [1,5-b]pyridazinyl]; unsaturated condensed heterocyclic group containing 1 to 2 oxygen atoms and 1 to 3 nitrogen atoms [e.g. benzoxazolyl, benzoxadiazolyl]; unsaturated condensed heterocyclic group containing 1 to 2 sulfur atoms and 1 to 3 nitrogen atoms [e.g., benzothiazolyl, benzothiadiazolyl]; and saturated, partially unsaturated and unsaturated condensed heterocyclic group containing 1 to 2 oxygen or sulfur atoms [e.g. benzofuryl, benzothienyl, 2,3-dihydro-benzo[1,4]dioxinyl and dihydrobenzofuryl]. Preferred heterocyclic radicals include five to ten membered fused or unfused radicals. More preferred examples of heteroaryl radicals include quinolyl, isoquinolyl, imidazolyl, pyridyl, thienyl, thiazolyl, oxazolyl, furyl and pyrazinyl. Other preferred heteroaryl radicals are 5- or 6-membered heteroaryl, containing one or two heteroatoms selected from sulfur, nitrogen and oxygen,

selected from thienyl, furyl, pyrrolyl, indazolyl, pyrazolyl, oxazolyl, triazolyl, imidazolyl, pyrazolyl, isoxazolyl, isothiazolyl, pyridyl, piperidinyl and pyrazinyl.

[0286] Particular examples of non-nitrogen containing heteroaryl include pyranyl, 2-furyl, 3-furyl, 2-thienyl, 3-thienyl, benzofuryl, and benzothienyl, and the like.

[0287] Particular examples of partially saturated and saturated heterocyclyl include pyrrolidinyl, imidazolidinyl, piperidinyl, pyrrolinyl, pyrazolidinyl, piperazinyl, morpholinyl, tetrahydropyranyl, thiazolidinyl, dihydrothienyl, 2,3-dihydro-benzo[1,4]dioxanyl, indolinyl, isoindolinyl, dihydrobenzothienyl, dihydrobenzofuryl, isochromanyl, chromanyl, 1,2-dihydroquinolyl, 1,2,3,4-tetrahydro-isoquinolyl, 1,2,3,4-tetrahydro-quinolyl, 2,3,4,4a,9,9a-hexahydro-1H-3-aza-fluorenyl, 5,6,7-trihydro-1,2,4-triazolo[3,4-a]isoquinolyl, 3,4-dihydro-2H-benzo[1,4]oxazinyl, benzo[1,4]dioxanyl, 2,3-dihydro-1H-1λ'-benzo[d]isothiazol-6-yl, dihydropyranyl, dihydrofuryl and dihydrothiazolyl, and the like.

[0288] The term "heterocyclo" thus encompasses the following ring systems: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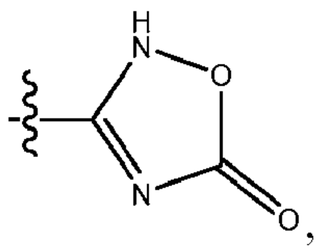
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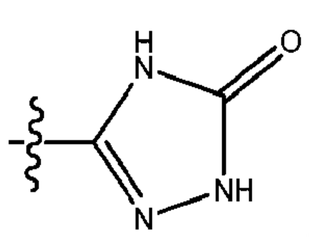
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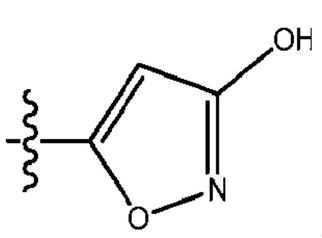
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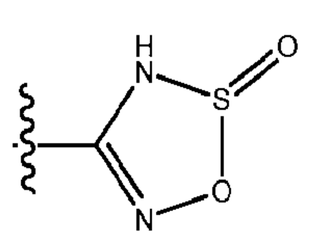
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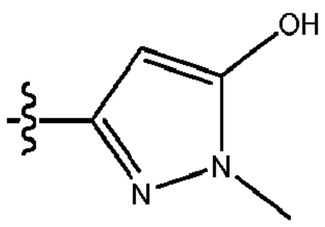
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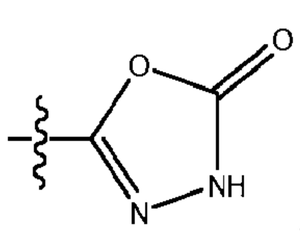
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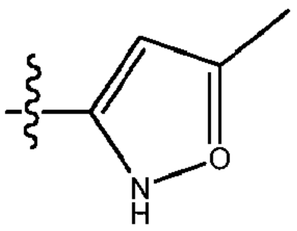
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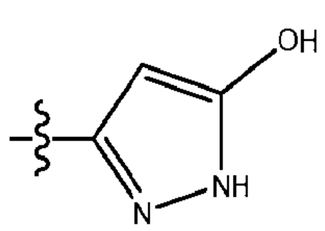
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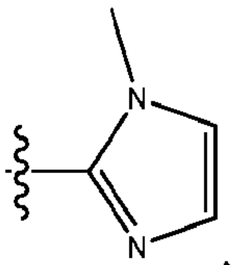
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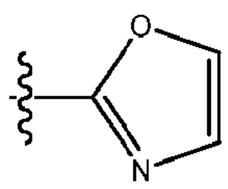
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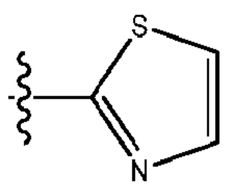
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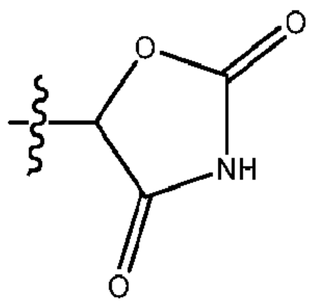
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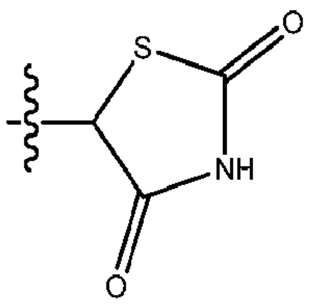
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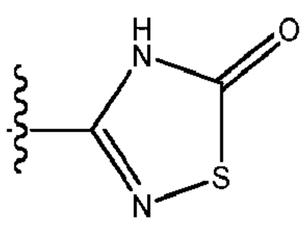
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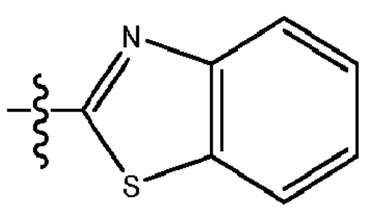
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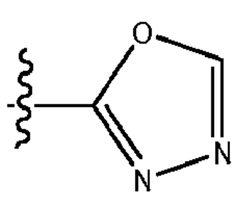
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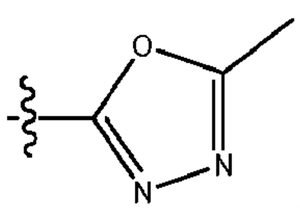
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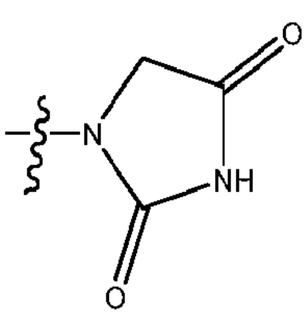
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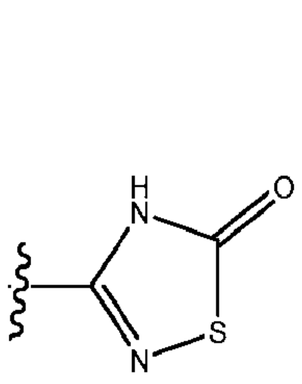
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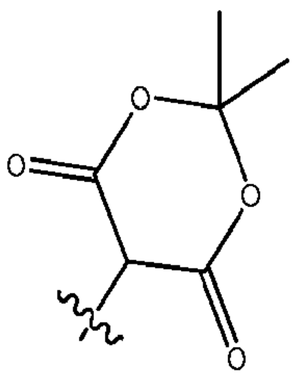
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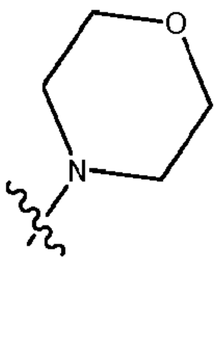
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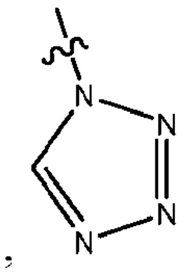
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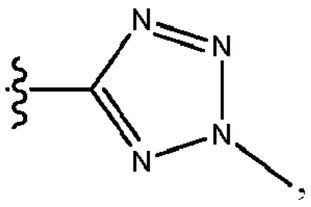
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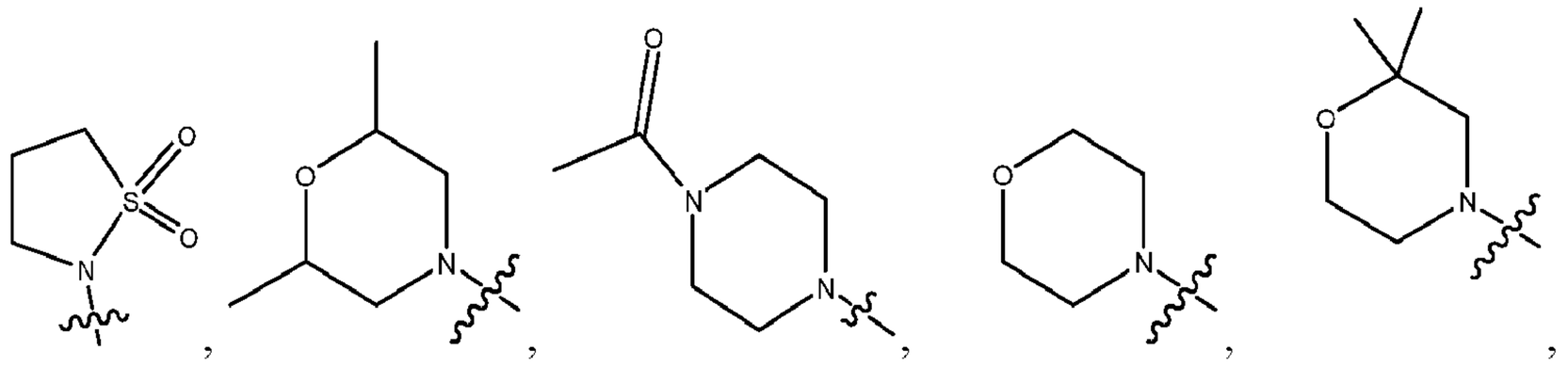
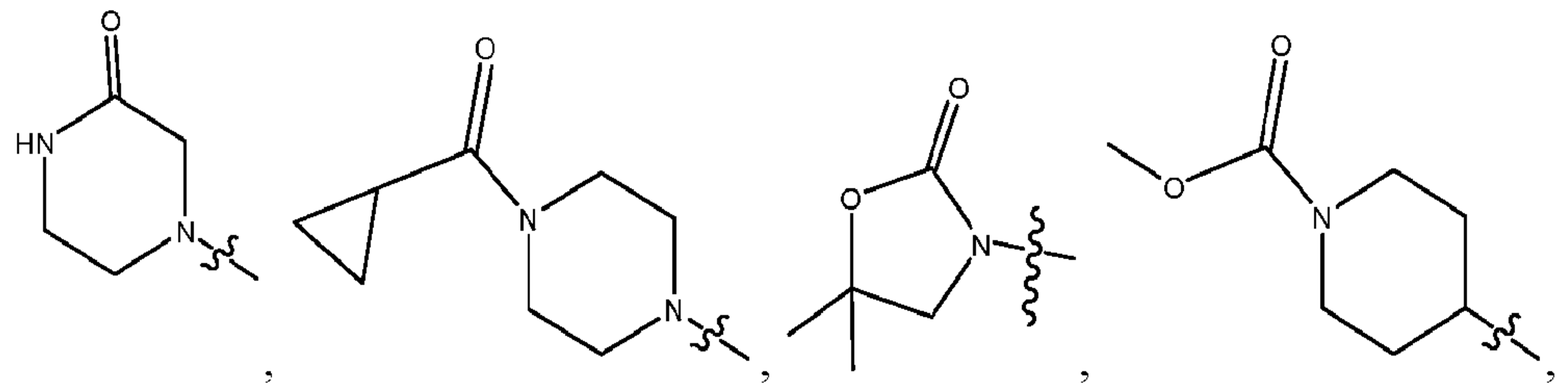
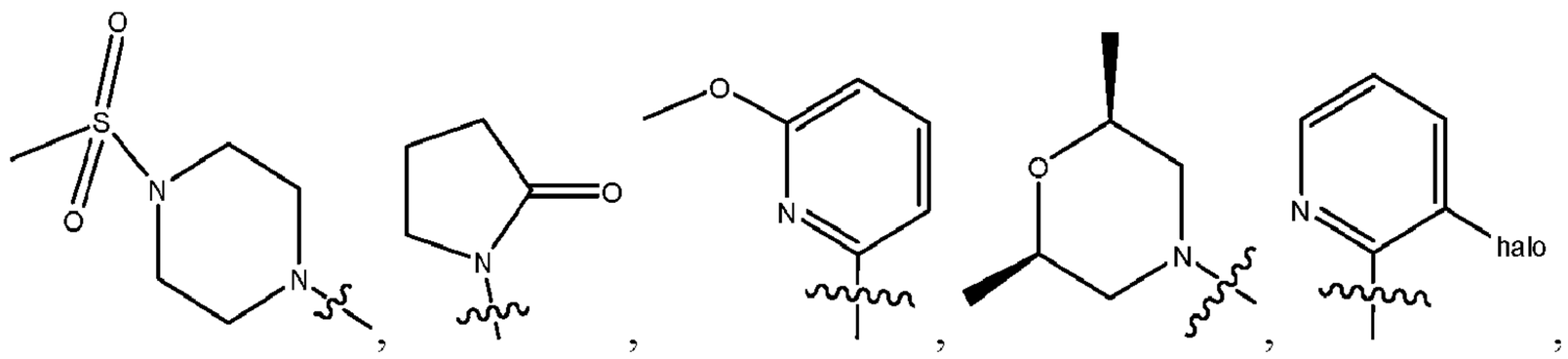
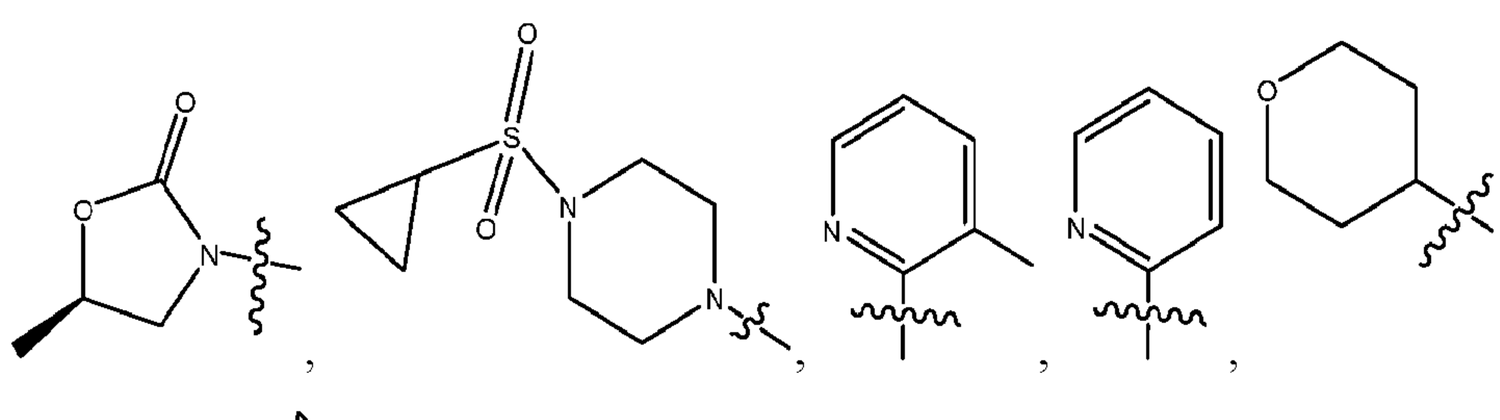
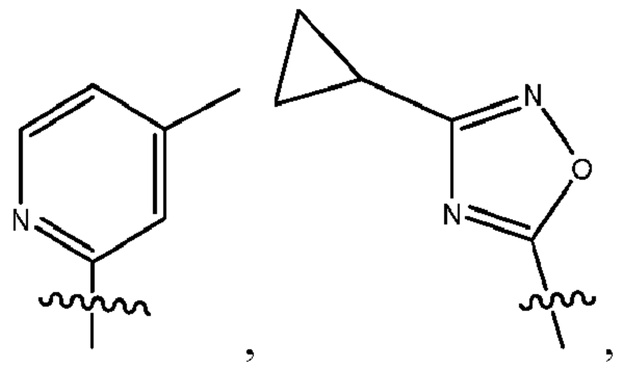
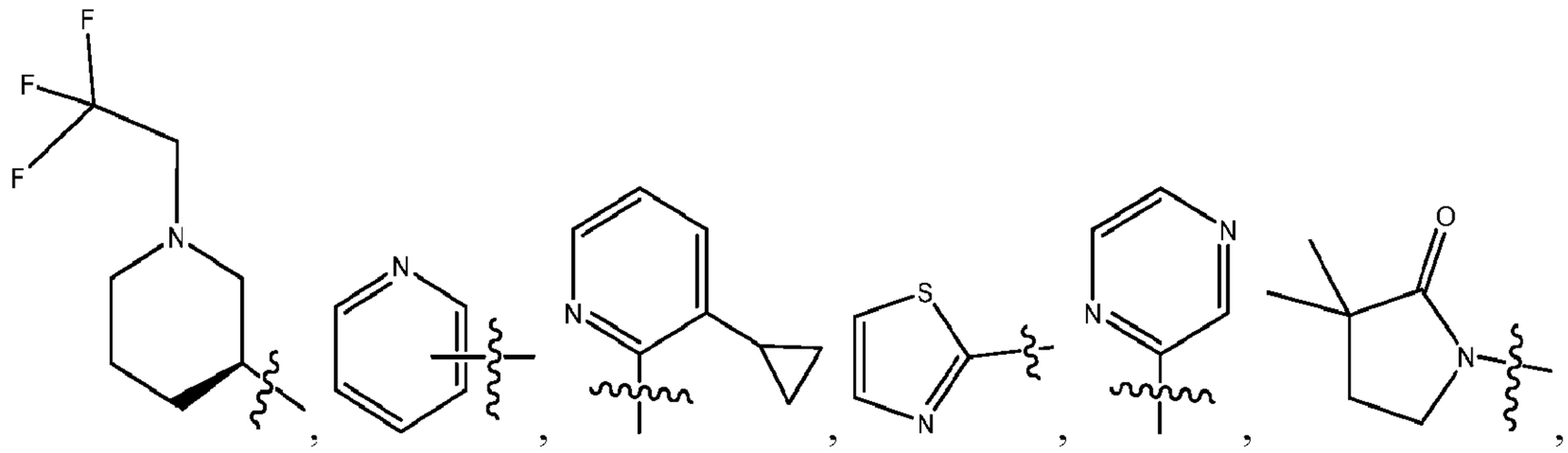


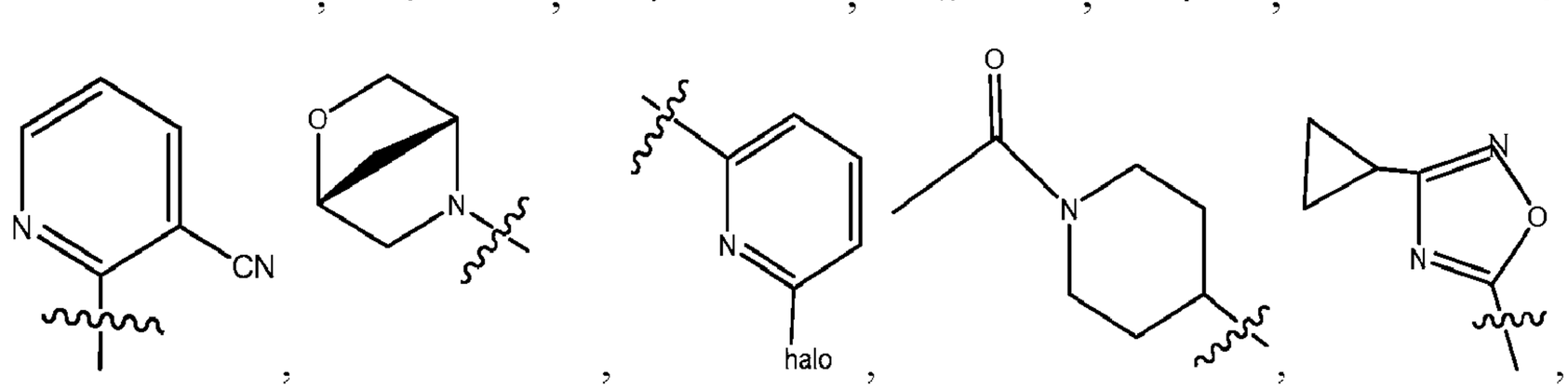


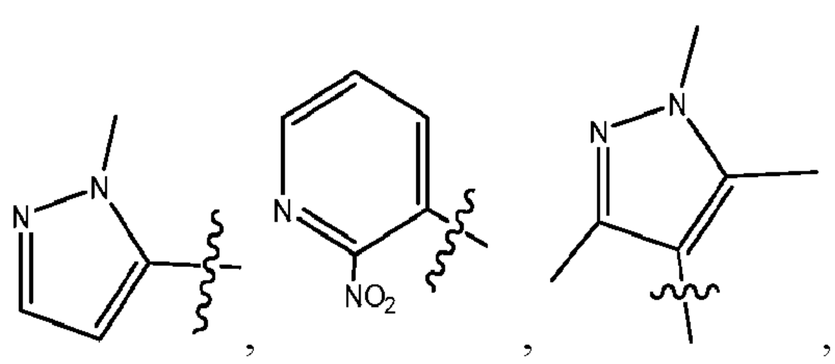












, and the like.

[0289] The term "sulfonyl", whether used alone or linked to other terms such as alkylsulfonyl, denotes respectively divalent radicals -SO_2-.

[0290] The terms "sulfamyl," "aminosulfonyl" and "sulfonamidyl," denotes a sulfonyl radical substituted with an amine radical, forming a sulfonamide (-SO_2NH_2).

[0291] The term "alkylaminosulfonyl" includes "N-alkylaminosulfonyl" where sulfamyl radicals are independently substituted with one or two alkyl radical(s). More preferred alkylaminosulfonyl radicals are "lower alkylaminosulfonyl" radicals having one to six carbon atoms. Even more preferred are lower alkylaminosulfonyl radicals having one to three carbon atoms. Examples of such lower alkylaminosulfonyl radicals include N-methylaminosulfonyl, and N-ethylaminosulfonyl.

[0292] The terms "carboxy" or "carboxyl," whether used alone or with other terms, such as "carboxyalkyl," denotes -CO_2H.

[0293] The term "carbonyl," whether used alone or with other terms, such as "aminocarbonyl," denotes -(C=O)-.

[0294] The term "aminocarbonyl" denotes an amide group of the formula C(=O)NH_2.

[0295] The terms "N-alkylaminocarbonyl" and "N,N-dialkylaminocarbonyl" denote aminocarbonyl radicals independently substituted with one or two alkyl radicals, respectively.

More preferred are "lower alkylaminocarbonyl" having lower alkyl radicals as described above attached to an aminocarbonyl radical.

[0296] The terms "N-arylaminocarbonyl" and "N-alkyl-N-arylaminocarbonyl" denote aminocarbonyl radicals substituted, respectively, with one aryl radical, or one alkyl and one aryl radical.

[0297] The terms "heterocyclylalkylenyl" and "heterocyclylalkyl" embrace heterocyclic-substituted alkyl radicals. More preferred heterocyclylalkyl radicals are "5- or 6-membered heteroarylalkyl" radicals having alkyl portions of one to six carbon atoms and a 5- or 6-membered heteroaryl radical. Even more preferred are lower heteroarylalkylenyl radicals having alkyl portions of one to three carbon atoms. Examples include such radicals as pyridylmethyl and thienylmethyl.

[0298] The term "aralkyl" embraces aryl-substituted alkyl radicals. Preferable aralkyl radicals are "lower aralkyl" radicals having aryl radicals attached to alkyl radicals having one to six carbon atoms. Even more preferred are "phenylalkylenyl" attached to alkyl portions having one to three carbon atoms. Examples of such radicals include benzyl, diphenylmethyl and phenylethyl. The aryl in said aralkyl may be additionally substituted with halo, alkyl, alkoxy, halkoalkyl and haloalkoxy.

[0299] The term "alkylthio" embraces radicals containing a linear or branched alkyl radical, of one to ten carbon atoms, attached to a divalent sulfur atom. Even more preferred are lower alkylthio radicals having one to three carbon atoms. An example of "alkylthio" is methylthio, (CH_3S-).

[0300] The term "haloalkylthio" embraces radicals containing a haloalkyl radical, of one to ten carbon atoms, attached to a divalent sulfur atom. Even more preferred are lower haloalkylthio radicals having one to three carbon atoms. An example of "haloalkylthio" is trifluoromethylthio.

[0301] The term "alkylamino" embraces "N-alkylamino" and "N,N-dialkylamino" where amino groups are independently substituted with one alkyl radical and with two alkyl radicals, respectively. More preferred alkylamino radicals are "lower alkylamino" radicals having one or two alkyl radicals of one to six carbon atoms, attached to a nitrogen atom. Even more preferred are lower alkylamino radicals having one to three carbon atoms. Suitable alkylamino radicals may be mono or dialkylamino such as N-methylamino, N-ethylamino, N,N-dimethylamino, and N,N-diethylamino, and the like.

[0302] The term "arylamino" denotes amino groups, which have been substituted with one or two aryl radicals, such as N-phenylamino. The arylamino radicals may be further substituted on the aryl ring portion of the radical.

[0303] The term "heteroarylamino" denotes amino groups, which have been substituted with one or two heteroaryl radicals, such as N-thienylamino. The "heteroarylamino" radicals may be further substituted on the heteroaryl ring portion of the radical.

[0304] The term "aralkylamino" denotes amino groups, which have been substituted with one or two aralkyl radicals. More preferred are phenyl-C_1-C_3-alkylamino radicals, such as N-benzylamino. The aralkylamino radicals may be further substituted on the aryl ring portion.

[0305] The terms "N-alkyl-N-arylamino" and "N-aralkyl-N-alkylamino" denote amino groups, which have been independently substituted with one aralkyl and one alkyl radical, or one aryl and one alkyl radical, respectively, to an amino group.

[0306] The term "aminoalkyl" embraces linear or branched alkyl radicals having one to about ten carbon atoms any one of which may be substituted with one or more amino radicals. More preferred aminoalkyl radicals are "lower aminoalkyl" radicals having one to six carbon atoms and one or more amino radicals. Examples of such radicals include aminomethyl, aminoethyl, aminopropyl, aminobutyl and aminohexyl. Even more preferred are lower aminoalkyl radicals having one to three carbon atoms.

[0307] The term "alkylaminoalkyl" embraces alkyl radicals substituted with alkylamino radicals. More preferred alkylaminoalkyl radicals are "lower alkylaminoalkyl" radicals having alkyl radicals of one to six carbon atoms. Even more preferred are lower alkylaminoalkyl radicals having alkyl radicals of one to three carbon atoms. Suitable alkylaminoalkyl radicals may be mono or dialkyl substituted, such as N-methylaminomethyl, N,N-dimethyl-aminoethyl, and N,N-diethylaminomethyl, and the like.

[0308] The term "alkylaminoalkoxy" embraces alkoxy radicals substituted with alkylamino radicals. More preferred alkylaminoalkoxy radicals are "lower alkylaminoalkoxy" radicals having alkoxy radicals of one to six carbon atoms. Even more preferred are lower alkylaminoalkoxy radicals having alkyl radicals of one to three carbon atoms. Suitable alkylaminoalkoxy radicals may be mono or dialkyl substituted, such as N-methylaminoethoxy, N,N-dimethylaminoethoxy, and N,N-diethylaminoethoxy, and the like.

[0309] The term "alkylaminoalkoxyalkoxy" embraces alkoxy radicals substituted with alkylaminoalkoxy radicals. More preferred alkylaminoalkoxyalkoxy radicals are "lower

alkylaminoalkoxyalkoxy" radicals having alkoxy radicals of one to six carbon atoms. Even more preferred are lower alkylaminoalkoxyalkoxy radicals having alkyl radicals of one to three carbon atoms. Suitable alkylaminoalkoxyalkoxy radicals may be mono or dialkyl substituted, such as N-methylaminomethoxyethoxy, N-methylaminoethoxyethoxy, N,N-dimethylaminoethoxyethoxy, and N,N-diethylaminomethoxymethoxy, and the like.

[0310] The term "carboxyalkyl" embraces linear or branched alkyl radicals having one to about ten carbon atoms any one of which may be substituted with one or more carboxy radicals. More preferred carboxyalkyl radicals are "lower carboxyalkyl" radicals having one to six carbon atoms and one carboxy radical. Examples of such radicals include carboxymethyl, and carboxypropyl, and the like. Even more preferred are lower carboxyalkyl radicals having one to three CH_2 groups.

[0311] The term "halosulfonyl" embraces sulfonyl radicals substituted with a halogen radical. Examples of such halosulfonyl radicals include chlorosulfonyl and fluorosulfonyl.

[0312] The term "arylthio" embraces aryl radicals of six to ten carbon atoms, attached to a divalent sulfur atom. An example of "arylthio" is phenylthio.

[0313] The term "aralkylthio" embraces aralkyl radicals as described above, attached to a divalent sulfur atom. More preferred are phenyl-C_1-C_3-alkylthio radicals. An example of "aralkylthio" is benzylthio.

[0314] The term "aryloxy" embraces optionally substituted aryl radicals, as defined above, attached to an oxygen atom. Examples of such radicals include phenoxy.

[0315] The term "aralkoxy" embraces oxy-containing aralkyl radicals attached through an oxygen atom to other radicals. More preferred aralkoxy radicals are "lower aralkoxy" radicals having optionally substituted phenyl radicals attached to lower alkoxy radical as described above.

[0316] The term "heteroaryloxy" embraces optionally substituted heteroaryl radicals, as defined above, attached to an oxygen atom.

[0317] The term "heteroarylalkoxy" embraces oxy-containing heteroarylalkyl radicals attached through an oxygen atom to other radicals. More preferred heteroarylalkoxy radicals are "lower heteroarylalkoxy" radicals having optionally substituted heteroaryl radicals attached to lower alkoxy radical as described above.

[0318] The term "cycloalkyl" includes saturated carbocyclic groups. Preferred cycloalkyl groups include C_3-C_6 rings. More preferred compounds include, cyclopentyl, cyclopropyl, and cyclohexyl.

[0319] The term “cycloalkylalkyl" embraces cycloalkyl-substituted alkyl radicals. Preferable cycloalkylalkyl radicals are "lower cycloalkylalkyl" radicals having cycloalkyl radicals attached to alkyl radicals having one to six carbon atoms. Even more preferred are "5 to 6-membered cycloalkylalkyl" attached to alkyl portions having one to three carbon atoms. Examples of such radicals include cyclohexylmethyl. The cycloalkyl in said radicals may be additionally substituted with halo, alkyl, alkoxy and hydroxy.

[0320] The term "cycloalkenyl" includes carbocyclic groups having one or more carbon-carbon double bonds including "cycloalkyldienyl" compounds. Preferred cycloalkenyl groups include C_3-C_6 rings. More preferred compounds include, for example, cyclopentenyl, cyclopentadienyl, cyclohexenyl and cycloheptadienyl.

[0321] The term "comprising" is meant to be open ended, including the indicated component but not excluding other elements.

[0322] A group or atom that replaces a hydrogen atom is also called a substituent.

[0323] Any particular molecule or group can have one or more substituent depending on the number of hydrogen atoms that can be replaced.

[0324] The symbol "–" represents a covalent bond and can also be used in a radical group to indicate the point of attachment to another group. In chemical structures, the symbol is commonly used to represent a methyl group in a molecule.

[0325] The term "therapeutically effective amount" means an amount of a compound that ameliorates, attenuates or eliminates one or more symptom of a particular disease or condition, or prevents or delays the onset of one of more symptom of a particular disease or condition.

[0326] The terms "patient" and “subject” may be used interchangeably and mean animals, such as dogs, cats, cows, horses, sheep and humans. Particular patients are mammals. The term patient includes males and females.

[0327] The term "pharmaceutically acceptable" means that the referenced substance, such as a compound of Formula I, or a salt of a compound of Formula I, or a formulation

containing a compound of Formula I, or a particular excipient, are suitable for administration to a patient.

[0328] The terms "treating", "treat" or "treatment" and the like include preventative (e.g., prophylactic) and palliative treatment.

[0329] The term "excipient" means any pharmaceutically acceptable additive, carrier, diluent, adjuvant, or other ingredient, other than the active pharmaceutical ingredient (API), which is typically included for formulation and/or administration to a patient.

[0330] The term "cancer" means a physiological condition in mammals that is characterized by unregulated cell growth. General classes of cancers include carcinomas, lymphomas, sarcomas, and blastomas.

Composition

[0331] The compounds of the present invention are administered to a patient in a therapeutically effective amount. The compounds can be administered alone or as part of a pharmaceutically acceptable composition or formulation. In addition, the compounds or compositions can be administered all at once, as for example, by a bolus injection, multiple times, such as by a series of tablets, or delivered substantially uniformly over a period of time, as for example, using transdermal delivery. It is also noted that the dose of the compound can be varied over time.

[0332] The compounds of the present invention, if desired, can be administered to a patient either orally, rectally, parenterally, (for example, intravenously, intramuscularly, or subcutaneously) intracisternally, intravaginally, intraperitoneally, intravesically, locally (for example, powders, ointments or drops), or as a buccal or nasal spray. All methods that are used by those skilled in the art to administer a pharmaceutically active agent are contemplated.

[0333] Compositions suitable for parenteral injection may comprise physiologically acceptable sterile aqueous or nonaqueous solutions, dispersions, suspensions, or emulsions, and sterile powders for reconstitution into sterile injectable solutions or dispersions. Examples of suitable aqueous and nonaqueous carriers, diluents, solvents, or vehicles include water, ethanol, polyols (propylene glycol, polyethylene glycol, glycerol, and the like), suitable mixtures thereof, vegetable oils (such as olive oil) and injectable organic esters such as ethyl oleate. Proper fluidity can be maintained, for example, by the use of a coating such as

lecithin, by the maintenance of the required particle size in the case of dispersions, and by the use of surfactants.

[0334] These compositions may also contain adjuvants such as preserving, wetting, emulsifying, and dispersing agents. Microorganism contamination can be prevented by adding various antibacterial and antifungal agents, for example, parabens, chlorobutanol, phenol, sorbic acid, and the like. It may also be desirable to include isotonic agents, for example, sugars, sodium chloride, and the like. Prolonged absorption of injectable pharmaceutical compositions can be brought about by the use of agents delaying absorption, for example, aluminum monostearate and gelatin.

[0335] Solid dosage forms for oral administration include capsules, tablets, powders, and granules. In such solid dosage forms, the active compound is admixed with at least one inert customary excipient (or carrier) such as sodium citrate or dicalcium phosphate or (a) fillers or extenders, as for example, starches, lactose, sucrose, mannitol, and silicic acid; (b) binders, as for example, carboxymethylcellulose, alginates, gelatin, polyvinylpyrrolidone, sucrose, and acacia; (c) humectants, as for example, glycerol; (d) disintegrating agents, as for example, agar-agar, calcium carbonate, potato or tapioca starch, alginic acid, certain complex silicates, and sodium carbonate; (a) solution retarders, as for example, paraffin; (f) absorption accelerators, as for example, quatemary ammonium compounds; (g) wetting agents, as for example, cetyl alcohol and glycerol monostearate; (h) adsorbents, as for example, kaolin and bentonite; and (i) lubricants, as for example, talc, calcium stearate, magnesium stearate, solid polyethylene glycols, sodium lauryl sulfate, or mixtures thereof. In the case of capsules, and tablets, the dosage forms may also comprise buffering agents.

[0336] Solid compositions of a similar type may also be used as fillers in soft and hard filled gelatin capsules using such excipients as lactose or milk sugar, as well as high molecular weight polyethylene glycols, and the like.

[0337] Solid dosage forms such as tablets, dragees, capsules, pills, and granules can be prepared with coatings and shells, such as enteric coatings and others well known in the art. They may also contain opacifying agents, and can also be of such composition that they release the active compound or compounds in a certain part of the intestinal tract in a delayed manner. Examples of embedding compositions that can be used are polymeric substances and waxes. The active compounds can also be in micro-encapsulated form, if appropriate, with one or more of the above-mentioned excipients.

[0338] Liquid dosage forms for oral administration include pharmaceutically acceptable emulsions, solutions, suspensions, syrups, and elixirs. In addition to the active compounds, the liquid dosage form may contain inert diluents commonly used in the art, such as water or other solvents, solubilizing agents and emulsifiers, as for example, ethyl alcohol, isopropyl alcohol, ethyl carbonate, ethyl acetate, benzyl alcohol, benzyl benzoate, propylene glycol, 1,3-butylene glycol, dimethylformamide, oils, in particular, cottonseed oil, groundnut oil, corn germ oil, olive oil, castor oil, and sesame seed oil, glycerol, tetrahydrofurfuryl alcohol, polyethylene glycols and fatty acid esters of sorbitan, or mixtures of these substances, and the like.

[0339] Besides such inert diluents, the composition can also include adjuvants, such as wetting agents, emulsifying and suspending agents, sweetening, flavoring, and perfuming agents. Suspensions, in addition to the active compound, may contain suspending agents, as for example, ethoxylated isostearyl alcohols, polyoxyethylene sorbitol and sorbitan esters, microcrystalline cellulose, aluminum metahydroxide, bentonite, agar-agar, and tragacanth, or mixtures of these substances, and the like.

[0340] Compositions for rectal administration are preferable suppositories, which can be prepared by mixing the compounds of the present invention with suitable non-irritating excipients or carriers such as cocoa butter, polyethylene glycol or a suppository wax, which are solid at ordinary room temperature, but liquid at body temperature, and therefore, melt in the rectum or vaginal cavity and release the active component.

[0341] Dosage forms for topical administration of a compound of the present invention include ointments, powders, sprays and inhalants. The active compound or fit compounds are admixed under sterile condition with a physiologically acceptable carrier, and any preservatives, buffers, or propellants that may be required. Opthalmic formulations, eye ointments, powders, and solutions are also contemplated as being within the scope of this invention.

[0342] The compounds of the present invention can be administered to a patient at dosage levels in the range of about 0.1 to about 3,000 mg per day. For a normal adult human having a body weight of about 70 kg, a dosage in the range of about 0.01 to about 100 mg per kilogram body weight is typically sufficient. The specific dosage and dosage range that can be used depends on a number of factors, including the requirements of the patient, the severity of the condition or disease being treated, and the pharmacological activity of the

compound being administered. The determination of dosage ranges and optimal dosages for a particular patient is within the ordinary skill in the art.

[0343] The compounds of the present invention can be administered as pharmaceutically acceptable salts, esters, amides or prodrugs. The term "salts" refers to inorganic and organic salts of compounds of the present invention. The salts can be prepared in situ during the final isolation and purification of a compound, or by separately reacting a purified compound in its free base or acid form with a suitable organic or inorganic base or acid and isolating the salt thus formed. Representative salts include the hydrobromide, hydrochloride, sulfate, bisulfate, nitrate, acetate, oxalate, palmitiate, stearate, laurate, borate, benzoate, lactate, phosphate, tosylate, citrate, maleate, fumarate, succinate, tartrate, naphthylate, mesylate, glucoheptonate, lactobionate, and laurylsulphonate salts, and the like. The salts may include cations based on the alkali and alkaline earth metals, such as sodium, lithium, potassium, calcium, magnesium, and the like, as well as non-toxic ammonium, quaternary ammonium, and amine cations including, but not limited to, ammonium, tetramethylammonium, tetraethylammonium, methylamine, dimethylamine, trimethylamine, triethylamine, ethylamine, and the like. See, for example, S. M. Berge, et al., "Pharmaceutical Salts," J Pharm Sci, 66: 1-19 (1977).

[0344] Examples of pharmaceutically acceptable esters of the compounds of the present invention include C_1-C_8 alkyl esters. Acceptable esters also include C_5-C_7 cycloalkyl esters, as well as arylalkyl esters such as benzyl. C_1-C_4 alkyl esters are commonly used. Esters of compounds of the present invention may be prepared according to methods that are well known in the art.

[0345] Examples of pharmaceutically acceptable amides of the compounds of the present invention include amides derived from ammonia, primary C_1-C_8 alkyl amines, and secondary C_1-C_8 dialkyl amines. In the case of secondary amines, the amine may also be in the form of a 5 or 6 membered heterocycloalkyl group containing at least one nitrogen atom. Amides derived from ammonia, C_1-C_3 primary alkyl amines and C_1-C_2 dialkyl secondary amines are commonly used. Amides of the compounds of the present invention may be prepared according to methods well known to those skilled in the art.

[0346] The term "prodrug" means compounds that are transformed in vivo to yield a compound of the present invention. The transformation may occur by various mechanisms, such as through hydrolysis in blood. A discussion of the use of prodrugs is provided by T. Higuchi and W. Stella, "Prodrugs as Novel Delivery Systems," Vol. 14 of the A.C.S.

Symposium Series, and in Bioreversible Carriers in Drug Design, ed. Edward B. Roche, American Pharmaceutical Association and Pergamon Press, 1987.

[0347] To illustrate, if the compound of the invention contains a carboxylic acid functional group, a prodrug can comprise an ester formed by the replacement of the hydrogen atom of the acid group with a group such as (C_1-C_8 alkyl, (C_2-C_{12})alkanoyloxymethyl, 1-(alkanoyloxy)ethyl having from 4 to 9 carbon atoms, 1-methyl-1-(alkanoyloxy)ethyl having from 5 to 10 carbon atoms, alkoxycarbonyloxymethyl having from 3 to 6 carbon atoms, 1-(alkoxycarbonyloxy)ethyl having from 4 to 7 carbon atoms, 1-methyl-1-(alkoxycarbonyloxy)ethyl having from 5 to 8 carbon atoms, N-(alkoxycarbonyl)aminomethyl having from 3 to 9 carbon atoms, 1-(N-(alkoxycarbonyl)aminomethyl having from 4 to 10 carbon atoms, 3-phthalidyl, 4-crotonolactonyl, gamma-butyrolacton-4-yl, di-N,N-(C_1-C_2)alkylamino(C_2-C_3)alkyl (such as β-dimethylaminoethyl), carbamoyl-(C_1-C_2)alkyl, N,N-di(C_1-C_2)alkylcarbamoyl-(C_1-C_2)alkyl and piperidino-, pyrrolidino- or morpholino(C_2-C_3)alkyl.

[0348] Similarly, if a compound of the present invention comprises an alcohol functional group, a prodrug can be formed by the replacement of the hydrogen atom of the alcohol group with a group such as (C_1-C_6)alkanoyloxymethyl, 1-((C_1-C_6)alkanoyloxy)ethyl, 1-methyl-1-((C_1-C_6)alkanoyloxy)ethyl, (C_1-C_6)alkoxycarbonyloxymethyl, N-(C_1-C_6)alkoxycarbonylaminomethyl, succinoyl, (C_1-C_6)alkanoyl, α-amino(C_1-C_4)alkanoyl, arylacyl and α-aminoacyl, or α-aminoacyl-α-aminoacyl, where each α-aminoacyl group is independently selected from the naturally occurring L-amino acids, –P(O)(OH)2, –P(O)(O(C_1-C_6)alkyl)2 or glycosyl (the radical resulting from the removal of a hydroxyl group of the hemiacetal form of a carbohydrate).

[0349] The compounds of the present invention may contain asymmetric or chiral centers, and therefore, exist in different stereoisomeric forms. It is contemplated that all stereoisomeric forms of the compounds as well as mixtures thereof, including racemic mixtures, form part of the present invention. In addition, the present invention contemplates all geometric and positional isomers. For example, if the compound contains a double bond, both the cis and trans forms (designated as S and E, respectively), as well as mixtures, are contemplated.

[0350] Mixture of stereoisomers, such as diastereomeric mixtures, can be separated into their individual stereochemical components on the basis of their physical chemical

differences by known methods such as chromatography and/or fractional crystallization. Enantiomers can also be separated by converting the enantiomeric mixture into a diastereomeric mixture by reaction with an appropriate optically active compound (e.g., an alcohol), separating the diastereomers and converting (e.g., hydrolyzing) the individual diastereomers to the corresponding pure enantiomers. Also, some compounds may be atropisomers (e.g., substituted biaryls).

[0351] The compounds of the present invention may exist in unsolvated as well as solvated forms with pharmaceutically acceptable solvents such as water (hydrate), ethanol, and the like. The present invention contemplates and encompasses both the solvated and unsolvated forms.

[0352] It is also possible that compounds of the present invention may exist in different tautomeric forms. All tautomers of compounds of the present invention are contemplated. For example, all of the tautomeric forms of the tetrazole moiety are included in this invention. Also, for example, all keto-enol or imine-enamine forms of the compounds are included in this invention.

[0353] Those skilled in the art will recognize that the compound names and structures contained herein may be based on a particular tautomer of a compound. While the name or structure for only a particular tautomer may be used, it is intended that all tautomers are encompassed by the present invention, unless stated otherwise.

[0354] It is also intended that the present invention encompass compounds that are synthesized in vitro using laboratory techniques, such as those well known to synthetic chemists; or synthesized using in vivo techniques, such as through metabolism, fermentation, digestion, and the like. It is also contemplated that the compounds of the present invention may be synthesized using a combination of in vitro and in vivo techniques.

[0355] The present invention also includes isotopically-labelled compounds, which are identical to those recited herein, but for the fact that one or more atoms are replaced by an atom having an atomic mass or mass number different from the atomic mass or mass number usually found in nature. Examples of isotopes that can be incorporated into compounds of the invention include isotopes of hydrogen, carbon, nitrogen, oxygen, phosphorous, fluorine and chlorine, such as ^{2}H, ^{3}H, ^{13}C, ^{14}C, ^{15}N, ^{16}O, ^{17}O, ^{18}O, ^{31}P, ^{32}P, ^{35}S, ^{18}F, and ^{36}Cl. In one aspect, the present invention relates to compounds wherein one or more hydrogen atom is replaced with deuterium (2H) atoms.

[0356] Compounds of the present invention that contain the aforementioned isotopes and/or other isotopes of other atoms are within the scope of this invention. Certain isotopically-labelled compounds of the present invention, for example those into which radioactive isotopes such as ^{3}H and ^{14}C are incorporated, are useful in drug and/or substrate tissue distribution assays. Tritiated, i.e., ^{3}H, and carbon-14, i.e., ^{14}C, isotopes are particularly preferred for their ease of preparation and detection. Further, substitution with heavier isotopes such as deuterium, i.e., ^{2}H, can afford certain therapeutic advantages resulting from greater metabolic stability, for example increased in vivo half-life or reduced dosage requirements and, hence, may be preferred in some circumstances. Isotopically labelled compounds of this invention can generally be prepared by substituting a readily available isotopically labelled reagent for a non-isotopically labelled reagent.

[0357] The compounds of the present invention may exist in various solid states including crystalline states and as an amorphous state. The different crystalline states, also called polymorphs, and the amorphous states of the present compounds are contemplated as part of this invention.

[0358] All patents, published patent applications and other publications recited herein are hereby incorporated by reference.

Compounds

[0359] The present invention relates to novel compounds that can bind cereblon (CRBN), but variously have reduced ability to recruit liability substrate proteins, such as SALL4 and ASS1 and have varied ability recruit more common substrates, such as IKZF1 to CRBN. Differential recruitment profiles among CRBN binding molecules create novel starting points for selective small molecule substrate degrader glues, either alone, or as a modular component of a CRBN-binding heterobifunctional molecule (HBM). Recruitment profiles of key liability substrates offer an objective means to prioritize and select promising small molecules. In one embodiment, some CRBN binding compounds described herein, after binding with CRBN, reduce CRBN's ability to recruit selected liability substrates, such as SALL4 and ASS1, and common substrates, such as IKZF1. These compounds is referred as "silent" compounds. In one embodiment, some CRBN binding compounds described herein, after binding with CRBN, increase CRBN's ability to recruit selected liability substrates.

[0360] CRBN acts as a substrate receptor protein within an E3 ligase complex to direct substrate protein degradation via the proteasome, forming functional interactions with DNA

Damage Binding Protein 1 (DDB1), Cullin4 (4A or 4B) and Regulator of Culling 1 (RoC1) as well as an E2 ligase protein, such as UBE2G1, to substrate ubiquitination and subsequent degradation.

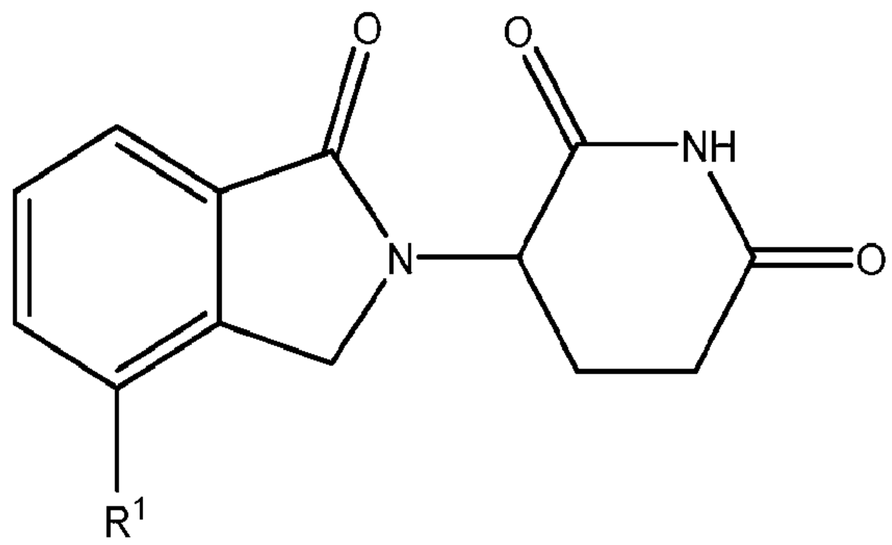
[0361] Small molecules deriving from the glutarimide-containing drug (IMiD), thalidomide, have been shown to bind CRBN and, as a complex, recruit novel neosubstrates to the E3 ligase complex.

[0362] The consequence of the IMiD-induced recruitment of substrate proteins to CRBN is that such proteins are then degraded by the Ubiquitin Proteasome Pathway (UPP).

[0363] New compounds are provided, along with their uses and manufacture that bind cereblon. It is believed that binding of the disclosed compounds to cereblon results in increased or reduced interactions of cereblon with IKZF1, SALL4, or ASS1, leading to their subsequent ubiquitination and degradation in the proteasome. The selected compounds are found to be both potent binders of cereblon as well as showing potential therapeutic use.

[0364] Compounds disclosed herein, pharmaceutically acceptable salts thereof, or pharmaceutically acceptable compositions can be used to treat a disorder mediated by one or more of cereblon, IKZF1, SALL4, andASS1.

[0365] In one aspect, the compound of the present invention is selected from Formula I:



I

or a pharmaceutically acceptable salt thereof, wherein:

R^1 is aryl, $-N(R^5)-X-R^6$, $-SO_2R^5$, or $-O(CH_2)_mR^5$, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n-$

aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, $(C_1$-$C_3)$alkyl, -$(C_1$-$C_3)$alkoxy, $(C_3$-$C_{10})$heterocyclo, $(C_3$-$C_{10})$cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$ cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing $(C_3$-$C_{10})$heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo$(C_3$-$C_{10})$heterocyclo, $(C_3$-$C_{10})$cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$ cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, -SO_2-, -$(CH_2)_n$C(O)$(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

m is 0, 1, 2, 3, or 4;

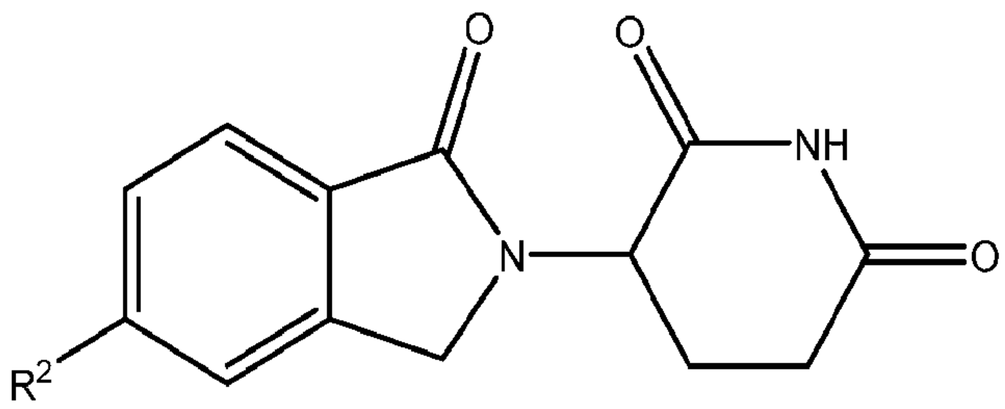
n is 0, 1, 2, 3, or 4.

[0366] In an embodiment, R^1 is phenyl optionally substituted with 1 or more R^w groups as allowed by valence.

[0367] In an embodiment, R^1 is phenyl.

[0368] In an embodiment, R^1 is phenyl optionally substituted with one or more $(C_1$-$C_3)$alkyl, $(C_1$-$C_3)$alkoxy, or OH.

[0369] In one aspect, the compound of the present invention is selected from Formula II:



II

or a pharmaceutically acceptable salt thereof, wherein:

R^2 is aryl, -NH-(C_3-C_{10}) heteroaryl, or -N(R^5)-(CH_2)$_m$-X-(CH_2)$_n$-R^6, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -(CH_2)$_n$-(C_3-C_{10}) cycloalkyl, -(CH_2)$_n$-(C_3-C_{10})heterocyclo, -(CH_2)$_n$-aryl, -(CH_2)$_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -(CH_2)$_n$-(C_3-C_{10}) cycloalkyl, -(CH_2)$_n$-(C_3-C_{10})heterocyclo, -(CH_2)$_n$-aryl, -(CH_2)$_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -(CH_2)$_n$-(C_3-C_{10}) cycloalkyl, -(CH_2)$_n$-(C_3-C_{10})heterocyclo, -(CH_2)$_n$-aryl, -(CH_2)$_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, -SO_2-, -(CH_2)$_n$C(O)(CH_2)$_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -(CH_2)$_n$-;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

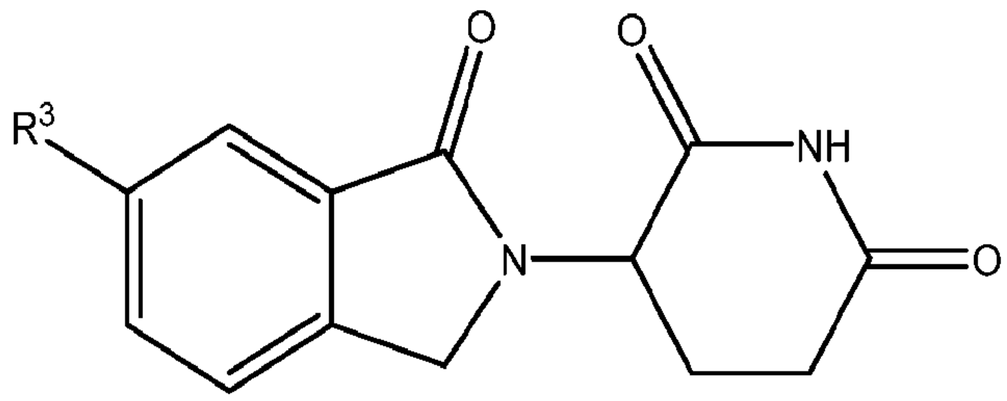
[0370] In an embodiment, R^2 is phenyl optionally substituted with 1 or more R^w groups as allowed by valence.

[0371] In an embodiment, R^2 is -NH-(C_3-C_{10}) heteroaryl.

[0372] In an embodiment, R^2 is phenyl optionally substituted with one or more (C_1-C_3)alkyl, (C_1-C_3)alkoxy, or OH.

[0373] In an embodiment, R^2 is $-N(R^5)-(CH_2)_m-X-(CH_2)_n-R^6$; R^5 is H; R^6 is OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, $-NR^5R^5$, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, or heteroaryl.

[0374] In one aspect, the compound of the present invention is selected from Formula III:



III

or a pharmaceutically acceptable salt thereof, wherein:

R^3 is cyano, aryl, -NH-(C_3-C_{10}) heteroaryl, (C_3-C_{10})heterocyclo, or $-N(R^5)-(CH_2)_m-X-(CH_2)_n-R^6$, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -(CH_2)$_n$-(C_3-C_{10}) cycloalkyl, -(CH_2)$_n$-(C_3-C_{10})heterocyclo, -(CH_2)$_n$-aryl, -(CH_2)$_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -(CH_2)$_n$-(C_3-C_{10})

cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

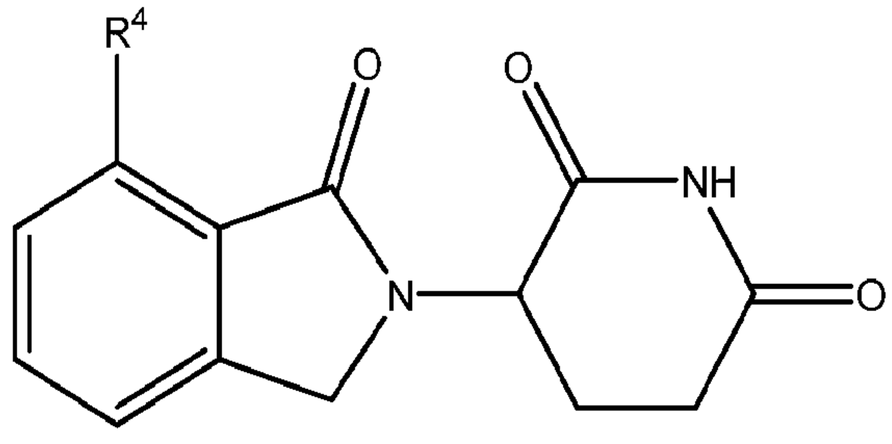
X is a bond, -SO_2-, -$(CH_2)_nC(O)(CH_2)_m$-, -C(O)NH-, -$C(O)N(R^w)$-, -NHC(O)NH-, or -$(CH_2)_n$-;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

[0375] In an embodiment, R^3 is -$N(R^5)$-$(CH_2)_m$-X-$(CH_2)_n$-R^6; R^5 is H; R^6 is OH, $(C_1$-$C_3)$alkyl, -$(C_1$-$C_3)$alkoxy, -NR^5R^5, $(C_3$-$C_{10})$heterocyclo, $(C_3$-$C_{10})$cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$ cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl.

[0376] In one aspect, the compound of the present invention is selected from Formula IV:



IV

or a pharmaceutically acceptable salt thereof, wherein:

R^4 is halo, cyano, aryl, OR^5, or -$N(R^5)$-$(CH_2)_m$-X-$(CH_2)_n$-R^6, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, $(C_1$-$C_3)$alkyl, $(C_3$-$C_{10})$heterocyclo, $(C_3$-$C_{10})$cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$ cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, $(C_1$-$C_3)$alkyl, -$(C_1$-$C_3)$alkoxy, $(C_3$-$C_{10})$heterocyclo, $(C_3$-$C_{10})$cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$ cycloalkyl, -$(CH_2)_n$-$(C_3$-$C_{10})$heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing $(C_3$-$C_{10})$heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl,

alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

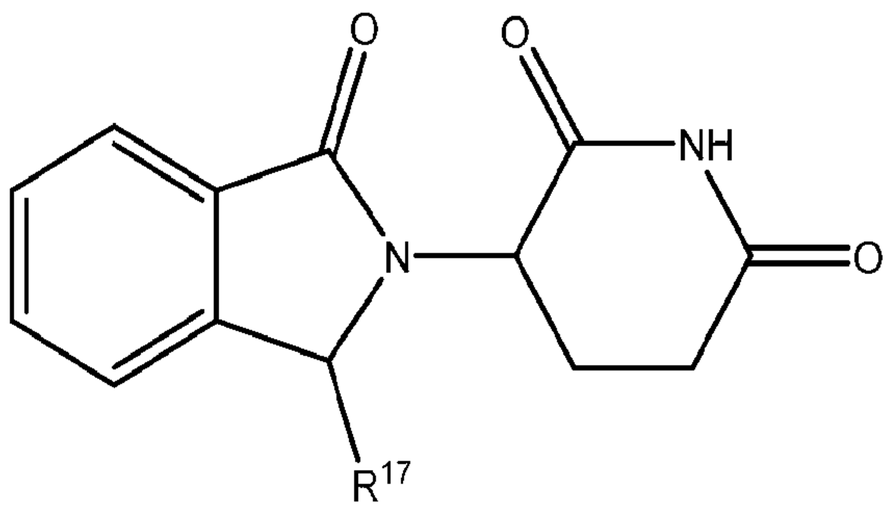
X is a bond, -SO_2-, -$(CH_2)_nC(O)(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

[0377] In an embodiment, R^4 is -N(R^5)-$(CH_2)_m$-X-$(CH_2)_n$-R^6; R^5 is H; R^6 is OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, -NR^5R^5, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl.

[0378] In one aspect, the compound of the present invention is selected from Formula V:



V

or a pharmaceutically acceptable salt thereof, wherein:

R^{17} is cyano, heteroaryl, -$(CH_2)_m$-C(O)O-R^6, or -N(R^5)-$(CH_2)_m$-X-$(CH_2)_n$-R^6, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken

together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

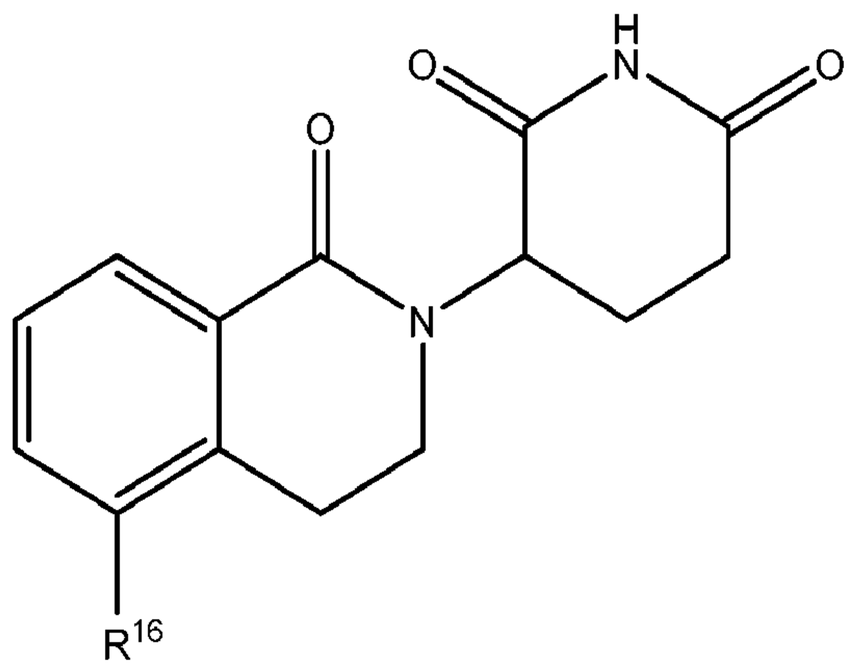
X is a bond, -SO_2-, -$(CH_2)_n$C(O)$(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

[0379] In an embodiment, R^{17} is heteroaryl optionally substituted with OH, halo, (C_1-C_3)alkyl or (C_1-C_3)alkoxy.

[0380] In one aspect, the compound of the present invention is selected from Formula VI:



VI

or a pharmaceutically acceptable salt thereof, wherein:

R^{16} is NH_2 or -N(R^5)-$(CH_2)_m$-X-$(CH_2)_n$-R^6, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

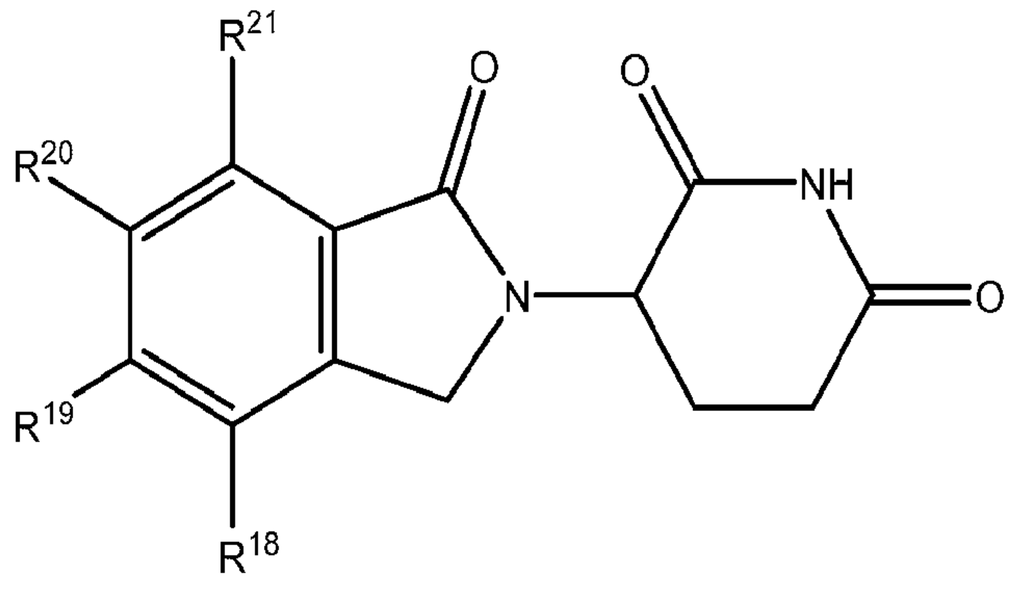
R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, -SO_2-, -$(CH_2)_n$C(O)$(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

[0381] In one aspect, the compound of the present invention is selected from Formula VII:



VII

or a pharmaceutically acceptable salt thereof, wherein:

R^{18}, R^{19}, R^{20}, R^{21} each independently is H, halo, (C_1-C_3)alkyl, or -N(R^5)-X-R^6, with the proviso that no more than two substituents of R^{18}, R^{19}, R^{20}, R^{21} are H; or

R^{18}, R^{19} taken together with the carbons they are attached to forming a (C_3-C_{10})cycloalkyl or a (C_3-C_{10})heterocyclo, or R^{19}, R^{20} taken together with the carbons they are attached to forming a (C_3-C_{10})cycloalkyl or a (C_3-C_{10})heterocyclo, or R^{20}, R^{21} taken together with the carbons they are attached to forming a (C_3-C_{10})cycloalkyl or a (C_3-C_{10})heterocyclo, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

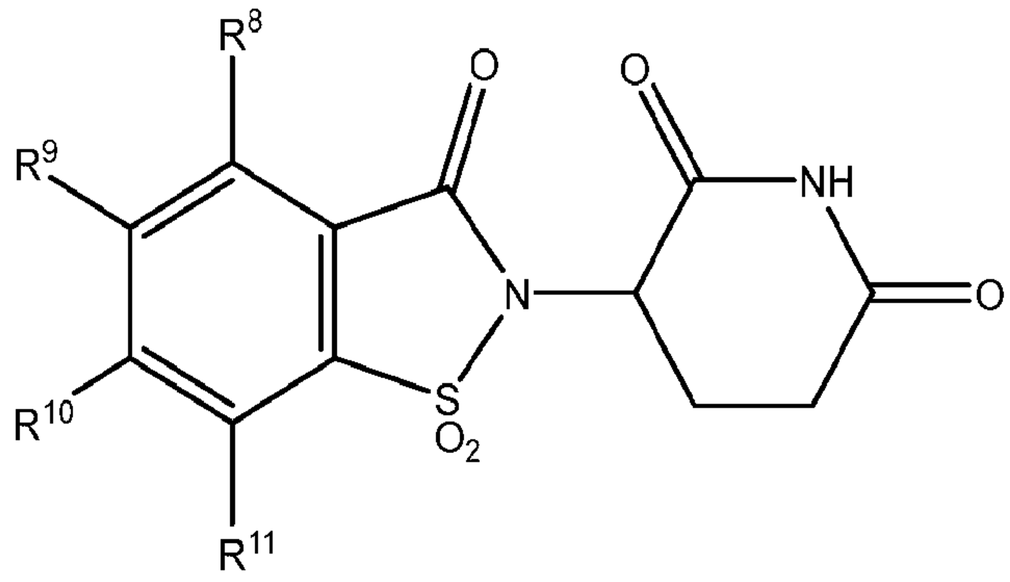
R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, -SO_2-, -$(CH_2)_n$C(O)$(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

[0382] In one aspect, the compound of the present invention is selected from Formula VIII:



VIII

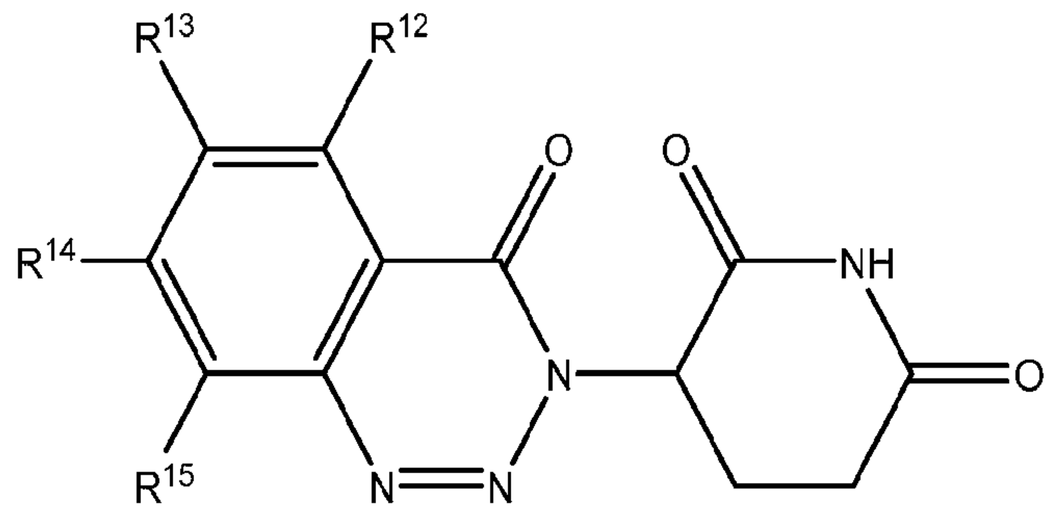
or a pharmaceutically acceptable salt thereof, wherein:

R^8, R^9, R^{10}, R^{11} each independently is H, halo, OH, cyano, (C_1-C_3)alkyl, (C_1-C_3)alkoxy, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently, H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

n is 0, 1, 2, 3, or 4.

[0383] In one aspect, the compound of the present invention is selected from Formula IX:



IX

or a pharmaceutically acceptable salt thereof, wherein:

R^{12}, R^{13}, R^{14}, R^{15} each is independently H, NH_2, $(C_1\text{-}C_3)$alkyl, $-N(R^5)\text{-}(CH_2)m\text{-}N(R^5)\text{-}X\text{-}R^6$, with proviso that no more than three substituents out of R^{12}, R^{13}, R^{14}, and R^{15} are H, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, $(C_1\text{-}C_3)$alkyl, $(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$ cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$heterocyclo, $-(CH_2)_n\text{-}$aryl, $-(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, $(C_1\text{-}C_3)$alkyl, $-(C_1\text{-}C_3)$alkoxy, $(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$ cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$heterocyclo, $-(CH_2)_n\text{-}$aryl, $-(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing $(C_3\text{-}C_{10})$heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

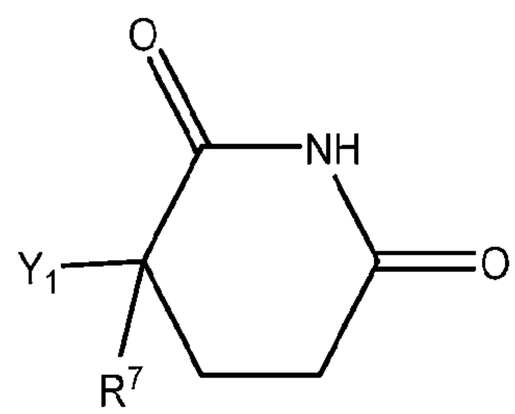
R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo$(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$ cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$heterocyclo, $-(CH_2)_n\text{-}$aryl, $-(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, $-SO_2\text{-}$, $-(CH_2)_nC(O)(CH_2)_m\text{-}$, -C(O)NH-, $-C(O)N(R^w)\text{-}$, -NHC(O)NH-, or $-(CH_2)_n\text{-}$;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

[0384] In one aspect, the compound of the present invention is selected from Formula X:



X

or a pharmaceutically acceptable salt thereof, wherein:

Y is $–NHR^{33}$, $-NHC(O)R^{33}$, or $–CHR^{33}R^{34}$;

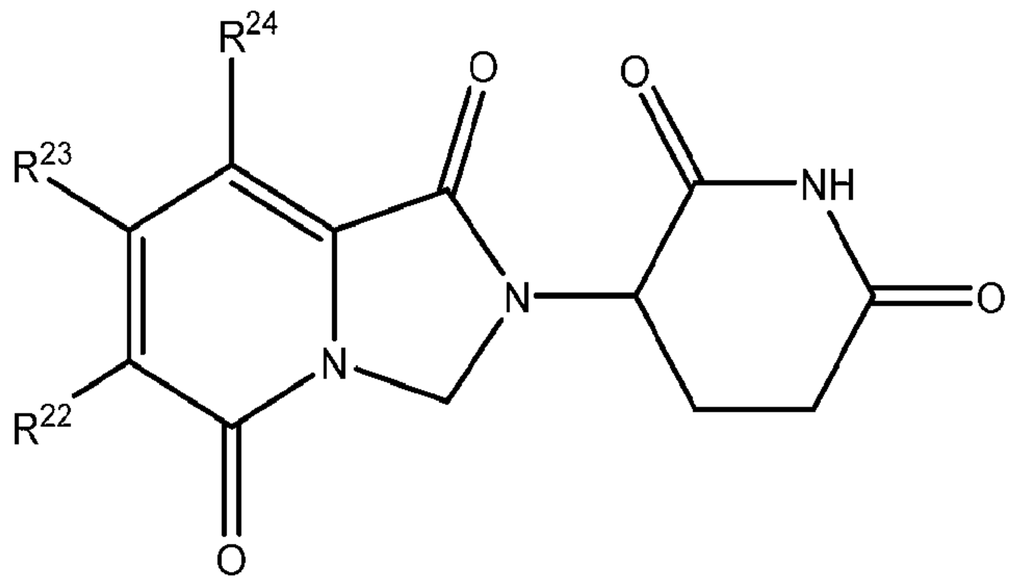
R^7 is H, $(C_1\text{-}C_3)$alkyl, or R^7 and R^{34} taken together with the carbons they are attached to forming a carbon double bond;

R^{33} is aryl, heteroaryl, or $(C_3\text{-}C_{10})$heterocyclo, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently, H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo$(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, $-(CH_2)_n-(C_3\text{-}C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3\text{-}C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

n is 0, 1, 2, 3, or 4.

[**0385**] In one aspect, the compound of the present invention is a compound of Formula XI



XI

or a pharmaceutically acceptable salt thereof, wherein:

R^{22} is H, halo, OH, $-NR^5R^5$, $(C_1\text{-}C_3)$alkyl, $(C_1\text{-}C_3)$alkoxy, (hydroxy)$(C_1\text{-}C_3)$alkyl, cyano, $-N(R^5)\text{-}X\text{-}R^6$, $-N(R^5)\text{-}(CH_2)m\text{-}N(R^5)\text{-}X\text{-}R^6$, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^{23} is H, halo, OH, $-NR^5R^5$, $-(CH_2)_n-NR^5R^5$, $(C_1\text{-}C_3)$alkyl, $(C_1\text{-}C_3)$alkoxy, $-C(O)NR^5R^6$, (hydroxy)$(C_1\text{-}C_3)$alkyl, cyano, $-N(R^5)\text{-}X\text{-}R^6$, $-N(R^5)\text{-}(CHR^5)_m\text{-}X\text{-}R^6$, $-N(R^5)\text{-}(CH_2)m\text{-}N(R^5)\text{-}X\text{-}R^6$, aryl, heteroaryl, or R^{22} and R^{23} taken together with the

carbons they are attached to forming a (C_3-C_{10})cycloalkyl ring or a (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^{24} is H, halo, OH, -NR^5R^5, -$(CH_2)_n$-NR^5R^5, (C_1-C_3)alkyl, (C_1-C_3)alkoxy, (halo)(C_1-C_3)alkyl, (hydroxy)(C_1-C_3)alkyl, cyano, -NO_2, -$N(R^5)$-X-R^6, -$N(R^5)$-(CH_2)m-$N(R^5)$-X-R^6, aryl, heteroaryl, or R^{23} and R^{24} taken together with the carbons they are attached to forming a (C_3-C_{10})cycloalkyl ring or a (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

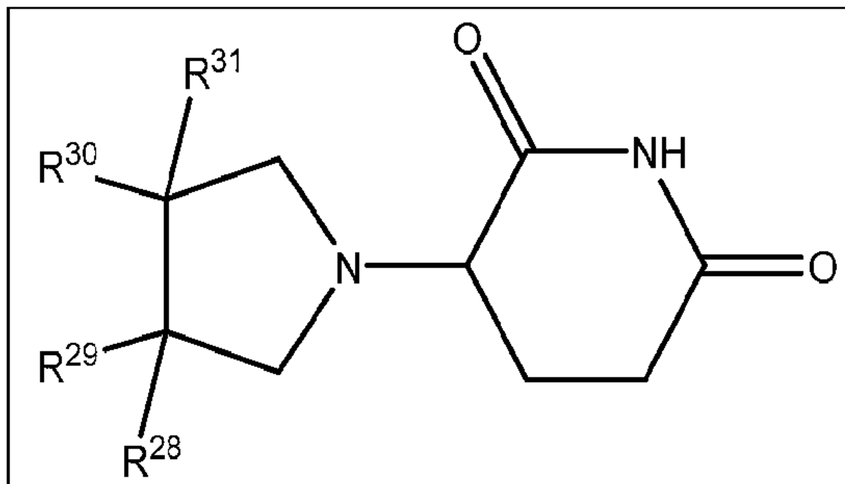
X is a bond, -SO_2-, -$(CH_2)_n$C(O)$(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

m is 0, 1, 2, 3, or 4;

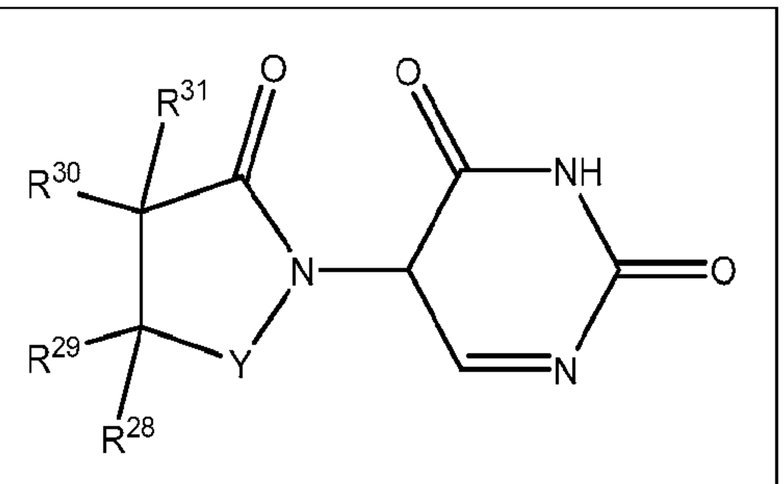
n is 0, 1, 2, 3, or 4.

[0386] In an embodiment, R^{22} is H; R^{23} is H; R^{24} is halo.

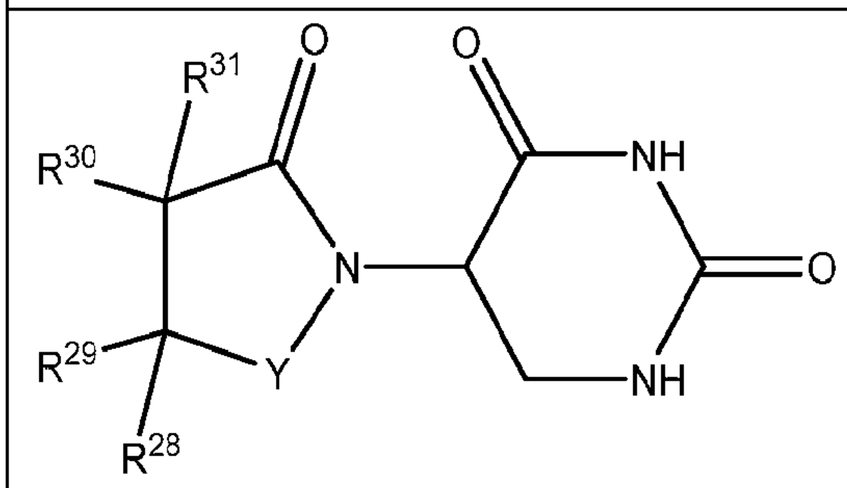
[0387] In one aspect, the present invention relates to a compound of Formula XII, XIII, XIV, XV, XVI, XVII, or XVIII



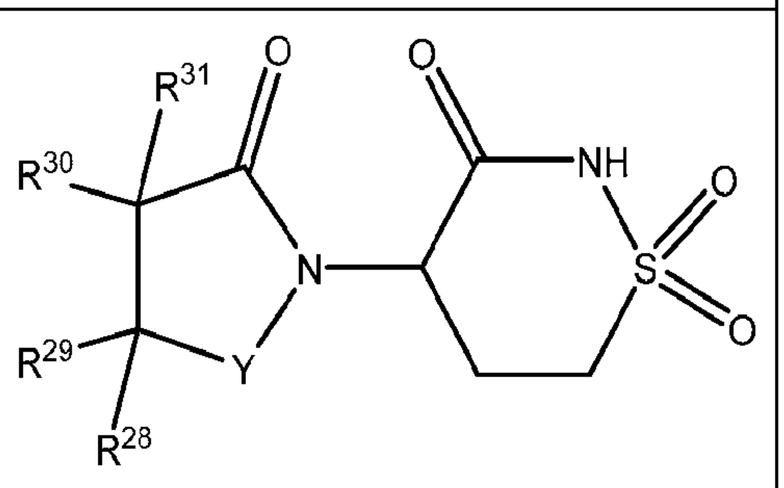
XII



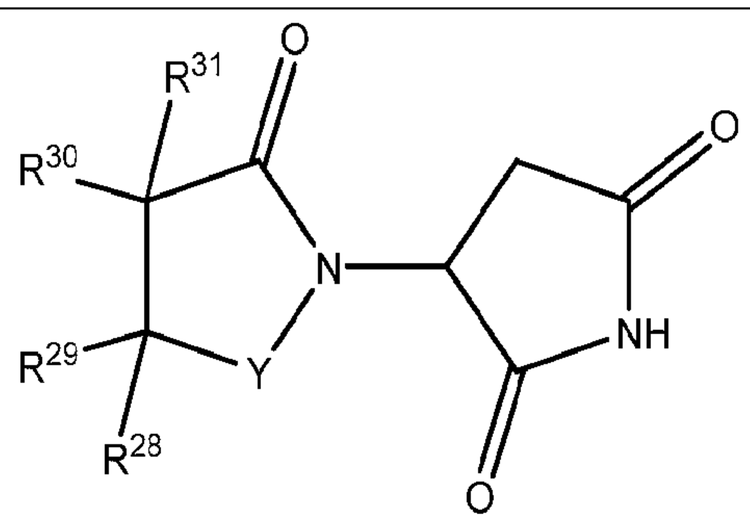
XIII



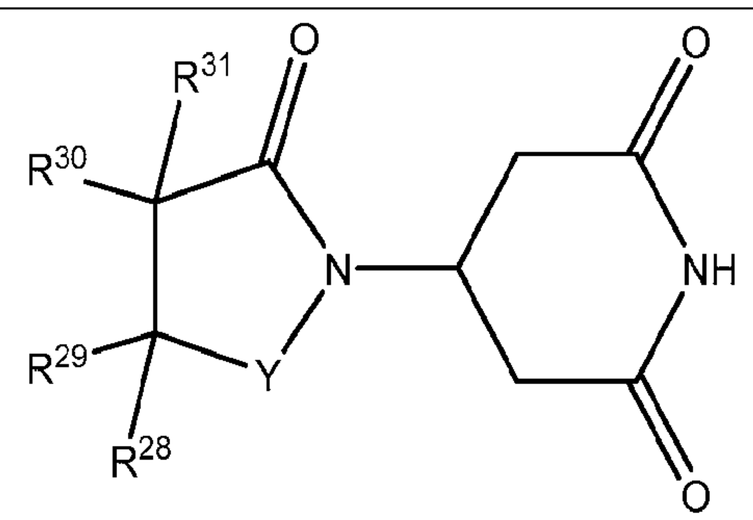
XIV



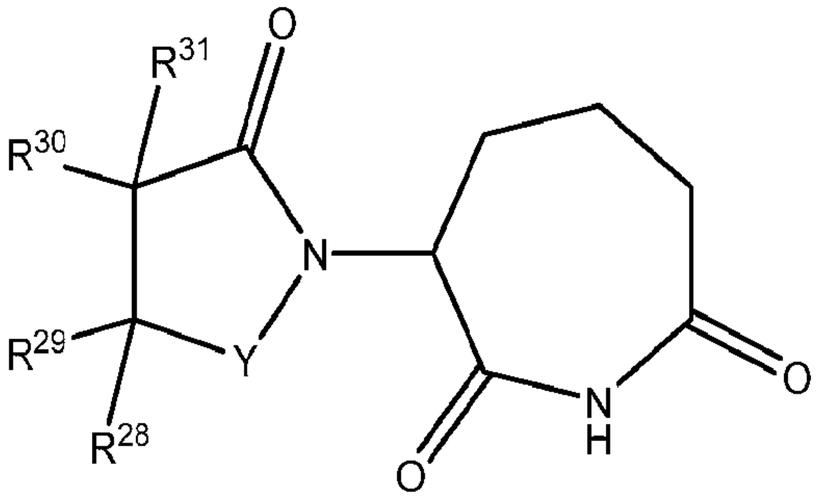
XV



XVI



XVII



XVIII

or a pharmaceutically acceptable salt thereof, wherein:

R^{28}, R^{29}, R^{30}, R^{31} is independently H, halo, OH, $-NR^5R^5$, $-(CH_2)_n-NR^5R^5$, (C_1-C_3)alkyl, (C_1-C_3)alkoxy, (halo)(C_1-C_3)alkyl, (hydroxy)(C_1-C_3)alkyl, cyano, $-NO_2$, $-N(R^5)-X-R^6$, $-N(R^5)-(CH_2)m-N(R^5)-X-R^6$, aryl, heteroaryl, or R^{28}, R^{29} taken together with the carbons to which they are attached to form a (C_3-C_{10})cycloalkyl or a (C_3-C_{10})heterocyclo, or R^{30}, R^{31} taken together with the carbons to which they are attached to form a (C_3-C_{10})cycloalkyl or a (C_3-C_{10})heterocyclo, or R^{29}, R^{30} taken together to form a bond, or R^{29}, R^{30} taken together with the carbons to which they are attached to form a (C_3-C_{10})cycloalkyl or a (C_3-C_{10})heterocyclo or an aryl or a heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n-$aryl, $-(CH_2)_n-$heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, $-(C_1-C_3)$alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n-$aryl, $-(CH_2)_n-$heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n-$aryl, $-(CH_2)_n-$heteroaryl, aryl, and heteroaryl;

X is a bond, $-SO_2-$, $-(CH_2)_nC(O)(CH_2)_m-$, $-C(O)NH-$, $-C(O)N(R^w)-$, $-NHC(O)NH-$, or $-(CH_2)_n-$;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

[0388] In one aspect, the compound of the present invention is selected from the compounds listed in Table 1 in Example 4.

[0389] In one aspect, the compound of the present invention is selected from the group consisting of:

3-[1-oxo-5-(quinazolin-4-ylamino)isoindolin-2-yl]piperidine-2,6-dione;

3-[5-[(4-aminothieno[2,3-d]pyrimidin-2-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

N-[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]acetamide;

3-[5-[(2-aminopyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

6-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]pyridazine-3-carbonitrile;

3-[[2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]acetyl]amino]benzamide;

2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]acetic acid;

N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]quinoline-2-carboxamide;

3-[6-[[2-(2-methyl-1-piperidyl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[(2-isoindolin-2-yl-2-oxo-ethyl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

N-(cyclopropylmethyl)-2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-methyl-acetamide;

acetic acid;3-[1-oxo-6-(quinazolin-4-ylamino)isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[[2-(3-methyl-1-piperidyl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[(4-methyl-3-oxo-pyrazin-2-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[1-oxo-6-(quinoxalin-2-ylamino)isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[(1-methylpyrazolo[3,4-d]pyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-(5,7-dihydrofuro[3,4-d]pyrimidin-2-ylamino)-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[(6-methylpyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-phenyl-acetamide;

3-[6-[[2-(2,4-dimethylpiperazin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-(dimethylamino)-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-(1-oxo-6-phenyl-isoindolin-2-yl)piperidine-2,6-dione;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N,N-dimethyl-acetamide;

3-[6-[[2-(2-methylmorpholin-4-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-methyl-N-[(1-methylpyrazol-4-yl)methyl]acetamide;

N-benzyl-2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetamide;

6-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]pyridazine-3-carbonitrile;

3-[6-[(6-methylpyrrolo[3,2-d]pyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

2-(dimethylamino)-N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]acetamide;

N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]-5H-pyrrolo[2,3-b]pyridine-4-carboxamide;

N-cyclopropyl-2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetamide;

3-[1-oxo-6-(2-oxoimidazolidin-1-yl)isoindolin-2-yl]piperidine-2,6-dione;

2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-5-carbonitrile;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]propanoic acid;

2-acetamido-N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]acetamide;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetamide;

3-[6-[[2-(3-methyl-5-oxo-piperazin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]acetamide;

3-[6-[[2-(4-methyl-3-oxo-piperazin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]-3H-imidazo[4,5-b]pyridine-6-carboxamide;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-tetrahydropyran-4-yl-acetamide;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetic acid;

3-[1-oxo-6-[[2-oxo-2-(1-piperidyl)ethyl]amino]isoindolin-2-yl]piperidine-2,6-dione;

3-(1-oxo-7-phenyl-isoindolin-2-yl)piperidine-2,6-dione;

2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-4-carbonitrile;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-4-yl]amino]acetic acid;

3-(7-fluoro-1-oxo-isoindolin-2-yl)piperidine-2,6-dione;

3-(5-amino-1-oxo-3,4-dihydroisoquinolin-2-yl)piperidine-2,6-dione;

t-butyl 2-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-1-yl]acetate;

3-[1-(2H-indol-3-yl)-3-oxo-isoindolin-2-yl]piperidine-2,6-dione;

2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-1-carbonitrile;

3-[1-(dimethylamino)-3-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-(2-oxopyrrolidin-1-yl)piperidine-2,6-dione;

3-(quinazolin-2-ylamino)piperidine-2,6-dione;

(3Z)-3-benzylidenepiperidine-2,6-dione;

3-(quinoxalin-2-ylamino)piperidine-2,6-dione;

3-(pyrimidin-2-ylamino)piperidine-2,6-dione;

N-(2,6-dioxo-3-piperidyl)-2-oxo-3H-pyridine-6-carboxamide;

3-(4-methyl-1,1,3-trioxo-1,2-benzothiazol-2-yl)piperidine-2,6-dione;

3-(8-amino-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione;

3-(5-amino-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione;

3-(4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione;

3-(5-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione;

3-(6-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione; and

3-(8-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione.

[0390] In one aspect, the present invention relates to a composition comprising a pharmaceutically effective amount of the compound described herein and a pharmaceutically acceptable carrier.

[0391] In one aspect, the present invention relates to a method of treating a disease comprising administering the composition comprising a pharmaceutically effective amount of the compound described herein and a pharmaceutically acceptable carrier to a subject in need thereof..

[0392] In one aspect, the present invention relates to a method of treating a cancer comprising administering the composition comprising a pharmaceutically effective amount of the compound described herein and a pharmaceutically acceptable carrier to a subject in need thereof. In an embodiment, the cancer is selected from the group consisting of squamous-cell carcinoma, basal cell carcinoma, adenocarcinoma, hepatocellular carcinomas, renal cell

carcinomas, bladder cancer, bowel cancer, breast cancer, cervical cancer, colon cancer, esophageal cancer, head cancer, kidney cancer, liver cancer, lung cancer, neck cancer, ovarian cancer, pancreatic cancer, prostate cancer, stomach cancer, uterine cancer, leukemias, lymphomas, Burkitt's lymphoma, Non-Hodgkin's lymphoma, melanomas, myeloproliferative diseases, multiple myeloma, sarcomas, including Ewing's sarcoma, hemangiosarcoma, Kaposi's sarcoma, liposarcoma, myosarcomas, peripheral neuroepithelioma, synovial sarcoma, gliomas, astrocytomas, oligodendrogliomas, ependymomas, glioblastomas, neuroblastomas, ganglioneuromas, gangliogliomas, medulloblastomas, pineal cell tumors, meningiomas, meningeal sarcomas, neurofibromas, Schwannomas, testicular cancer, thyroid cancer, astrocytoma, Hodgkin's disease, Wilms' tumor, and teratocarcinomas.

[0393] In another aspect, the present invention relates to a method of treating or preventing one or more autoimmune diseases or disorders comprising administering a composition comprising a pharmaceutically effective amount of the compound described herein and a pharmaceutically acceptable carrier to a subject in need thereof. In an embodiment, the autoimmune disease or disorder is selected from, such as multiple sclerosis, diabetes mellitus, lupus, celiac disease, Crohn's disease, ulcerative colitis, Guillain-Barre syndrome, scleroderms, Goodpasture's syndrome, Wegener's granulomatosis, autoimmune epilepsy, Rasmussen's encephalitis, Primary biliary sclerosis, Sclerosing cholangitis, Autoimmune hepatitis, Addison's disease, Hashimoto's thyroiditis, Fibromyalgia, Menier's syndrome; transplantation rejection (*e.g.*, prevention of allograft rejection) pernicious anemia, rheumatoid arthritis, systemic lupus erythematosus, dermatomyositis, Sjogren's syndrome, lupus erythematosus, multiple sclerosis, myasthenia gravis, Reiter's syndrome, Grave's disease, and other autoimmune diseases or disorders.

[0394] In an embodiment, the subject is a human.

[0395] In another aspect, the present invention relates to a method of modulating cereblon comprising administering the composition comprising the compounds of Formulas I-XVIII to a subject in need thereof. In an embodiment, the present invention relates to a method of modulating cereblon comprising administering the composition comprising the compounds selected from the compounds listed in Table 1 in Example 4 to a subject in need thereof.

[0396] In another aspect, the present invention relates to a method of modulating proteasomal degradation of a protein comprising administering the composition comprising the compounds of Formulas I-XVIII to a subject in need thereof. In an embodiment, the

present invention relates to a method of modulating proteasomal degradation of a protein comprising administering the composition comprising the compounds selected from the compounds listed in Table 1 in Example 4 to a subject in need thereof.

[0397] In another aspect, the present invention relates to a method of modulating sequestration of a protein to the proteasome comprising administering the composition comprising the compounds of Formulas I-XVIII to a subject in need thereof. In an embodiment, the present invention relates to a method of modulating sequestration of a protein to the proteasome comprising administering the composition comprising the compounds selected from the compounds listed in Table 1 in Example 4 to a subject in need thereof.

EXAMPLES

General Synthetic Schemes

[0398] Compounds of the present invention generally can be prepared beginning with commercially available starting materials and using synthetic techniques known to those of skill in the art. Outlined below are some reaction schemes suitable for preparing compounds of the present invention. Further exemplification is found in the specific examples provided.

Example 1: Competition Assay

[0399] CRBN binding was assessed with a MAPPIT-like assay by determining the ability of test compounds to compete with a trimethoprim-lenalidomide hybrid ligand for binding to CRBN in cells. The traditional MAPPIT assay, as described for example in Lemmens, *et al.* "MAPPIT, a mammalian two-hybrid method for in-cell detection of protein-protein interactions," *Methods Mol Biol.* 2015;1278:447-55, has been used to monitor protein-protein interactions. A bait protein (protein A) is expressed as a fusion protein in which it is genetically fused to an engineered intracellular receptor domain of the leptin receptor, which is itself fused to the extracellular domain of the erythropoietin (Epo) receptor. Binding of Epo ligand to the EpoR component results in activation of receptor-associated intracellular JAK2. However, activated JAK2 cannot activate the leptin receptor to trigger STAT3 binding and its phosphorylation because its tyrosine residues, normally phosphorylated by activated JAK2, have been mutated. Reconstitution of a JAK2 phosphorylatable STAT3 docking site is instead created through interaction of a protein B with protein A, whereby protein B is fused to a cytoplasmic domain of the gp130 receptor (which now harbors appropriate tyrosine resides recognized by the activated JAK2 kinase). Thus, physical interaction of protein A

with protein B reconstitutes and Epo triggers JAK2-STAT3 signaling pathway activation. Activation of STAT3 can be monitored by introduction of a STAT3-responsive reporter gene, including a luciferase-encoding gene or a gene encoding a fluorescent marker such as GFP or some other type of fluorescent protein (EGF etc.). In this manner, the MAPPIT assay provides a versatile assay to assess such recombinant protein-protein interactions, or compound- or hybrid ligand-induced protein-protein interactions, in intact cells.

[0400] Here, a similar MAPPIT-like assay was used to determine the ability of test compounds to compete with the trimpethoprim-lenalidomide-induced binding between DHFR and CRBN. Therefore, HEK293 cells transfected with the appropriate cDNAs encoding transgenes (encoding DHFR and CRBN fusion proteins), were used to generate a positive assay signal as a result of ternary protein/compound complex formation, including a DHFR-fusion protein, a trimethoprim(TMP)-lenalidomide hybrid ligand (TMP is a ligand for DHFR), and a CRBN-gp130 fusion protein (CRBN binds the ligand lenalidomide) – thus, a DHFR-TMP-LEN-CRBN complex formation. Formation of the complex resulted in activation of a STAT-responsive luciferase reporter gene. That signal was set to 100% luciferase activity. In a separate sample set up, cells were prepared in the same manner but, in addition, co-incubated with a test compound whose interaction with CRBN was investigated. Binding to the CRBN fusion protein would compete with binding of the hybrid ligand to the same CRBN protein, hence inhibiting the assay signal due to prevention of ternary complex formation, which was required to generate an assay signal. Increasing concentrations of test compound were assessed to determine CRBN binding efficiency as determined in this type of ligand competition experiment in living cells. Specificity of signal inhibition was assessed by a parallel experimental set up in which test compound effect was assessed for inhibition of signal generated by a control gp130 fusion protein (CTRL) that directly bound to the DHFR-fusion protein in the absence of hybrid ligand (*i.e.* a direct interaction of the proteins).

[0401] In more detail, HEK293T cells were cultured in Dulbecco's modified Eagle's medium supplemented with 10% fetal calf serum, incubated at 37 °C, 8% CO_2. Cells were transfected with a plasmid encoding *E. coli* Dihydrofolate Reductase (DHFR) fused to the tails of the cytoplasmic domain of a mutated leptin receptor (pCLG-eDHFR), a plasmid encoding a CRBN prey fused to gp130 cytoplasmic domain (pMG1-CRBN) or a plasmid encoding a REM2 control prey that could directly interact with the leptin receptor of the DHFR fusion protein (pMG1-REM2), and the STAT3 responsive pXP2d2-rPAPI-luciferase reporter plasmid - using a standard transfection method, as described (Lievens, *et al.* "Array

MAPPIT: high-throughput interactome analysis in mammalian cells." Journal of Proteome Research 8.2 (2009): 877-886). Cells were treated with leptin to activate the leptin receptor fusion protein and supplemented with 300 nM trimethoprim-lenalidomide fusion compound (hybrid ligand, where trimethoprim interacts with DHFR and lenalidomide with CRBN) without or with the indicated dose of test compound at 24 hours after transfection. Luciferase activity, induced by formation of the ternary complex including DHFR-trimethoprim-lenalidomide-CRBN, and consequential activation of STAT3 signaling, was measured 24 hours after compound treatment using the Luciferase Assay System kit (PROMEGA, Madison, WI) with an Ensight plate reader (PERKIN ELMER LIFE SCIENCES, Waltham, MA). Data points represented the average luciferase activity of triplicate samples derived from cells treated with leptin + test compound for the REM2 control (CTRL) or cells treated with leptin + hybrid ligand + test compound (CRBN) relative to leptin (CTRL) or leptin + hybrid ligand (CRBN) only treated samples (the signals obtained in absence of added test compound for both cases is set at 100% of luciferase activity on y-axis). Error bars represented standard deviations. Curves were fit using 4-parameter nonlinear regression in GRAPHPAD PRISM software

Example 2: Recruitment Assays:

[0402] In this Example 2, a similar MAPPIT-like assay was applied as described in Example 1 to determine test compound-induced binding of a particular substrate protein of interest to CRBN. In this experimental set-up, cells were transfected with a construct encoding a CRBN-fusion protein and another one encoding a substrate-fusion protein. Test compound activity was assessed with increasing concentrations of test compounds (dose-response studies) to monitor the ability to promote CRBN-ligand-induced protein interaction.

[0403] Specifically, HEK293T cells were transfected with a plasmid encoding the MAPPIT receptor fusion wherein the protein of interest (CRBN or substrate protein) is genetically linked to a cytoplasmic domain of the leptin receptor, which itself is fused to the extracellular domain of the erythropoietin (Epo) receptor (pSEL-X, where X represents either CRBN or any of the tested substrate proteins of interest), a plasmid encoding the MAPPIT gp130 fusion (pMG1-Y, Y being either any of the tested substrate proteins or CRBN) and a STAT3-responsive luciferase-encoding reporter plasmid (pXP2d2-rPAPI-luciferase reporter plasmid), as described (Lievens, *et al.* "Array MAPPIT: high-throughput interactome analysis in mammalian cells." Journal of Proteome Research 8.2 (2009): 877-886). Full size proteins were fused for each of the target proteins tested, except in the case of IKZF1 where isoform 7

was used. For the study, the following were used: IKZF1 recruitment: pSEL-CRBN + pMG1-IKZF1(isoform 7); ASS1 recruitment: pSEL-CRBN + pMG1-ASS1. SALL4 recruitment: pSEL-SALL4 + pMG1-CRBN. Cells were treated with erythropoietin (Epo) without or with the indicated dose of test compound at 24 hours after transfection. Luciferase activity was measured 24 hours after test compound treatment using the Luciferase Assay System kit (PROMEGA, Madison, WI) with an Ensight plate reader (PERKIN ELMER LIFE SCIENCES, Waltham, MA). Data points depicted fold induction of the average luciferase activity of triplicate samples from EPO + test compound treated cells versus EPO only treated cells. Error bars represent standard deviations. Curves were fit using 4-parameter nonlinear regression in GRAPHPAD PRISM software.

Example 3: Preparation of the Compounds

[0404] The compounds of the present invention can be prepared by methods well known in the art of organic chemistry. See, for example, J. March, 'Advanced Organic Chemistry' 4th Edition, John Wiley and Sons. During synthetic sequences it may be necessary and/or desirable to protect sensitive or reactive groups on any of the molecules concerned. This is achieved by means of conventional protecting groups, such as those described in T.W. Greene and P.G.M. Wutts 'Protective Groups in Organic Synthesis' 3rd Edition, John Wiley and Sons, 1999. The protective groups are optionally removed at a convenient subsequent stage using methods well known in the art. The products of the reactions are optionally isolated and purified, if desired, using conventional techniques, but not limited to, filtration, distillation, crystallization, chromatography and the like. Such materials are optionally characterized using conventional means, including physical constants and spectral data.

[0405] In synthesizing compounds of the present invention, it may be desirable to use certain leaving groups. The term "leaving groups" ("LG") generally refer to groups that are displaceable by a nucleophile. Such leaving groups are known in the art. Examples of leaving groups include, but are not limited to, halides (e.g., I, Br, F, Cl), sulfonates (e.g., mesylate, tosylate), sulfides (e.g., SCH3), N-hydroxsuccinimide, N-hydroxybenzotriazole, and the like. Examples of nucleophiles include, but are not limited to, amines, thiols, alcohols, Grignard reagents, anionic species (e.g., alkoxides, amides, carbanions) and the like.

HPLC purification

[0406] Purification was performed using HPLC (H_2O – MeOH; Agilent 1260 Infinity systems equipped with DAD and mass-detectors. Waters Sunfire C18 OBD Prep Column,

100Å, 5 µm, 19 mm X 100 mm with SunFire C18 Prep Guard Cartridge, 100Å, 10 µm, 19 mm X 10 mm) The material was dissolved in 0.7 mL DMSO. Flow : 30mL/min. Purity of the obtained fractions was checked via the analytical LCMS. Spectra were recorded for each fraction as it was obtained straight after chromatography in the solution form. The solvent was evaporated in the flow of N_2 at 80°C. On the basis of post-chromatography LCMS analysis fractions were united. Solid fractions were dissolved in 0.5 mL MeOH and transferred into a pre-weighted marked vials. Obtained solutions were again evaporated in the flow of N_2 at 80°C. After drying, products were finally characterized by LCMS and ^{1}H NMR. For clarity, in the synthetic schemes of this section, hydrogen atom is not shown for simplicity, for example: "-NH_2" is shown as "–N"; "-OH" is shown as "-O".

Analytical Methods

NMR

Instrument specifications:

Bruker AVANCE DRX 500

Varian UNITYplus 400

LC/MS

Instrument specifications:

Agilent 1100 Series LC/MSD system with DAD\ELSD and Agilent LC\MSD VL (G1956A), SL (G1956B) mass-spectrometer.

Agilent 1200 Series LC/MSD system with DAD\ELSD and Agilent LC\MSD SL (G6130A), SL (G6140A) mass-spectrometer.

All the LC/MS data were obtained using positive/negative mode switching.

Column Zorbax SB-C18 1.8 µm 4.6x15mm Rapid Resolution cartridge (PN 821975-932)

Mobile phase A – acetonitrile, 0.1% formic acid

B – water (0.1% formic acid)

Flow rate 3ml/min

Gradient 0 min – 100% B

0.01 min – 100% B

1.5 min - 0% B

1.8 min - 0% B

1.81 min - 100% B

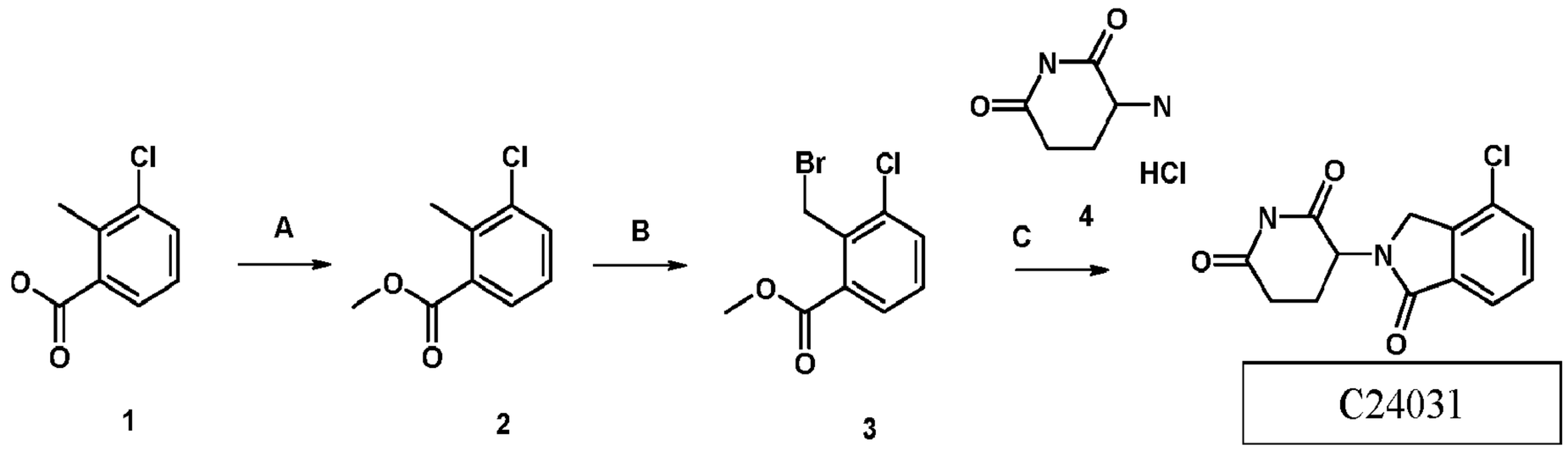
Injection volume 1µl

Ionization mode atmospheric pressure chemical ionization (APCI)

Scan range m/z 80-1000

C24031

[0407] Synthesis of target compound was carried out following the scheme given below:



General Procedure A:

[0408] Compound 1 (20 mmol) and K_2CO_3 (24 mmol) were suspended in DMF (20 mL). To the reaction mixture, was added iodomethane (24 mmol). The reaction was stirred at r.t. overnight, then diluted with water (150 mL). The solution was extracted with ethyl acetate (2x200 mL), organic phase was washed with brine (3x150ml), dried with $CaCl_2$ and evaporated to give the methyl ester 2. Yield: 94%.

General Procedure B:

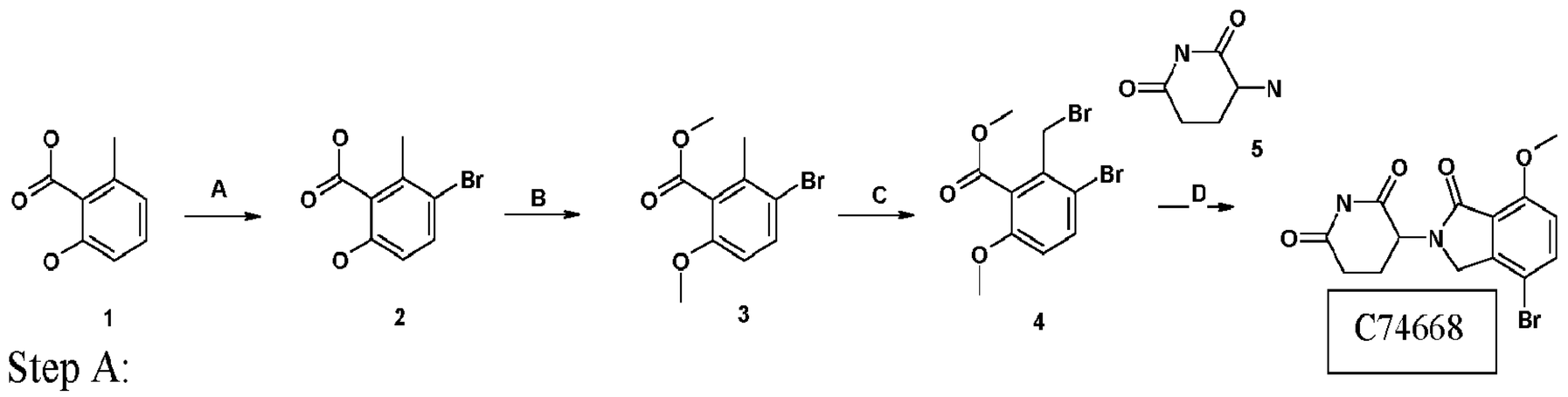
[0409] To a solution of compound 2 (1.6 mmol) in CCl_4 (3ml) was added AIBN (0.1 mmol) and NBS (2 mmol) during 15min at 25°C. The reaction was heated for 12h at 60°C and cooled to r.t. The solvent was then removed in vacuo. The crude residue was purified using LC. Yield: 64%.

General Procedure C:

[0410] Compound 1 (1 mmol), DIPEA (2.1 mmol) and compound 2 hydrochloride (1.3 mmol) were dissolved in 5 ml DMF, the mixture was heated at 80°C for 18 hours (TLC and LCMS control). The reaction mixture was cooled, filtered and the solvent was evaporated. The crude residue was purified using HPLC. Yield: 49%.

C74668

[0411] Synthesis of target compound was carried out following the scheme given below:


A
B
C
D
Br
Br
Br
N
O
N
O
O
O

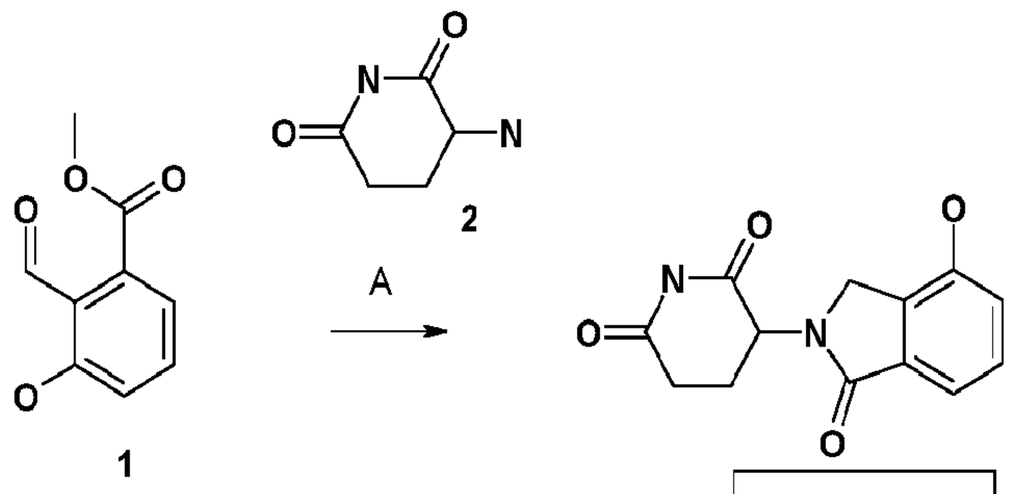
[**0418**] This compound was prepared according to General Procedure C for C24031. Yield: 87%.

Step C:

[**0419**] To a solution of compound 4 (0.5 mmol) in methanol (2 mL) was added palladium carbon (5%, 10 mg), and the mixture was stirred under a hydrogen atmosphere at room temperature for 10 h. The reaction mixture was filtered through celite. The filtrate was concentrated under reduced pressure and after was purified by using HPLC. Yield: 39 %.

C89676

[**0420**] Synthesis of target compound was carried out following the scheme given below:



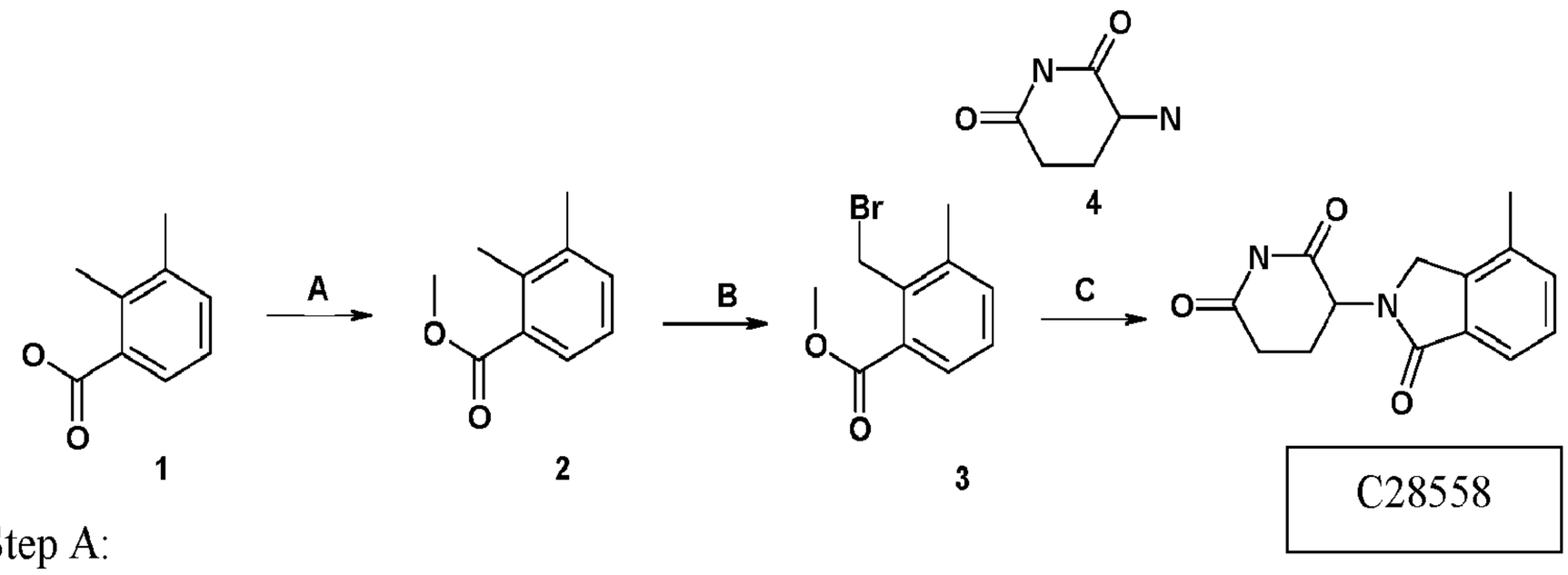
C89676

General Procedure A:

[**0421**] Compound 1 (1 mmol), $NaH(OAc)_3$ (5 mmol), HOAc (1 mmol) and compound 2 (1.3 mmol) were dissolved in 5 ml of MeOH, the mixture was heated at 80°C for 12 hours. TLC and LCMS control. The reaction mixture was cooled, then filtered and the solvent was evaporated. The crude residue was purified using HPLC. Yield 58%.

C28558

[**0422**] Synthesis of target compound was carried out following the scheme given below:



C28558

Step A:

[**0423**] This compound was prepared according to General Procedure A for C24031. Yield: 98%.

Step B:

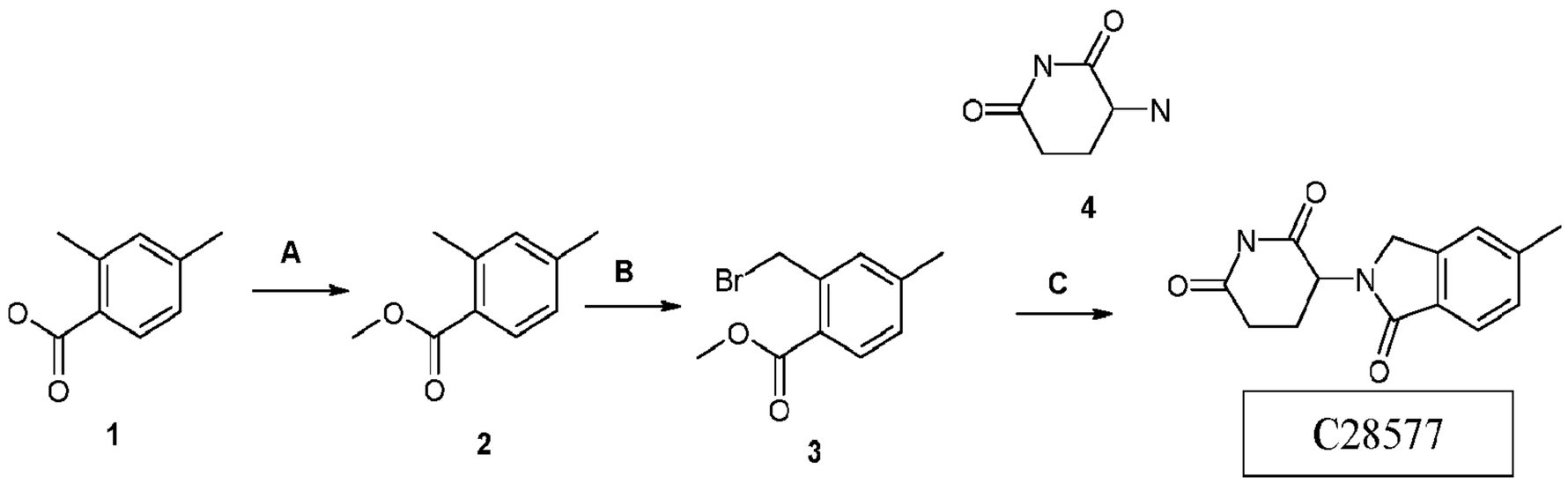
[**0424**] This compound was prepared according to General Procedure B for C24031. Yield: 56%.

Step C:

[**0425**] This compound was prepared according to General Procedure C for C24031. Yield: 67%.

C28577

[**0426**] Synthesis of target compound was carried out following the scheme given below:



Step A:

[**0427**] This compound was prepared according to General Procedure A for C24031. Yield: 98%.

Step B:

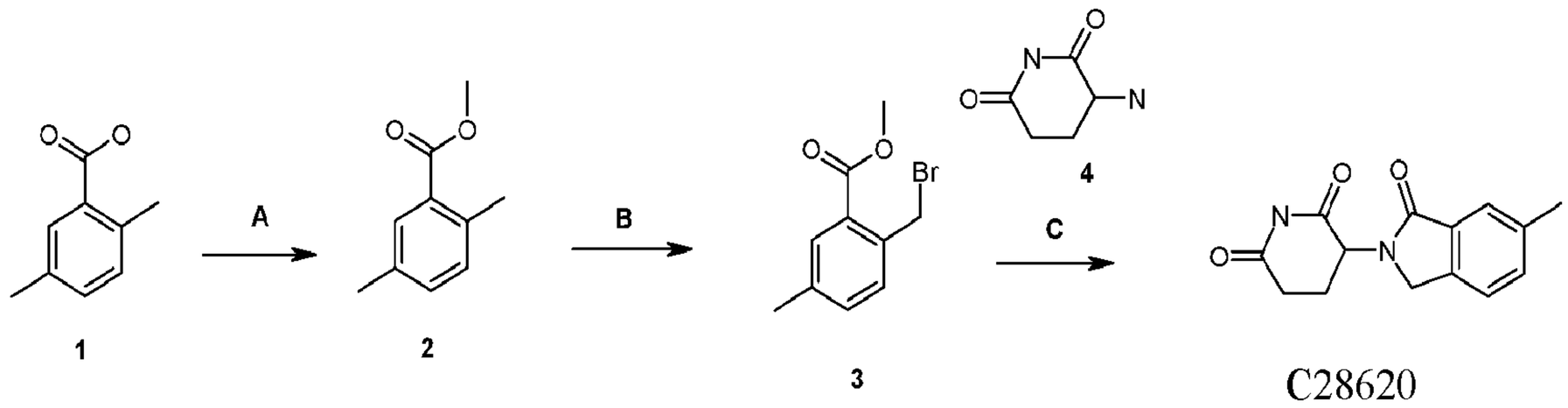
[**0428**] This compound was prepared according to General Procedure B for C24031. Yield: 59%.

Step C:

[**0429**] This compound was prepared according to General Procedure C for C24031. Yield: 81%.

C28620

[**0430**] Synthesis of target compound was carried out following the scheme given below:



Step A:

[**0431**] This compound was prepared according to General Procedure A for C24031. Yield: 95%.

Step B:

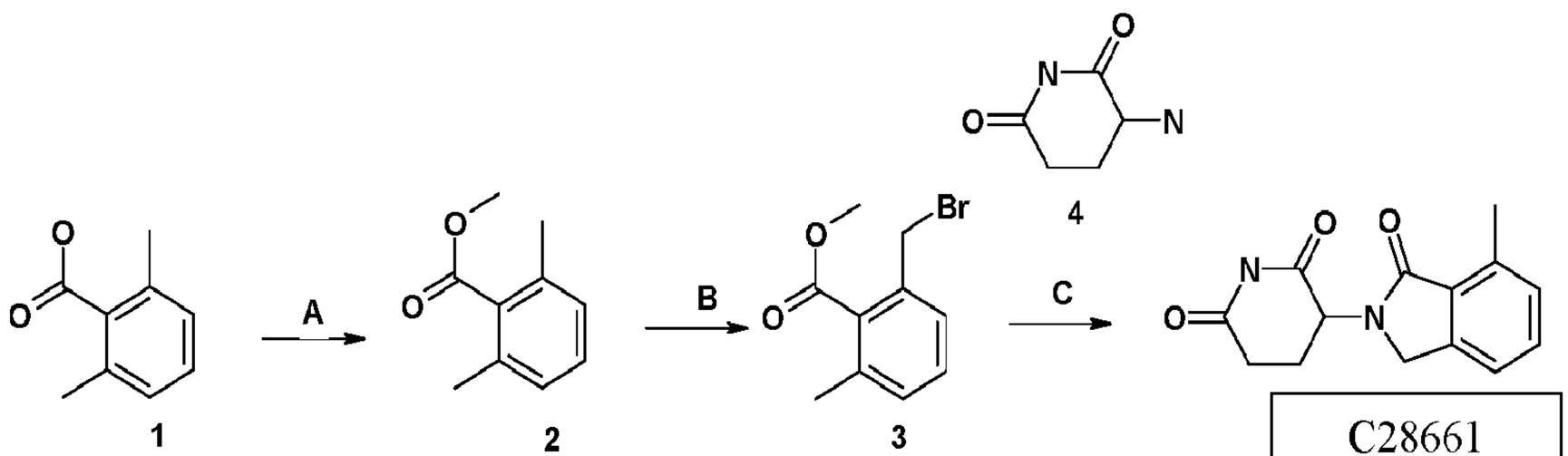
[0432] This compound was prepared according to General Procedure B for C24031. Yield: 59%.

Step C:

[0433] This compound was prepared according to General Procedure C for C24031. Yield: 72%.

C28661

[0434] Synthesis of target compound was carried out following the scheme given below:



Step A:

[0435] This compound was prepared according to General Procedure A for C24031. Yield: 95%.

Step B:

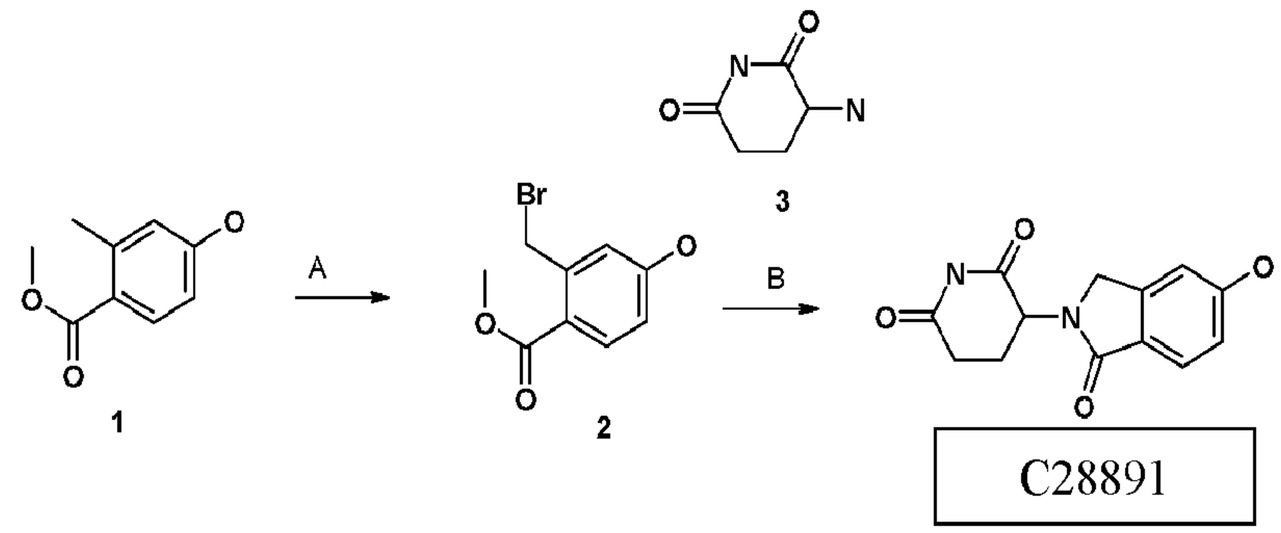
[0436] This compound was prepared according to General Procedure B for C24031. Yield: 49%.

Step C:

[0437] This compound was prepared according to General Procedure C for C24031. Yield: 64%.

C28891

[0438] Synthesis of target compound was carried out following the scheme given below:



Step A:

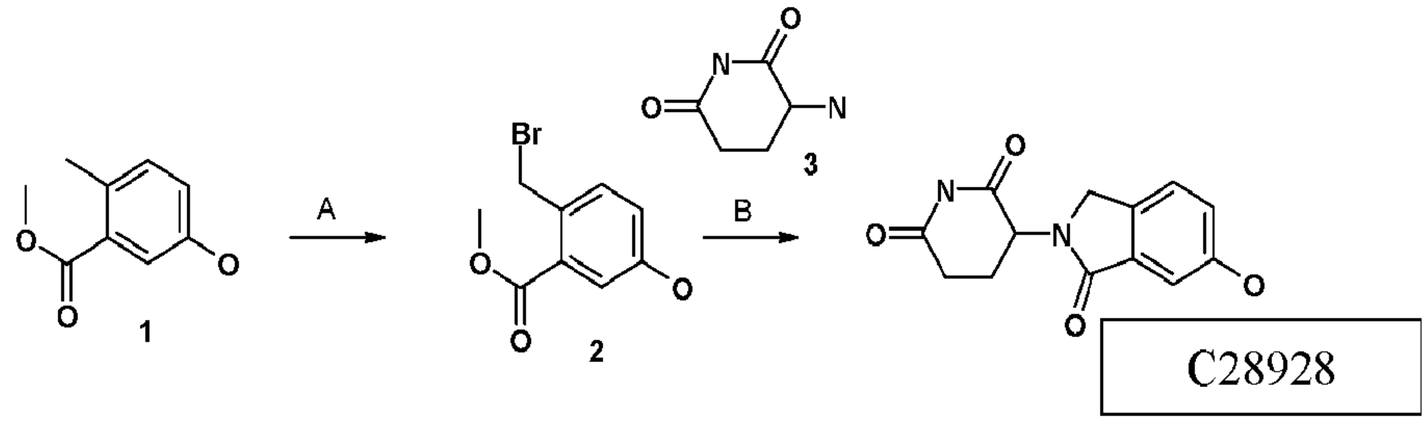
[0439] This compound was prepared according to General Procedure B for C24031. Yield: 69%.

Step B:

[0440] This compound was prepared according to General Procedure C for C24031. Yield: 62%.

C28928

[0441] Synthesis of target compound was carried out following the scheme given below:



Step A:

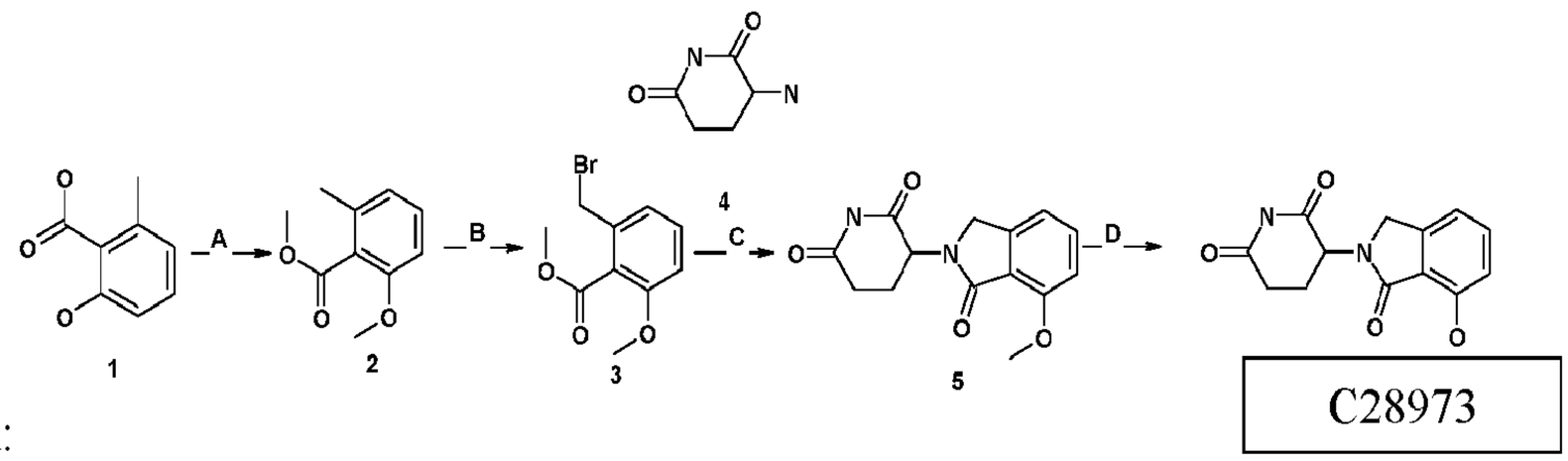
[0442] This compound was prepared according to General Procedure B for C24031. Yield: 37%.

Step B:

[0443] This compound was prepared according to General Procedure C for C24031. Yield: 55%.

C28973

[0444] Synthesis of target compound was carried out following the scheme given below:



Step A:

[0445] To a stirred solution of compound 1 (10 mmol) in acetone (10 mL) was added anhydrous powdered potassium carbonate (20 mmol). Dimethyl sulfate (12 mmol) was added in portions for about 10 min at room temperature. After the addition was complete, the solution was heated to reflux temperature on a water bath and maintained for 5 h. The solution was cooled to room temperature and then concentrated under reduced pressure. Distilled water (20 mL) was added to the reaction mixture, which was then extracted with ethyl acetate (50 mL). The organic layer was washed with distilled water (2 x 20 mL), dried over anhydrous sodium sulfate, and concentrated. Yield 86%.

Step B:

[**0446**] This compound was prepared according to General Procedure B for C24031. Yield: 45%.

Step C:

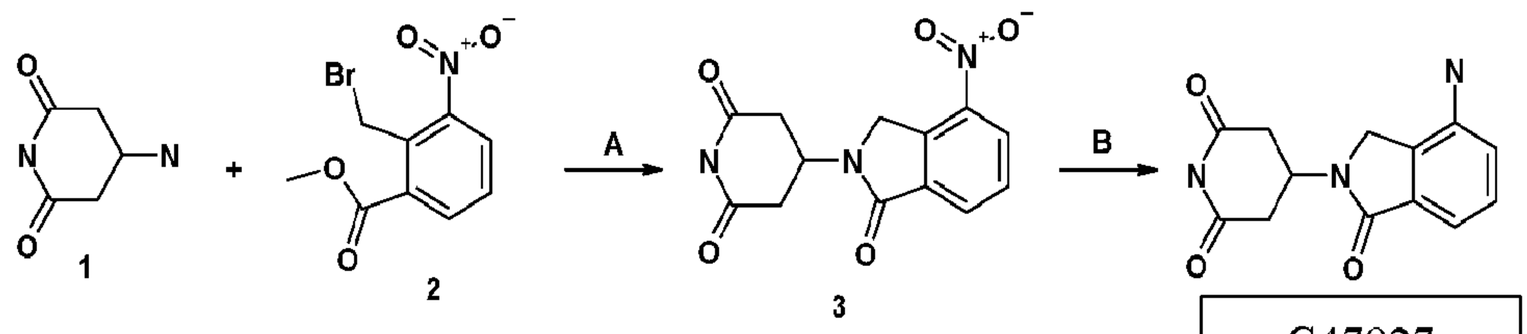
[**0447**] This compound was prepared according to General Procedure C for C24031. Yield: 74%.

Step D:

[**0448**] To a solution of compound 5 (0.5 mmol) in dichloromethane (2.0 ml) was added TFA (2 mmol). The reaction stirred at room temperature for 0.5h. The reaction was poured into water and extracted (2x) with dichloromethane. The combined organic layers were dried over magnesium sulfate, filtered and concentrated. The crude residue was purified by HPLC. Yield: 26%.

C47927

[**0449**] Synthesis of target compound was carried out following the scheme given below:



[**0450**] Step A:

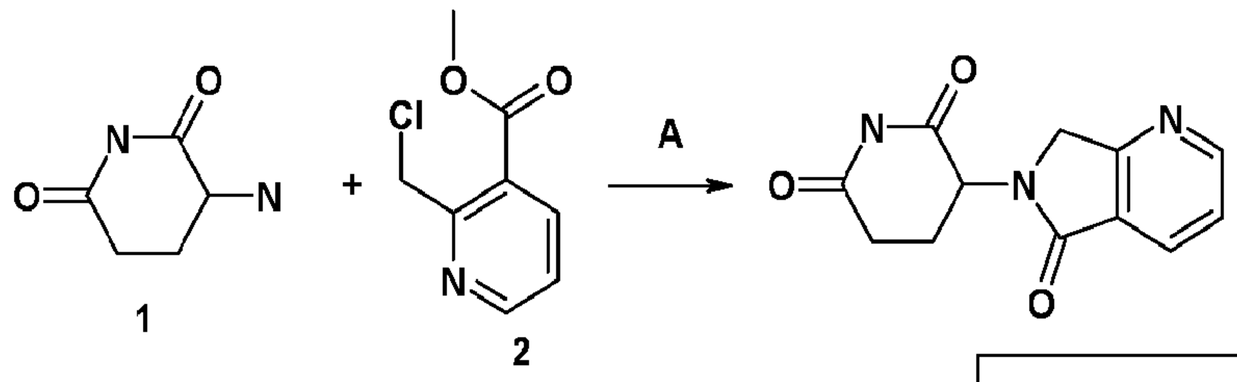
[**0451**] This compound was prepared according to General Procedure C for C24031. Yield: 84%.

[**0452**] Step B:

[**0453**] To a solution of compound 4 (0.5 mmol) in methanol (2 mL) was added palladium carbon (5%, 10 mg), and the mixture was stirred under a hydrogen atmosphere at room temperature for 10 h. The reaction mixture was filtered through celite. The filtrate was concentrated under reduced pressure and after was purified by using HPLC. Yield: 79 %.

C47959

[**0454**] Synthesis of target compound was carried out following the scheme given below:



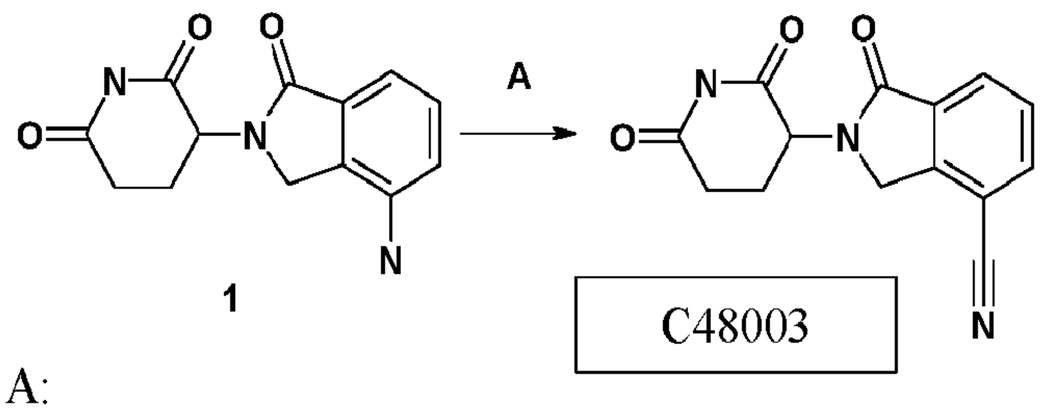
C47959

General Procedure A:

[0455] Compound 1 (1 mmol), DIPEA (3.1 mmol) and compound 2 hydrochloride (1.3 mmol) were dissolved in 5 ml DMF, the mixture was heated at 80°C for 18 hours (TLC and LCMS control). The reaction mixture was cooled, filtered and the solvent was evaporated. The crude residue was purified using HPLC. Yield: 29%.

C48003

[0456] Synthesis of target compound was carried out following the scheme given below:



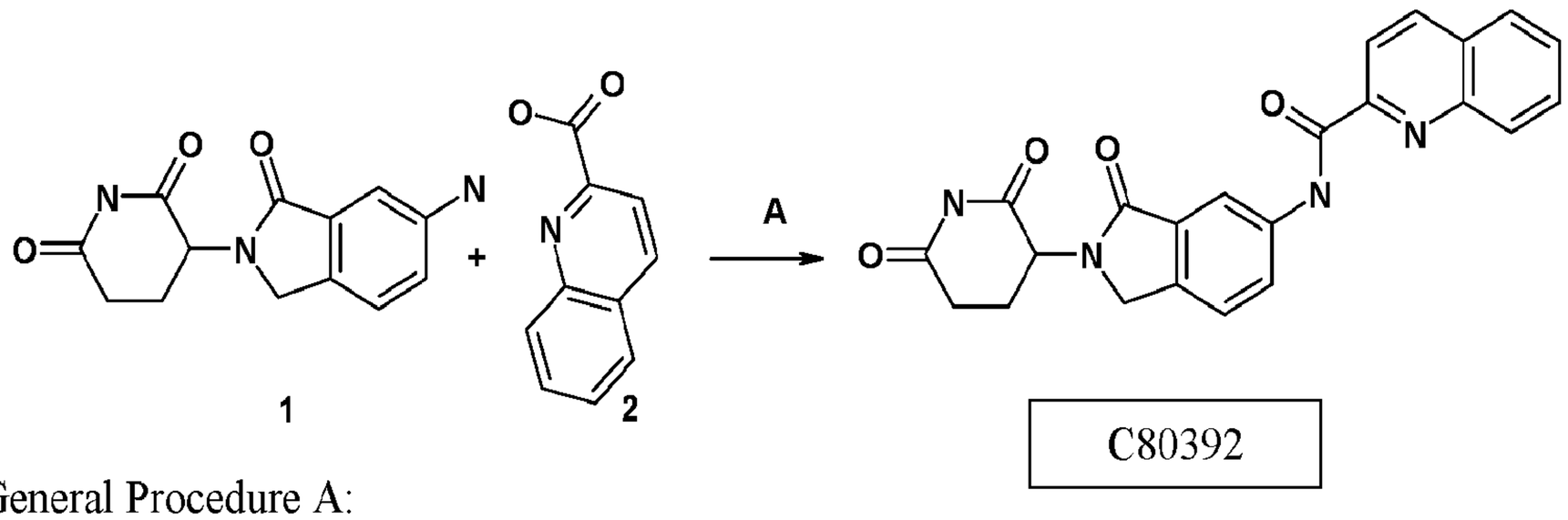
C48003

General Procedure A:

[0457] Compound 1 (27mmol) was treated with 50ml of dilute (1:3) hydrochloric acid. The resulting suspension was cooled to 0-3°C and a solution of $NaNO_2$ (108mmol) in 50ml of water was added during 20min. The mixture was neutralized with $NaHCO_3$ and a suspension of CuCN (30mmol) in 20ml of toluene was added. The mixture was kept for 10-12h at room temperature and 100ml of toluene was added. The toluene was evaporated, washed with water and recrystallization from mixture DMF/i-PrOH (1/3). Yield: 39%.

C80392

[0458] Synthesis of target compound was carried out following the scheme given below:



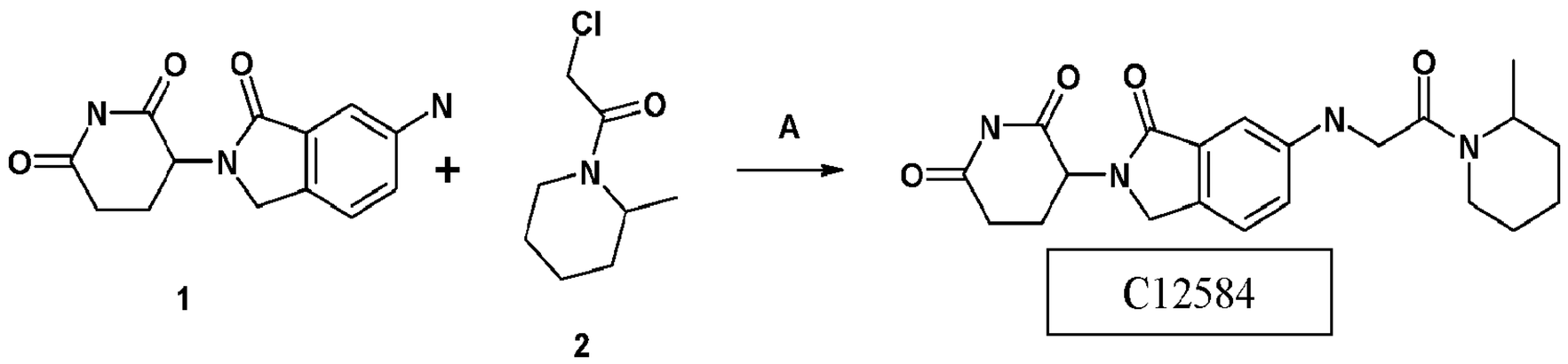
C80392

General Procedure A:

[0459] Compound 1 (1mmol) and 2 (1mmol) were dissolved in 7ml of dry DMF, DIPEA (3mmol) and HATU (2mmol) were added. The resulting mixture was stirred at 50°C for 10-12h (LCMS control), cooled to room temperature, 15ml of water and HOAc (5mmol) were added. The mixture was extracted with EtOAc (3x25ml), washed with brine (3x25ml) and EtOAc was evaporated. The crude residue was purified using HPLC. Yield: 49%.

C12584

[0460] Synthesis of target compound was carried out following the scheme given below:

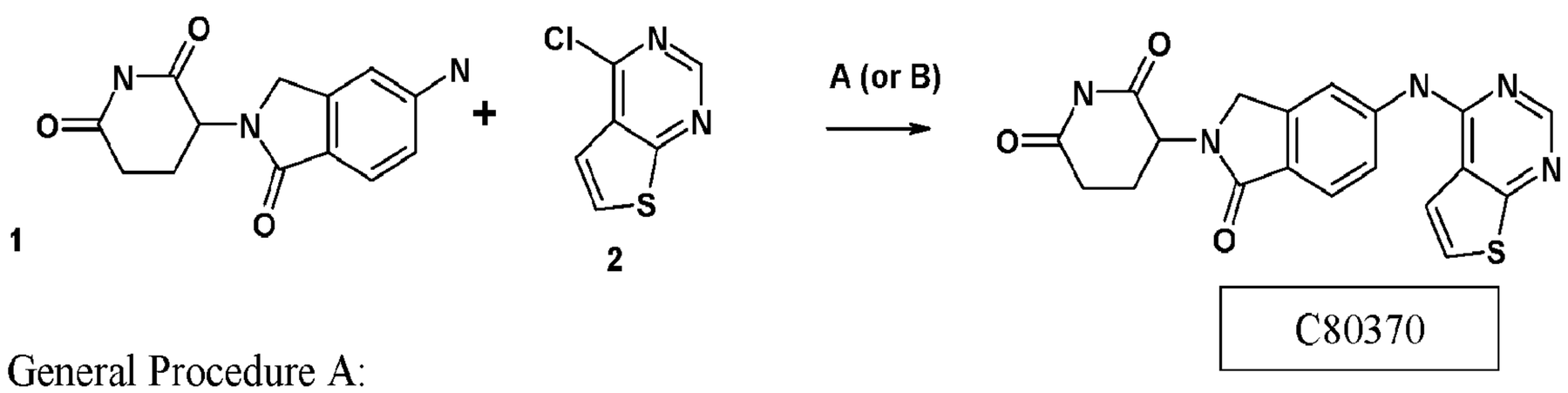


General Procedure A:

[0461] Compound 1 (1mmol) and 2 (1mmol) were dissolved in 10ml of dry DMF, DIPEA (3mmol) was added. The resulting mixture was stirred at 90°C for 3-5h (LCMS control), cooled to room temperature, 20ml of water was added. The precipitate was filtered, washed with water (3x25ml). The crude residue was purified using HPLC. Yield: 24%.

C80370

[0462] Synthesis of target compound was carried out following the scheme given below:



General Procedure A:

[0463] Compound 1 (1mmol) and 2 (1mmol) were dissolved in 10ml of dry DMF, DIPEA (2mmol) was added. The resulting mixture was stirred at 80°C for 10-12h (LCMS control), cooled to room temperature, 20ml of water was added. The precipitate was filtered, washed with water (3x25ml). The crude residue was purified using HPLC. Yield: 32%.

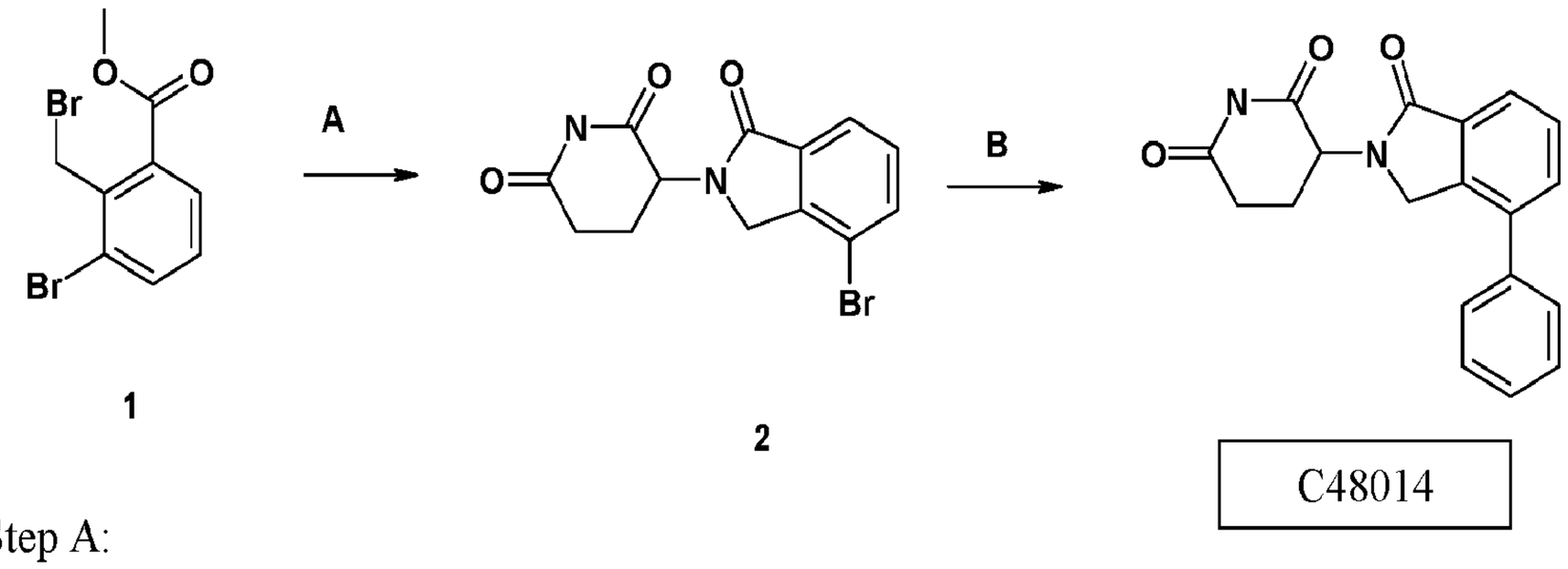
General Procedure B:

[0464] Compound 1 (1mmol) and 2 (1mmol) were dissolved in 10ml of dry HOAc. The resulting mixture was heated at 80 °C with stirring for 10-48h (LCMS control), cooled to

room temperature, 20ml of water was added. The precipitate was filtered, washed with water (3x25ml). The crude residue was purified using HPLC. Yield: 38%.

C48014

[0465] Synthesis of target compound was carried out following the scheme given below:



Step A:

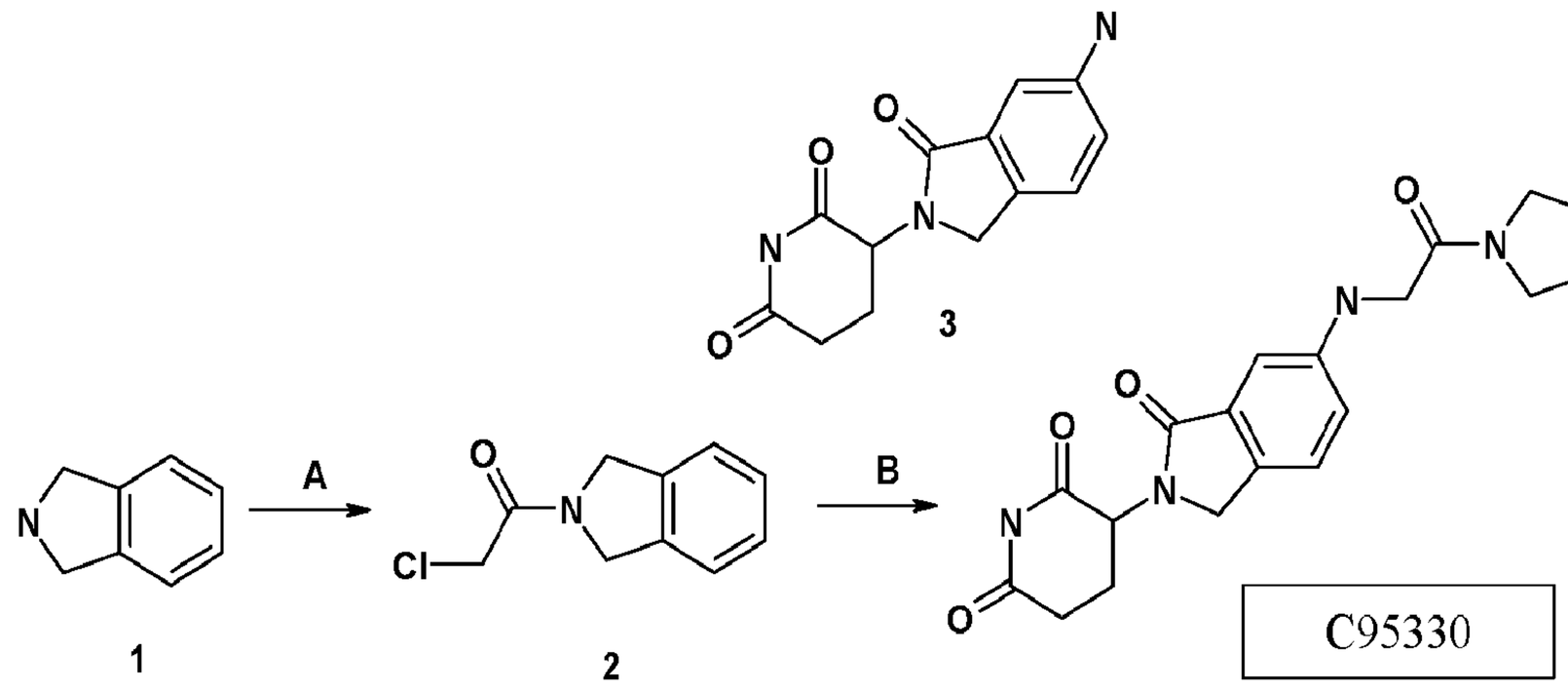
[0466] This compound was prepared according to General Procedure A for C47959. Yield: 82%.

General Procedure B:

[0467] Compound 2 (1mmol), $PhB(OH)_2$ (1.5mmol), $NaHCO_3$ (2mmol), Pd(PPh3)4 (0.1mmol) and xPhOS (0.05mmol) were dissolved in 10ml of dry Dioxane under Ar and 10ml of water was added. The resulting mixture was heated at 80 °C with stirring for 10-12h (LCMS control), cooled to room temperature, solvent was evaporated. The crude residue was purified using HPLC. Yield: 24%.

C95330

[0468] Synthesis of target compound was carried out following the scheme given below:



General Procedure A:

[0469] Compound 1 (1mmol) was dissolved in 20ml of CH_2Cl_2, water (20ml) and $NaHCO_3$ (2mmol) were added. Chloroacetylchloride (1.1mmol) was added dropwise during 15min at

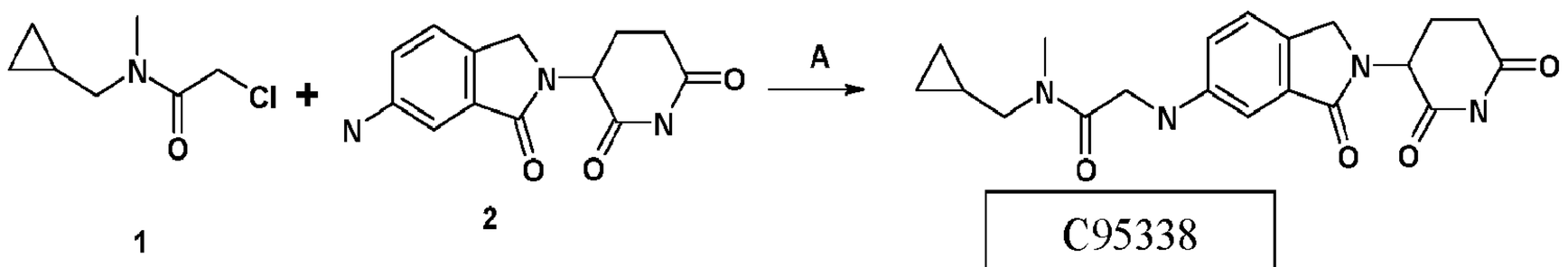
10-15 °C with stirring. The resulting mixture was stirred at room temperature for 3-5h. The organic phase was removed, washed with brine (3x25ml), dried and solvent was evaporated. The crude residue was purified using FC. Yield: 88%.

Step B:

[0470] This compound was prepared according to General Procedure A for C12584. Yield: 22%.

C95338

[0471] Synthesis of target compound was carried out following the scheme given below:

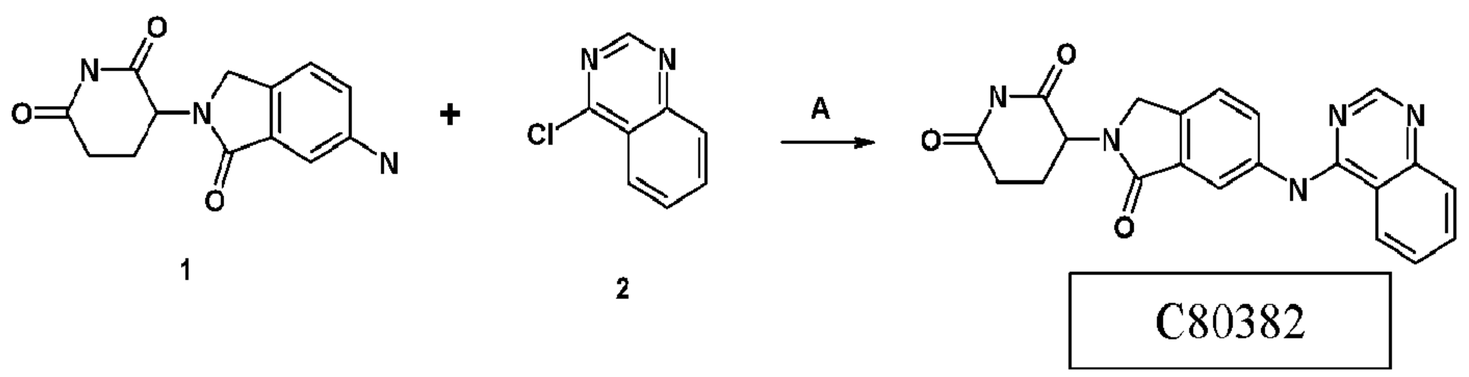


Step A:

[0472] This compound was prepared according to General Procedure A for C12584. Yield: 29%.

C80382

[0473] Synthesis of target compound was carried out following the scheme given below:

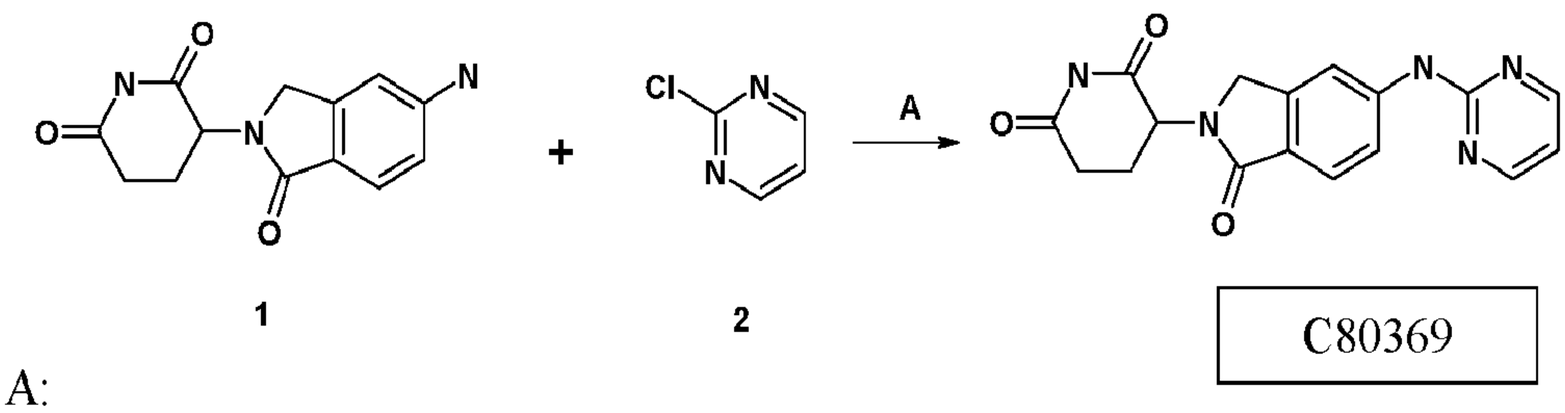


Step A:

[0474] This compound was prepared according to General Procedure A for C80370. Yield: 31%.

C80369

[0475] Synthesis of target compound was carried out following the scheme given below:

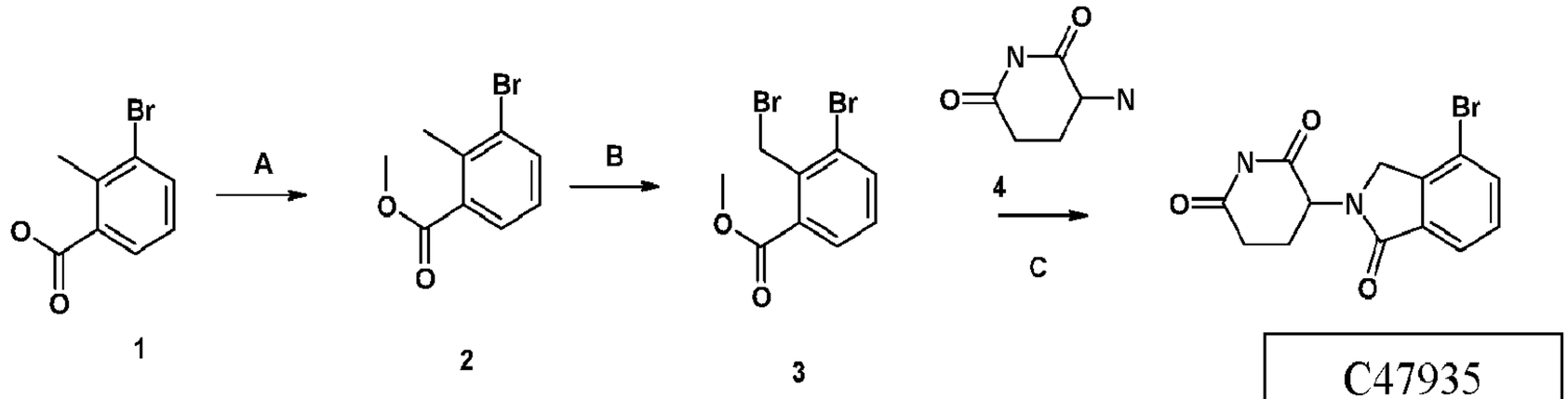


Step A:

[**0476**] This compound was prepared according to General Procedure A for C80370. Yield: 41%.

C47935

[**0477**] Synthesis of target compound was carried out following the scheme given below:



General Procedure A:

[**0478**] Compound 1 (20 mmol) and K_2CO_3 (24 mmol) were suspended in DMF (20 mL). To the reaction mixture, was added iodomethane (24 mmol). The reaction was stirred at r.t. overnight, then diluted with water (150 mL). The solution was extracted with ethyl acetate (2x200 mL), organic phase was washed with brine (3x150ml), dried with $CaCl_2$ and evaporated to give the methyl ester 2. Yield: 94%.

General Procedure B:

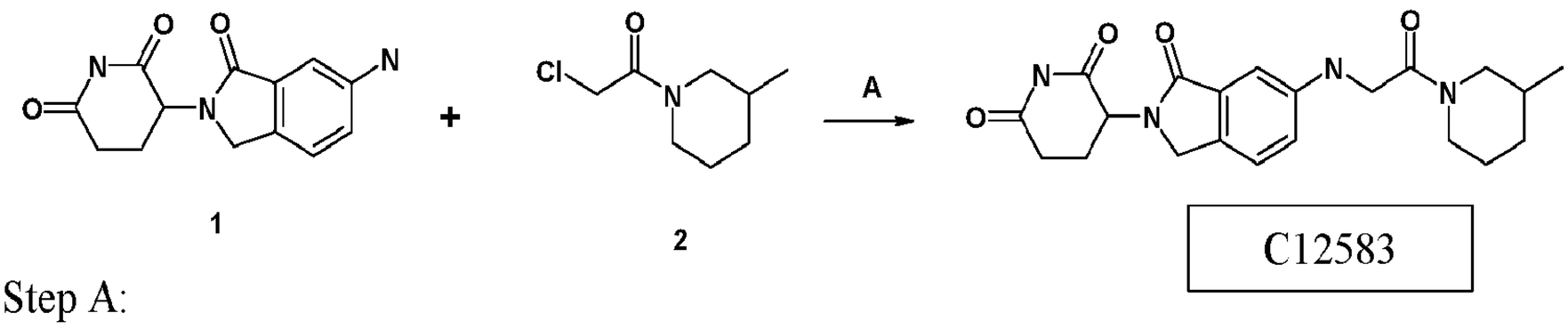
[**0479**] To a solution of compound 2 (1.6 mmol) in CCl_4 (3ml) was added AIBN (0.1 mmol) and NBS (2 mmol) during 15min at 25°C. The reaction was heated for 12h at 60 °C and cooled to r.t. The solvent was then removed in vacuo. The crude residue was purified using LC. Yield: 64%.

Step C:

[**0480**] This compound was prepared according to General Procedure A for C47959. Yield: 79%.

C12583

[**0481**] Synthesis of target compound was carried out following the scheme given below:

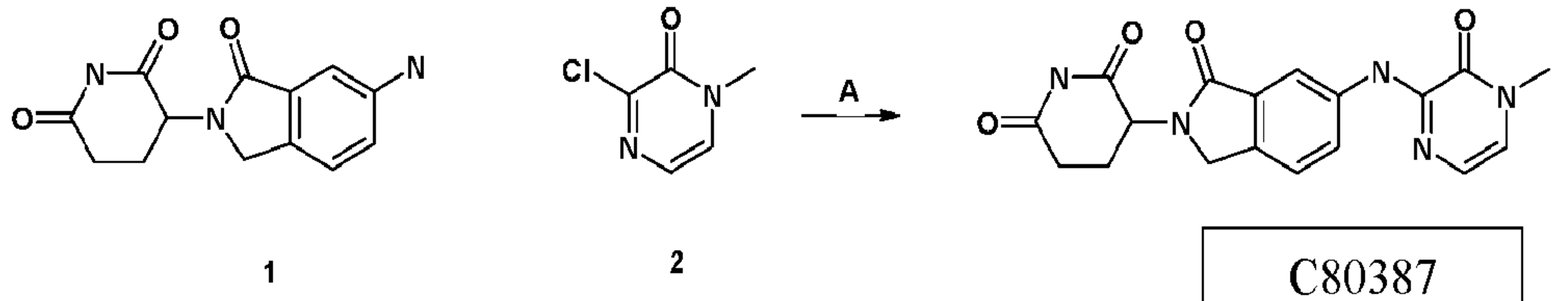


Step A:

[**0482**] This compound was prepared according to General Procedure A for C12584. Yield: 32%.

C80387

[0483] Synthesis of target compound was carried out following the scheme given below:

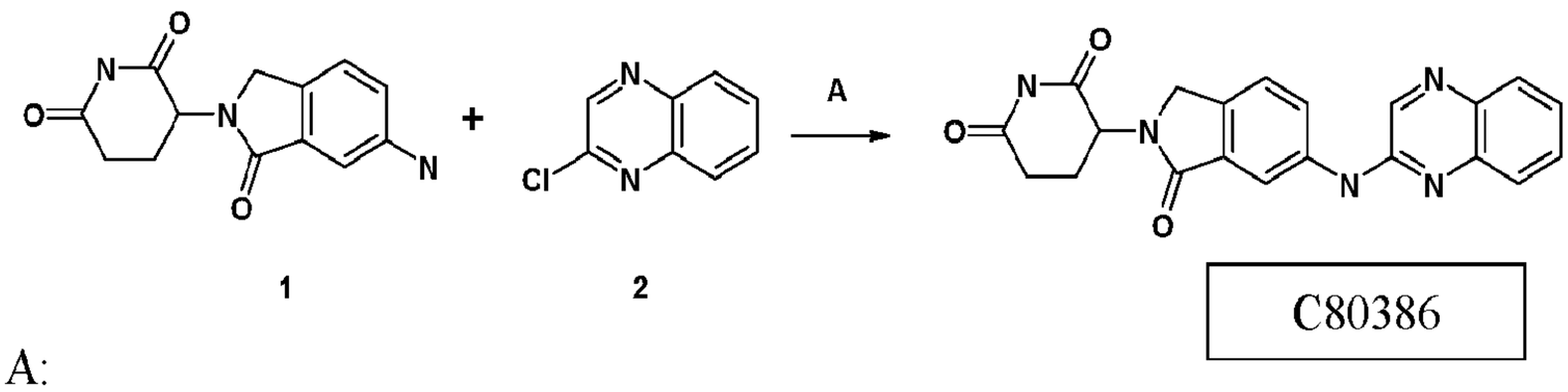


Step A:

[0484] This compound was prepared according to General Procedure A for C80370. Yield: 44%.

C80386

[0485] Synthesis of target compound was carried out following the scheme given below:

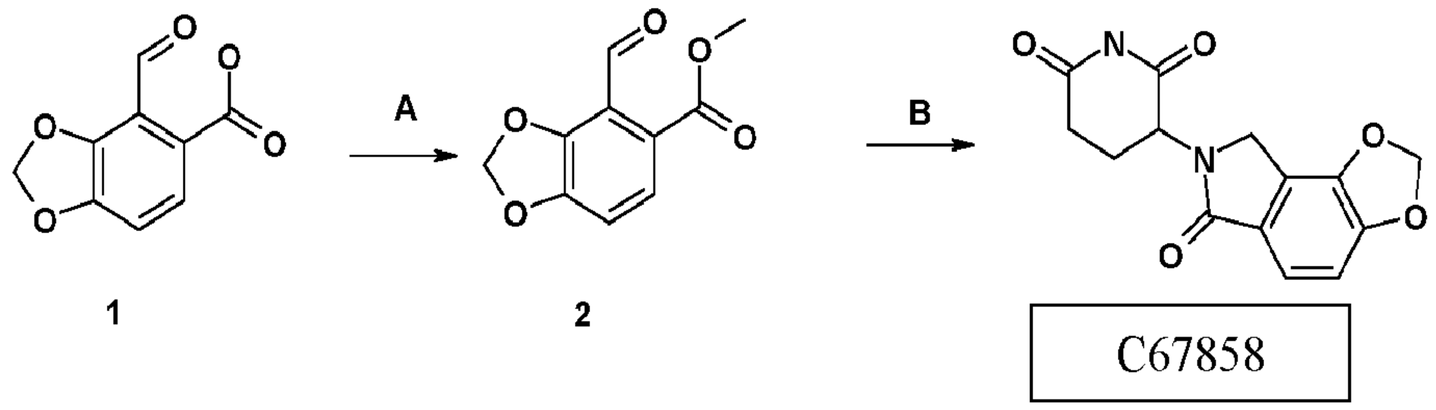


Step A:

[0486] This compound was prepared according to General Procedure B for C80370. Yield: 46%.

C67858

[0487] Synthesis of target compound was carried out following the scheme given below:



Step A:

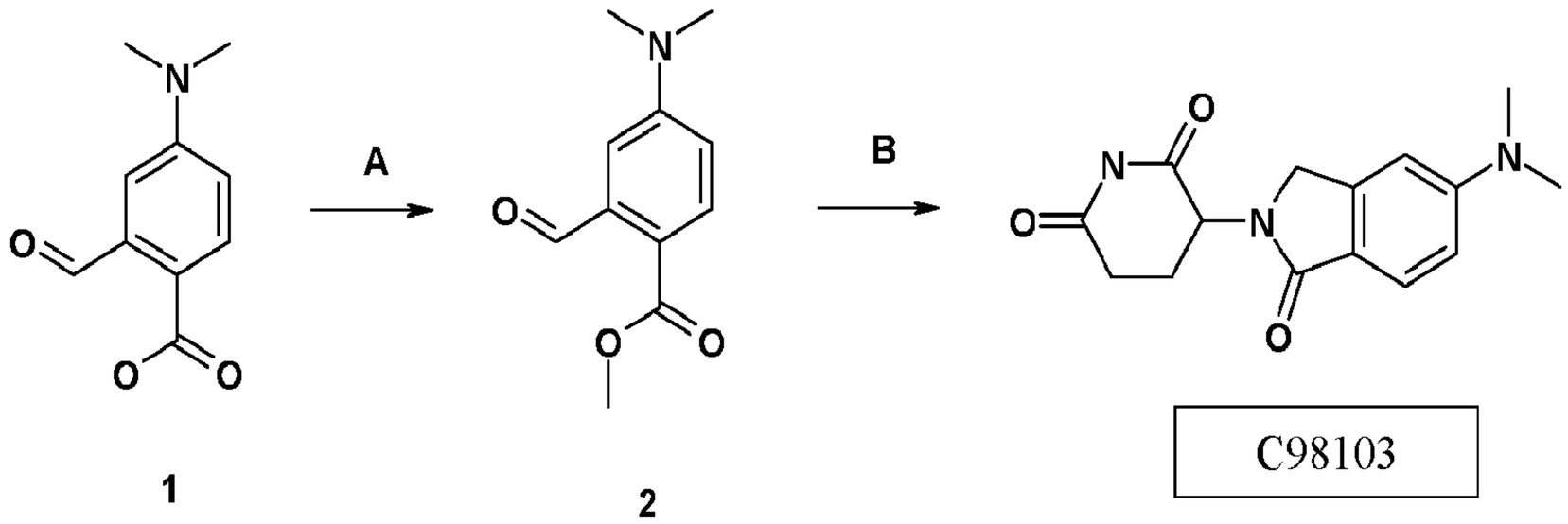
[0488] This compound was prepared according to General Procedure A for C47935. Yield: 69%.

General Procedure B:

[0489] Compound 1 (1 mmol), $NaH(OAc)_3$ (5 mmol), HOAc (1 mmol) and compound 2 (1.3 mmol) were dissolved in 5 ml of MeOH, the mixture was heated at 80 °C for 12 hours. TLC and LCMS control. The reaction mixture was cooled, then filtered and the solvent was evaporated. The crude residue was purified using HPLC. Yield 48%.

C98103

[0490] Synthesis of target compound was carried out following the scheme given below:



Step A:

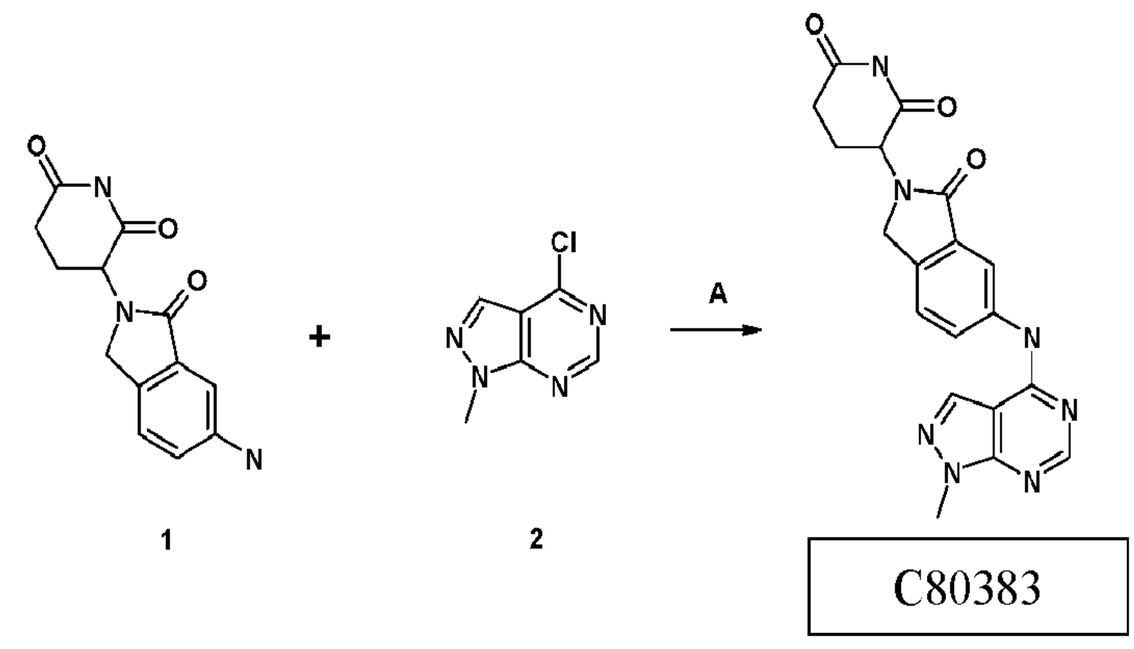
[0491] This compound was prepared according to General Procedure A for C47935. Yield: 71%.

Step B:

[0492] This compound was prepared according to General Procedure B for C67858. Yield: 43%.

C80383

[0493] Synthesis of target compound was carried out following the scheme given below:

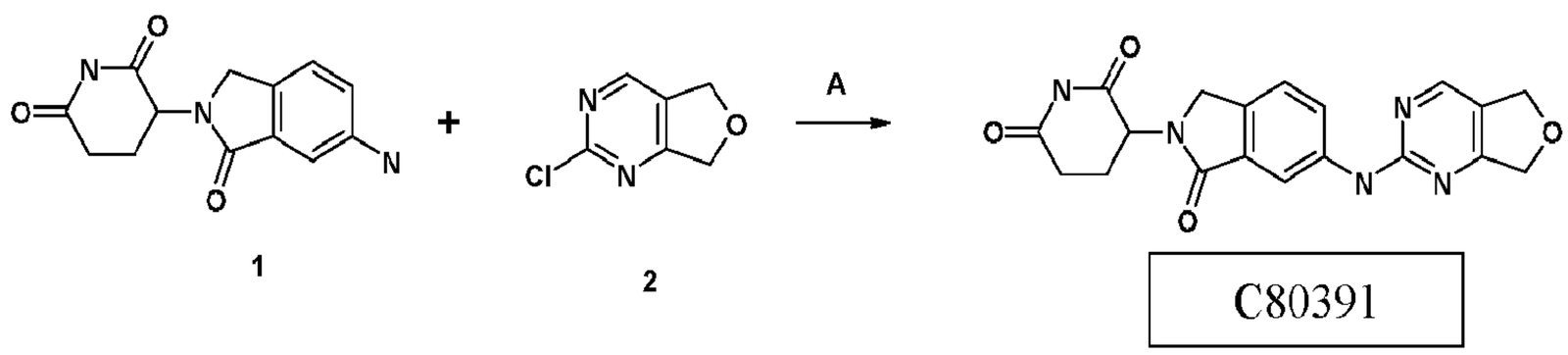


Step A:

[0494] This compound was prepared according to General Procedure A for C80370. Yield: 39%.

C80391

[0495] Synthesis of target compound was carried out following the scheme given below:

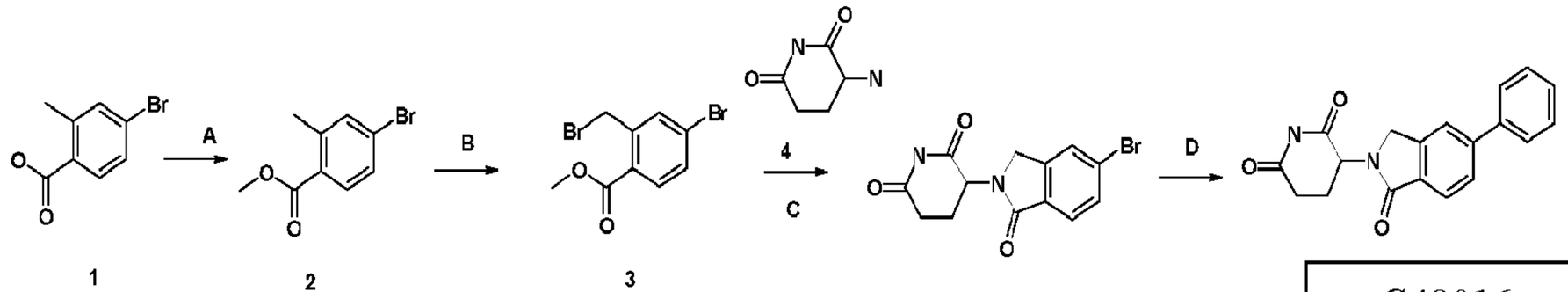


Step A:

[0496] This compound was prepared according to General Procedure A for C80370. Yield: 49%.

C48016

[0497] Synthesis of target compound was carried out following the scheme given below:



Step A:

[0498] This compound was prepared according to General Procedure A for C47935. Yield: 95%.

Step B:

[0499] This compound was prepared according to General Procedure B for C47935. Yield: 64%.

Step C:

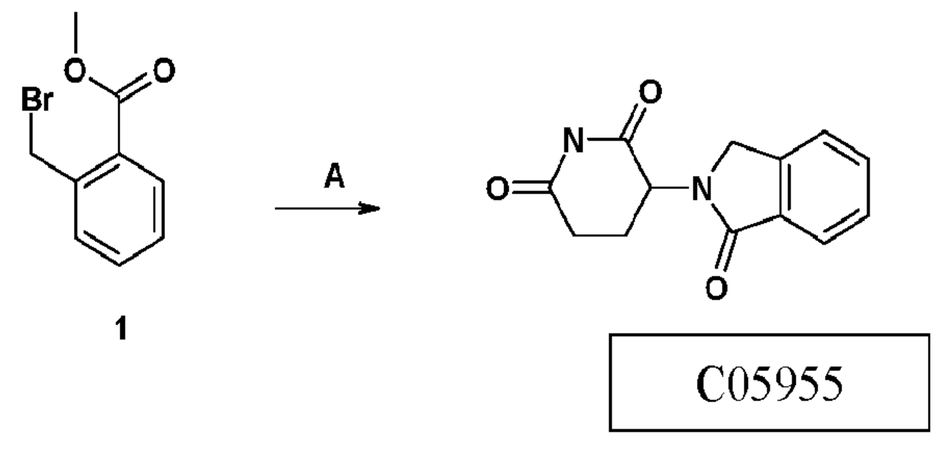
[0500] This compound was prepared according to General Procedure A for C47959. Yield: 79%.

Step D:

[0501] This compound was prepared according to General Procedure A for C48014. Yield: 33%.

C05955

[0502] Synthesis of target compound was carried out following the scheme given below:

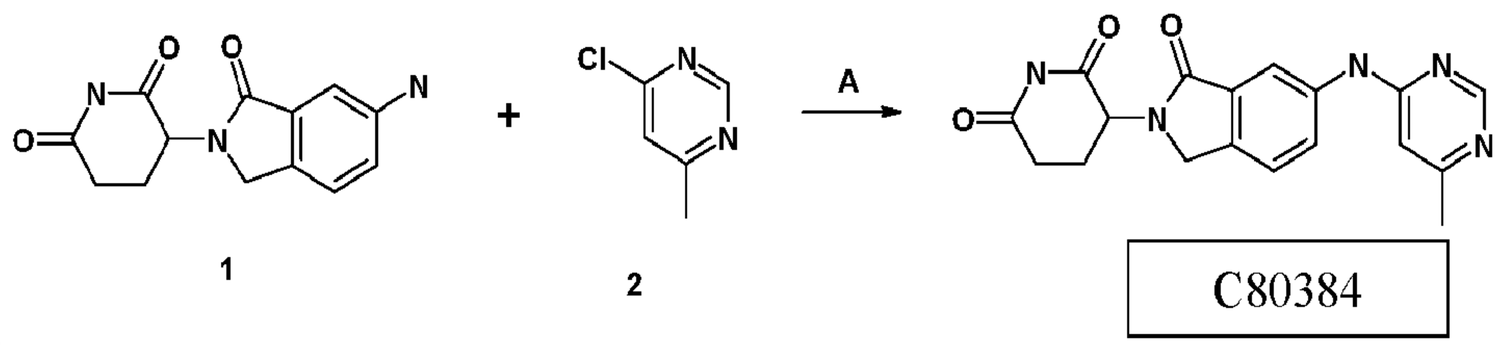


Step A:

[0503] This compound was prepared according to General Procedure A for C47959. Yield: 91%.

C80384

[0504] Synthesis of target compound was carried out following the scheme given below:

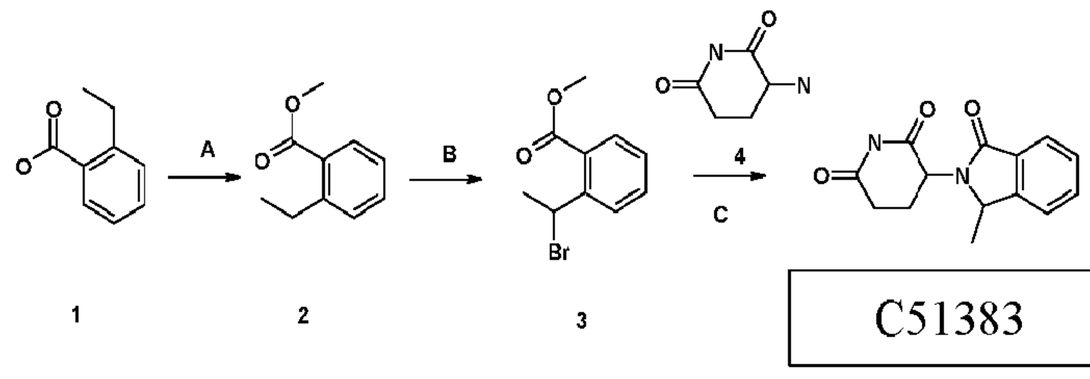


Step A:

[0505] This compound was prepared according to General Procedure A for C80370. Yield: 52%.

C51383

[0506] Synthesis of target compound was carried out following the scheme given below:



Step A:

[0507] This compound was prepared according to General Procedure A for C47935. Yield: 89%.

Step B:

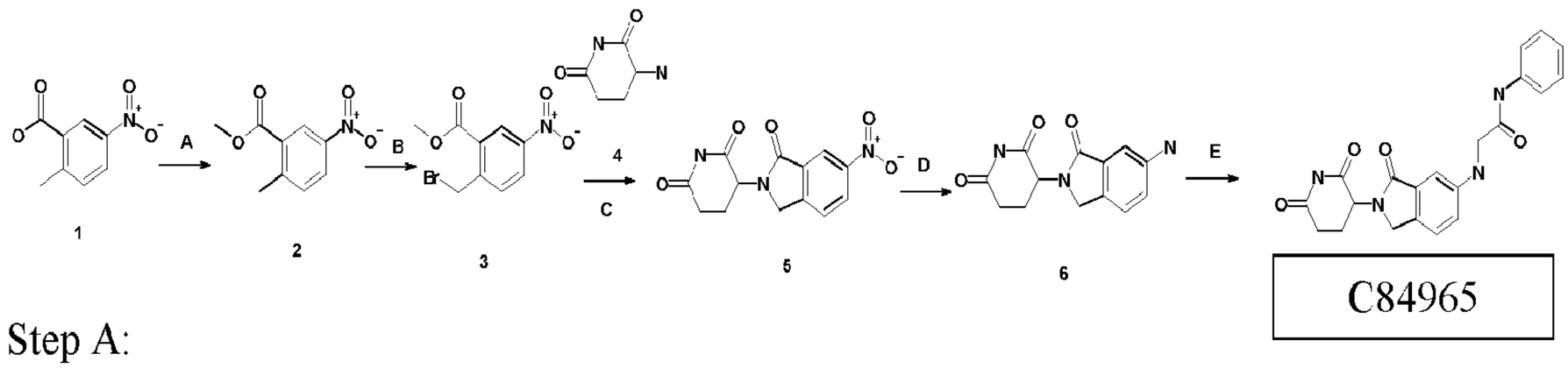
[0508] This compound was prepared according to General Procedure B for C47935. Yield: 25%.

Step C:

[0509] This compound was prepared according to General Procedure A for C47959. Yield: 22%.

C84965

[0510] Synthesis of target compound was carried out following the scheme given below:



Step A:

[0511] This compound was prepared according to General Procedure A for C47935. Yield: 93%.

Step B:

[**0512**] This compound was prepared according to General Procedure B for C47935. Yield: 74%.

Step C:

[**0513**] This compound was prepared according to General Procedure A for C47959. Yield: 82%.

General Procedure D:

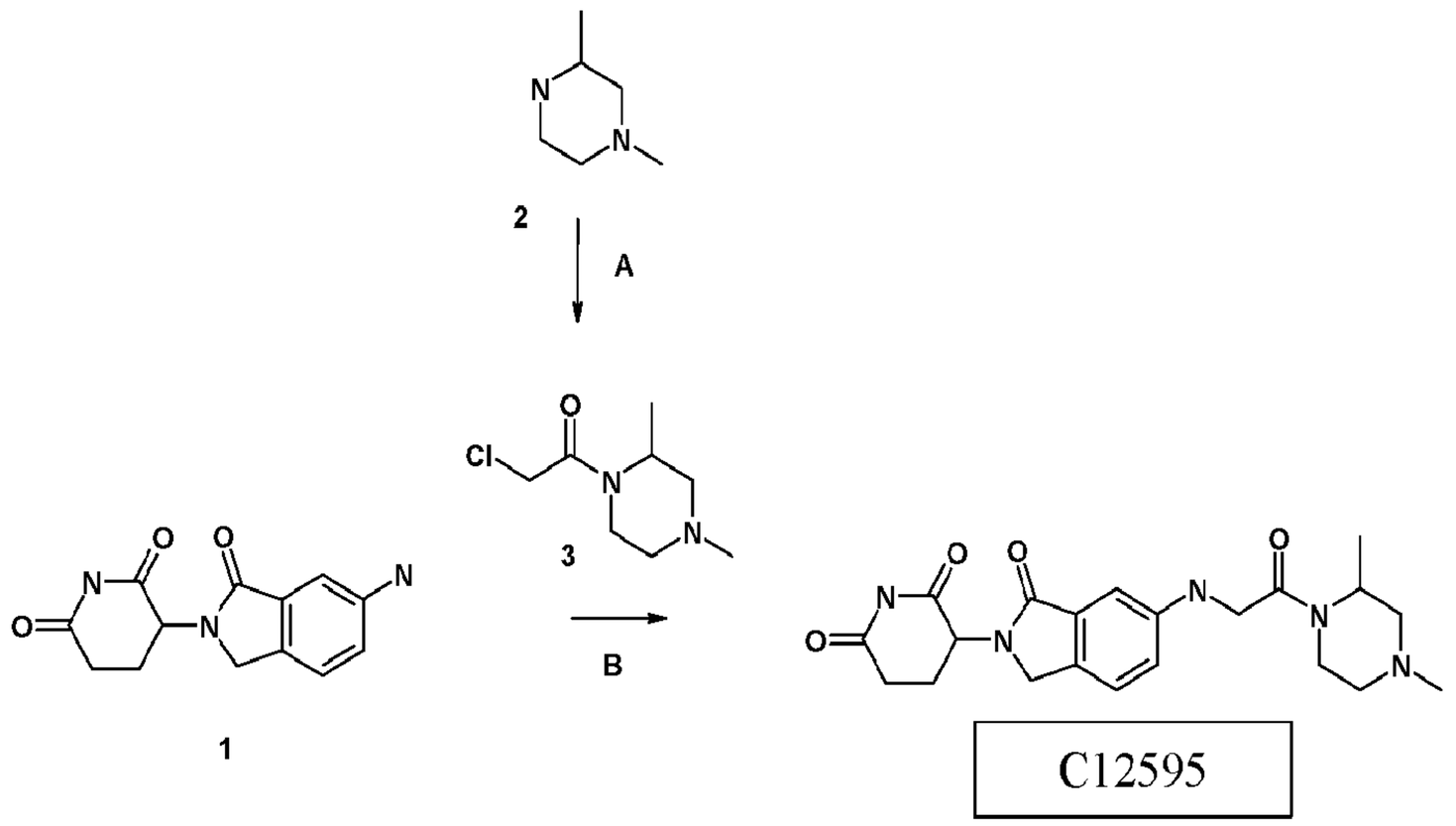
[**0514**] To a solution of compound 5 (0.5 mmol) in methanol (2 mL) was added palladium carbon (5%, 10 mg), and the mixture was stirred under a hydrogen atmosphere at room temperature for 10 h. The reaction mixture was filtered through celite. The filtrate was concentrated under reduced pressure and after was purified by using HPLC. Yield: 39 %.

Step E:

[**0515**] This compound was prepared according to General Procedure A for C12584. Yield: 34%.

C12595

[**0516**] Synthesis of target compound was carried out following the scheme given below:



Step A:

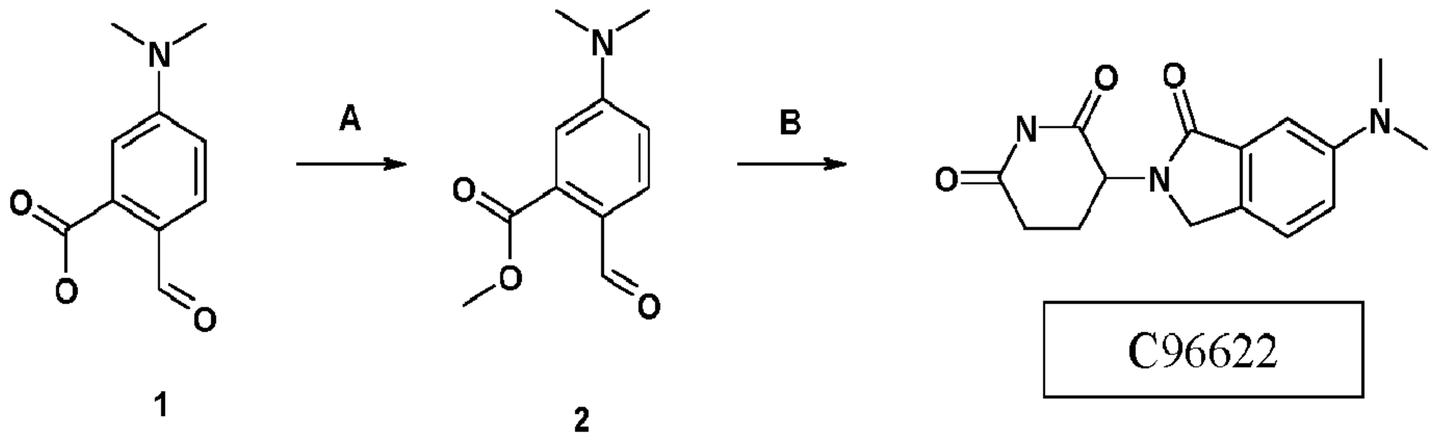
[**0517**] This compound was prepared according to General Procedure A for C95330. Yield: 82%.

Step B:

[**0518**] This compound was prepared according to General Procedure A for C12584. Yield: 22%.

C96622

[**0519**] Synthesis of target compound was carried out following the scheme given below:



Step A:

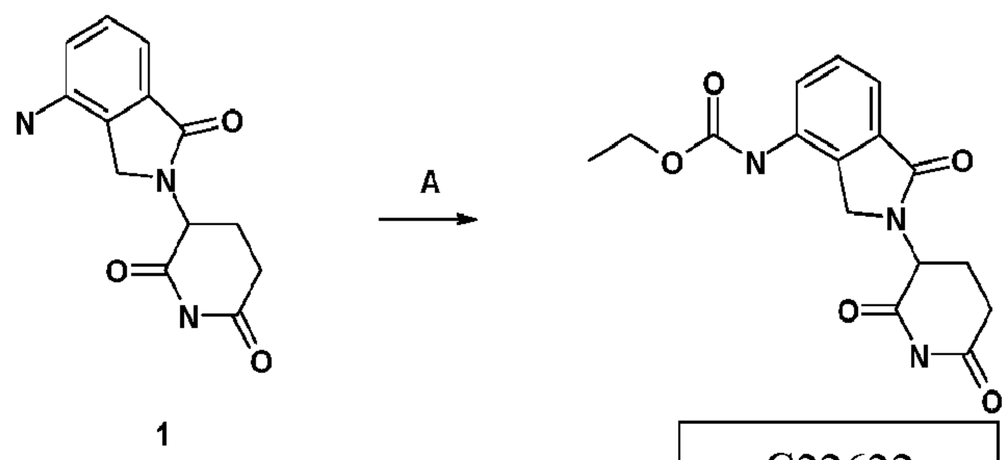
[0520] This compound was prepared according to General Procedure A for C47935. Yield: 88%.

Step B:

[0521] This compound was prepared according to General Procedure B for C67858. Yield: 57%.

C22622

[0522] Synthesis of target compound was carried out following the scheme given below:

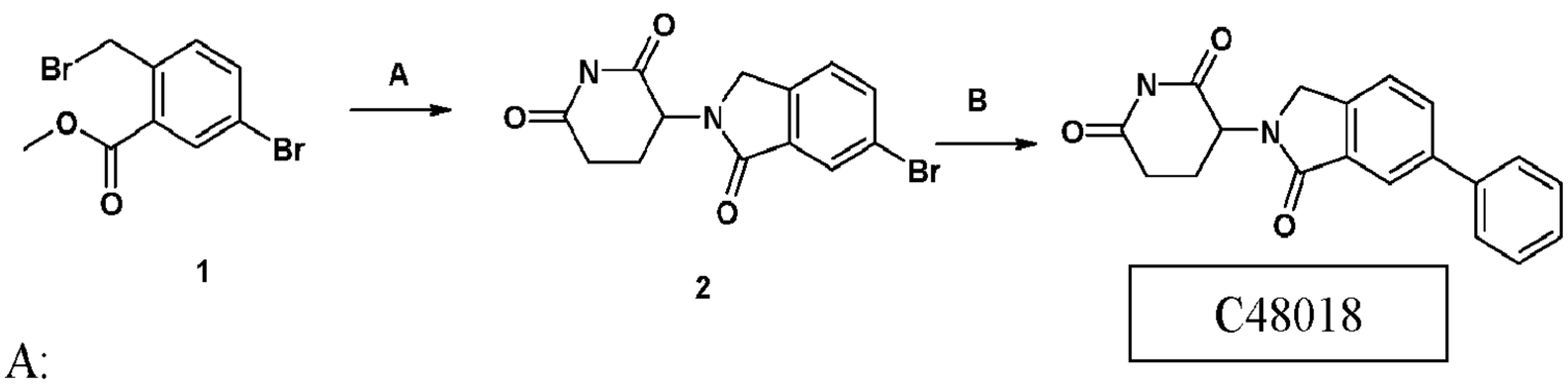


Step A:

[0523] This compound was prepared according to General Procedure A for C95330. Yield: 53%.

C48018

[0524] Synthesis of target compound was carried out following the scheme given below:



Step A:

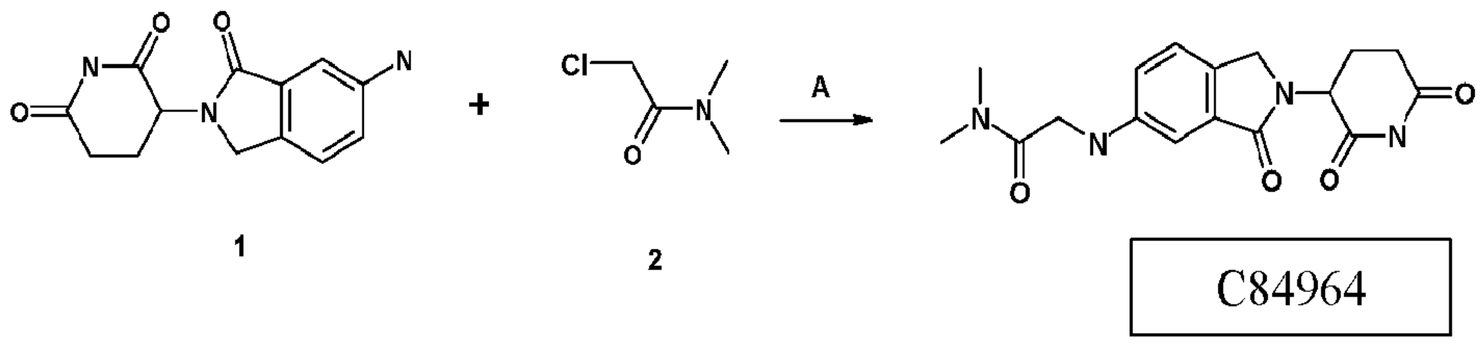
[0525] This compound was prepared according to General Procedure A for C47959. Yield: 79%.

Step B:

[0526] This compound was prepared according to General Procedure A for C48014. Yield: 28%.

C84964

[**0527**] Synthesis of target compound was carried out following the scheme given below:

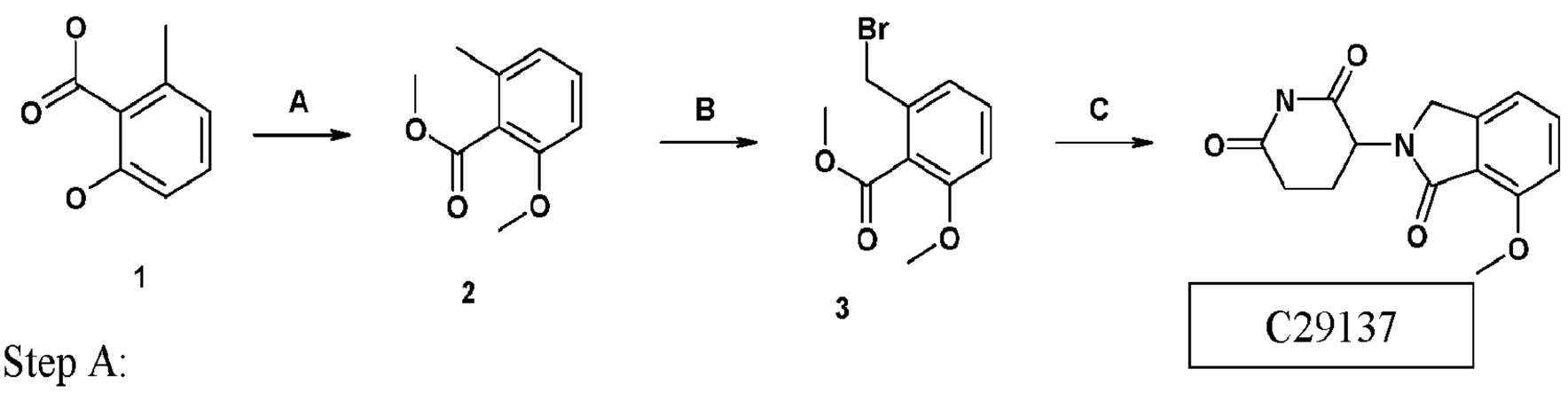


Step A:

[**0528**] This compound was prepared according to General Procedure A for C12584. Yield: 39%.

C29137

[**0529**] Synthesis of target compound was carried out following the scheme given below:



Step A:

[**0530**] This compound was prepared according to General Procedure A for C47935. Yield: 97%.

Step B:

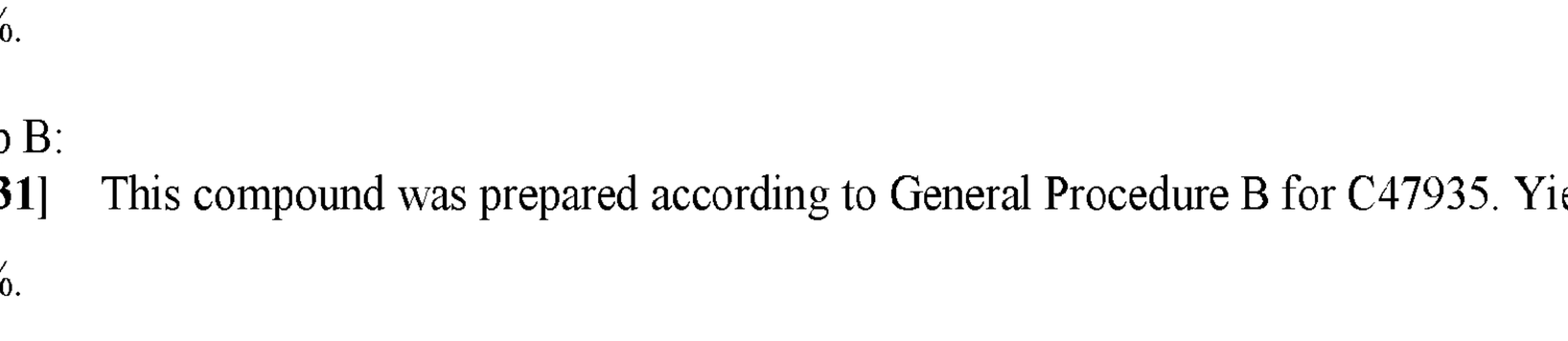
[**0531**] This compound was prepared according to General Procedure B for C47935. Yield: 64%.

Step C:

[**0532**] This compound was prepared according to General Procedure A for C47959. Yield: 62%.

C12586

[**0533**] Synthesis of target compound was carried out following the scheme given below:

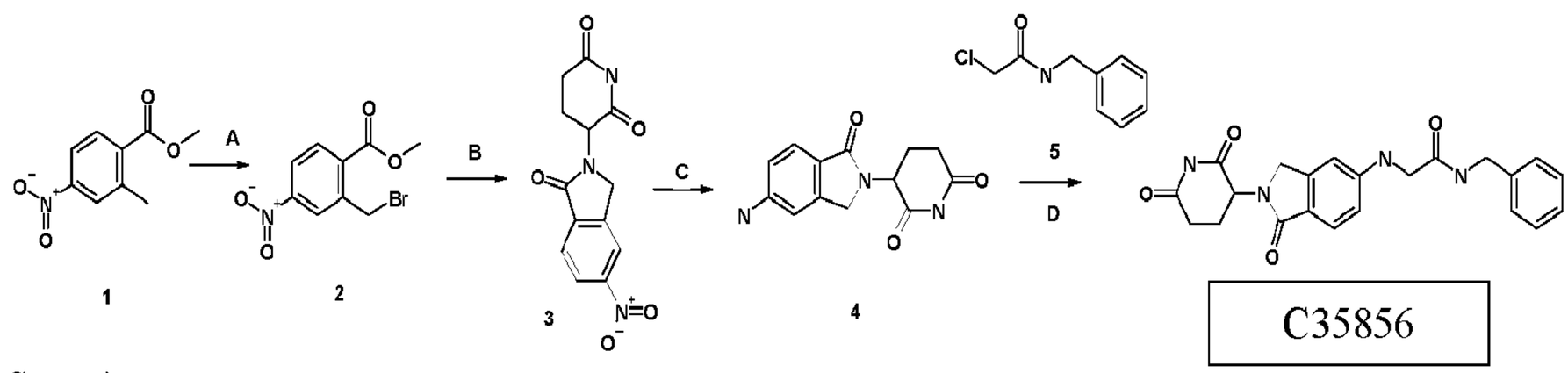


Step A:

[**0534**] This compound was prepared according to General Procedure A for C12584. Yield: 42%.

C35856

[0535] Synthesis of target compound was carried out following the scheme given below:



Step A:

[0536] This compound was prepared according to General Procedure B for C47935. Yield: 91%.

Step B:

[0537] This compound was prepared according to General Procedure A for C47959. Yield: 82%.

Step C:

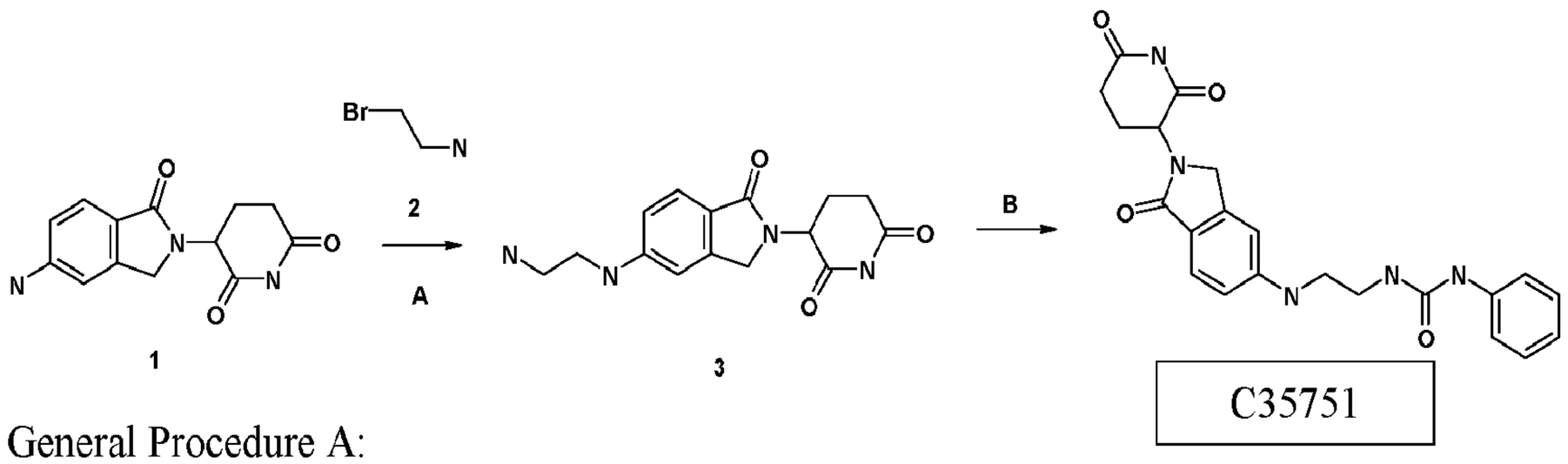
[0538] This compound was prepared according to General Procedure D for C84965. Yield: 81%.

Step D:

[0539] This compound was prepared according to General Procedure A for C12584. Yield: 22%.

C35751

[0540] Synthesis of target compound was carried out following the scheme given below:



General Procedure A:

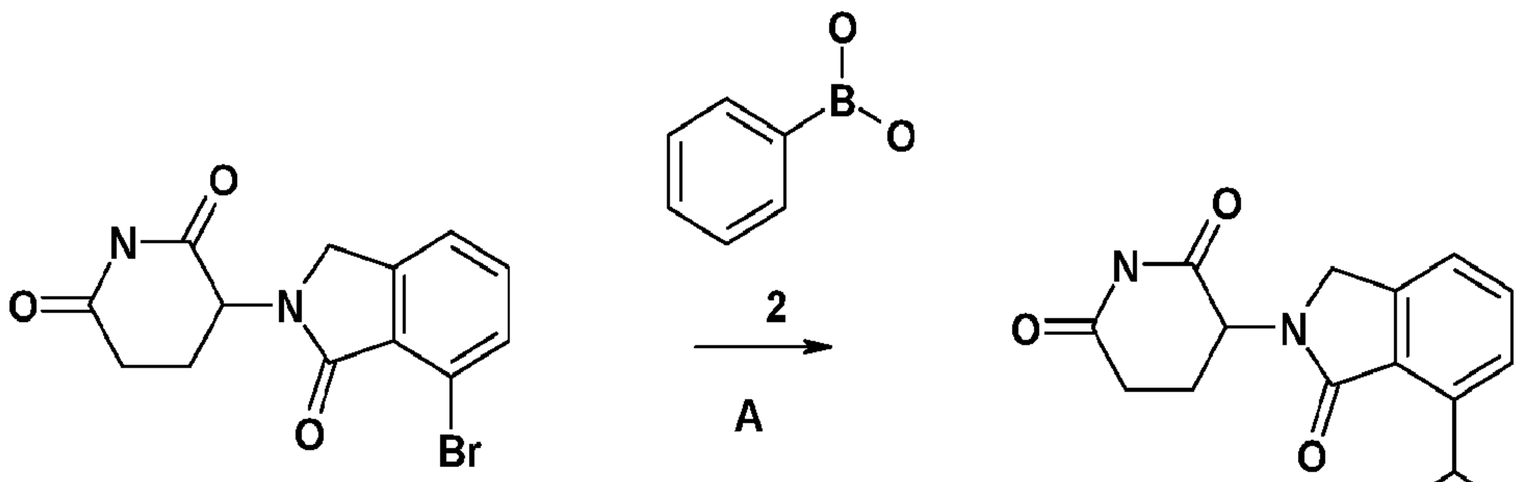
[0541] Compound 1 (20 mmol) and K_2CO_3 (24 mmol) were suspended in DMF (20 mL). Compound 2 hydrobromide (100mmol) was added and the reaction mixture was heated at 90°C with stirring for 10h. The suspension was filtered, washed with DMF (3x10ml) and solvent was evaporated to give the compound 3. The crude residue was purified using LC. Yield: 9%.

General Procedure B:

[**0542**] Compound 3 (1 mmol) was dissolved in acetonitrile (10 mL). PhNCO (1.1mmol) and 1 drop of NEt_3 were added and the reaction mixture was heated at 60-70°C with stirring for 3-5h. The suspension was cooled, filtered, washed with acetonitrile (3x10 mL) and solvent was evaporated to give the compound 3. The crude residue was purified using LC. Yield: 46%.

C48020

[**0543**] Synthesis of target compound was carried out following the scheme given below:

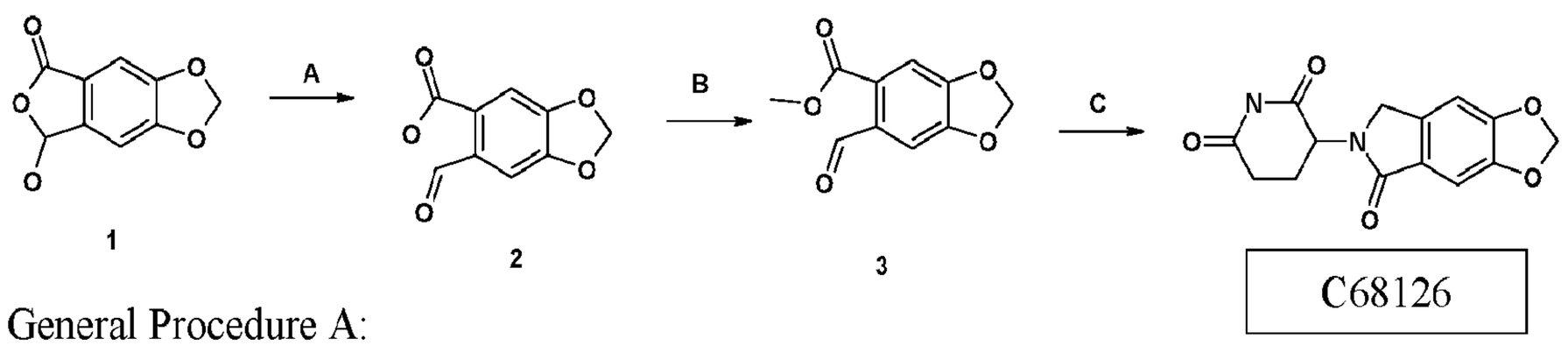


Step A:

[**0544**] This compound was prepared according to General Procedure A for C48014. Yield: 25%.

C68126

[**0545**] Synthesis of target compound was carried out following the scheme given below:



General Procedure A:

[**0546**] Compound 1 (1 mmol) and K_2CO_3 (2 mmol) were mixed with water (20 mL). The reaction mixture was heated at 80 °C with stirring overnight, then water was evaporated and Na salt of the product was treatment with 50ml of mixture EtOAc:THF (4:1), filtered, washed with mixture EtOAc:THF (4:1) and dried. Yield: 44%.

Step B:

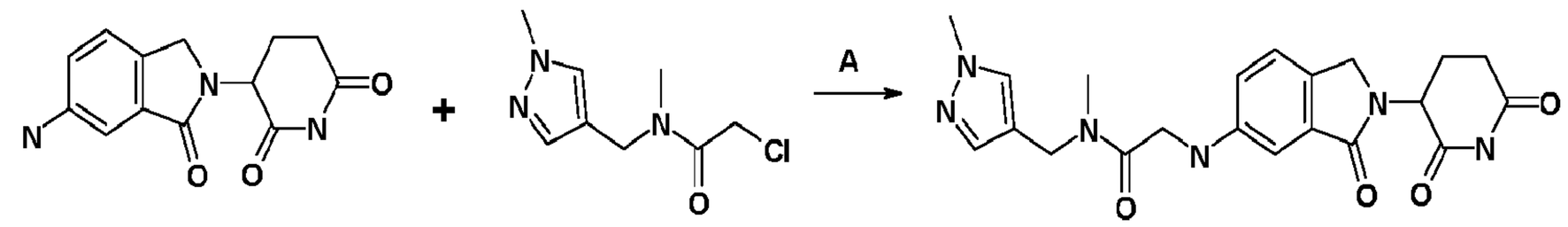
[**0547**] This compound was prepared according to General Procedure A for C47935. Yield: 69%.

Step C:

[0548] This compound was prepared according to General Procedure B for C67858. Yield: 38%.

C95333

[0549] Synthesis of target compound was carried out following the scheme given below:



1 2

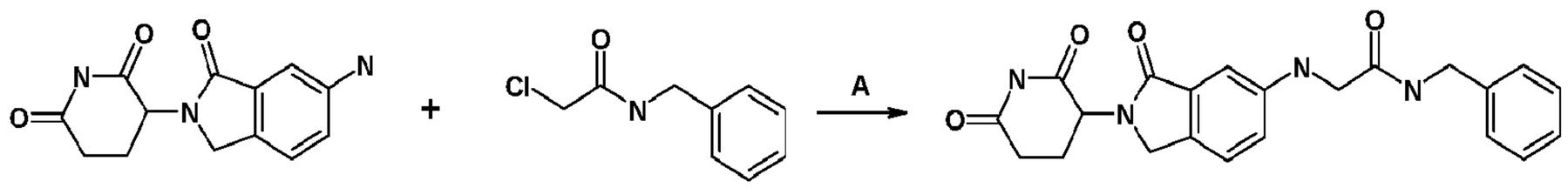
C95333

Step A:

[0550] This compound was prepared according to General Procedure A for C12584. Yield: 42%.

C84966

[0551] Synthesis of target compound was carried out following the scheme given below:



1 2

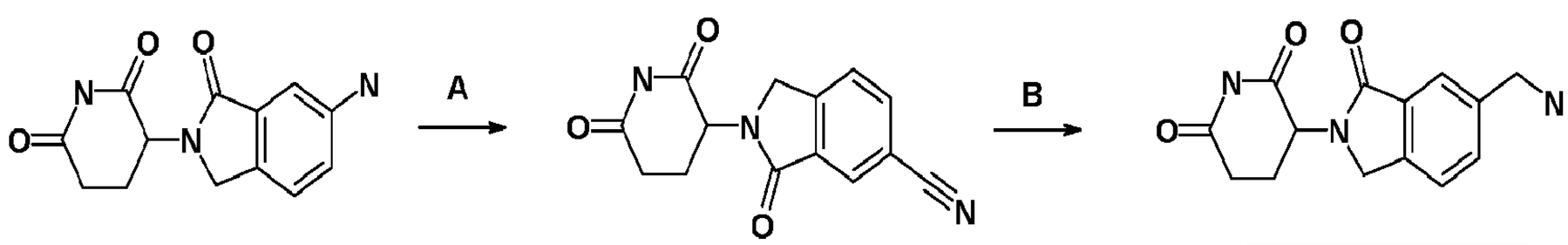
C84966

Step A:

[0552] This compound was prepared according to General Procedure A for C12584. Yield: 37%.

C66979

[0553] Synthesis of target compound was carried out following the scheme given below:



1 2

C66979

Step A:

[0554] This compound was prepared according to General Procedure A for C48003. Yield: 59%.

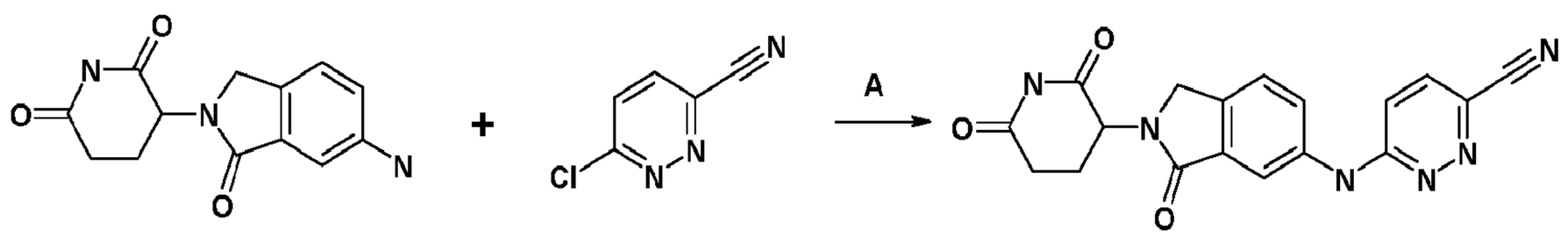
Step B:

[0555] To a solution of compound 4 (0.5 mmol) in THF (2 mL) was added palladium carbon (5%, 10 mg), and the mixture was stirred under a hydrogen atmosphere at 80 °C for 20

h. The reaction mixture was filtered through celite. The filtrate was concentrated under reduced pressure and after was purified by using HPLC. Yield: 14 %.

C80389

[0556] Synthesis of target compound was carried out following the scheme given below:



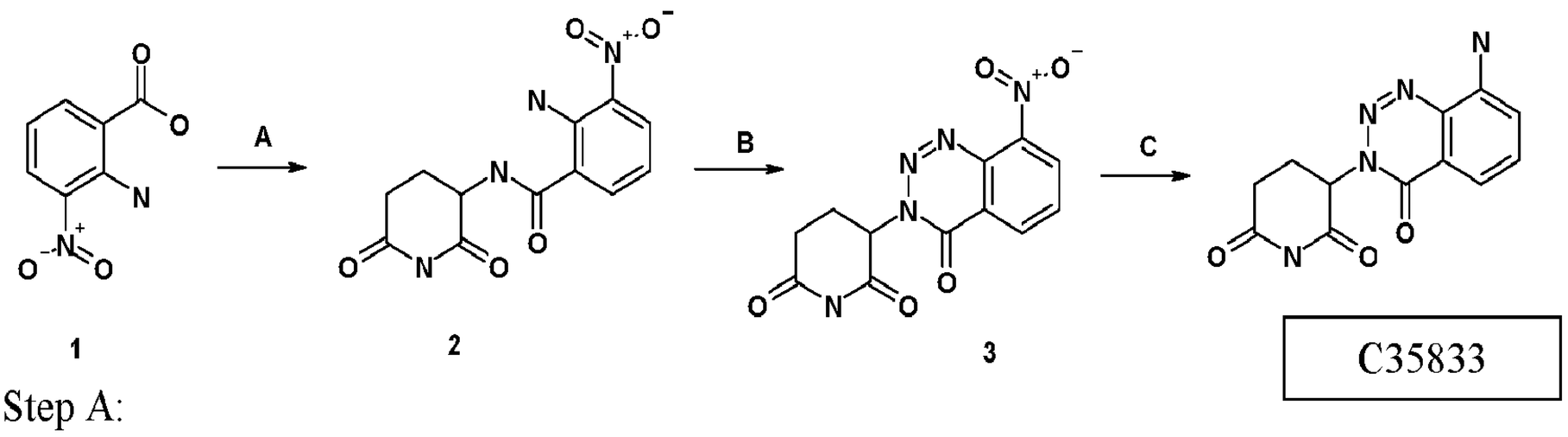
1 2 C80389

Step A:

[0557] This compound was prepared according to General Procedure B for C80370. Yield: 25%.

C35833

[0558] Synthesis of target compound was carried out following the scheme given below:



1 2 3 C35833

Step A:

[0559] This compound was prepared according to General Procedure B for C47935. Yield: 96%.

General Procedure B:

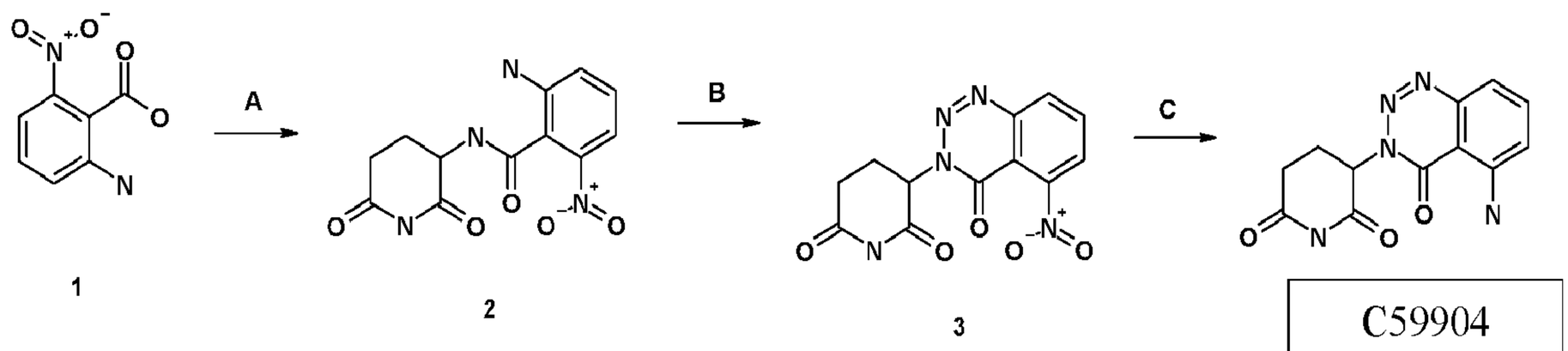
[0560] Compound 2 (1mmol) was treated with 10ml of dilute (1:3) hydrochloric acid and 10ml of dioxane was added. The resulting suspension was cooled to 10 °C and a solution of $NaNO_2$ (2mmol) in 10ml of water was added during 2-3min. The mixture was stirred at r.t. for 10h, neutralized with $NaHCO_3$ and a precipitate was filtered, washed with water (3x25ml) and recrystallization from mixture DMF/i-PrOH (1/1). Yield: 29%.

Step C:

[0561] This compound was prepared according to General Procedure D for C84965. Yield: 32%.

C59904

[0562] Synthesis of target compound was carried out following the scheme given below:



Step A:

[0563] This compound was prepared according to General Procedure B for C47935. Yield: 95%.

Step A:

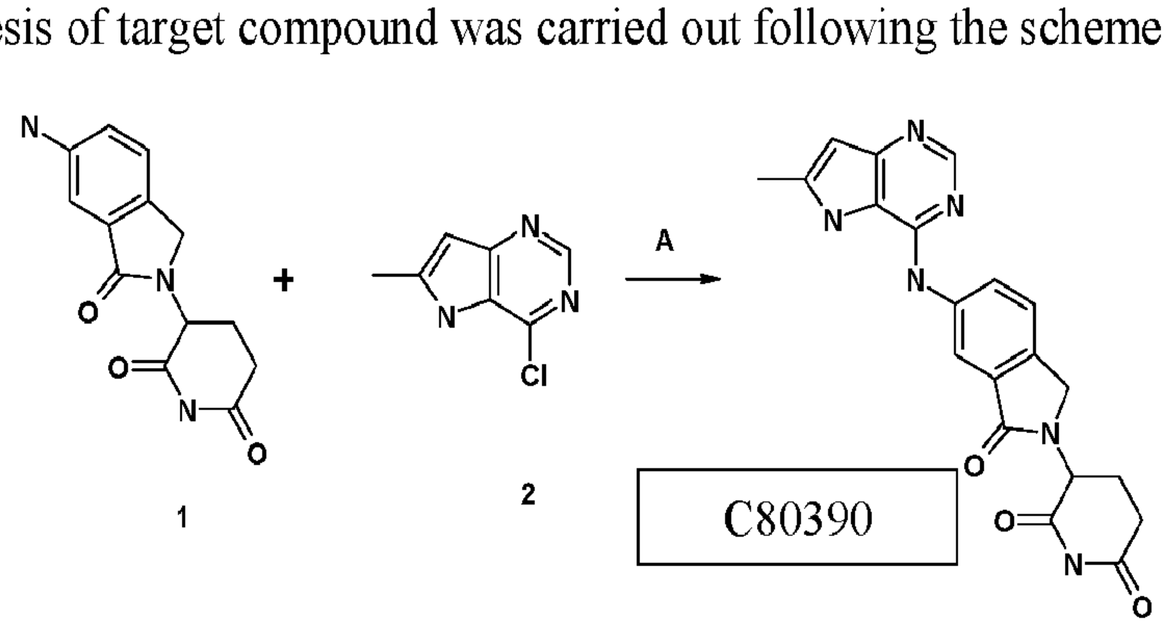
[0564] This compound was prepared according to General Procedure B for C35833. Yield: 23%.

Step C:

[0565] This compound was prepared according to General Procedure D for C84965. Yield: 37%.

C80390

[0566] Synthesis of target compound was carried out following the scheme given below:

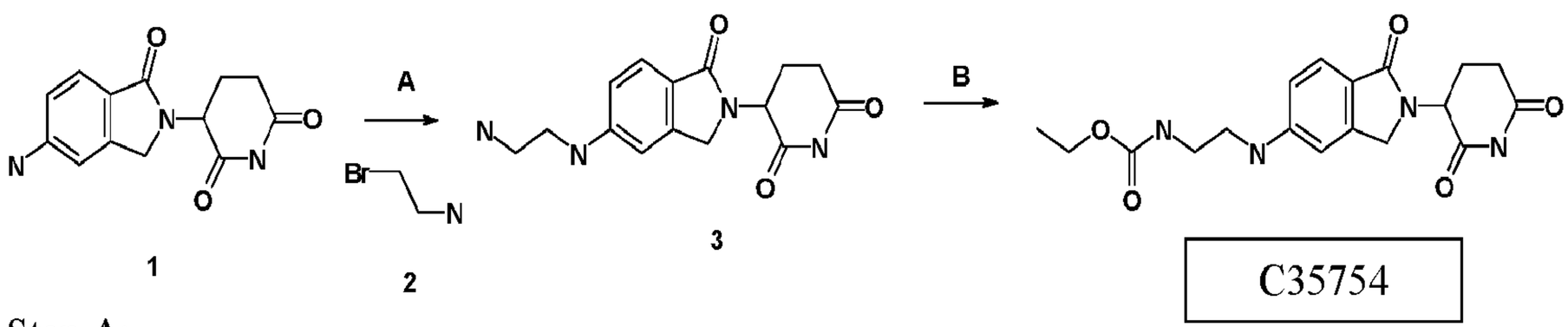


Step A:

[0567] This compound was prepared according to General Procedure B for C80370. Yield: 21%.

C35754

[0568] Synthesis of target compound was carried out following the scheme given below:



Step A:

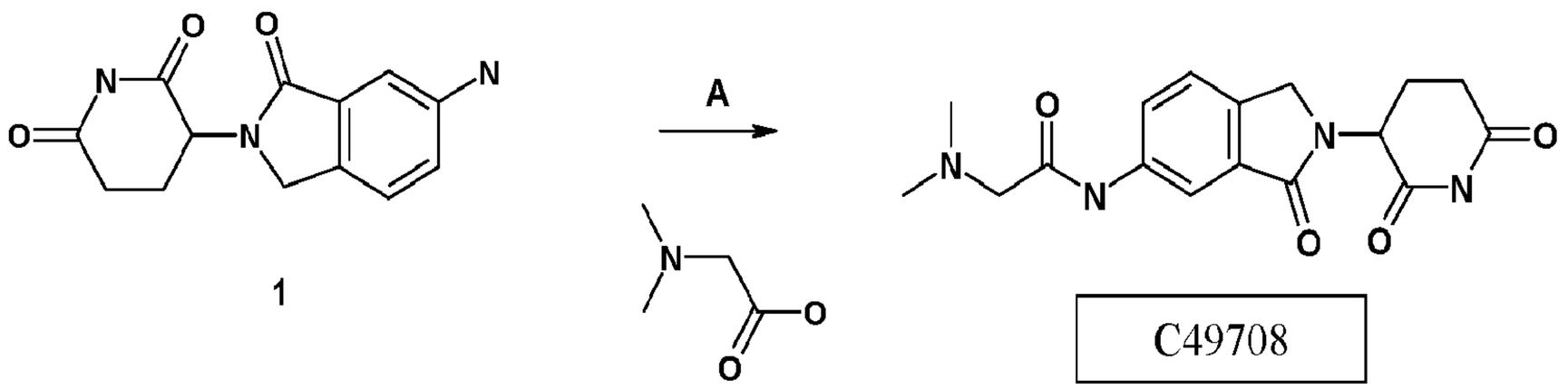
[0569] This compound was prepared according to General Procedure A for C35751. Yield: 9%.

Step B:

[0570] This compound was prepared according to General Procedure A for C95330. Yield: 51%.

C49708

[0571] Synthesis of target compound was carried out following the scheme given below:

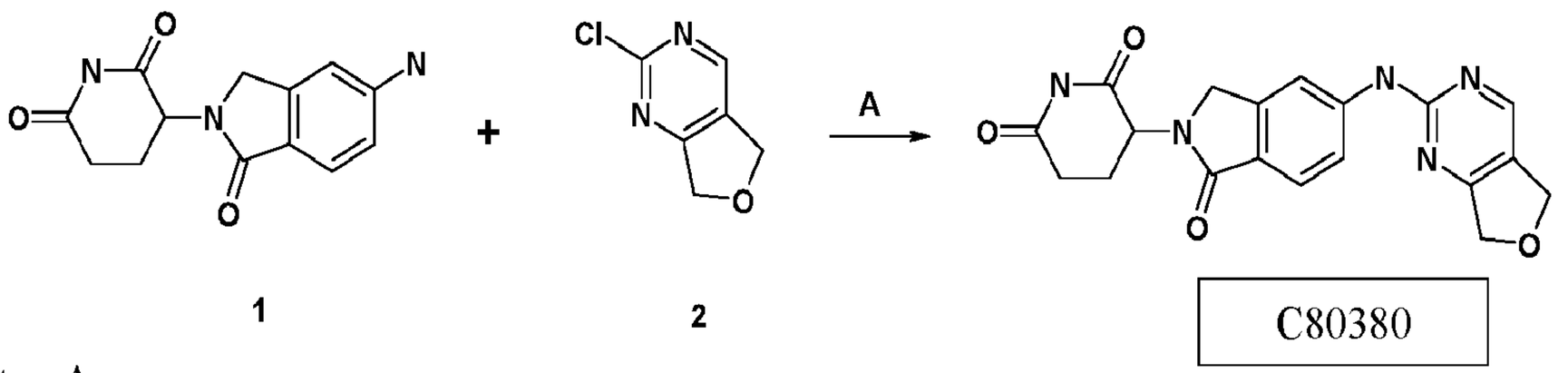


Step A:

[0572] This compound was prepared according to General Procedure A for C80392. Yield: 57%.

C80380

[0573] Synthesis of target compound was carried out following the scheme given below:

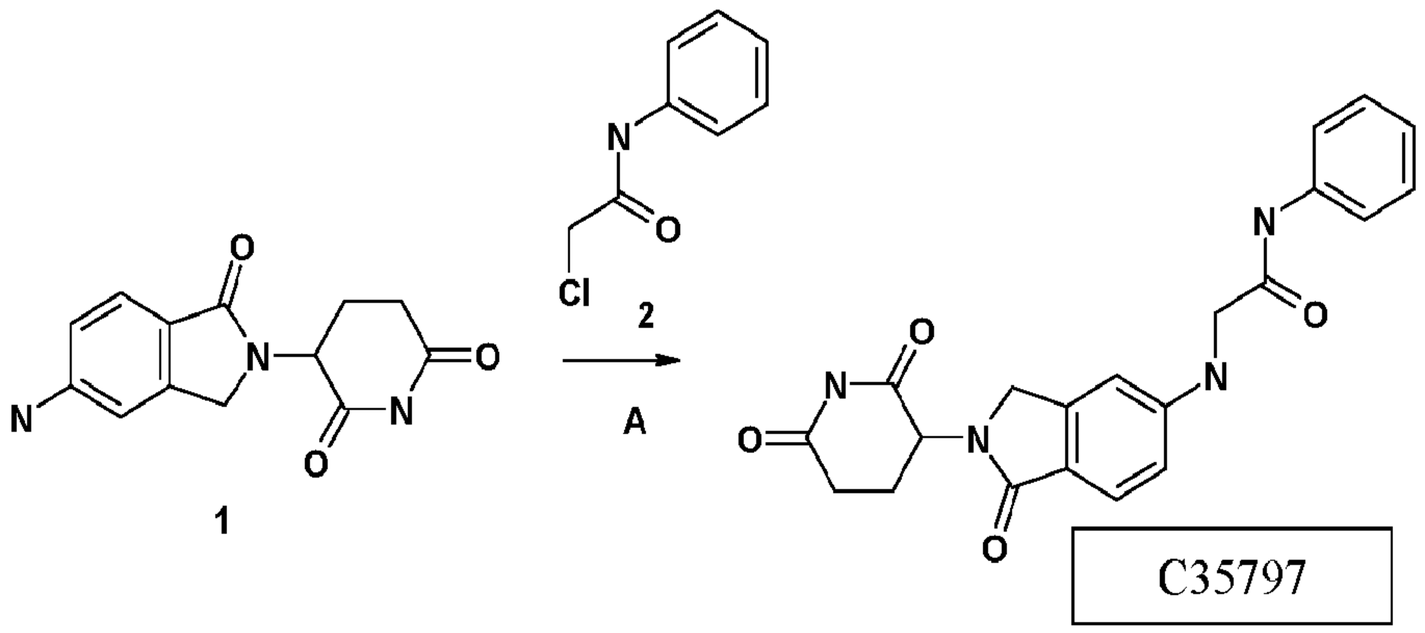


Step A:

[0574] This compound was prepared according to General Procedure A for C80370. Yield: 36%.

C35797

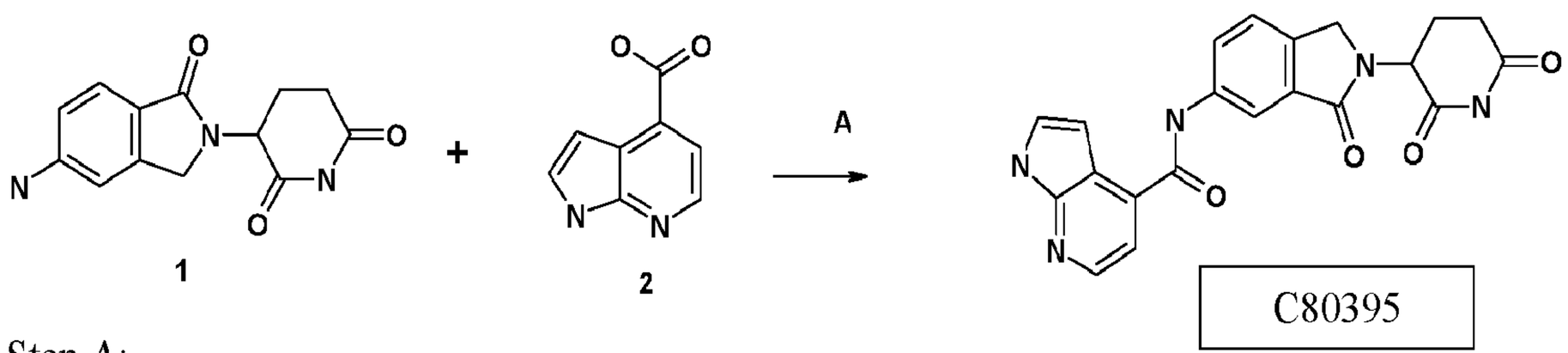
[0575] Synthesis of target compound was carried out following the scheme given below:



Step A:
This compound was prepared according to General Procedure A for C12584. Yield: 39%.

C80395

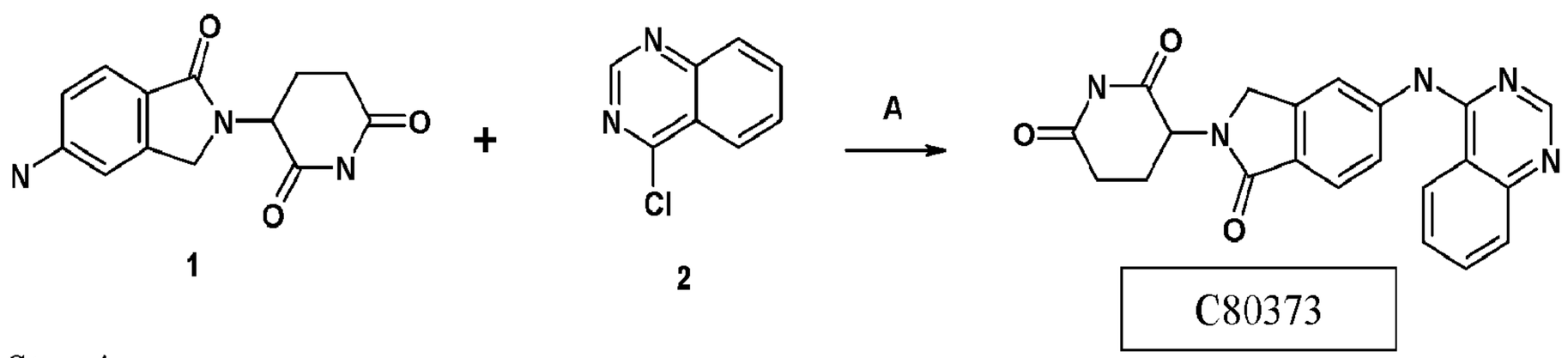
[0576] Synthesis of target compound was carried out following the scheme given below:



Step A:
This compound was prepared according to General Procedure A for C80392. Yield: 32%.

C80373

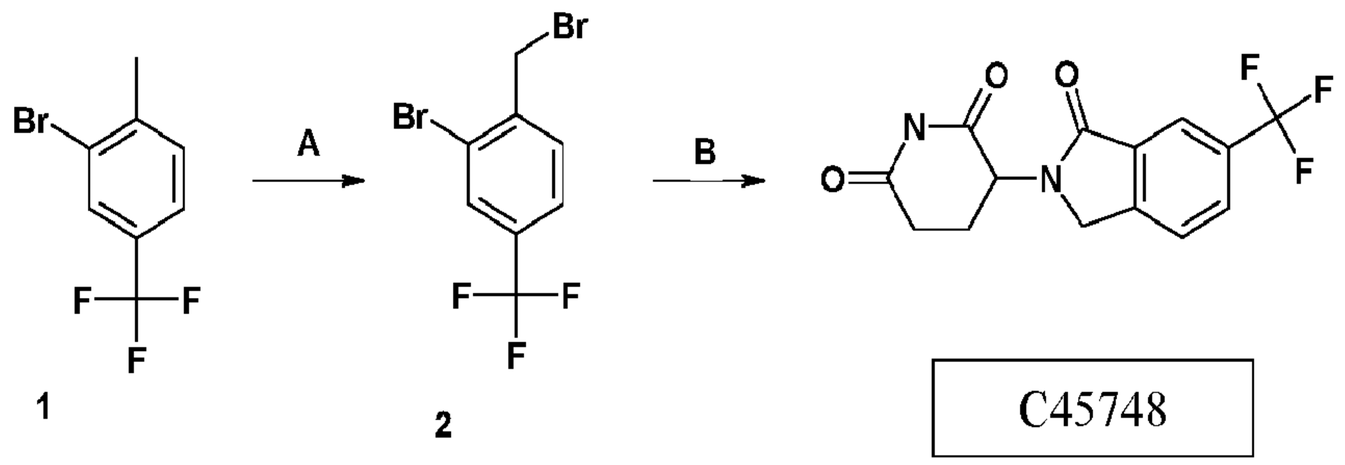
[0577] Synthesis of target compound was carried out following the scheme given below:



Step A:
[0578] This compound was prepared according to General Procedure A for C80370. Yield: 71%.

C45748

[0579] Synthesis of target compound was carried out following the scheme given below:



Step A:

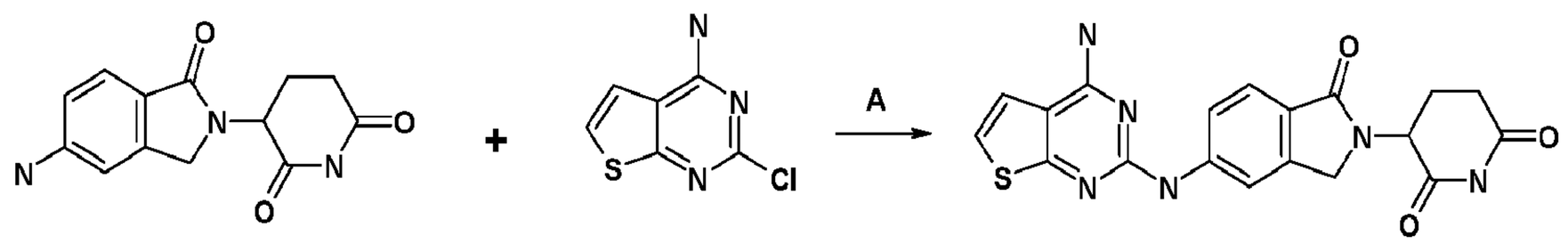
[0580] This compound was prepared according to General Procedure B for C47935. Yield: 66%.

Step B:

[0581] This compound was prepared according to General Procedure A for C47959. Yield: 65%.

C80379

[0582] Synthesis of target compound was carried out following the scheme given below:

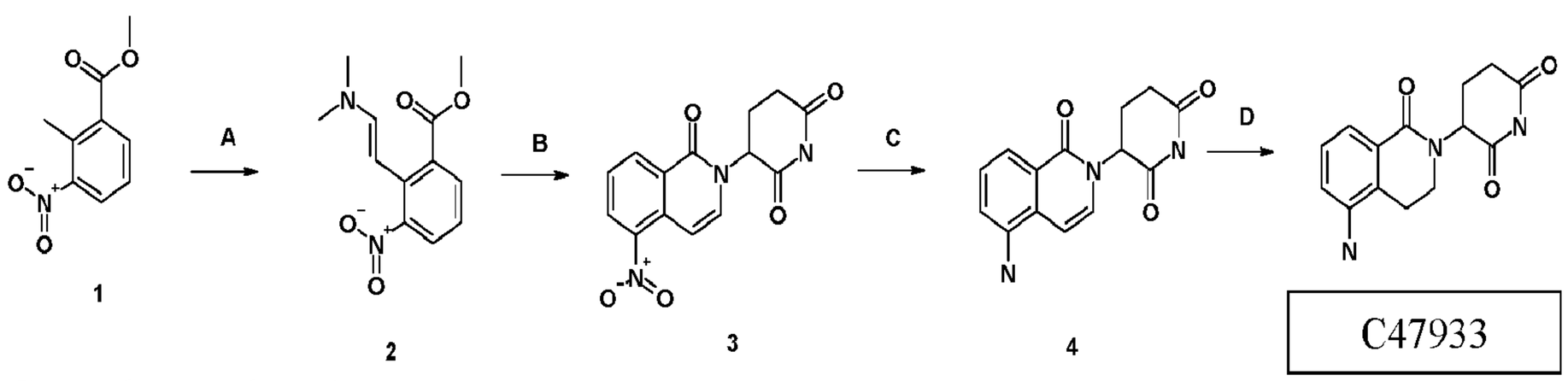


Step A:

[0583] This compound was prepared according to General Procedure B for C80370. Yield: 26%.

C47933

[0584] Synthesis of target compound was carried out following the scheme given below:



General Procedure A:

[0585] Compound 1 (1 mmol) was dissolved in 10ml of dry DMF, DMFDMA (1.2mmol) was added and the reaction mixture was stirred at 50 °C overnight, then diluted with water (50 mL). The solution was extracted with ethyl acetate (2x50 mL), organic phase was washed with brine (3x150ml), dried with $CaCl_2$ and evaporated to give the methyl ester 2. Yield: 88%.

General Procedure B:

[0586] Compound 2 (1 mmol) was dissolved in 10ml of dry DMF, Glutarimide (1.2mmol) was added and the reaction mixture was stirred at 90 °C 10h, then solvent was evaporated to give the compound 3. The crude residue was recrystallization with use mixture DMF:iPrOH (1:2). Yield: 76%.

Step C:

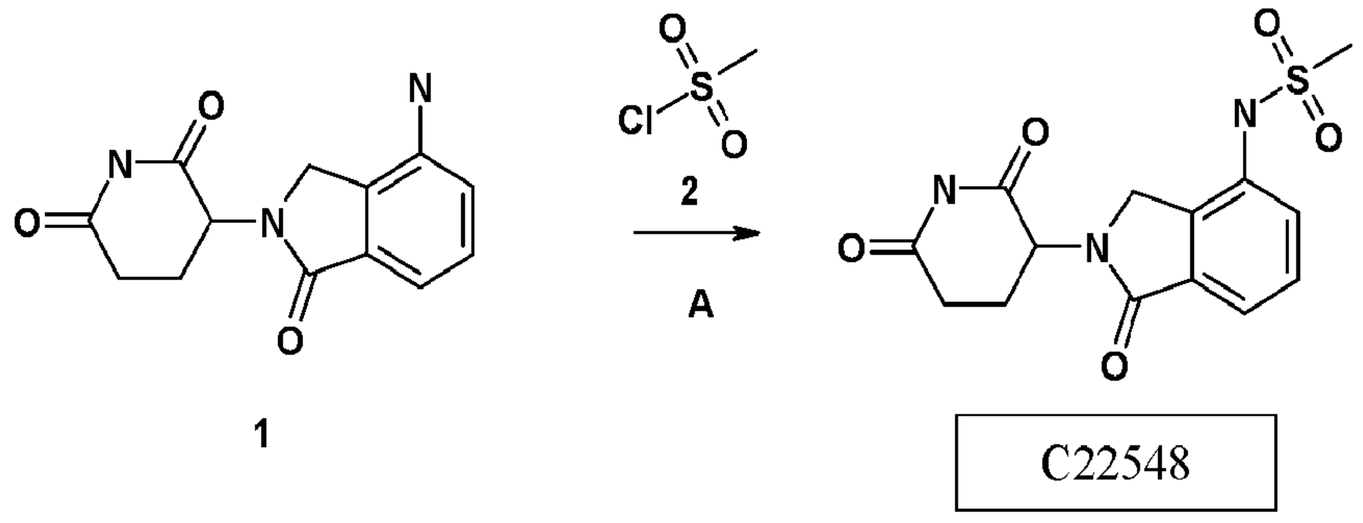
[0587] This compound was prepared according to General Procedure D for C84965. Yield: 53%.

Step D:

[0588] To a suspension of compound 4 (1 mmol) in dioxane (20 mL) was added palladium carbon (5%, 15 mg), and the mixture was stirred under a hydrogen atmosphere at 90 °C for 15 h. The reaction mixture was filtered through celite. The filtrate was concentrated under reduced pressure and after was purified by using HPLC. Yield: 65 %.

C22548

[0589] Synthesis of target compound was carried out following the scheme given below:

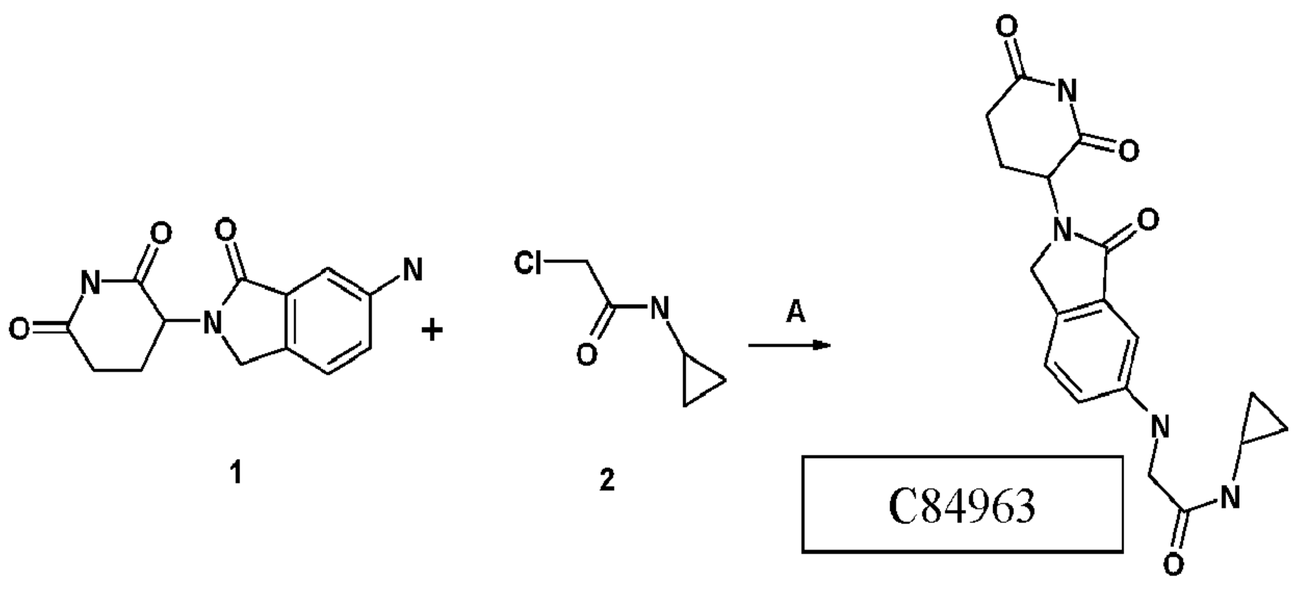


Step A:

[0590] This compound was prepared according to General Procedure A for C95330. Yield: 37%.

C84963

[0591] Synthesis of target compound was carried out following the scheme given below:

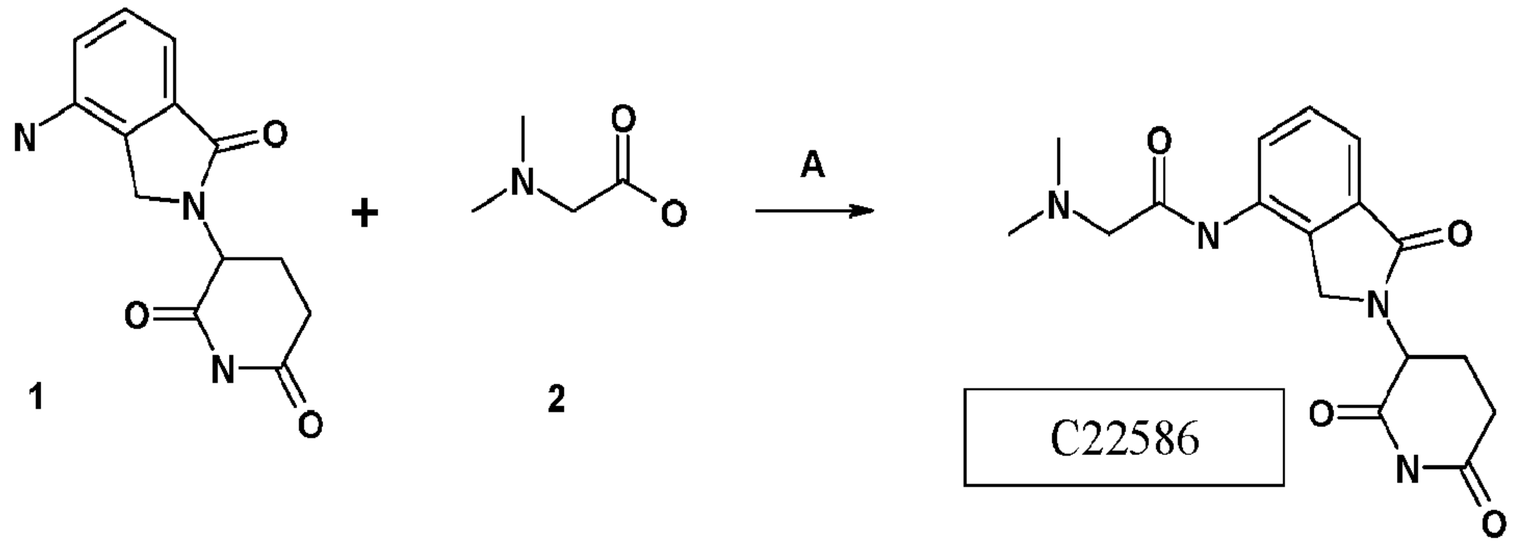


Step A:

[0592] This compound was prepared according to General Procedure A for C12584. Yield: 31%.

C22586

[0593] Synthesis of target compound was carried out following the scheme given below:

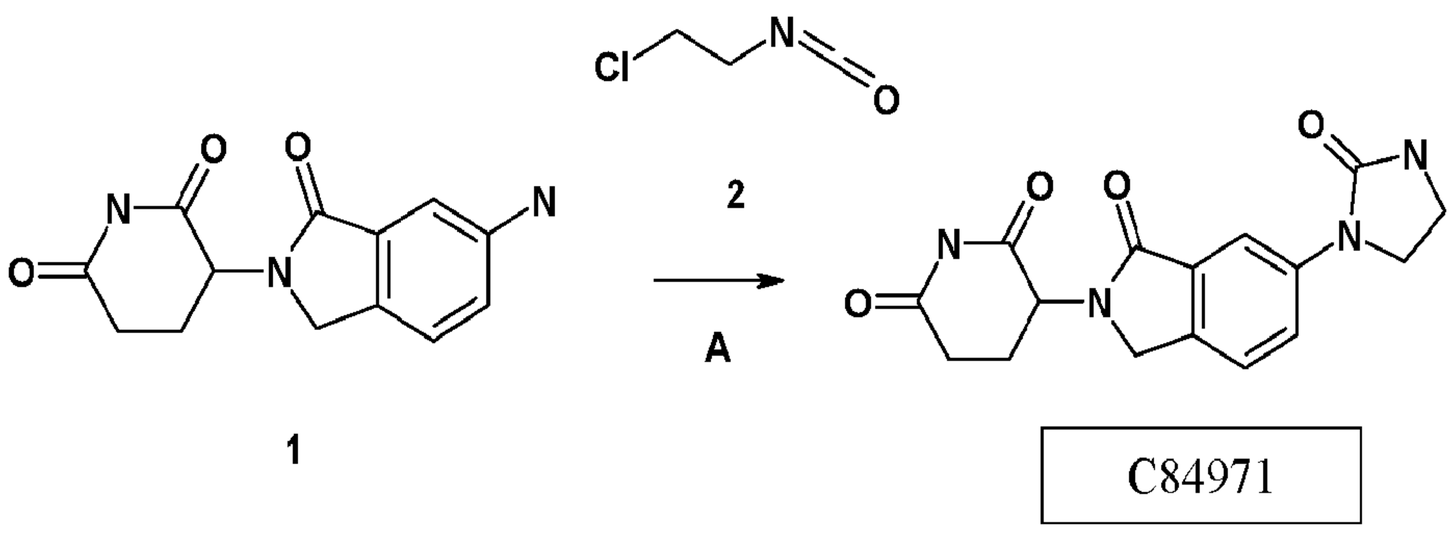


Step A:

[0594] This compound was prepared according to General Procedure A for C80392. Yield: 58%.

C84971

[0595] Synthesis of target compound was carried out following the scheme given below:

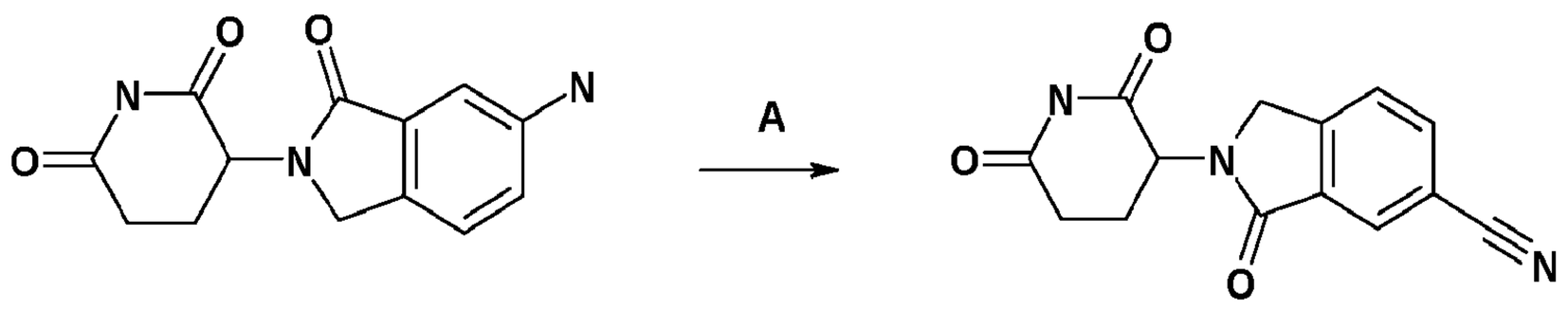


Step A:

[0596] This compound was prepared according to General Procedure B for C35751. Yield: 48%.

C48007

[0597] Synthesis of target compound was carried out following the scheme given below:



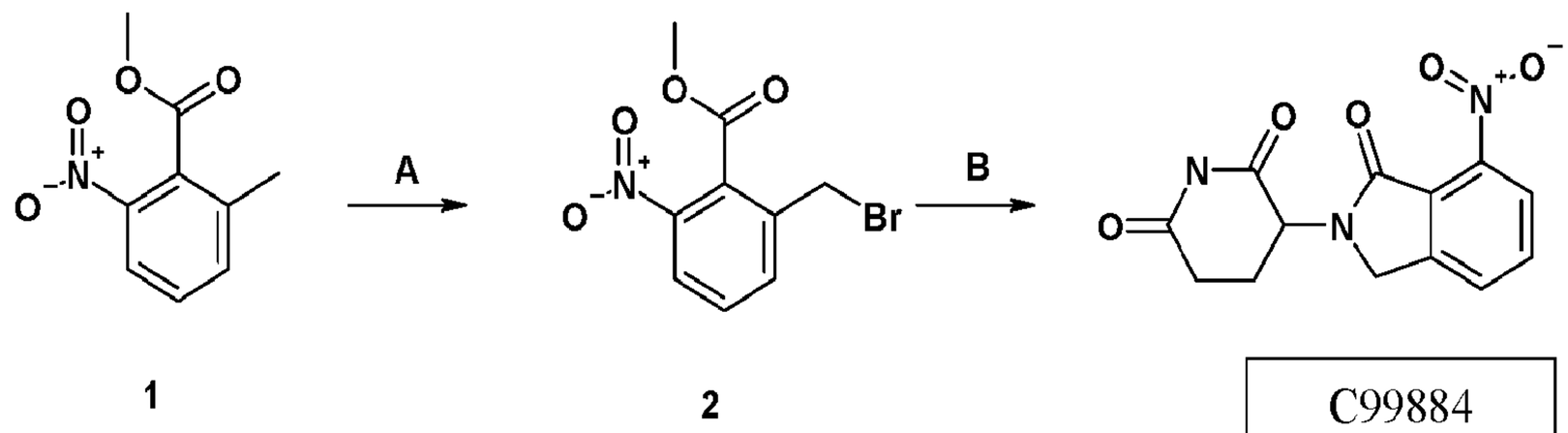
1 C48007

Step A:

[0598] This compound was prepared according to General Procedure A for C48003. Yield: 69%.

C99884

[0599] Synthesis of target compound was carried out following the scheme given below:



1 2 C99884

Step A:

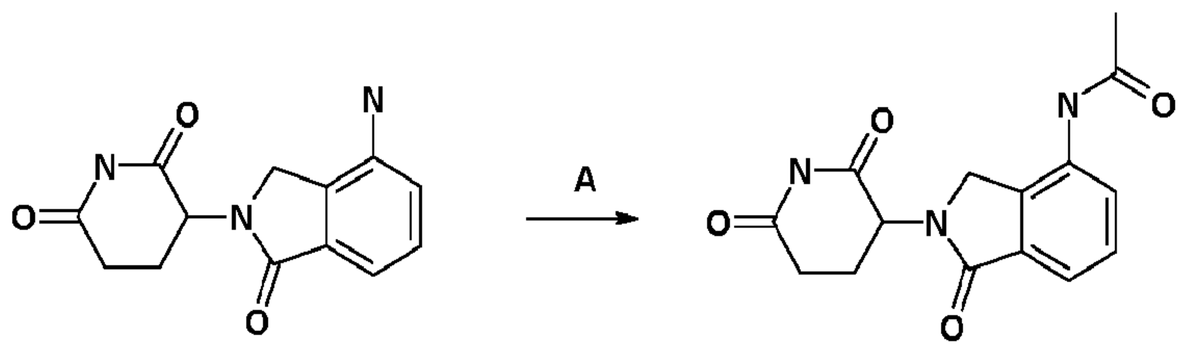
[0600] This compound was prepared according to General Procedure B for C47935. Yield: 79%.

Step B:

[0601] This compound was prepared according to General Procedure A for C47959. Yield: 82%.

C29330

[0602] Synthesis of target compound was carried out following the scheme given below:



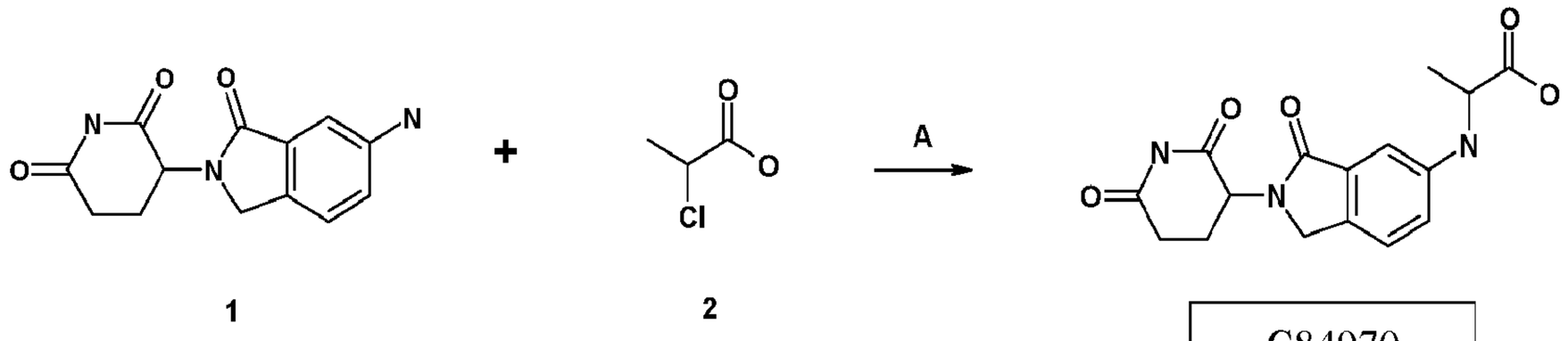
1 C29330

Step A:

[0603] This compound was prepared according to General Procedure A for C80392. Yield: 87%.

C84970

[0604] Synthesis of target compound was carried out following the scheme given below:



1 2 C84970

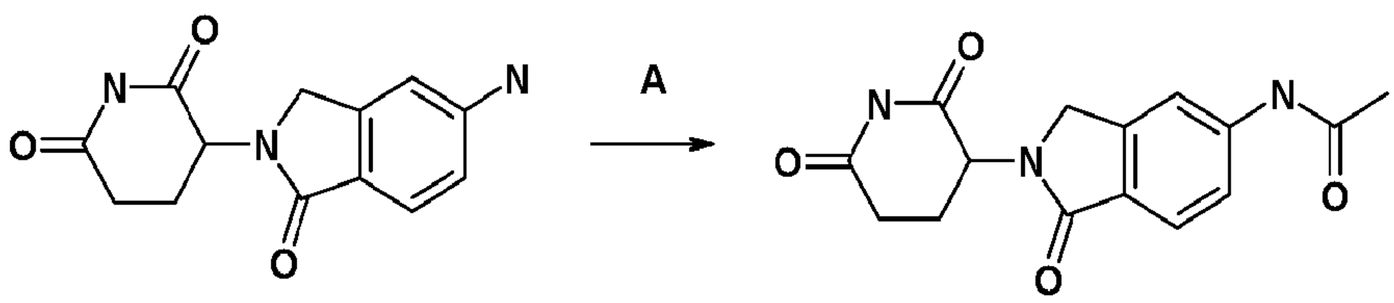
Step A:

[0605] This compound was prepared according to General Procedure A for C12584. Yield: 11%.

[0606] In this case we used additional amount of HOAc (3eq) before separation of the product from reaction mixture.

C29361

[0607] Synthesis of target compound was carried out following the scheme given below:



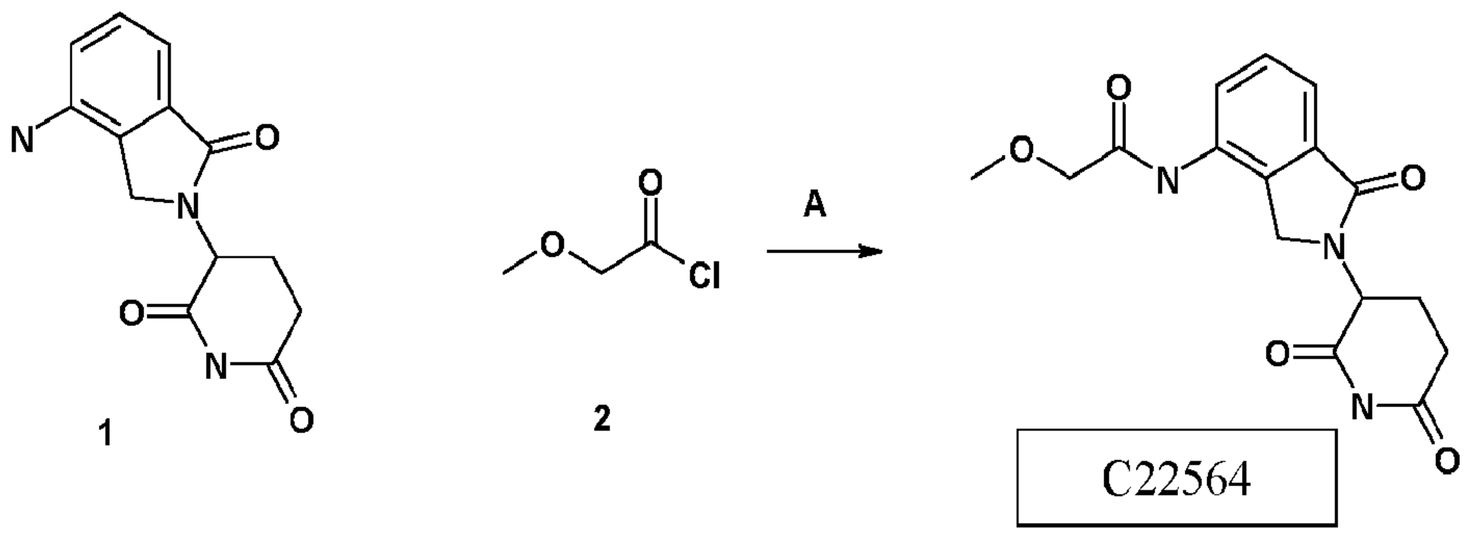
1 C29361

Step A:

[0608] This compound was prepared according to General Procedure A for C80392. Yield: 78%.

C22564

[0609] Synthesis of target compound was carried out following the scheme given below:



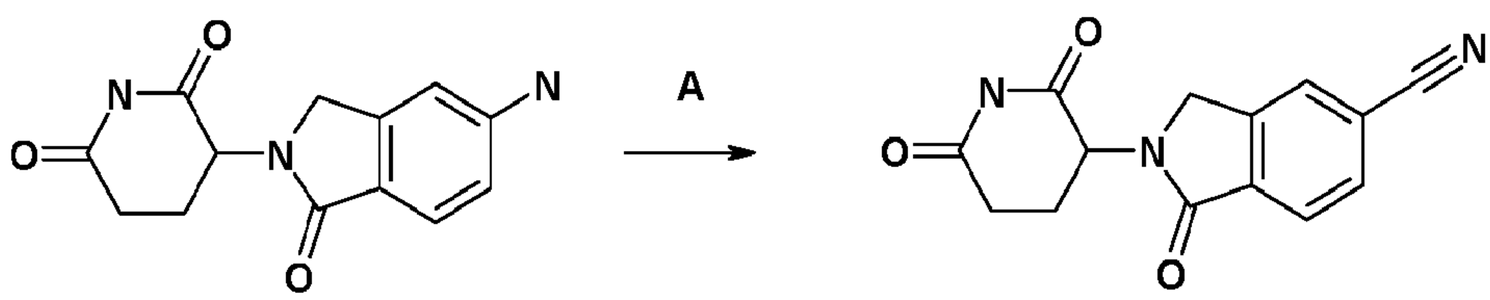
1 2 C22564

Step A:

[0610] This compound was prepared according to General Procedure A for C95330. Yield: 45%.

C48005

[0611] Synthesis of target compound was carried out following the scheme given below:



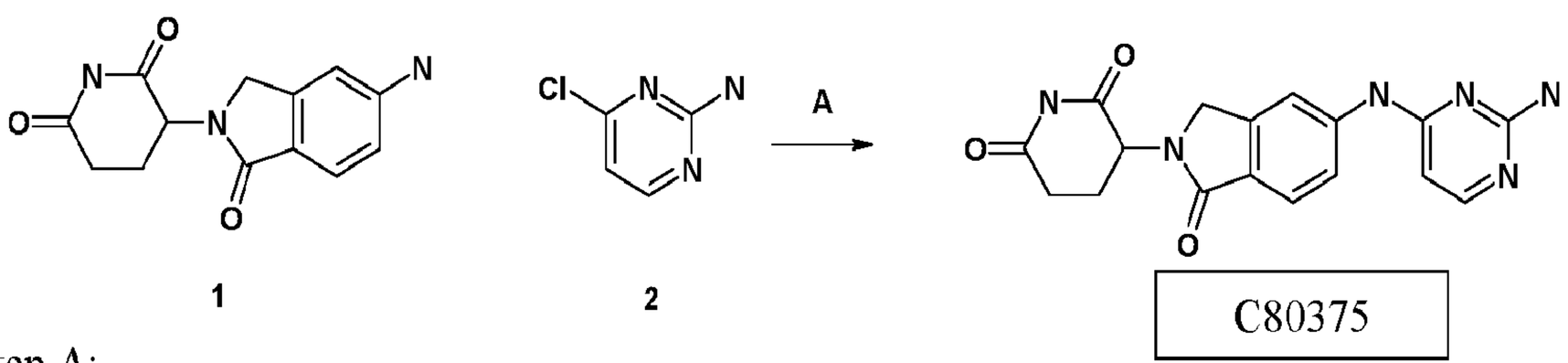
1 C48005

Step A:

[0612] This compound was prepared according to General Procedure A for C48003. Yield: 59%.

C80375

[0613] Synthesis of target compound was carried out following the scheme given below:



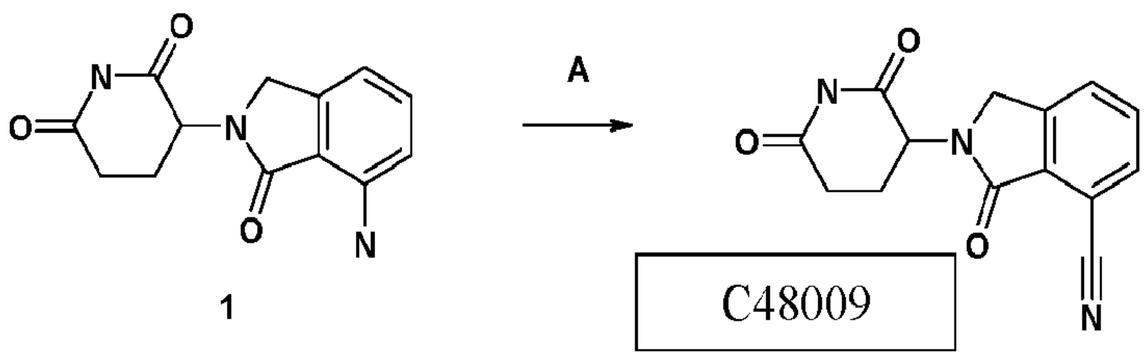
1 2 C80375

Step A:

[0614] This compound was prepared according to General Procedure A for C80370. Yield: 19%.

C48009

[0615] Synthesis of target compound was carried out following the scheme given below:



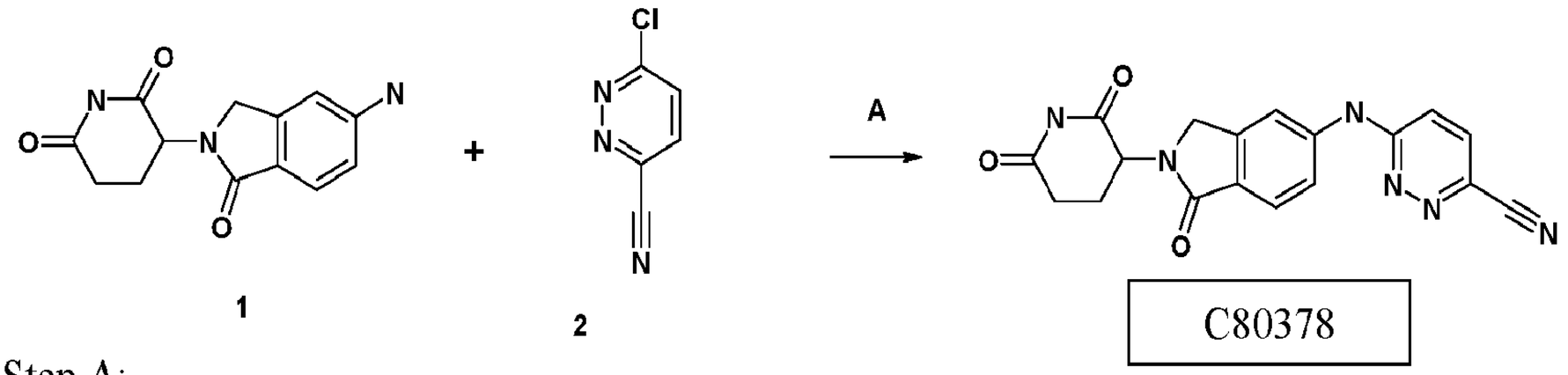
1 C48009

Step A:

[0616] This compound was prepared according to General Procedure A for C48003. Yield: 22%.

C80378

[0617] Synthesis of target compound was carried out following the scheme given below:

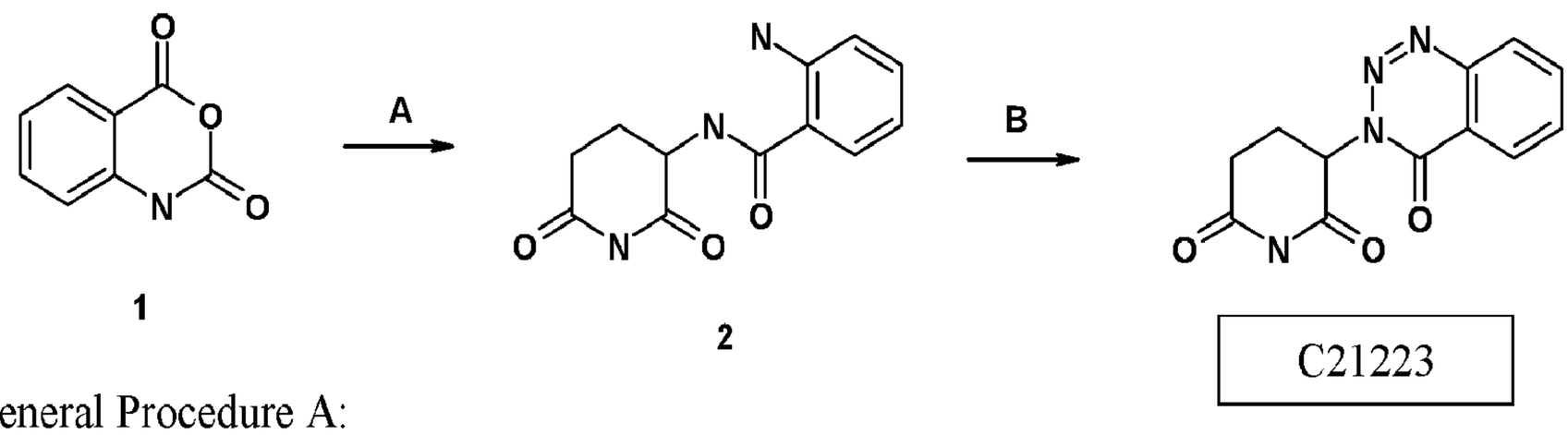


Step A:

[0618] This compound was prepared according to General Procedure A for C80370. Yield: 31%.

C21223

[0619] Synthesis of target compound was carried out following the scheme given below:



General Procedure A:

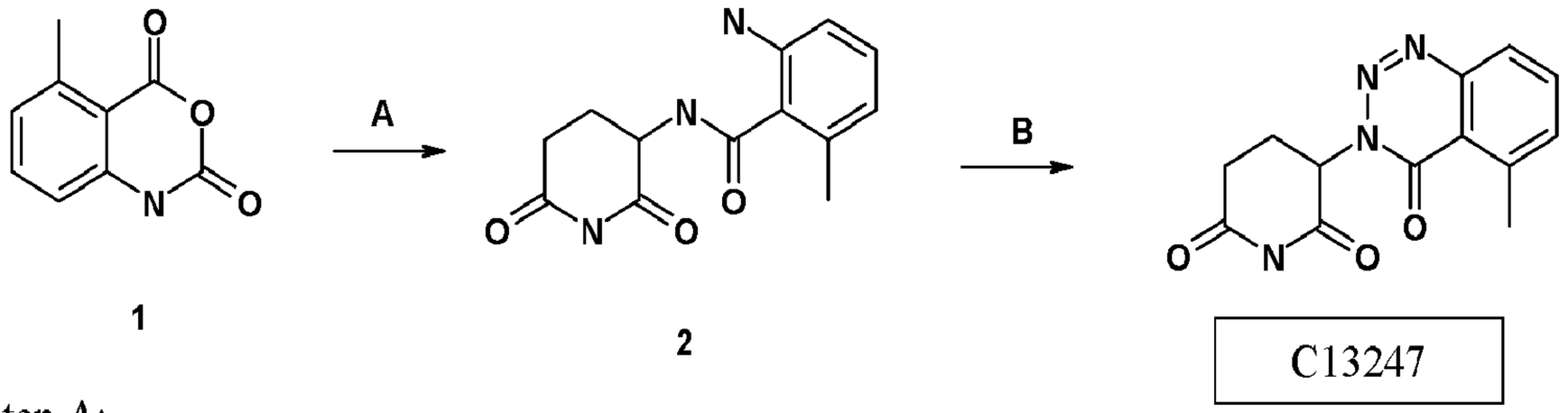
[0620] Compound 1 (1.1 mmol) and Glutarimide (1 mmol) were dissolved in dioxane (10 mL) and NEt3 (1.3 mmol) was added. The reaction mixture was heated at 80 °C with stirring at overnight, then diluted with water (150 mL). The precipitate was filtered, washed with water (3x25ml) and recrystallization from mixture iPrOH:Water (4:1). Yield: 90%.

Step B:

[0621] This compound was prepared according to General Procedure B for C35833. Yield: 42%.

C13247

[0622] Synthesis of target compound was carried out following the scheme given below:



Step A:

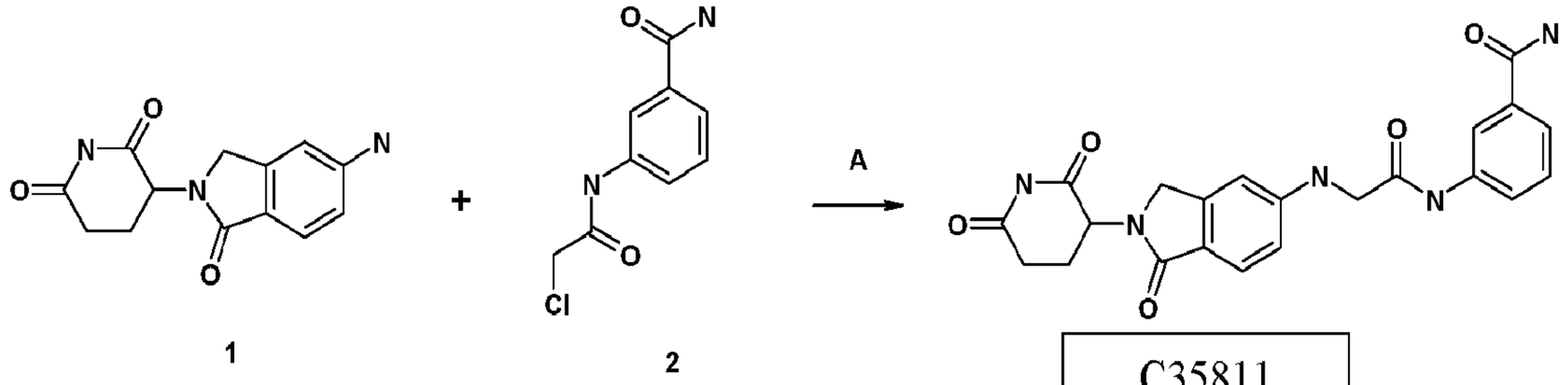
[0623] This compound was prepared according to General Procedure A for C21223. Yield: 73%.

Step B:

[0624] This compound was prepared according to General Procedure B for C35833. Yield: 33%.

C35811

[0625] Synthesis of target compound was carried out following the scheme given below:

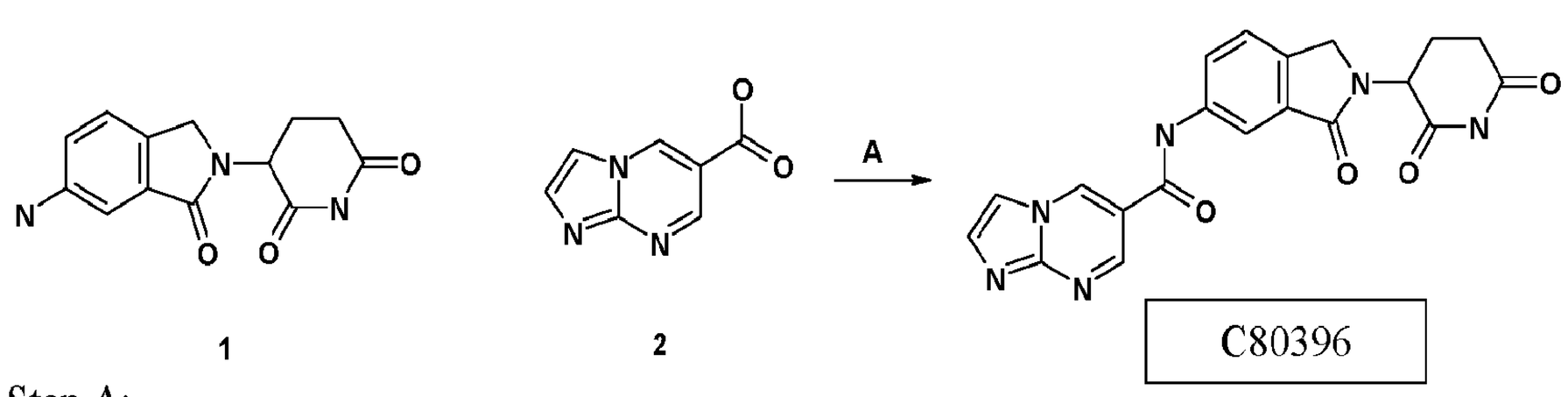


Step B:

[0626] This compound was prepared according to General Procedure A for C12584. Yield: 21%.

C80396

[0627] Synthesis of target compound was carried out following the scheme given below:

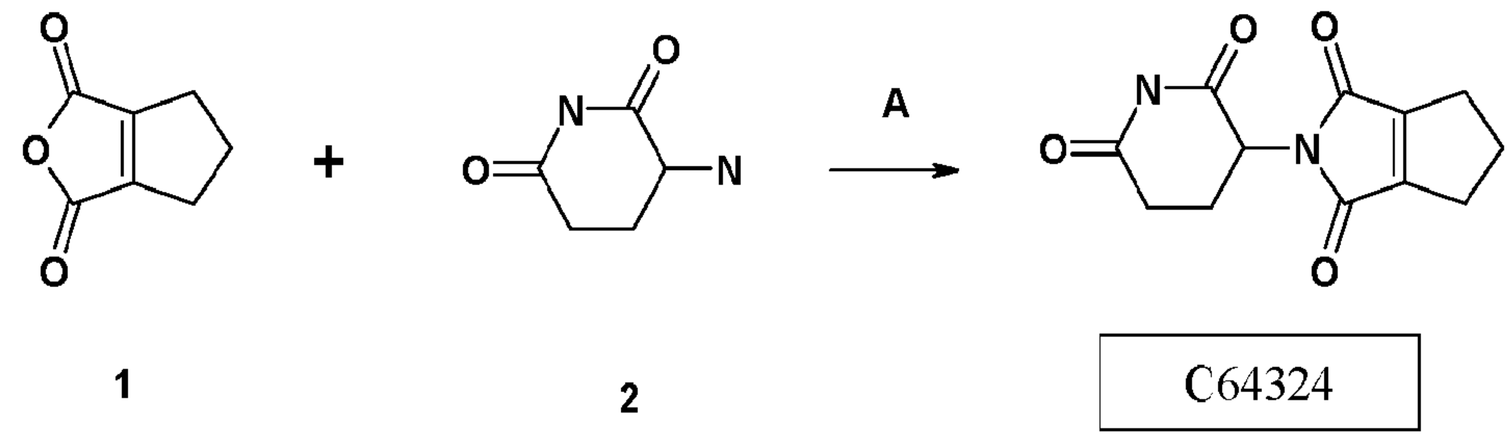


Step A:

[0628] This compound was prepared according to General Procedure A for C80392. Yield: 47%.

C64324

[0629] Synthesis of target compound was carried out following the scheme given below:



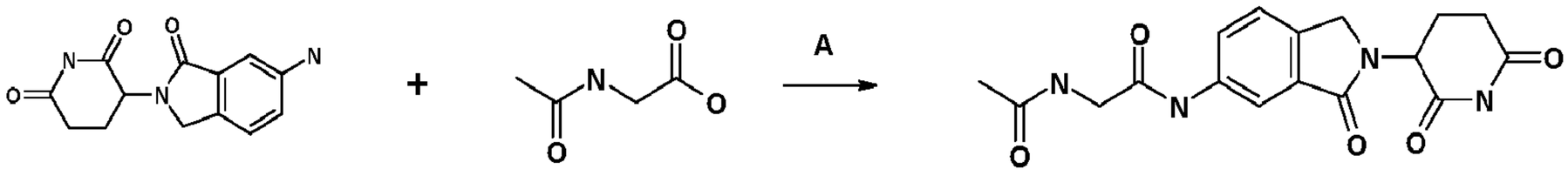
C64324

General Procedure A:

[0630] Compound 1 (1 mmol), hydrochloride 2 (1 mmol) and dry NaOAc (5 mmol) were dissolved in 10 ml of dry HOAc, the mixture was heated at 100 °C for 10-24 hours (LCMS control). The reaction mixture was cooled, filtered and the solvent was evaporated. The crude residue was purified using HPLC. Yield: 29%.

C84967

[0631] Synthesis of target compound was carried out following the scheme given below:



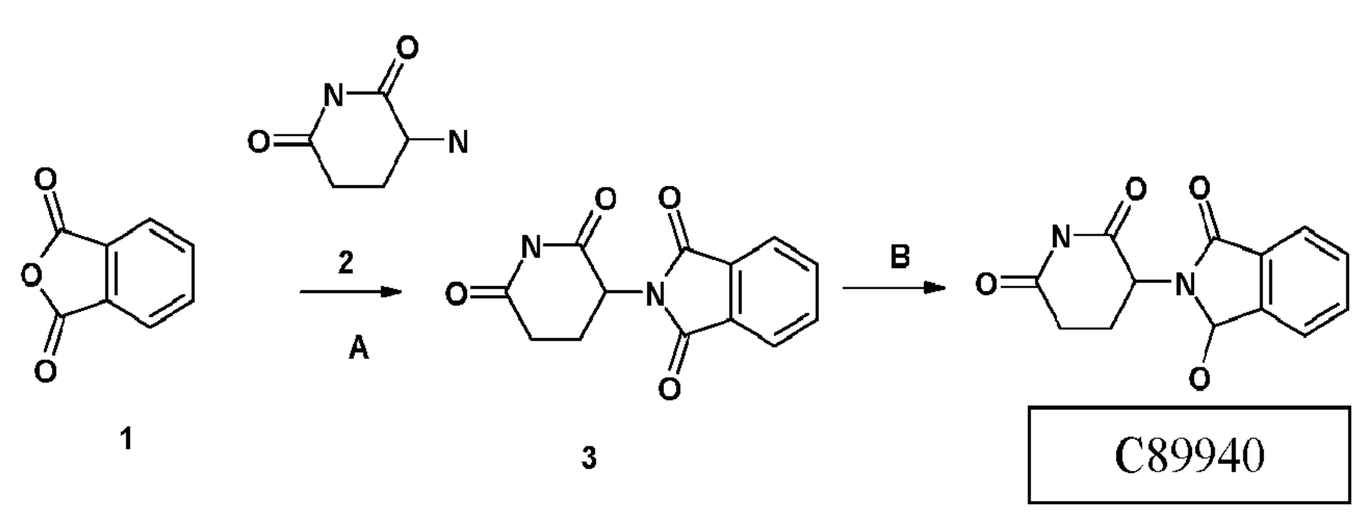
1 2 C84967

Step A:

[0632] This compound was prepared according to General Procedure A for C80392. Yield: 34%.

C89940

[0633] Synthesis of target compound was carried out following the scheme given below:



1 3 C89940

Step A:

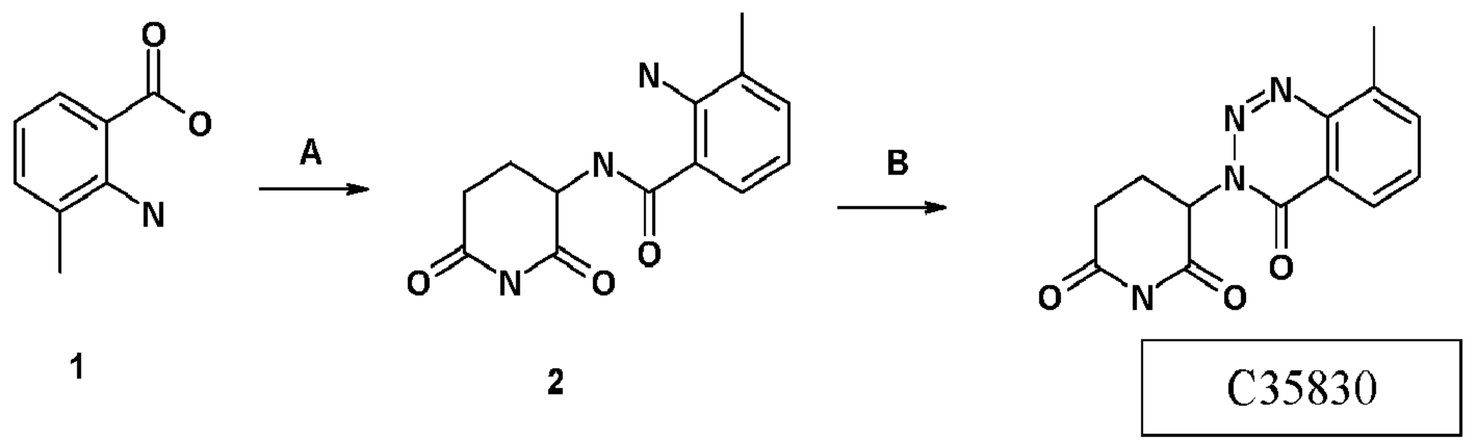
[0634] This compound was prepared according to General Procedure A for C64324. Yield: 34%.

General Procedure B:

[0635] Compound 1 (1 mmol) was dissolved in 10ml of HOAc, $NaBH_4$ (1 mmol) was added by portions during 15min at r.t. The mixture was stirred at r.t. for 10 hours. TLC and LCMS control. The reaction mixture was mixture with water (25ml), then filtered and washed with water (3x25ml). The crude residue was purified using HPLC. Yield 58%.

C35830

[0636] Synthesis of target compound was carried out following the scheme given below:



1 2 C35830

Step A:

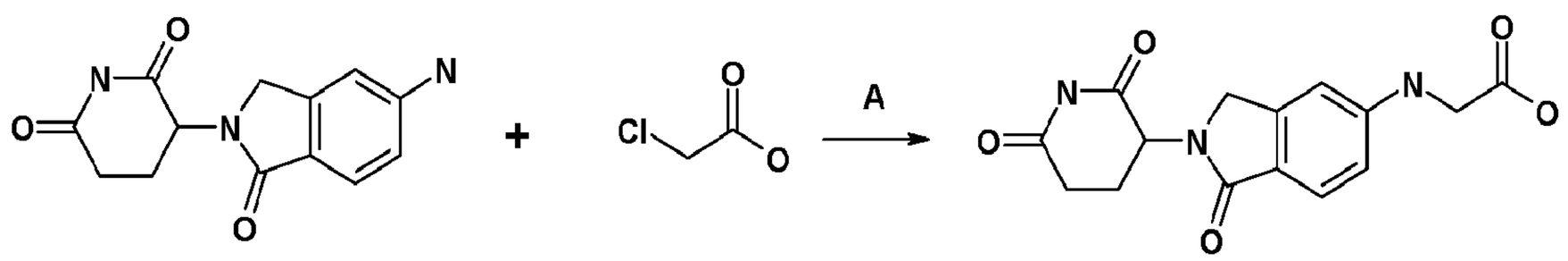
[0637] This compound was prepared according to General Procedure B for C35833. Yield: 36%.

Step B:

[0638] This compound was prepared according to General Procedure B for C35833. Yield: 30%.

C47995

[0639] Synthesis of target compound was carried out following the scheme given below:



1 2 C47995

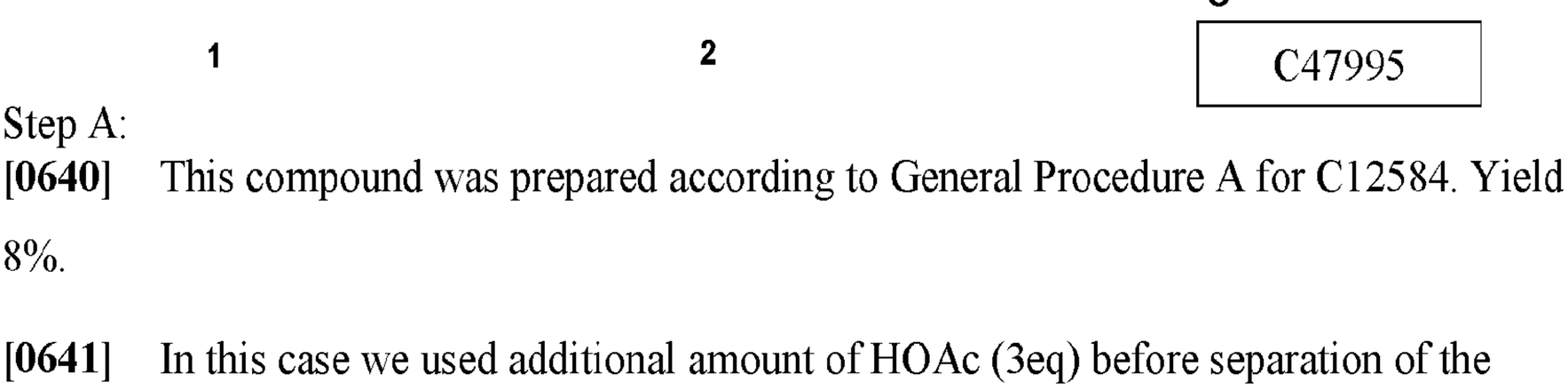
Step A:

[0640] This compound was prepared according to General Procedure A for C12584. Yield: 8%.

[0641] In this case we used additional amount of HOAc (3eq) before separation of the product from reaction mixture.

C64376

[0642] Synthesis of target compound was carried out following the scheme given below:



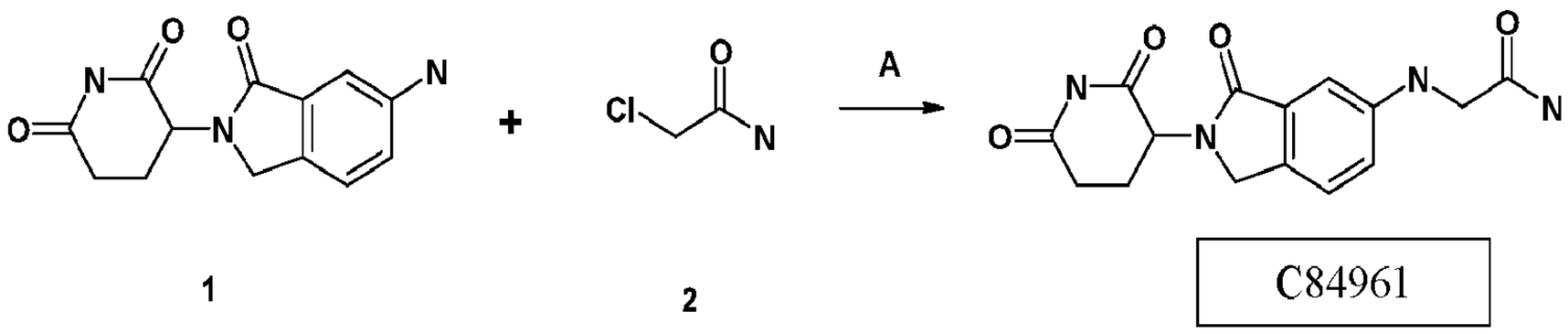
1 2 C64376

Step A:

[0643] This compound was prepared according to General Procedure A for C64324. Yield: 31%.

C84961

[0644] Synthesis of target compound was carried out following the scheme given below:

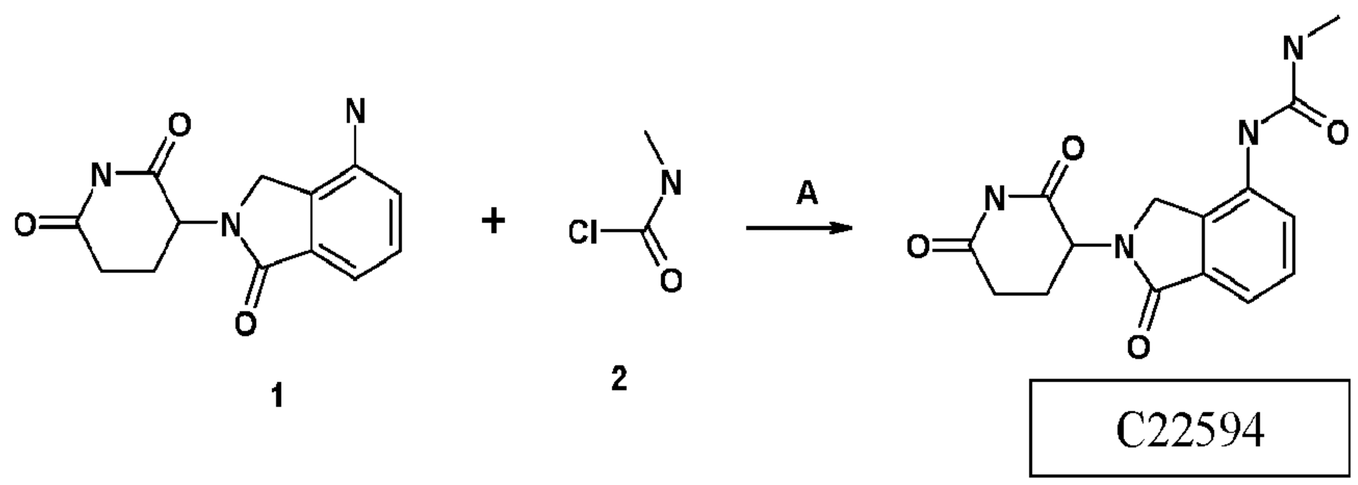


Step A:

[0645] This compound was prepared according to General Procedure A for C12584. Yield: 11%.

C22594

[0646] Synthesis of target compound was carried out following the scheme given below:

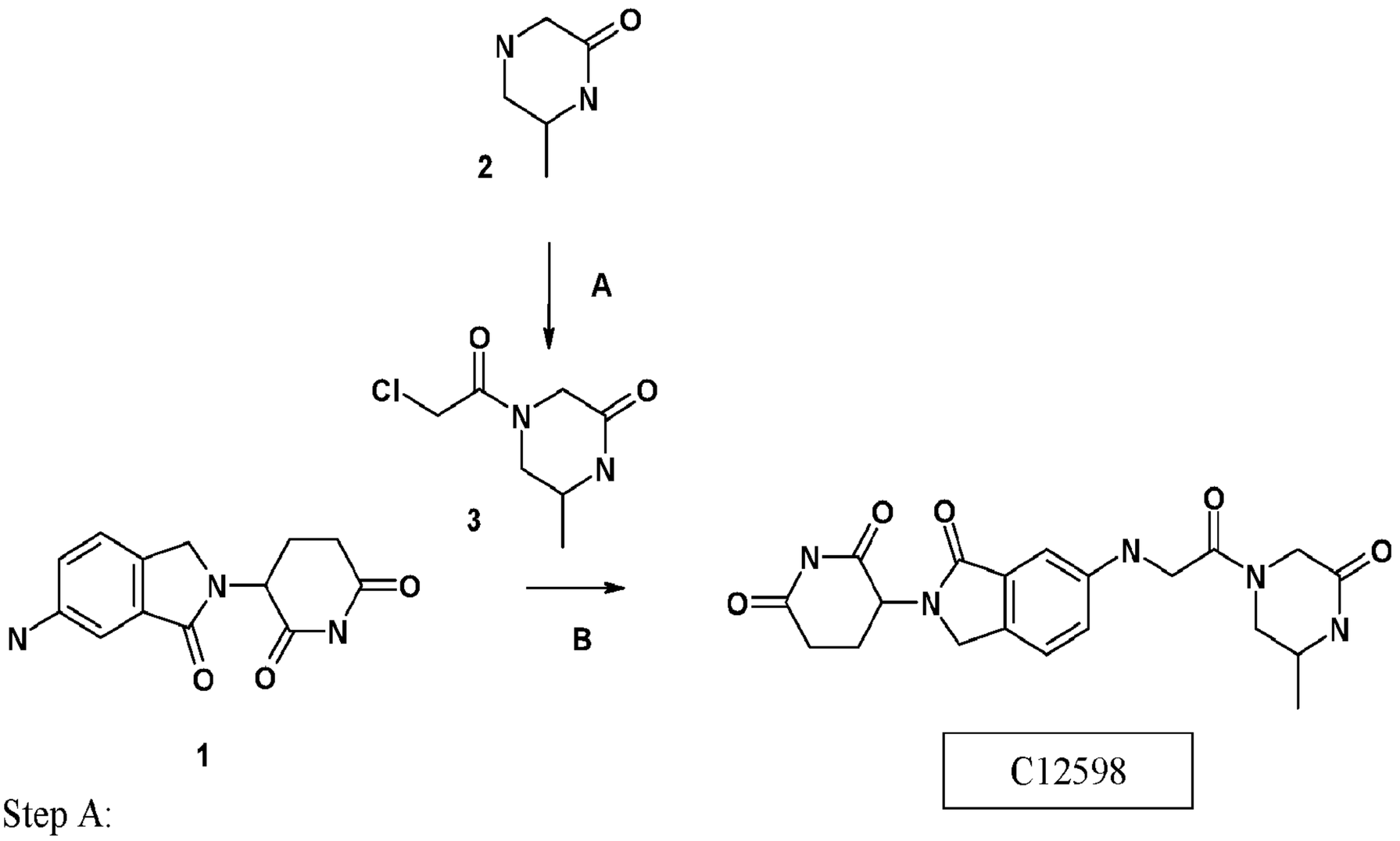


Step A:

[0647] This compound was prepared according to General Procedure A for C95330. Yield: 34%.

C12598

[0648] Synthesis of target compound was carried out following the scheme given below:



Step A:

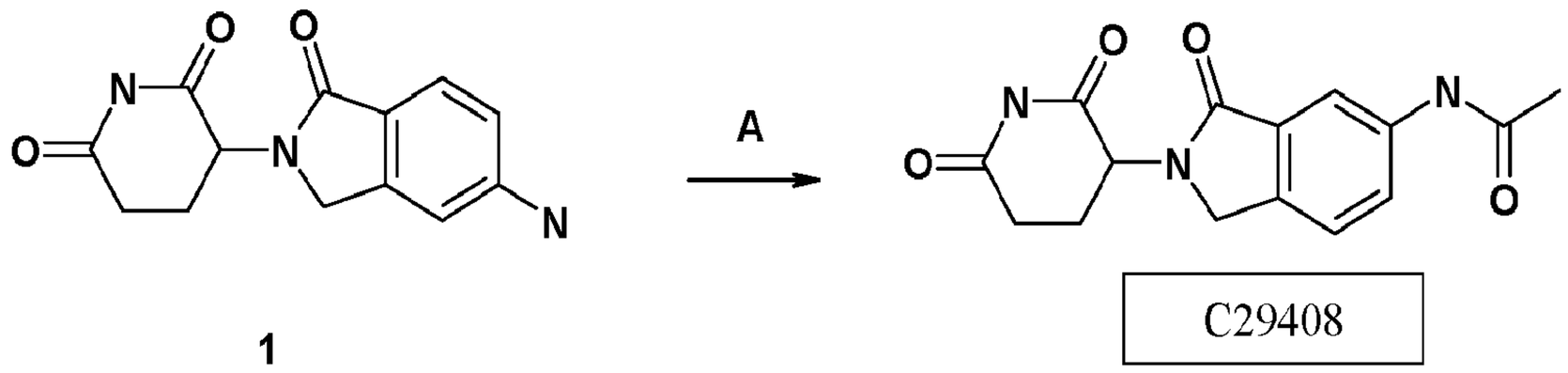
[0649] This compound was prepared according to General Procedure A for C95330. Yield: 81%.

Step B:

[0650] This compound was prepared according to General Procedure A for C12584. Yield: 19%.

C29408

[0651] Synthesis of target compound was carried out following the scheme given below:

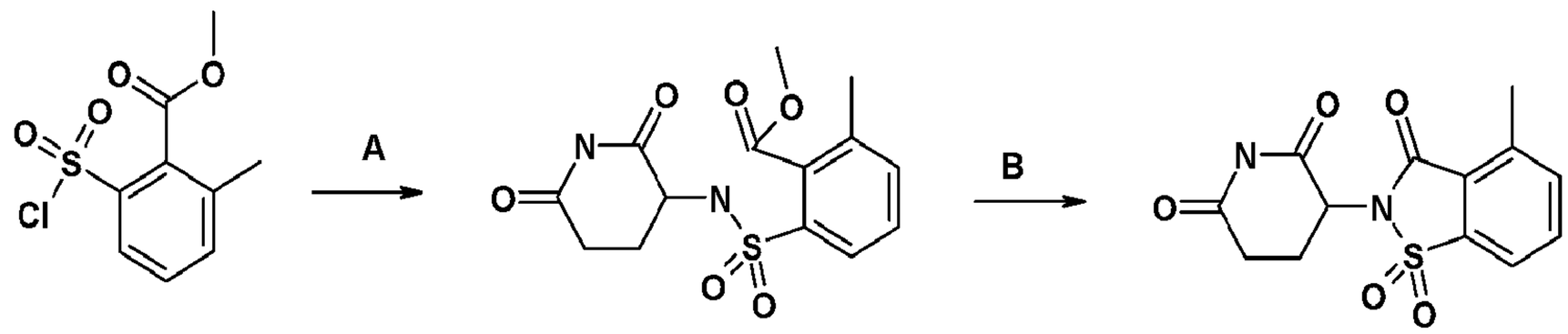


Step A:

[0652] This compound was prepared according to General Procedure A for C80392. Yield: 68%.

C73349

[0653] Synthesis of target compound was carried out following the scheme given below:



Step A:

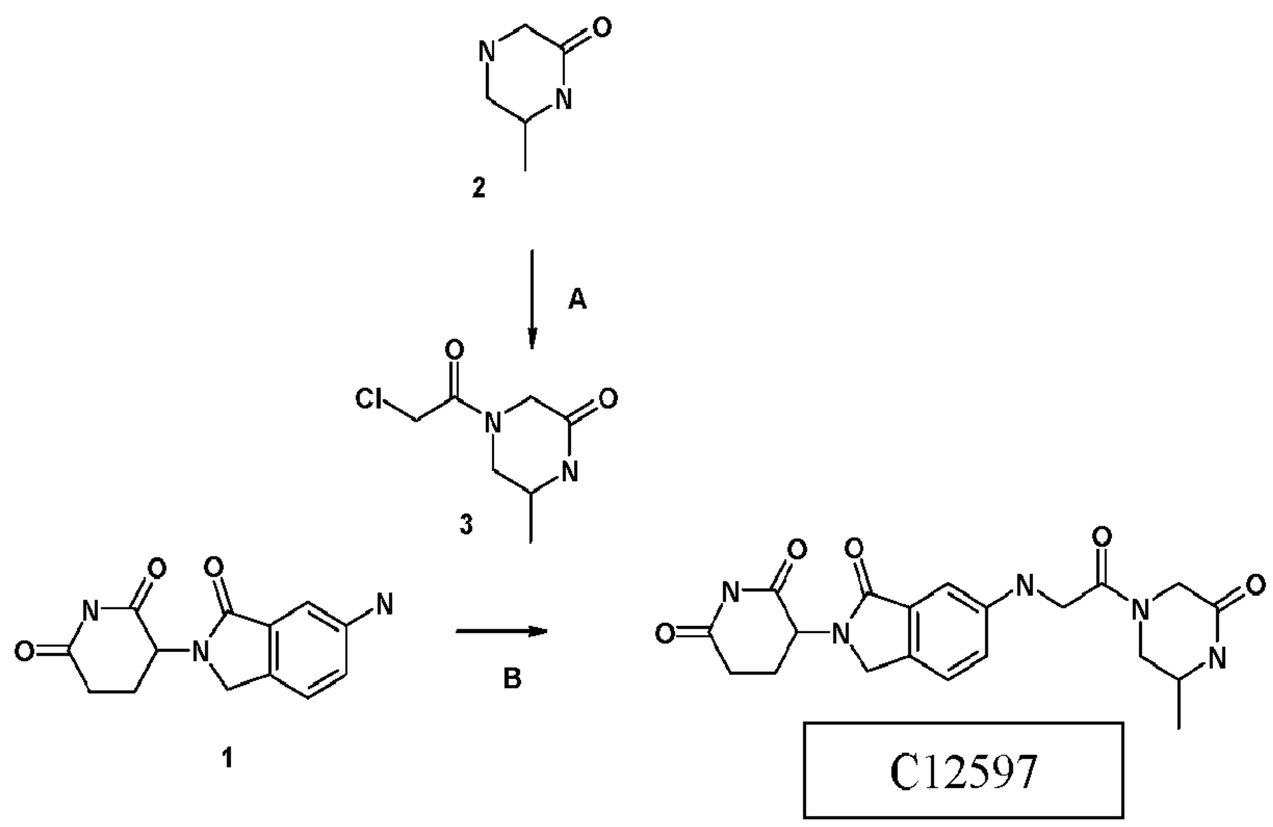
[0654] This compound was prepared according to General Procedure A for C95330. Yield: 86%.

Step B:

[0655] Compound 2 (1 mmol), DIPEA (2 mmol) were dissolved in 10 ml of dioxane, the mixture was heated at 90 °C for 20 hours (TLC and LCMS control). The reaction mixture was cooled and the solvent was evaporated. The crude residue was purified using HPLC. Yield: 22%.

C12597

[0656] Synthesis of target compound was carried out following the scheme given below:



Step A:

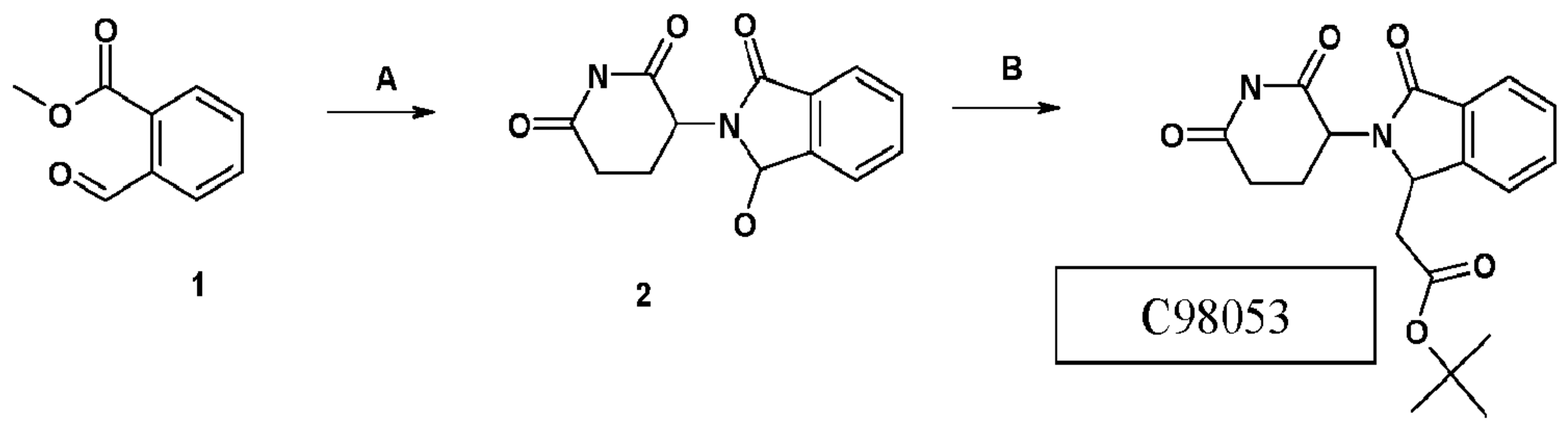
[0657] This compound was prepared according to General Procedure A for C95330. Yield: 84%.

Step B:

[0658] This compound was prepared according to General Procedure A for C12584. Yield: 16%.

C98053

[0659] Synthesis of target compound was carried out following the scheme given below:



Step A:

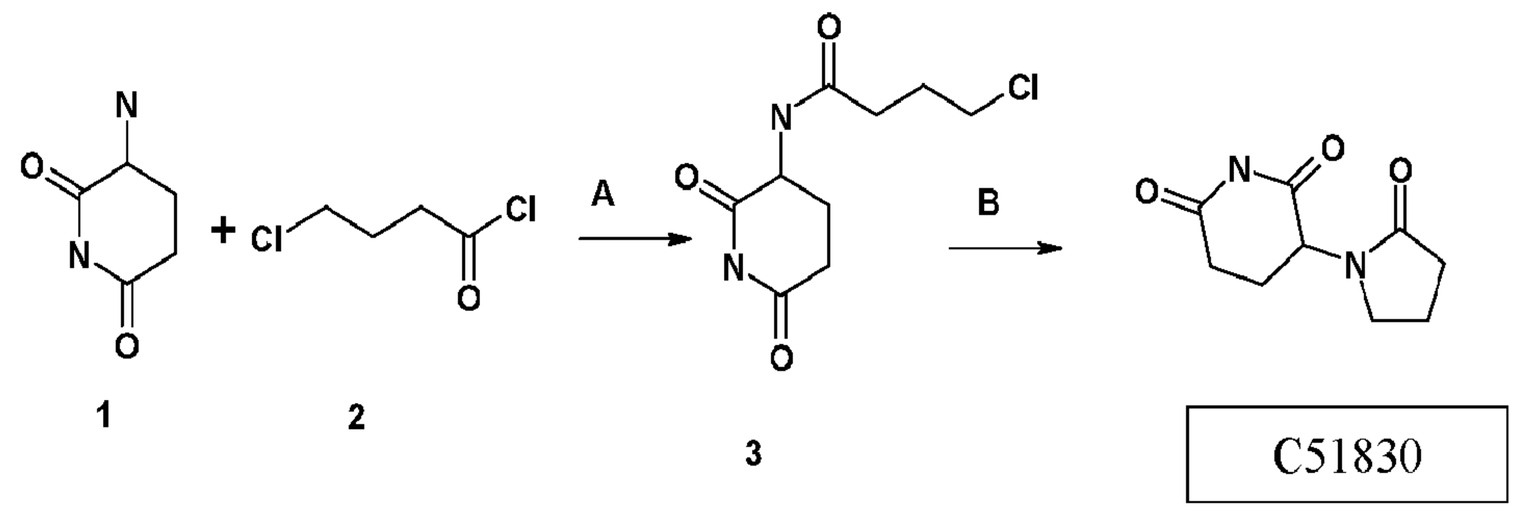
[0660] This compound was prepared according to General Procedure B for C67858. Yield: 79%.

Step B:

[0661] Compound 2 (1 mmol), Wittig reagent tertBu ester (1.1 mmol) was refluxed in 20ml of toluene for 96 hours (TLC and LCMS control). The reaction mixture was cooled, filtered and the solvent was evaporated. The crude residue was purified using HPLC. Yield: 29%.

C51830

[0662] Synthesis of target compound was carried out following the scheme given below:



Step A:

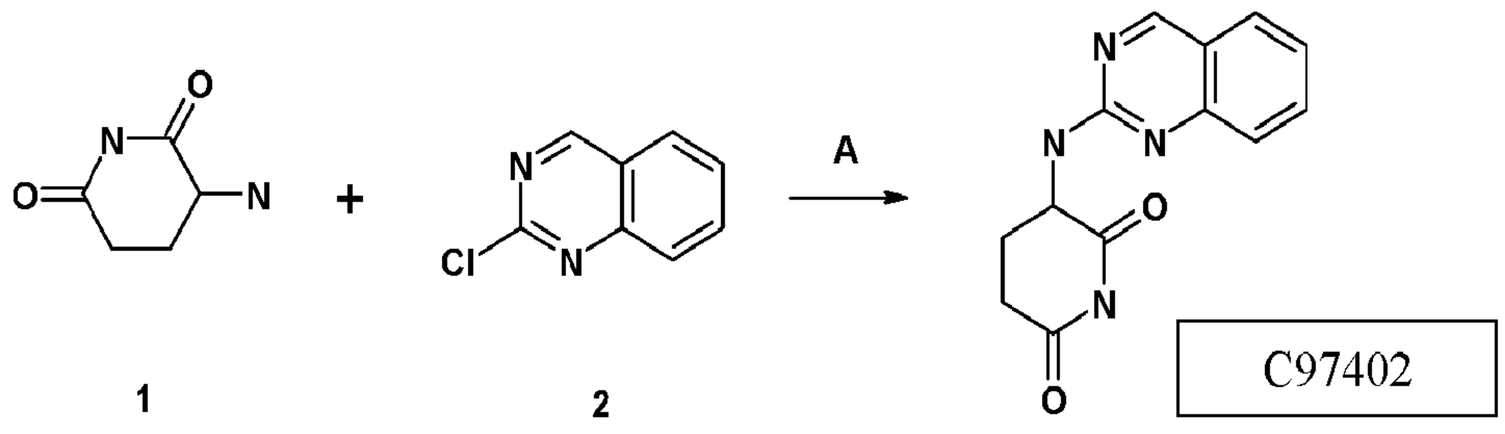
[0663] This compound was prepared according to General Procedure A for C95330. Yield: 12%.

Step B:

[0664] Compound 2 (1 mmol), K_2CO_3 (2 mmol) were dissolved in 10 ml of acetonitrile, the mixture was heated at 80 °C for 12 hours. The reaction mixture was cooled, filtered and the solvent was evaporated. The crude residue was purified using HPLC. Yield: 14%.

C97402

[0665] Synthesis of target compound was carried out following the scheme given below:



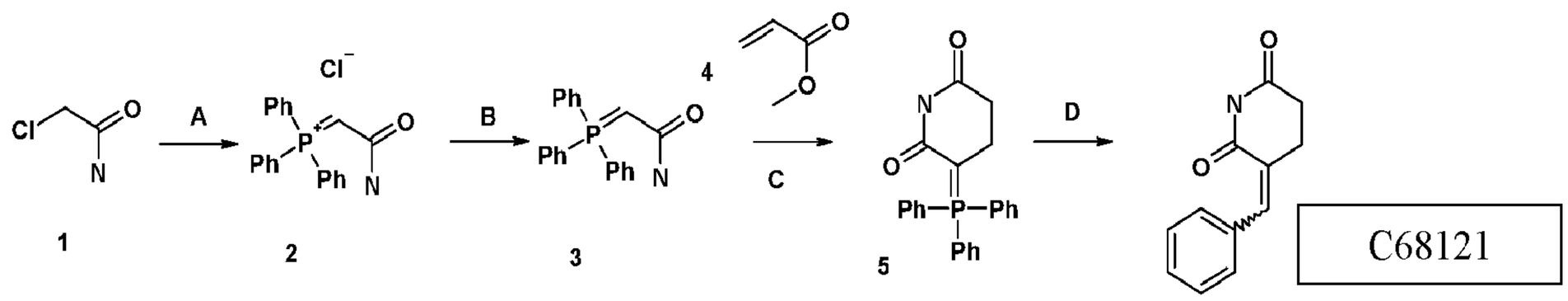
1 2

Step A:

[0666] This compound was prepared according to General Procedure A for C80370. Yield: 26%.

C68121

[0667] Synthesis of target compound was carried out following the scheme given below:



1 2 3 5

Step A:

[0668] Compound 1 (1 mmol) and PPh_3 (1.1 mmol) was heated at 80 °C in toluene (20ml) for 10 hours (TLC and LCMS control). The reaction mixture was cooled, filtered and the precipitate was washed with toluene (3x25ml). Yield: 94%.

Step B:

[0669] Compound 2 (1 mmol) was dissolved in THF (20ml), $NaHCO_3$ (5mmol) was added and mixture was stirred at r.t. for 30min. Then 50ml of water was added, precipitate was filtered, washed with water and dried. Yield: 54%.

Step C:

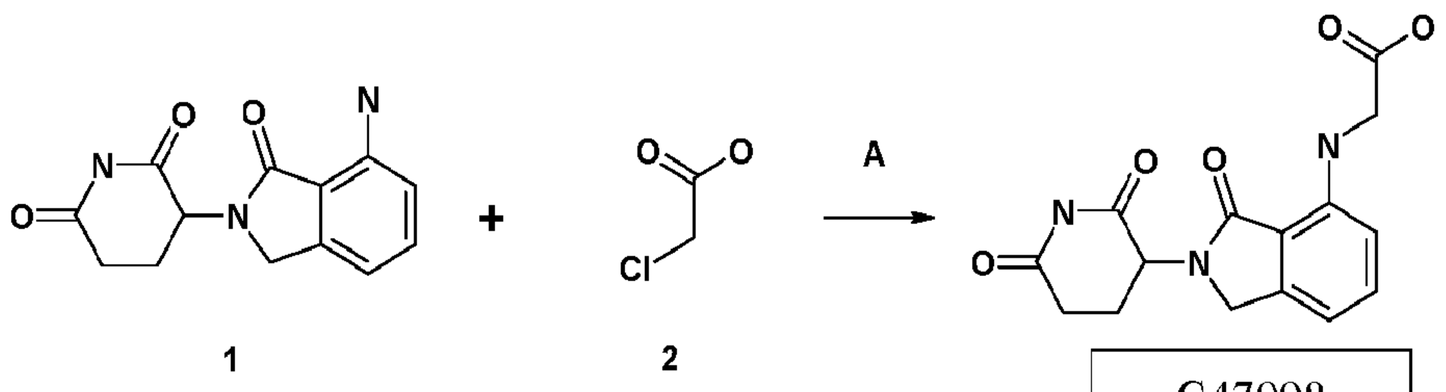
[0670] Compound 3 (1 mmol) and 4 (1.2 mmol) was dissolved in 10ml of THF under Ar. NEt_3 (0.1mmol) was added at 0°C. The mixture was stirred at r.t. for 1h and then at 50 °C for 10h. HOAc (0.1mol) was added, solvent was evaporated. The residue was purified with use LC. Yield: 42%.

Step D:

[0671] Compound 5 (1 mmol), Benzaldehyde (1.1 mmol) was refluxed in 20ml of toluene for 96h hours (TLC and LCMS control). The reaction mixture was cooled, filtered and the solvent was evaporated. The crude residue was purified using HPLC. Yield: 22%.

C47998

[0672] Synthesis of target compound was carried out following the scheme given below:



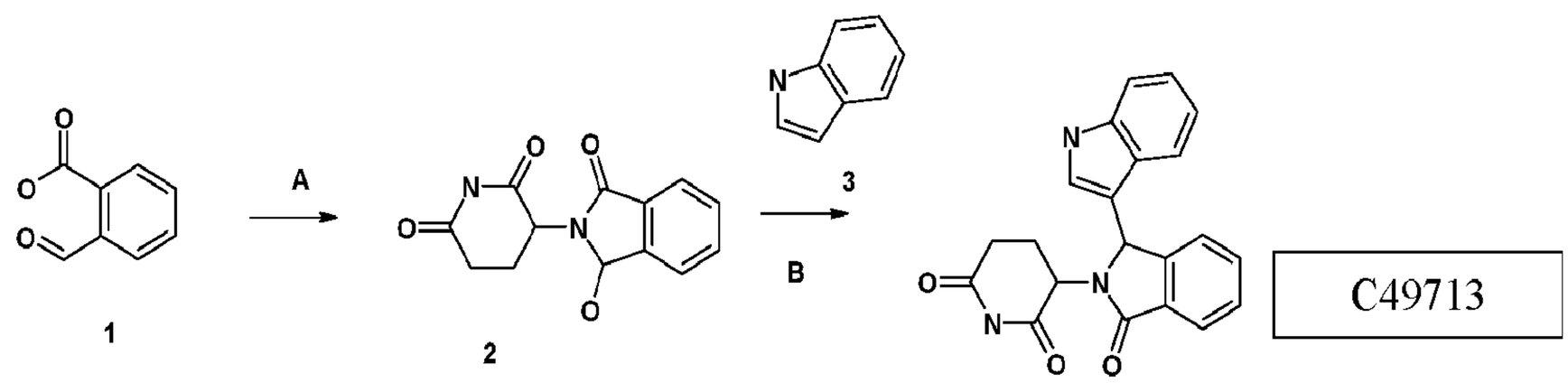
Step A:

[0673] This compound was prepared according to General Procedure A for C12584. Yield: 14%.

[0674] In this case we used additional amount of HOAc (3eq) before separation of the product from reaction mixture.

C49713

[0675] Synthesis of target compound was carried out following the scheme given below:



Step A:

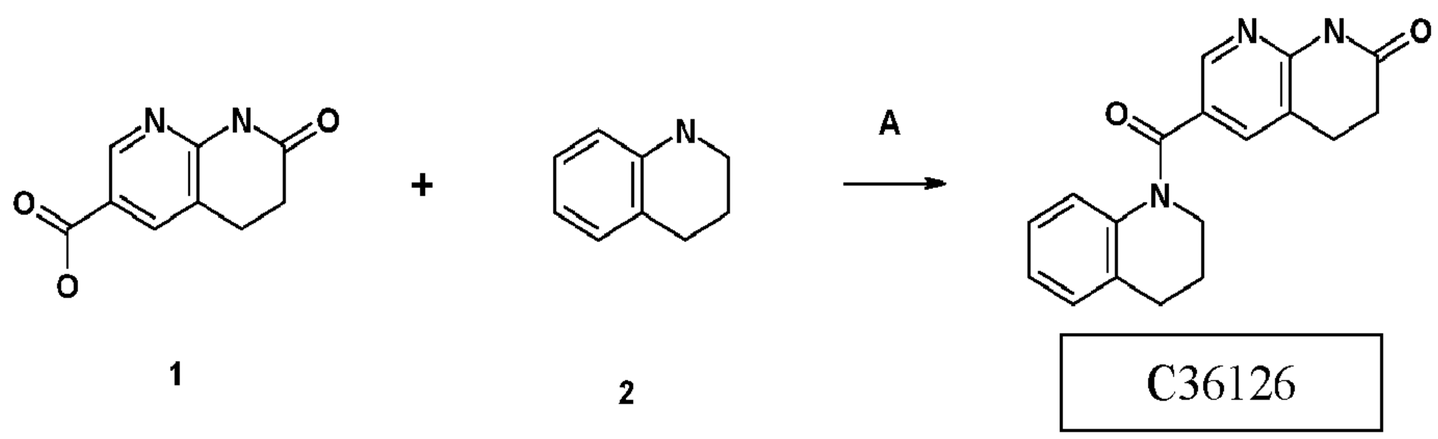
[0676] This compound was prepared according to General Procedure A for C80392. Yield: 39%.

Step B:

[0677] Compound 2 (1 mmol) was dissolved in 10ml of TFA, cooled to 10°C and solution of 3 in 5ml of TFA was added under Ar. The reaction mixture was stirred at r.t. for 12h, solvent was evaporated. The crude residue was purified using HPLC. Yield: 64%.

C36126

[0678] Synthesis of target compound was carried out following the scheme given below:

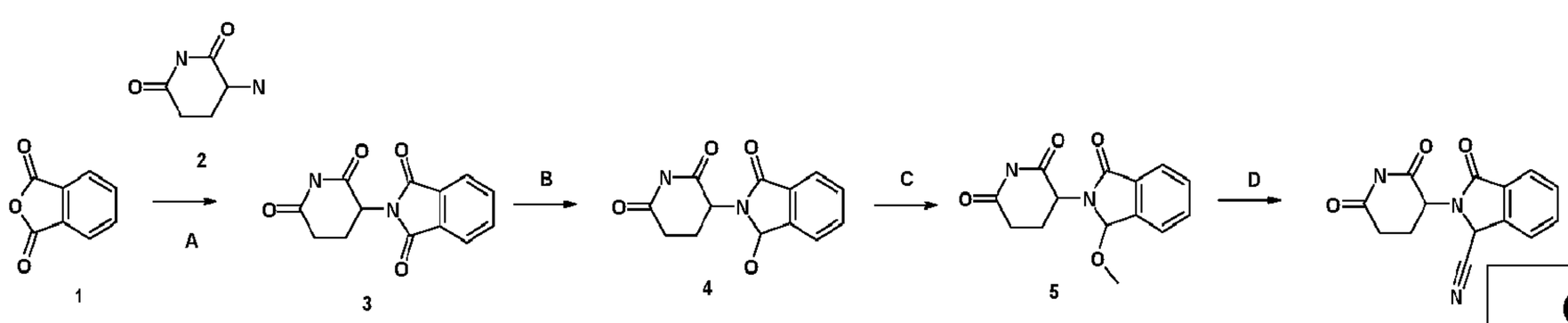


Step A:

[**0679**] This compound was prepared according to General Procedure A for C80392. Yield: 59%.

C39453

[**0680**] Synthesis of target compound was carried out following the scheme given below:



C39453

Step A:

[**0681**] This compound was prepared according to General Procedure A for C64324. Yield: 54%.

Step B:

[**0682**] This compound was prepared according to General Procedure B for C89940. Yield: 58%.

Step C:

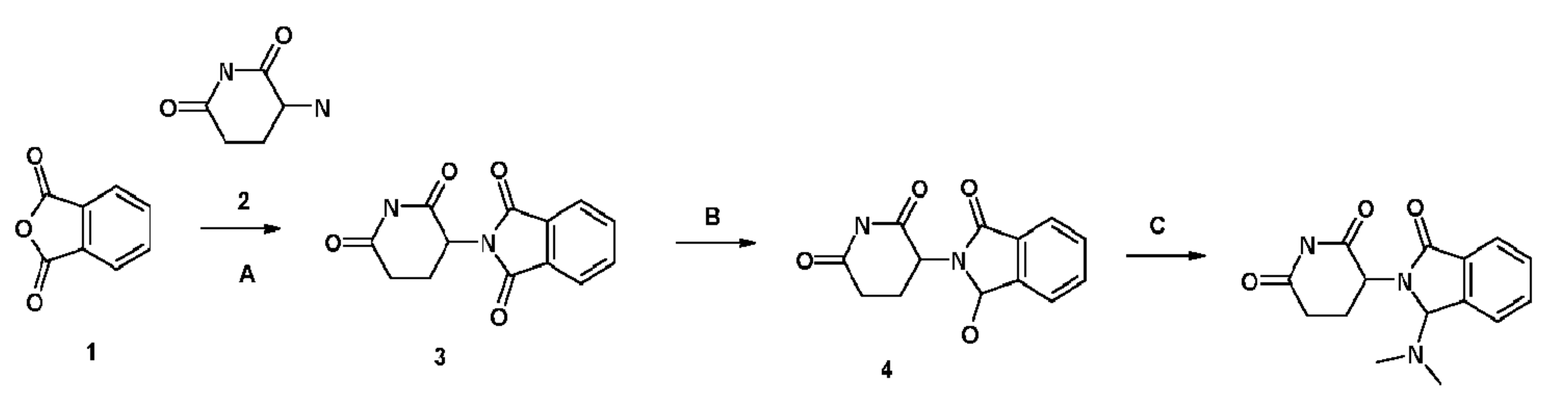
[**0683**] Compound 4 (1 mmol) was dissolved in 50ml of methanol and refluxed for 12h. The solvent was evaporated. The crude residue was purified using HPLC. Yield: 83%.

Step D:

[**0684**] Compound 5 (1 mmol) was dissolved in 10ml of DMF, NaCN (0.5 mmol) was added. The reaction mixture was heated at 65 °C for 10h and refluxed for 12h. The mixture was filtered, washed with methanol (3x10ml) and the solvent was evaporated. The crude residue was purified using HPLC. Yield: 12%.

C10981

[**0685**] Synthesis of target compound was carried out following the scheme given below:



C10981

Step A:

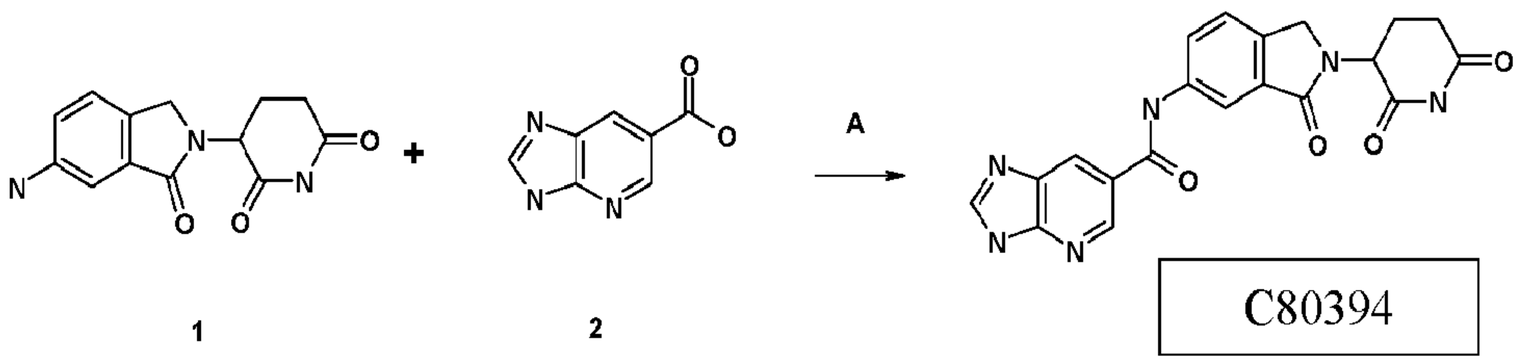
[**0686**] This compound was prepared according to General Procedure A for C64324. Yield: 54%.

Step B:
[0687] This compound was prepared according to General Procedure B for C89940. Yield: 58%.

Step C:
[0688] Compound 4 (1 mmol), dimethylamine 40% water solution (10 mmol) were dissolved in 50 ml toluene and 5mg of TSA was added. The mixture was refluxed with us Din-Stark 18, cooled, solvent was evaporated. The crude residue was purified using HPLC. Yield: 34%.

C80394

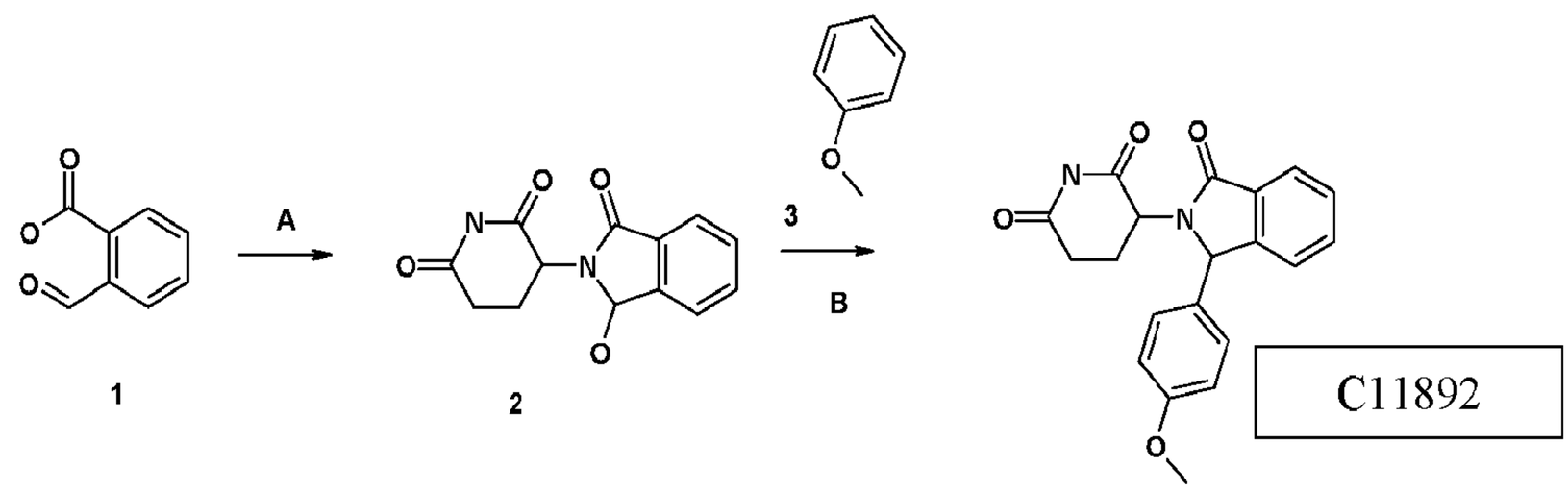
[0689] Synthesis of target compound was carried out following the scheme given below:



Step A:
[0690] This compound was prepared according to General Procedure A for C80392. Yield: 60%.

C11892

[0691] Synthesis of target compound was carried out following the scheme given below:

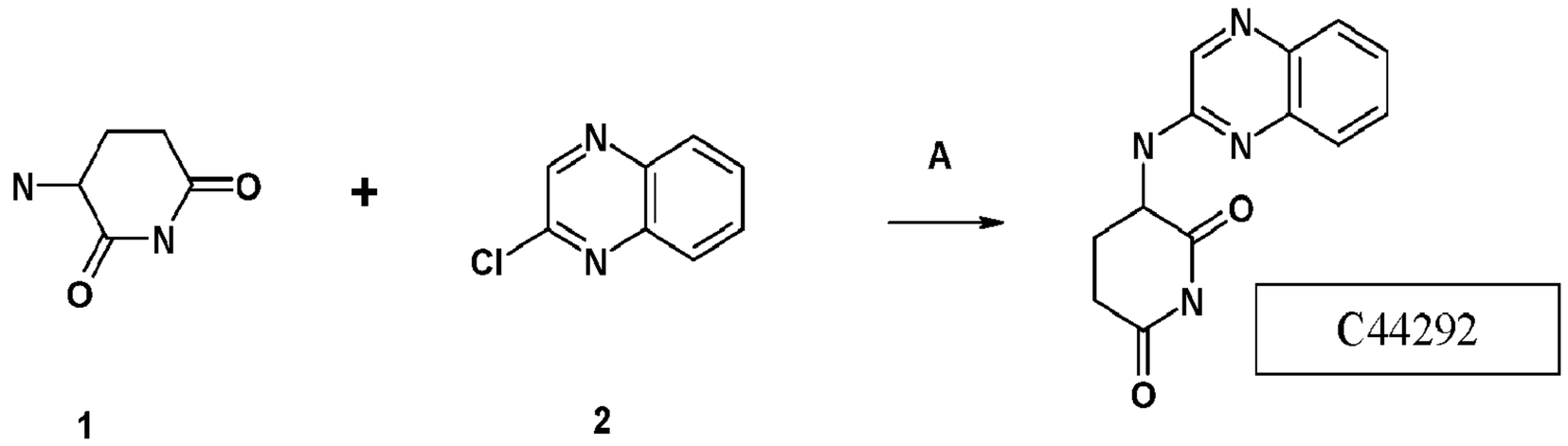


Step A:
[0692] This compound was prepared according to General Procedure A for C80392. Yield: 39%.

Step B:
[0693] This compound was prepared according to General Procedure B for C49713. Yield: 62%.

C44292

[0694] Synthesis of target compound was carried out following the scheme given below:



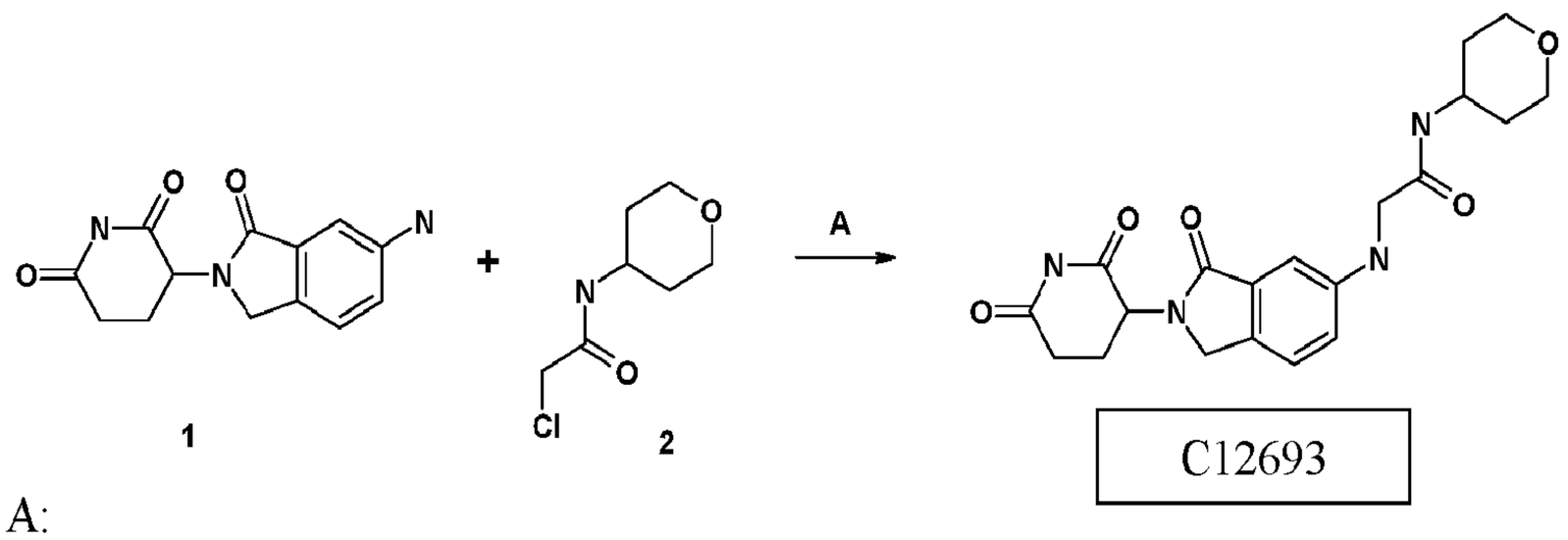
1 2

Step A:

[0695] This compound was prepared according to General Procedure B for C80370. Yield: 18%.

C12693

[0696] Synthesis of target compound was carried out following the scheme given below:



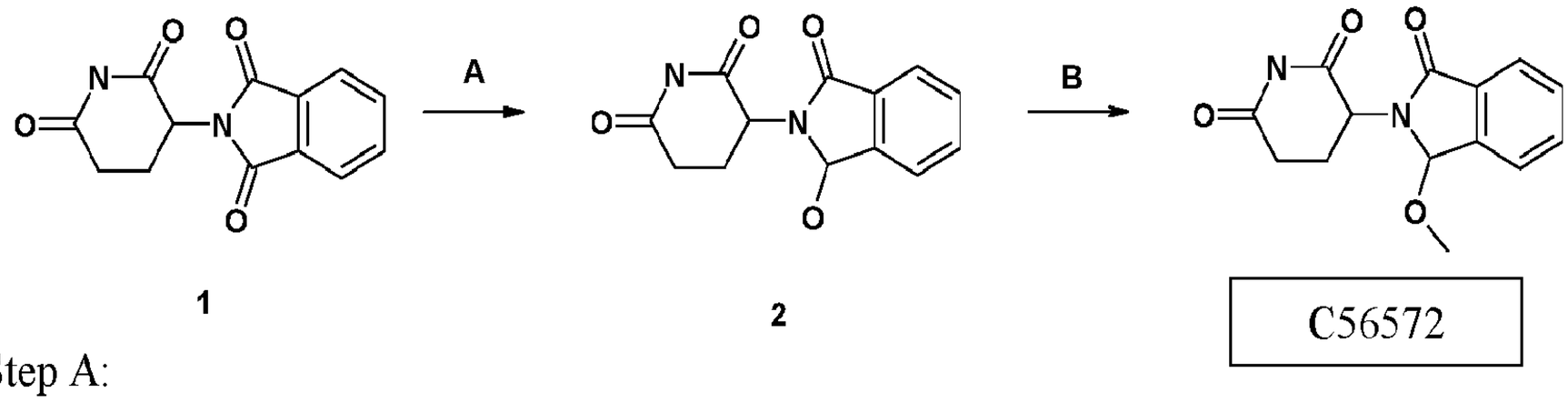
1 2

Step A:

[0697] This compound was prepared according to General Procedure A for C12584. Yield: 26%.

C56572

[0698] Synthesis of target compound was carried out following the scheme given below:



1 2

Step A:

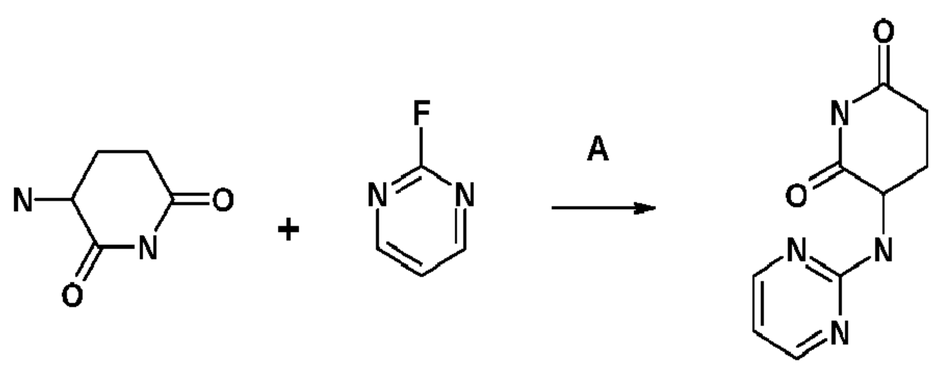
[0699] This compound was prepared according to General Procedure B for C89940. Yield: 58%.

Step B:

[0700] Compound 4 (1 mmol) was dissolved in 50ml of methanol and refluxed for 12h. The solvent was evaporated. The crude residue was purified using HPLC. Yield: 83%.

C55468

[0701] Synthesis of target compound was carried out following the scheme given below:



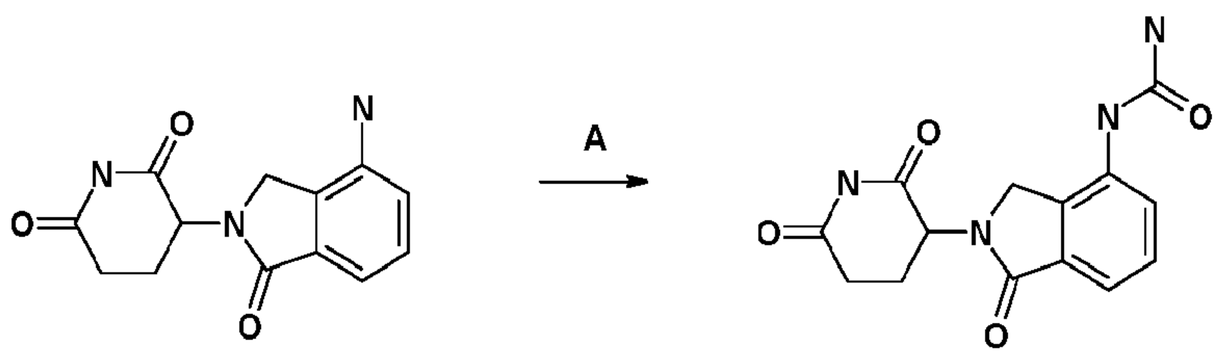
1 2 C55468

Step A:

[0702] This compound was prepared according to General Procedure A for C80370. Yield: 38%.

C29490

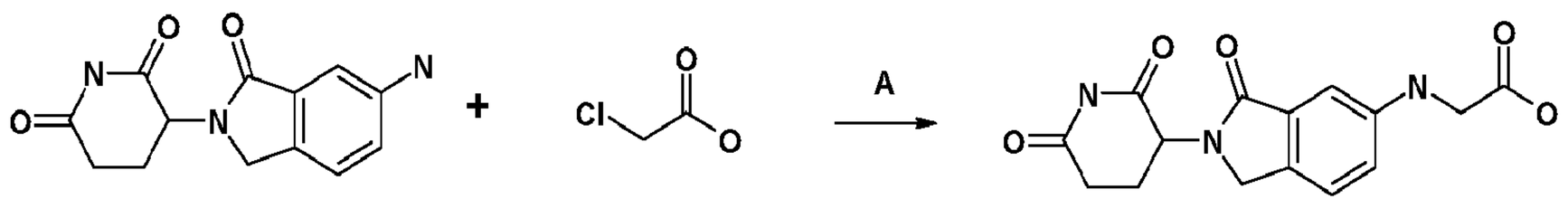
[0703] Synthesis of target compound was carried out following the scheme given below:



1 C29490

C47997

[0704] Synthesis of target compound was carried out following the scheme given below:



1 2 C47997

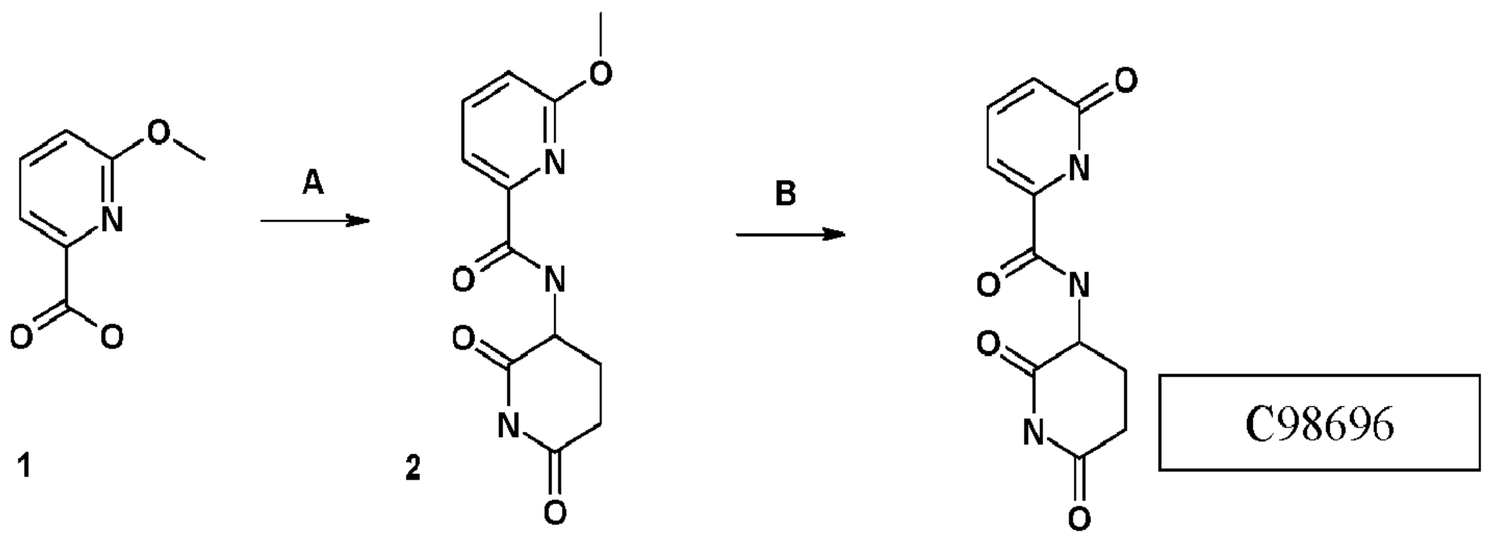
Step A:

[0705] This compound was prepared according to General Procedure A for C12584. Yield: 14%.

[0706] In this case we used additional amount of HOAc (3eq) before separation of the product from reaction mixture.

C98696

[0707] Synthesis of target compound was carried out following the scheme given below:



Step A:

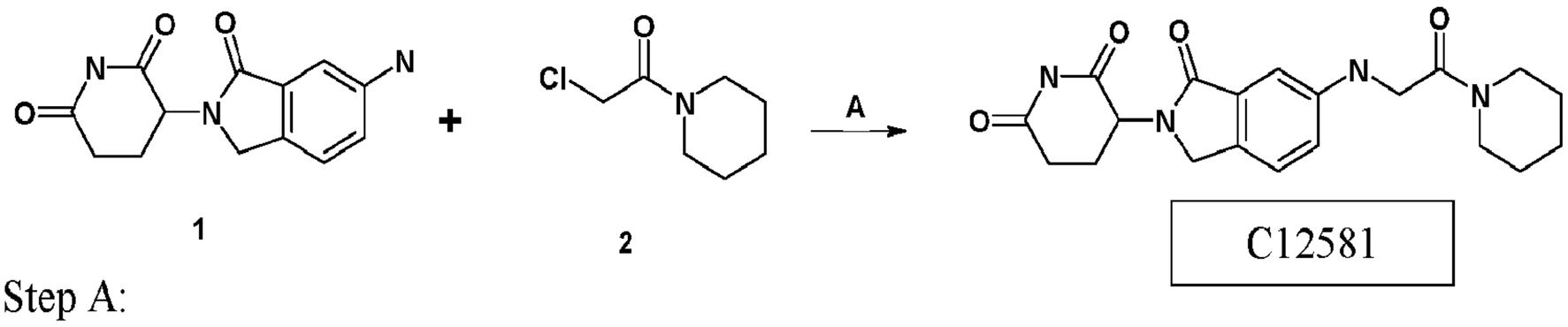
[0708] This compound was prepared according to General Procedure A for C80392. Yield: 72%.

Step B:

[0709] Compound 2 (1 mmol) was dissolved in 10ml of TFA and mixture was heated at 80 °C with stirring for 12h. The reaction mixture was cooled, filtered and the solvent was evaporated. The crude residue was purified using HPLC. Yield: 29%.

C12581

[0710] Synthesis of target compound was carried out following the scheme given below:



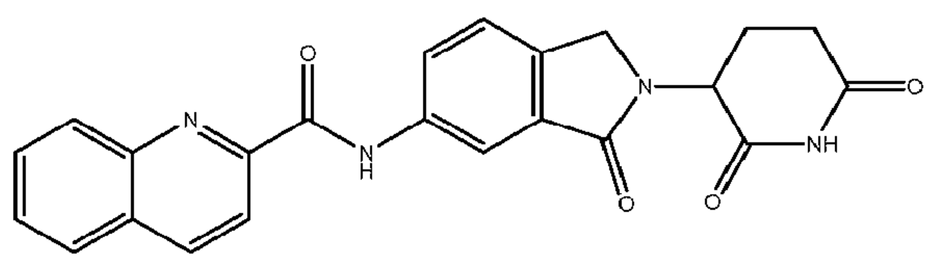
Step A:

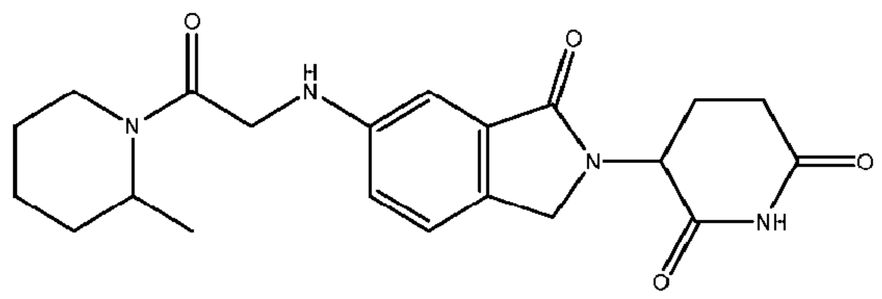
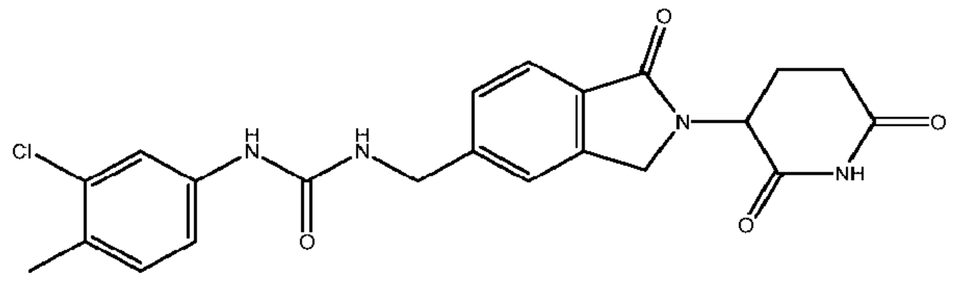
[0711] This compound was prepared according to General Procedure A for C12584. Yield: 22%.

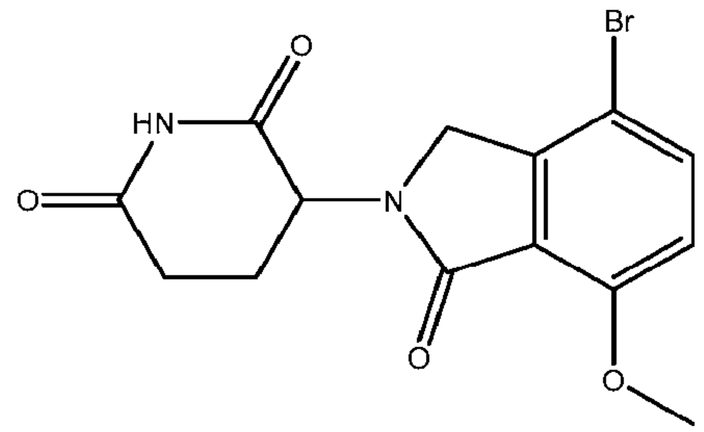
Example 4: Test Results

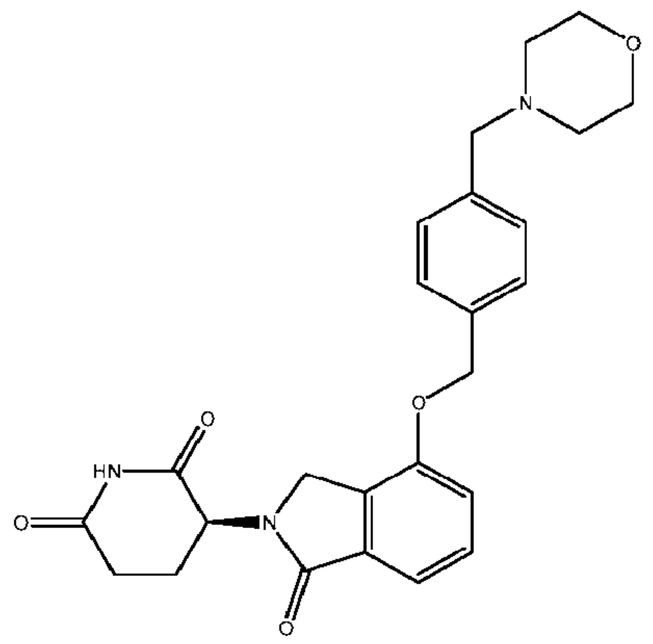
[0712] The following compounds were tested in the Competition Assay and/or Recruitment Assay described herein, and the results are listed below.

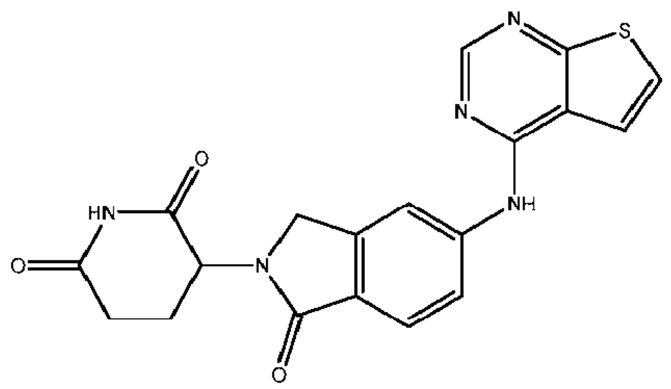
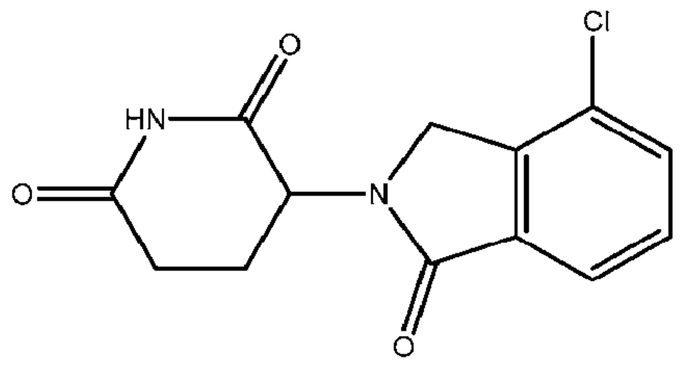
Table 1: IC50 Competition values were determined using the protocol and reagents described in Example 1. EC50 values for recruitment of IKZF1, ASS1 and SALL4 were determined using the protocols and reagents described in Example 2. Recruitment assessment was made for each compound, where TRUE = observation of recruitment of any tested substrate at any tested compound concentration from among IKZF1, ASS1 and SALL4, and FALSE = no observed recruitment of any tested substrate at any tested compound concentration from among IKF1, ASS1 and SALL4. NA represents instances where no substrate recruitment was observed at any tested concentration , >> represents instances were an EC50 curve could not be calculated as values did not reach a plateau over the measured concentration range, and << represents instances where an EC50 could not be calculated because a value was read above 50% of control at the first concentration tested for the compound (13.7 nM).

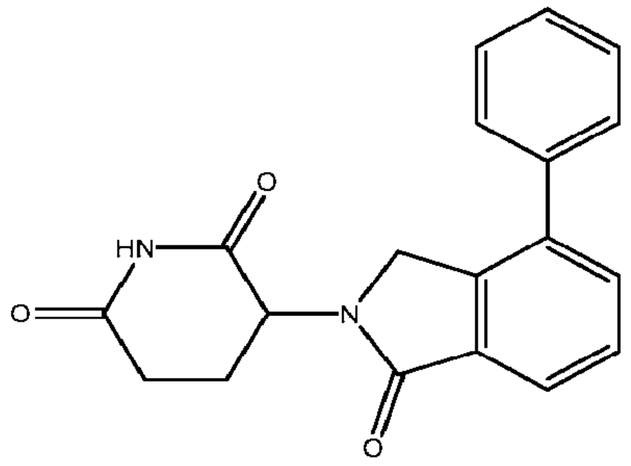
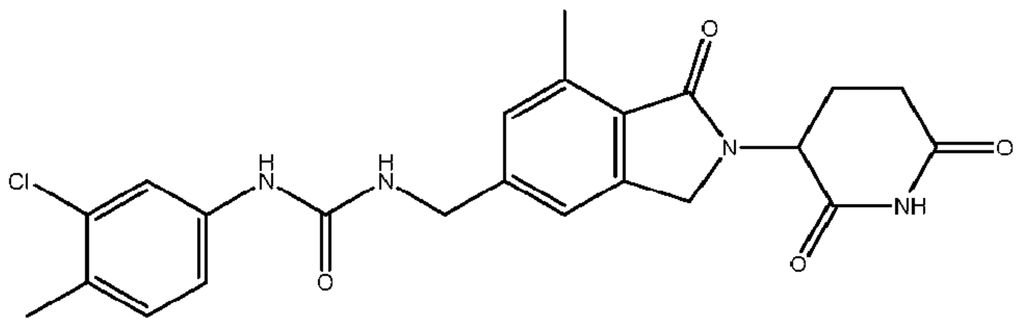
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C80392	 N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]quinoline-2-carboxamide	2.05303E-11	NA	NA	NA	FALSE

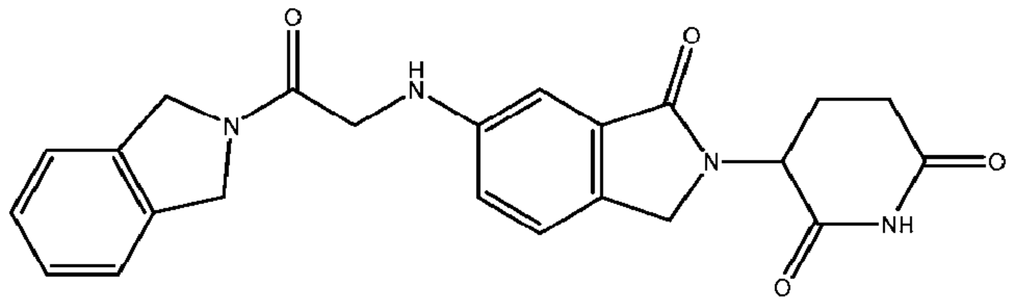
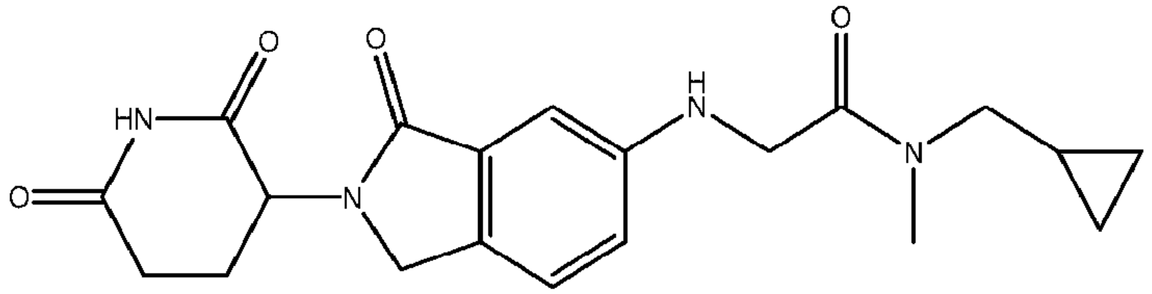
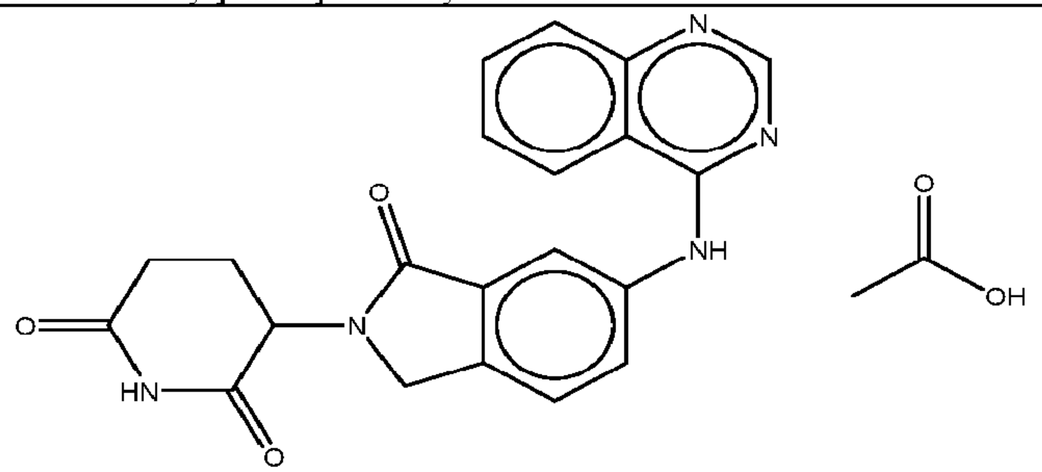
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C12584	 3-[6-[[2-(2-methyl-1-piperidyl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	7.91364E-11	NA	NA	NA	FALSE
CC-885	 1-(3-chloro-4-methyl-phenyl)-3-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]methyl]urea	4.65169E-10	<<	8.01E-08	NA	TRUE
C74668		1.88601E-09	NA	NA	NA	FALSE

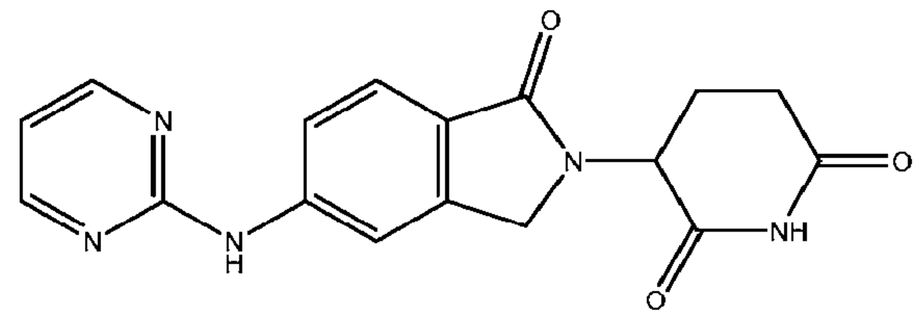
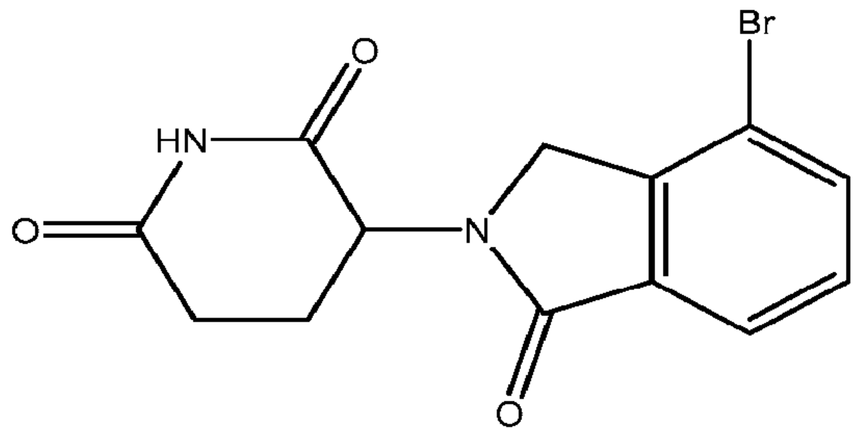
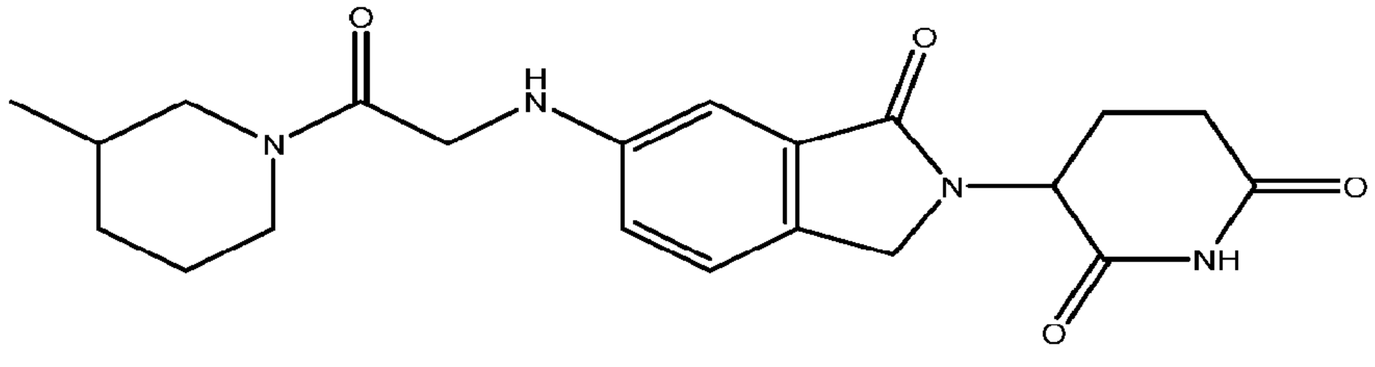
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
	 3-(4-bromo-7-methoxy-1-oxo-isoindolin-2-yl)piperidine-2,6-dione					

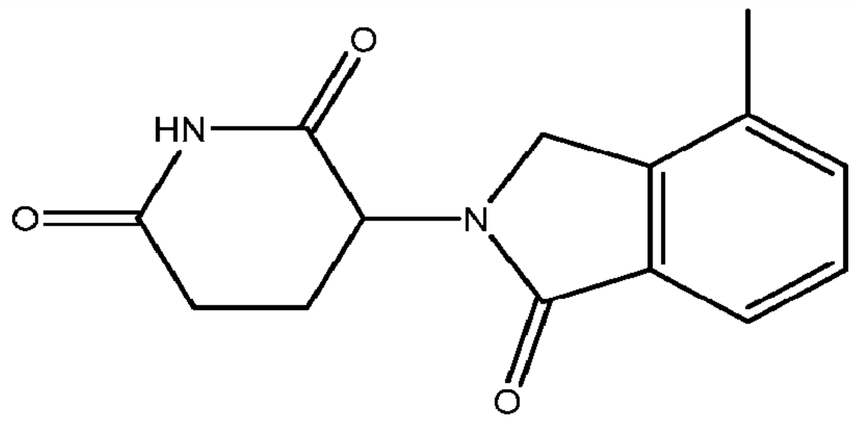
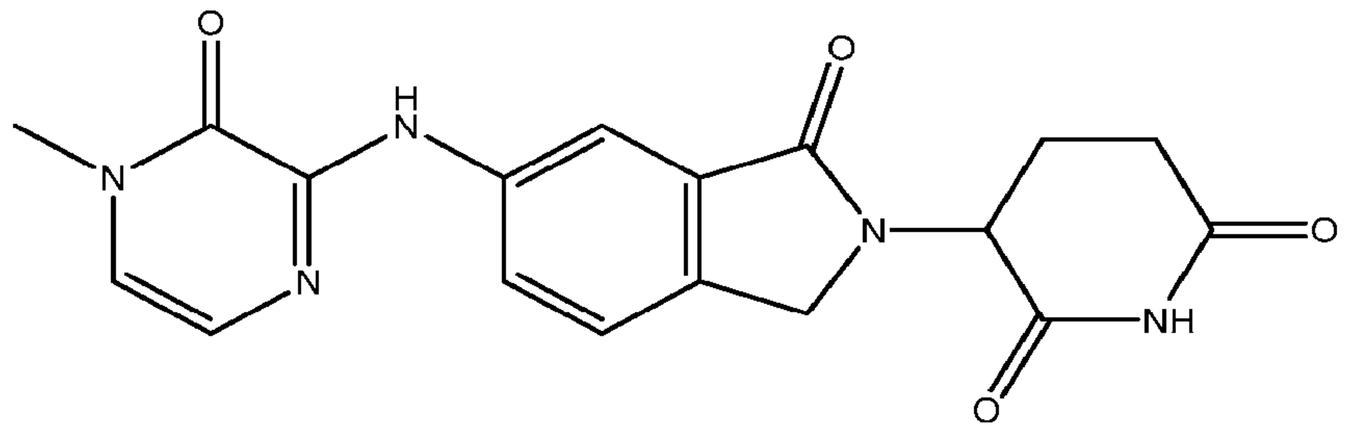
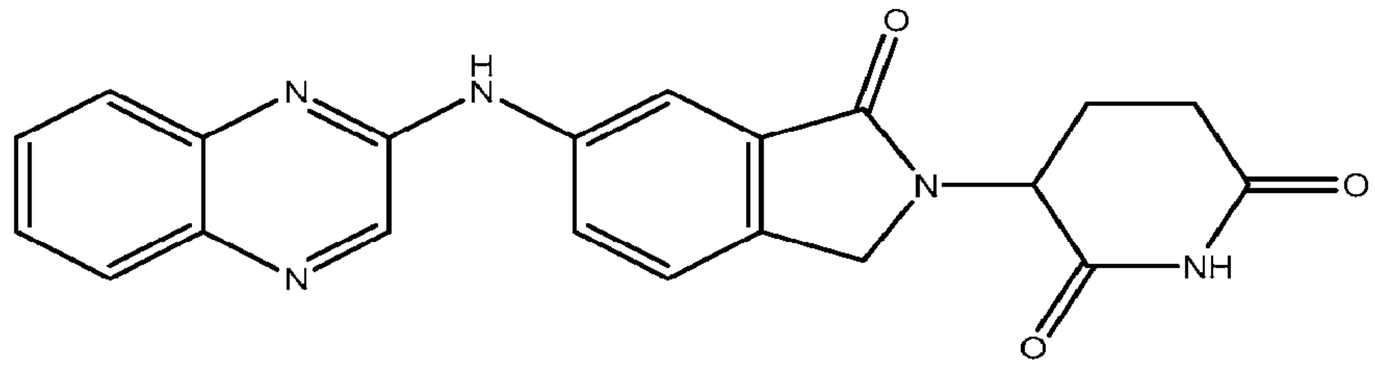
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
CC-220	 (3S)-3-[4-[[4-(morpholinomethyl)phenyl]methoxy]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	1.00796E-08	<<	6.24E-08	<<	TRUE

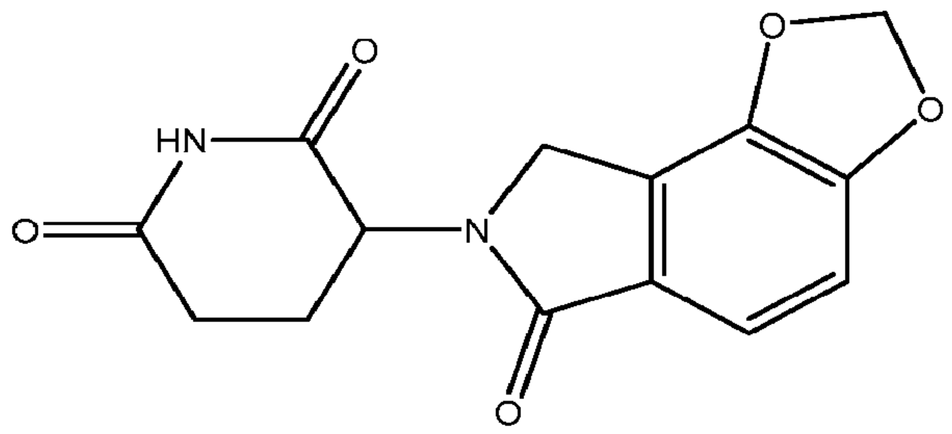
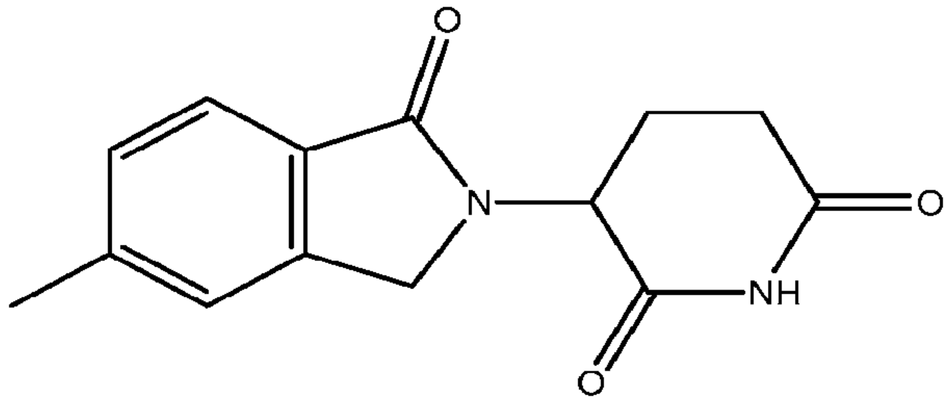
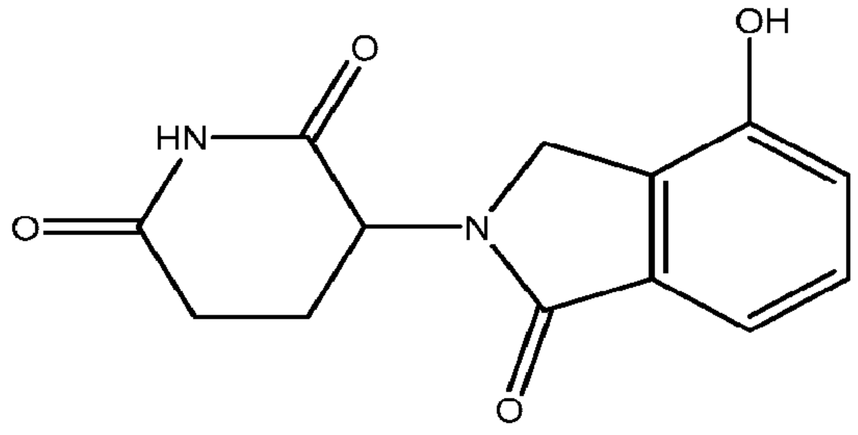
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C80370	 3-[1-oxo-5-(thieno[2,3-d]pyrimidin-4-ylamino)isoindolin-2-yl] piperidine-2,6-dione	1.09103E-08	NA	NA	NA	FALSE
C24031	 3-(4-chloro-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	1.14592E-08	5.87E-08	2.59E-07	<<	TRUE

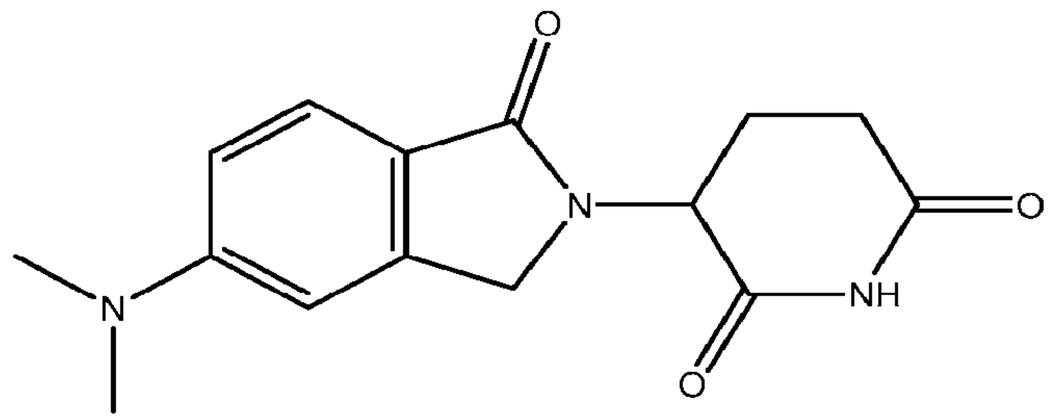
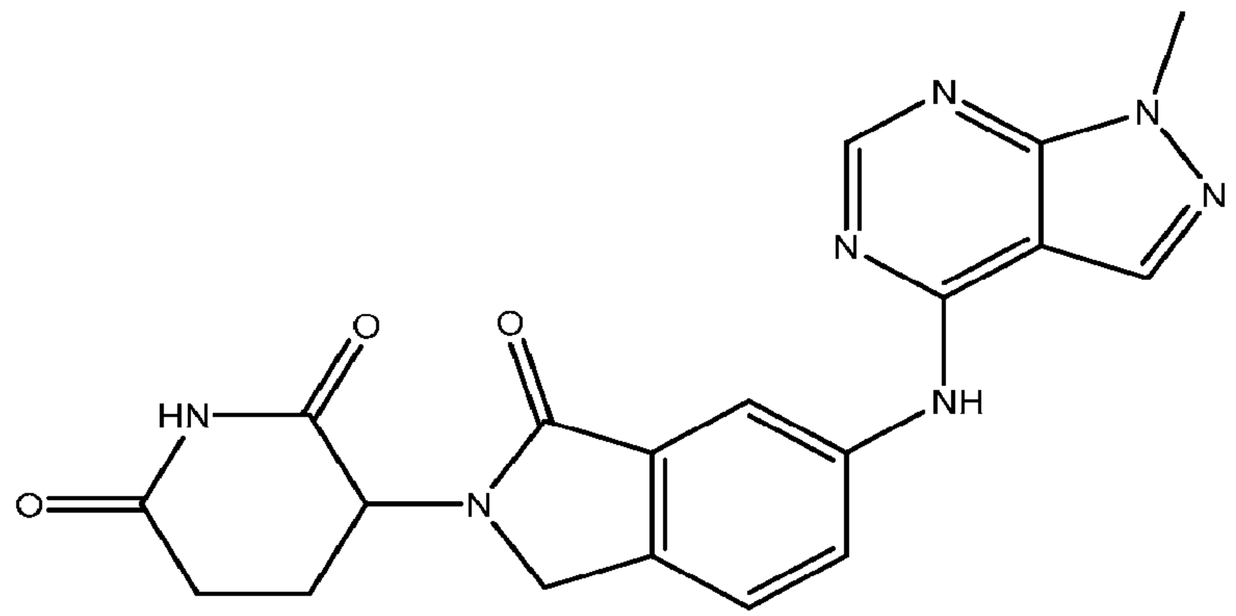
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C48014	 3-(1-oxo-4-phenyl-isoindolin-2-yl)piperidine-2,6-dione	2.43314E-08	1.24E-06	9.21E-07	6.21E-08	TRUE
C58181	 1-(3-chloro-4-methyl-phenyl)-3-[[2-(2,6-dioxo-3-piperidyl)-7-methyl-1-oxo-isoindolin-5-yl]methyl]urea	2.91268E-08	NA	>>	NA	TRUE

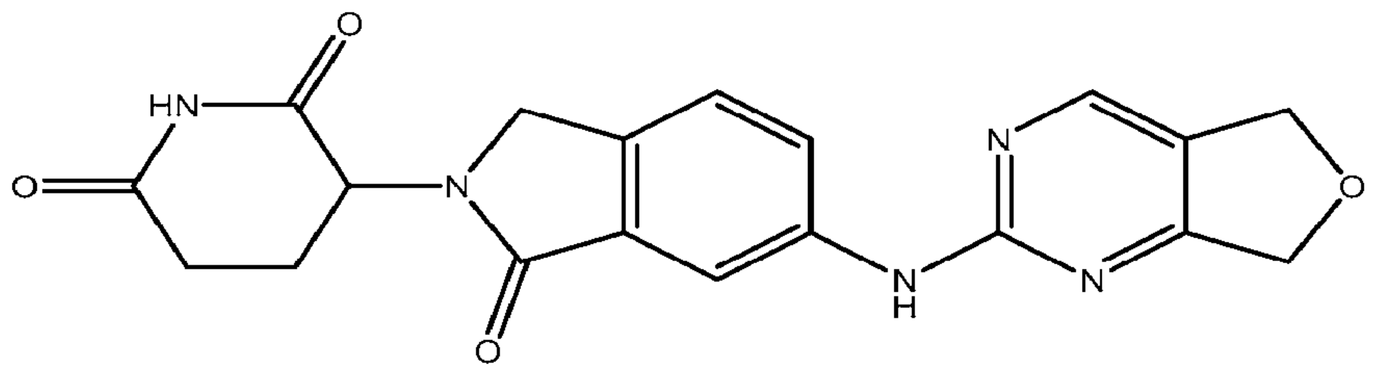
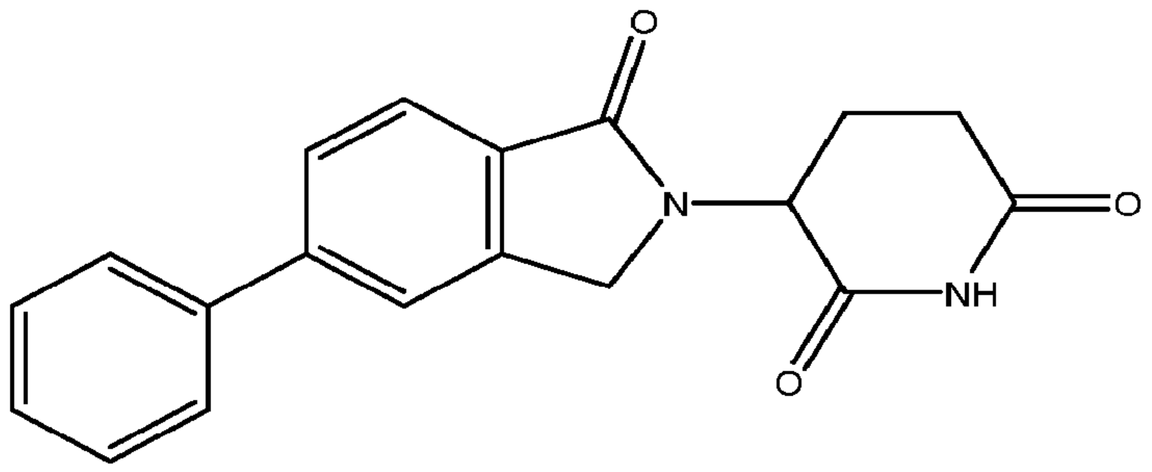
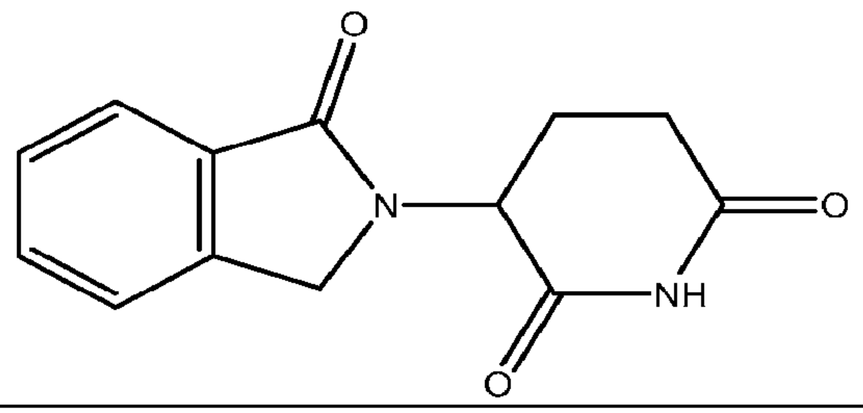
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C95330	 3-[6-[(2-isoindolin-2-yl-2-oxo-ethyl)amino]-1-oxo-isoindolin-2-yl] piperidine-2,6-dione	3.0027E-08	NA	NA	NA	FALSE
C95338	 N-(cyclopropylmethyl)-2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-methyl-acetamide	3.20528E-08	NA	NA	NA	FALSE
C80382 acetic acid salt	 acetic acid;3-[1-oxo-6-(quinazolin-4-ylamino)isoindolin-2-yl]piperidine-2,6-dione	3.34174E-08	NA	NA	NA	FALSE

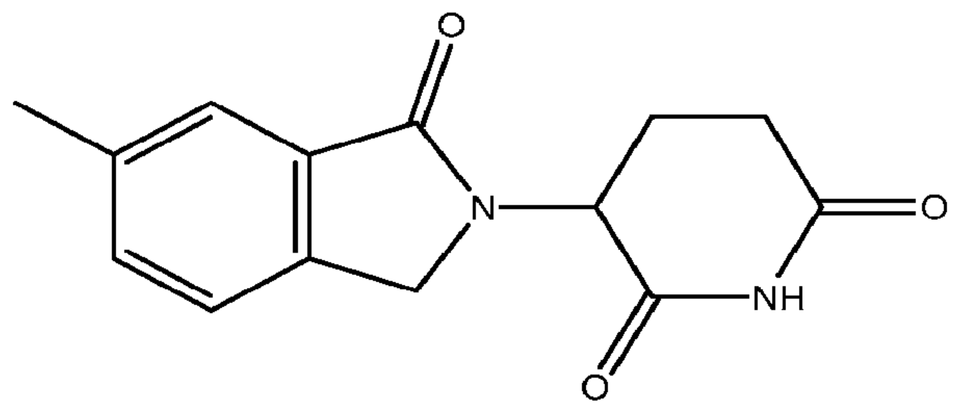
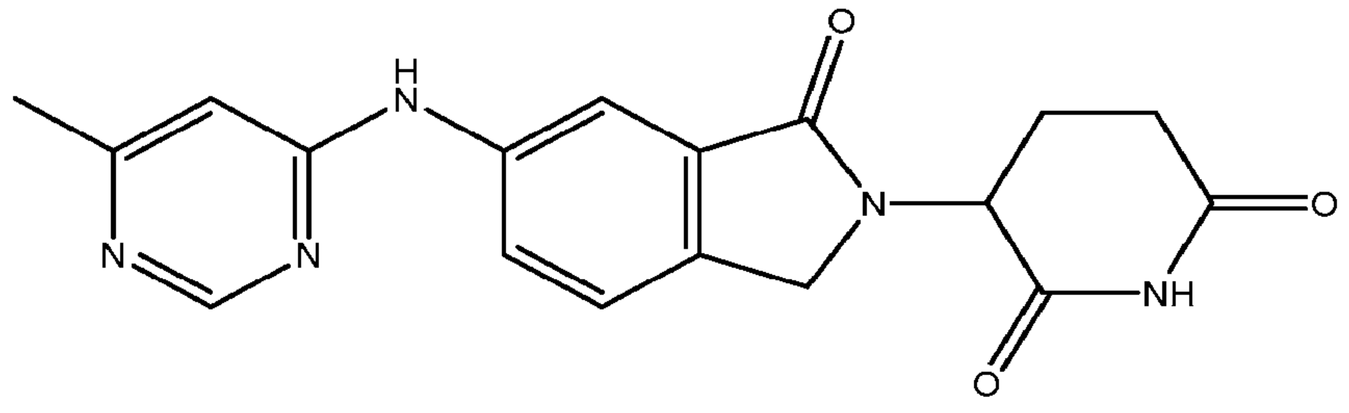
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1 (M)	EC50_SALL4(M)	Recruitment Assessment
C80369	 3-[1-oxo-5-(pyrimidin-2-ylamino)isoindolin-2-yl]piperidine-2,6-dione	4.15416E-08	>>	1.29E-06	NA	TRUE
C47935	 3-(4-bromo-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	4.53754E-08	1.62E-07	6.77E-07	2.70E-08	TRUE
C12583	 3-[6-[[2-(3-methyl-1-piperidyl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	4.9194E-08	NA	NA	NA	FALSE

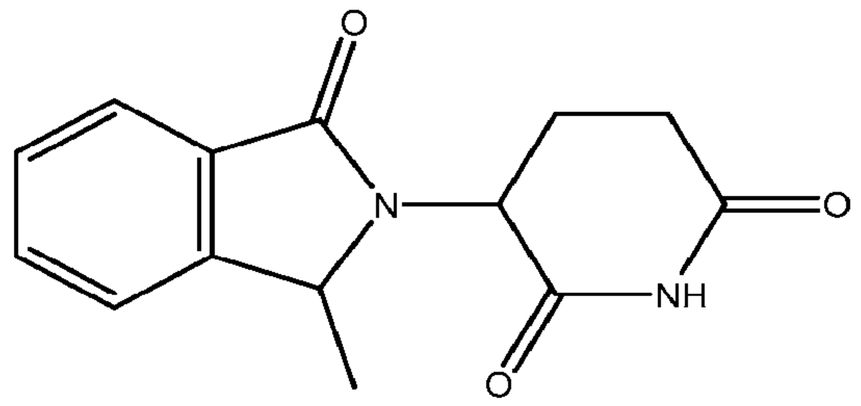
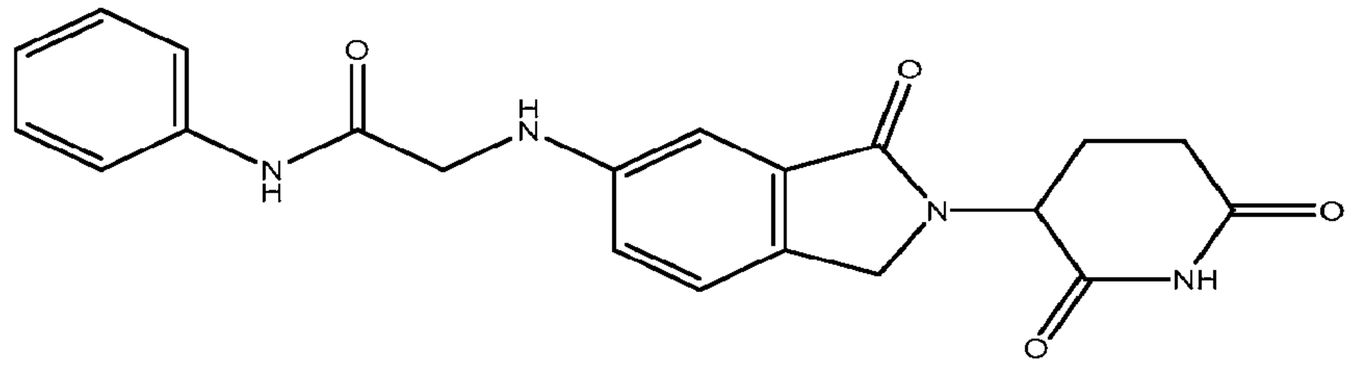
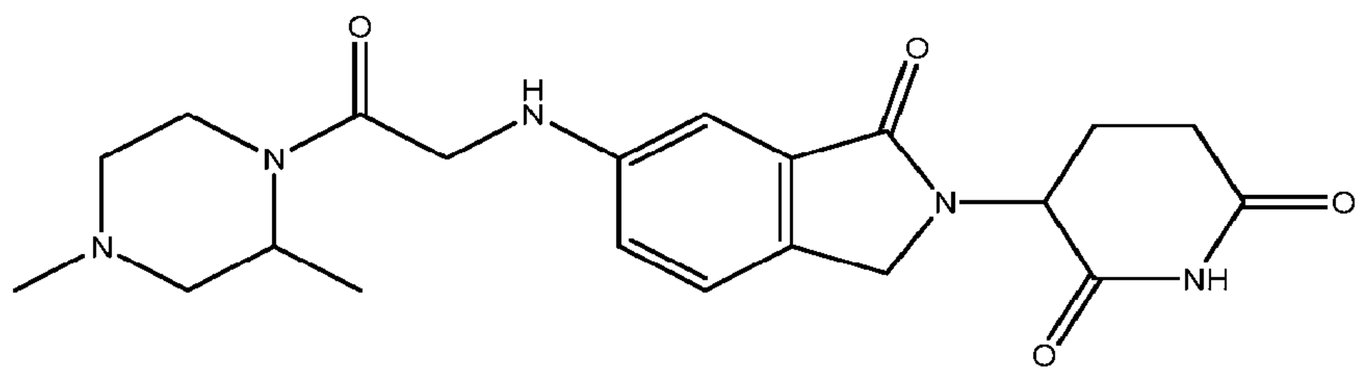
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C28558	 3-(4-methyl-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	5.04383E-08	7.74E-08	3.68E-07	<<	TRUE
C80387	 3-[6-[(4-methyl-3-oxo-pyrazin-2-yl)amino]-1-oxo-isoindolin-2-yl] piperidine-2,6-dione	5.41939E-08	NA	NA	NA	FALSE
C80386	 3-[1-oxo-6-(quinoxalin-2-ylamino)isoindolin-2-yl]piperidine-2,6-dione	6.73708E-08	NA	NA	NA	FALSE

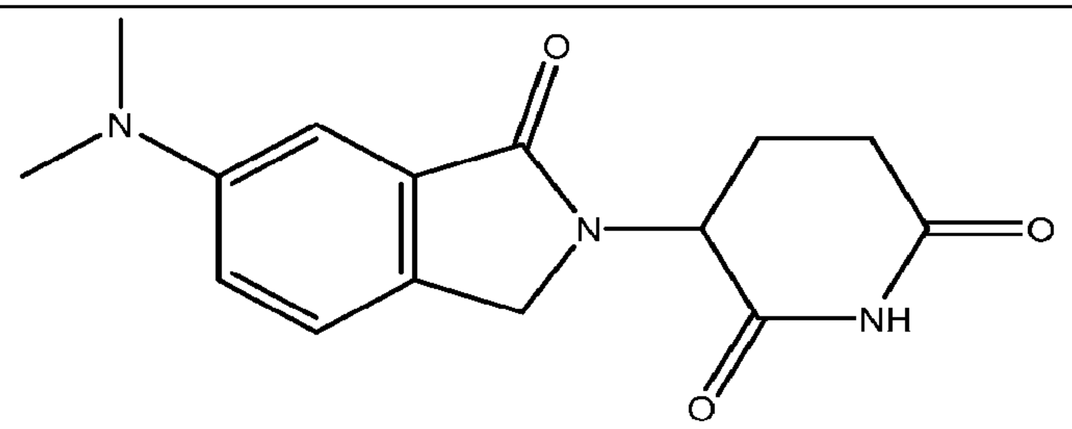
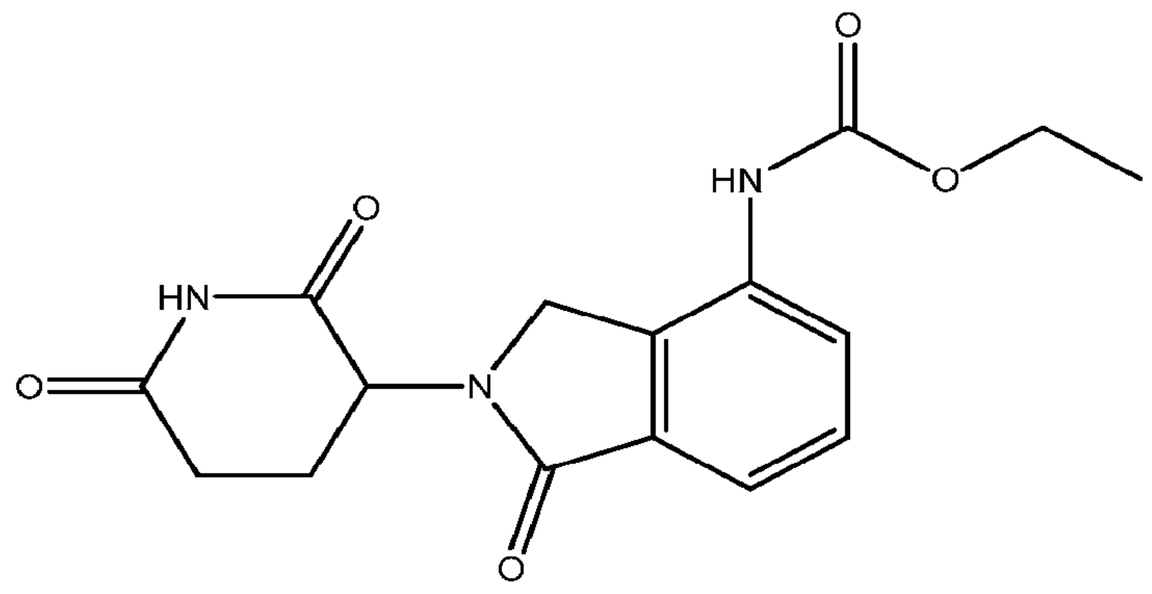
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C67858	 3-(6-oxo-8H-[1,3]dioxolo[4,5-e]isoindol-7-yl)piperidine-2,6-dione	1.06453E-07	5.69E-07	8.84E-07	2.93E-08	TRUE
C28577	 3-(5-methyl-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	1.12883E-07	1.61E-06	6.53E-07	<<	TRUE
C89676	 3-(4-hydroxy-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	1.26858E-07	1.13E-07	8.32E-07	<<	TRUE

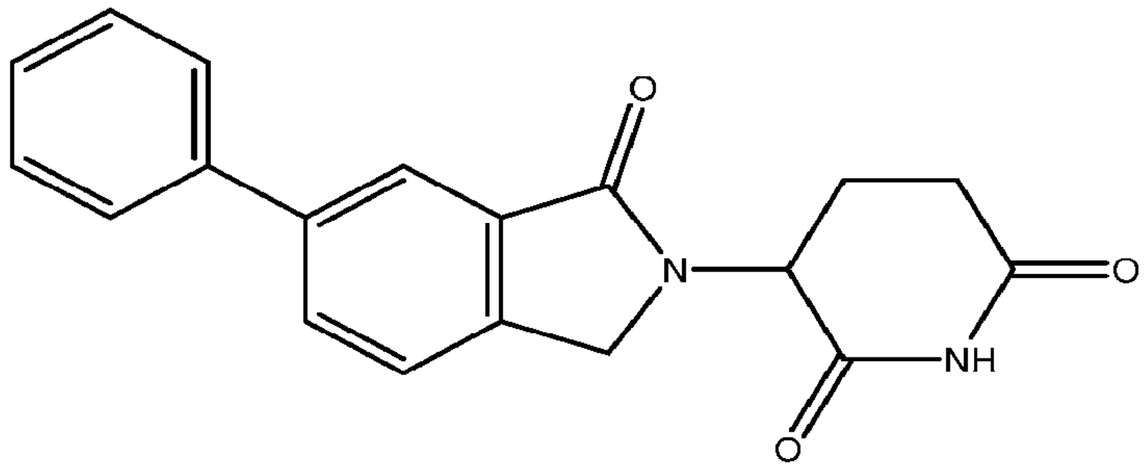
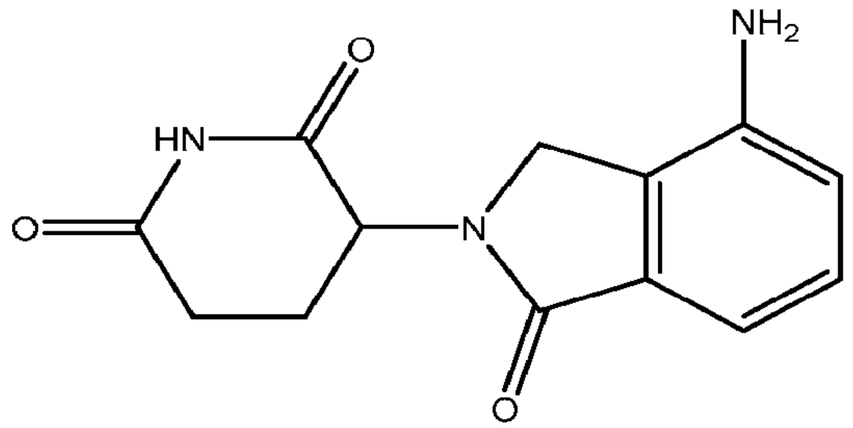
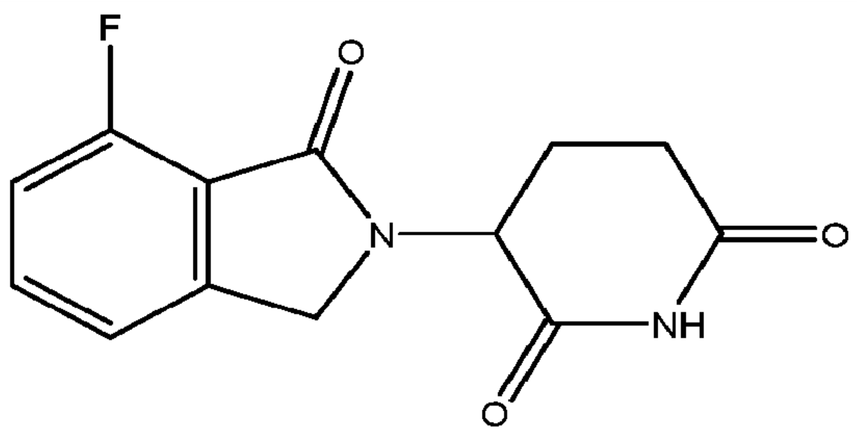
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C98103	 3-[5-(dimethylamino)-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	1.44886E-07	1.29E-06	>>	<<	TRUE
C80383	 3-[6-[(1-methylpyrazolo[3,4-d]pyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	1.47987E-07	NA	NA	NA	FALSE

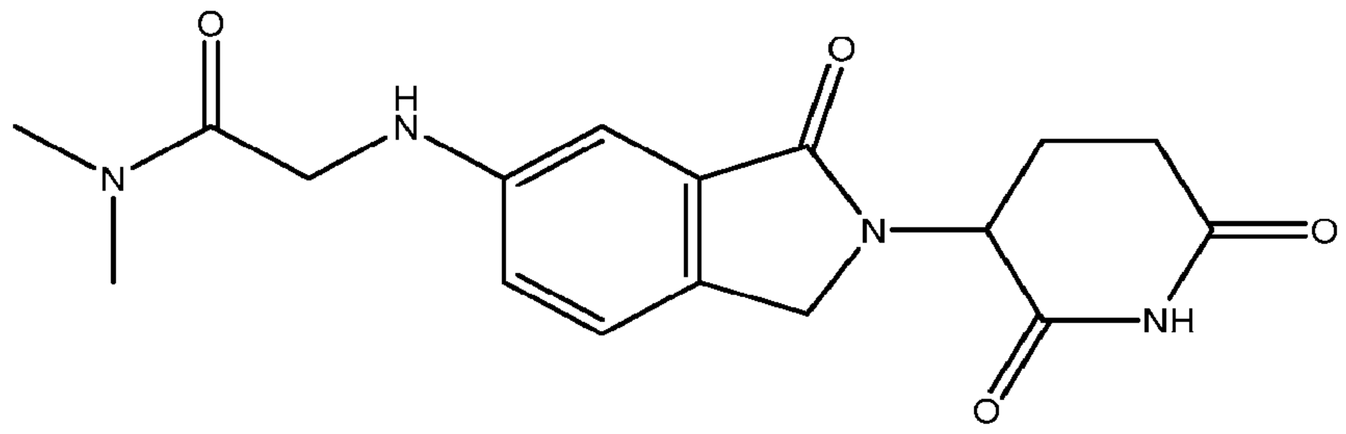
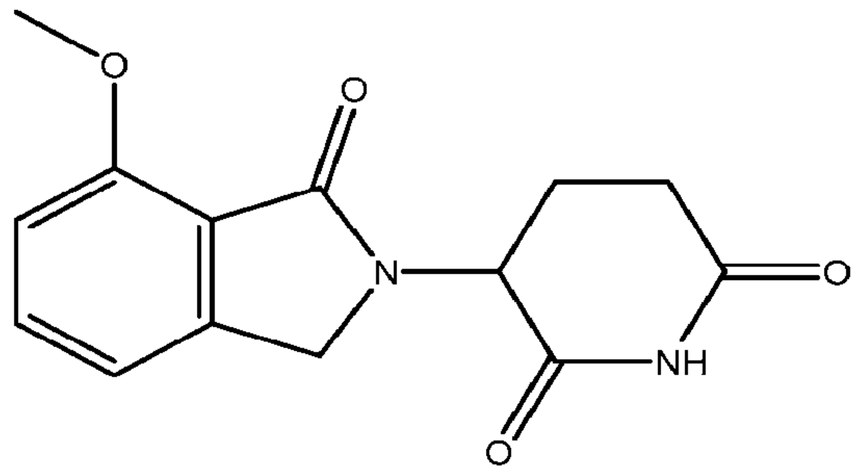
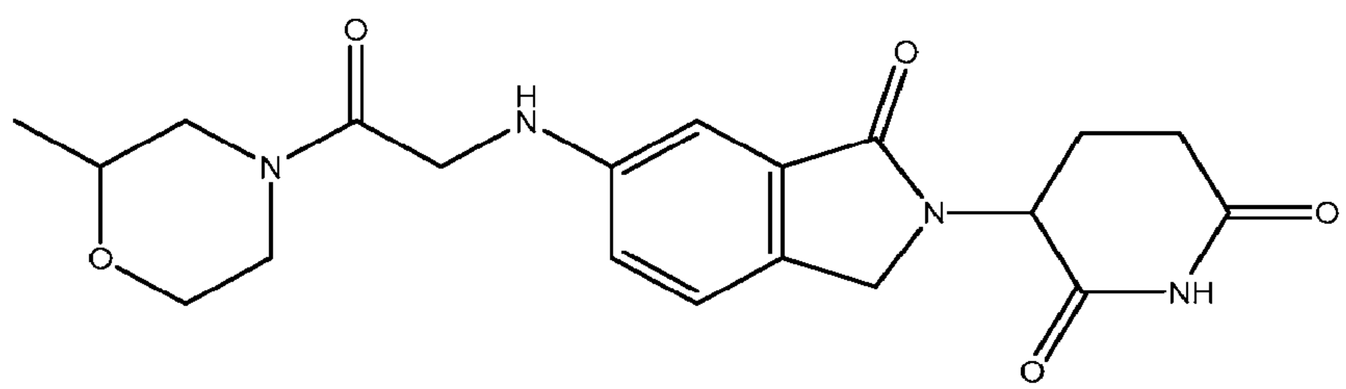
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C80391	 3-[6-(5,7-dihydrofuro[3,4-d]pyrimidin-2-ylamino)-1-oxo-isoindolin-2-yl] piperidine-2,6-dione	1.62797E-07	>>	NA	1.52E-07	TRUE
C48016	 3-(1-oxo-5-phenyl-isoindolin-2-yl)piperidine-2,6-dione	1.73495E-07	>>	NA	1.22E-07	TRUE
C05955		1.7519E-07	5.21E-07	1.55E-06	<<	TRUE

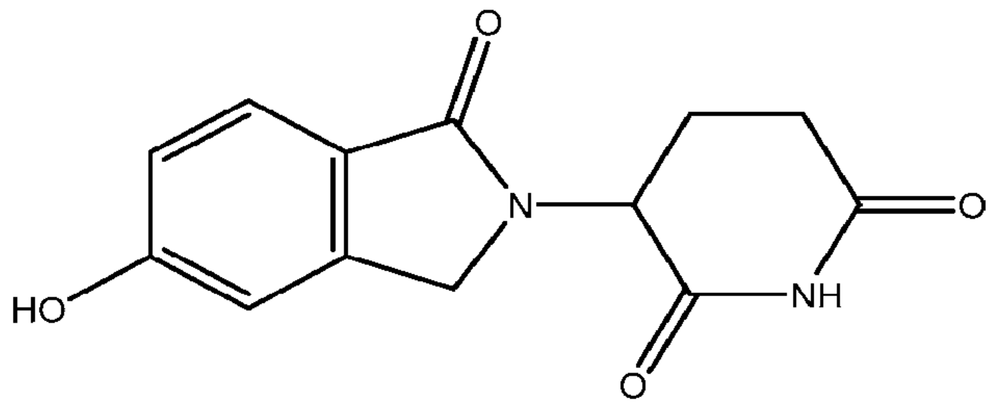
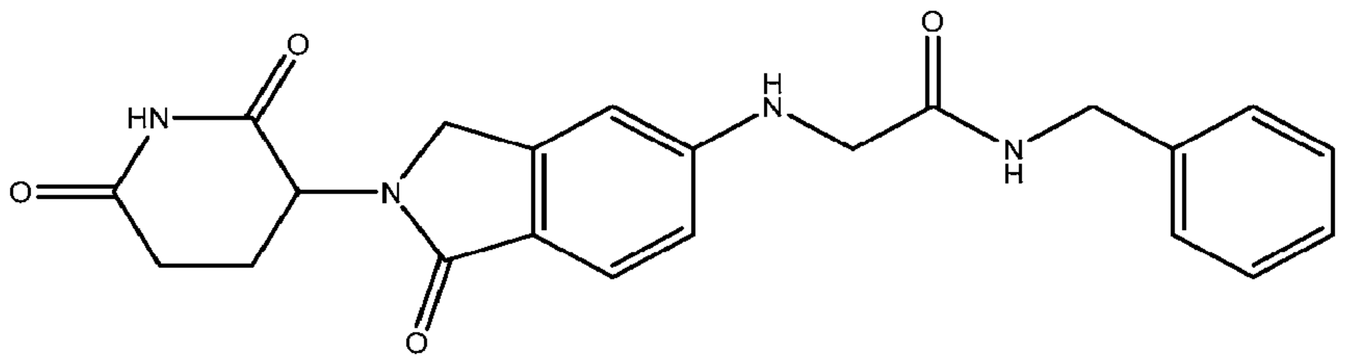
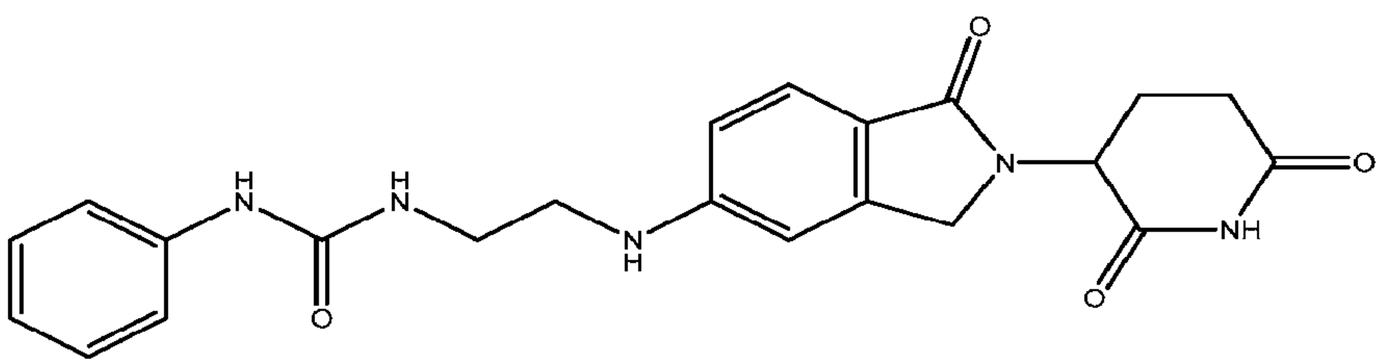
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
	3-(1-oxoisoindolin-2-yl)piperidine-2,6-dione					
C28620	 3-(6-methyl-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	1.78223E-07	>>	NA	2.70E-07	TRUE
C80384	 3-[6-[(6-methylpyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl] piperidine-2,6-dione	1.78827E-07	NA	NA	NA	FALSE

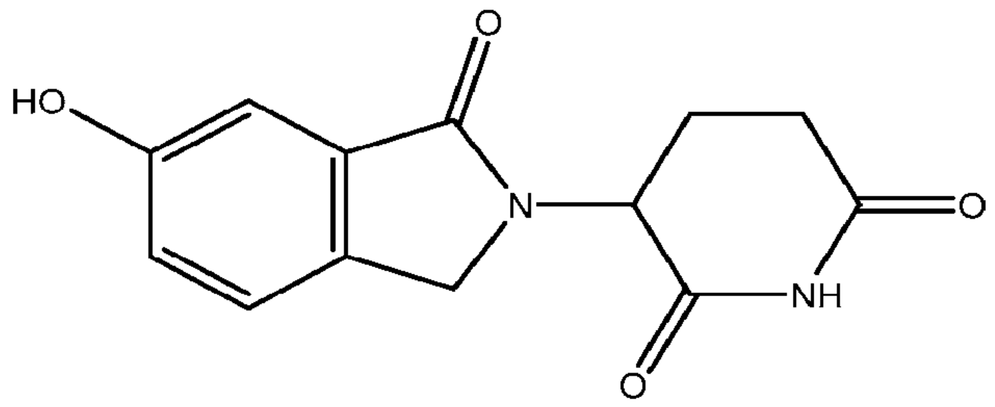
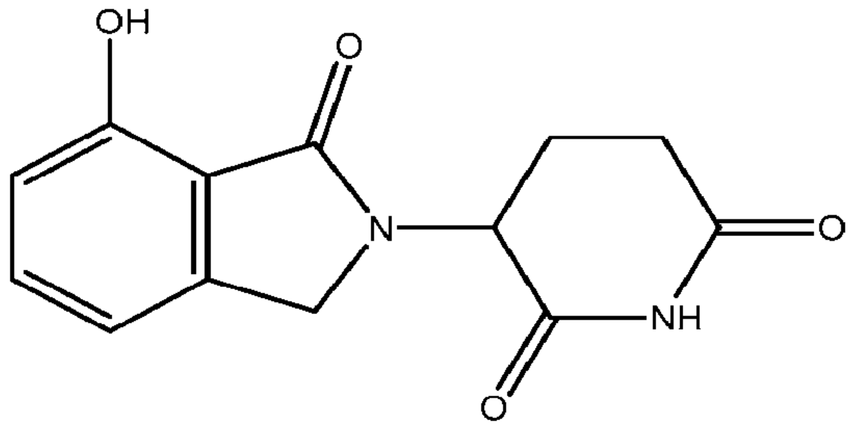
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C51383	 3-(1-methyl-3-oxo-isoindolin-2-yl)piperidine-2,6-dione	1.90194E-07	1.52E-06	1.70E-06	5.93E-08	TRUE
C84965	 2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-phenyl-acetamide	1.99835E-07	>>	NA	NA	TRUE
C12595	 3-[6-[[2-(2,4-dimethylpiperazin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	2.07712E-07	NA	NA	NA	FALSE

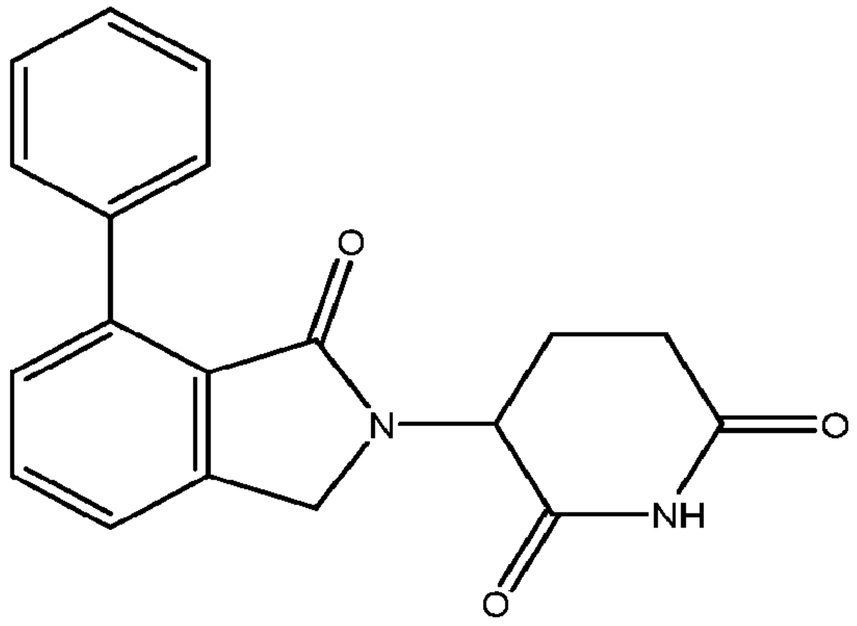
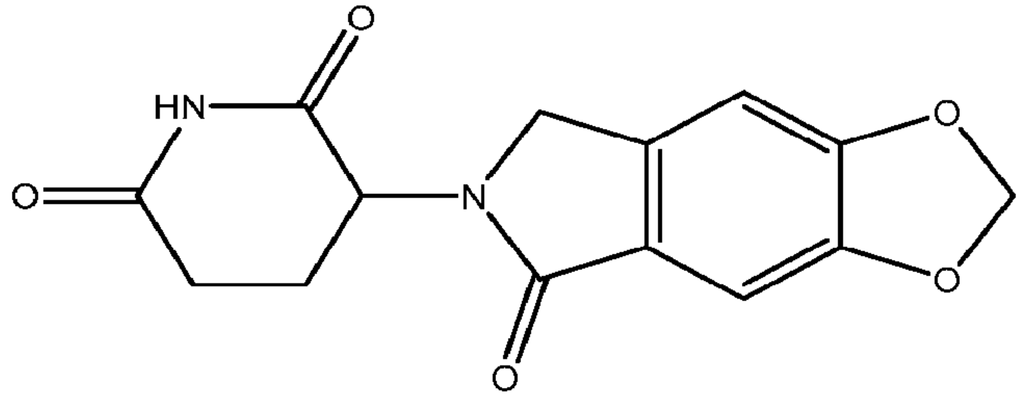
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C96622	 3-[6-(dimethylamino)-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	2.13914E-07	NA	NA	NA	FALSE
C22622	 ethyl N-[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-4-yl]carbamate	2.25027E-07	>>	>>	1.21E-07	TRUE

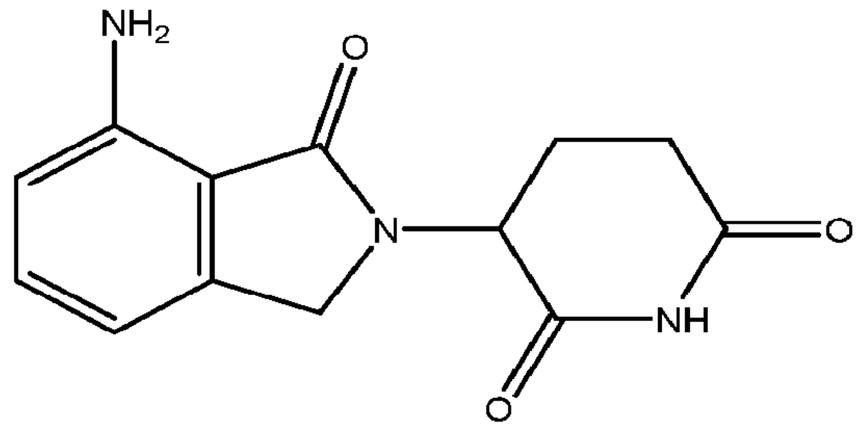
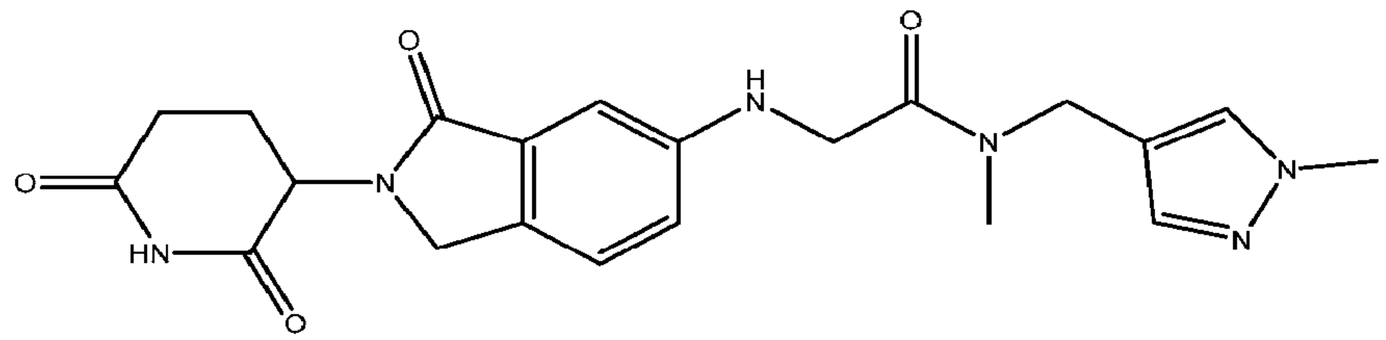
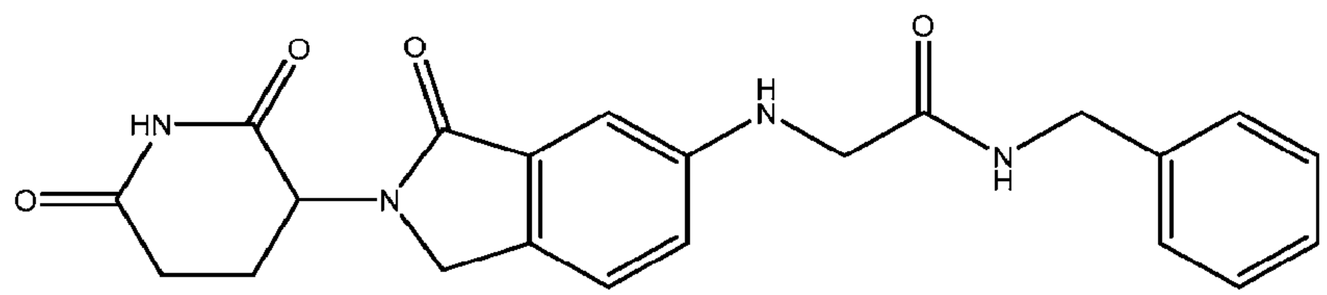
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C48018	 3-(1-oxo-6-phenyl-isoindolin-2-yl)piperidine-2,6-dione	2.28101E-07	>>	NA	3.95E-07	TRUE
LEN	 3-(4-amino-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	2.43162E-07	6.22E-07	1.05E-06	1.33E-07	TRUE
C23066	 3-(7-fluoro-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	2.48406E-07	>>	>>	8.82E-08	TRUE

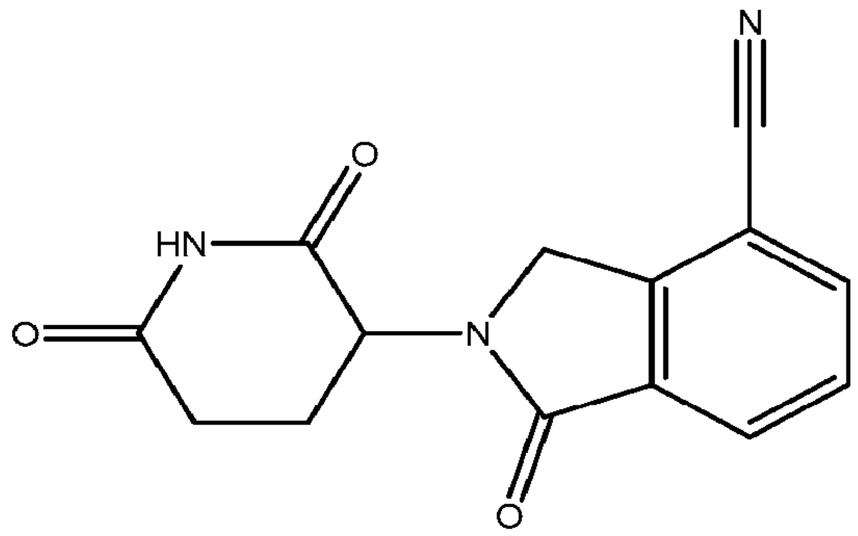
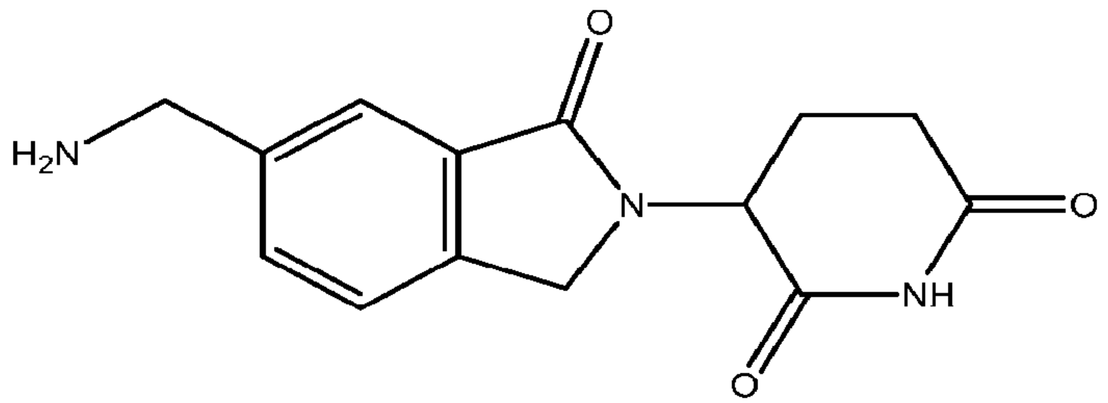
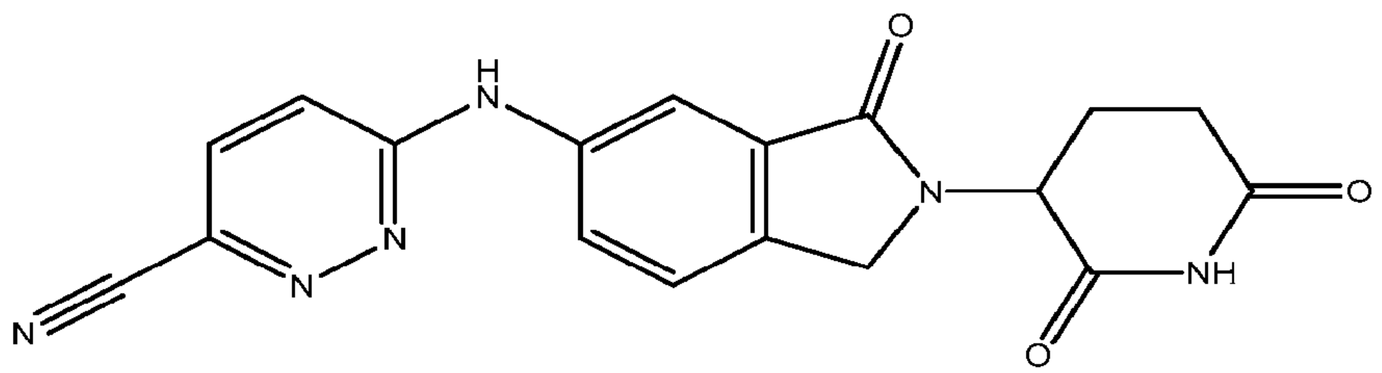
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C84964	 2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N,N-dimethyl-acetamide	2.65591E-07	NA	NA	NA	FALSE
C29137	 3-(7-methoxy-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	3.04218E-07	NA	NA	NA	FALSE
C12586	 3-[6-[[2-(2-methylmorpholin-4-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	3.82684E-07	NA	NA	NA	FALSE

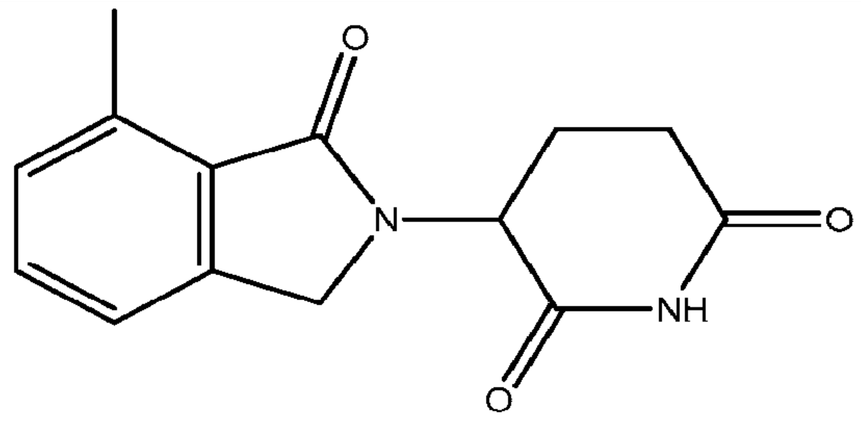
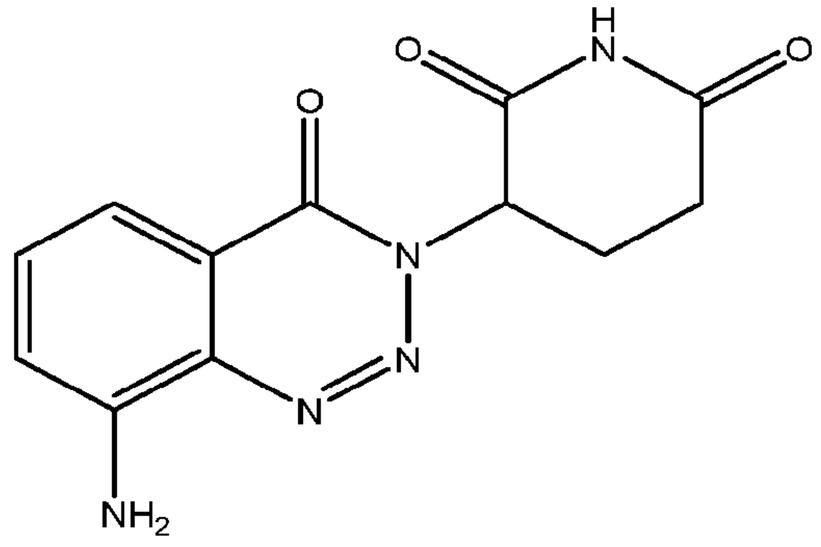
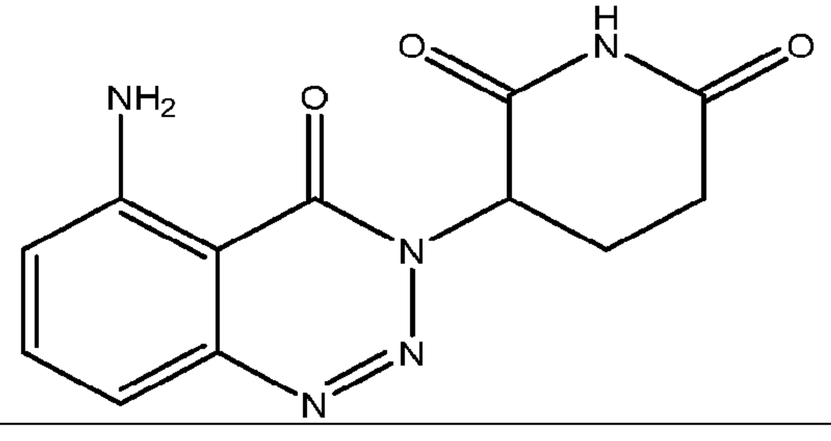
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C28891	 3-(5-hydroxy-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	4.79112E-07	1.04E-07	4.23E-06	1.05E-07	TRUE
C35856	 N-benzyl-2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]acetamide	4.84125E-07	1.15E-06	>>	1.88E-07	TRUE
C35751	 1-[2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]ethyl]-3-phenyl-urea	4.85851E-07	>>	1.45E-06	2.32E-07	TRUE

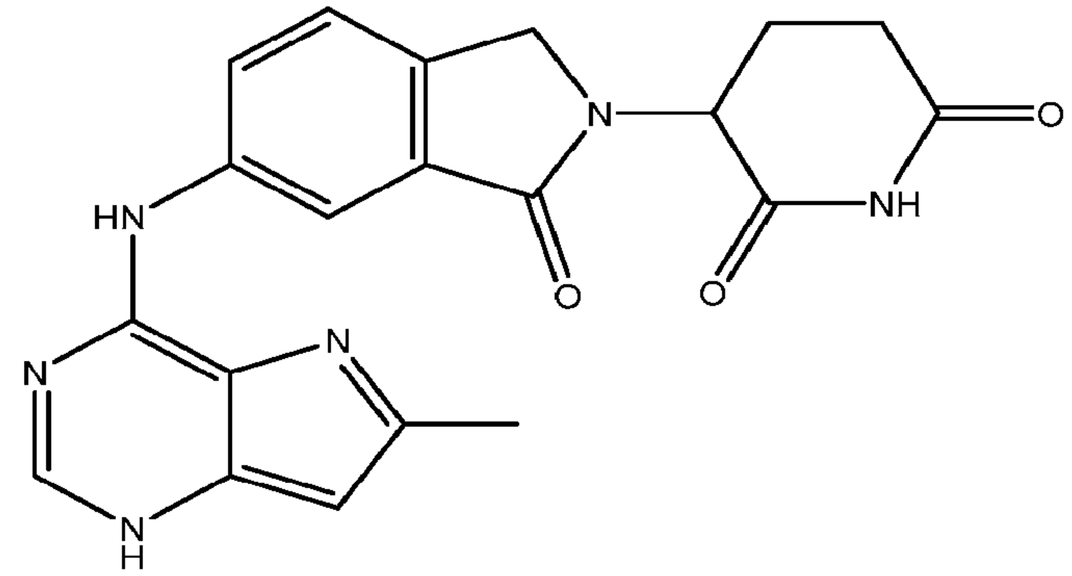
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C28928	 3-(6-hydroxy-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	4.88558E-07	>>	>>	2.26E-07	TRUE
C28973	 3-(7-hydroxy-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	5.26297E-07	>>	NA	1.50E-07	TRUE

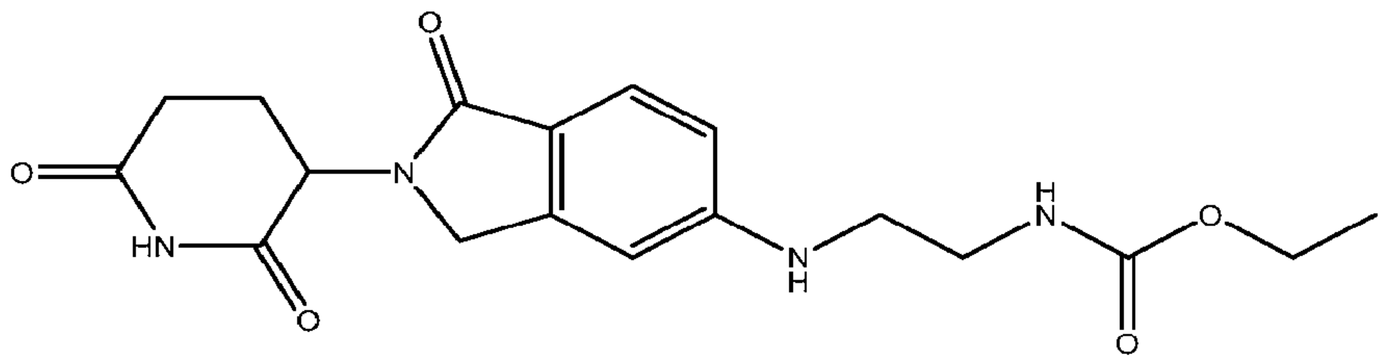
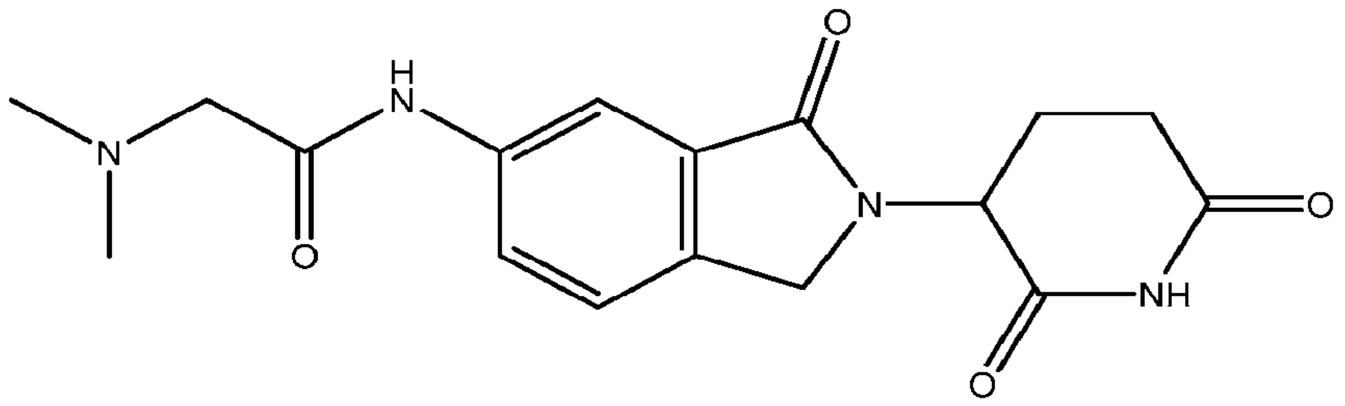
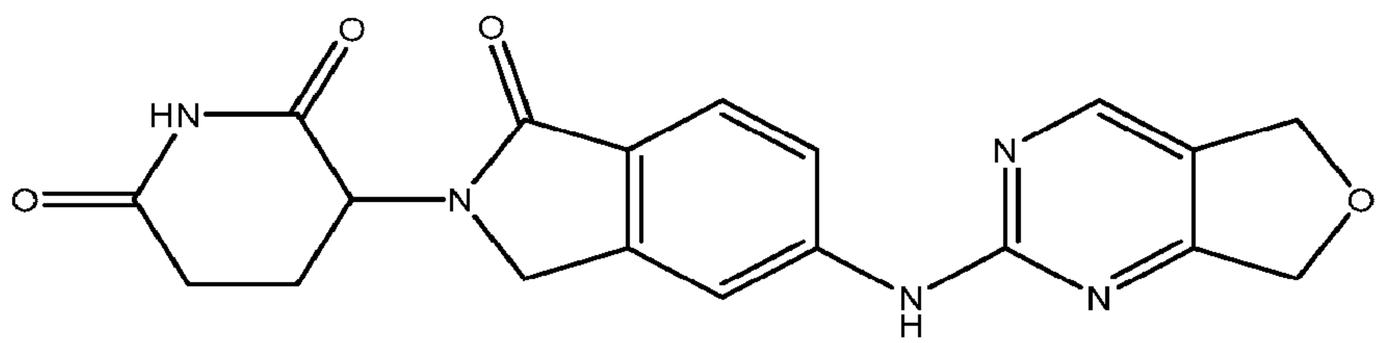
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C48020	 3-(1-oxo-7-phenyl-isoindolin-2-yl)piperidine-2,6-dione	5.4615E-07	NA	NA	NA	FALSE
C68126	 3-(7-oxo-5H-[1,3]dioxolo[4,5-f]isoindol-6-yl)piperidine-2,6-dione	5.64062E-07	>>	>>	3.19E-07	TRUE

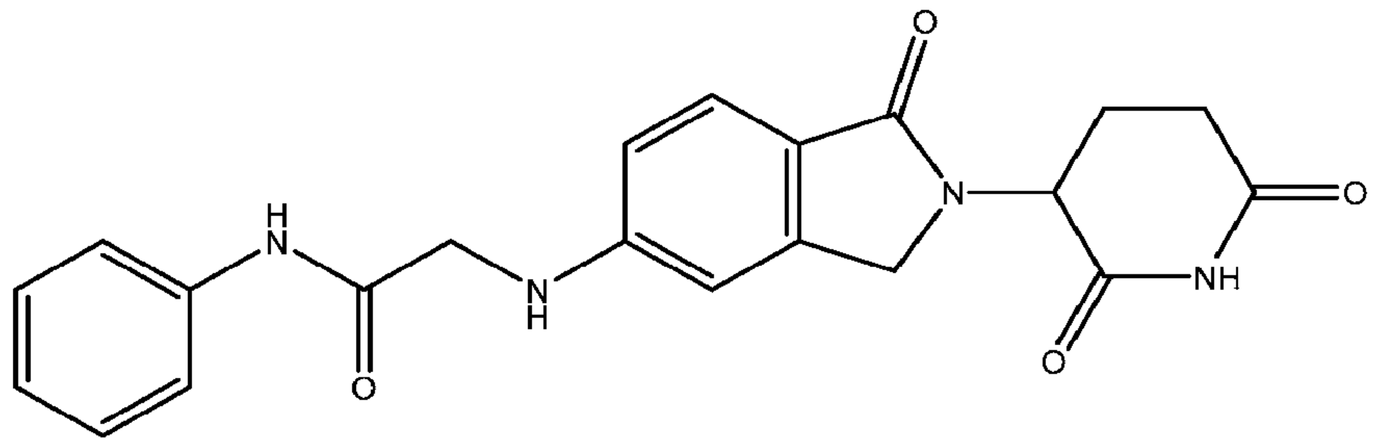
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1 (M)	EC50_SALL4(M)	Recruitment Assessment
C07207	 3-(7-amino-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	5.86861E-07	>>	NA	3.07E-07	TRUE
C95333	 2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-methyl-N-[(1-methylpyrazol-4-yl)meth	5.90522E-07	NA	NA	NA	FALSE
C84966	 N-benzyl-2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetamide	5.99373E-07	NA	NA	NA	FALSE

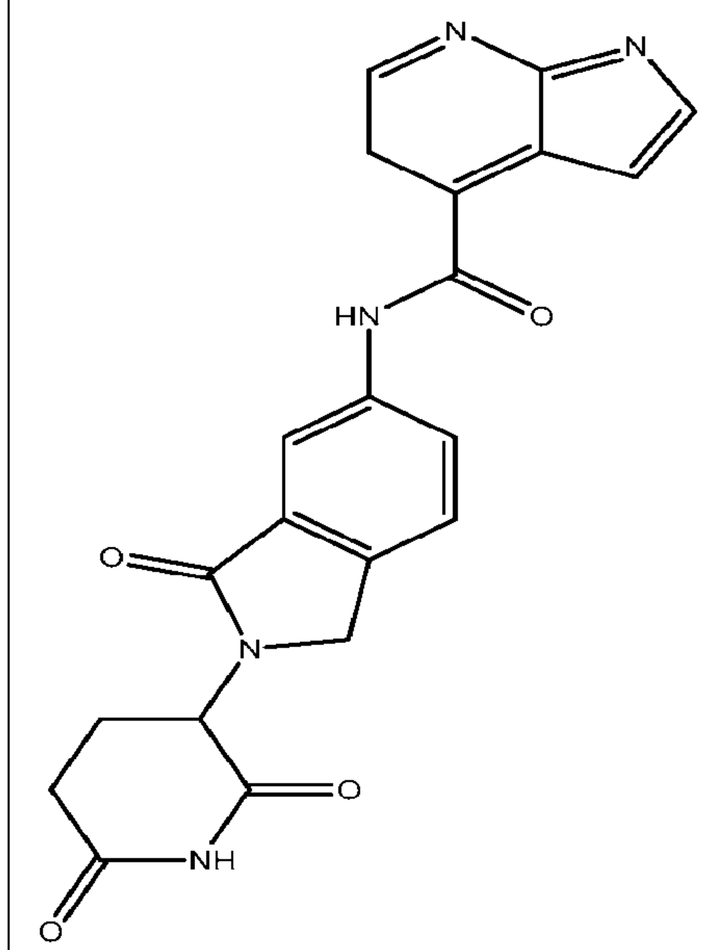
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C48003	 2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindoline-4-carbonitrile	6.21907E-07	>>	>>	5.81E-07	TRUE
C66979	 3-[6-(aminomethyl)-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	6.33015E-07	NA	NA	NA	FALSE
C80389	 6-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]pyridazine-3-carbonitrile	6.45036E-07	NA	NA	NA	FALSE

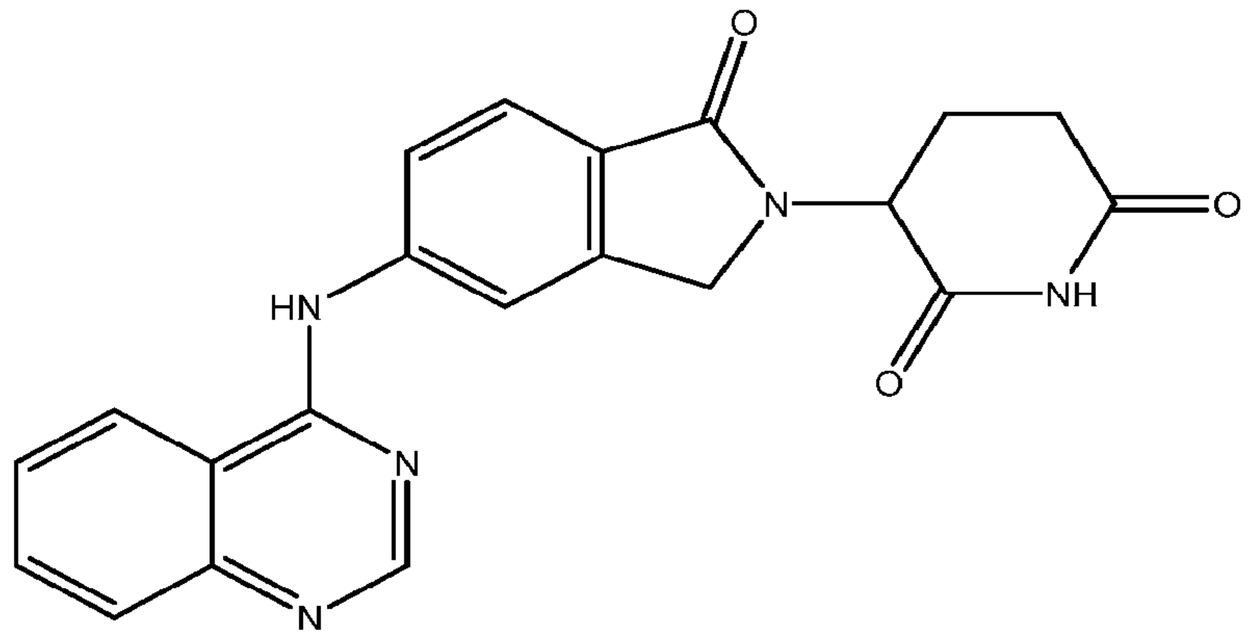
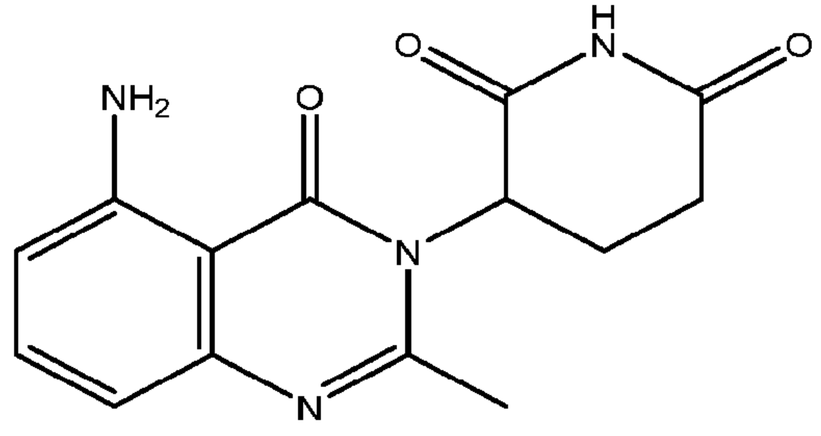
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C28661	 3-(7-methyl-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	6.54317E-07	NA	NA	NA	FALSE
C35833	 3-(8-amino-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione	6.83558E-07	NA	NA	NA	FALSE
C59904		7.03899E-07	1.22E-07	6.98E-07	3.30E-08	TRUE

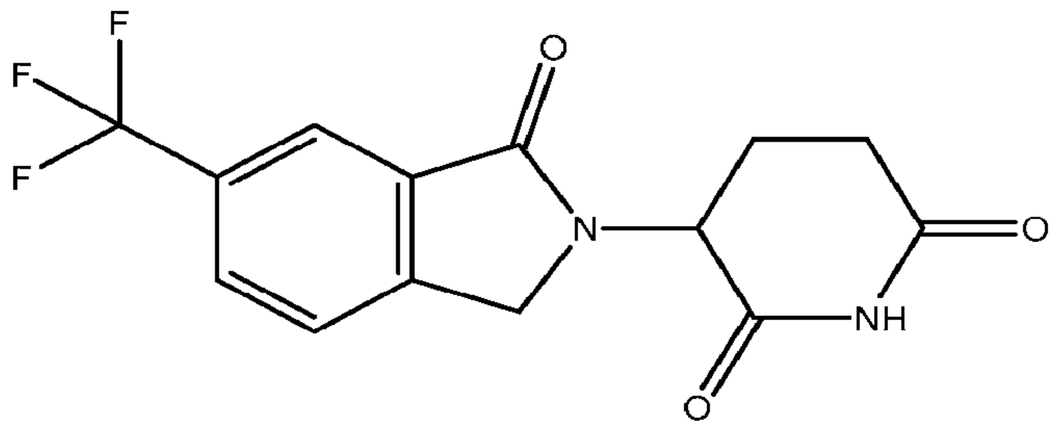
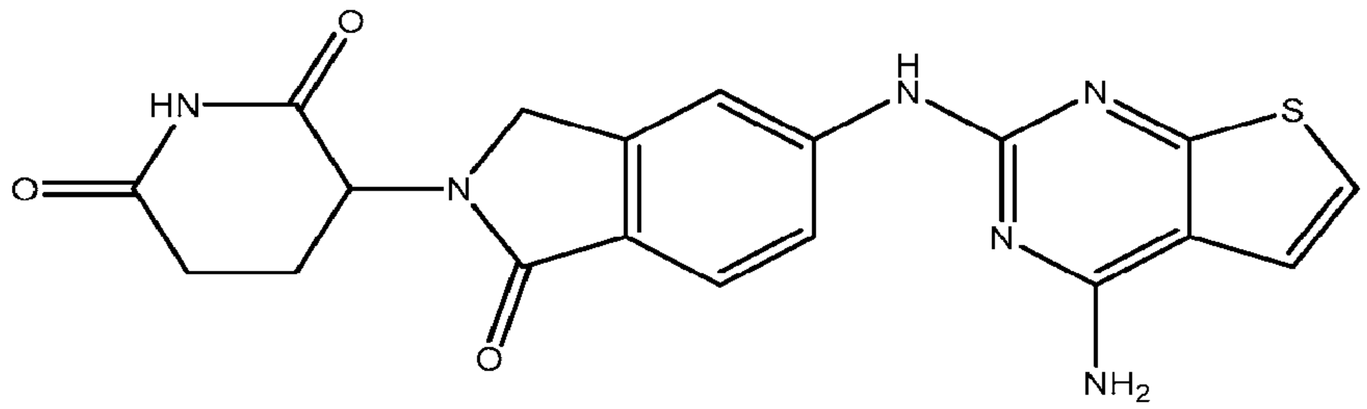
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
	3-(5-amino-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione					
C80390	 3-[6-[(6-methylpyrrolo[3,2-d]pyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	7.28895E-07	>>	NA	NA	TRUE

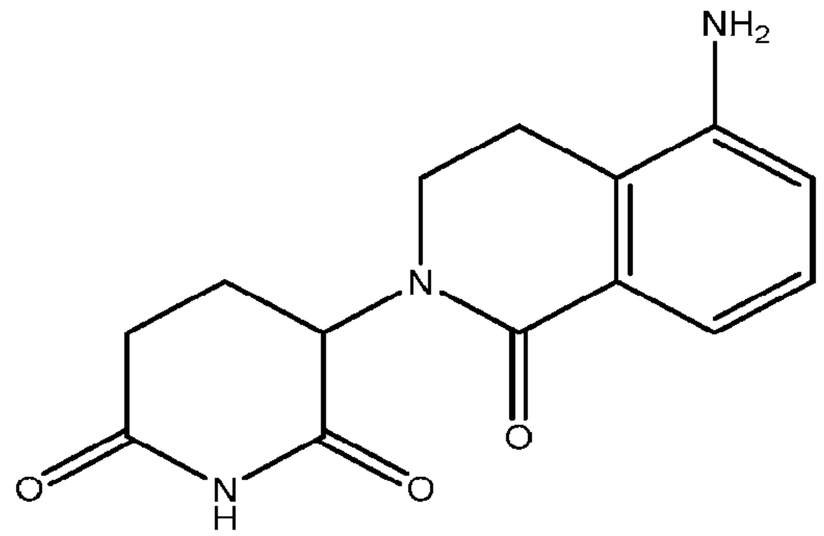
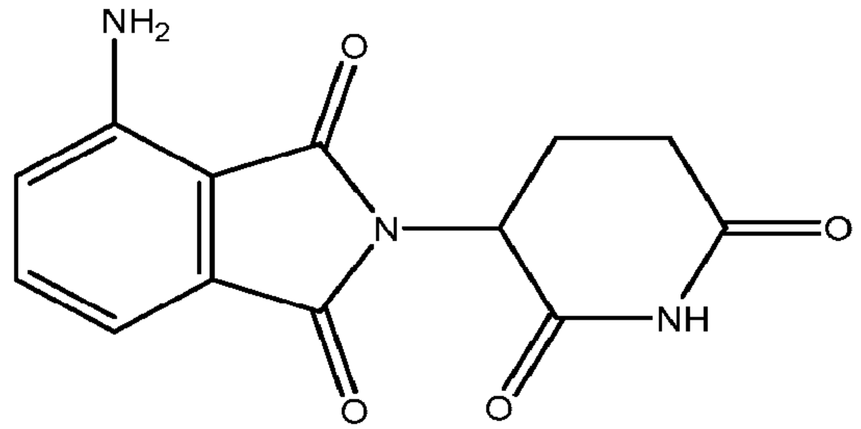
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C35754	 ethyl N-[2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]ethyl]carbamate	7.36821E-07	>>	>>	2.78E-07	TRUE
C49708	 2-(dimethylamino)-N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]acetamide	7.5179E-07	NA	NA	NA	FALSE
C80380	 3-[5-(5,7-dihydrofuro[3,4-d]pyrimidin-2-ylamino)-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	7.6043E-07	1.78E-06	NA	9.89E-09	TRUE

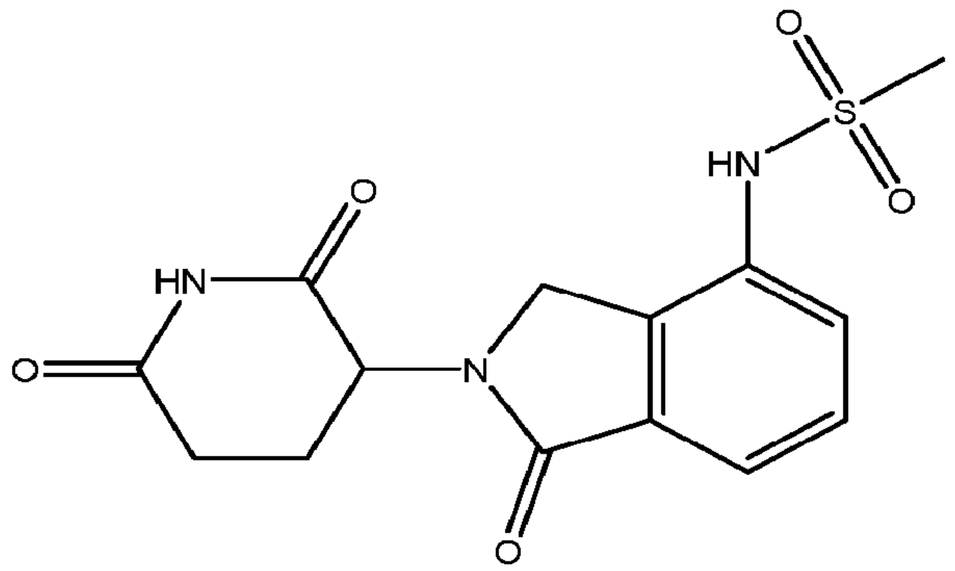
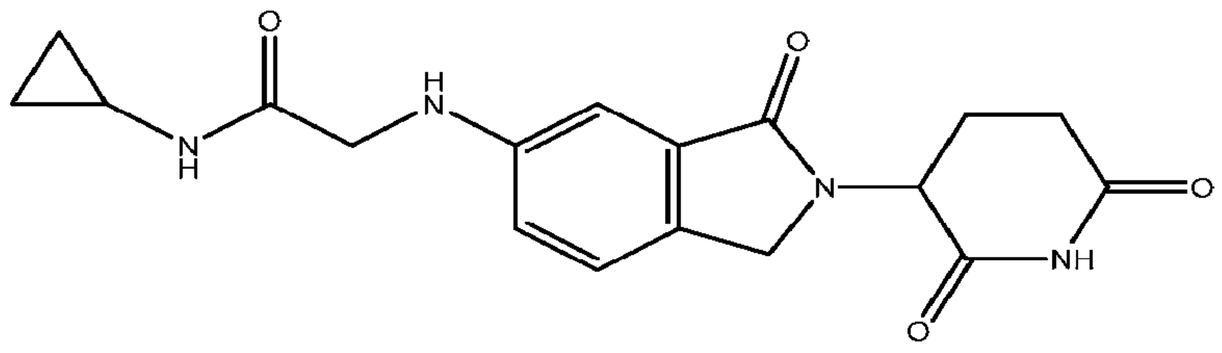
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1 (M)	EC50_SALL4(M)	Recruitment Assessment
C35797	 2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl] amino]-N-phenyl-acetamide	8.50894E-07	1.33E-06	>>	1.08E-06	TRUE

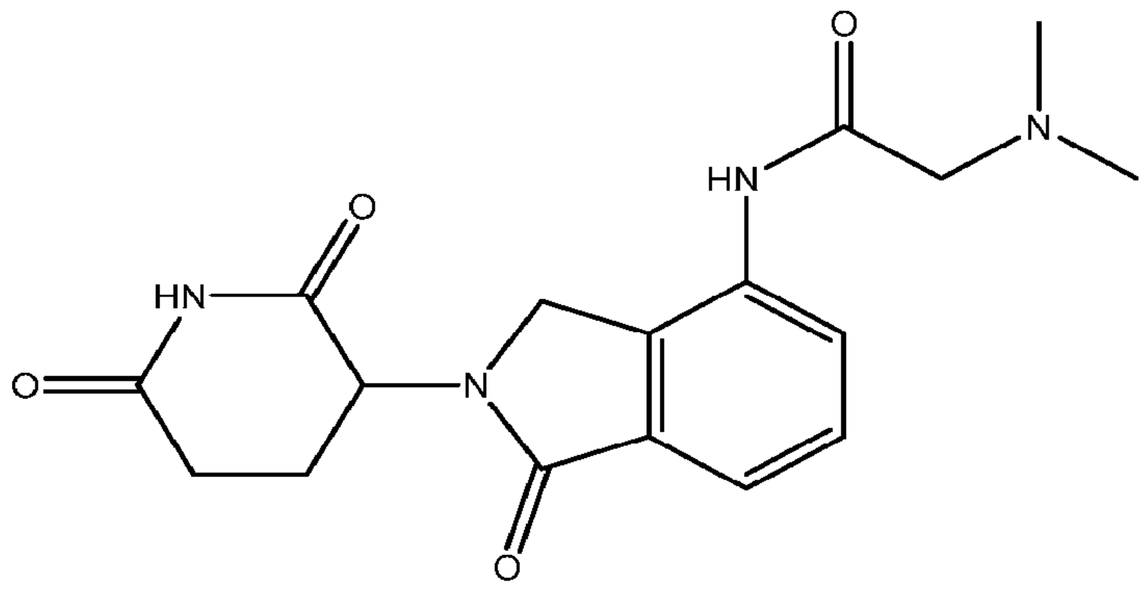
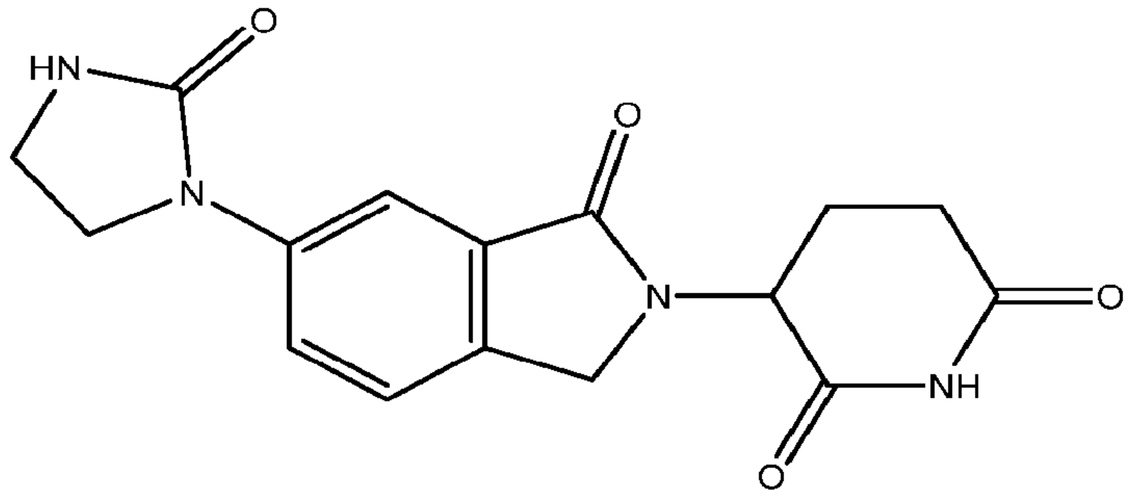
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C80395	 N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]-5H-pyrrolo [2,3-b]pyridine-4-carboxamide	8.80494E-07	>>	NA	NA	TRUE

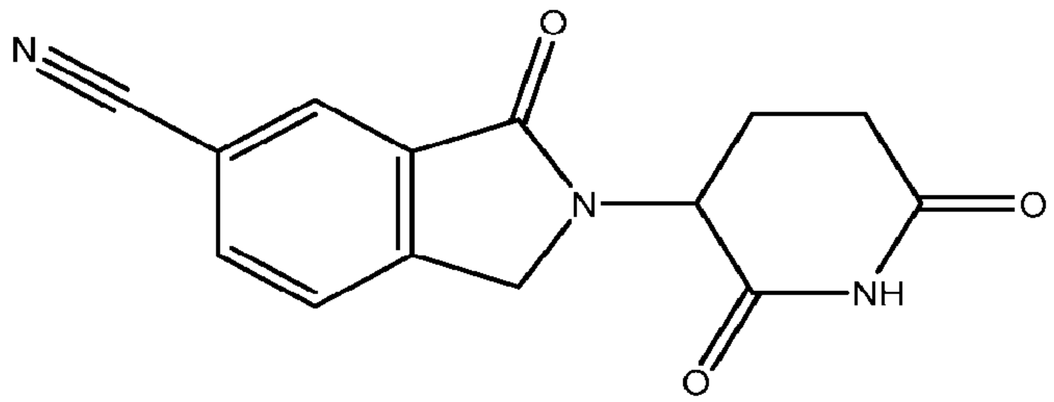
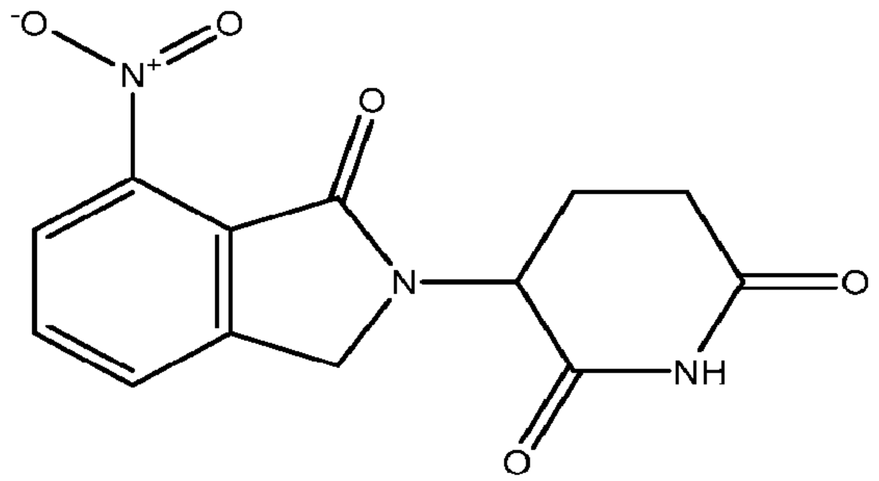
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C80373	 3-[1-oxo-5-(quinazolin-4-ylamino)isoindolin-2-yl]piperidine-2,6-dione	8.92014E-07	>>	>>	NA	TRUE
CC-122	 3-(5-amino-2-methyl-4-oxo-quinazolin-3-yl)piperidine-2,6-dione	9.46128E-07	2.01E-07	1.39E-06	1.99E-07	TRUE

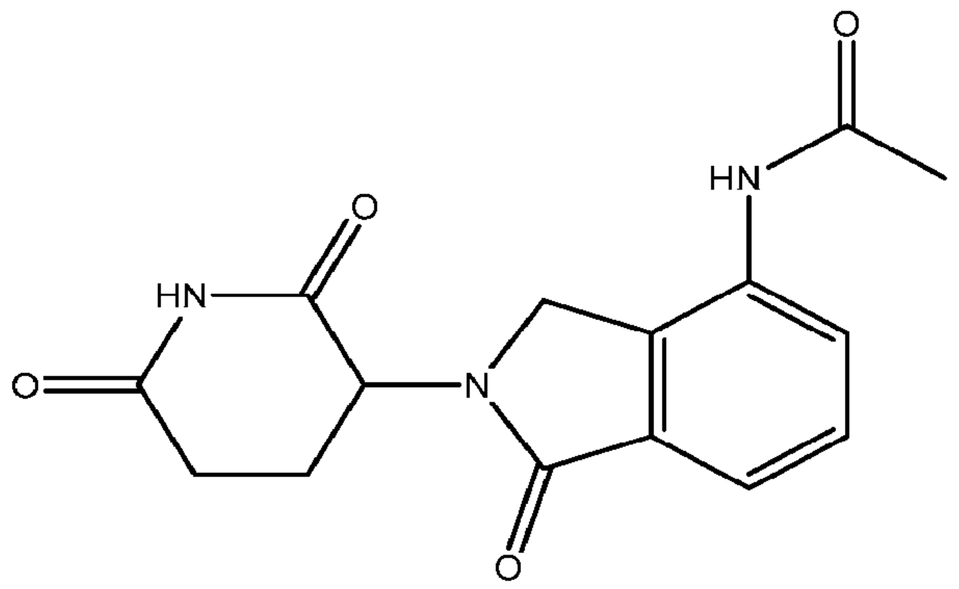
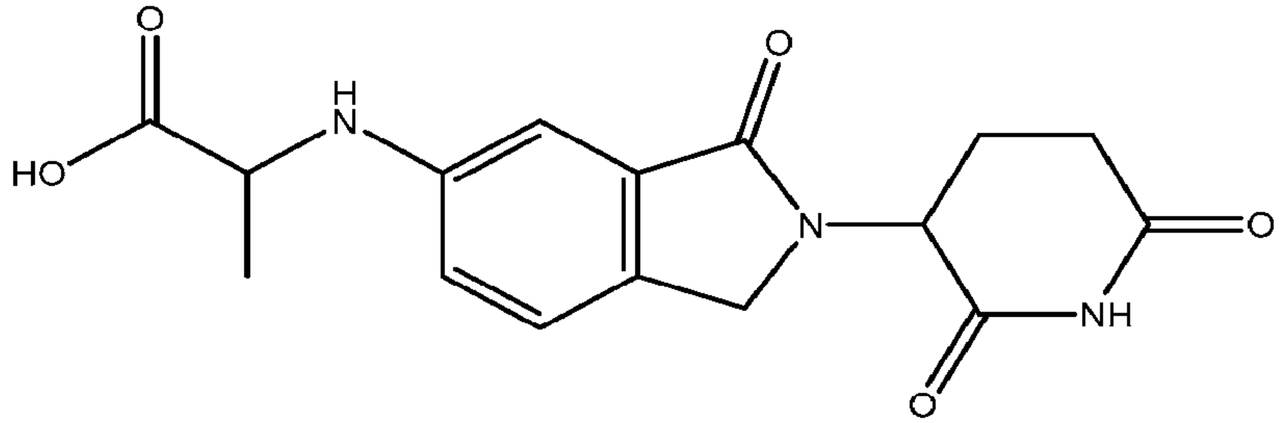
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C45748	 3-[1-oxo-6-(trifluoromethyl)isoindolin-2-yl]piperidine-2,6-dione	9.52933E-07	NA	NA	NA	FALSE
C80379	 3-[5-[(4-aminothieno[2,3-d]pyrimidin-2-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	9.70979E-07	>>	NA	NA	TRUE

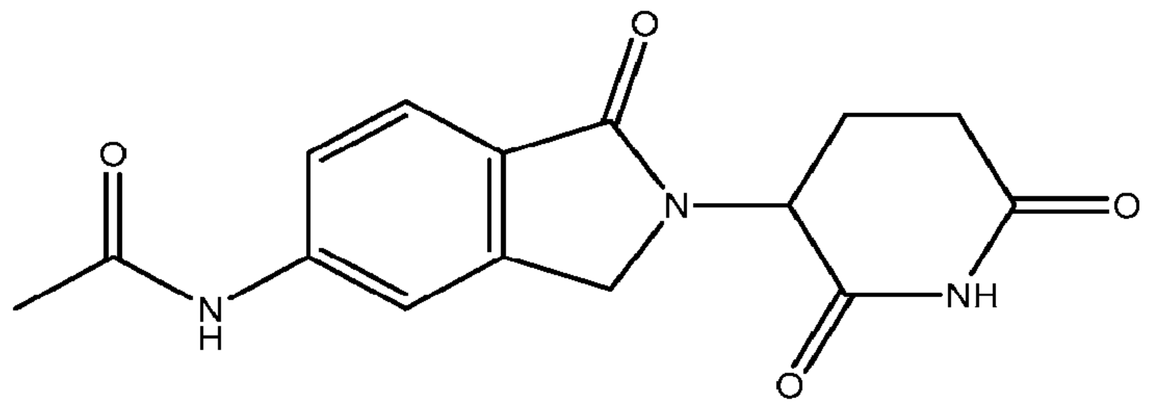
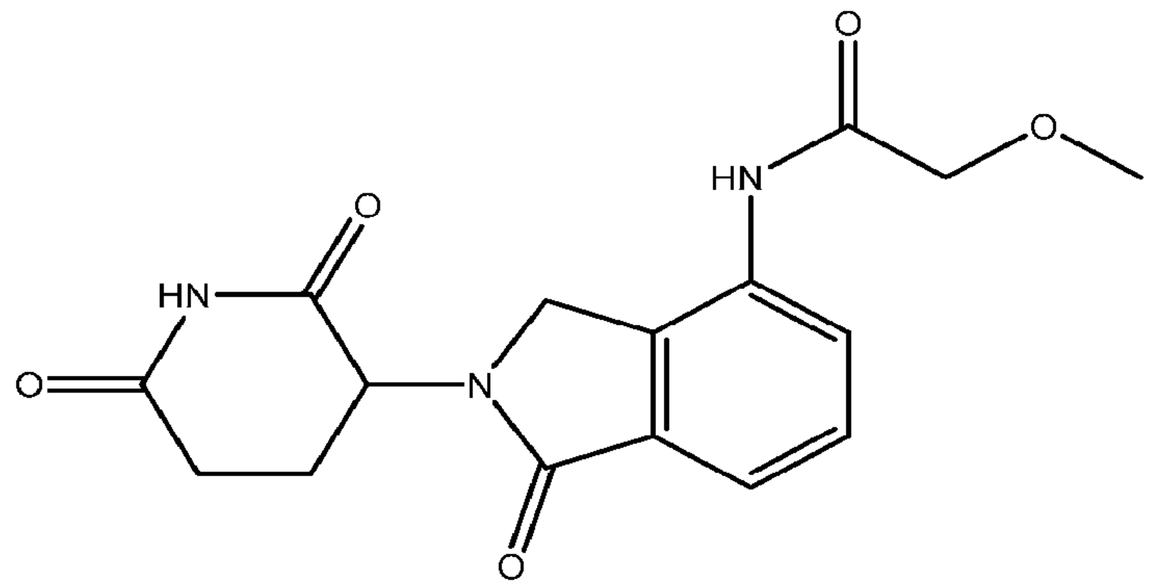
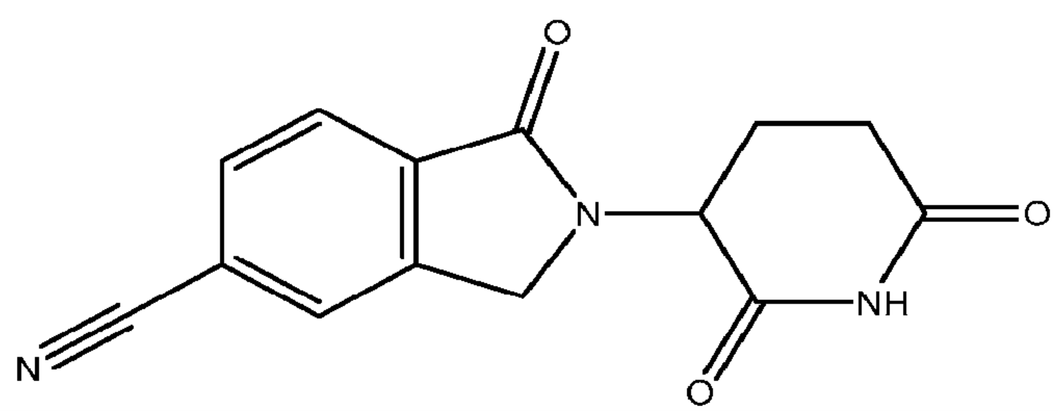
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C47933	 3-(5-amino-1-oxo-3,4-dihydroisoquinolin-2-yl)piperidine-2,6-dione	1.0938E-06	>>	NA	NA	TRUE
POM	 4-amino-2-(2,6-dioxo-3-piperidyl)isoindoline-1,3-dione	1.10121E-06	7.27E-07	2.07E-06	6.77E-08	TRUE

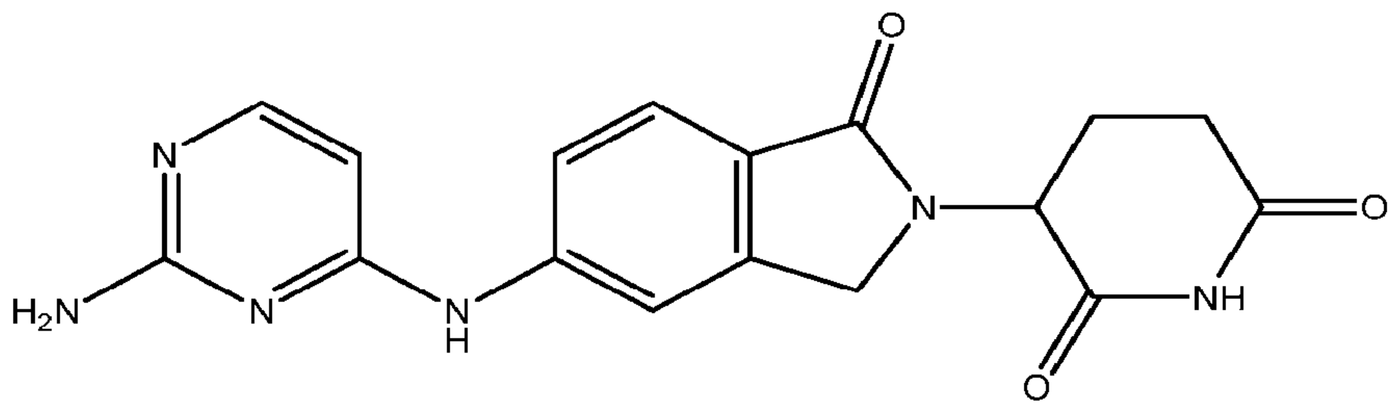
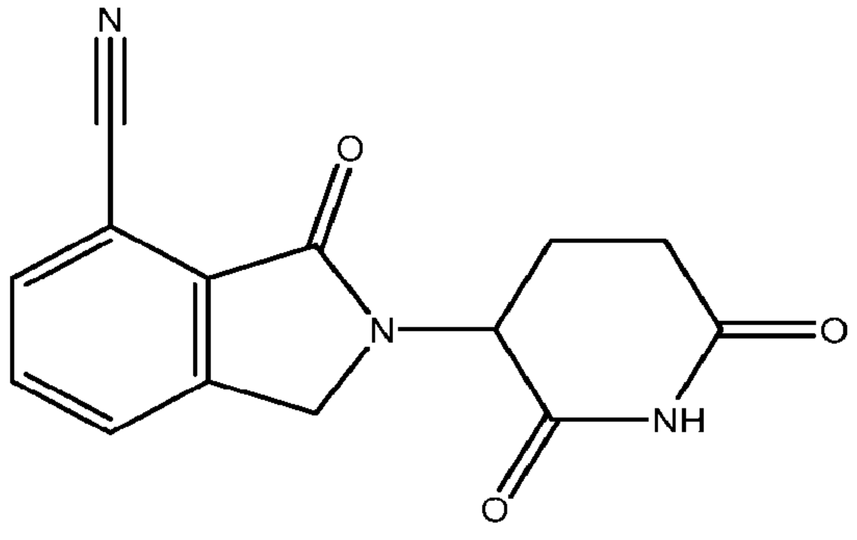
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C22548	 N-[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-4-yl]methanesulfonamide	1.10968E-06	4.94E-07	>>	6.31E-07	TRUE
C84963	 N-cyclopropyl-2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl] amino]acetamide	1.21084E-06	NA	NA	NA	FALSE

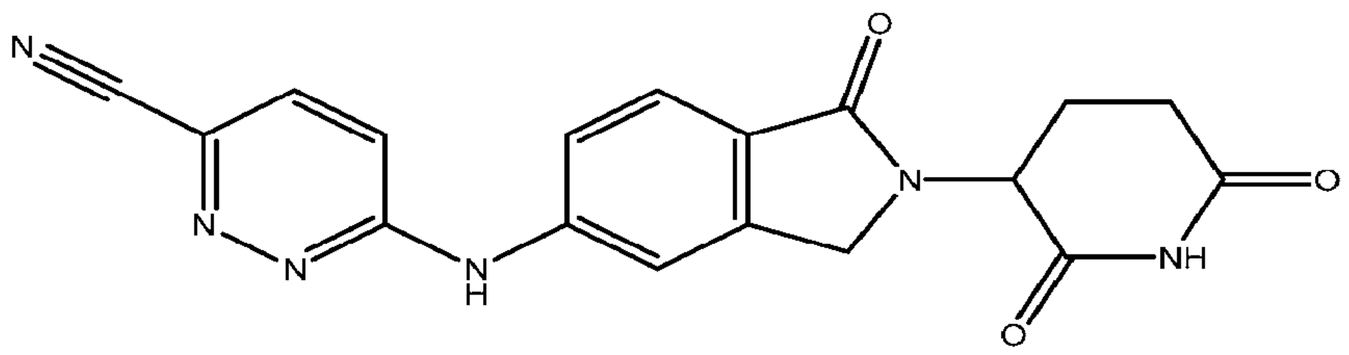
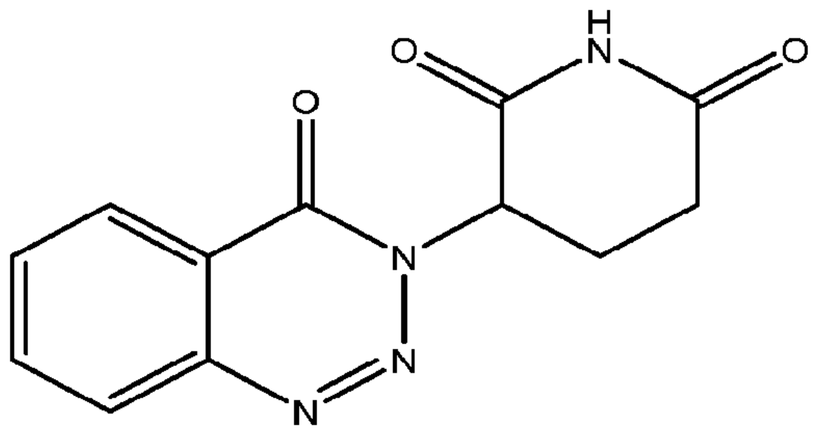
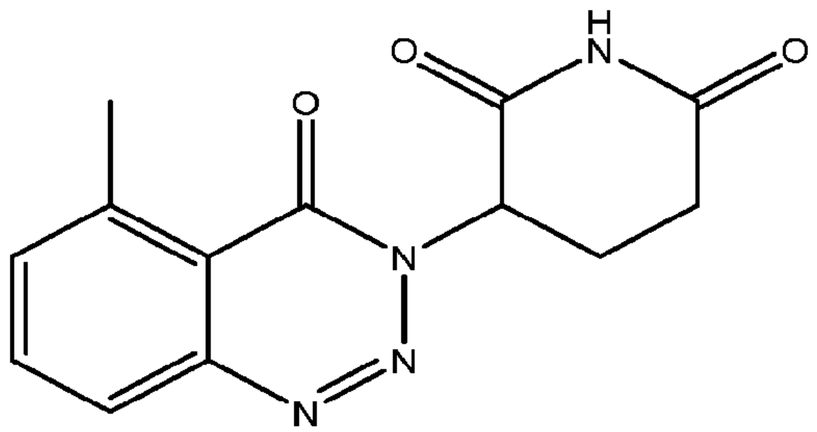
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C22586	 2-(dimethylamino)-N-[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-4-yl] acetamide	1.29799E-06	>>	NA	1.14E-06	TRUE
C84971	 3-[1-oxo-6-(2-oxoimidazolidin-1-yl)isoindolin-2-yl]piperidine-2,6-dione	1.31113E-06	NA	NA	NA	FALSE

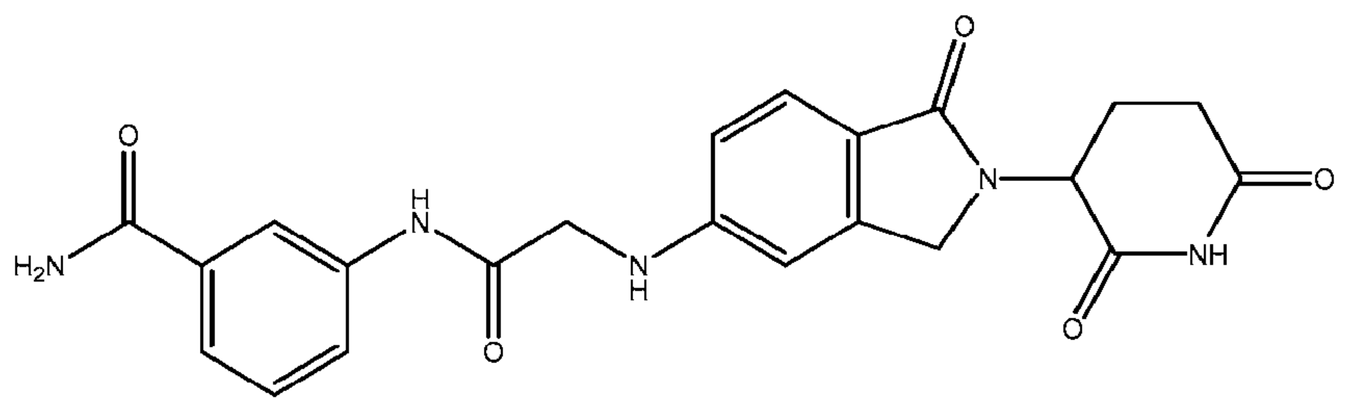
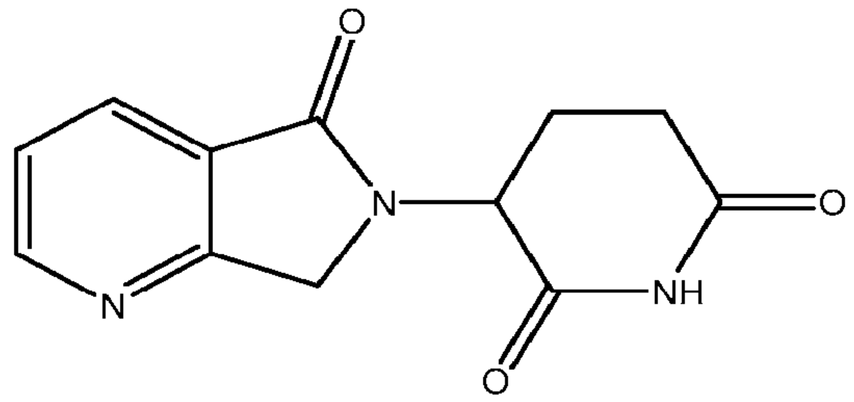
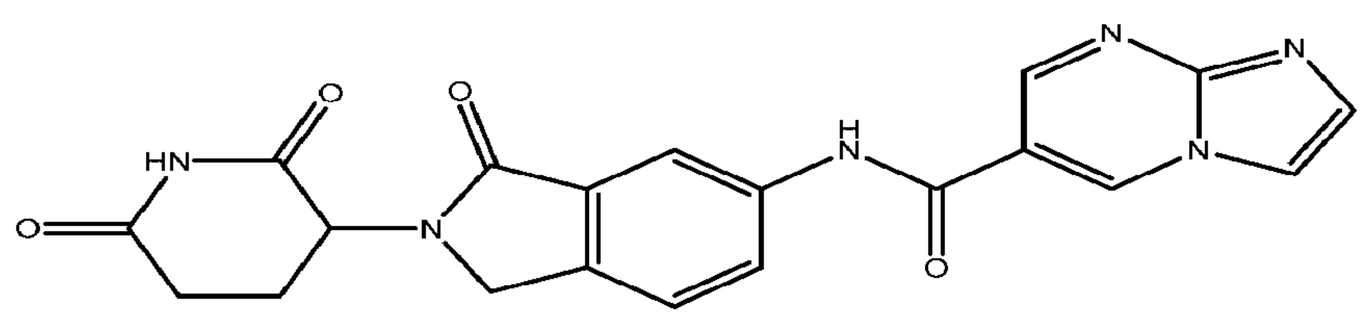
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C48007	 2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-5-carbonitrile	1.34315E-06	1.62E-06	>>	4.30E-07	TRUE
C99884	 3-(7-nitro-1-oxo-isoindolin-2-yl)piperidine-2,6-dione	1.36829E-06	NA	NA	NA	FALSE

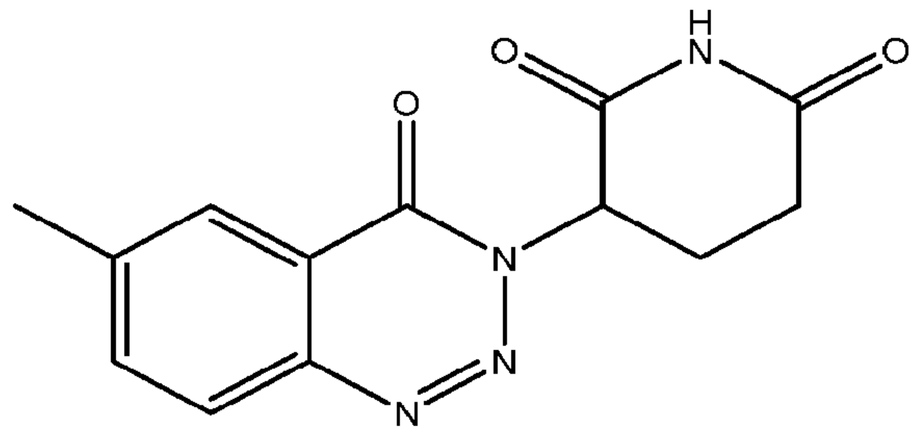
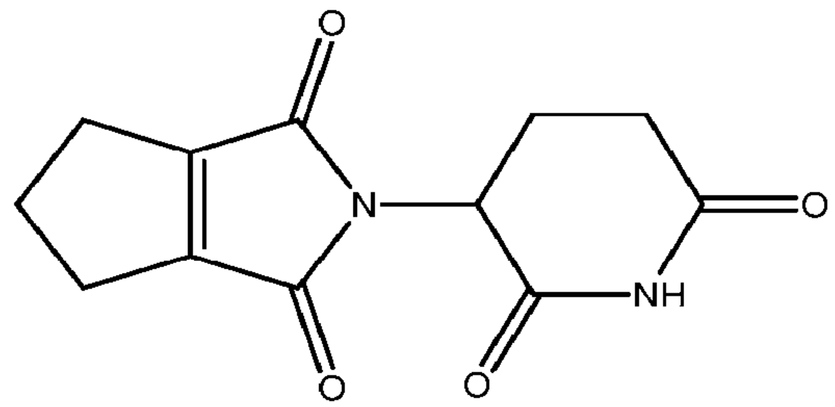
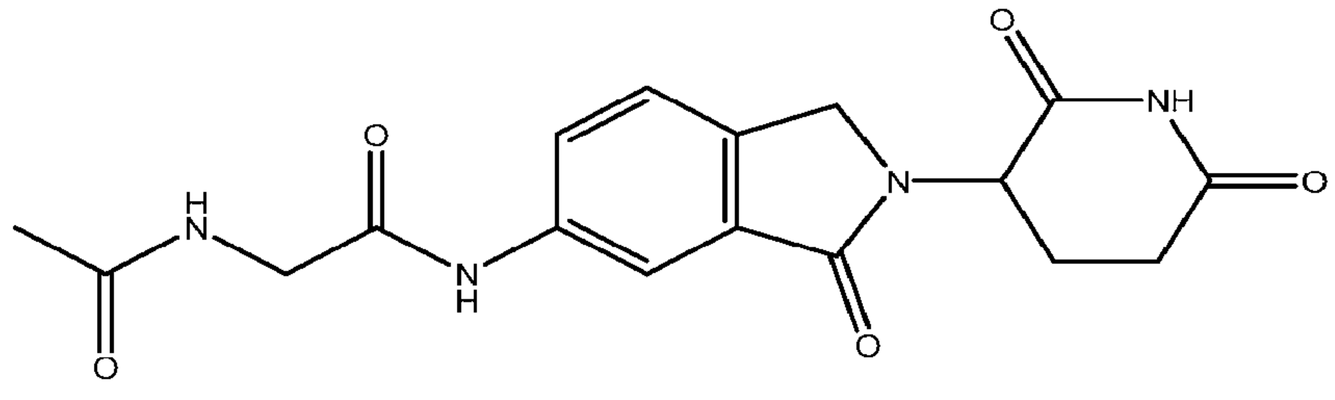
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C29330	 N-[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-4-yl]acetamide	1.41494E-06	>>	>>	2.50E-07	TRUE
C84970	 2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]propanoic acid	1.42322E-06	NA	NA	1.01E-06	TRUE

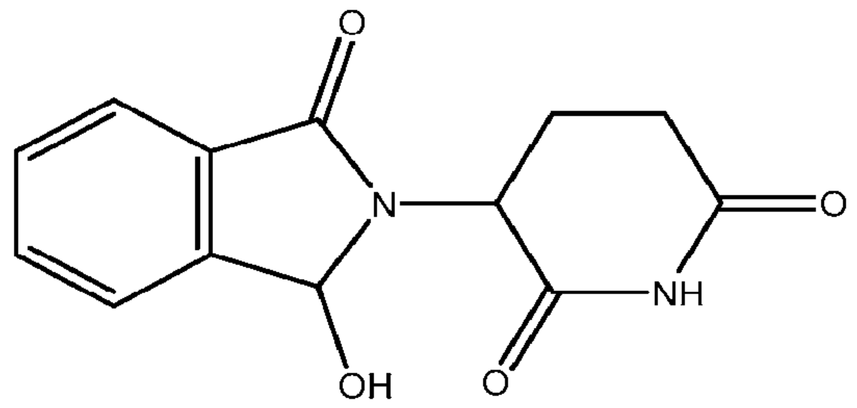
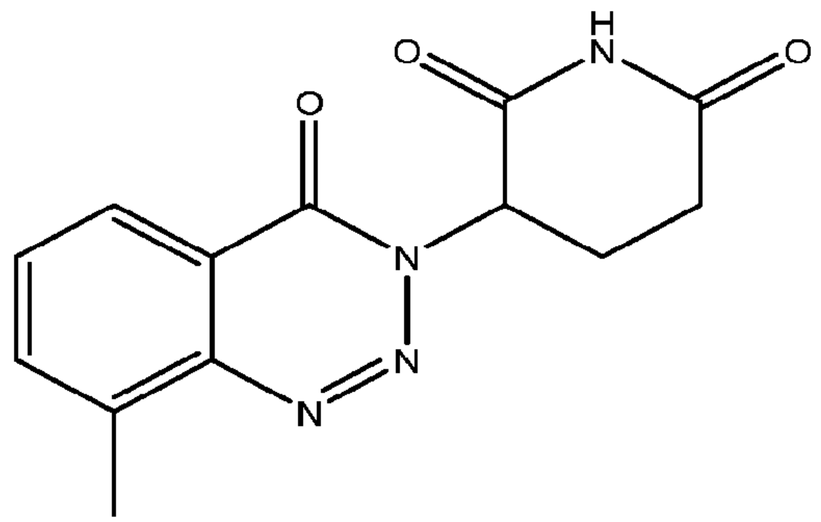
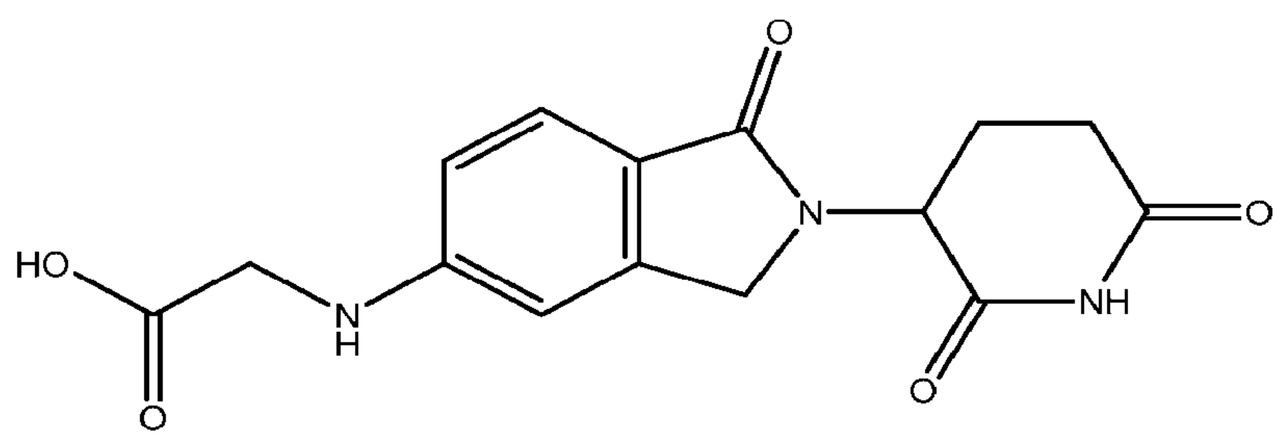
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C29361	 N-[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]acetamide	1.43168E-06	>>	>>	1.86E-07	TRUE
C22564	 N-[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-4-yl]-2-methoxy-acetamide	1.67347E-06	>>	>>	8.73E-07	TRUE
C48005		1.73199E-06	>>	NA	5.95E-07	TRUE

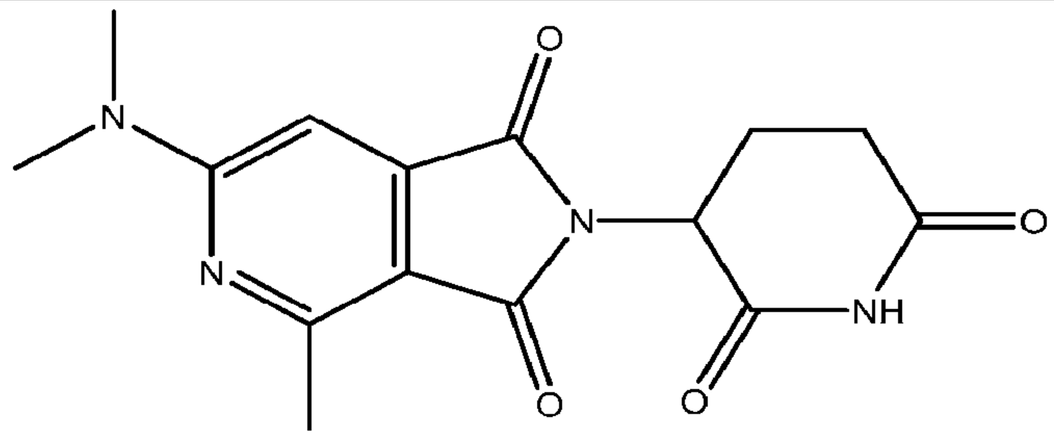
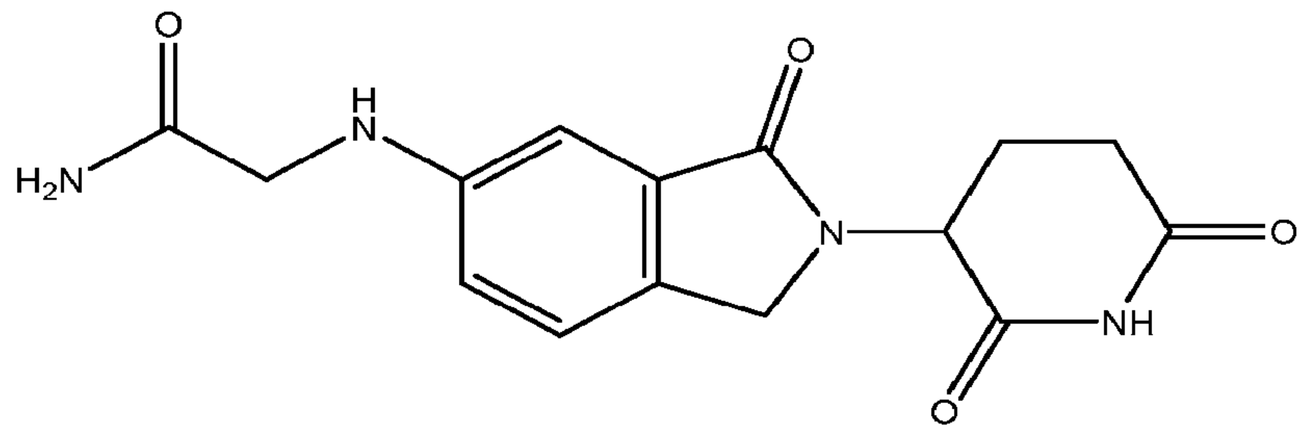
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
	2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindoline-5-carbonitrile					
C80375	 3-[5-[(2-aminopyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl] piperidine-2,6-dione	2.05608E-06	NA	NA	NA	FALSE
C48009	 2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-4-carbonitrile	2.18134E-06	NA	NA	NA	FALSE

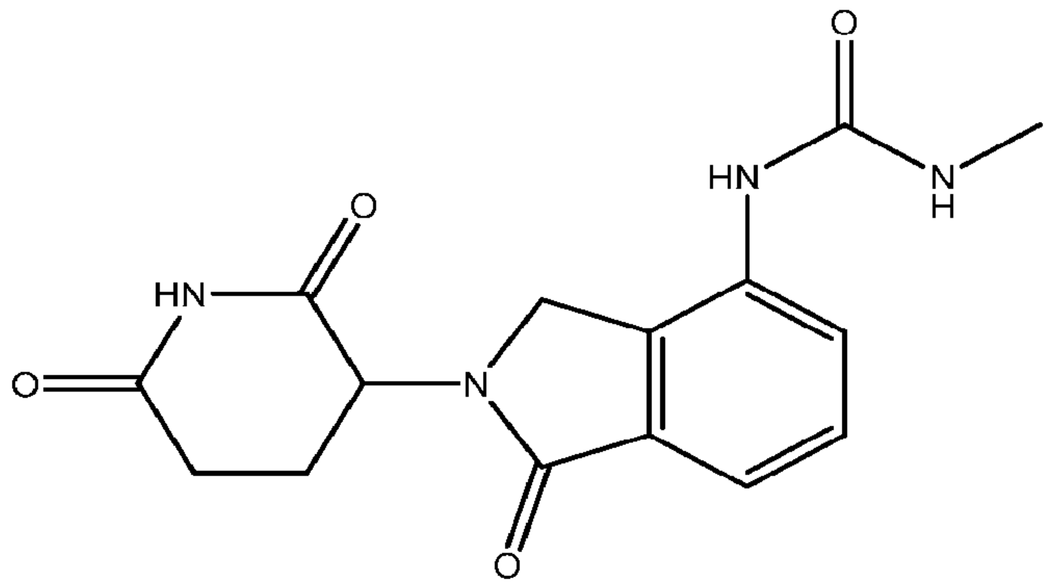
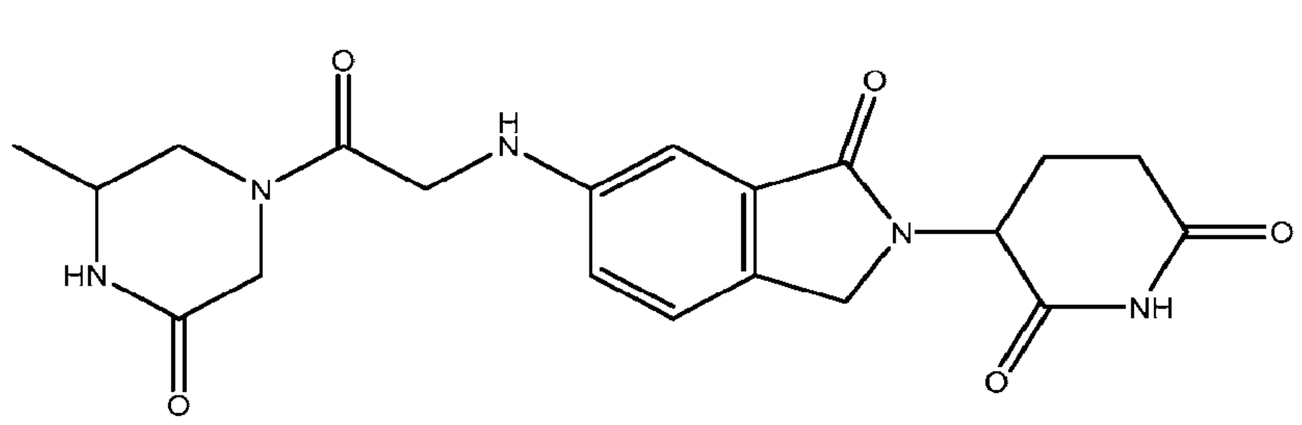
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C80378	 6-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]pyridazine-3-carbonitrile	2.20805E-06	>>	9.42E-06	3.87E-07	TRUE
C21223	 3-(4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione	2.29375E-06	>>	>>	5.17E-07	TRUE
C13247	 3-(5-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione	2.29444E-06	2.88E-06	8.55E-06	4.02E-07	TRUE

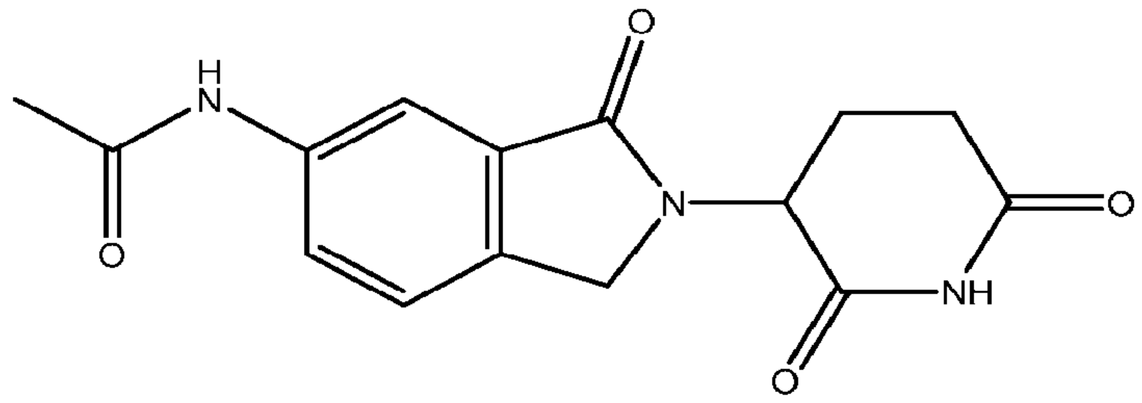
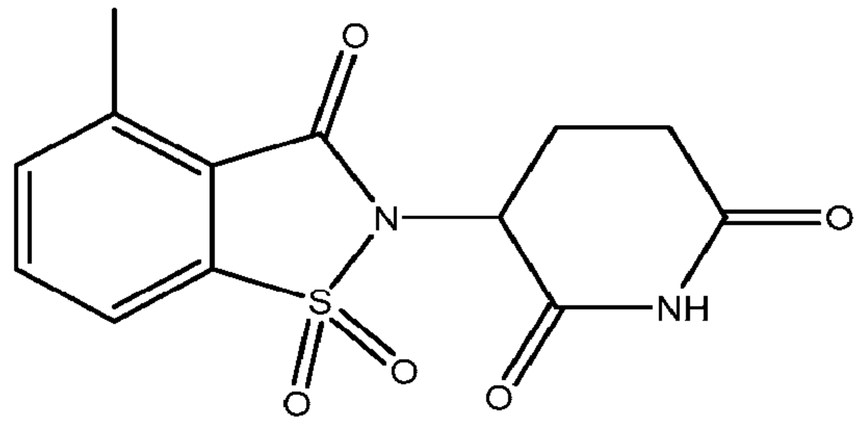
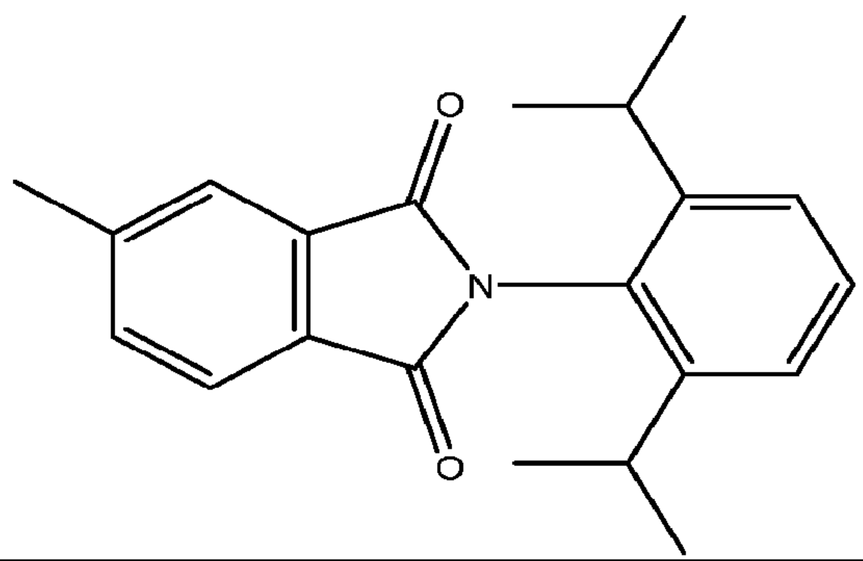
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1 (M)	EC50_SALL4(M)	Recruitment Assessment
C35811	 3-[[2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]acetyl]amino]benzamide	2.44321E-06	>>	>>	6.41E-07	TRUE
C47959	 3-(5-oxo-7H-pyrrolo[3,4-b]pyridin-6-yl)piperidine-2,6-dione	2.5664E-06	>>	>>	4.41E-07	TRUE
C80396	 N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]imidazo[1,2-a]pyrimidine-6-carboxamide	2.62647E-06	>>	NA	1.38E-06	TRUE

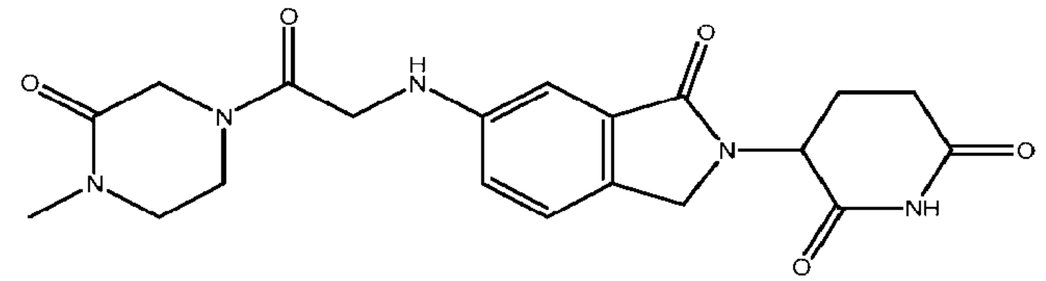
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C16463	 3-(6-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione	2.67093E-06	>>	NA	7.72E-07	TRUE
C64324	 2-(2,6-dioxo-3-piperidyl)-5,6-dihydro-4H-cyclopenta[c]pyrrole-1,3-dione	2.74862E-06	NA	NA	NA	FALSE
C84967	 2-acetamido-N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]acetamide	3.15182E-06	NA	NA	>>	TRUE

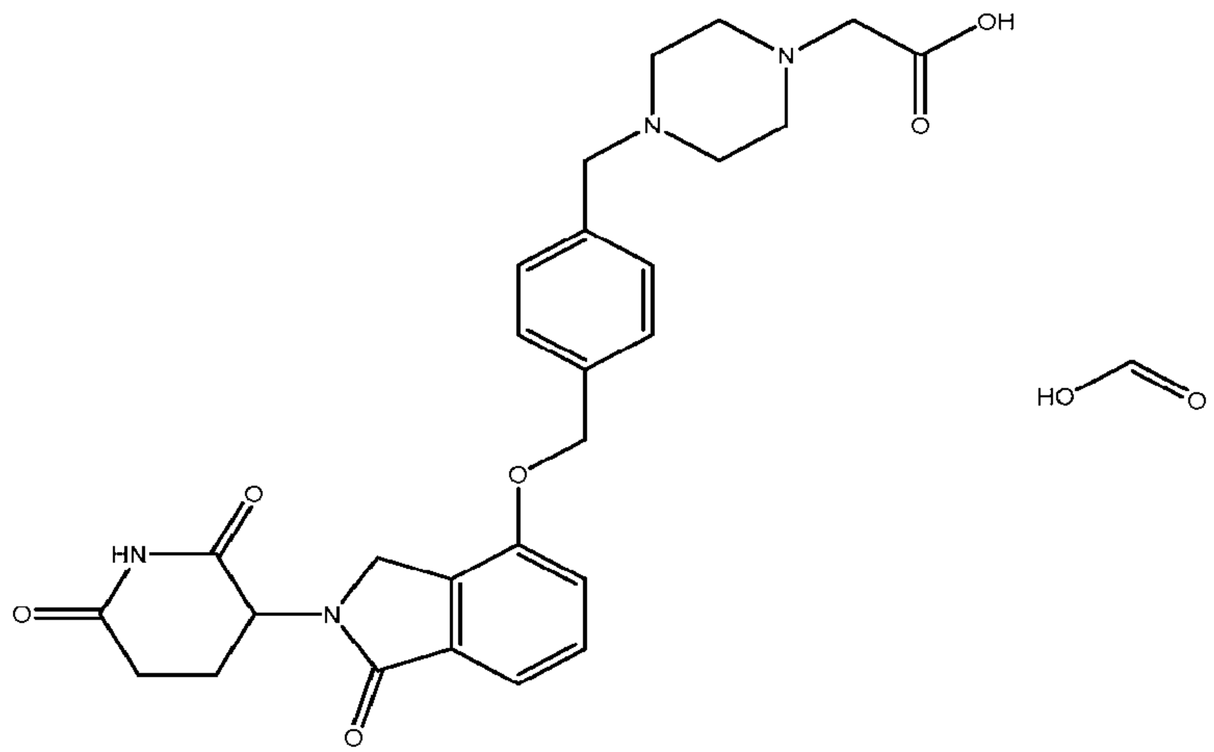
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C89940	 3-(1-hydroxy-3-oxo-isoindolin-2-yl)piperidine-2,6-dione	3.28532E-06	>>	>>	4.38E-07	TRUE
C35830	 3-(8-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione	3.45963E-06	>>	5.56E-06	5.88E-07	TRUE
C47995		3.70808E-06	>>	>>	5.18E-07	TRUE

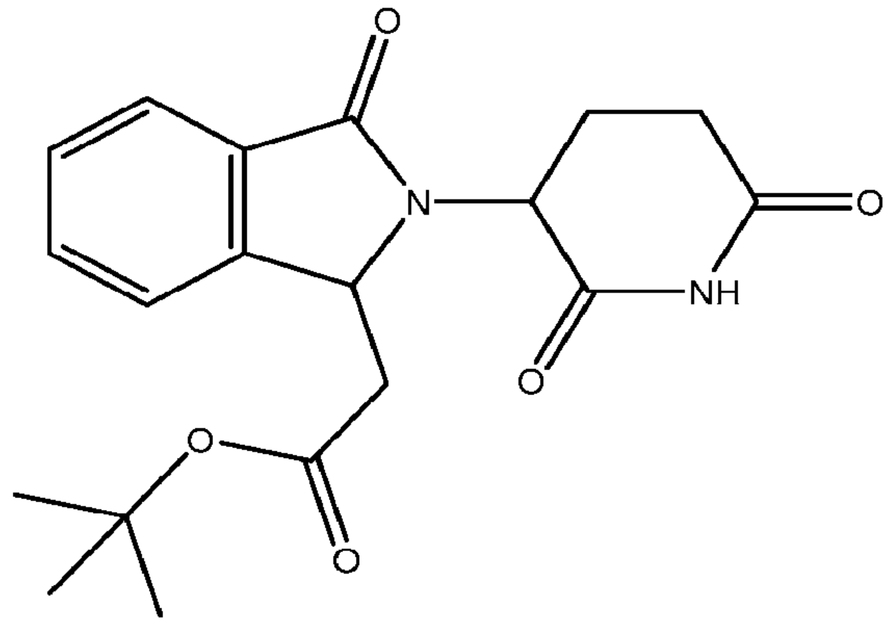
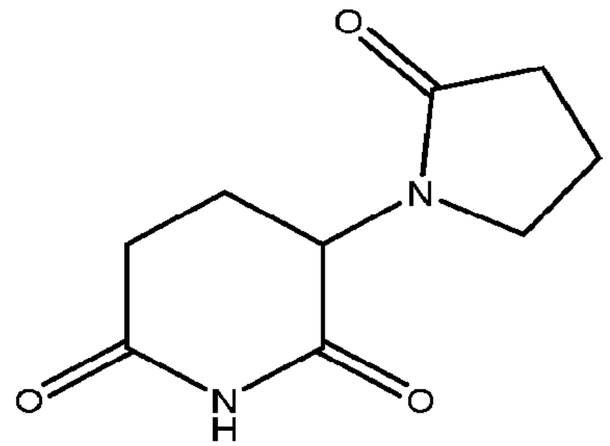
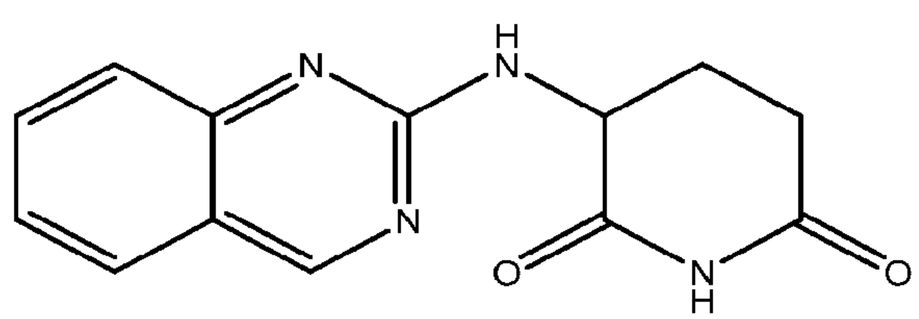
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
	2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]acetic acid					
C64376	 6-(dimethylamino)-2-(2,6-dioxo-3-piperidyl)-4-methyl-pyrrolo[3,4-c] pyridine-1,3-dione	3.94892E-06	NA	NA	NA	FALSE
C84961	 2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetamide	4.00542E-06	NA	NA	NA	FALSE

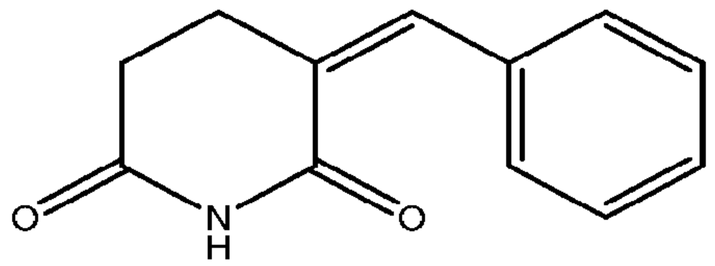
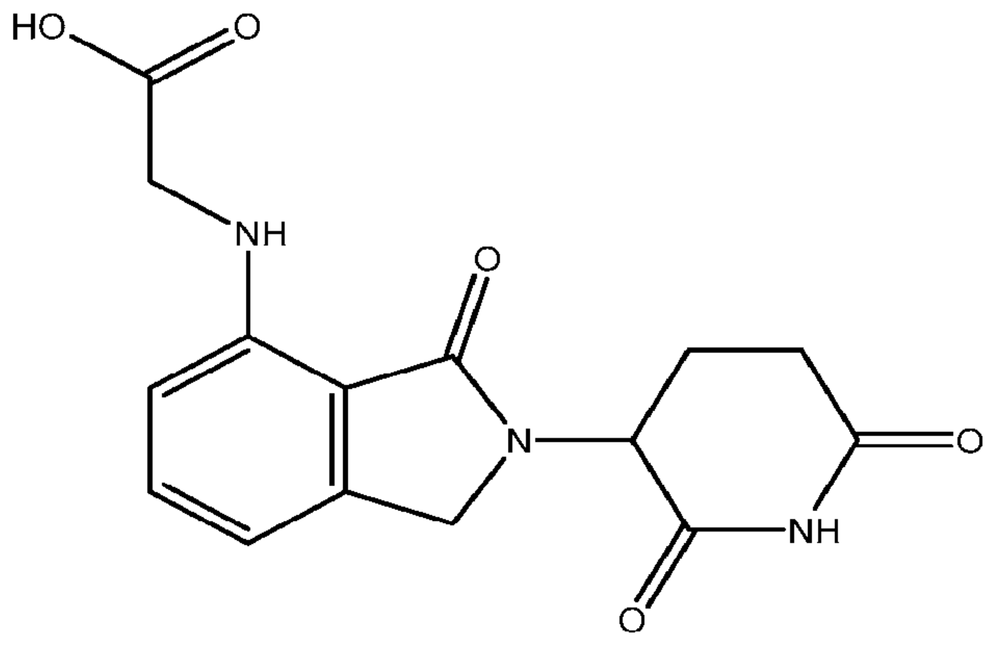
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C22594	 1-[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-4-yl]-3-methyl-urea	4.49003E-06	2.76E-06	>>	7.71E-07	TRUE
C12598	 3-[6-[[2-(3-methyl-5-oxo-piperazin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	4.88466E-06	NA	NA	NA	FALSE

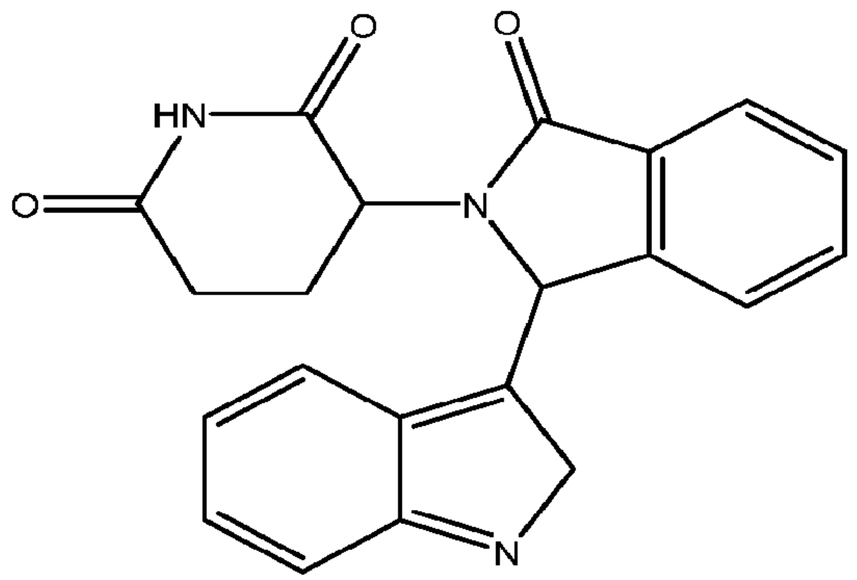
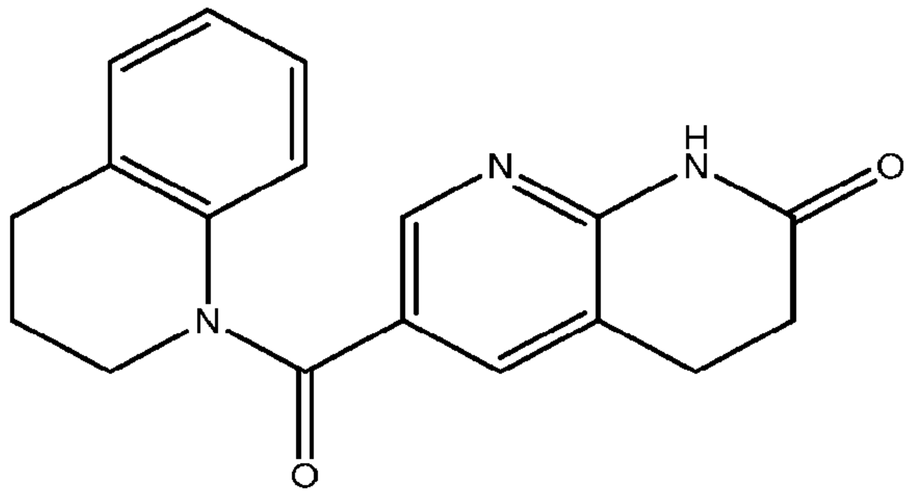
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1 (M)	EC50_SALL4(M)	Recruitment Assessment
C29408	 N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]acetamide	4.92017E-06	NA	NA	NA	FALSE
C73349	 3-(4-methyl-1,1,3-trioxo-1,2-benzothiazol-2-yl)piperidine-2,6-dione	4.94642E-06	NA	NA	NA	FALSE
5HPP-33		5.1107E-06	NA	NA	NA	FALSE

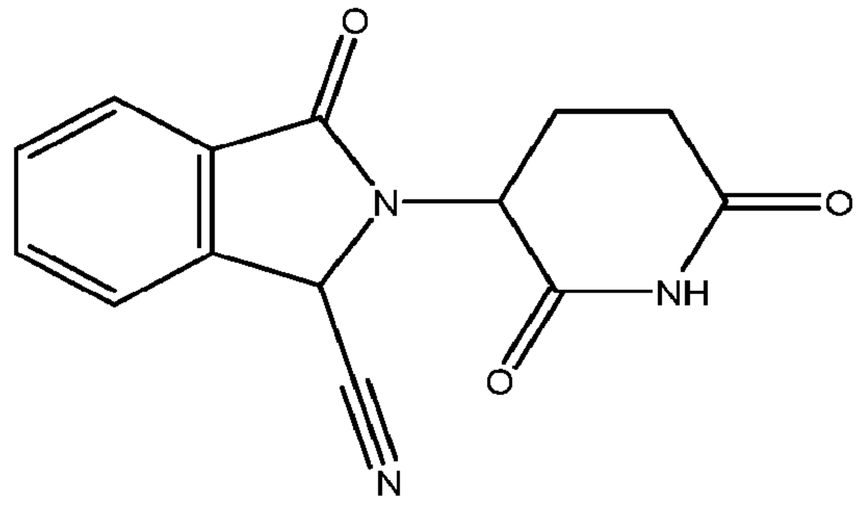
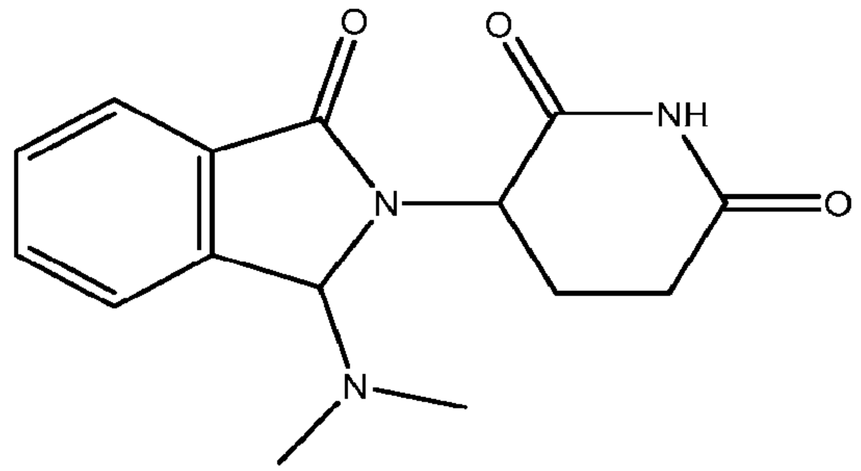
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
	2-(2,6-diisopropylphenyl)-5-methyl-isoindoline-1,3-dione					
C12597	 3-[6-[[2-(4-methyl-3-oxo-piperazin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	5.50144E-06	NA	NA	NA	FALSE

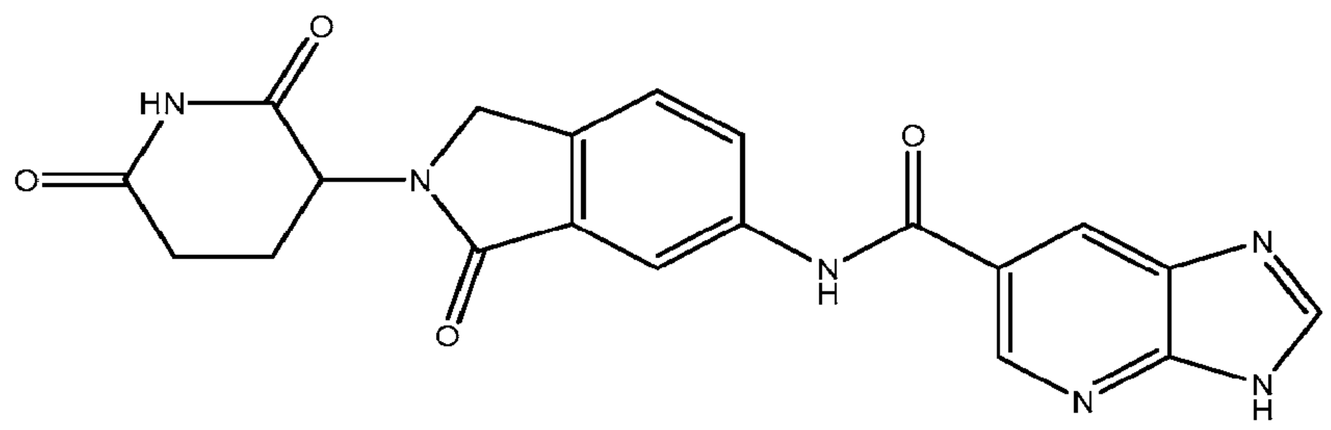
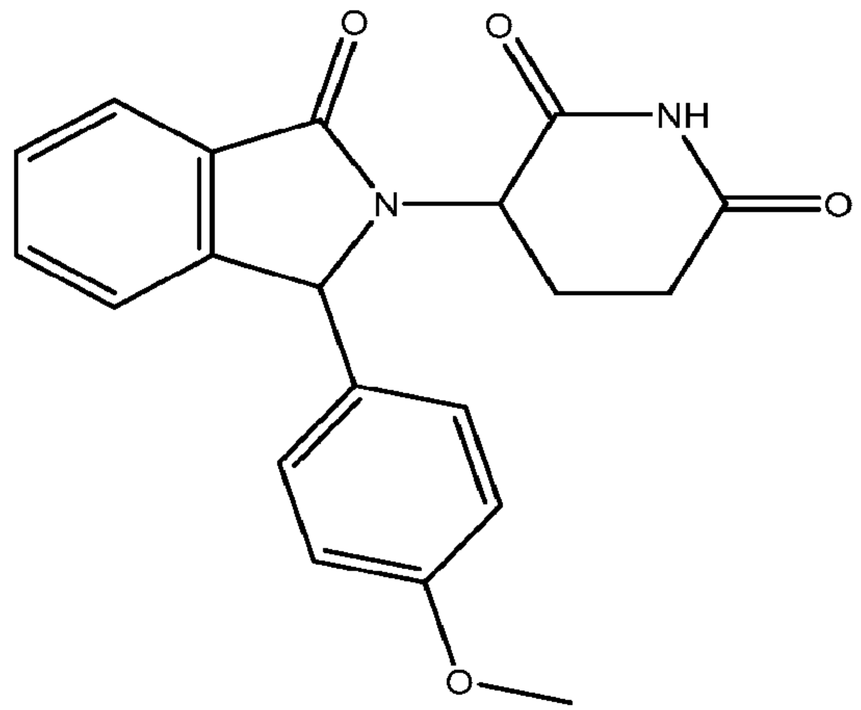
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
ZE26-0001	 2-[4-[[4-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-4-yl]oxymethyl]phenyl]methyl]piperazin-1-yl]acetic acid;formic acid	5.76168E-06	4.68E-06	>>	8.01E-07	TRUE

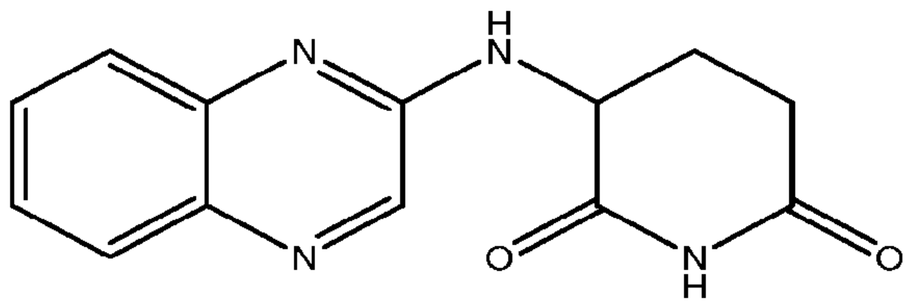
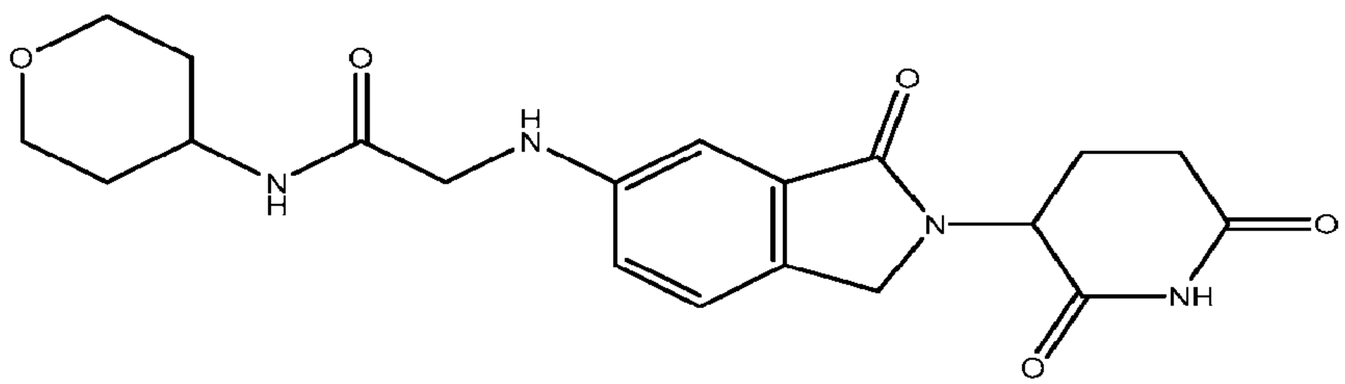
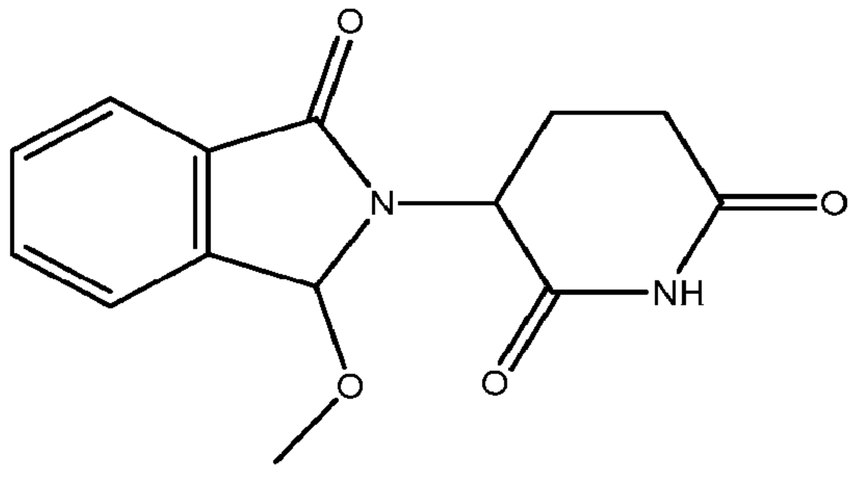
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C98053	 t-butyl 2-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-1-yl]acetate	5.76611E-06	NA	NA	NA	FALSE
C51830	 3-(2-oxopyrrolidin-1-yl)piperidine-2,6-dione	6.03878E-06	NA	NA	NA	FALSE
C97402		6.3212E-06	NA	NA	NA	FALSE

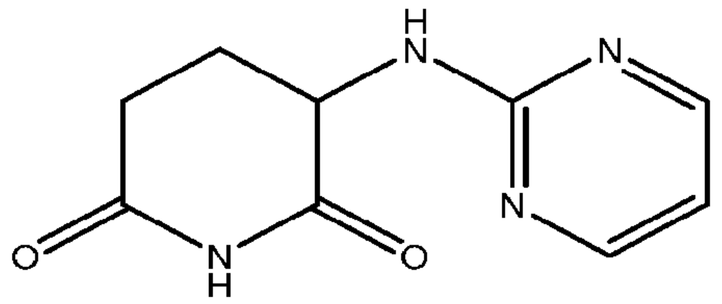
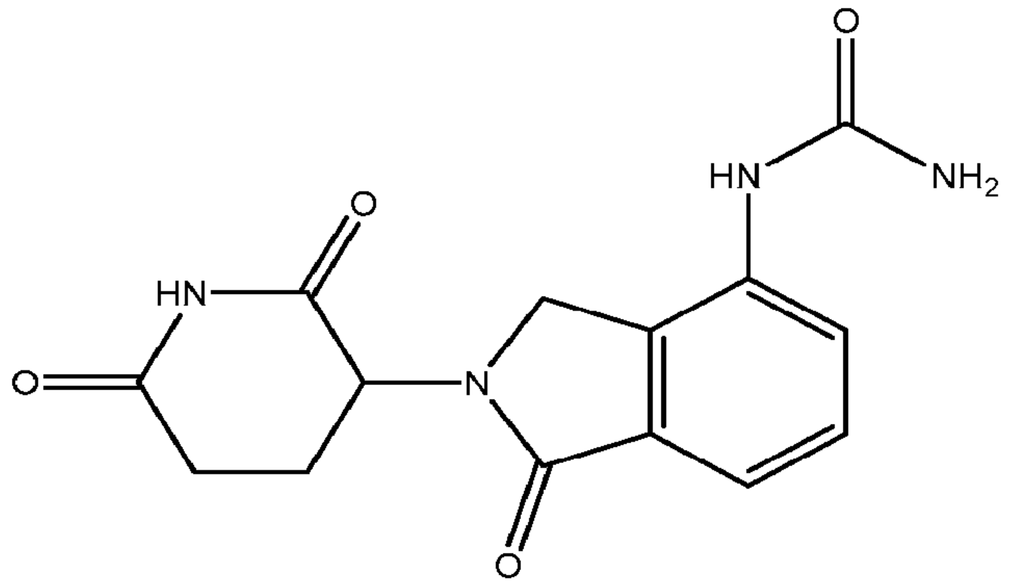
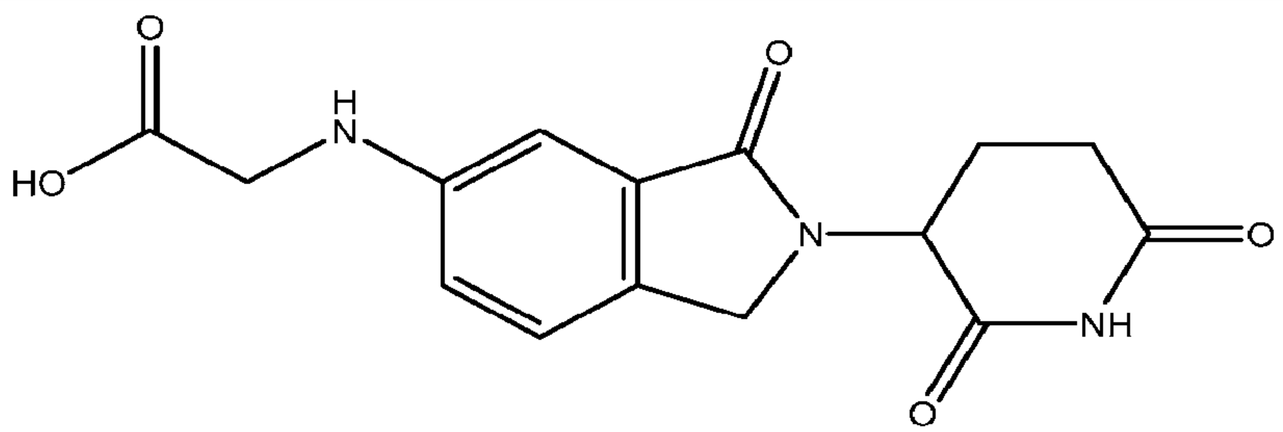
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
	3-(quinazolin-2-ylamino)piperidine-2,6-dione					
C68121	 (3Z)-3-benzylidenepiperidine-2,6-dione	6.5036E-06	NA	NA	NA	FALSE
C47998	 2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-4-yl]amino]acetic acid	6.58948E-06	NA	NA	2.17E-06	TRUE

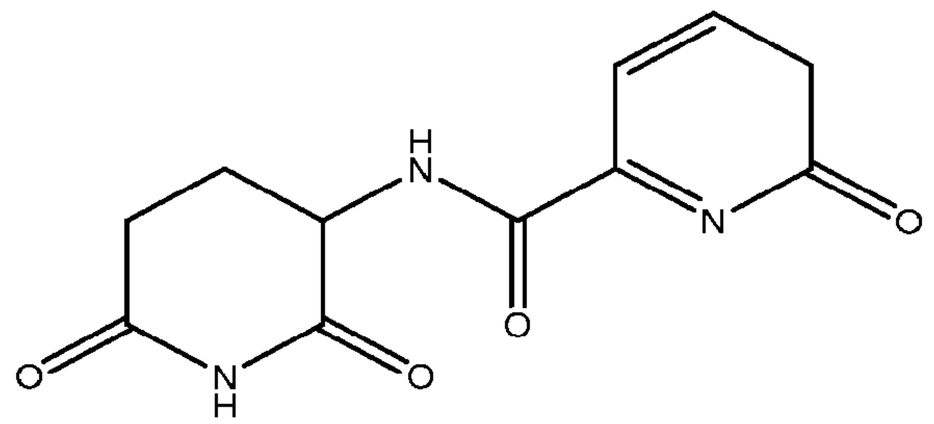
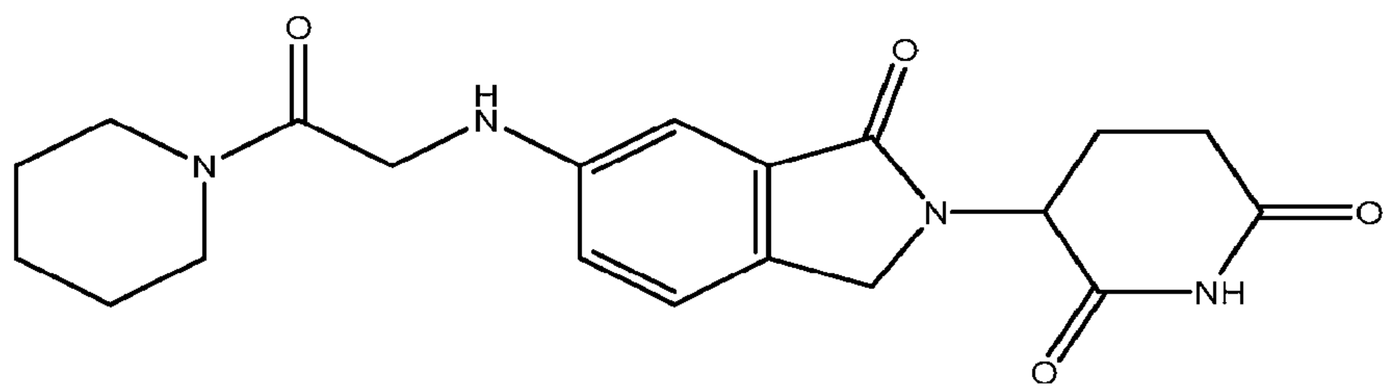
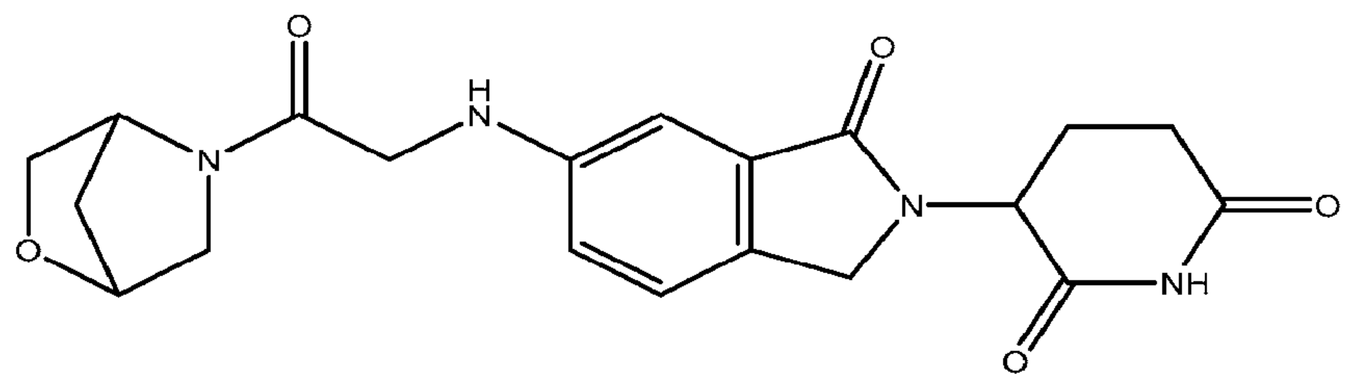
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C49713	 3-[1-(2H-indol-3-yl)-3-oxo-isoindolin-2-yl]piperidine-2,6-dione	6.73708E-06	NA	NA	NA	FALSE
C36126	 6-(3,4-dihydro-2H-quinoline-1-carbonyl)-3,4-dihydro-1H-1,8-naphthyridin-2-one	7.23164E-06	NA	NA	NA	FALSE

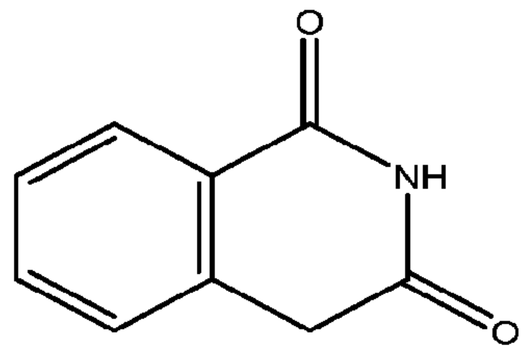
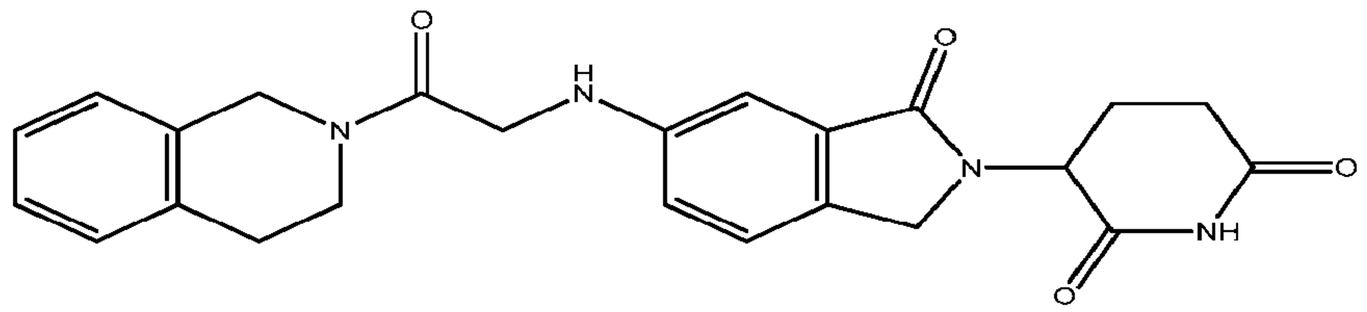
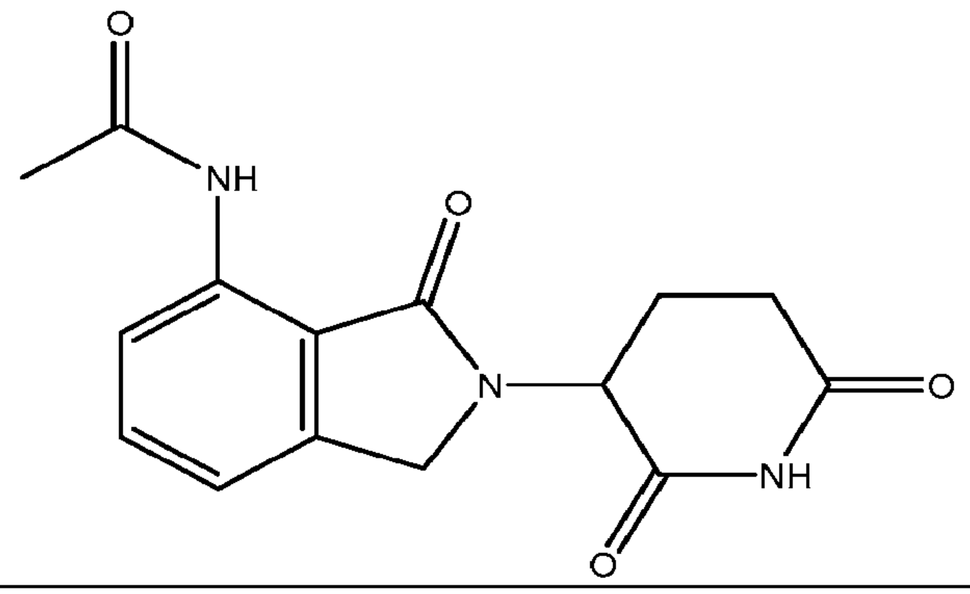
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1 (M)	EC50_SALL4(M)	Recruitment Assessment
C39453	 2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-1-carbonitrile	7.51549E-06	1.71E-05	NA	8.75E-07	TRUE
C10981	 3-[1-(dimethylamino)-3-oxo-isoindolin-2-yl]piperidine-2,6-dione	7.80566E-06	>>	>>	1.46E-06	TRUE

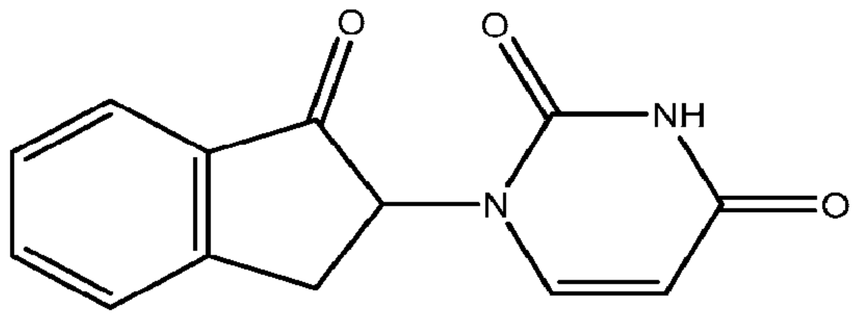
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1 (M)	EC50_SALL4(M)	Recruitment Assessment
C80394	 N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]-3H-imidazo[4,5-b] pyridine-6-carboxamide	7.99132E-06	>>	NA	NA	TRUE
C11892	 3-[1-(4-methoxyphenyl)-3-oxo-isoindolin-2-yl]piperidine-2,6-dione	8.15508E-06	NA	NA	NA	FALSE

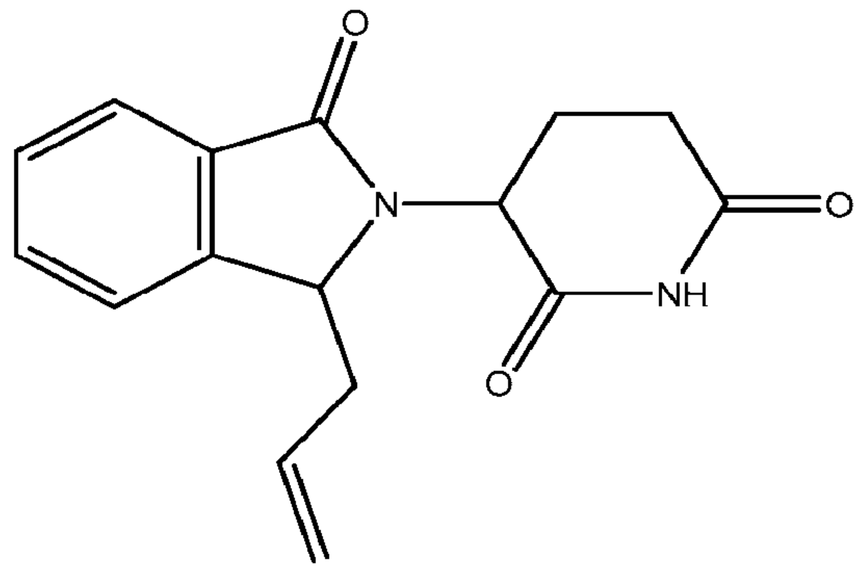
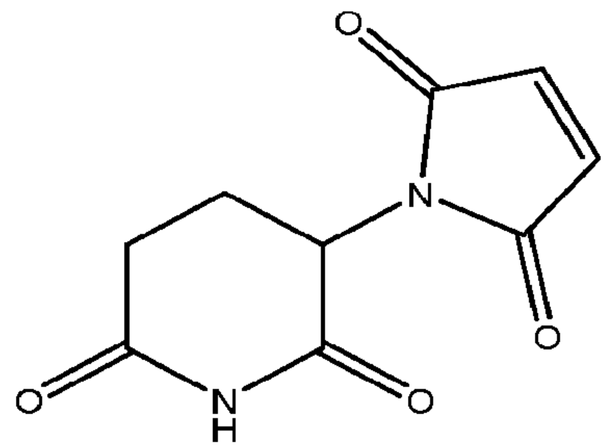
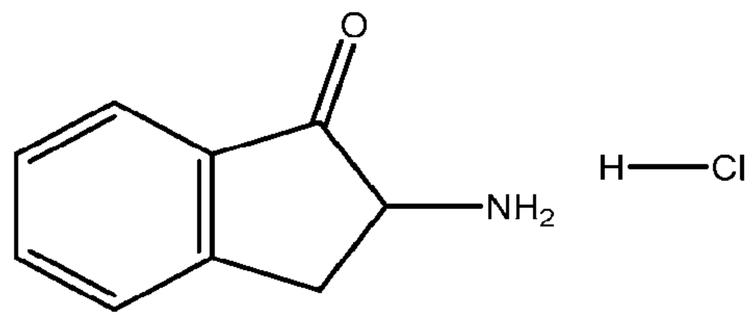
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C44292	 3-(quinoxalin-2-ylamino)piperidine-2,6-dione	8.32122E-06	NA	NA	NA	FALSE
C12693	 2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-tetrahydropyran-4-yl-acetamide	8.32631E-06	>>	NA	2.62E-06	TRUE
C56572	 3-(1-methoxy-3-oxo-isoindolin-2-yl)piperidine-2,6-dione	8.60508E-06	NA	NA	NA	FALSE

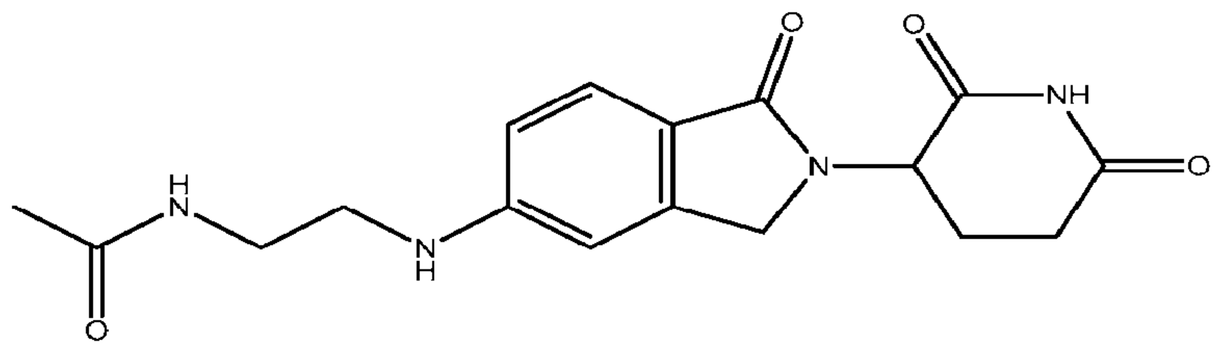
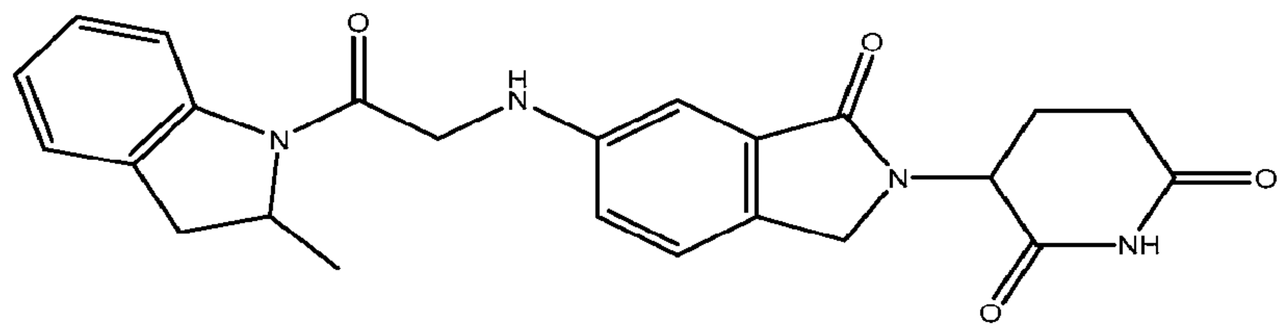
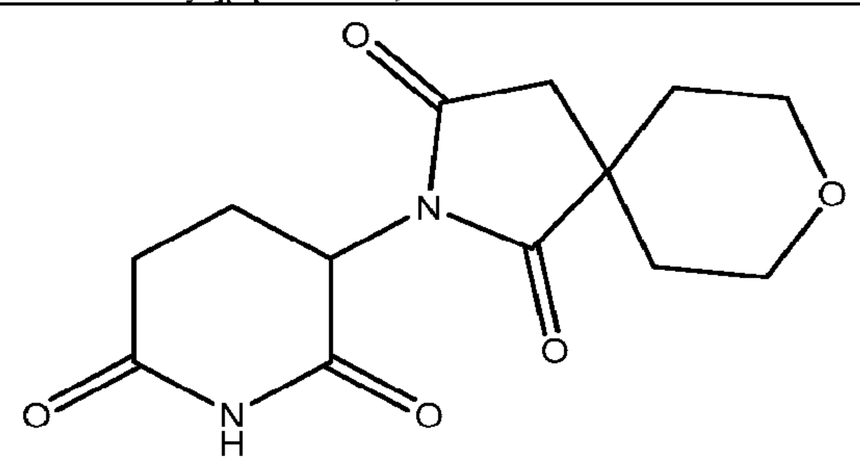
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C55468	 3-(pyrimidin-2-ylamino)piperidine-2,6-dione	8.68221E-06	NA	NA	NA	FALSE
C29490	 [2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-4-yl]urea	8.86373E-06	>>	NA	NA	TRUE
C47997	 2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetic acid	9.09859E-06	NA	NA	NA	FALSE

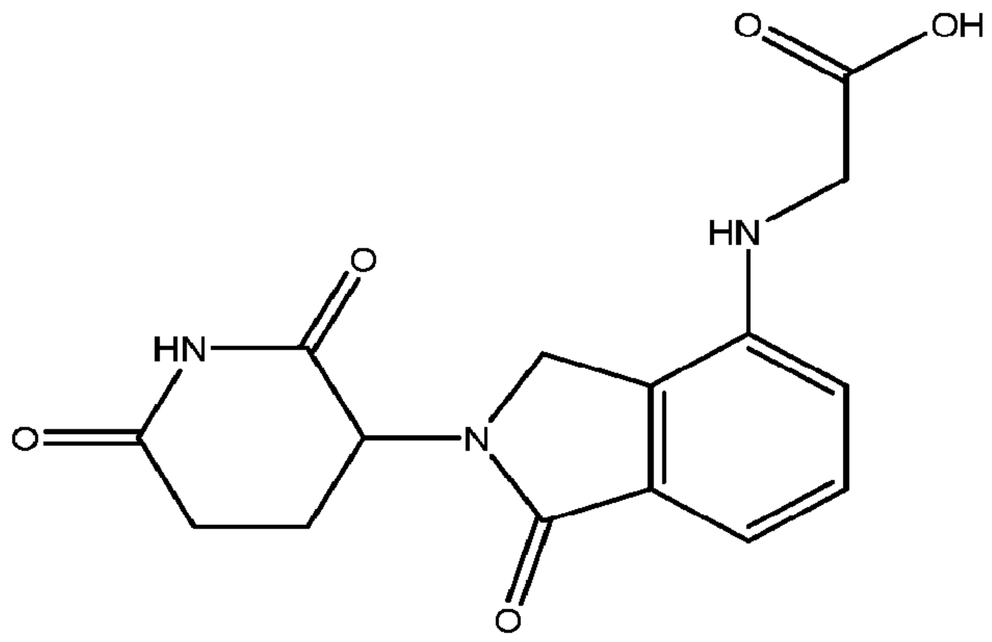
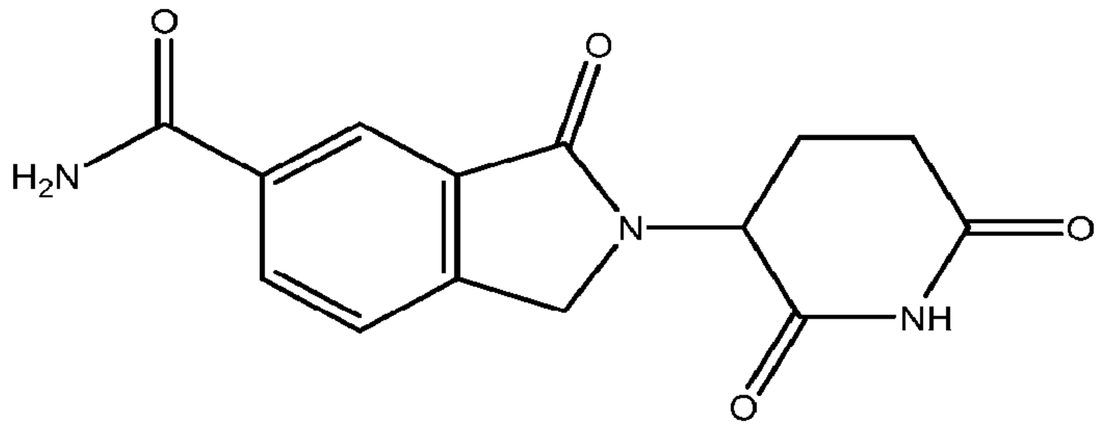
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C98696	 N-(2,6-dioxo-3-piperidyl)-2-oxo-3H-pyridine-6-carboxamide	9.3409E-06	NA	NA	NA	FALSE
C12581	 3-[1-oxo-6-[[2-oxo-2-(1-piperidyl)ethyl]amino]isoindolin-2-yl]piperidine-2,6-dione	9.99653E-06	NA	NA	NA	FALSE
C12589	 3-[6-[[2-(2-oxa-5-azabicyclo[2.2.1]heptan-5-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine	1.02777E-05	NA	NA	NA	FALSE

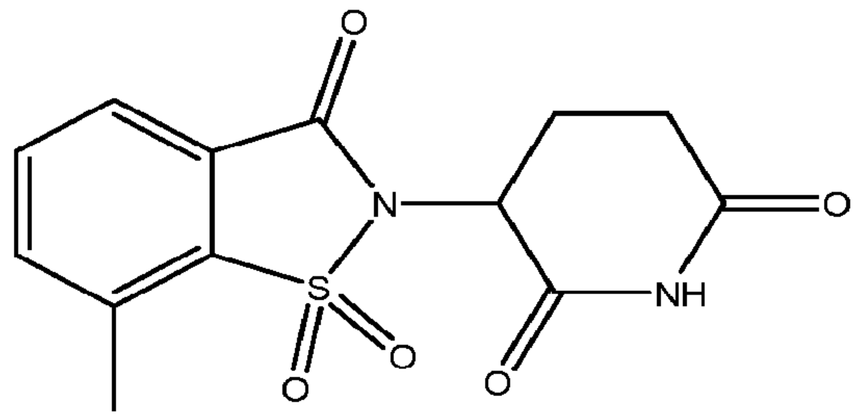
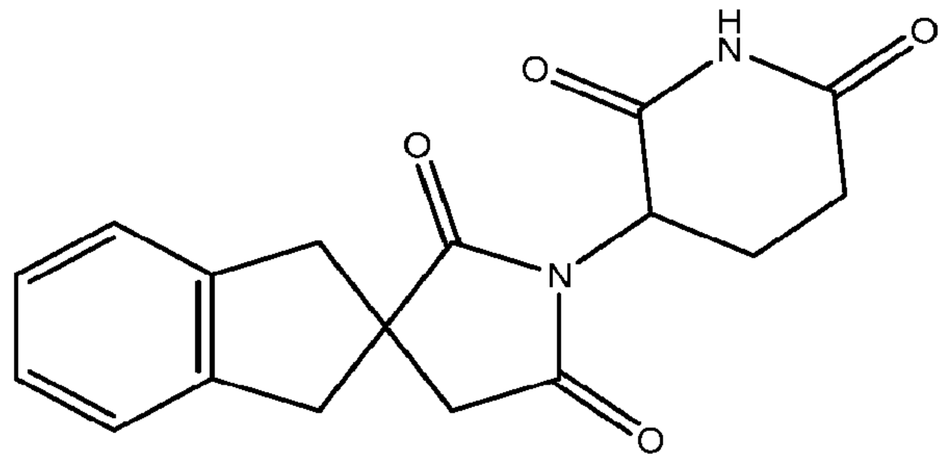
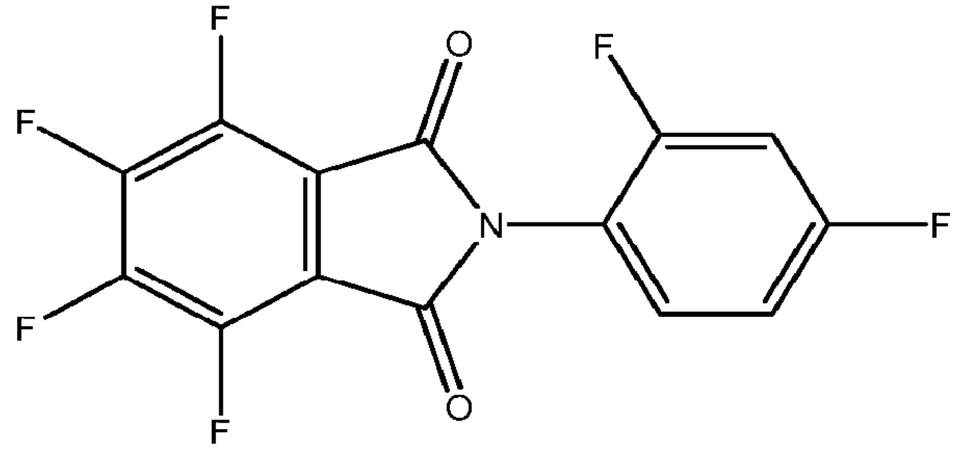
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C15352	 4H-isoquinoline-1,3-dione	1.031E-05	NA	NA	NA	FALSE
C95329	 3-[6-[[2-(3,4-dihydro-1H-isoquinolin-2-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-	1.03261E-05	NA	NA	NA	FALSE
C29457		1.03599E-05	>>	NA	>>	TRUE

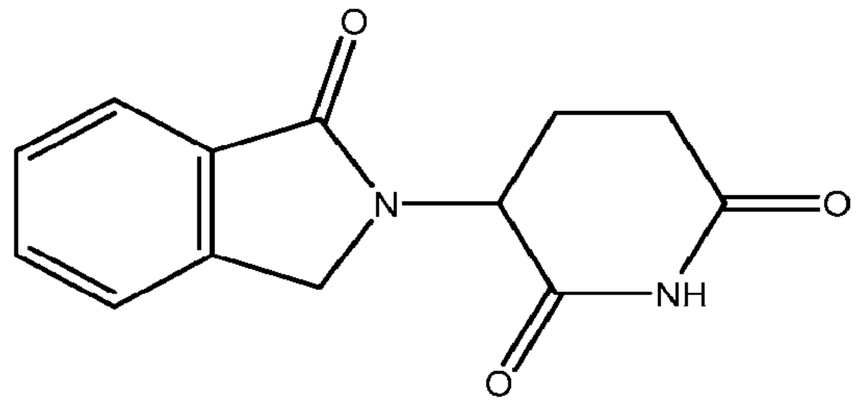
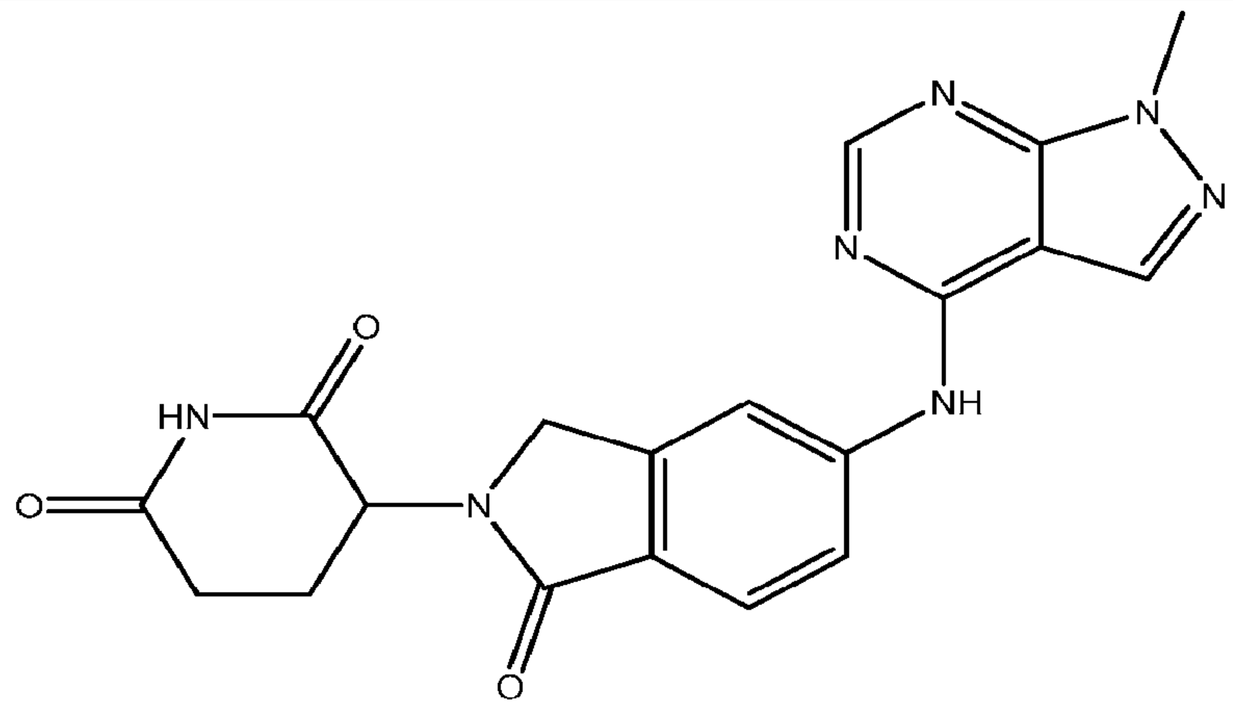
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
	N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-4-yl]acetamide					
C16899	 1-(1-oxoindan-2-yl)pyrimidine-2,4-dione	1.03816E-05	NA	NA	NA	FALSE

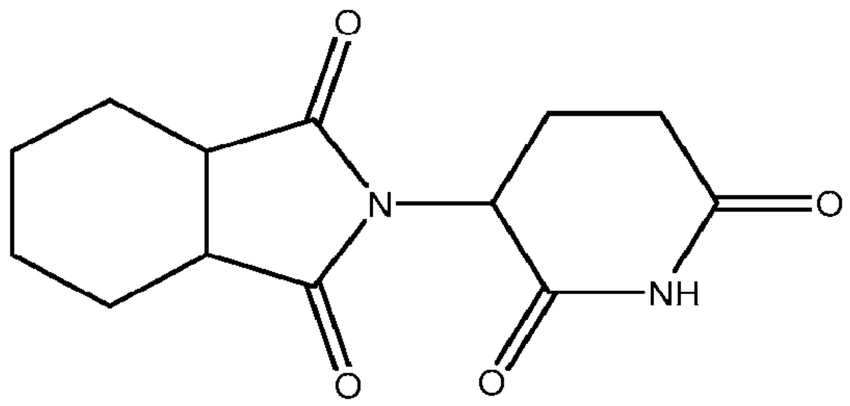
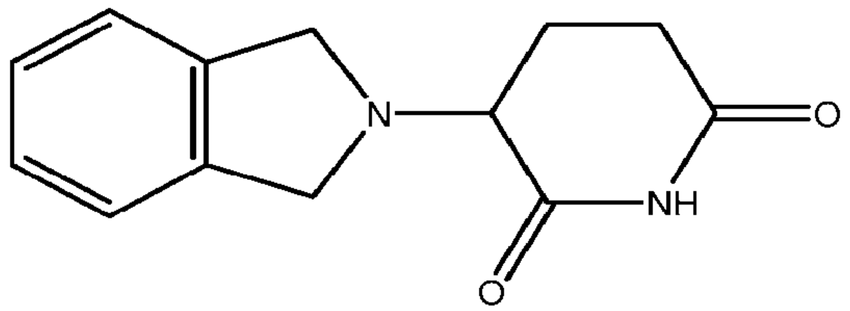
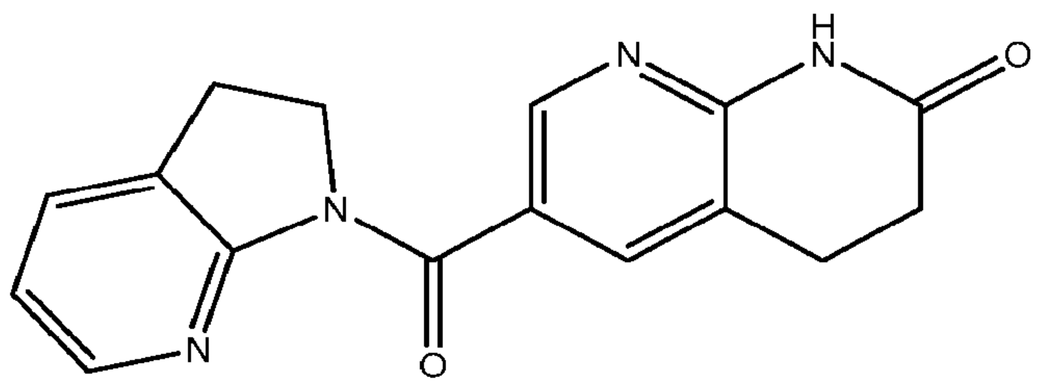
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1 (M)	EC50_SALL4(M)	Recruitment Assessment
C96413	 3-(1-allyl-3-oxo-isoindolin-2-yl)piperidine-2,6-dione	1.03991E-05	NA	NA	NA	FALSE
C40531	 3-(2,5-dioxopyrrol-1-yl)piperidine-2,6-dione	1.10435E-05	NA	NA	NA	FALSE
C75987	 2-aminoindan-1-one;hydrochloride	1.12251E-05	NA	NA	NA	FALSE

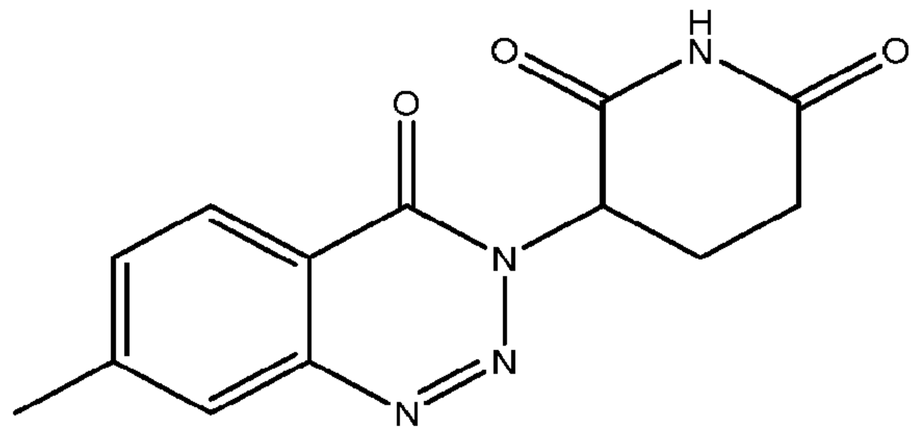
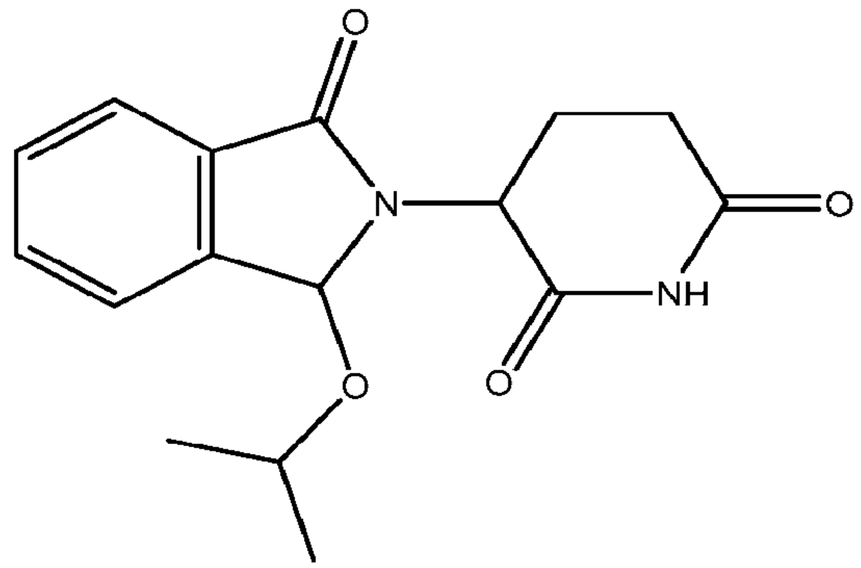
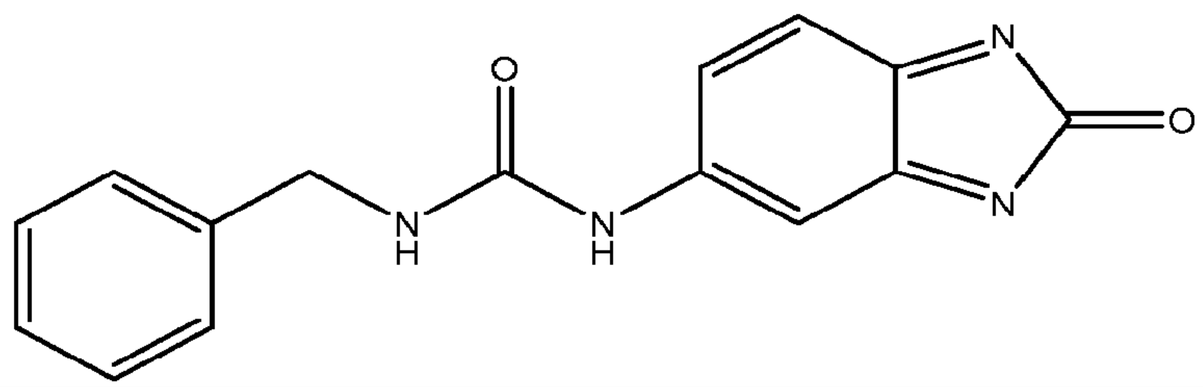
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C35745	 N-[2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]ethyl]acetamide	1.12483E-05	>>	NA	2.63E-06	TRUE
C95336	 3-[6-[[2-(2-methylindolin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	1.19471E-05	NA	NA	NA	FALSE
C64348	 2-(2,6-dioxo-3-piperidyl)-8-oxa-2-azaspiro[4.5]decane-1,3-dione	1.29256E-05	NA	NA	NA	FALSE

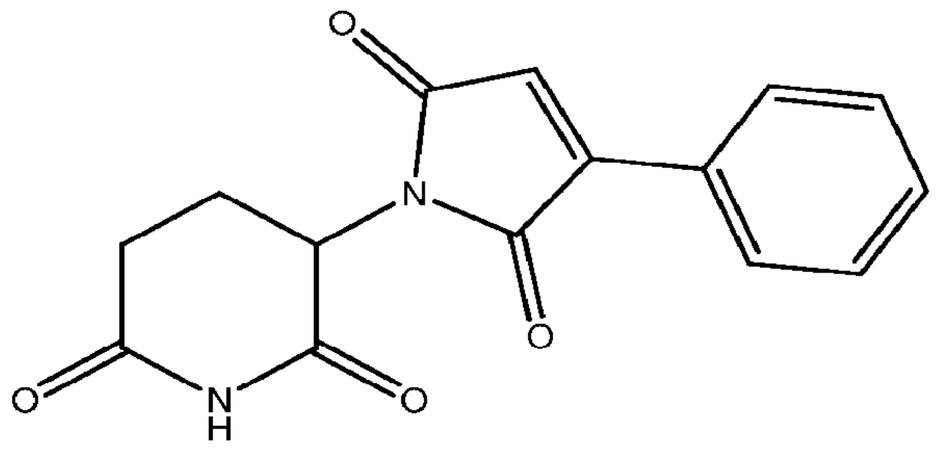
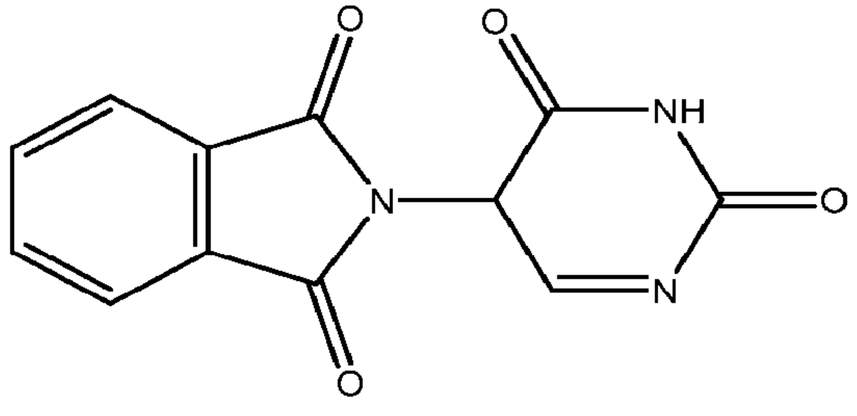
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C02896	 2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-4-yl]amino]acetic acid	1.38151E-05	NA	NA	NA	FALSE
C39772	 2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-5-carboxamide	1.38404E-05	NA	NA	NA	FALSE

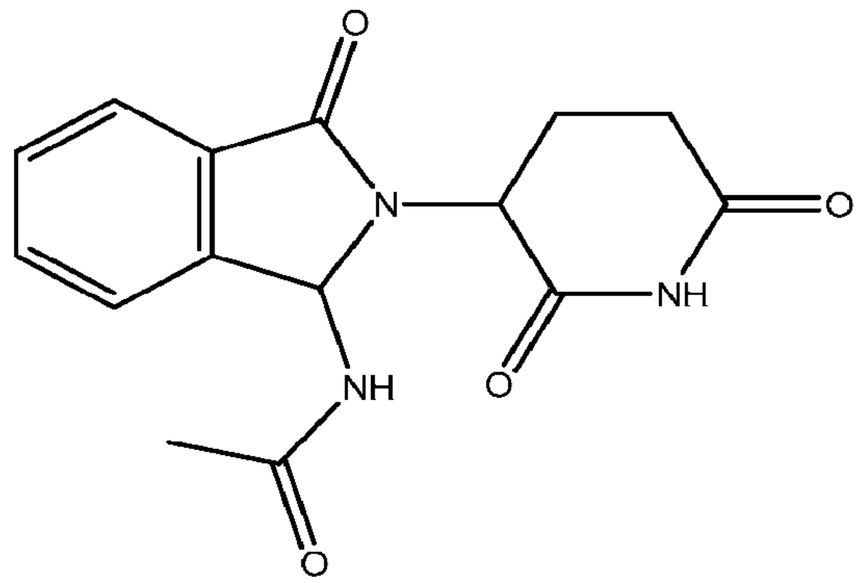
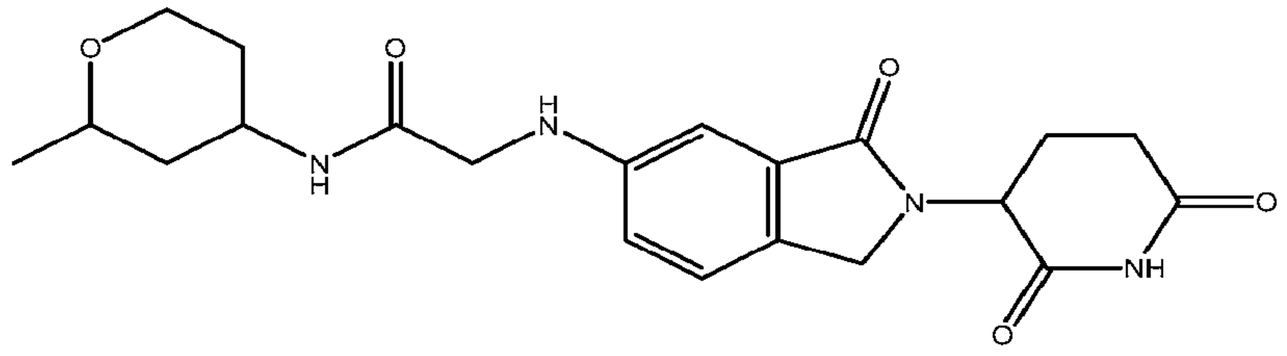
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C75688	 3-(7-methyl-1,1,3-trioxo-1,2-benzothiazol-2-yl)piperidine-2,6-dione	1.47323E-05	NA	NA	NA	FALSE
C64329	 1'-(2,6-dioxo-3-piperidyl)spiro[indane-2,3'-pyrrolidine]-2',5'-dione	1.51214E-05	NA	NA	NA	FALSE
C34491	 2-(2,4-difluorophenyl)-4,5,6,7-tetrafluoro-isoindoline-1,3-dione	1.61223E-05	NA	NA	NA	FALSE

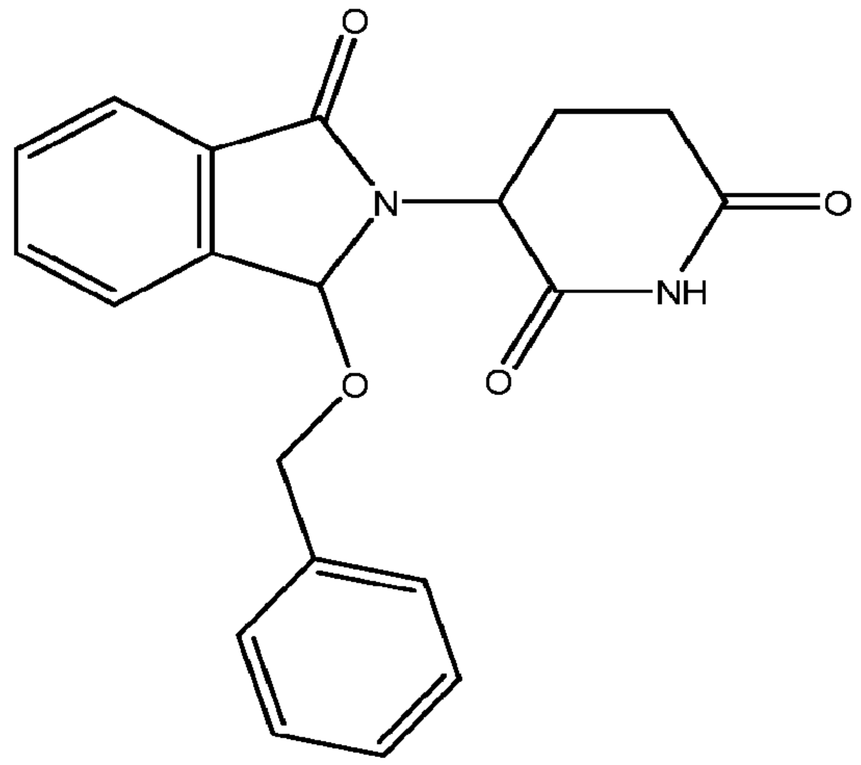
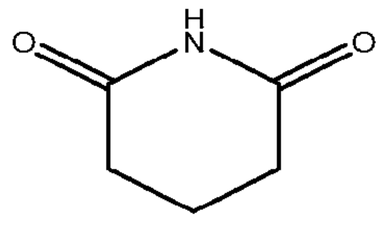
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
5'-OH-THL	 3-(1-oxoisoindolin-2-yl)piperidine-2,6-dione	1.61621E-05	NA	NA	NA	FALSE
C80374	 3-[5-[(1-methylpyrazolo[3,4-d]pyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	1.65805E-05	>>	NA	NA	TRUE

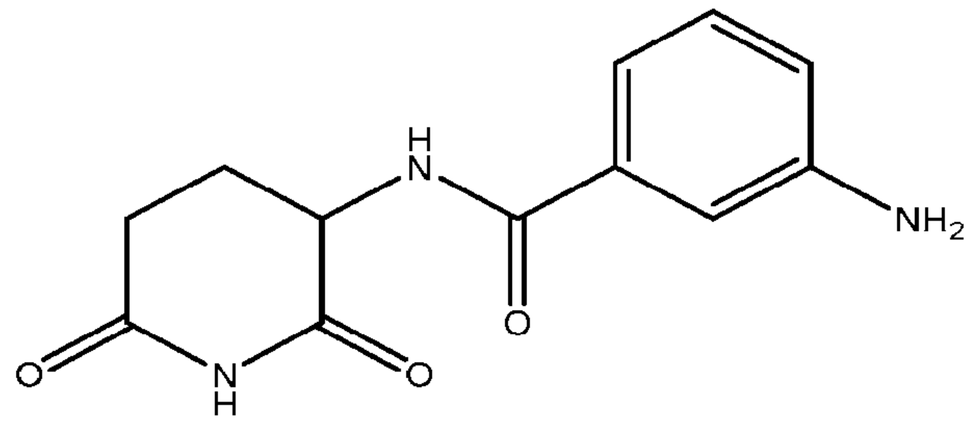
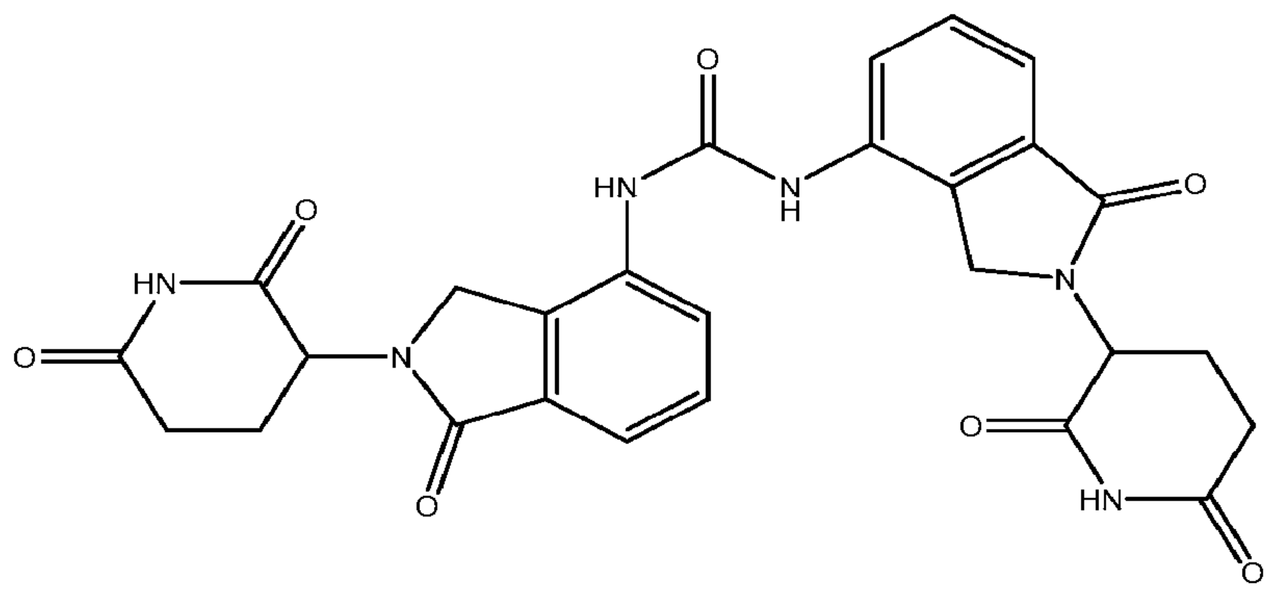
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C24191	 2-(2,6-dioxo-3-piperidyl)-3a,4,5,6,7,7a-hexahydroisoindole-1,3-dione	1.7708E-05	NA	NA	NA	FALSE
C87699	 3-isoindolin-2-ylpiperidine-2,6-dione	1.96334E-05	NA	NA	4.82E-06	TRUE
C36128	 6-(2,3-dihydropyrrolo[2,3-b]pyridine-1-carbonyl)-3,4-dihydro-1H-1,8-naphthyridin-2-one	2.02561E-05	NA	NA	NA	FALSE

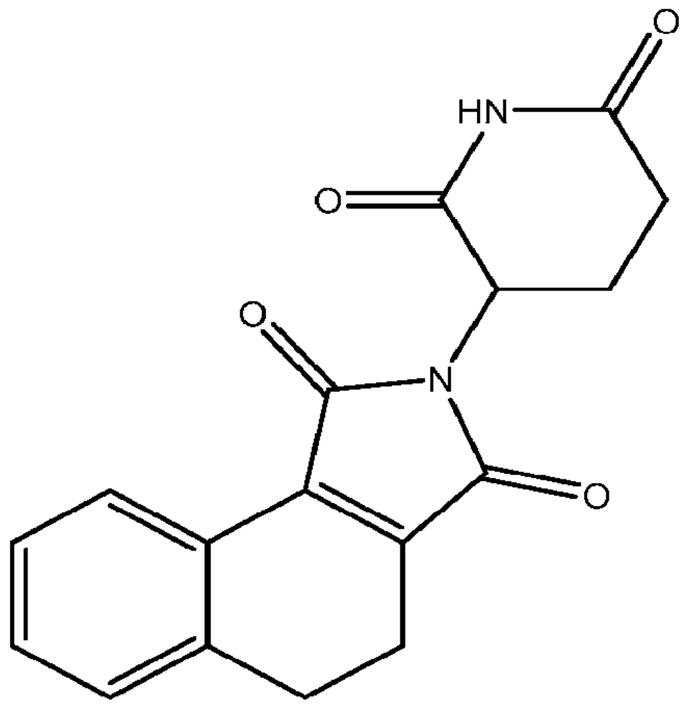
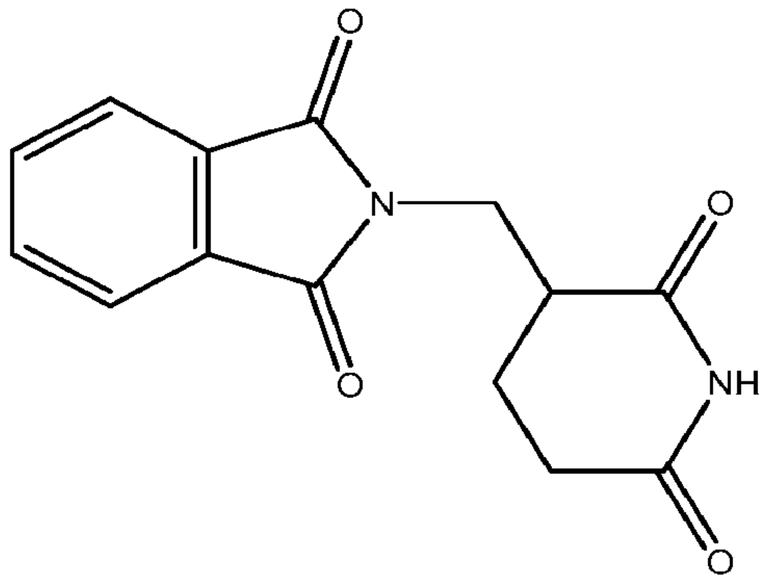
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C17800	 3-(7-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione	2.18924E-05	>>	NA	9.04E-07	TRUE
C08493	 3-(1-isopropoxy-3-oxo-isoindolin-2-yl)piperidine-2,6-dione	2.28752E-05	>>	NA	2.70E-06	TRUE
C07128		2.3835E-05	NA	NA	NA	FALSE

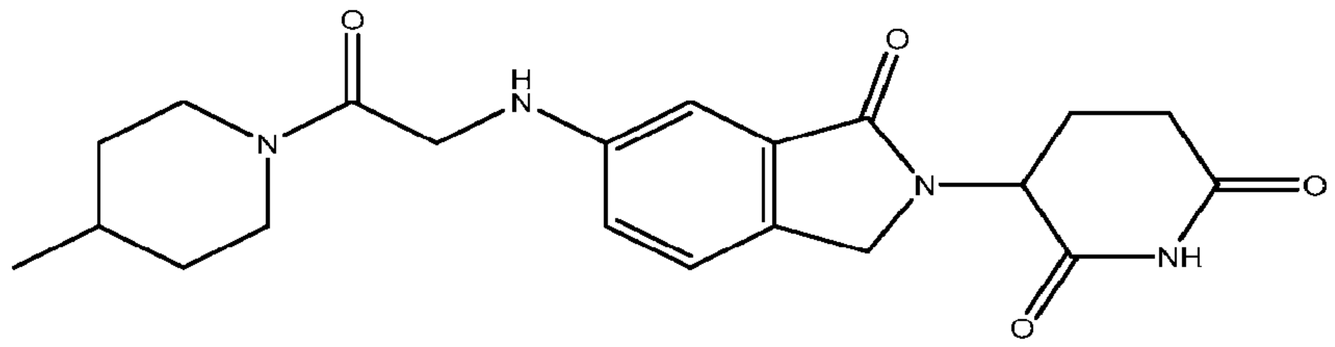
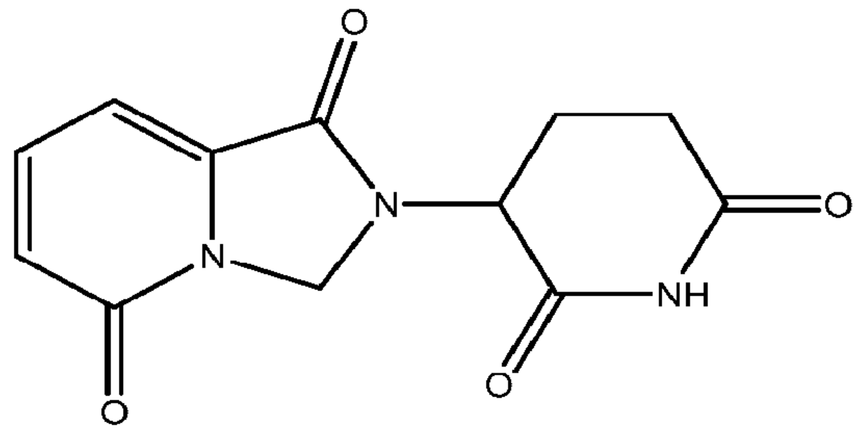
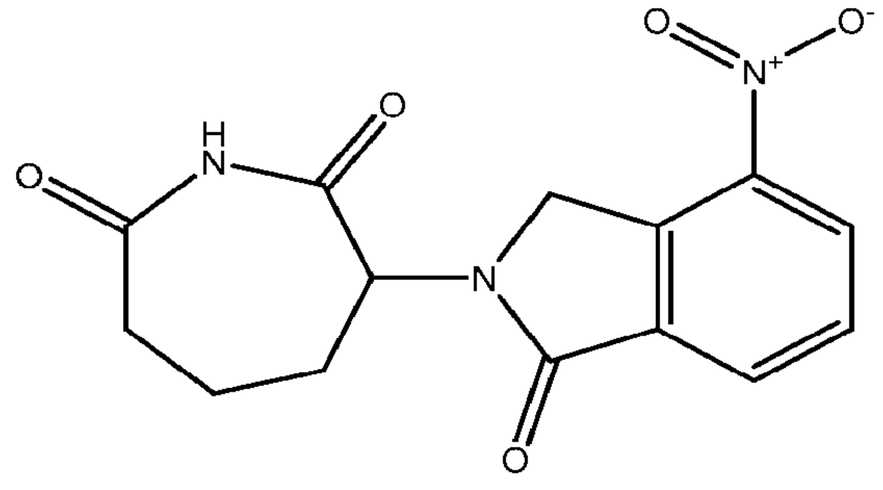
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
	1-benzyl-3-(2-oxobenzimidazol-5-yl)urea					
C64319	 3-(2,5-dioxo-3-phenyl-pyrrol-1-yl)piperidine-2,6-dione	4.28801E-05	NA	NA	NA	FALSE
C49278	 2-(2,6-dioxo-5H-pyrimidin-5-yl)isoindoline-1,3-dione	4.53958E-05	NA	NA	NA	FALSE

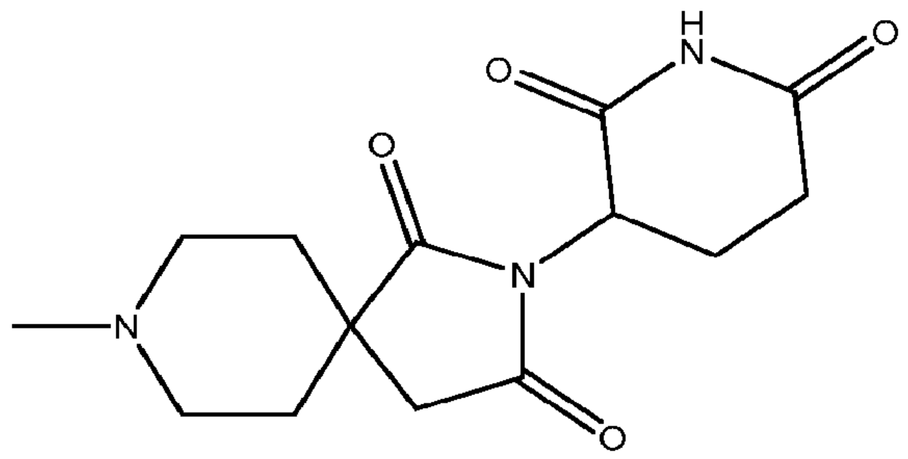
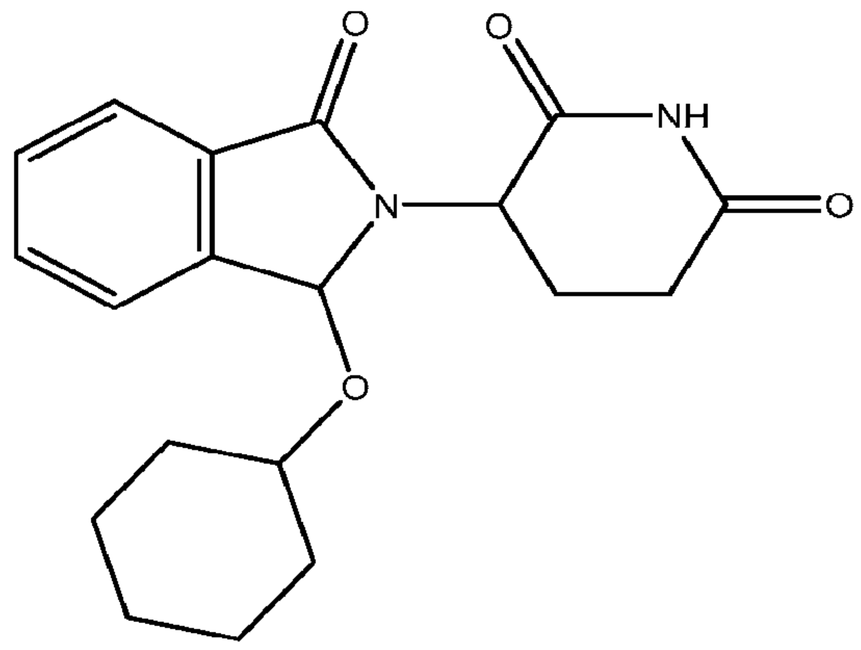
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C33779	 N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-1-yl]acetamide	4.94369E-05	NA	NA	3.03E-06	TRUE
C12695	 2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino] -N-(2-methyltetrahydropyran-4-yl)acetamide	5.79759E-05	NA	NA	NA	FALSE

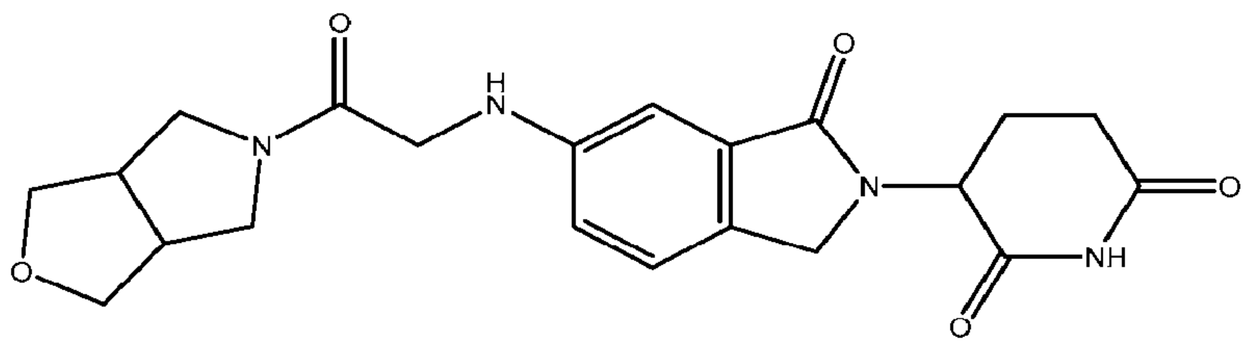
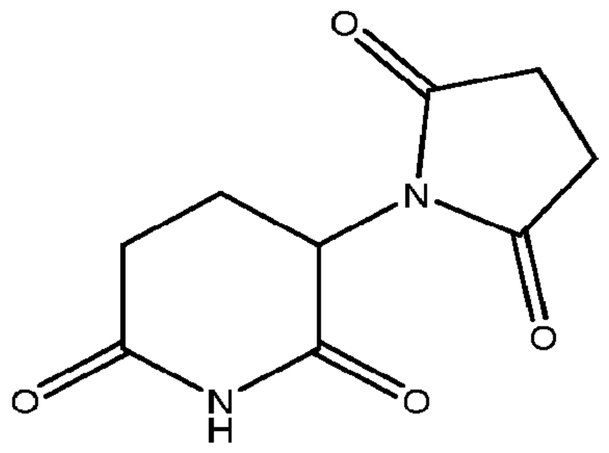
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C09563	 3-(1-benzyloxy-3-oxo-isoindolin-2-yl)piperidine-2,6-dione	5.82854E-05	NA	NA	NA	FALSE
glutarimide	 piperidine-2,6-dione	9.53602E-05	NA	NA	NA	FALSE

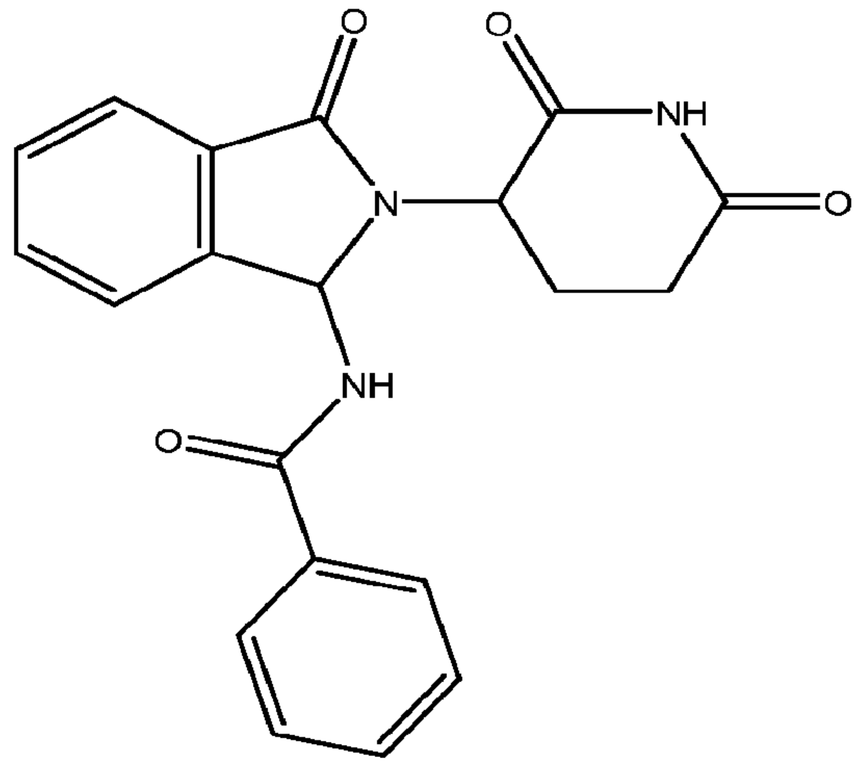
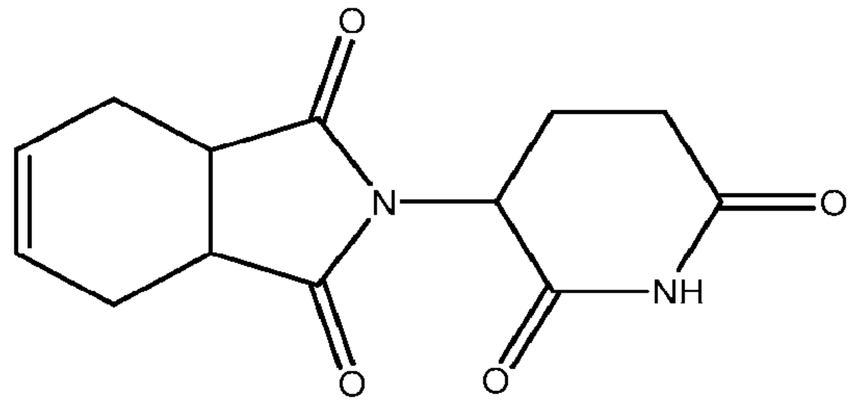
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C38935	 3-amino-N-(2,6-dioxo-3-piperidyl)benzamide	9.92946E-05	>>	NA	NA	TRUE
C30231	 1,3-bis[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-4-yl]urea	0.000247103	2.73E-06	>>	1.78E-06	TRUE

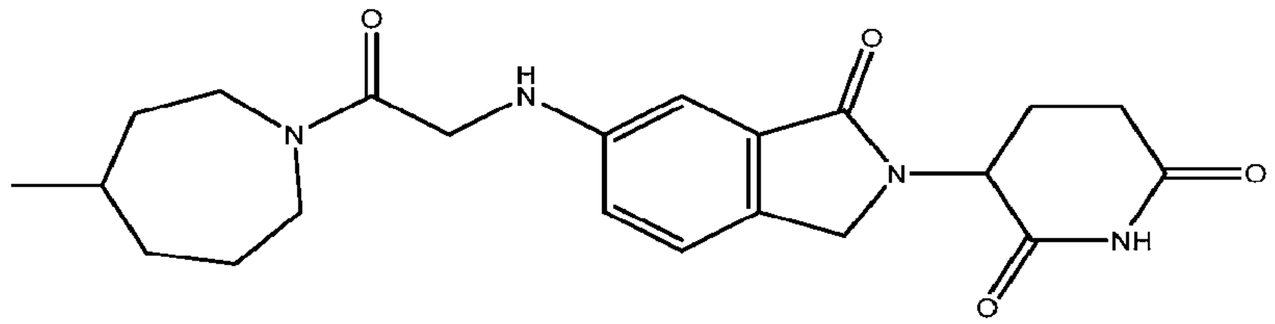
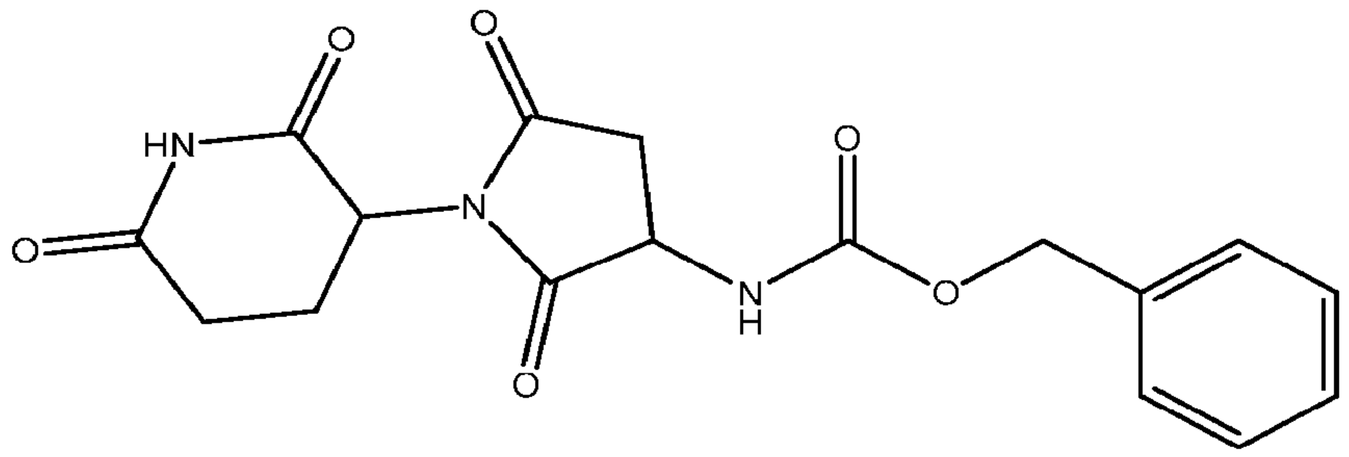
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C64340	 2-(2,6-dioxo-3-piperidyl)-4,5-dihydrobenzo[e]isoindole-1,3-dione	0.002503261	>>	NA	1.49E-06	TRUE
C23258	 2-[(2,6-dioxo-3-piperidyl)methyl]isoindoline-1,3-dione	0.014526546	NA	NA	NA	FALSE

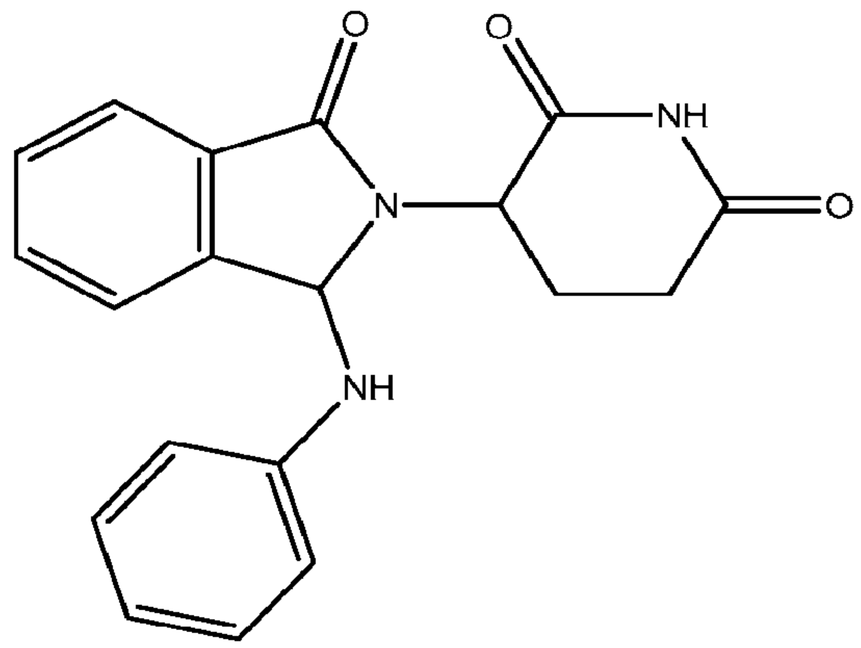
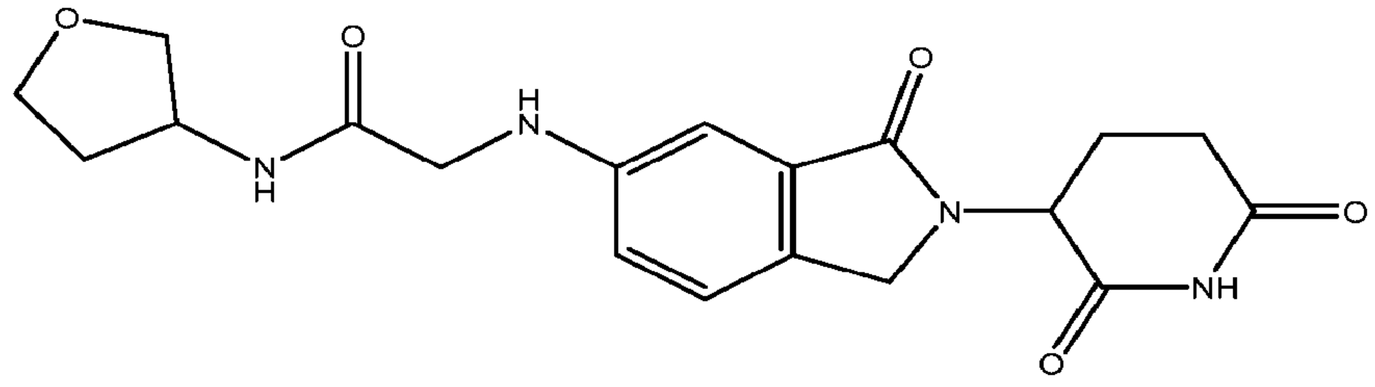
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C12582	 3-[6-[[2-(4-methyl-1-piperidyl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl] piperidine-2,6-dione	0.037396754	NA	NA	NA	FALSE
C60651	 2-(2,6-dioxo-3-piperidyl)-3H-imidazo[1,5-a]pyridine-1,5-dione	0.113371238	NA	NA	NA	FALSE
C29737	 3-(4-nitro-1-oxo-isoindolin-2-yl)azepane-2,7-dione	0.122564012	1.41E-06	NA	NA	TRUE

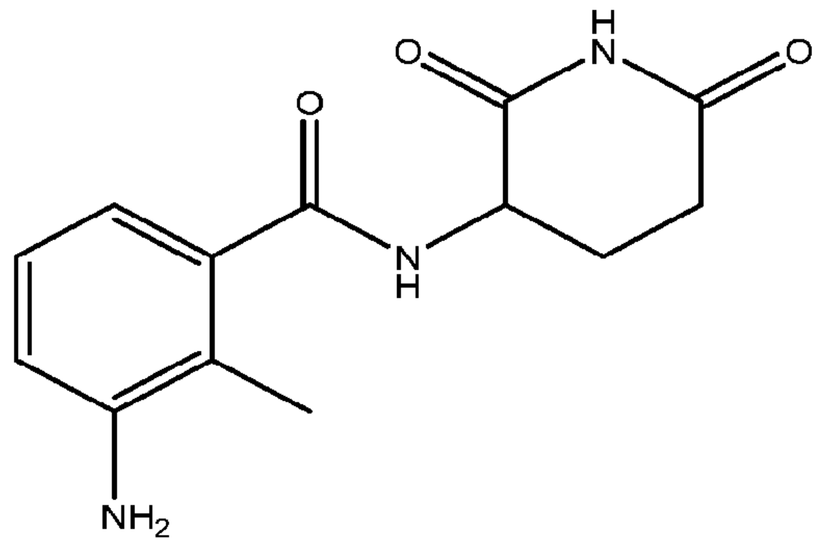
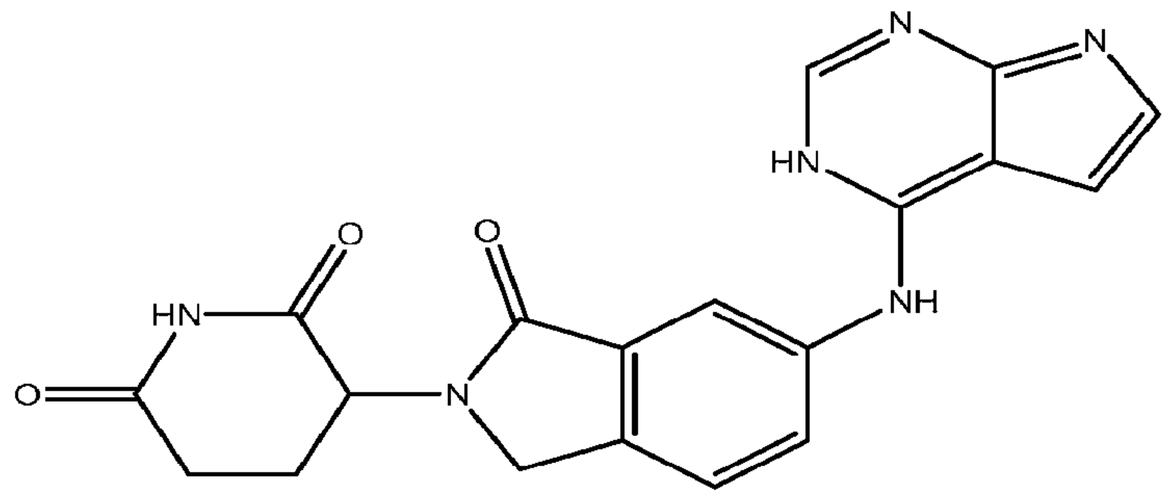
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C64372	 2-(2,6-dioxo-3-piperidyl)-8-methyl-2,8-diazaspiro[4.5]decane-1,3-dione	0.223963175	NA	NA	NA	FALSE
C09063	 3-[1-(cyclohexoxy)-3-oxo-isoindolin-2-yl]piperidine-2,6-dione	0.453327822	NA	NA	NA	FALSE

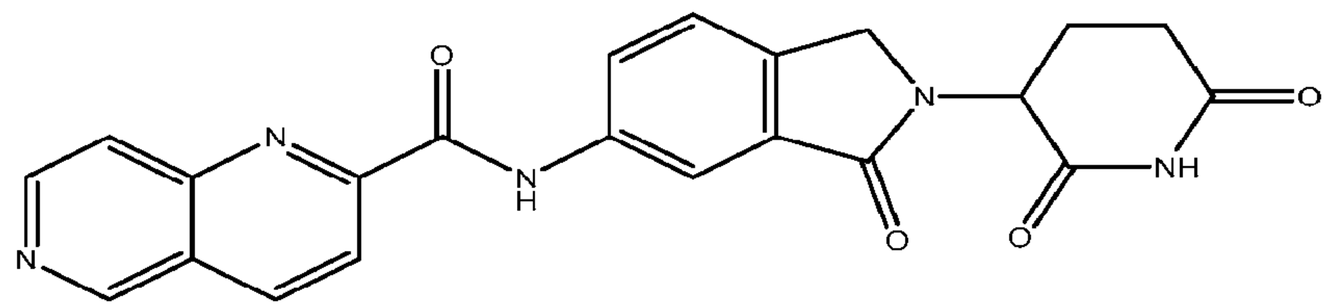
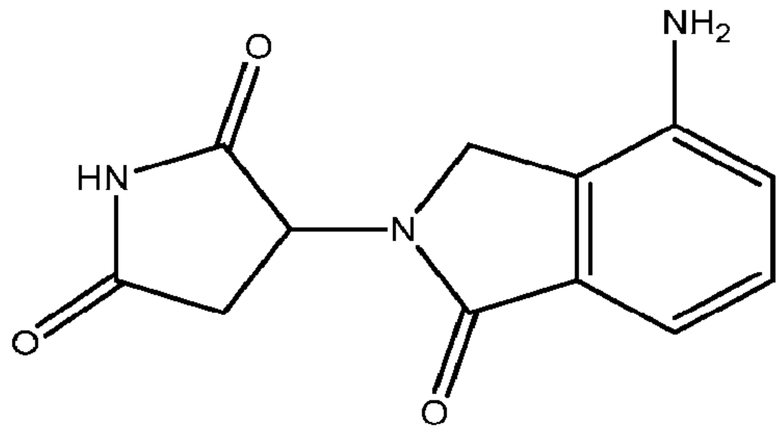
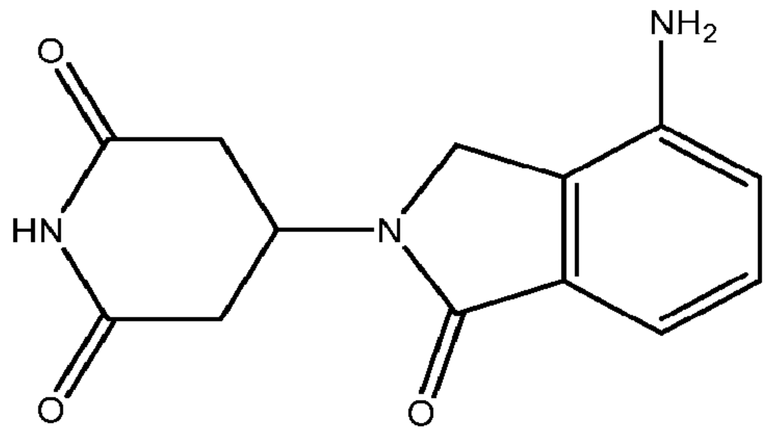
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C95334	 3-[6-[[2-(1,3,3a,4,6,6a-hexahydrofuro[3,4-c]pyrrol-5-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	1.594934429	NA	NA	NA	FALSE
C14950	 3-(2,5-dioxopyrrolidin-1-yl)piperidine-2,6-dione	3.958295874	NA	NA	NA	FALSE

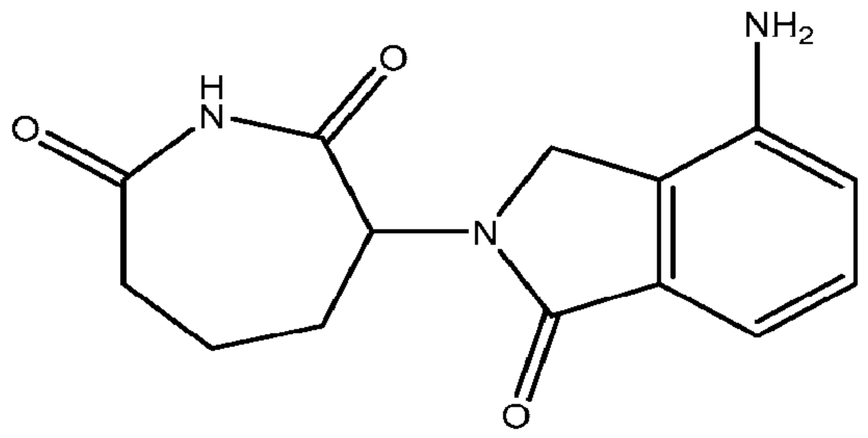
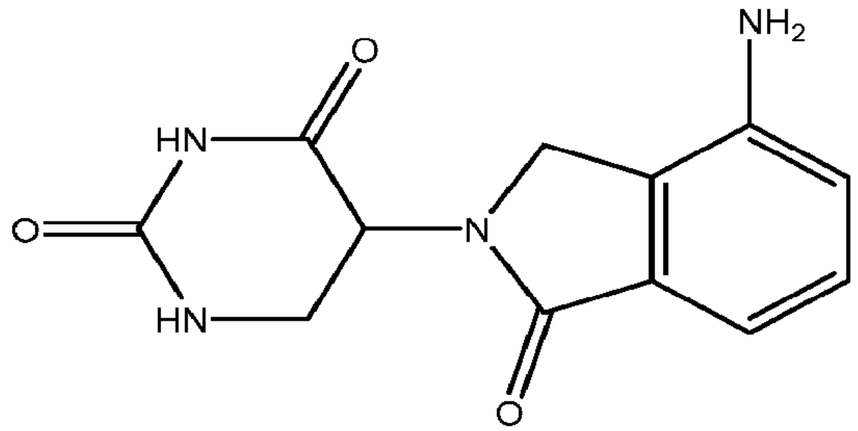
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1 (M)	EC50_SALL4(M)	Recruitment Assessment
C46003	 N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-1-yl]benzamide	32.56223026	NA	NA	NA	FALSE
C51647	 2-(2,6-dioxo-3-piperidyl)-3a,4,7,7a-tetrahydroisoindole-1,3-dione	51.17761807	NA	NA	NA	FALSE

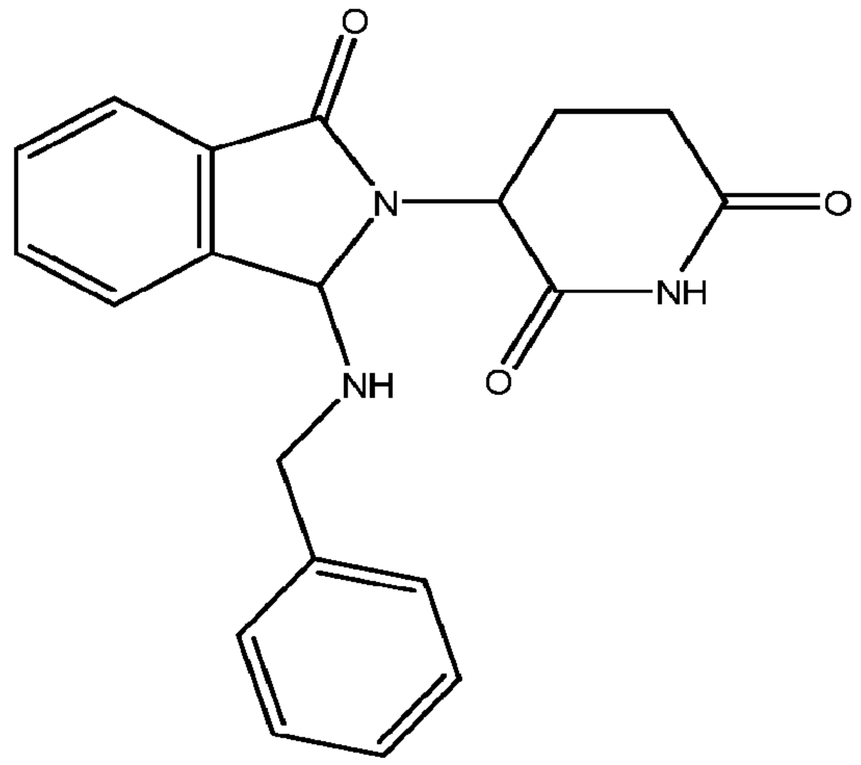
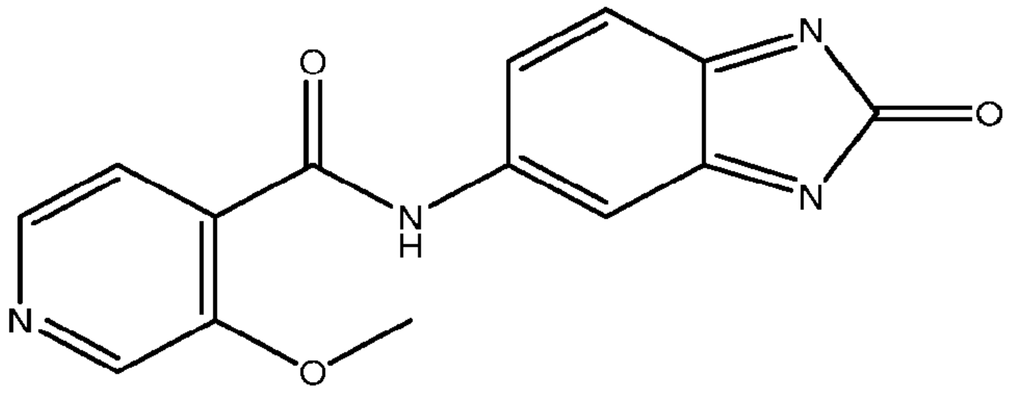
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C12697	 3-[6-[[2-(4-methylazepan-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione	51.67955472	NA	NA	NA	FALSE
C64344	 benzyl N-[1-(2,6-dioxo-3-piperidyl)-2,5-dioxo-pyrrolidin-3-yl]carbamate	112.7097496	NA	NA	NA	FALSE

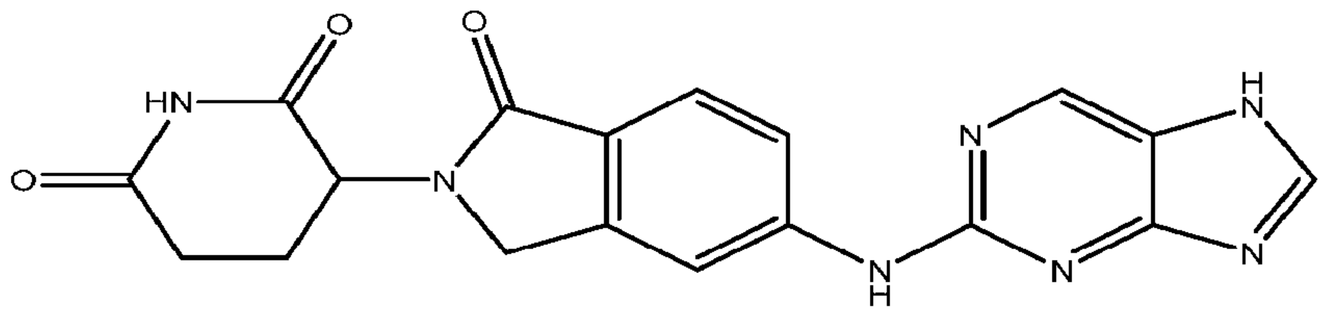
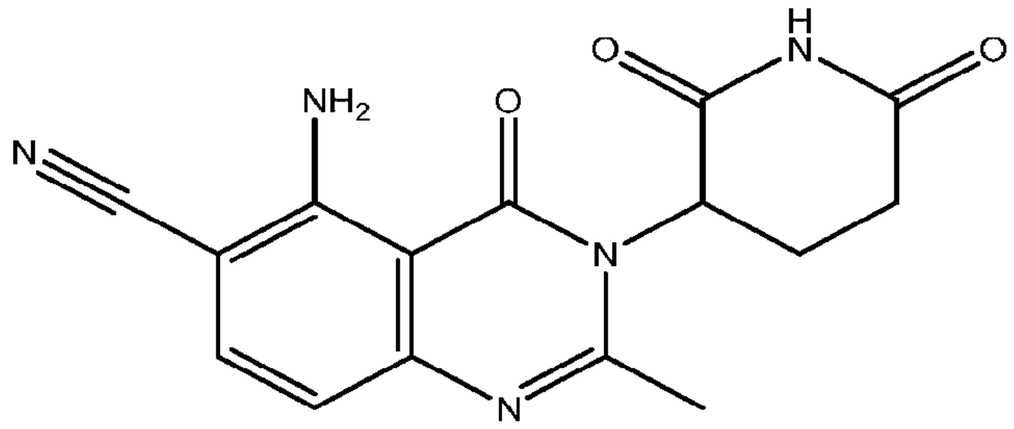
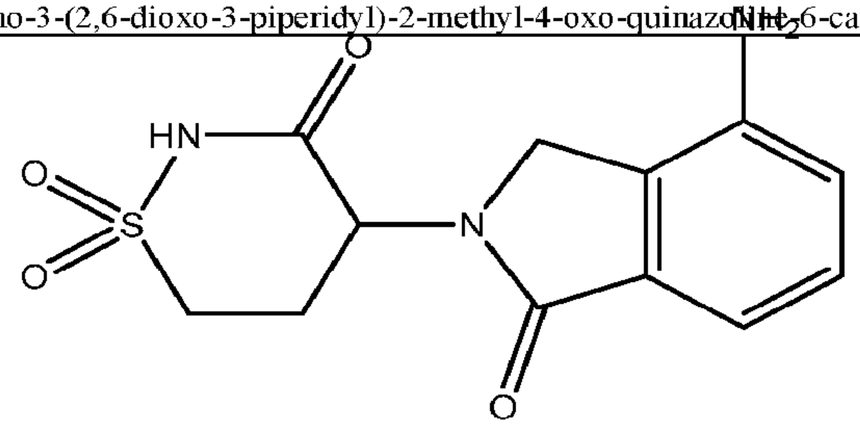
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C10537	 3-(1-anilino-3-oxo-isoindolin-2-yl)piperidine-2,6-dione		NA	NA	NA	FALSE
C12694	 2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-tetrahydrofuran-3-yl-acetamide		>>	NA	3.43E-06	TRUE

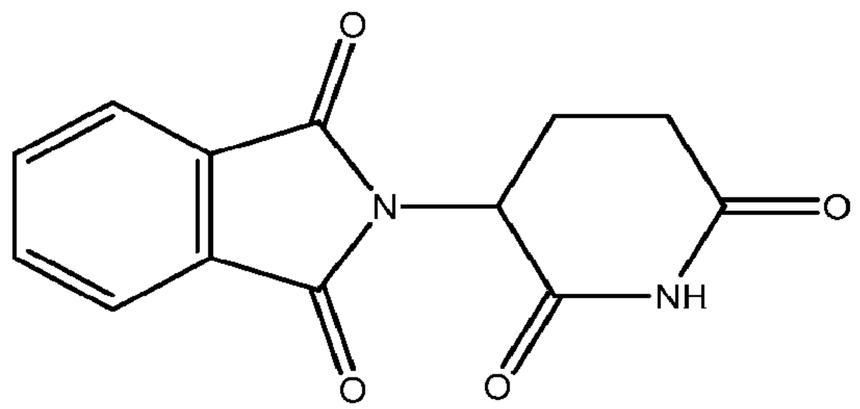
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C38930	 3-amino-N-(2,6-dioxo-3-piperidyl)-2-methyl-benzamide		NA	NA	NA	FALSE
C80385	 3-[1-oxo-6-(3H-pyrrolo[2,3-d]pyrimidin-4-ylamino)isoindolin-2-yl] piperidine-2,6-dione		NA	NA	NA	FALSE

ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C80393	 N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]-1,6-naphthyridine-2-carboxamide	7.00E-09	NA	NA	NA	FALSE
C47930	 3-(4-amino-1-oxo-isoindolin-2-yl)pyrrolidine-2,5-dione		7.84E-07	NA	NA	TRUE
C47927	 4-(4-amino-1-oxo-isoindolin-2-yl)piperidine-2,6-dione		>>	NA	NA	TRUE

ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C47932	 3-(4-amino-1-oxo-isoindolin-2-yl)azepane-2,7-dione		>>	NA	NA	TRUE
C47928	 5-(4-amino-1-oxo-isoindolin-2-yl)hexahydropyrimidine-2,4-dione		NA	NA	NA	FALSE

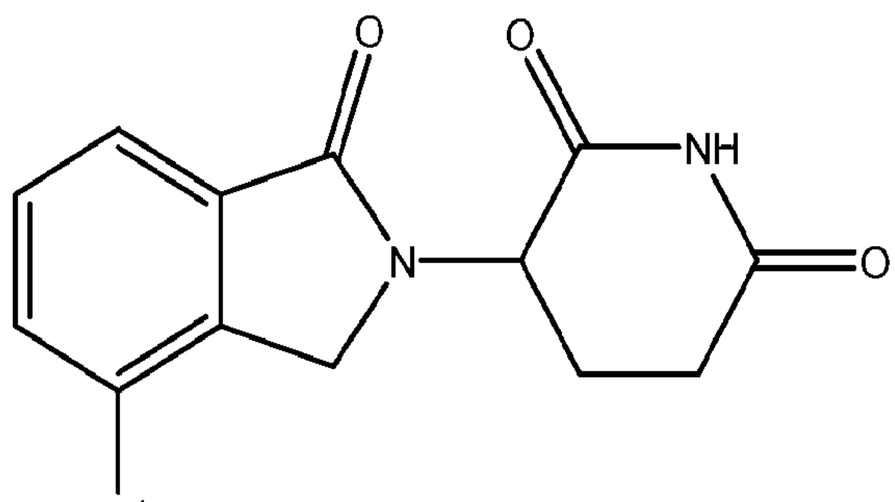
ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C10239	 3-[1-(benzylamino)-3-oxo-isoindolin-2-yl]piperidine-2,6-dione		>>	NA	1.16E-06	TRUE
C36124	 3-methoxy-N-(2-oxobenzimidazol-5-yl)pyridine-4-carboxamide		NA	NA	NA	FALSE

ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
C80376	 3-[1-oxo-5-(7H-purin-2-ylamino)isoindolin-2-yl]piperidine-2,6-dione		>>	NA	5.59E-07	TRUE
C10001	 5-amino-3-(2,6-dioxo-3-piperidyl)-2-methyl-4-oxo-quinazoline-6-carbonitrile		>>	>>	1.25E-06	TRUE
C55859	 4-(4-Amino-1-oxoisoindolin-2yl)-1,2-thiazinan-3-one 1,1-dioxide		NA	NA	NA	FALSE

ID	Structure/Name	IC50 Competition(M)	EC50_IKZF1(M)	EC50_ASS1(M)	EC50_SALL4(M)	Recruitment Assessment
THL	 2-(2,6-dioxo-3-piperidyl)isoindoline-1,3-dione		>>	>>	NA	TRUE

Claims

1. A compound of Formula I:



I

or a pharmaceutically acceptable salt thereof, wherein:

R^1 is aryl, $-N(R^5)-X-R^6$, $-SO_2R^5$, or $-O(CH_2)_mR^5$, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, $-(C_1-C_3)$alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, -SO_2-, -$(CH_2)_nC(O)(CH_2)_m$-, -C(O)NH-, -$C(O)N(R^w)$-, -NHC(O)NH-, or -$(CH_2)_n$-;

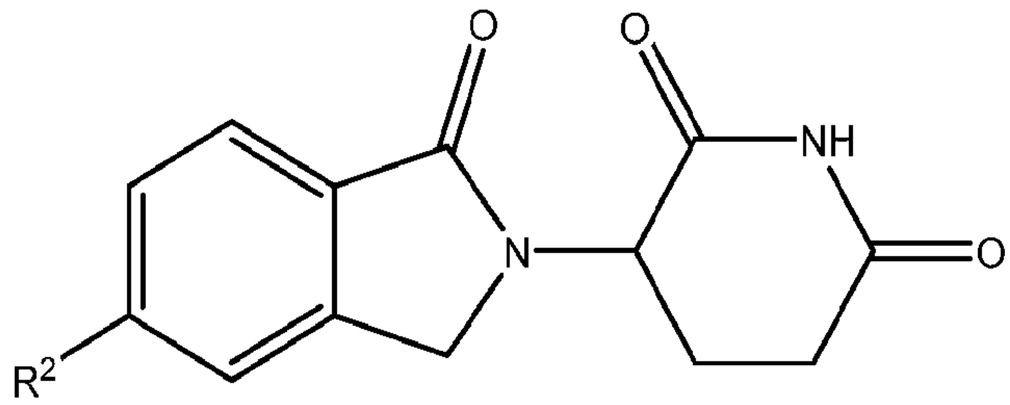
m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

2. The compound of claim 1, wherein:

R^1 is aryl optionally substituted with 1 or more R^w groups as allowed by valence.

3. A compound of Formula II,



II

or a pharmaceutically acceptable salt thereof, wherein:

R^2 is aryl, -NH-(C_3-C_{10}) heteroaryl, or -$N(R^5)$-$(CH_2)_m$-X-$(CH_2)_n$-R^6, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-

C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, -SO_2-, -$(CH_2)_n$C(O)$(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

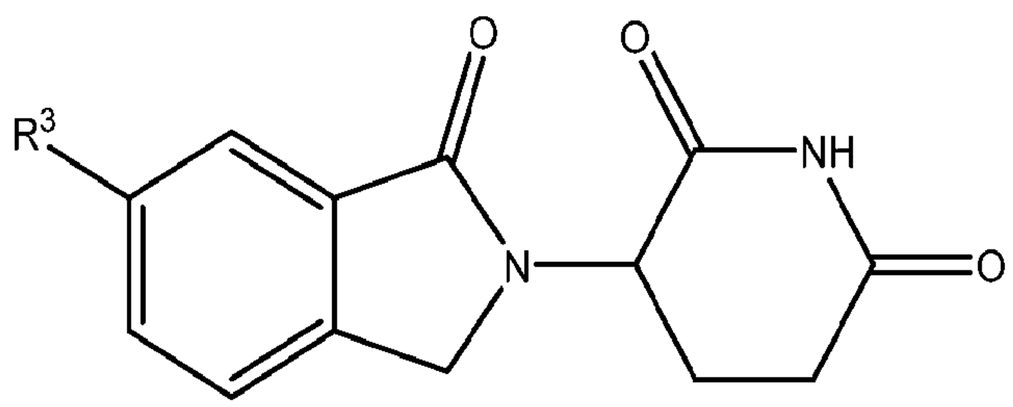
4. The compound of claim 3, wherein:

R^2 is -N(R^5)-$(CH_2)_m$-X-$(CH_2)_n$-R^6;

R^5 is H;

R^6 is OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, -NR^5R^5, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl.

5. A compound of Formula III



III

or a pharmaceutically acceptable salt thereof, wherein:

R^3 is cyano, aryl, -NH-(C_3-C_{10}) heteroaryl, (C_3-C_{10})heterocyclo, or -N(R^5)-$(CH_2)_m$-X-$(CH_2)_n$-R^6, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo$(C_3$-$C_{10})$heterocyclo, $(C_3$-$C_{10})$cycloalkyl, $-(CH_2)_n-(C_3$-$C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3$-$C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, $-SO_2-$, $-(CH_2)_nC(O)(CH_2)_m-$, $-C(O)NH-$, $-C(O)N(R^w)-$, $-NHC(O)NH-$, or $-(CH_2)_n-$;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

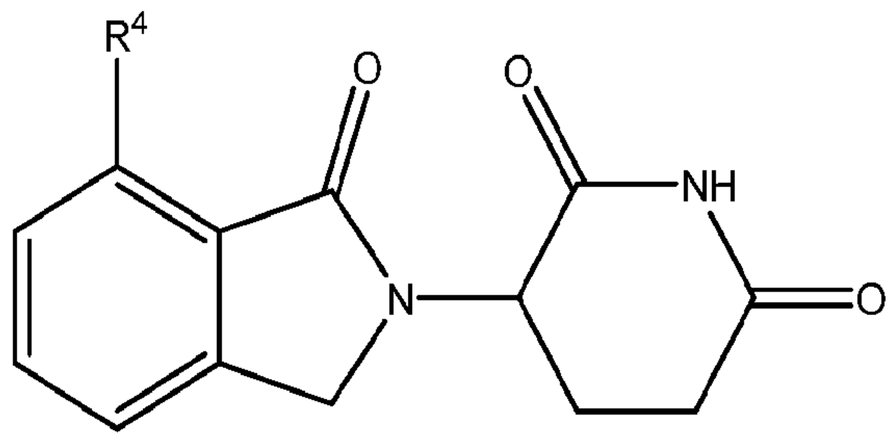
6. The compound of claim 5, wherein

R^3 is $-N(R^5)-(CH_2)_m-X-(CH_2)_n-R^6$;

R^5 is H;

R^6 is OH, $(C_1$-$C_3)$alkyl, $-(C_1$-$C_3)$alkoxy, $-NR^5R^5$, $(C_3$-$C_{10})$heterocyclo, $(C_3$-$C_{10})$cycloalkyl, $-(CH_2)_n-(C_3$-$C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3$-$C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, or heteroaryl.

7. A compound of Formula IV



IV

or a pharmaceutically acceptable salt thereof, wherein:

R^4 is halo, cyano, aryl, OR^5, or $-N(R^5)-(CH_2)_m-X-(CH_2)_n-R^6$, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, $(C_1$-$C_3)$alkyl, $(C_3$-$C_{10})$heterocyclo, $(C_3$-$C_{10})$cycloalkyl, $-(CH_2)_n-(C_3$-$C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3$-$C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, -SO_2-, -$(CH_2)_n$C(O)$(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

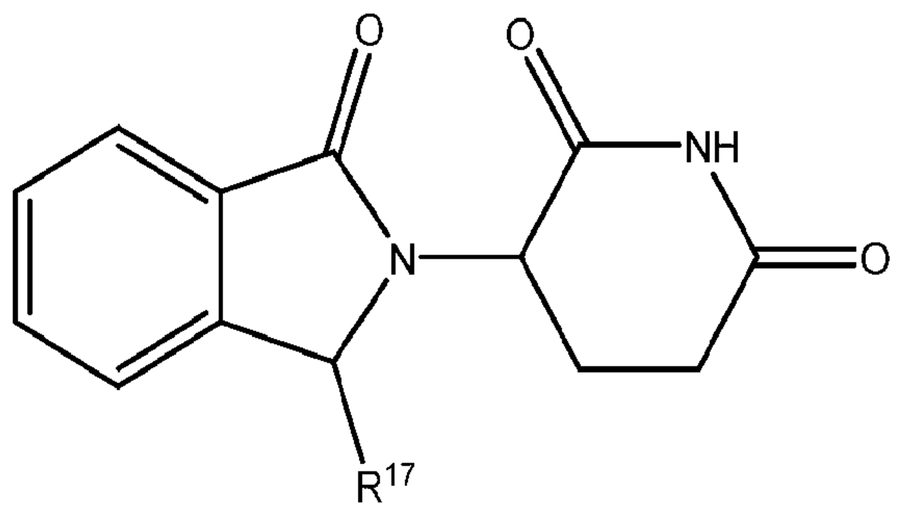
8. The compound of claim 7, wherein

R^4 is -N(R^5)-$(CH_2)_m$-X-$(CH_2)_n$-R^6;

R^5 is H;

R^6 is OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, -NR^5R^5, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl.

9. A compound of Formula V



V

or a pharmaceutically acceptable salt thereof, wherein:

R^{17} is cyano, heteroaryl, -$(CH_2)_m$-C(O)O-R^6, or -N(R^5)-$(CH_2)_m$-X-$(CH_2)_n$-R^6, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

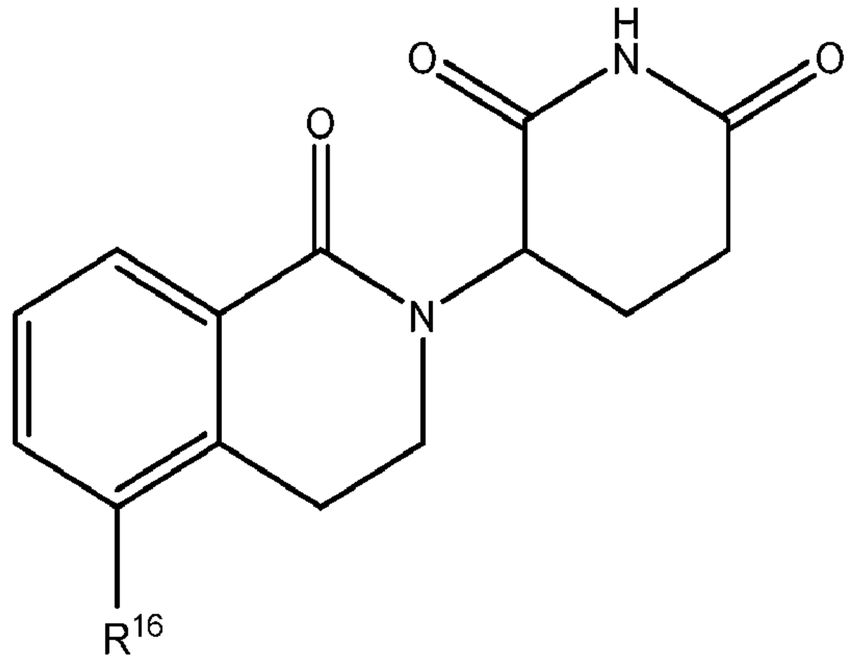
R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, -SO_2-, -$(CH_2)_n$C(O)$(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

10. A compound of Formula VI



VI

or a pharmaceutically acceptable salt thereof, wherein:

R^{16} is NH_2 or $-N(R^5)-(CH_2)_m-X-(CH_2)_n-R^6$, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, $-(C_1-C_3)$alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

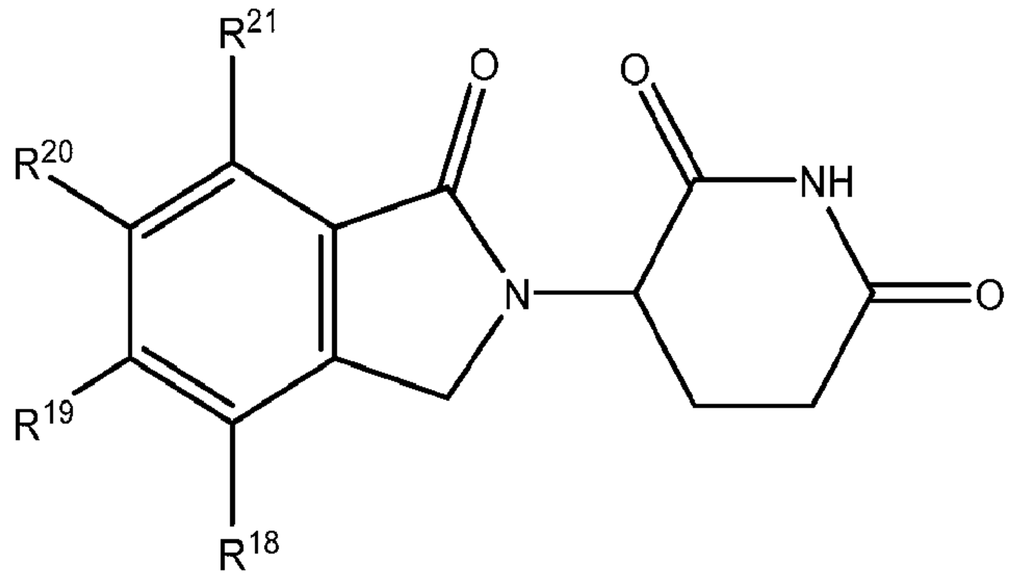
R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$ cycloalkyl, $-(CH_2)_n-(C_3-C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, $-SO_2-$, $-(CH_2)_nC(O)(CH_2)_m-$, $-C(O)NH-$, $-C(O)N(R^w)-$, $-NHC(O)NH-$, or $-(CH_2)_n-$;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

11. A compound of Formula VII



VII

or a pharmaceutically acceptable salt thereof, wherein:

R^{18}, R^{19}, R^{20}, R^{21} each independently is H, halo, (C_1-C_3)alkyl, (C_1-C_3)alkoxy, or -N(R^5)-X-R^6, with the proviso that no more than two substituents of R^{18}, R^{19}, R^{20}, R^{21} are H; or

R^{18}, R^{19} taken together with the carbons they are attached to forming a (C_3-C_{10})cycloalkyl or a (C_3-C_{10})heterocyclo, or R^{19}, R^{20} taken together with the carbons they are attached to forming a (C_3-C_{10})cycloalkyl or a (C_3-C_{10})heterocyclo, or R^{20}, R^{21} taken together with the carbons they are attached to forming a (C_3-C_{10})cycloalkyl or a (C_3-C_{10})heterocyclo, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, (C_1-C_3)alkyl, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, (C_1-C_3)alkyl, -(C_1-C_3)alkoxy, (C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing (C_3-C_{10})heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-

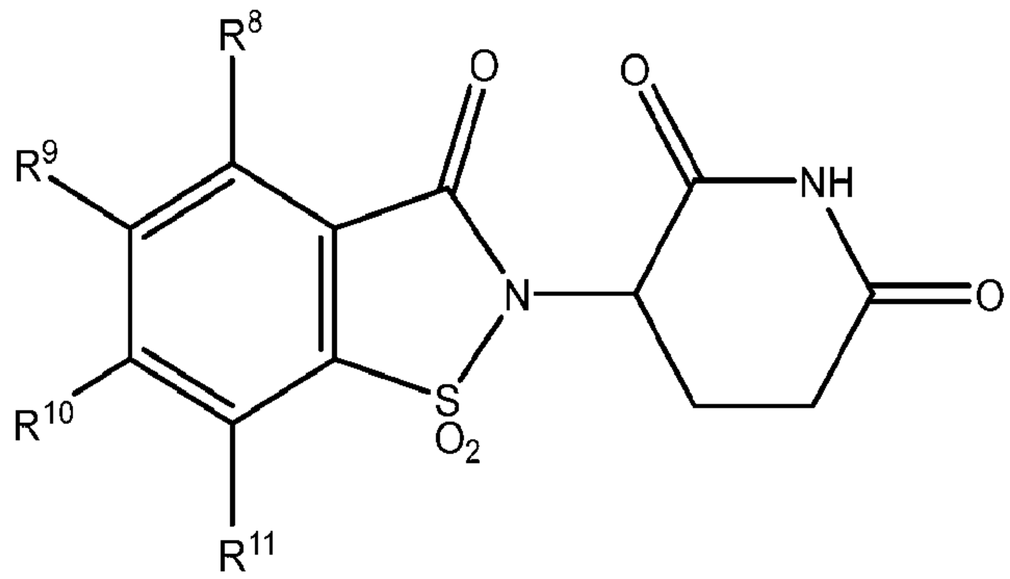
C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, -SO_2-, -$(CH_2)_n$C(O)$(CH_2)_m$-, -C(O)NH-, -C(O)N(R^w)-, -NHC(O)NH-, or -$(CH_2)_n$-;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

12. A compound of Formula VIII



VIII

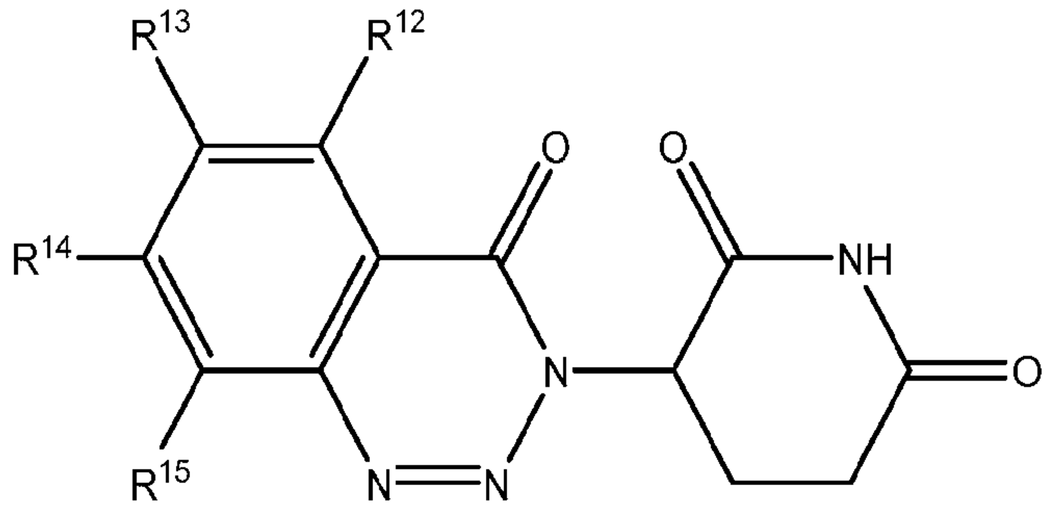
or a pharmaceutically acceptable salt thereof, wherein:

R^8, R^9, R^{10}, R^{11} each independently is H, halo, OH, cyano, (C_1-C_3)alkyl, (C_1-C_3)alkoxy, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently, H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo(C_3-C_{10})heterocyclo, (C_3-C_{10})cycloalkyl, -$(CH_2)_n$-(C_3-C_{10}) cycloalkyl, -$(CH_2)_n$-(C_3-C_{10})heterocyclo, -$(CH_2)_n$-aryl, -$(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

n is 0, 1, 2, 3, or 4.

13. A compound of Formula IX



IX

or a pharmaceutically acceptable salt thereof, wherein:

R^{12}, R^{13}, R^{14}, R^{15} each is independently H, NH_2, $(C_1\text{-}C_3)$alkyl, $-N(R^5)\text{-}(CH_2)m\text{-}N(R^5)\text{-}X\text{-}R^6$, with proviso that no more than three substituents out of R^{12}, R^{13}, R^{14}, and R^{15} are H, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^5 at each occurrence is independently H, $(C_1\text{-}C_3)$alkyl, $(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$ cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, or heteroaryl, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^6 at each occurrence is independently OH, $(C_1\text{-}C_3)$alkyl, $-(C_1\text{-}C_3)$alkoxy, $(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$ cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, heteroaryl, or R^5 and R^6 taken together with the atoms they are attached to forming a nitrogen containing $(C_3\text{-}C_{10})$heterocyclic ring, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

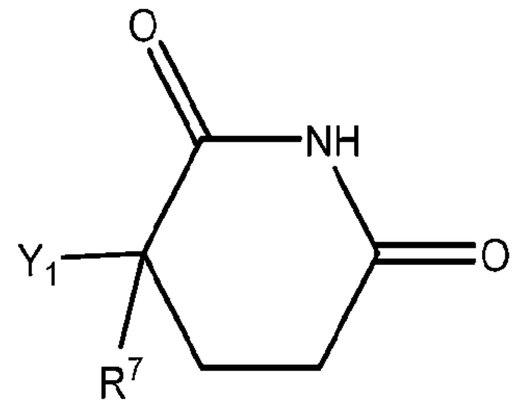
R^w at each occurrence is independently H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo$(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$ cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

X is a bond, $-SO_2$-, $-(CH_2)_nC(O)(CH_2)_m$-, -C(O)NH-, $-C(O)N(R^w)$-, -NHC(O)NH-, or $-(CH_2)_n$-;

m is 0, 1, 2, 3, or 4;

n is 0, 1, 2, 3, or 4.

14. A compound of Formula X



X

or a pharmaceutically acceptable salt thereof, wherein:

Y_1 is $-NHR^{33}$, $-NHC(O)R^{33}$, or $-CHR^{33}R^{34}$;

R^7 is H, $(C_1\text{-}C_3)$alkyl, or R^7 and R^{34} taken together with the carbons they are attached to forming a carbon carbon double bond;

R^{33} is aryl, heteroaryl, or $(C_3\text{-}C_{10})$heterocyclo, any of which may be optionally substituted with 1 or more R^w groups as allowed by valence;

R^w at each occurrence is independently, H, halo, cyano, nitro, oxo, alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, heterocycloalkyl, wherein said alkyl, haloalkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, heterocyclo, aryl, heteroaryl, arylalkyl, heteroarylalkyl, cycloalkylalkyl, and heterocycloalkyl groups may be further independently substituted with one or more groups selected from the group consisting of halo, cyano, oxo$(C_3\text{-}C_{10})$heterocyclo, $(C_3\text{-}C_{10})$cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$ cycloalkyl, $-(CH_2)_n\text{-}(C_3\text{-}C_{10})$heterocyclo, $-(CH_2)_n$-aryl, $-(CH_2)_n$-heteroaryl, aryl, and heteroaryl;

n is 0, 1, 2, 3, or 4.

15. A compound selected from the group consisting of:

3-[1-oxo-5-(quinazolin-4-ylamino)isoindolin-2-yl]piperidine-2,6-dione;

3-[5-[(4-aminothieno[2,3-d]pyrimidin-2-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

N-[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]acetamide;

3-[5-[(2-aminopyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

6-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]pyridazine-3-carbonitrile;

3-[[2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]acetyl]amino]benzamide;

2-[[2-(2,6-dioxo-3-piperidyl)-1-oxo-isoindolin-5-yl]amino]acetic acid;

N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]quinoline-2-carboxamide;

3-[6-[[2-(2-methyl-1-piperidyl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[(2-isoindolin-2-yl-2-oxo-ethyl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

N-(cyclopropylmethyl)-2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-methyl-acetamide;

acetic acid;3-[1-oxo-6-(quinazolin-4-ylamino)isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[[2-(3-methyl-1-piperidyl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[(4-methyl-3-oxo-pyrazin-2-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[1-oxo-6-(quinoxalin-2-ylamino)isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[(1-methylpyrazolo[3,4-d]pyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-(5,7-dihydrofuro[3,4-d]pyrimidin-2-ylamino)-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-[(6-methylpyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-phenyl-acetamide;

3-[6-[[2-(2,4-dimethylpiperazin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-[6-(dimethylamino)-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-(1-oxo-6-phenyl-isoindolin-2-yl)piperidine-2,6-dione;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N,N-dimethyl-acetamide;

3-[6-[[2-(2-methylmorpholin-4-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-methyl-N-[(1-methylpyrazol-4-yl)methyl]acetamide;

N-benzyl-2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetamide;

6-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]pyridazine-3-carbonitrile;

3-[6-[(6-methylpyrrolo[3,2-d]pyrimidin-4-yl)amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

2-(dimethylamino)-N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]acetamide;

N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]-5H-pyrrolo[2,3-b]pyridine-4-carboxamide;

N-cyclopropyl-2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetamide;

3-[1-oxo-6-(2-oxoimidazolidin-1-yl)isoindolin-2-yl]piperidine-2,6-dione;

2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-5-carbonitrile;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]propanoic acid;

2-acetamido-N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]acetamide;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetamide;

3-[6-[[2-(3-methyl-5-oxo-piperazin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]acetamide;

3-[6-[[2-(4-methyl-3-oxo-piperazin-1-yl)-2-oxo-ethyl]amino]-1-oxo-isoindolin-2-yl]piperidine-2,6-dione;

N-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]-3H-imidazo[4,5-b]pyridine-6-carboxamide;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]-N-tetrahydropyran-4-yl-acetamide;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-5-yl]amino]acetic acid;

3-[1-oxo-6-[[2-oxo-2-(1-piperidyl)ethyl]amino]isoindolin-2-yl]piperidine-2,6-dione;

3-(1-oxo-7-phenyl-isoindolin-2-yl)piperidine-2,6-dione;

2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-4-carbonitrile;

2-[[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-4-yl]amino]acetic acid;

3-(7-fluoro-1-oxo-isoindolin-2-yl)piperidine-2,6-dione;

3-(5-amino-1-oxo-3,4-dihydroisoquinolin-2-yl)piperidine-2,6-dione;

t-butyl 2-[2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindolin-1-yl]acetate;

3-[1-(2H-indol-3-yl)-3-oxo-isoindolin-2-yl]piperidine-2,6-dione;

2-(2,6-dioxo-3-piperidyl)-3-oxo-isoindoline-1-carbonitrile;

3-[1-(dimethylamino)-3-oxo-isoindolin-2-yl]piperidine-2,6-dione;

3-(2-oxopyrrolidin-1-yl)piperidine-2,6-dione;

3-(quinazolin-2-ylamino)piperidine-2,6-dione;

(3Z)-3-benzylidenepiperidine-2,6-dione;

3-(quinoxalin-2-ylamino)piperidine-2,6-dione;

3-(pyrimidin-2-ylamino)piperidine-2,6-dione;

N-(2,6-dioxo-3-piperidyl)-2-oxo-3H-pyridine-6-carboxamide;

3-(4-methyl-1,1,3-trioxo-1,2-benzothiazol-2-yl)piperidine-2,6-dione;

3-(8-amino-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione;

3-(5-amino-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione;

3-(4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione;

3-(5-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione;

3-(6-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione; and

3-(8-methyl-4-oxo-1,2,3-benzotriazin-3-yl)piperidine-2,6-dione.

16. A composition comprising a pharmaceutically effective amount of the compound of any of the preceding claims and a pharmaceutically acceptable carrier.

17. A method of treating a disease comprising administering the composition of claim 16 to a subject in need thereof.

18. The method of claim 17, wherein the disease is a cancer.

19. The method of claim 18, wherein the cancer is selected from the group consisting of squamous-cell carcinoma, basal cell carcinoma, adenocarcinoma, hepatocellular carcinomas, renal cell carcinomas, bladder cancer, bowel cancer, breast cancer, cervical cancer, colon cancer, esophageal cancer, head cancer, kidney cancer, liver cancer, lung cancer, neck cancer, ovarian cancer, pancreatic cancer, prostate cancer, stomach cancer, uterine cancer, leukemias, lymphomas, Burkitt's lymphoma, Non-Hodgkin's lymphoma, melanomas, myeloproliferative diseases, multiple myeloma, sarcomas, including Ewing's sarcoma, hemangiosarcoma, Kaposi's sarcoma, liposarcoma, myosarcomas, peripheral neuroepithelioma, synovial sarcoma, gliomas, astrocytomas, oligodendrogliomas, ependymomas, glioblastomas, neuroblastomas, ganglioneuromas, gangliogliomas, medulloblastomas, pineal cell tumors, meningiomas, meningeal sarcomas, neurofibromas, Schwannomas, testicular cancer, thyroid cancer, astrocytoma, Hodgkin's disease, Wilms' tumor, and teratocarcinomas.

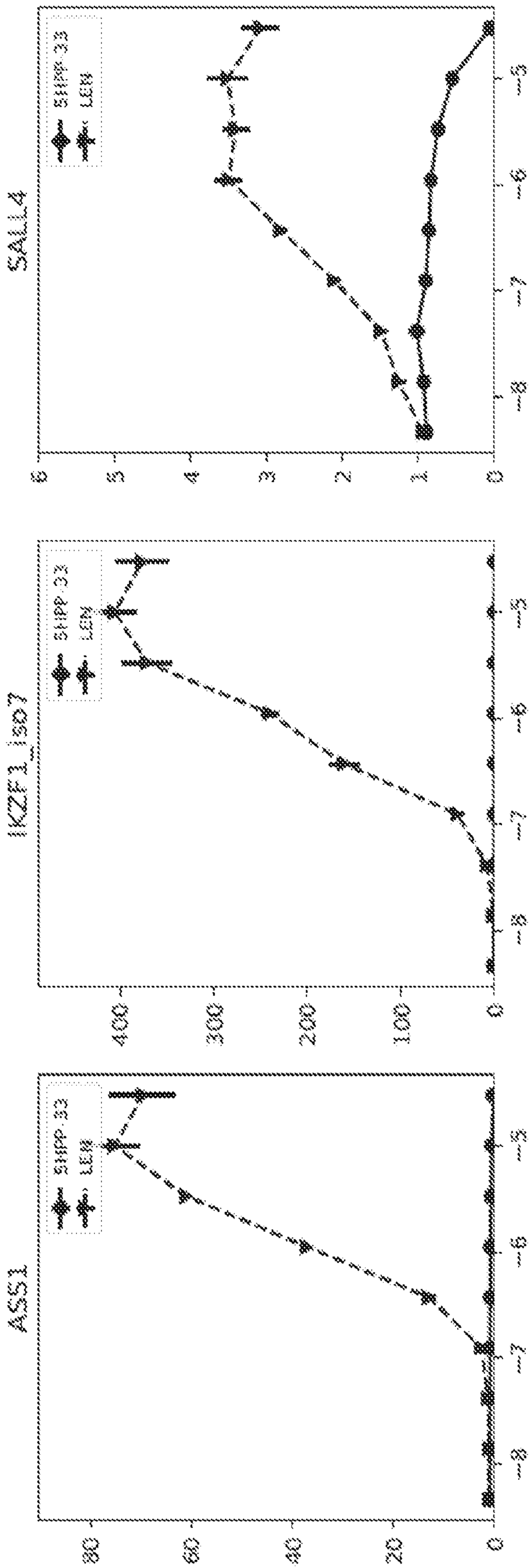
20. The method of claim 19, wherein the cancer is multiple myeloma. .

21. The method of claim 17, wherein the disease is an autoimmune disease or disorder.

22. The method of claim 21, wherein the the autoimmune disease or disorder is selected from, such as multiple sclerosis, diabetes mellitus, lupus, celiac disease, Crohn's disease, ulcerative colitis, Guillain-Barre syndrome, scleroderms, Goodpasture's syndrome, Wegener's granulomatosis, autoimmune epilepsy, Rasmussen's encephalitis, Primary biliary sclerosis, Sclerosing cholangitis, Autoimmune hepatitis, Addison's disease, Hashimoto's thyroiditis, Fibromyalgia, Menier's syndrome; transplantation rejection (*e.g.*, prevention of allograft rejection) pernicious anemia, rheumatoid arthritis, systemic lupus erythematosus, dermatomyositis, Sjogren's

syndrome, lupus erythematosus, multiple sclerosis, myasthenia gravis, Reiter's syndrome, Grave's disease, and other autoimmune diseases or disorders.

23. A method of modulating cereblon comprising administering the composition of claim 16 to a subject in need thereof.
24. A method of modulating proteasomal degradation of a protein comprising administering the composition of claim 16 to a subject in need thereof.
25. A method of modulating sequestration of a protein to the proteasome comprising administering the composition of claim 16 to a subject in need thereof.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SHP-2
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2.0E8
3.0E8
4.0E8
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20
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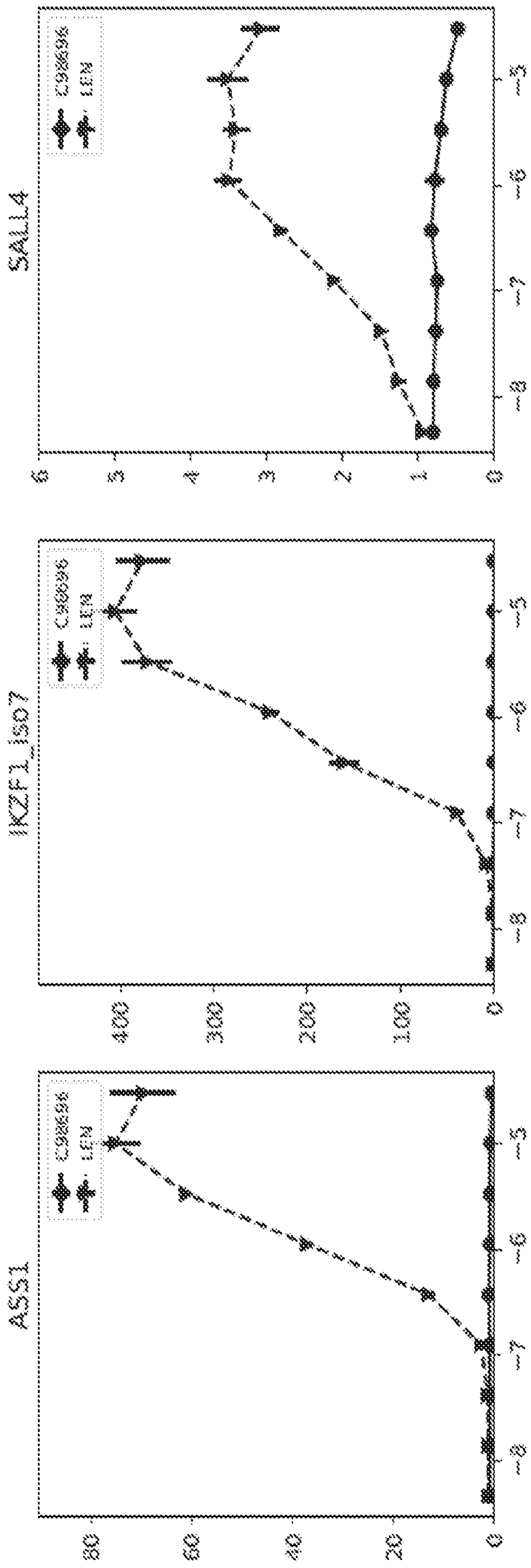
FIG. 1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R331
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C3886396
R331

FIG. 2

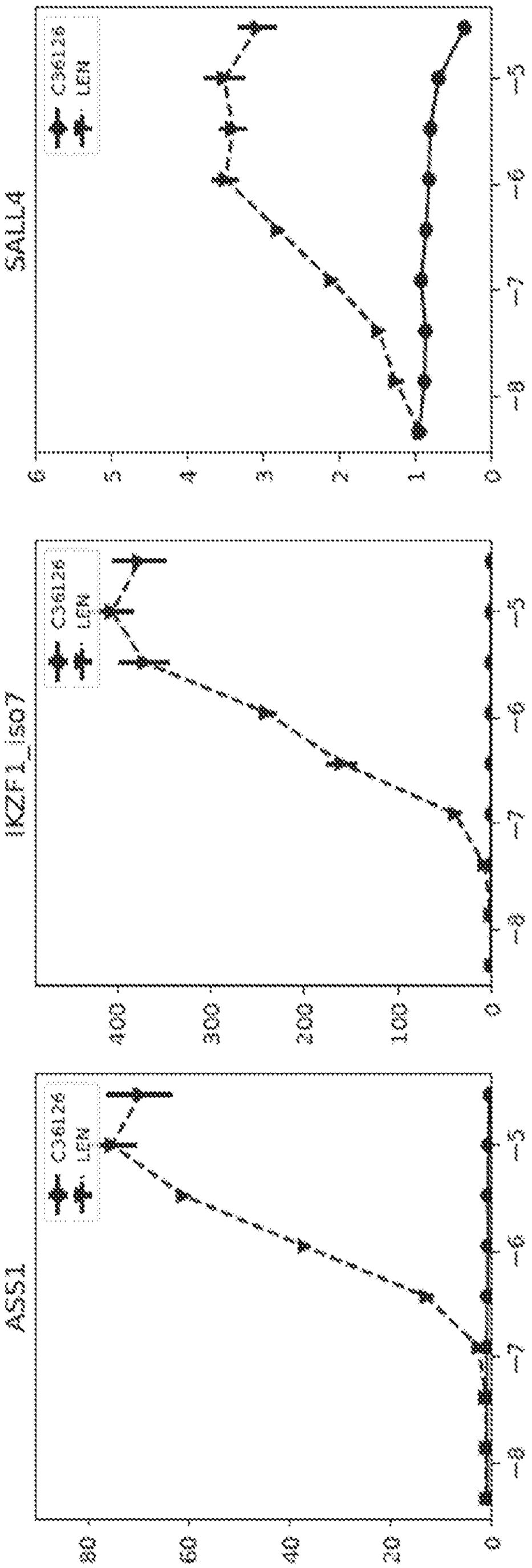
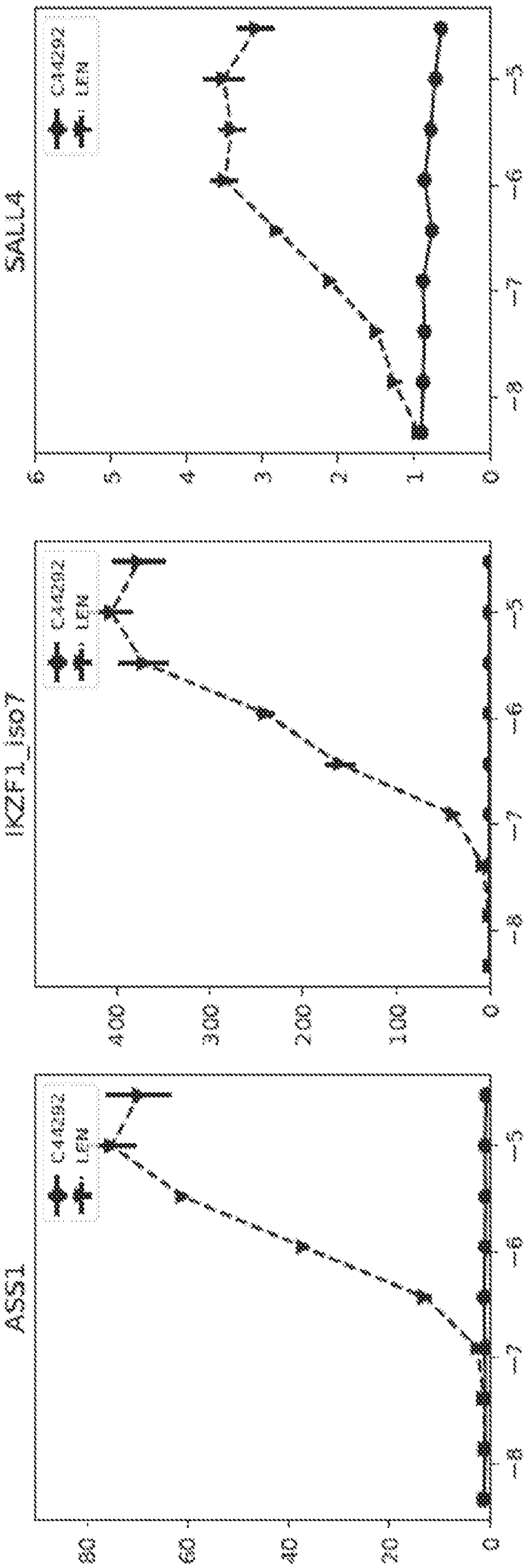


FIG. 3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ASS1
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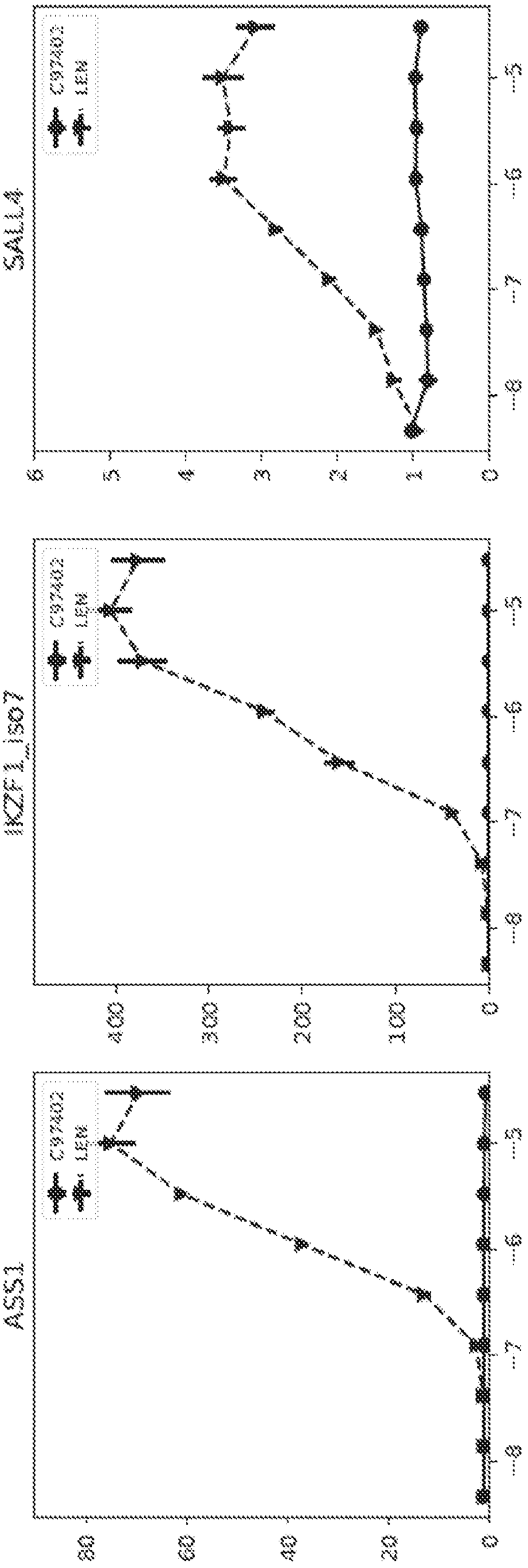
FIG. 4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ASS1
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LEK
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FIG. 5

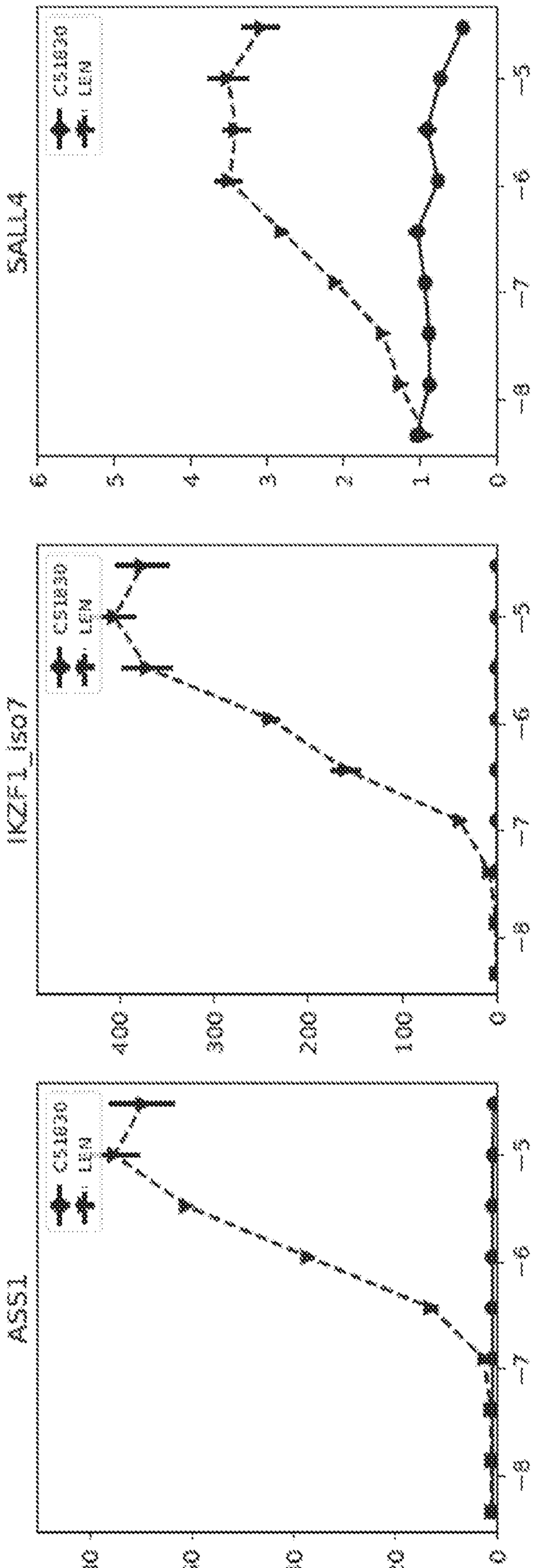

FIG. 6

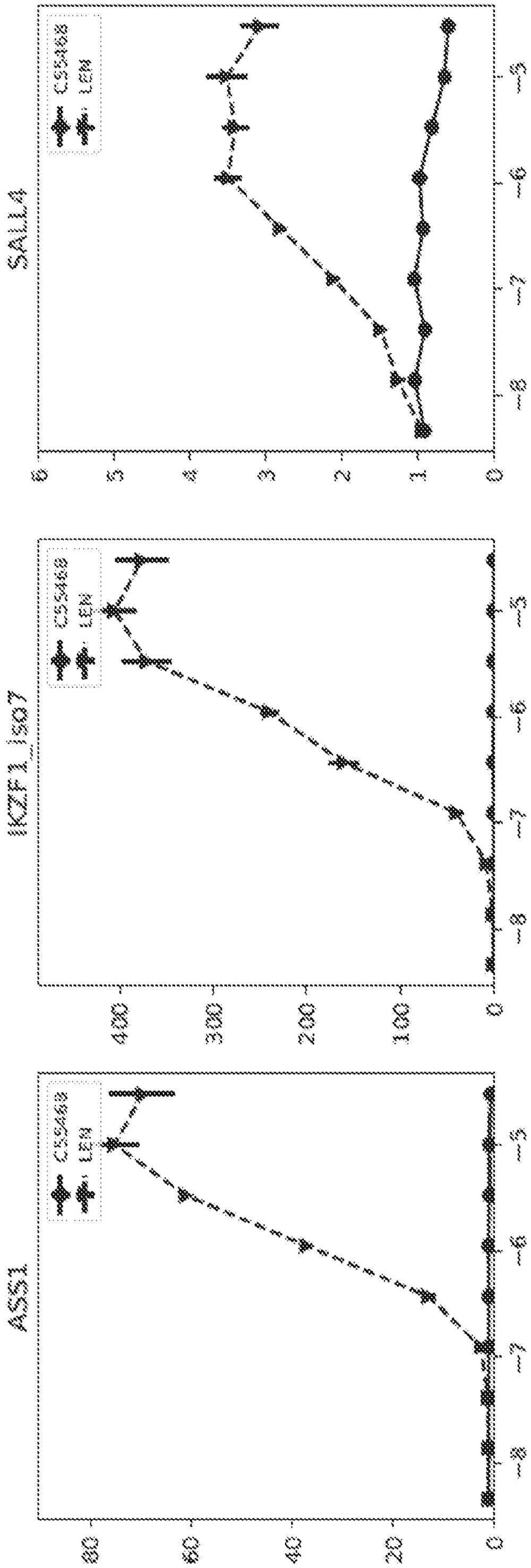
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FIG. 7

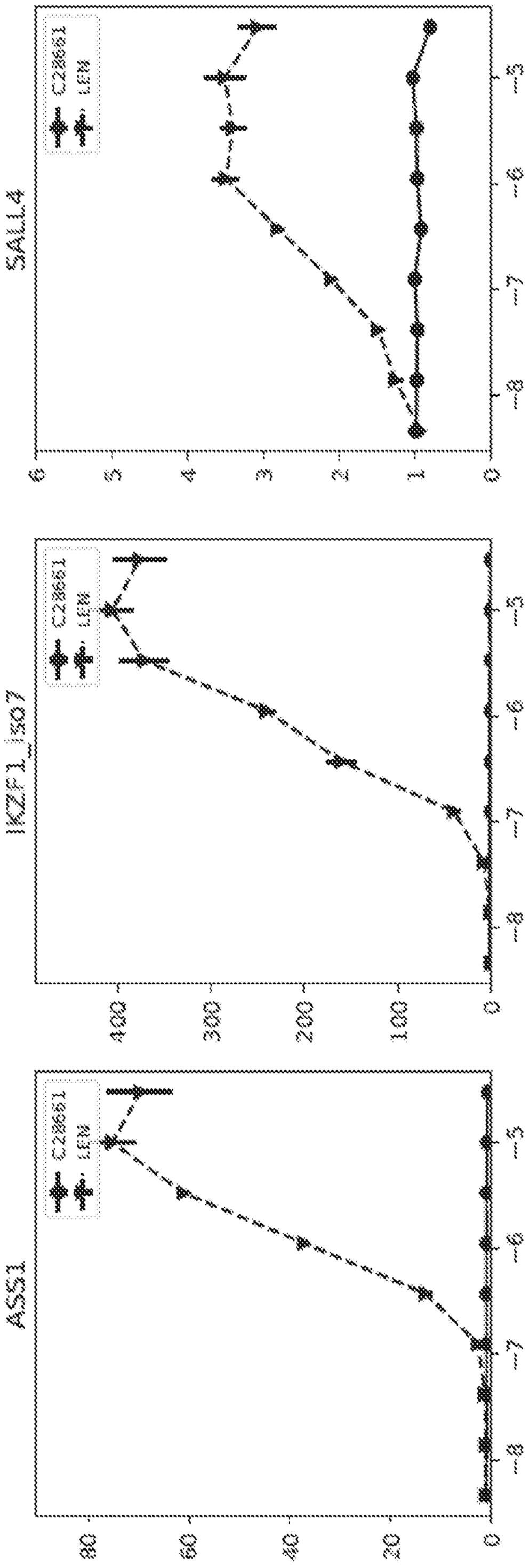
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FIG. 8

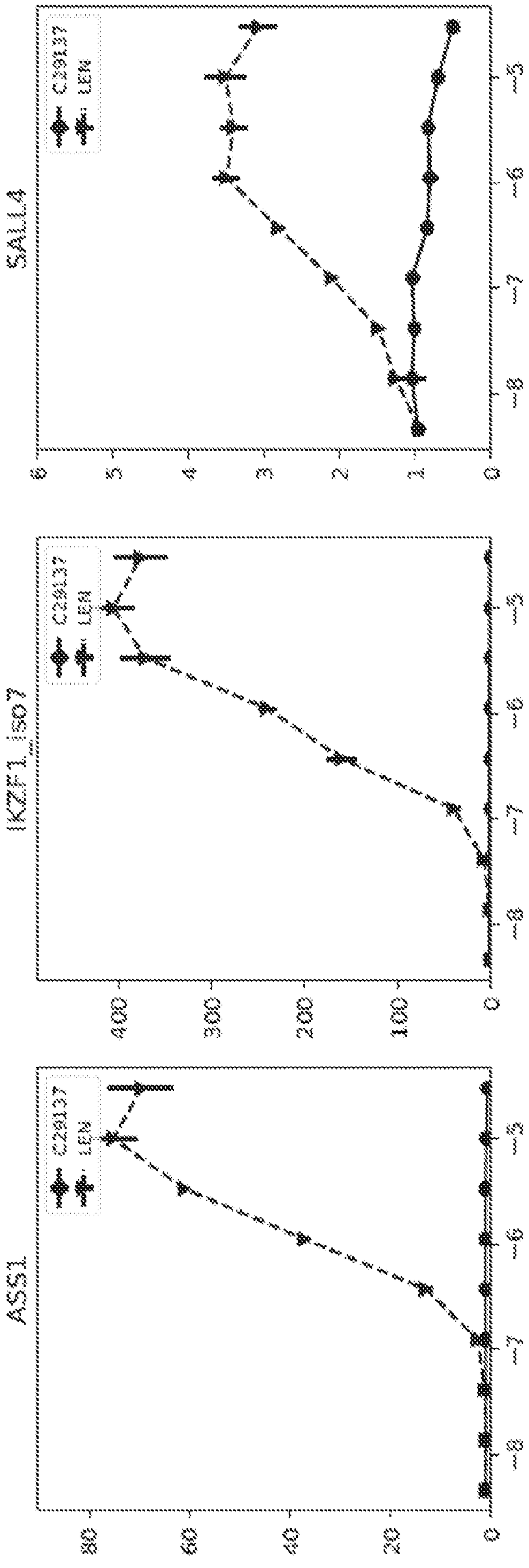
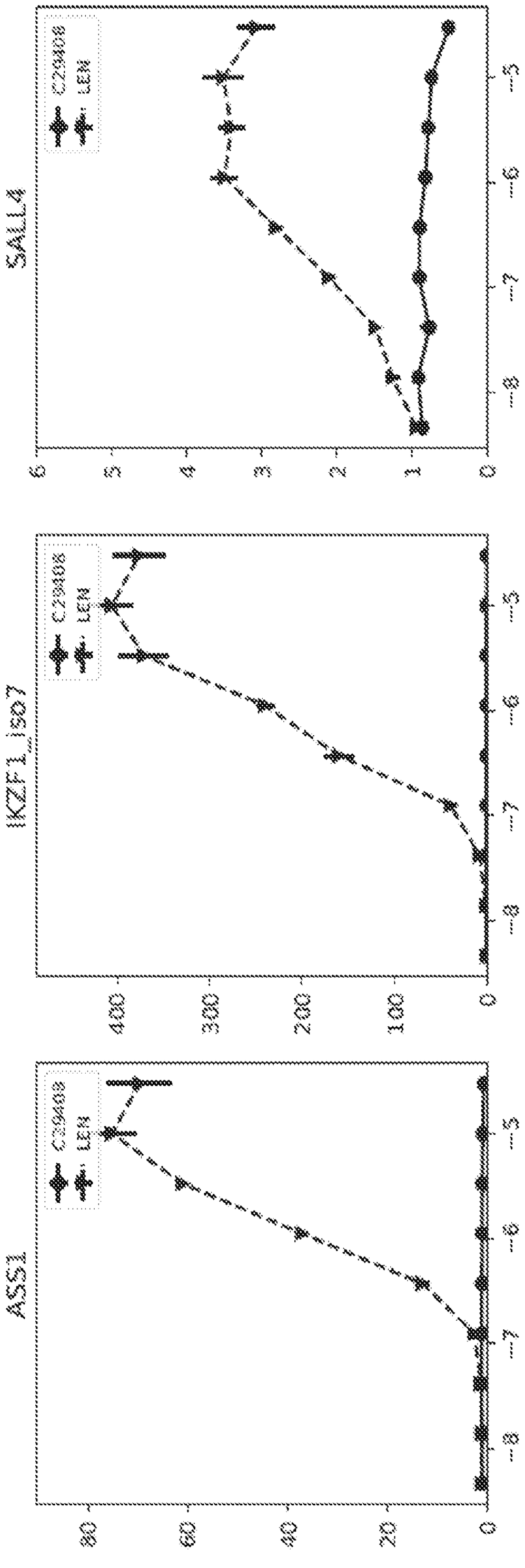


FIG. 9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-962
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-976
-977
-978
-979
-980
-981
-982
-983
-984
-985
-986
-987
-988
-989
-990
-991
-992
-993
-994
-995
-996
-997
-998
-999
-1000

FIG. 10

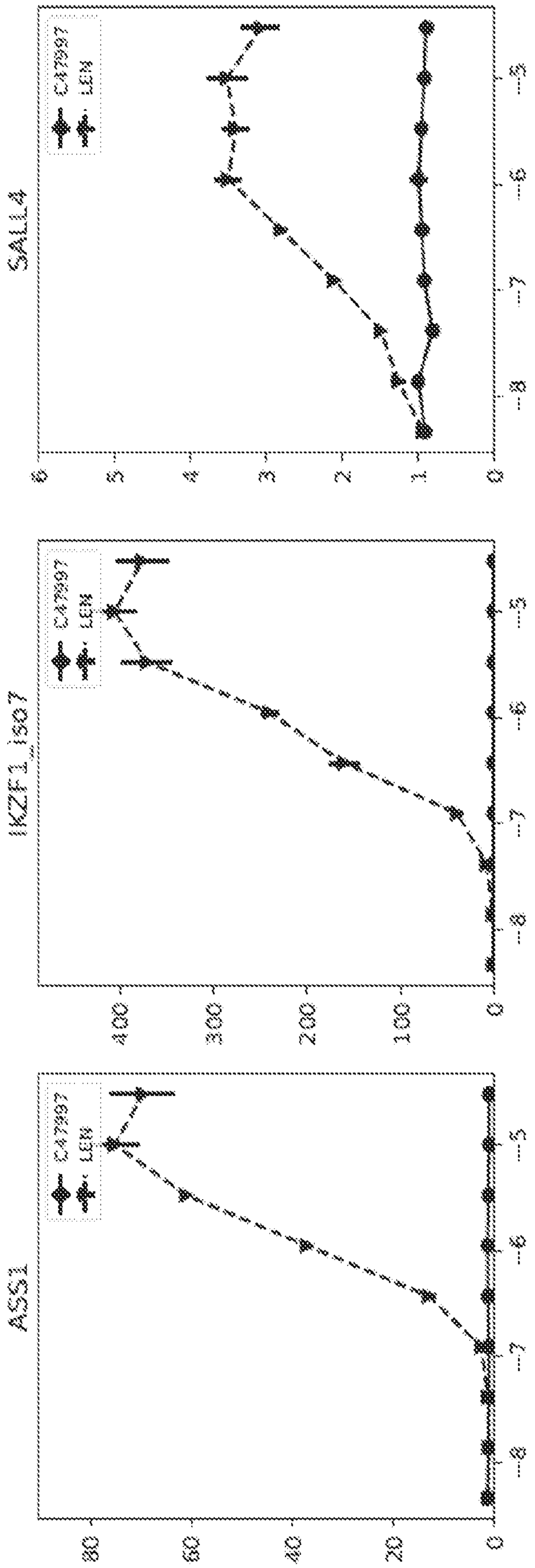

SALL4
IKZF1_isoT
ASS1
C479397
LEM
0
100
200
300
400
0
20
40
60
80
1
2
3
4
5
6
7
8
9

FIG. 11

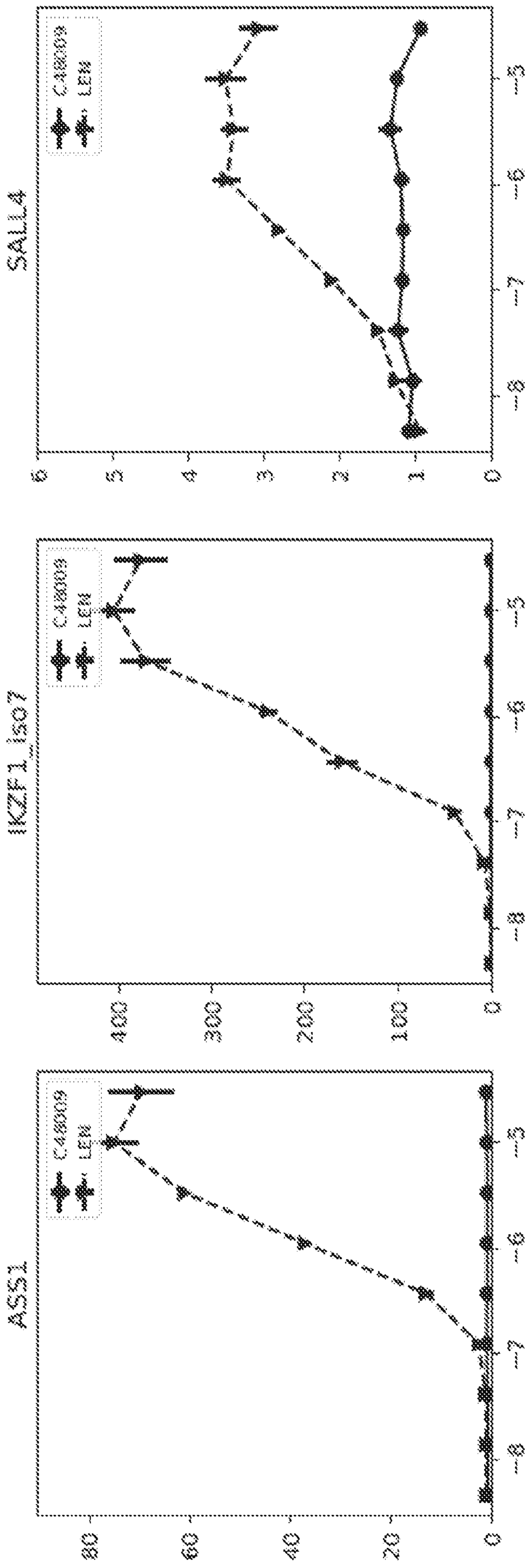

SALL4
IKZF1_iso7
ASS1
Cas9
LEM
0
100
200
300
400
0
20
40
60
80
3
4
5
6
7
8

FIG. 12

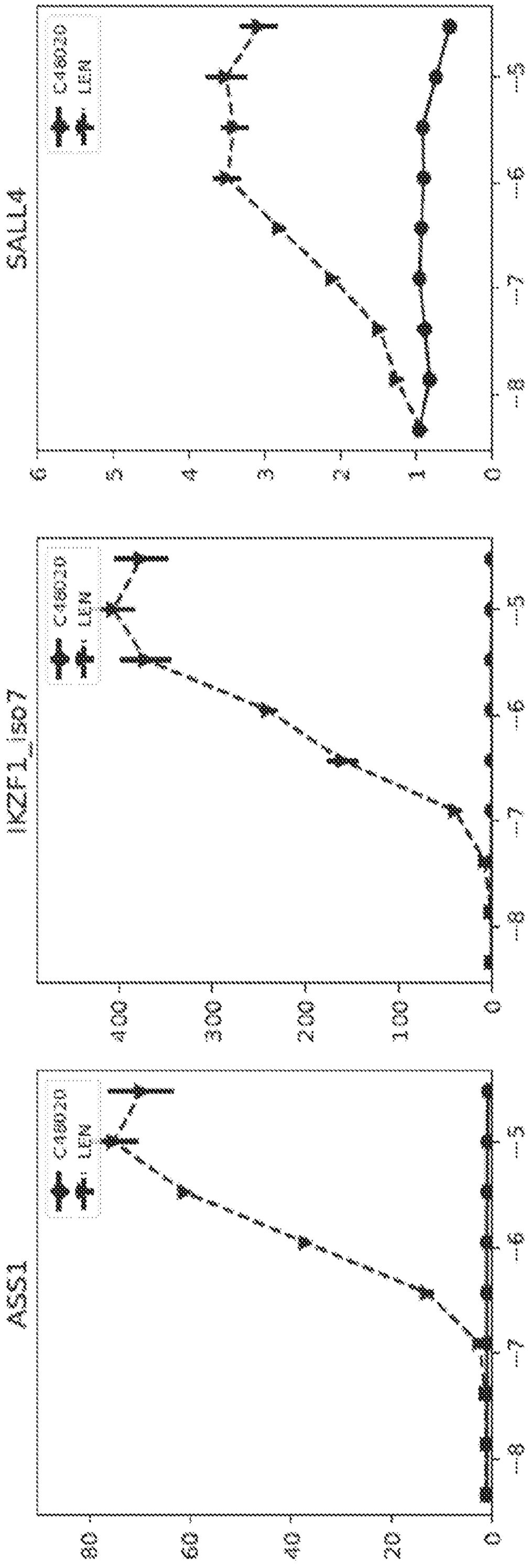

SALL4
IKZF1_iso7
ASS1
C460120
LEM
0
1
2
3
4
5
6
7
8
0
20
40
60
80
100
200
300
400

FIG. 13

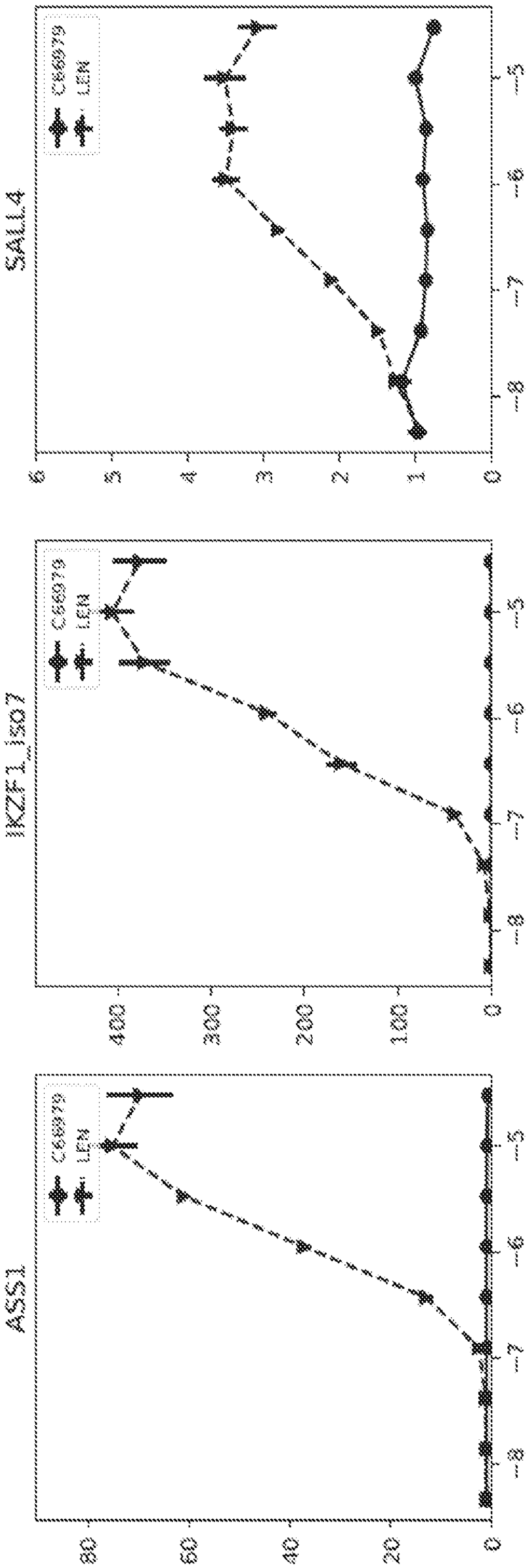

SALL4
IKZF1_iso7
STAT5A
STAT5B
CS69779
LEN
0
1,000
2,000
3,000
4,000
0
20
40
60
80
0
1
2
3
4
5
5
6
7
8
5
6
7
8
5
6
7
8

FIG. 14

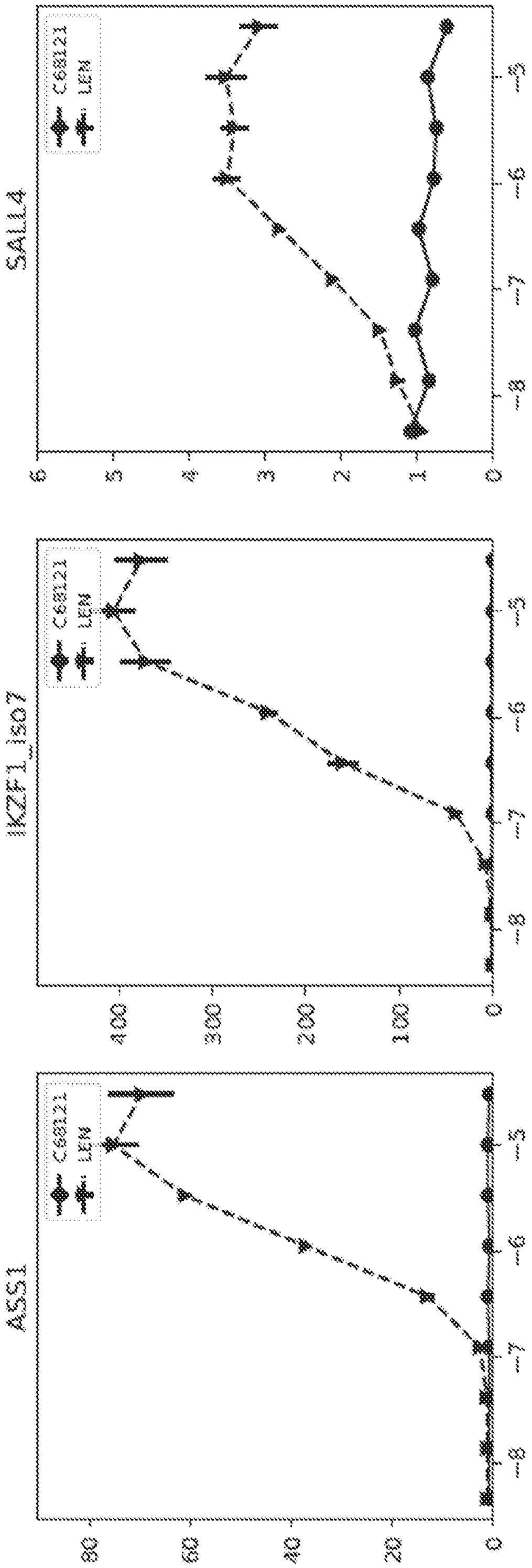

SALL4
IKZF1 isoT
ASS1
C68121
LEM
0
1
2
3
4
5
6
0
100
200
300
400
0
20
40
60
80
-8
-7
-6
-5
-4
-3

FIG. 15

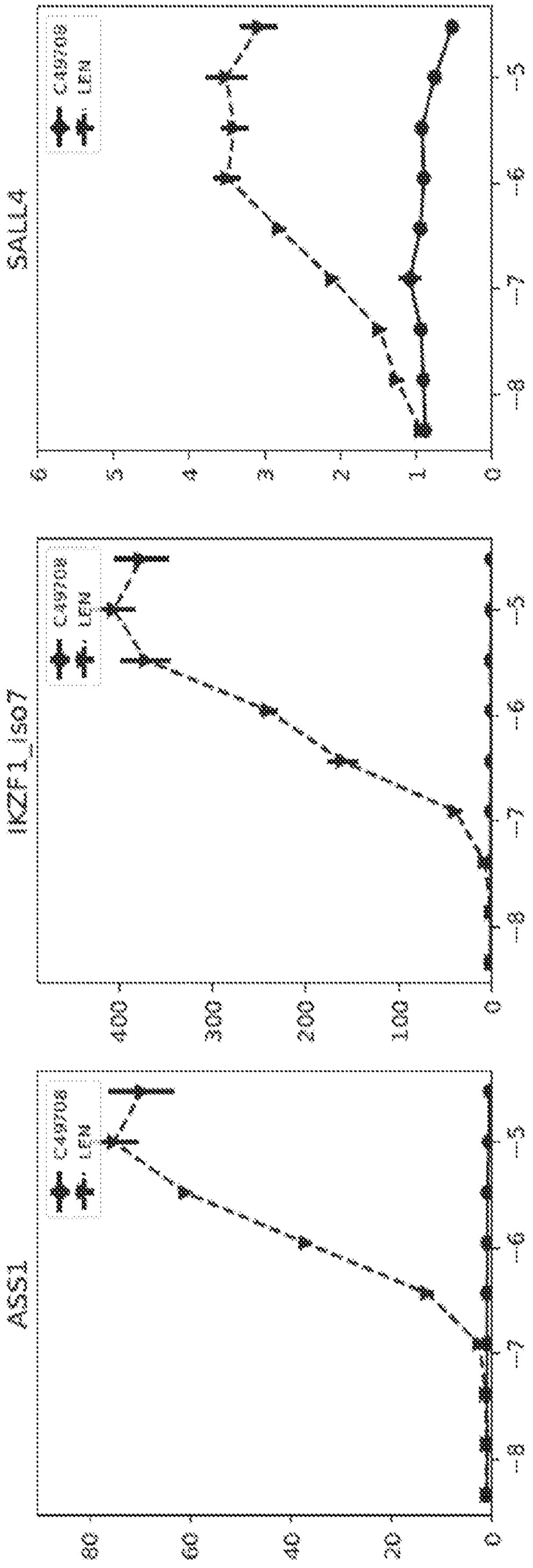

SALL4
IKZF1_IS07
AS51
CAR708
LEM
0
1
2
3
4
5
6
7
8
0
100
200
300
400
0
20
40
60
80

FIG. 16

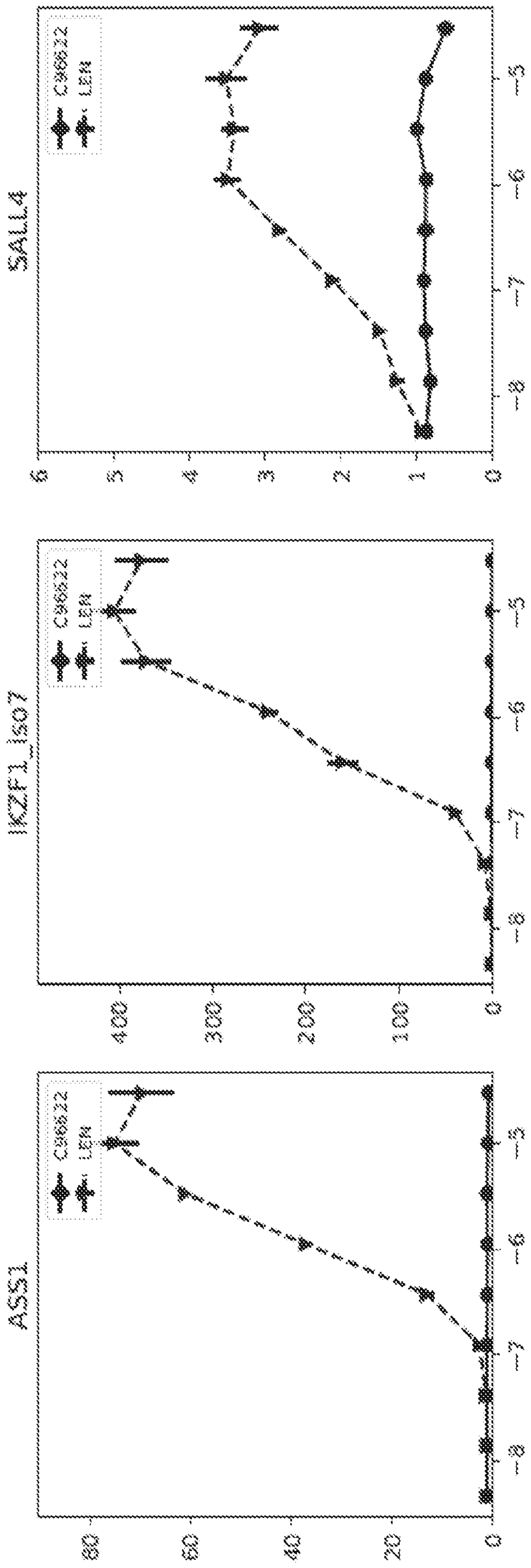

SALL4
IKZF1_iso7
ASS1
C96632
LEM
0
100
200
300
400
0
20
40
60
80
1
2
3
4
5
6
7
8

FIG. 17

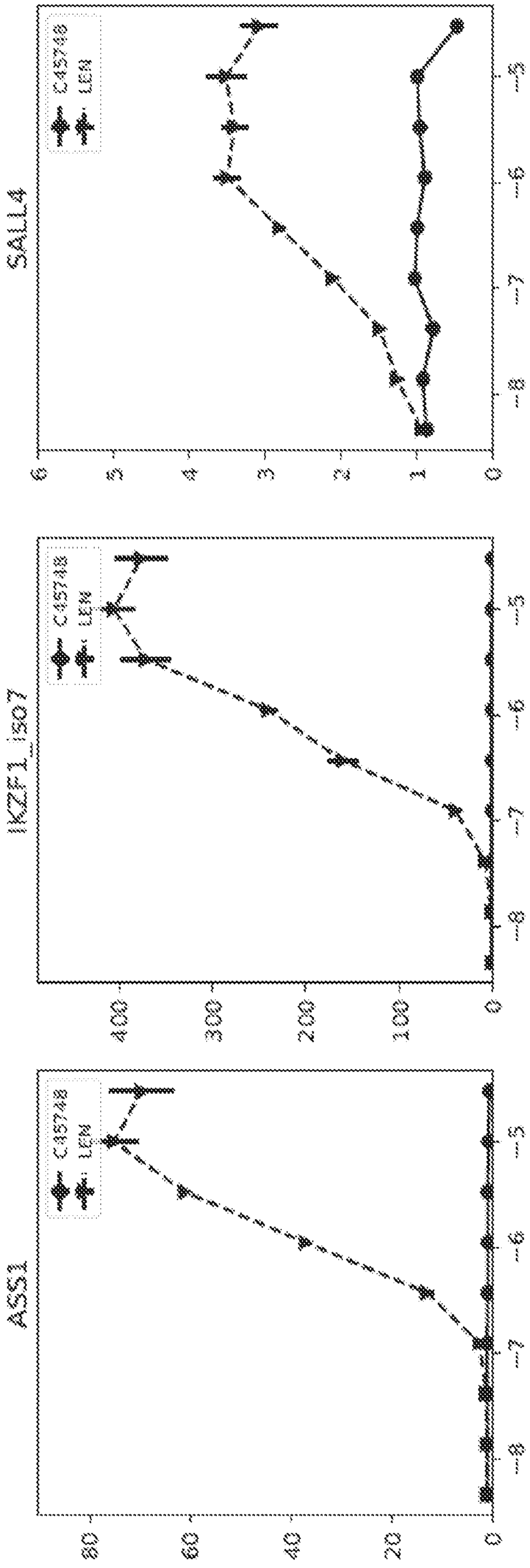


FIG. 18

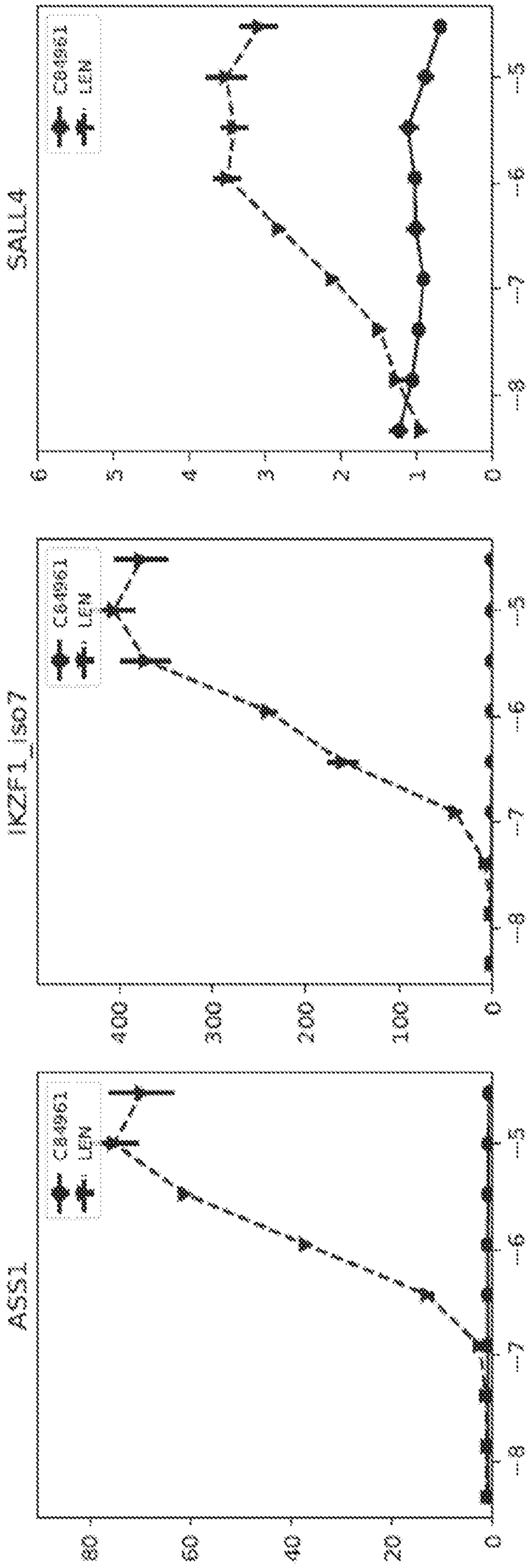

SALL4
IKZF1 isoform 1
ASS1
C8466851
LE84
0
1
2
3
4
5
6
7
8
9
0
100
200
300
400
0
0.1
0.2
0.3

FIG. 19

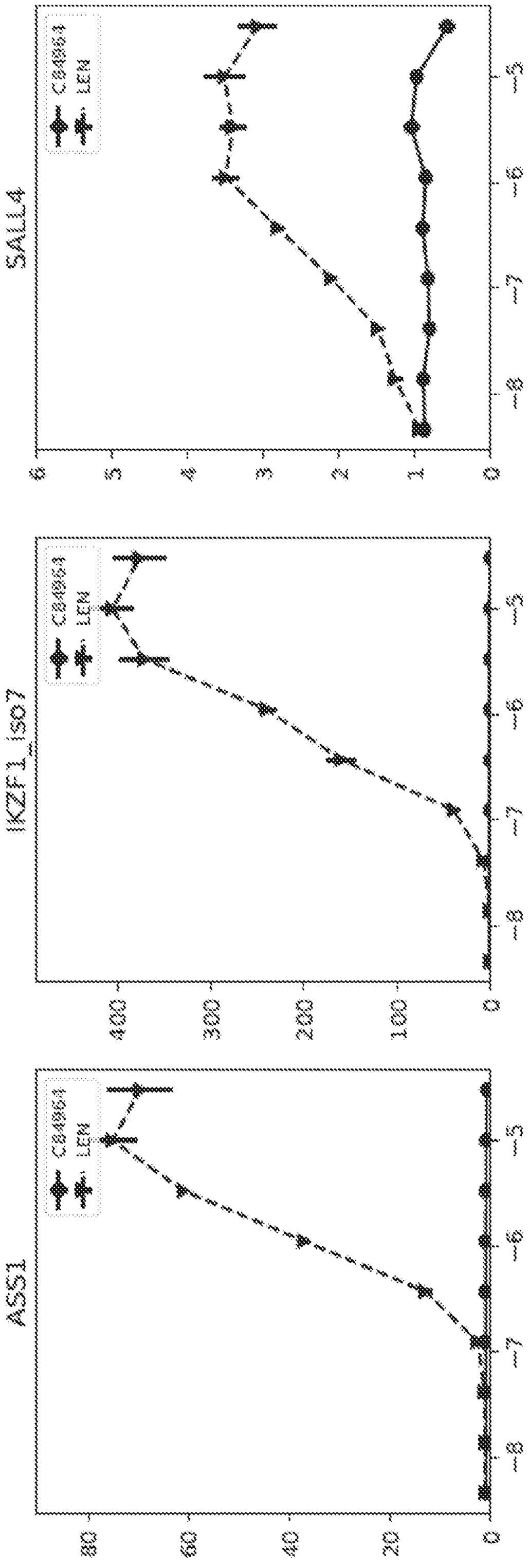


FIG. 20

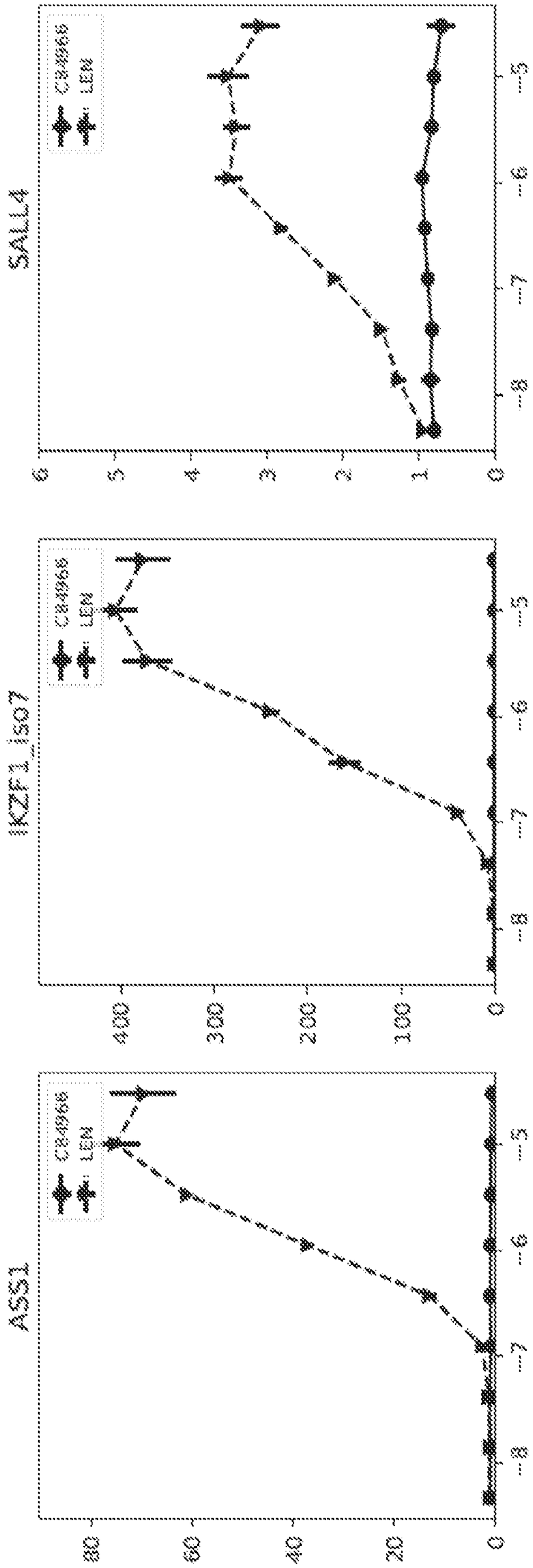
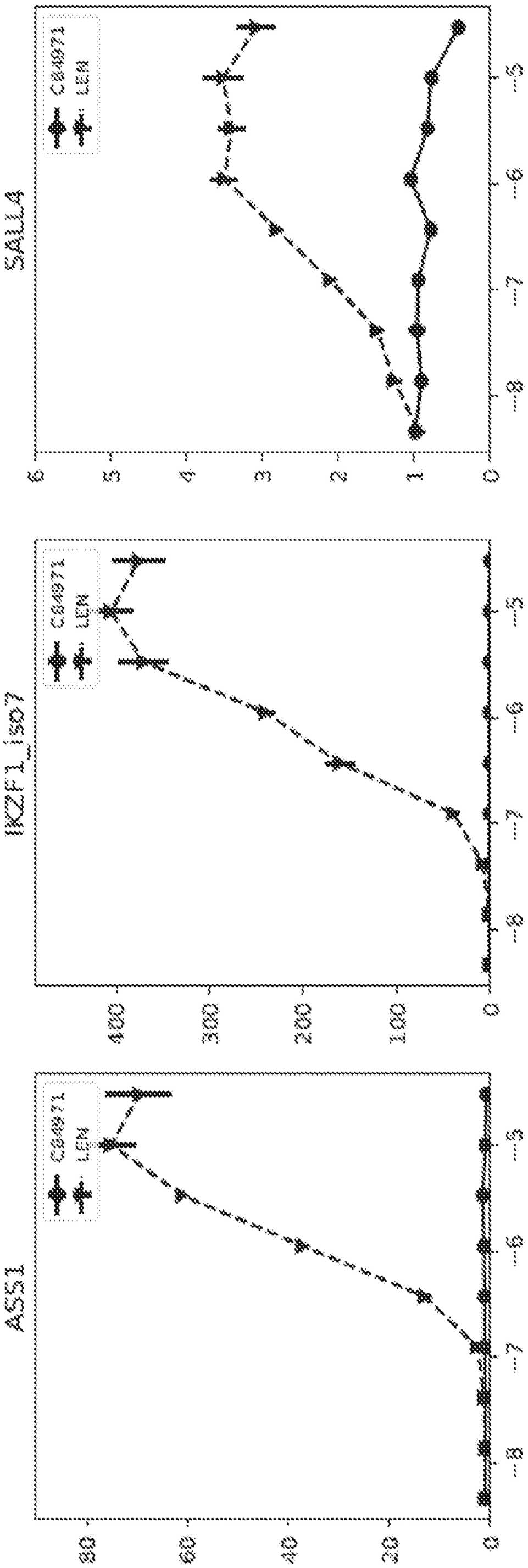

SAHA
ATRA
C8466
LEM
0
1
2
3
4
5
6
7
8
9
HDAC1_iso1
0
100
200
300
400
0
20
40
60
80
ASS1

FIG. 21


SALL4
IKZF1_iso7
AES1
CC-90009
DMSO
0
1
2
3
4
5
6
100
200
300
400
20
40
60
80
-8
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-6
-5

FIG. 22

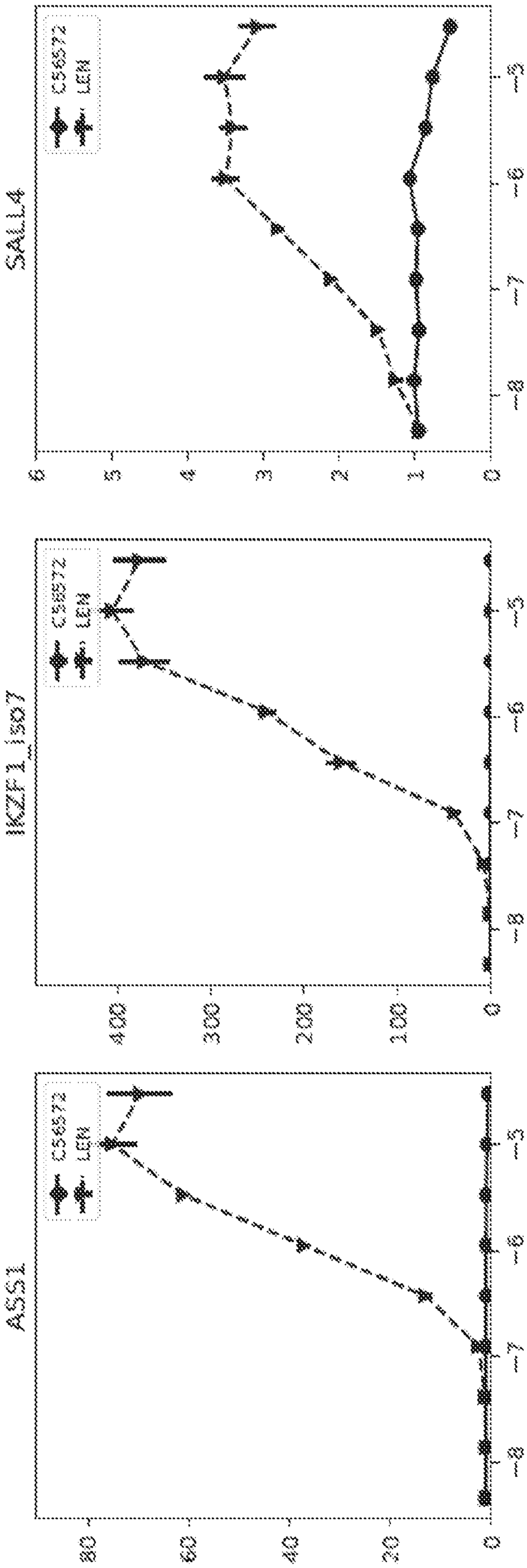

FIG. 23

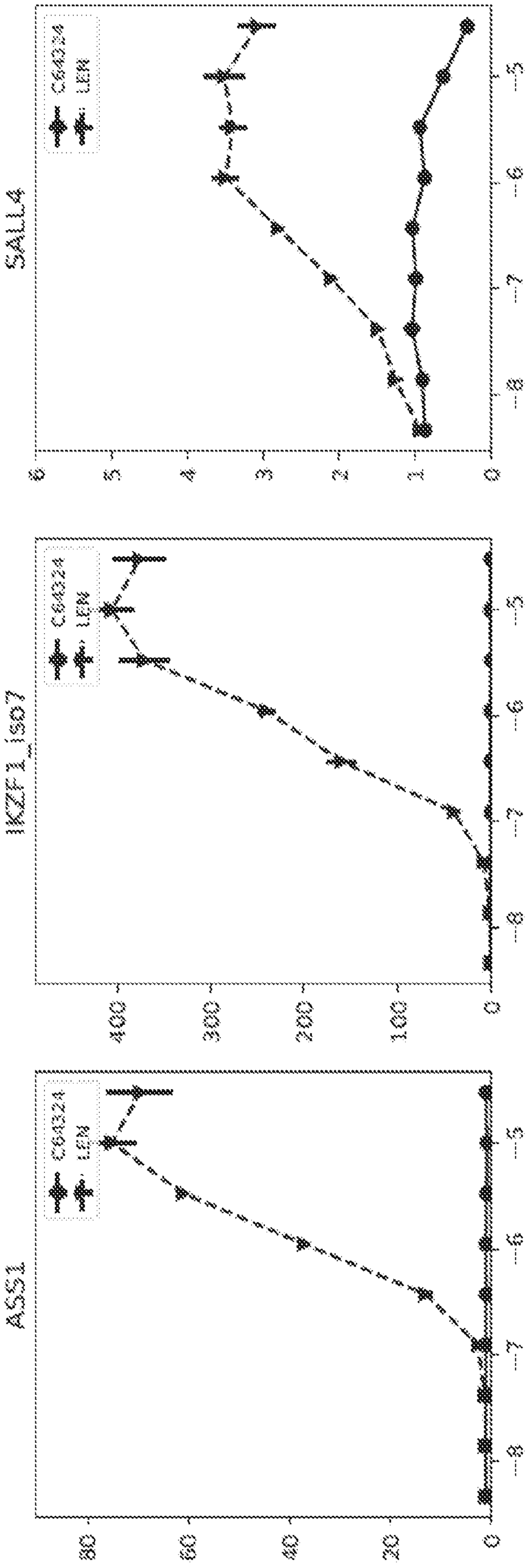
SALL4
C643224
LER
0
1
2
3
4
5
6
IKZF1_iso7
C643224
LER
0
100
200
300
400
ASS1
C643224
LER
0
20
40
60
80
2
3
4
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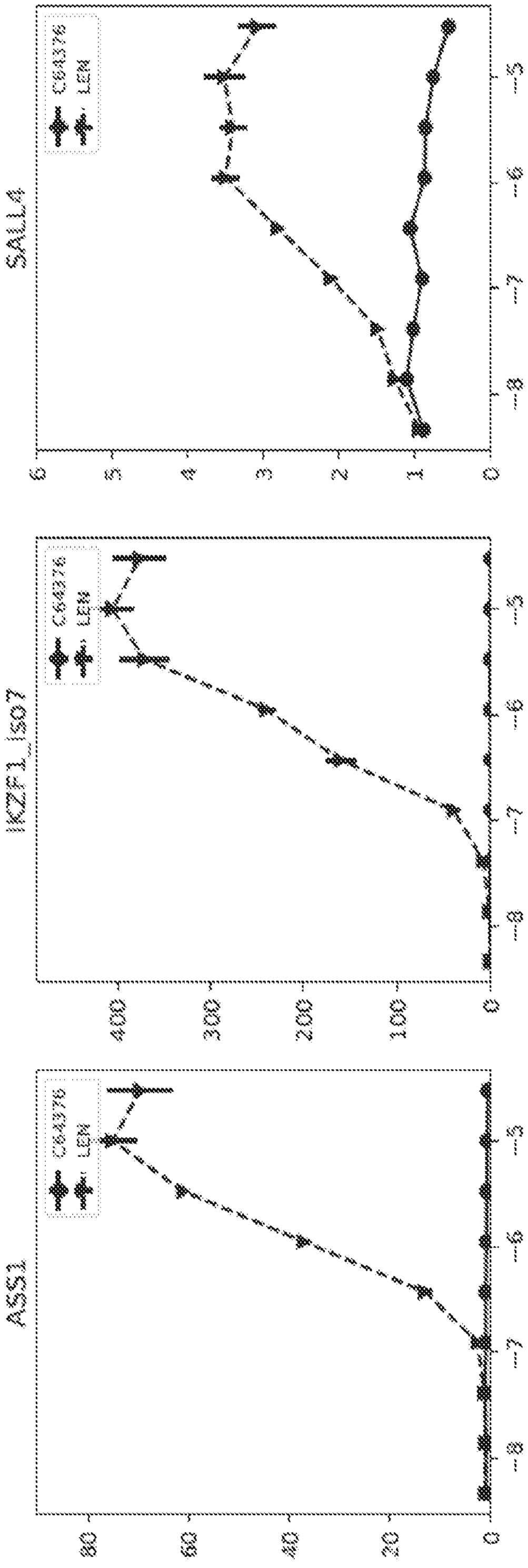
FIG. 24


SALL4
IKZF1_iso7
ASS1
C643776
LEM
0
1
2
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4
5
6
100
200
300
400
20
40
60
80
-3
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-7
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FIG. 25

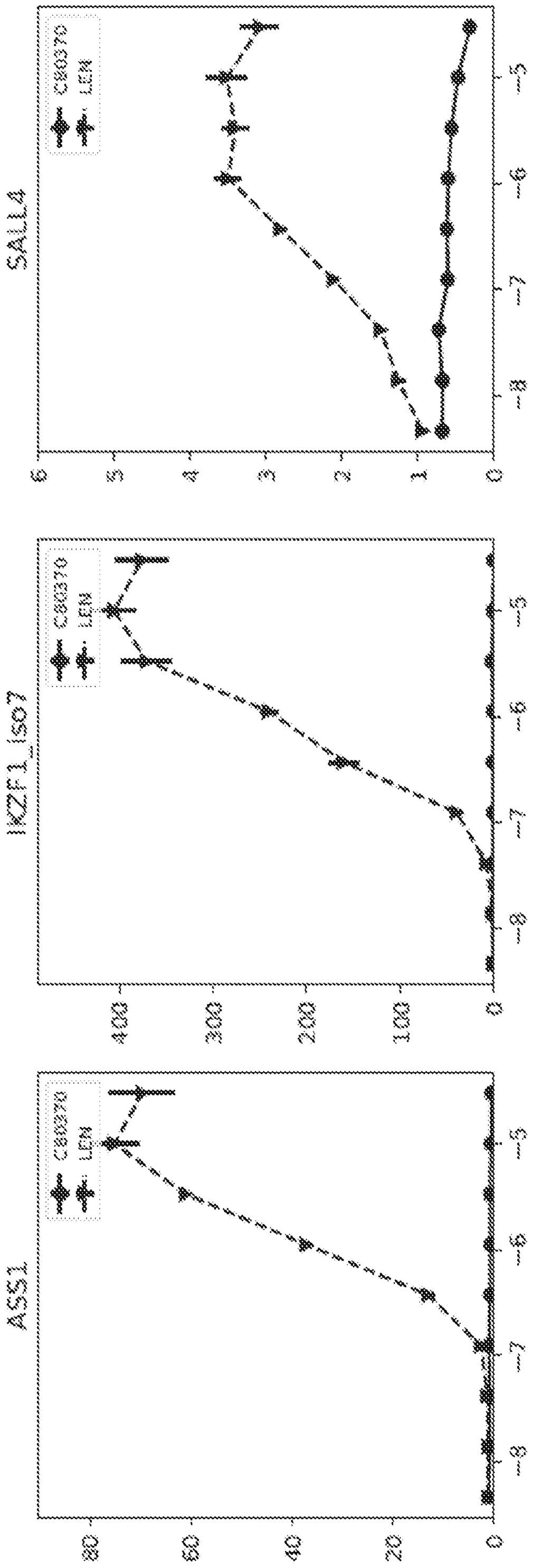
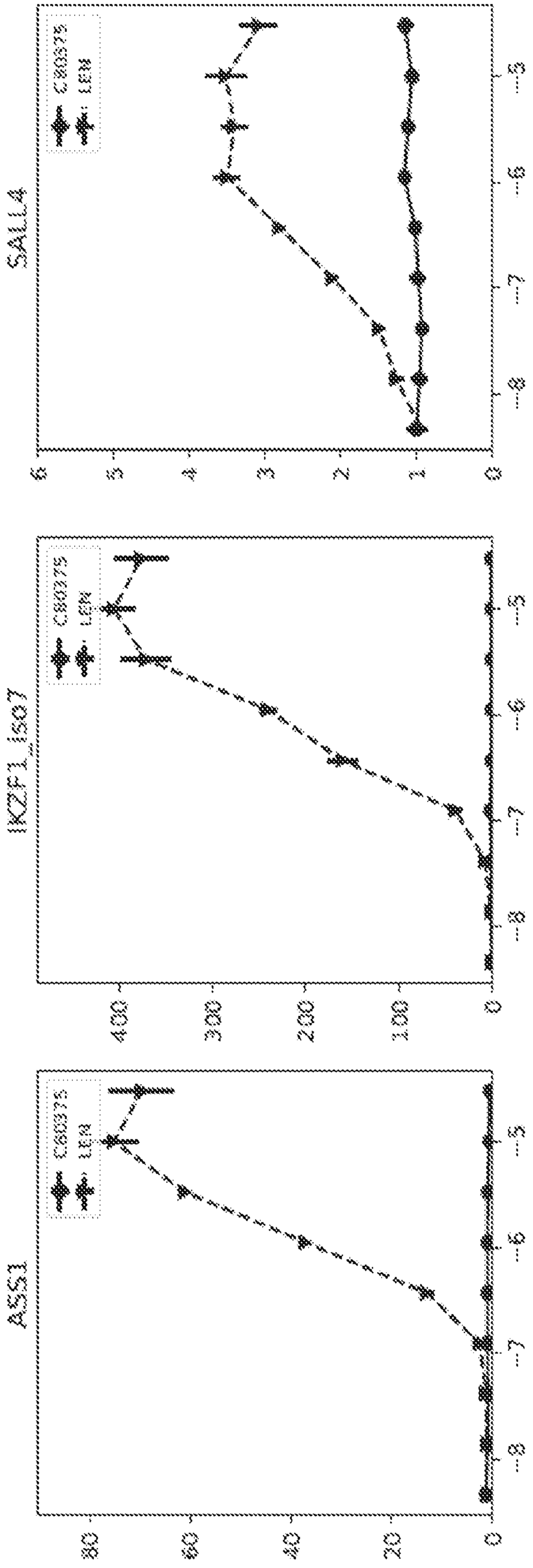

SALL4
IKZF1_iso7
ASS1
CB0330
LEM
0
100
200
300
400
0
20
40
60
80
-3
-4
-5
-6
-7
-8

FIG. 26


SALL4
IKZF1_iso7
ASS1
CRISPR
LEM
0
100
200
300
400
0
20
40
60
80
1
2
3
4
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7
8

FIG. 27

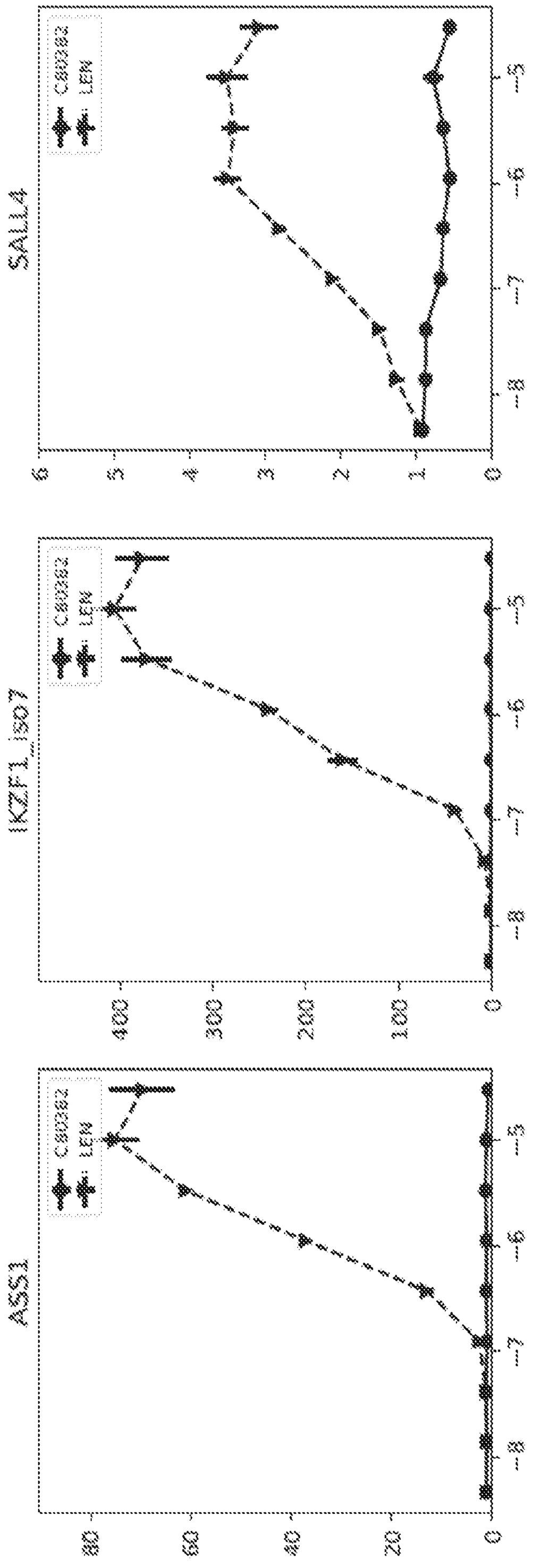

SALL4
IKZF1 isoform
ASS1
Cabozantinib
LEN
0
100
200
300
400
0
1
2
3
4
5
6
0
20
40
60
80
-5
-6
-7
-8

FIG. 28

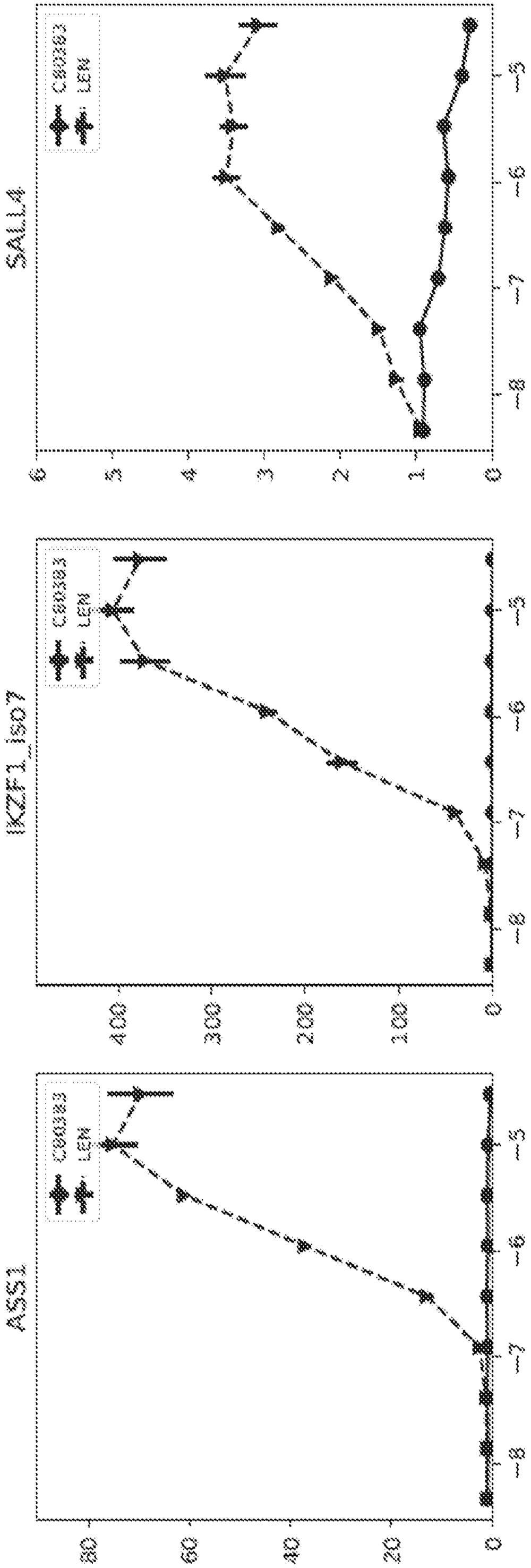

SALL4
IKZF1_iso7
ASS1
Cas9
LEM
0
1
2
3
4
5
6
100
200
300
400
20
40
60
80
-3
-6
-7
-8

FIG. 29

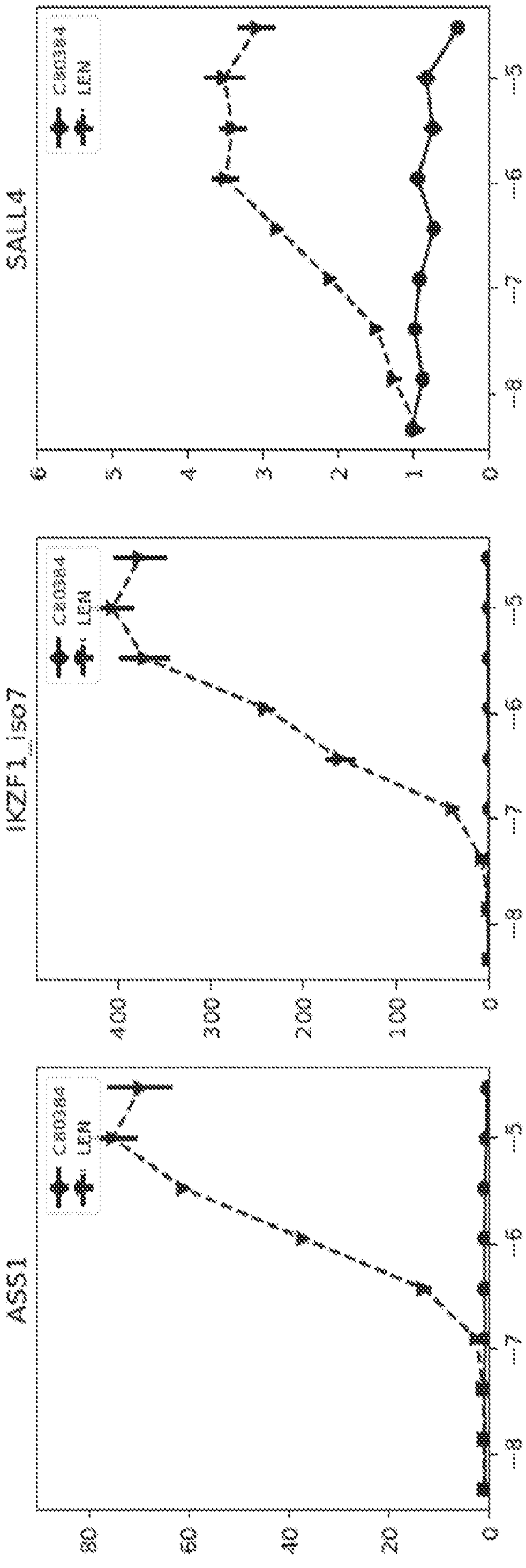

SALL4
IKZF1_iso7
ASS1
CB0384
LER
0
1
2
3
4
5
6
7
8
0
20
40
60
80
1000
2000
3000
4000

FIG. 30

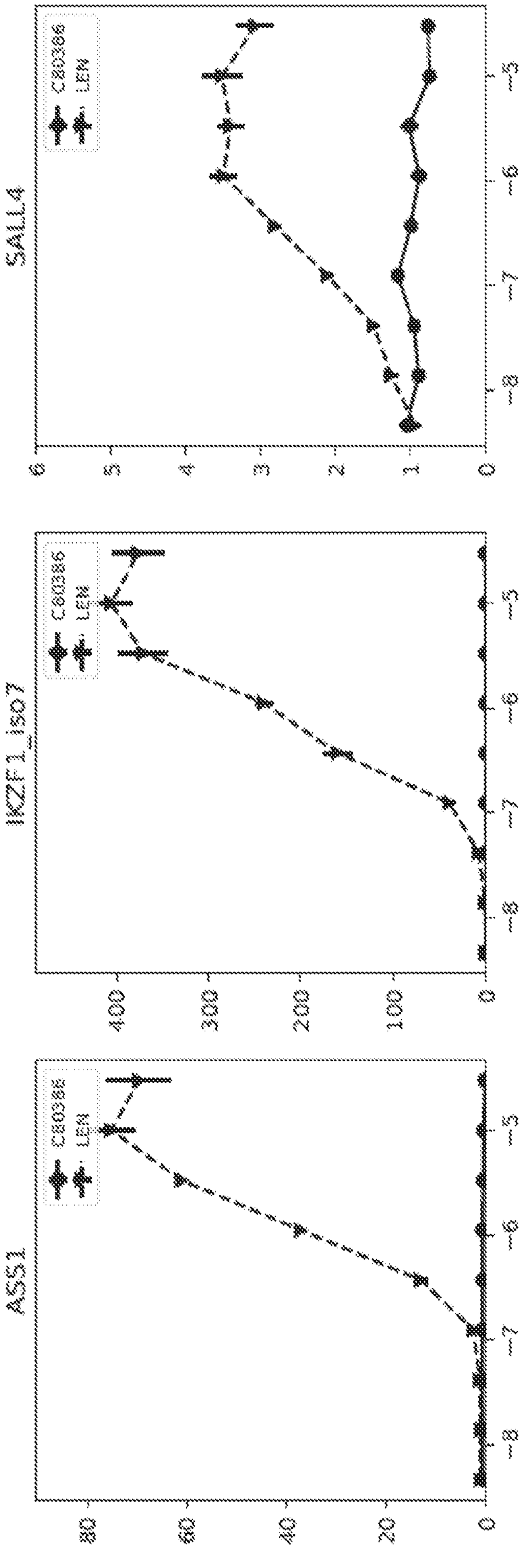

SALL4
CB03386
LEM
0
1
2
3
4
5
6
7
8
IKZF1_iso7
CB03386
LEM
0
100
200
300
400
5
6
7
8
9
10
ASXL1
CB03386
LEM
0
20
40
60
80
3
6
7
8

FIG. 31

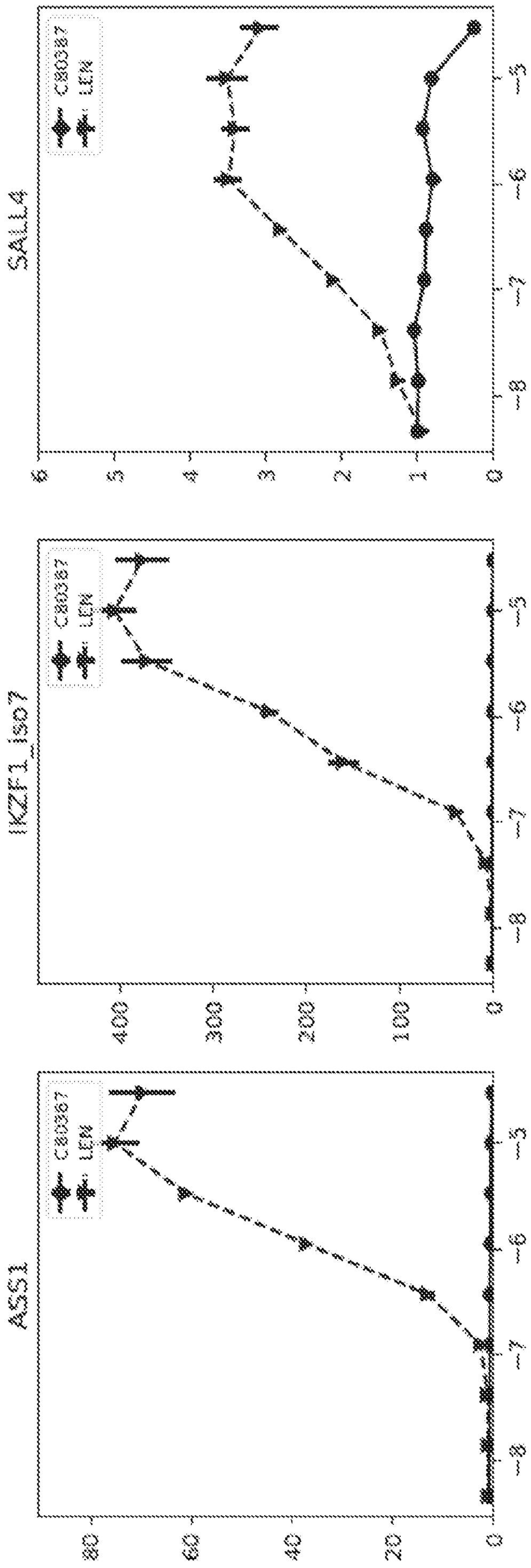

SALL4
IKZF1_iso7
ASS1
CB0387
LEM
0
1
2
3
4
5
6
100
200
300
400
0
20
40
60
−3
−6
−7
−8

FIG. 32

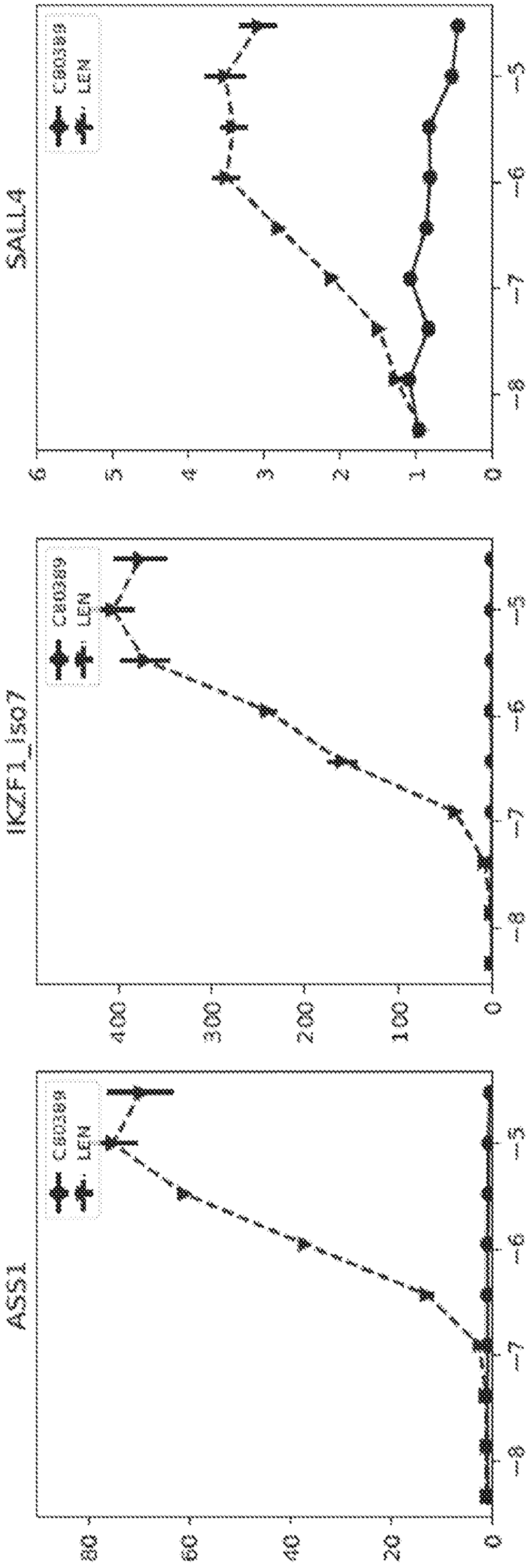

SALL4
IKZF1_ISO7
ASS1
CASIS69
LEM
0
1
2
3
4
5
6
7
8
100
200
300
400
20
40
60
80

FIG. 33

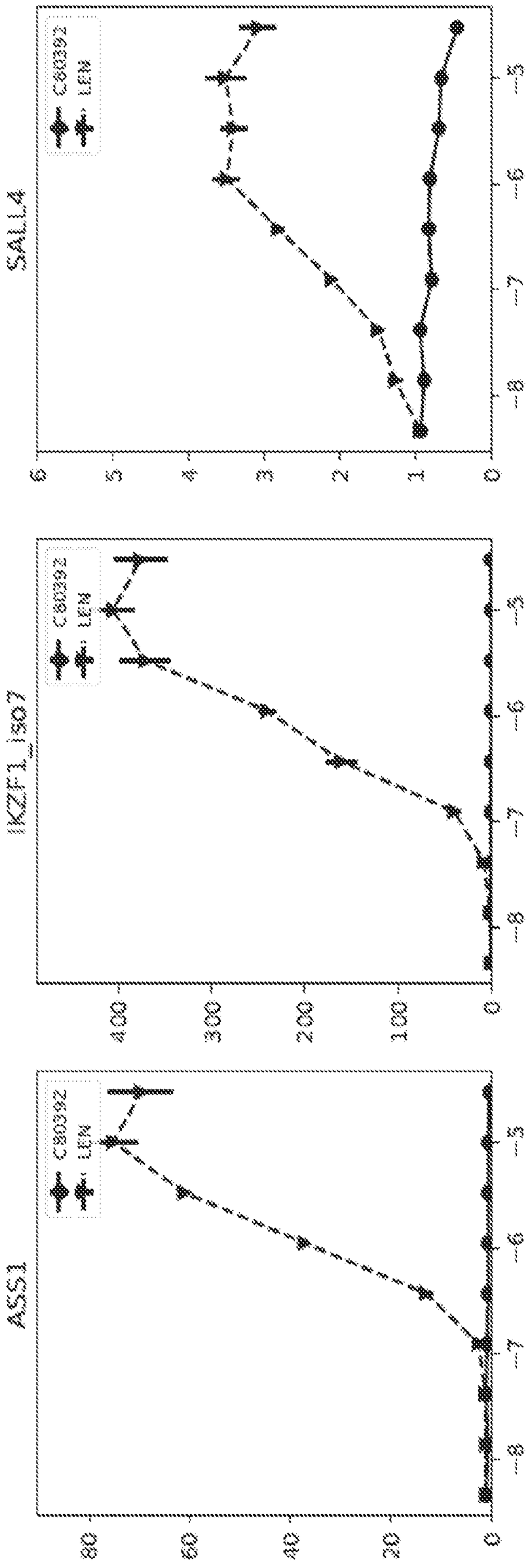

SALL4
IKZF1_iso7
ASS1
CB0392
LEM
0
1
2
3
4
5
6
80
60
40
20
0
300
200
100
-5
-6
-7
-8
-9

FIG. 34

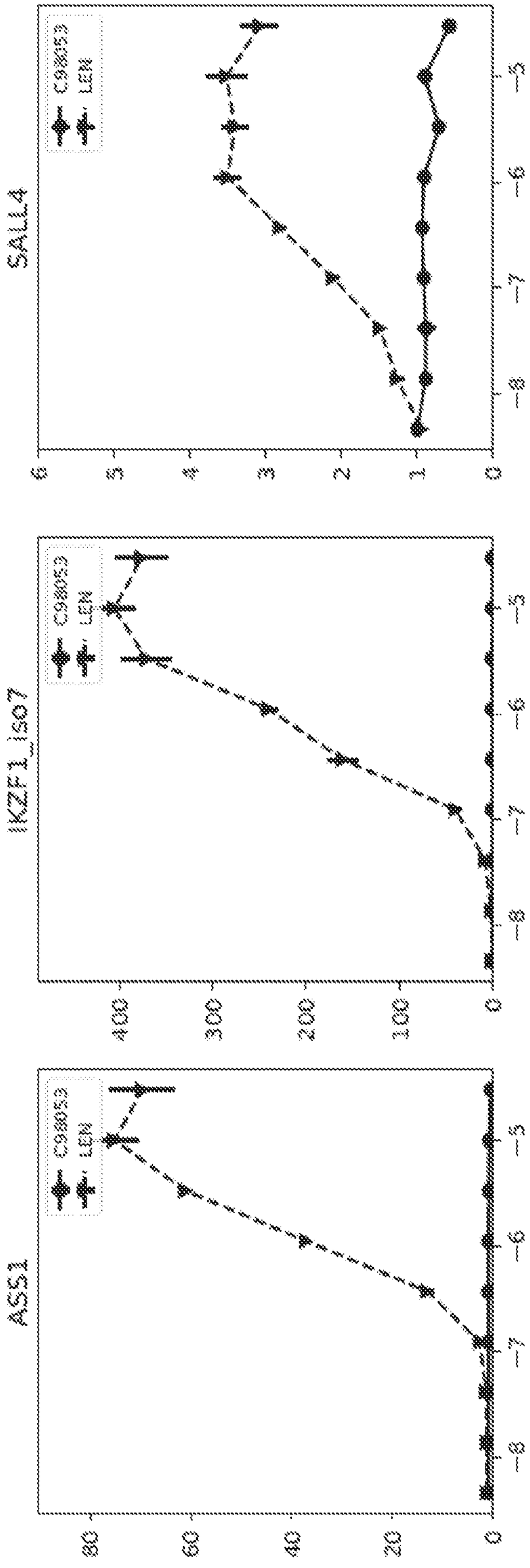

SALL4
C9ORF53
LEM
IKZF1_ISO7
AS51
1
2
3
4
5
6
7
8
0
100
200
300
400
20
40
60
80

FIG. 35

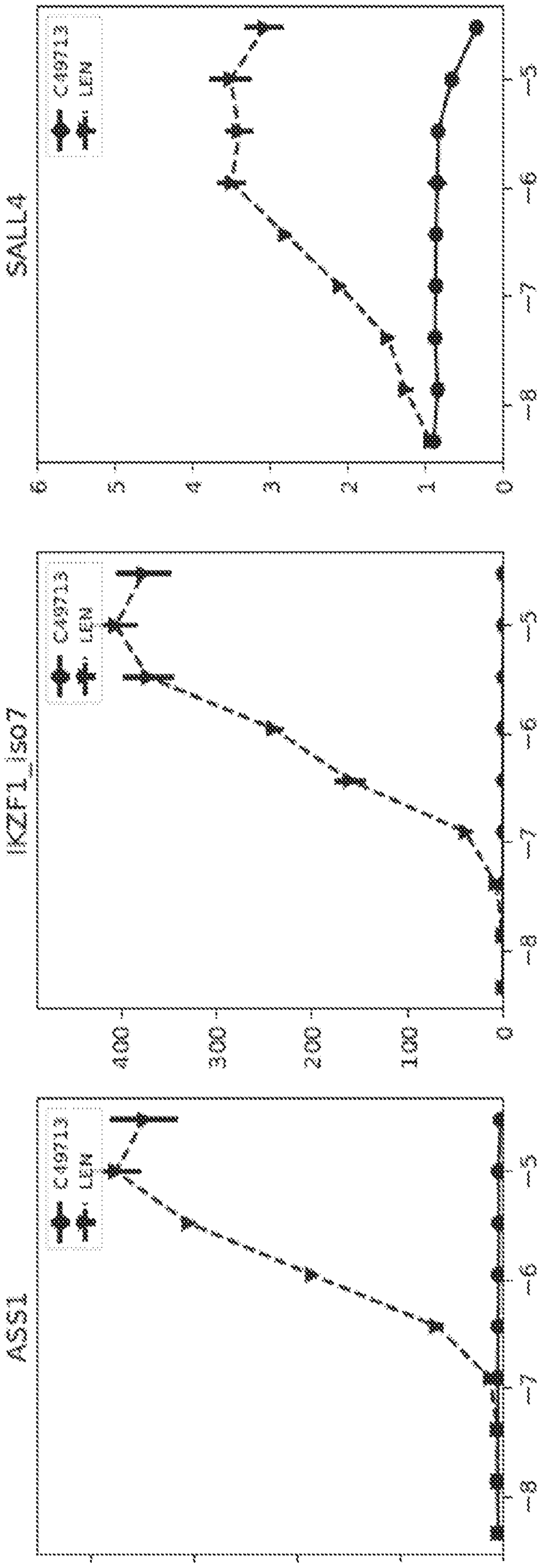

SALL4
C49713
LEM
0
1.00
2.00
3.00
4.00
5.00
6.00
~3
~6
~7
~8
IKZF1_iso7
C49713
LEM
0
100
200
300
400
~3
~6
~7
~8
ASS1
C49713
LEM
0
20
40
60
80
~3
~6
~7
~8

FIG. 36

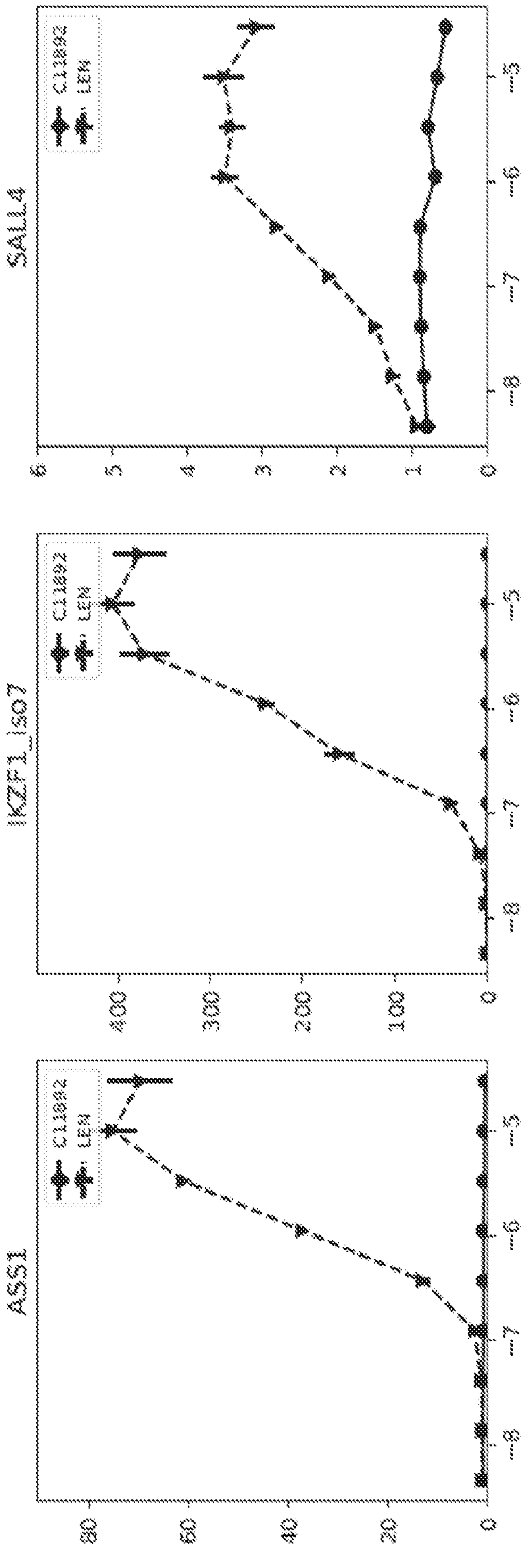

SALL4
IKZF1_iso7
ASS1
C1189z2
LE%
0
1000
2000
3000
4000
0
20
40
60
80
-5
-6
-7
-8
-9

FIG. 37

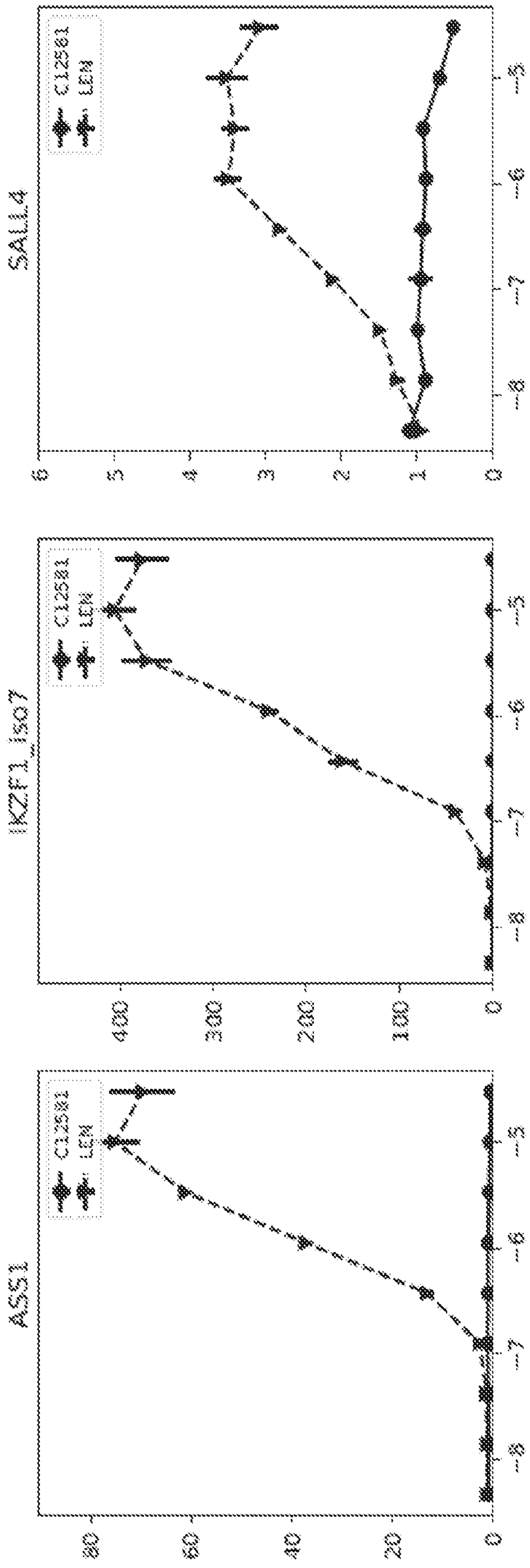


FIG. 38

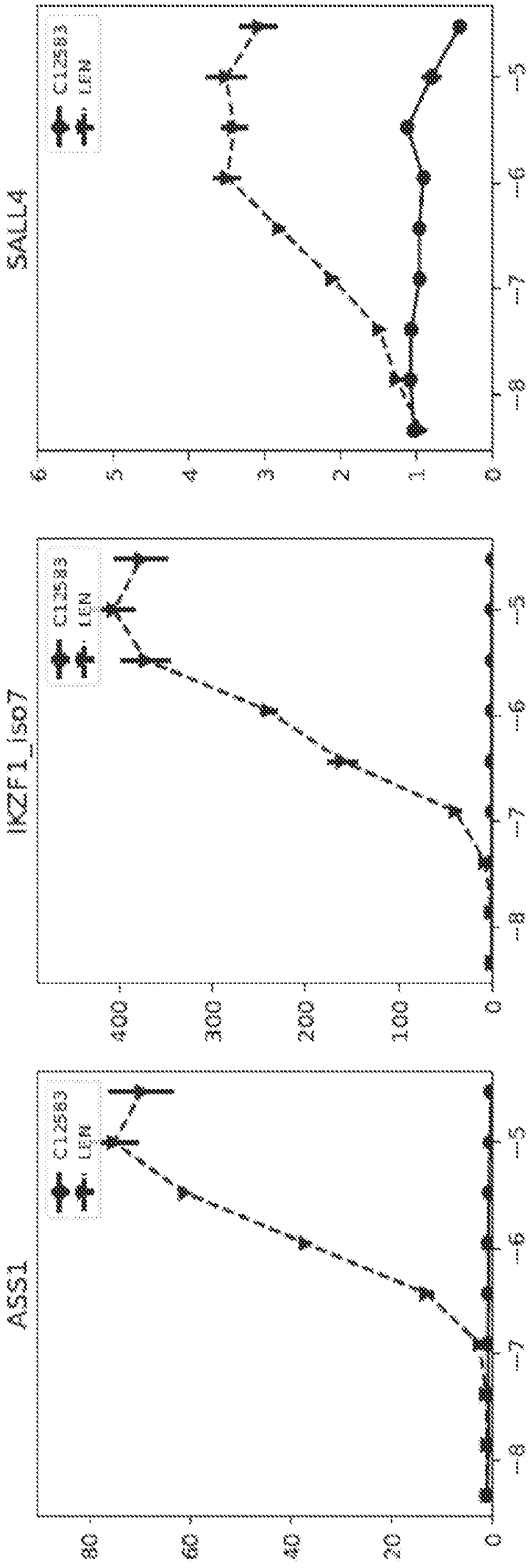

SMYD3
C125683
LEM
IKZF1_isoform
C125683
LEM
ASS1
C125683
LEM

FIG. 39

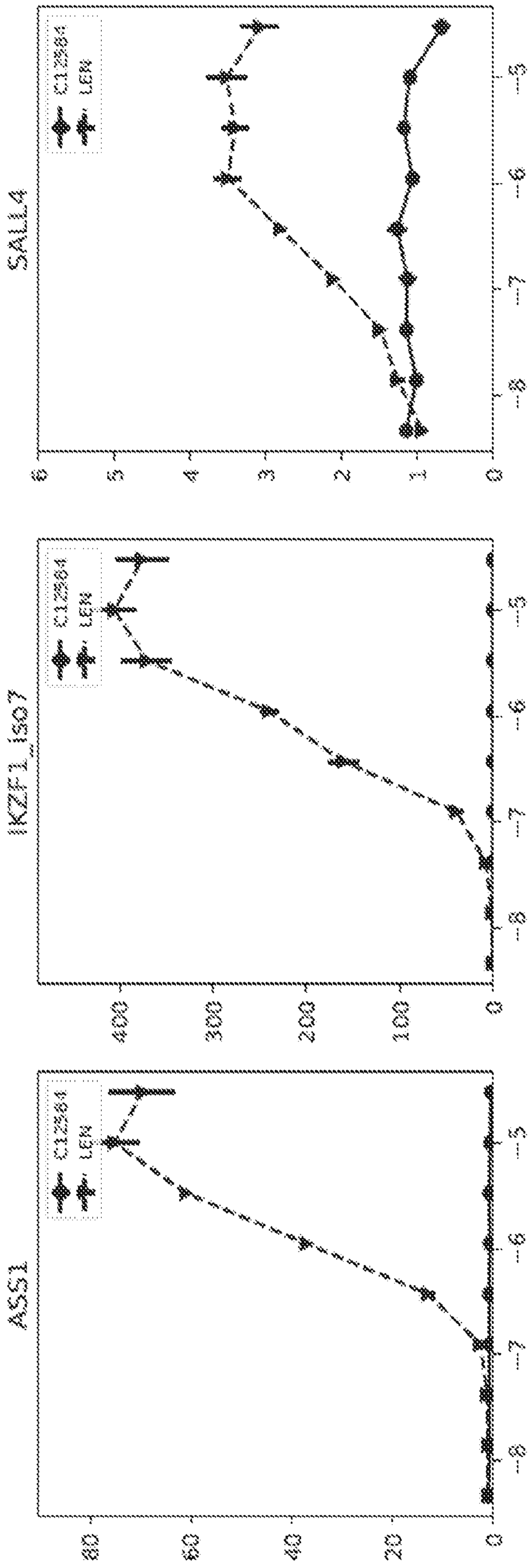

SALL4
IKZF1_iso7
ASS1
C12564
L63k
0
1
2
3
4
5
6
100
200
300
400
20
40
60
80
-3
-4
-5
-6
-7
-8
-9

FIG. 40

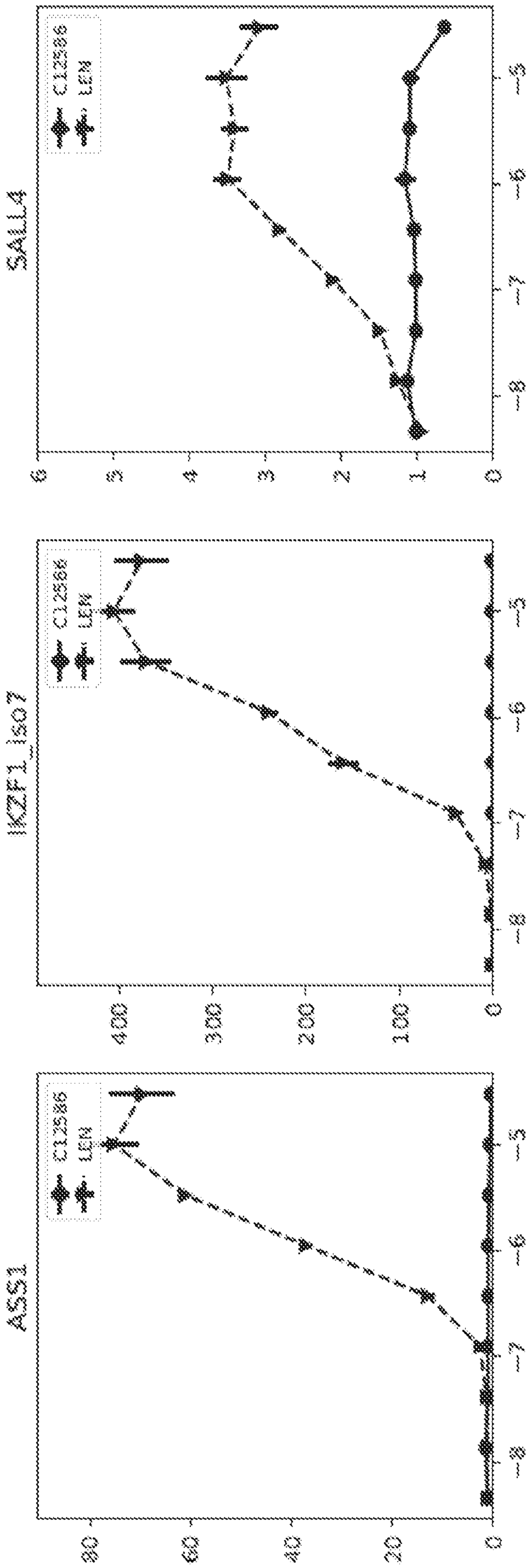

SAA4
C12566
L87M
0
1
2
3
4
5
6
—1
—2
—3
—4
—5
—6
—7
—8
IKZF1_I50T
C12566
L87M
0
1
2
3
4
5
6
—1
—2
—3
—4
—5
—6
—7
—8
ASS1
C12566
L87M
0
20
40
60
80
0
1000
2000
3000
4000
—1
—2
—3
—4
—5
—6
—7
—8

FIG. 41

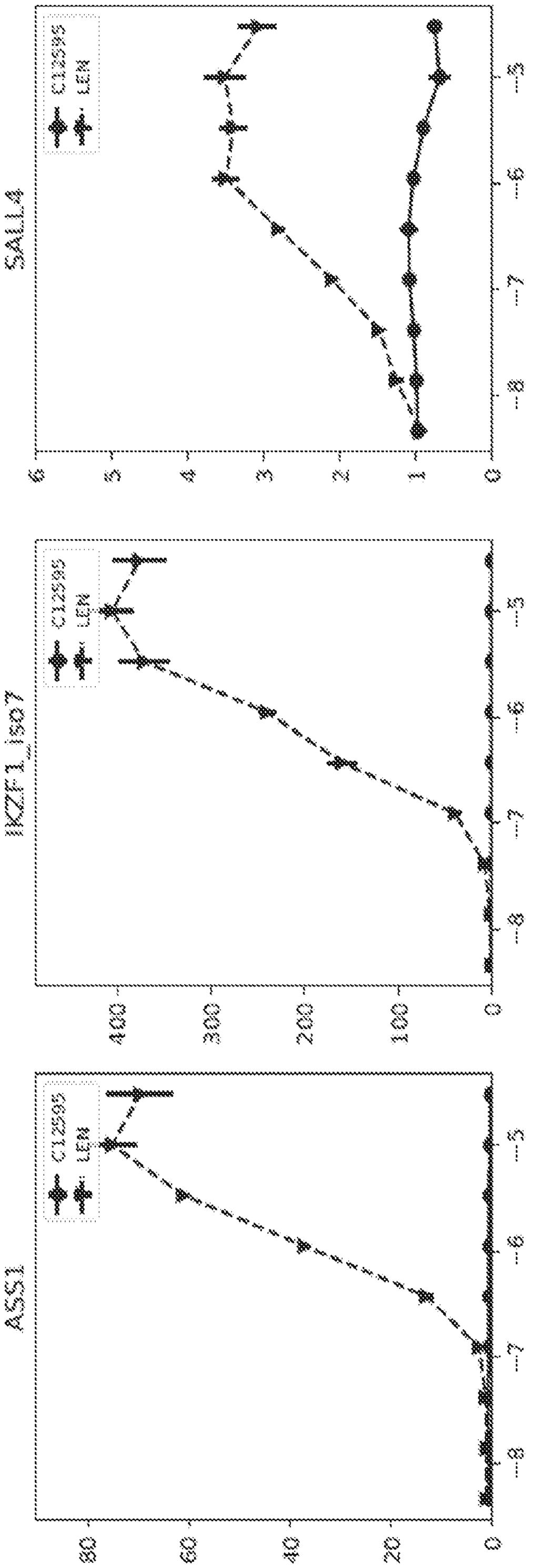


FIG. 42

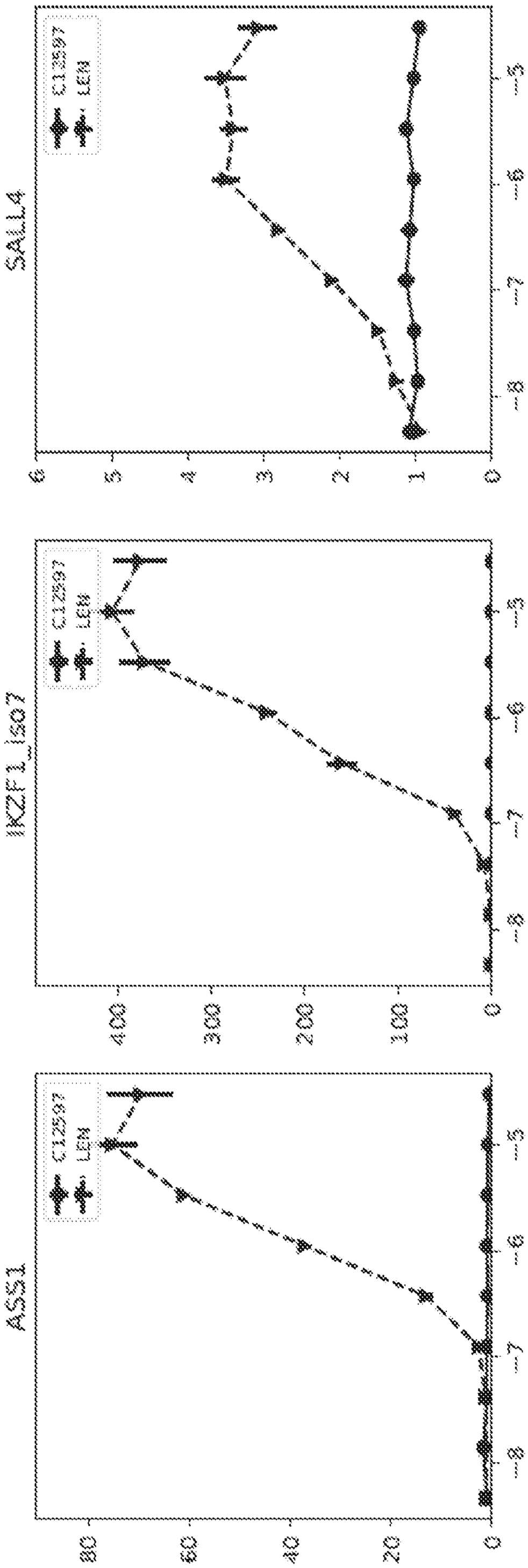

SALL4
IKZF1_iso7
ASS1
C12997
LE99
0
1
2
3
4
5
6
-8
-7
-6
-5
-4
-3
0
100
200
300
400
0
20
40
60
80

FIG. 43

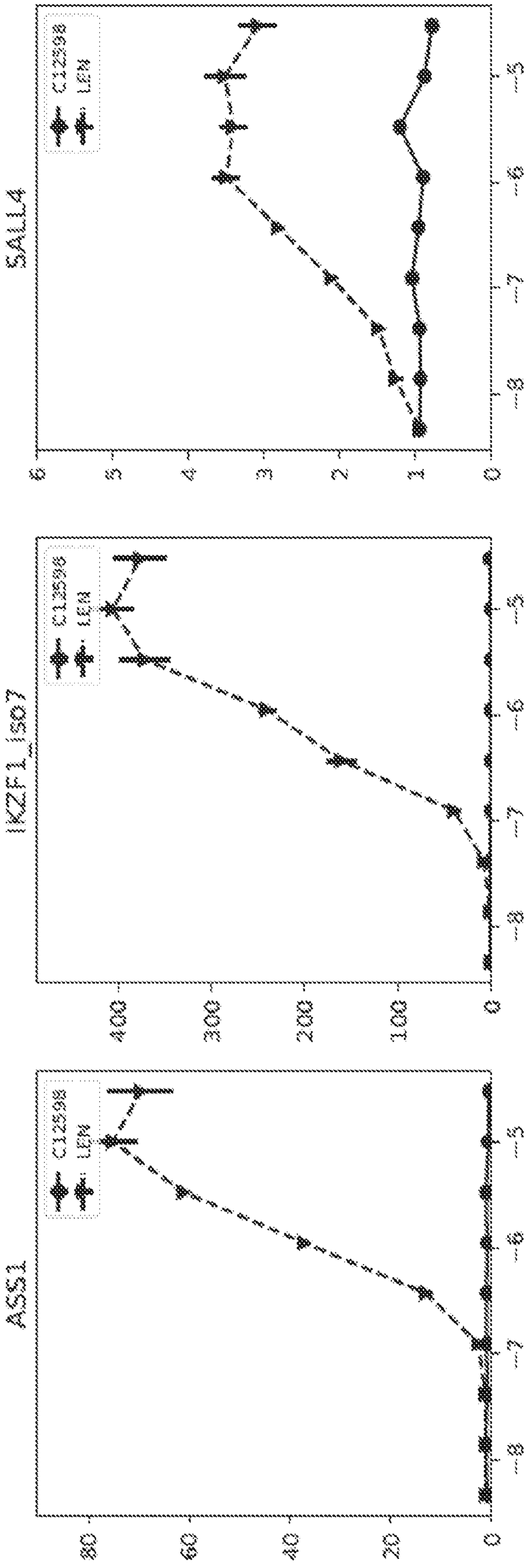

SALL4
C12298
LEM
6
5
4
3
2
1
0
-5
-6
-7
-8
IKZF1_iso3
C12298
LEM
400
300
200
100
0
-5
-6
-7
-8
ASS1
C12298
LEM
80
60
40
20
0
-5
-6
-7
-8

FIG. 44

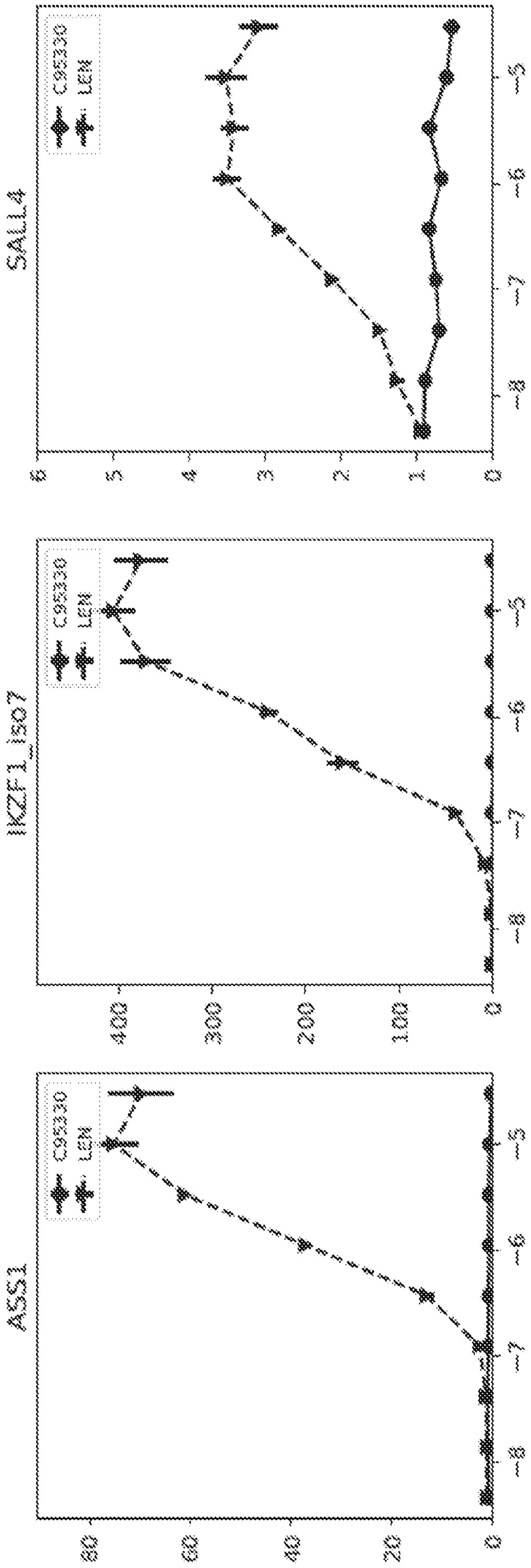

SALL4
IKZF1_iso7
ASS1
C95330
LEM
0
1.00
2.00
3.00
4.00
0
20
40
60
80
1
2
3
4
5
6
7
8

FIG. 45

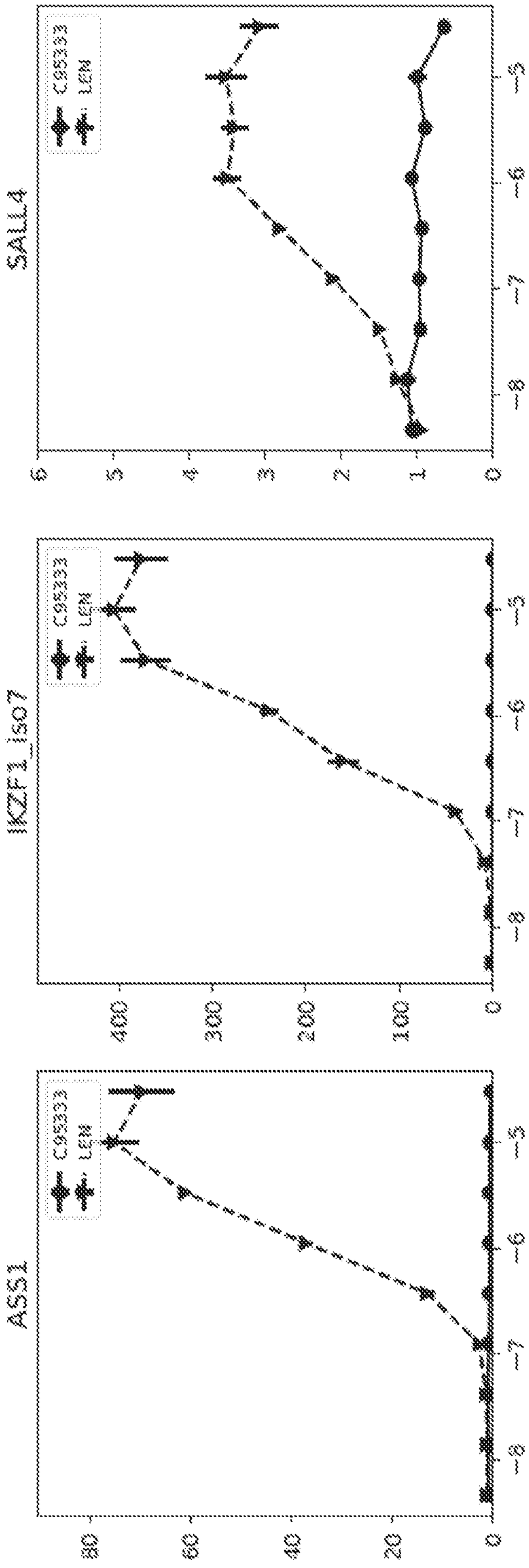

SAL14
C95233
LCM
0
1
2
3
4
5
6
8
IKZF1_iso7
C95233
LCM
0
100
200
300
400
2
6
7
A531
C95233
LCM
0
20
40
60
80
5
6
7
8

FIG. 46

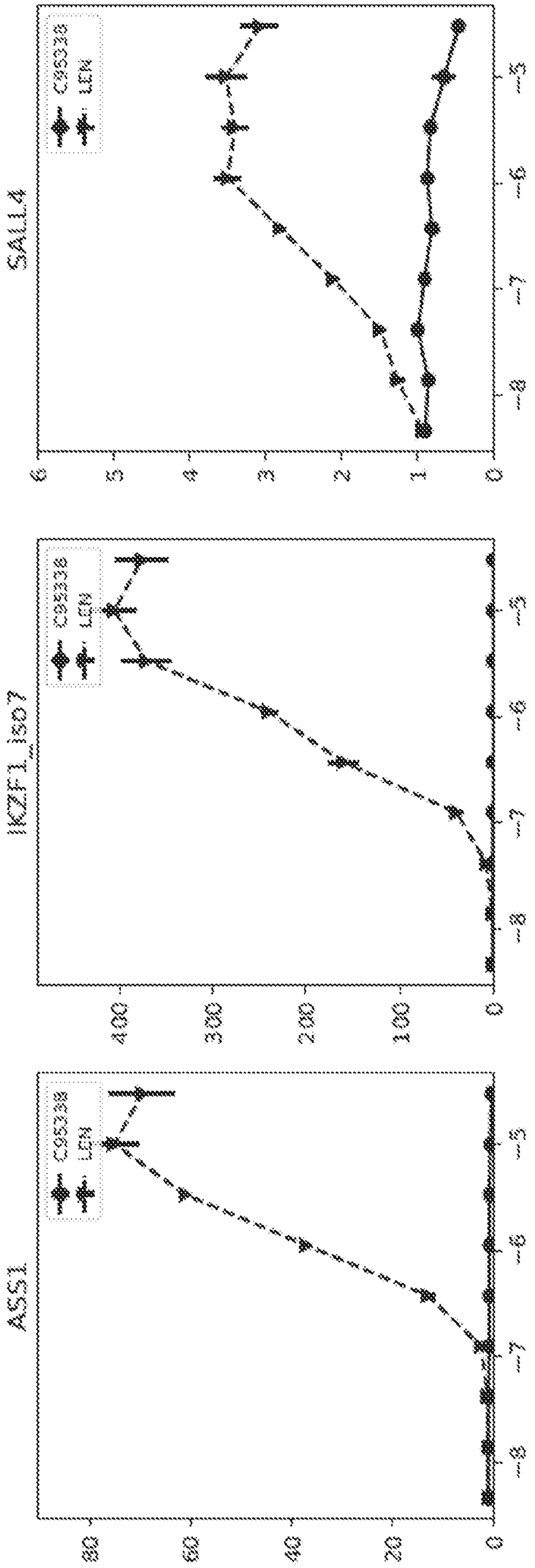


FIG. 47

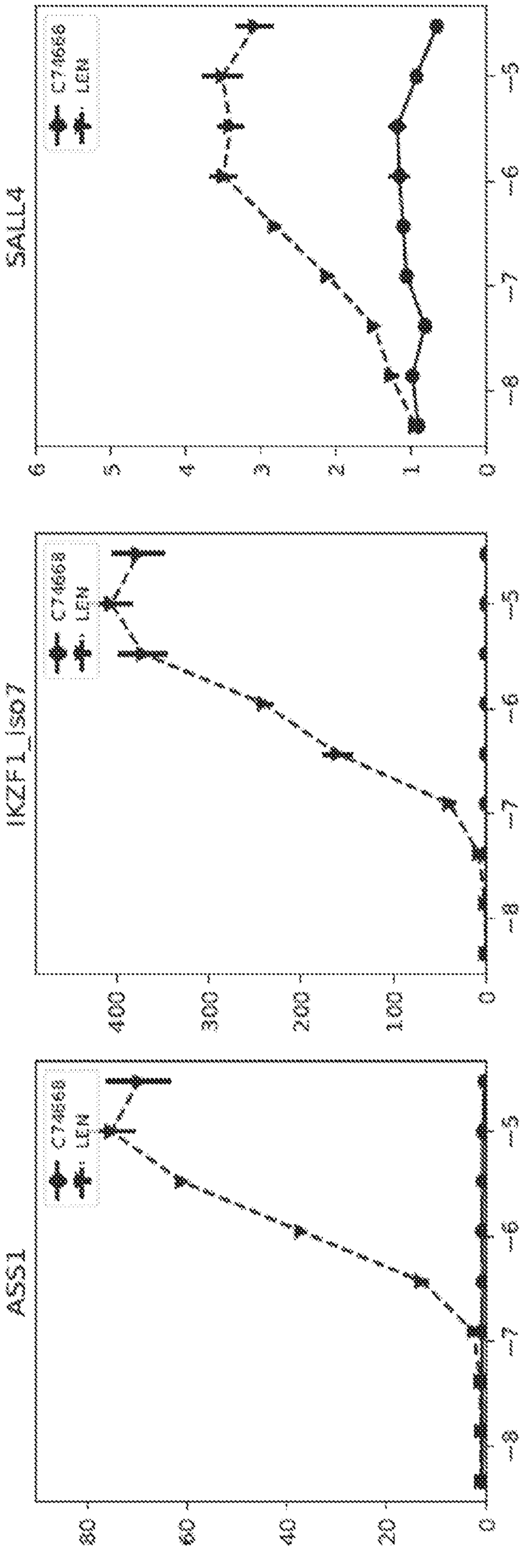

SALL4
C746550
LEM
0
1
2
3
4
5
6
5
6
7
8
IKZF1_iso7
C746668
LEM
0
100
200
300
400
5
6
7
8
ASS1
C746668
LEM
0
20
40
60
80
5
6
7
8

FIG. 48

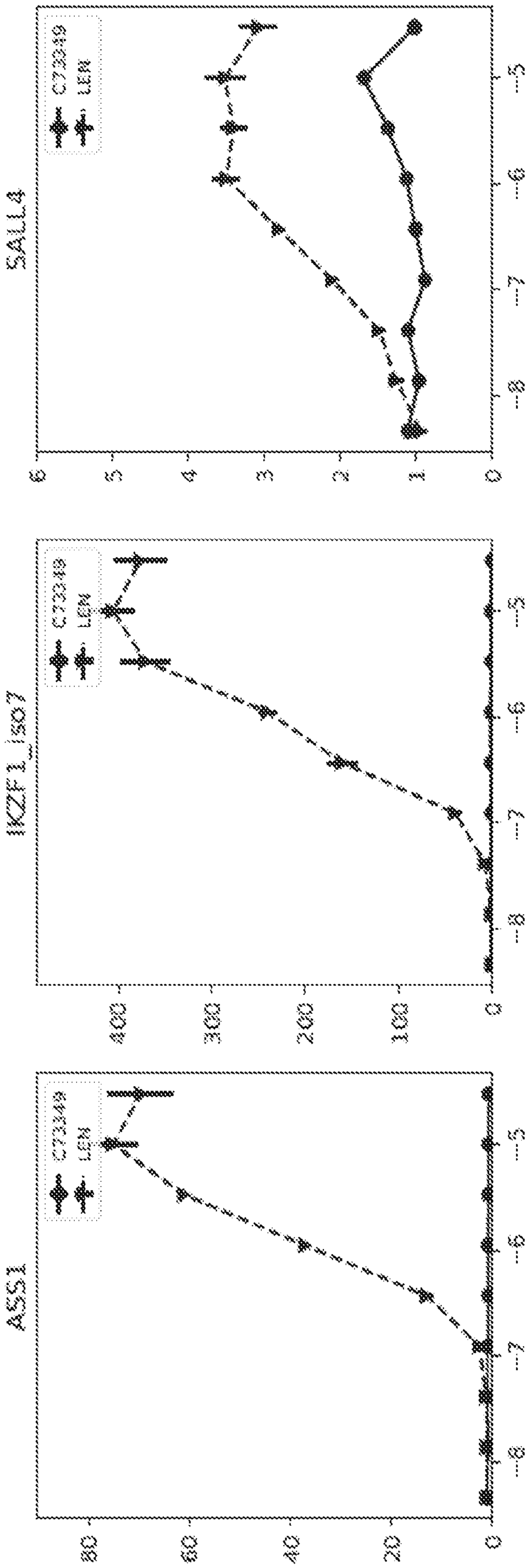

SALL4
IKZF1_iso7
ASS1
C73349
LEM
0
1
2
3
4
5
6
100
200
300
400
20
40
60
80
--3
--6
--7
--8
--5

FIG. 49

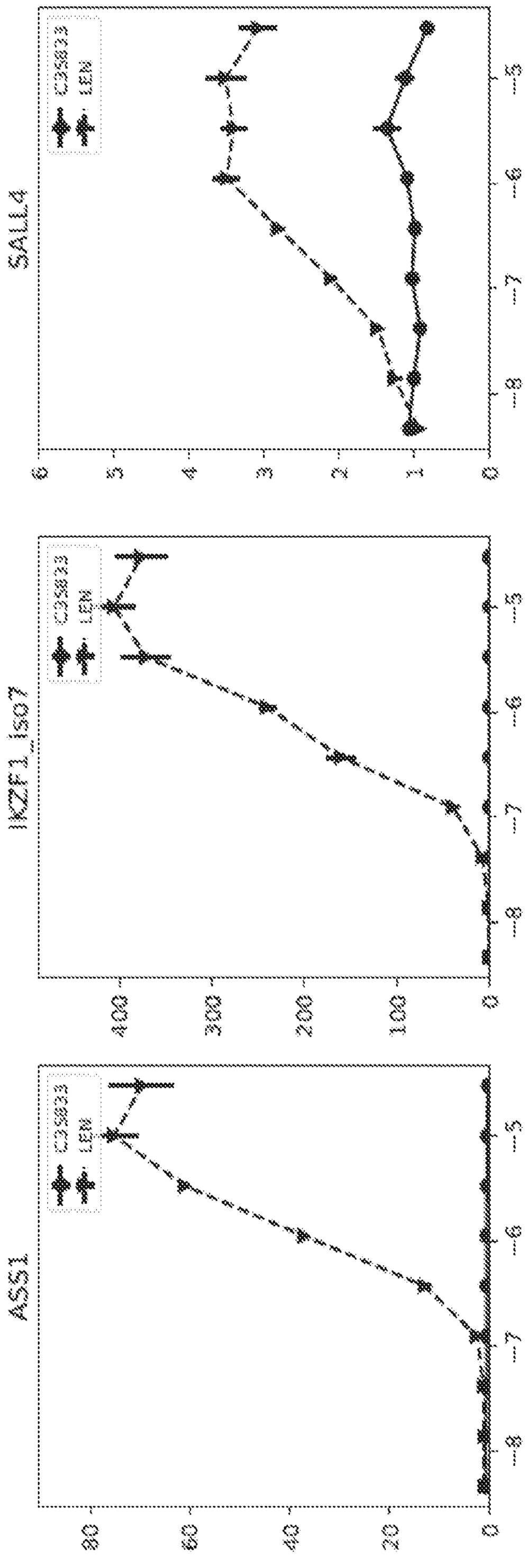

SALL4
IKZF1_iso7
ASS1
C3586333
LEM
0
5
4
3
2
1
0
400
300
200
100
0
80
60
40
20
0
1
2
3
4
5
6
7
8

FIG. 50

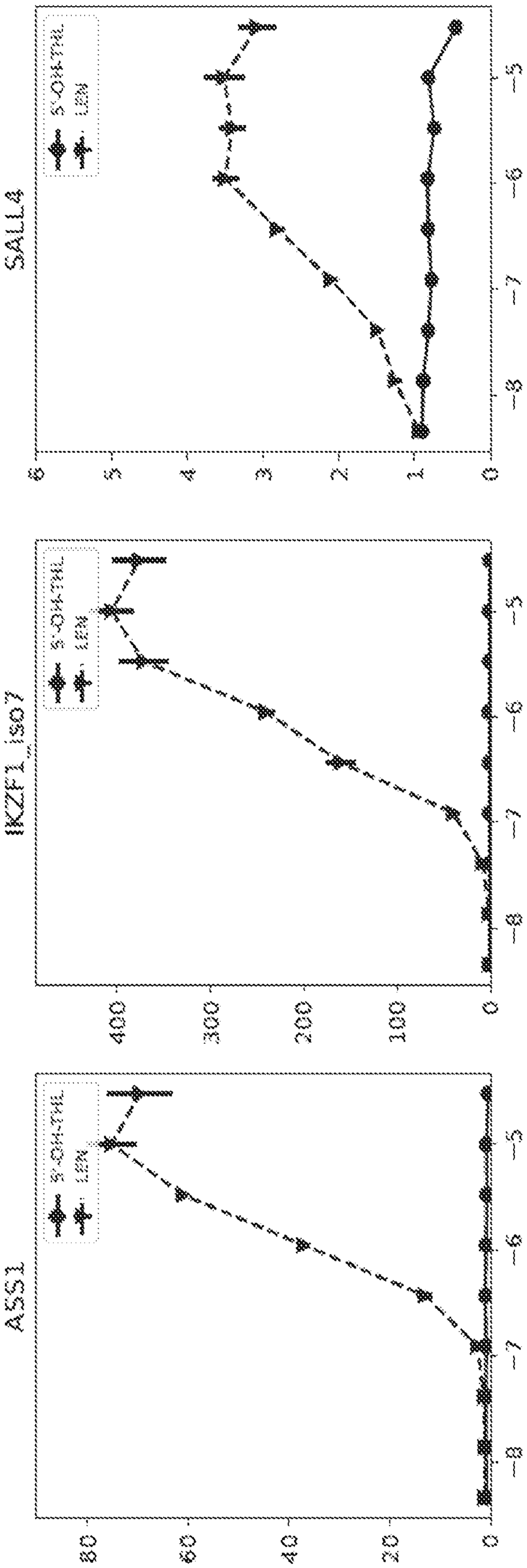

SALL4
IKZF1_iso7
ASS1
SCRAMBL
LEN
0
2
4
6
100
200
300
400
0
20
40
60
80
−8
−7
−6
−5
−4
−3

FIG. 51

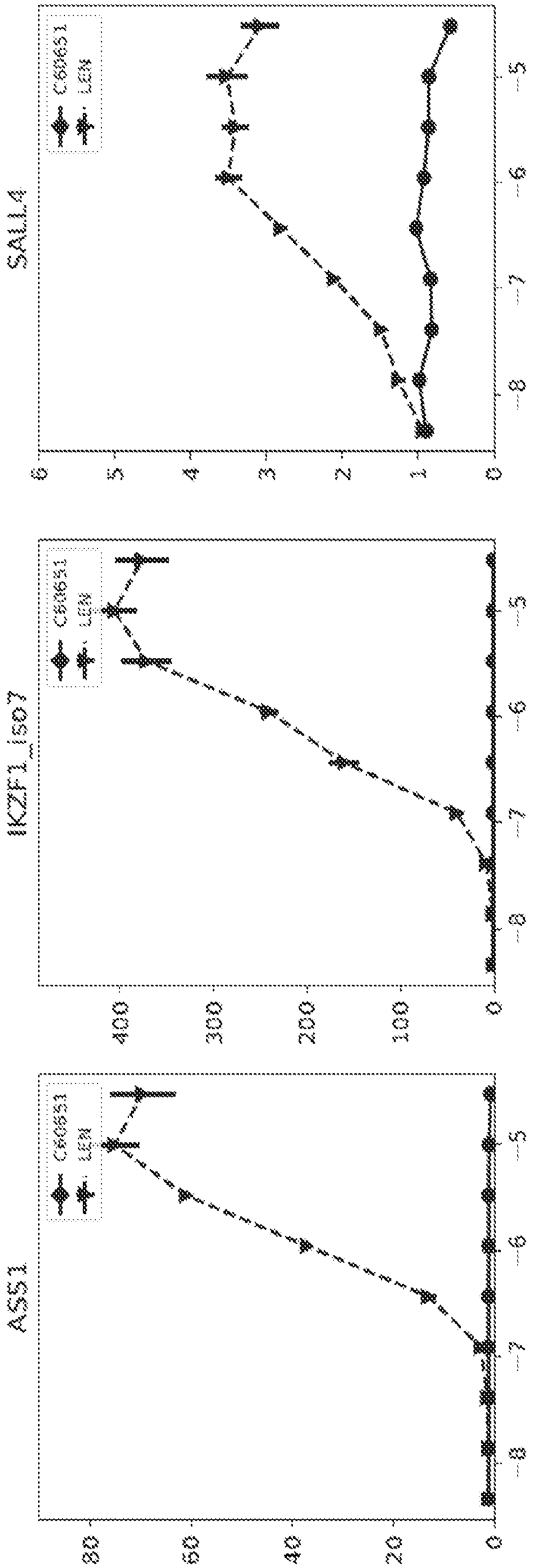

SALL4
C60651
LEN
0
1
2
3
4
5
6
5
6
7
8
IKZF1_iso7
C60651
LEN
0
100
200
300
400
5
6
7
8
ASS1
C60651
LEN
0
20
40
60
80
5
6
7
8

FIG. 52

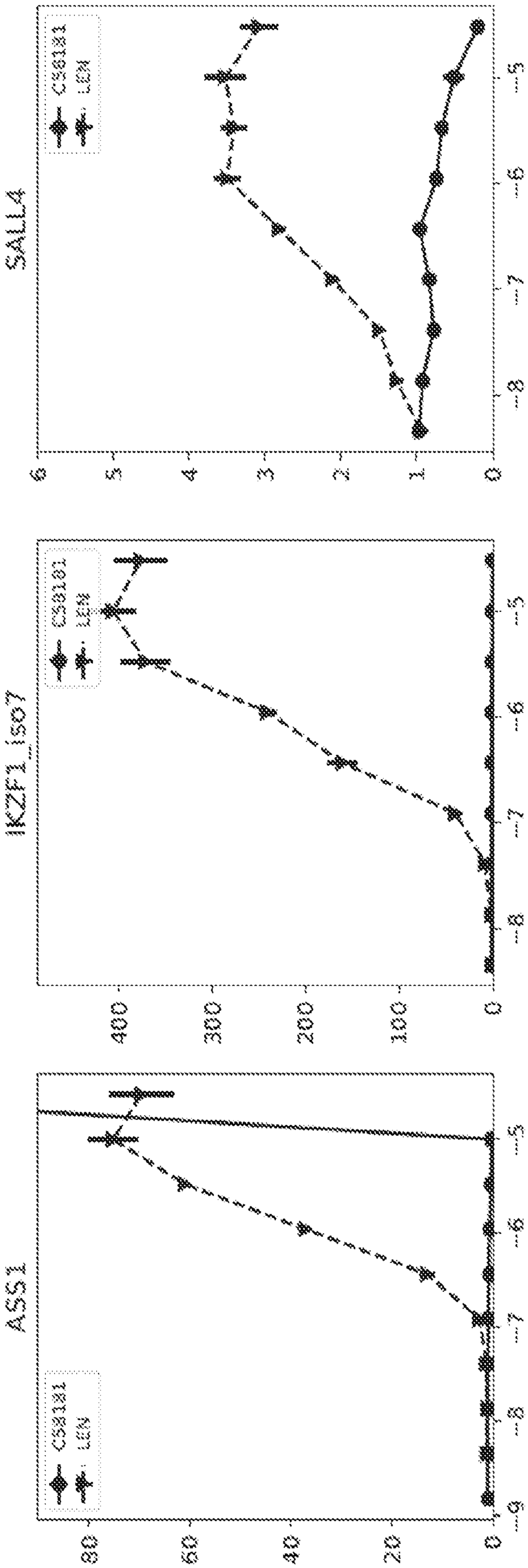


FIG. 53

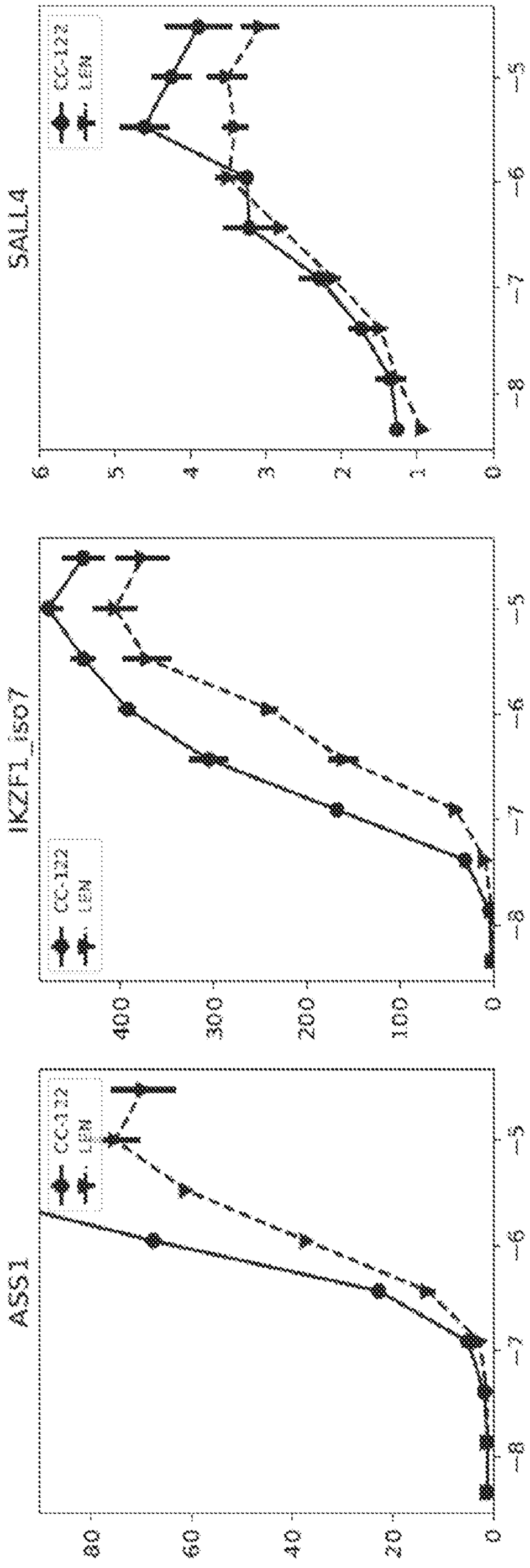

SALL4
IKZF1 isoform 1
ASS1
CC-122
LEN
0
1
2
3
4
5
6
100
200
300
400
0
20
40
60
-8
-7
-6
-5
-4
-3

FIG. 54

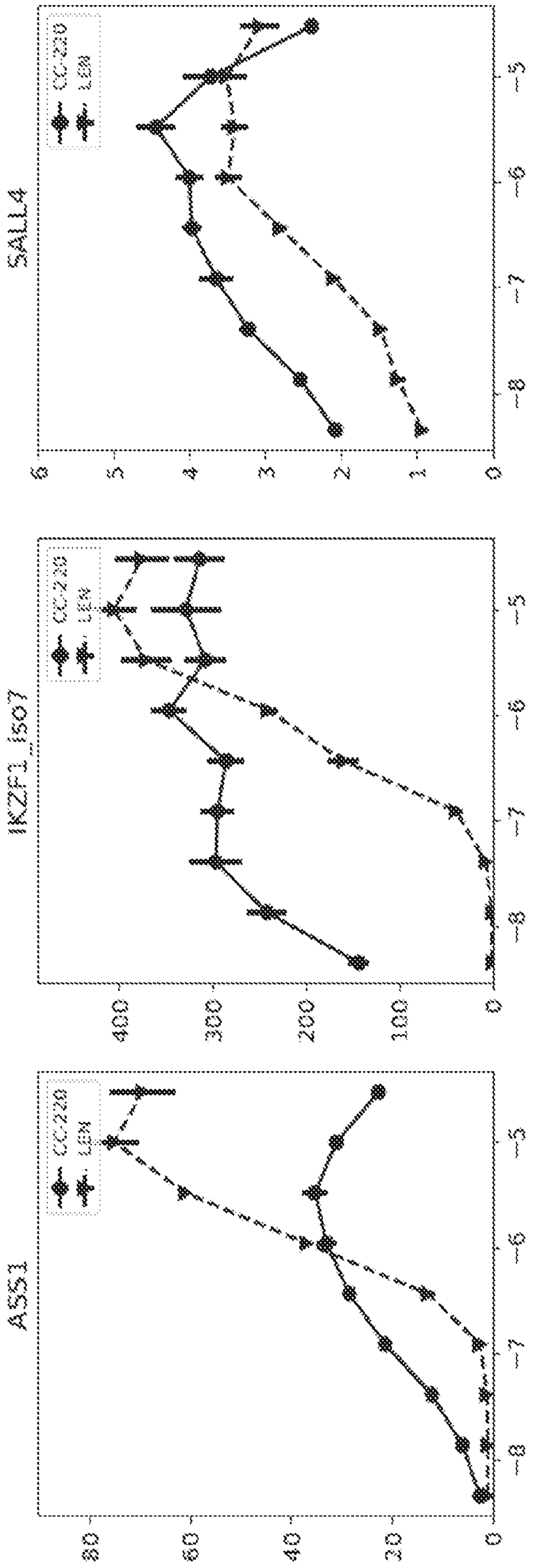

SALL4
IKZF1_iso7
ASS1
CC-220
LEN
0
1
2
3
4
5
6
7
8
0
100
200
300
400
0
20
40
60
80

FIG. 55

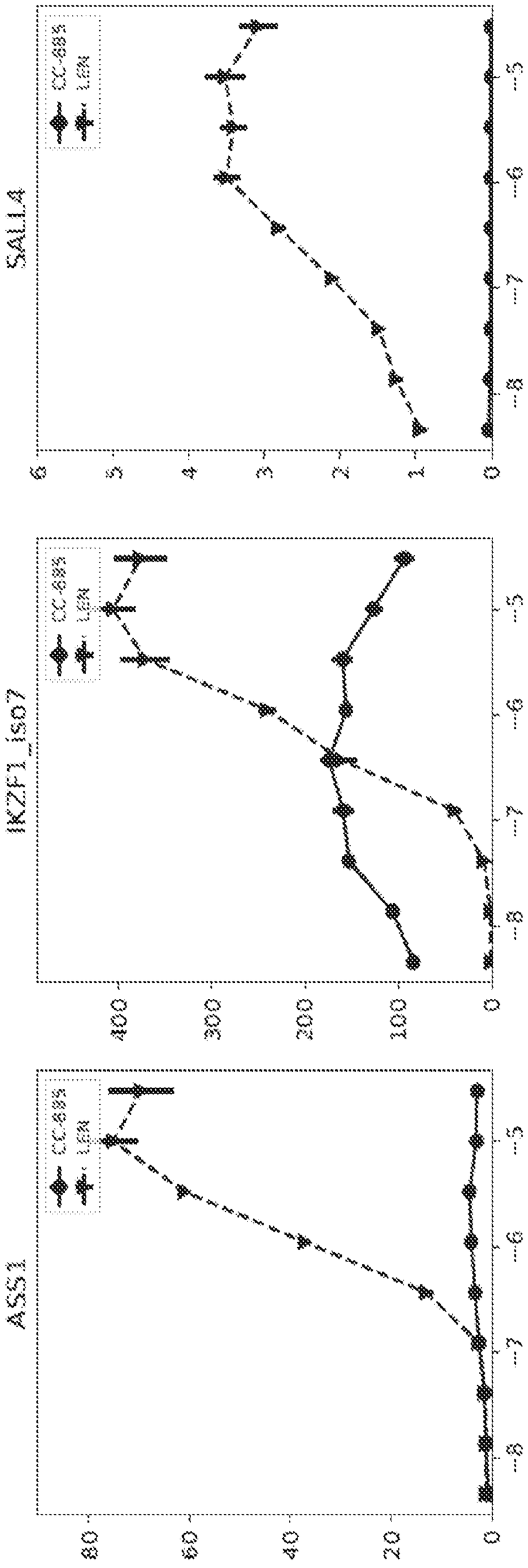

SALL4
IKZF1_iso7
ASS1
CC-885
LEN
0
1
2
3
4
5
6
0
100
200
300
400
0
20
40
60
80
-5
-6
-7
-8

FIG. 56

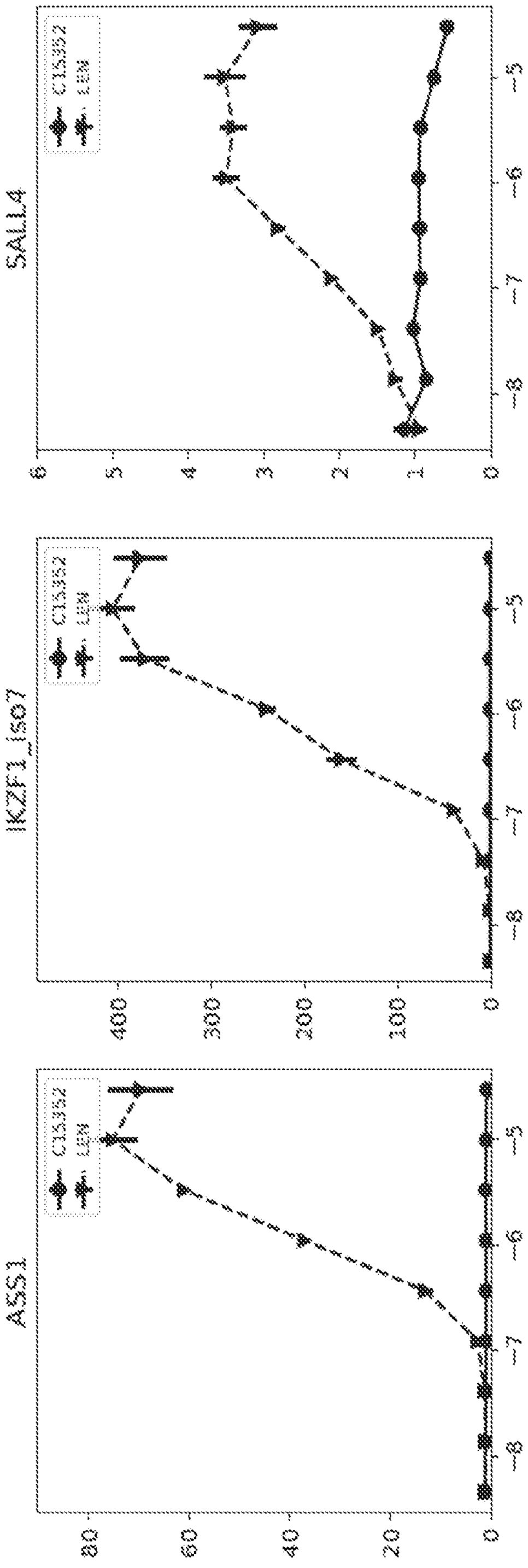

SALL4
IKZF1_isoform1
ASS1
C15332
Lenalidomide
0
1
2
3
4
5
6
7
8
0
100
200
300
400
0
20
40
60
80

FIG. 57

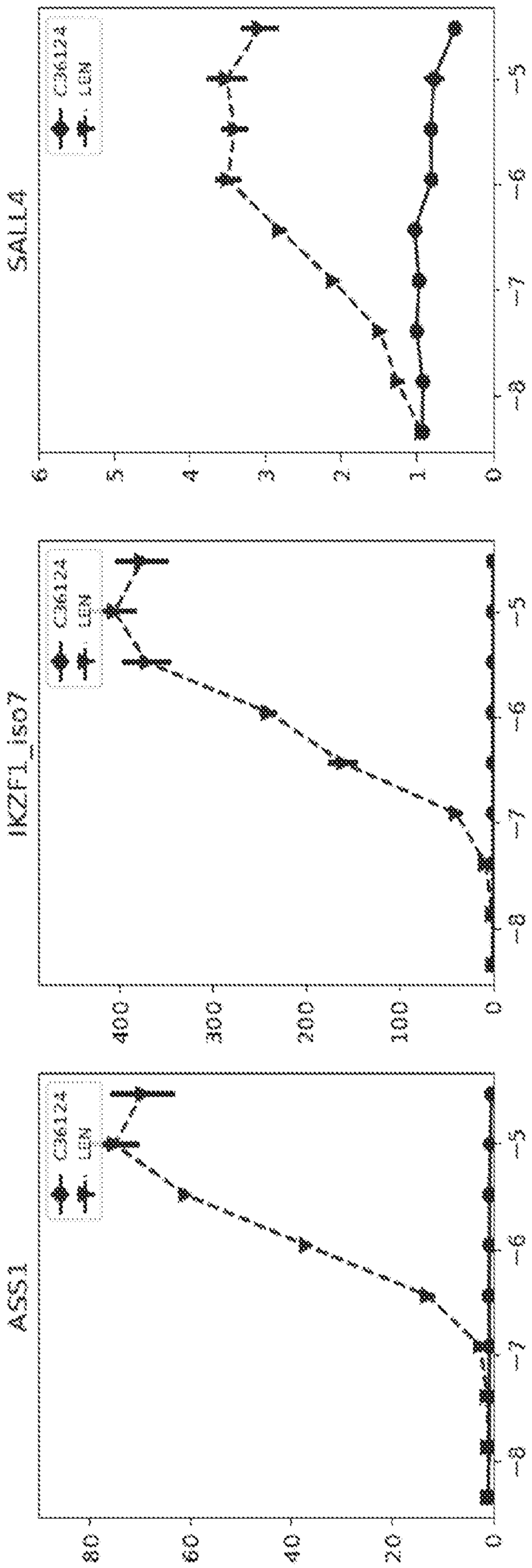

SALL4
IKZF1_iso7
ASS1
C36124
LBX
0
1
2
3
4
5
6
7
8
0
20
40
60
80
100
200
300
400

FIG. 58

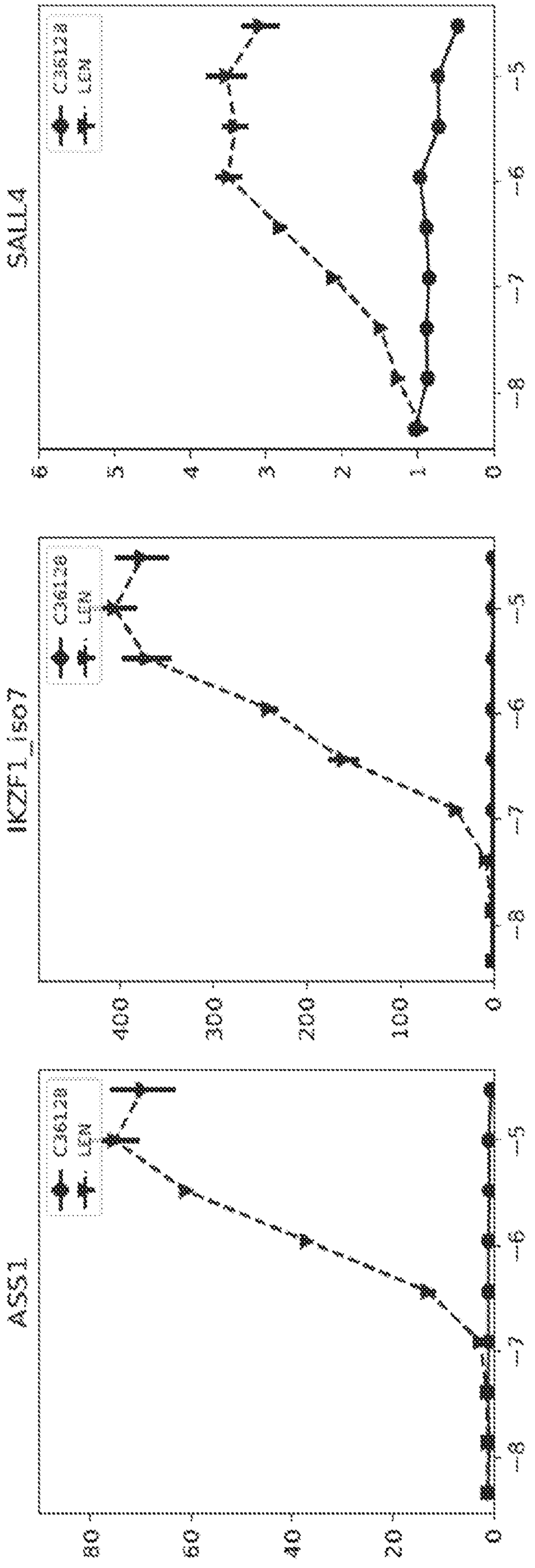


FIG. 59

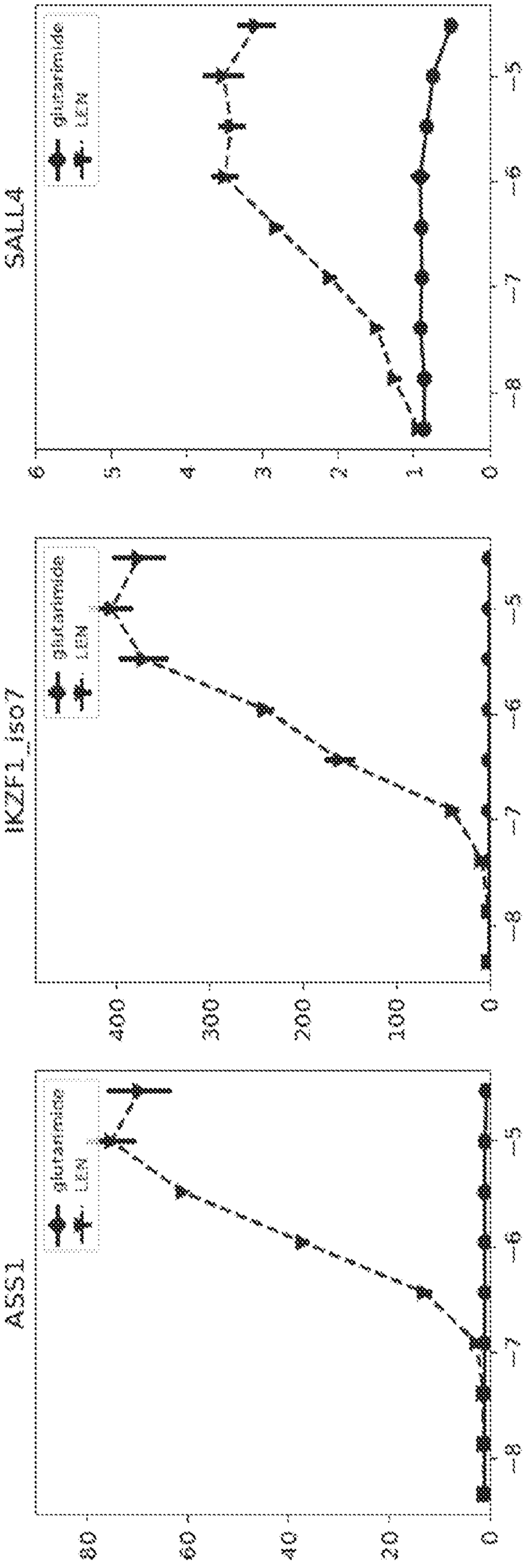

SALL4
glutamide
LEN
IKZF1_iso7
glutamide
LEN
ASS1
glutamide
LEN

FIG. 60

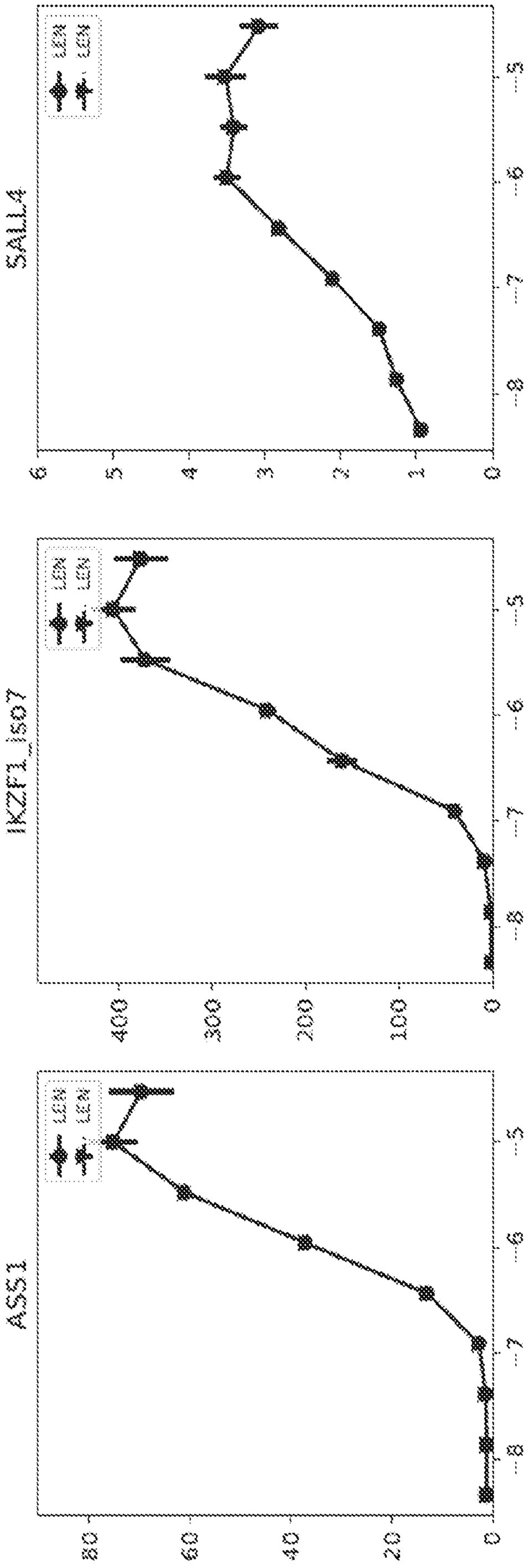

SALL4
IKZF1_iso7
ASS1
LEN
LEN
0
2
4
6
100
200
300
400
0
20
40
60
3
5
6
7
8

FIG. 61

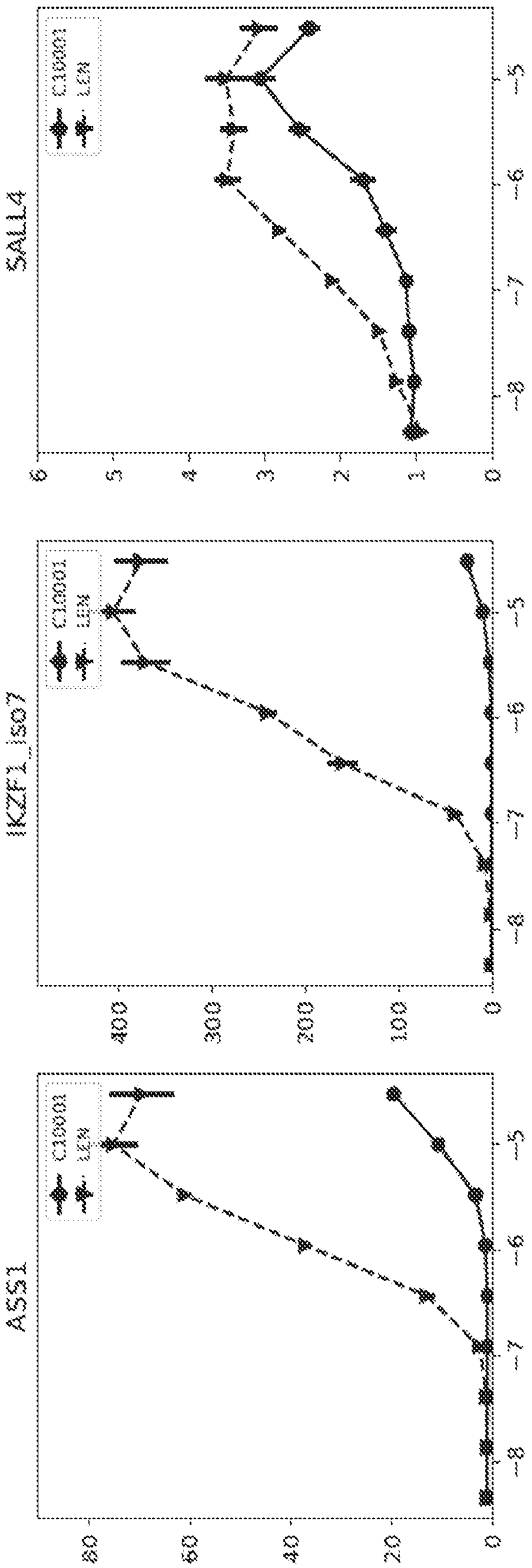


FIG. 62

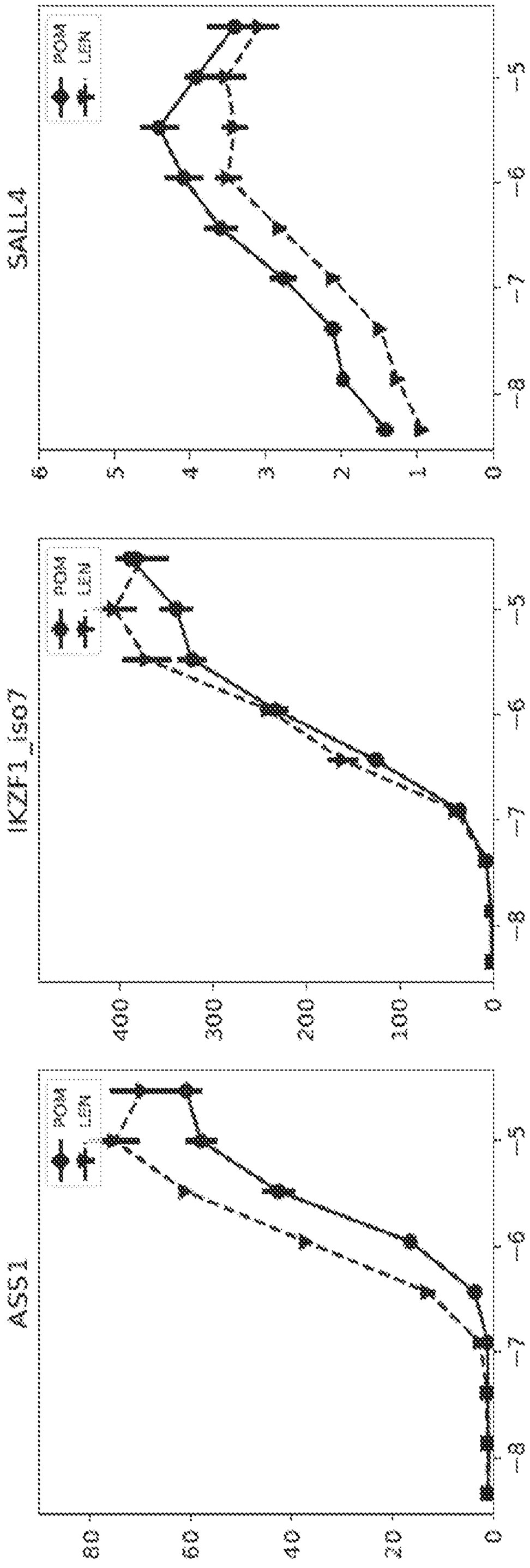


FIG. 63

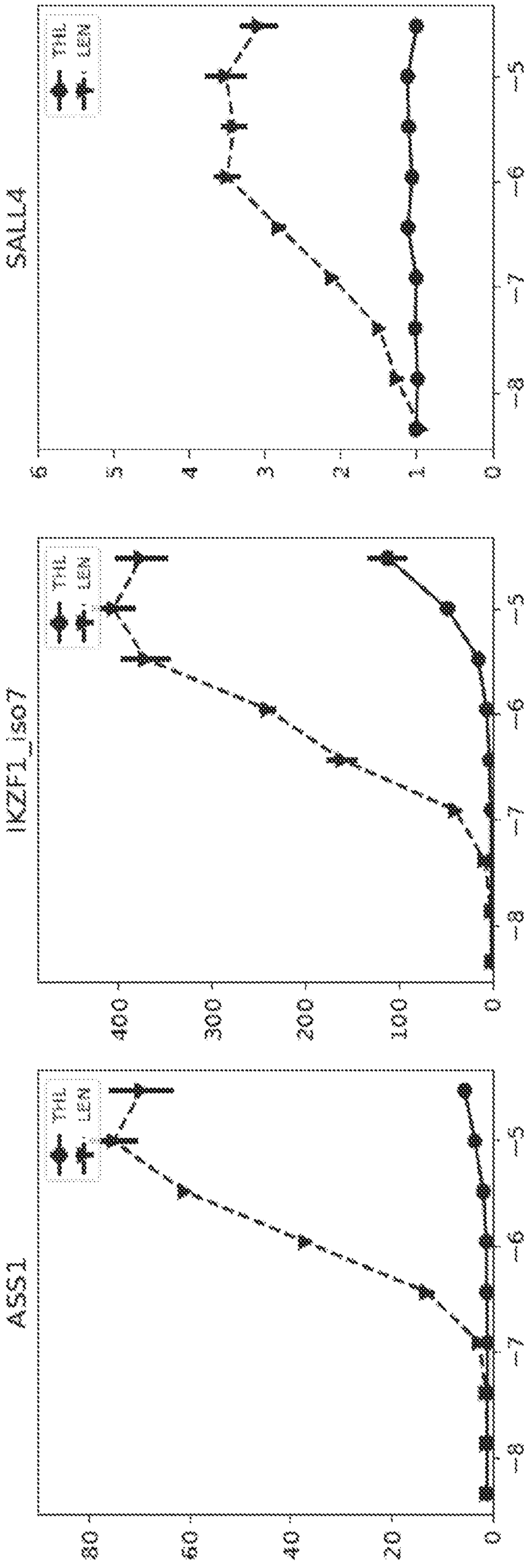

SALL4
IKZF1_ISO7
ASS1
THL
LEN
0
1
2
3
4
5
0
100
200
300
400
0
20
40
60
80
2
3
6
7
8

FIG. 64

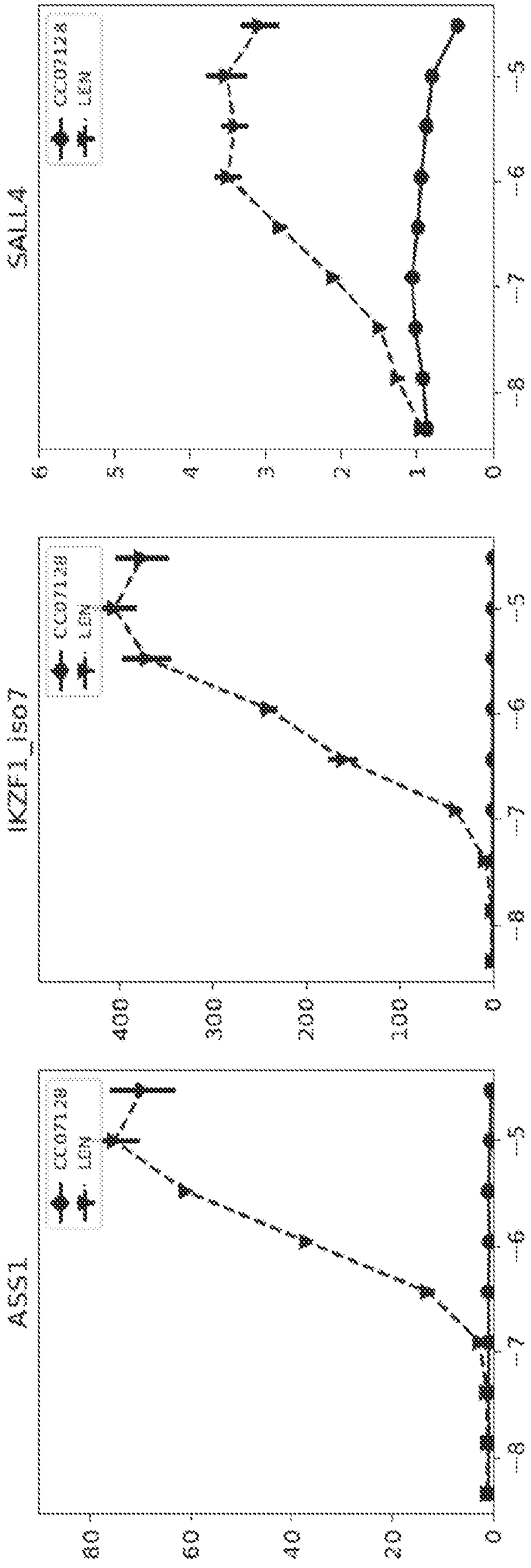


FIG. 65

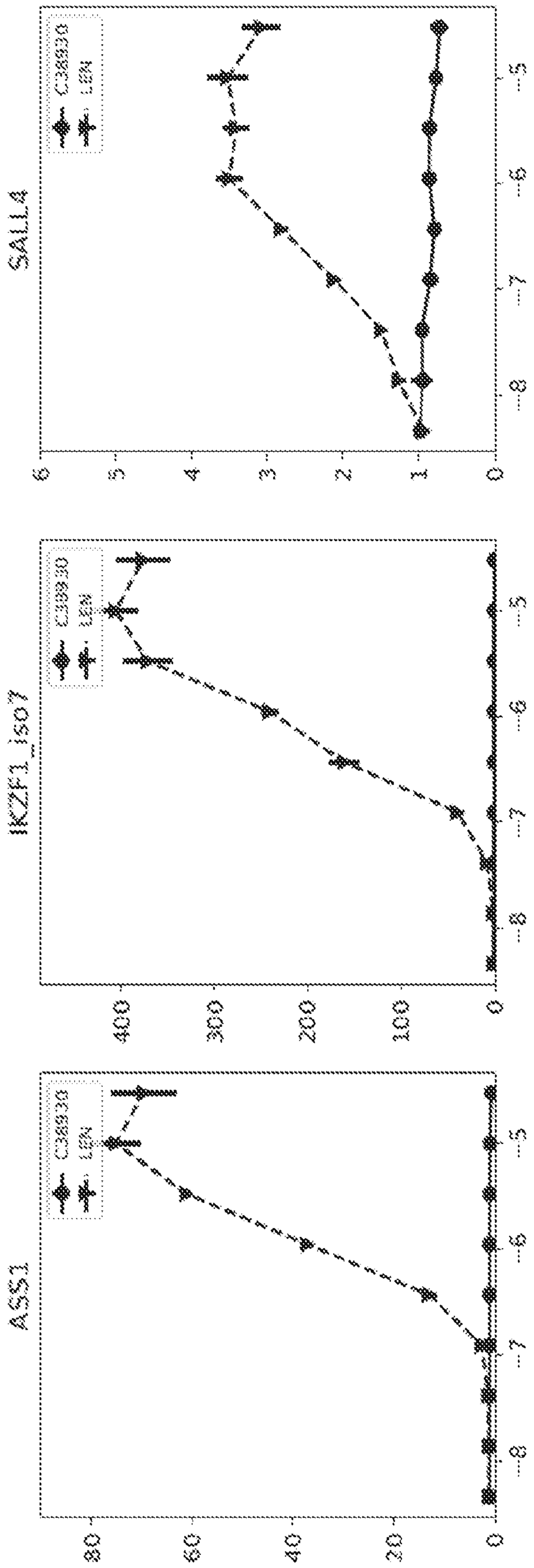

SALL4
IKZF1_iso7
AGS1
C38930
LEN
0
100
200
300
400
0
20
40
60
80
3
4
5
6
7
8

FIG. 66

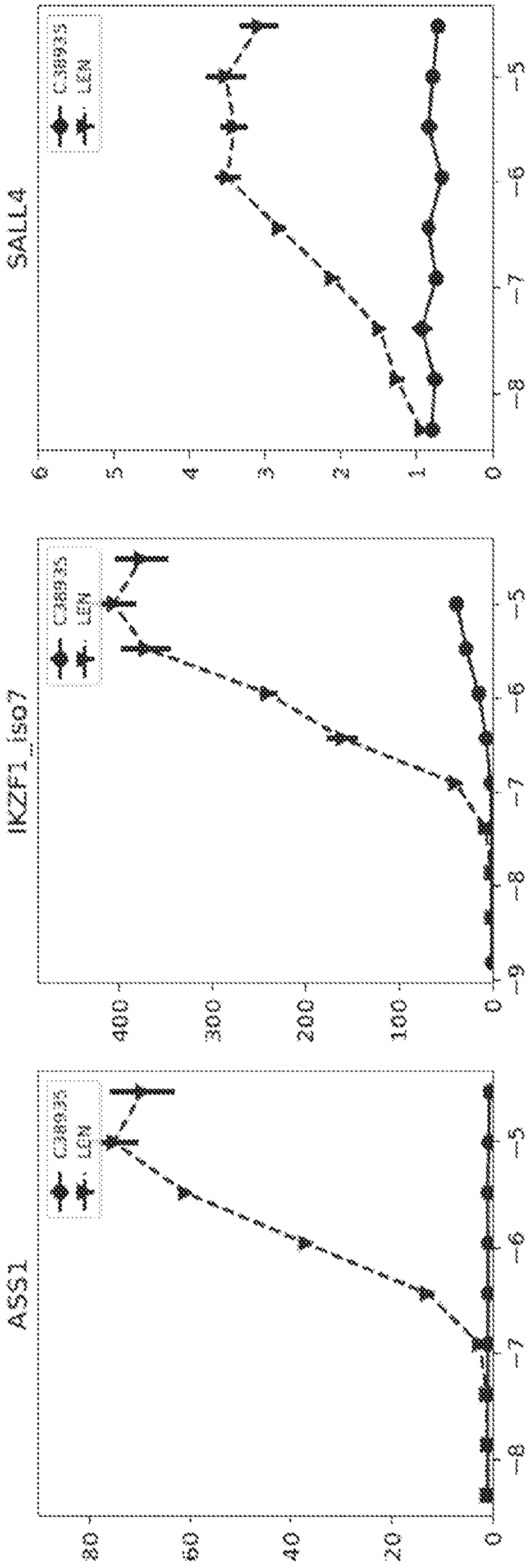

SALL4
IKZF1_iso7
ASS1
CB6336
LEN
0
100
200
300
400
0
20
40
60
80
0
1
2
3
4
5
6
7
8
9

FIG. 67

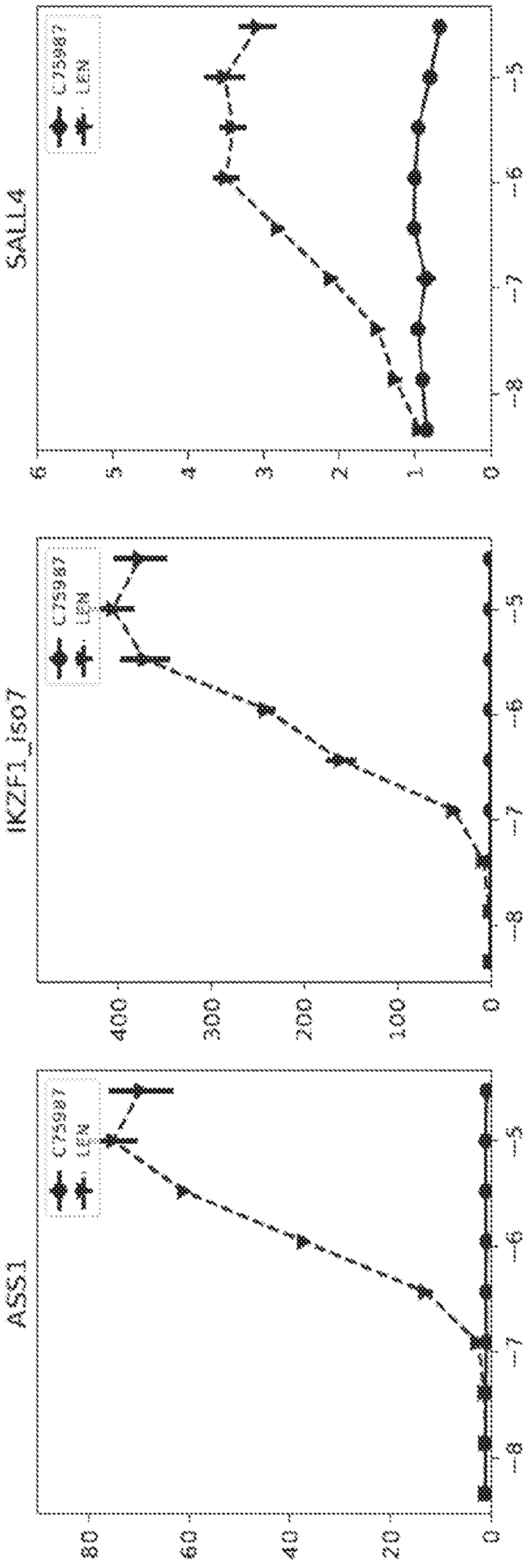


FIG. 68

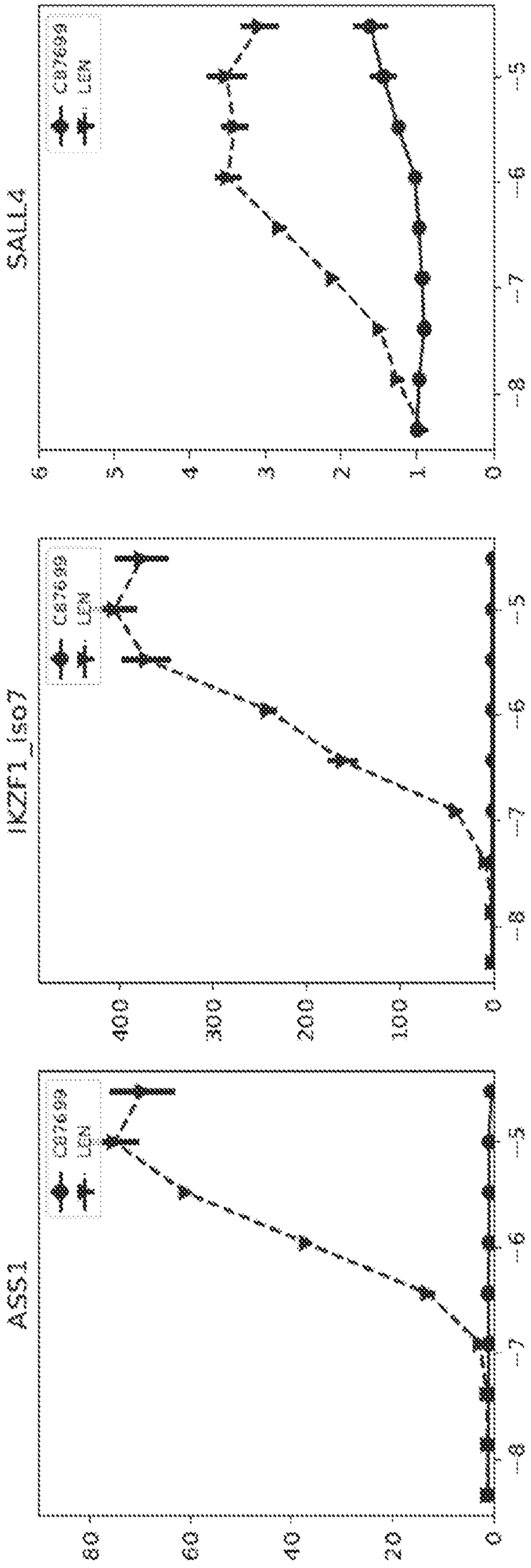

SALL4
IKZF1_iso7
ASS1
CB7693
LEN
0
1
2
3
4
5
6
-5
-6
-7
-8
100
200
300
400
20
40
60

FIG. 69

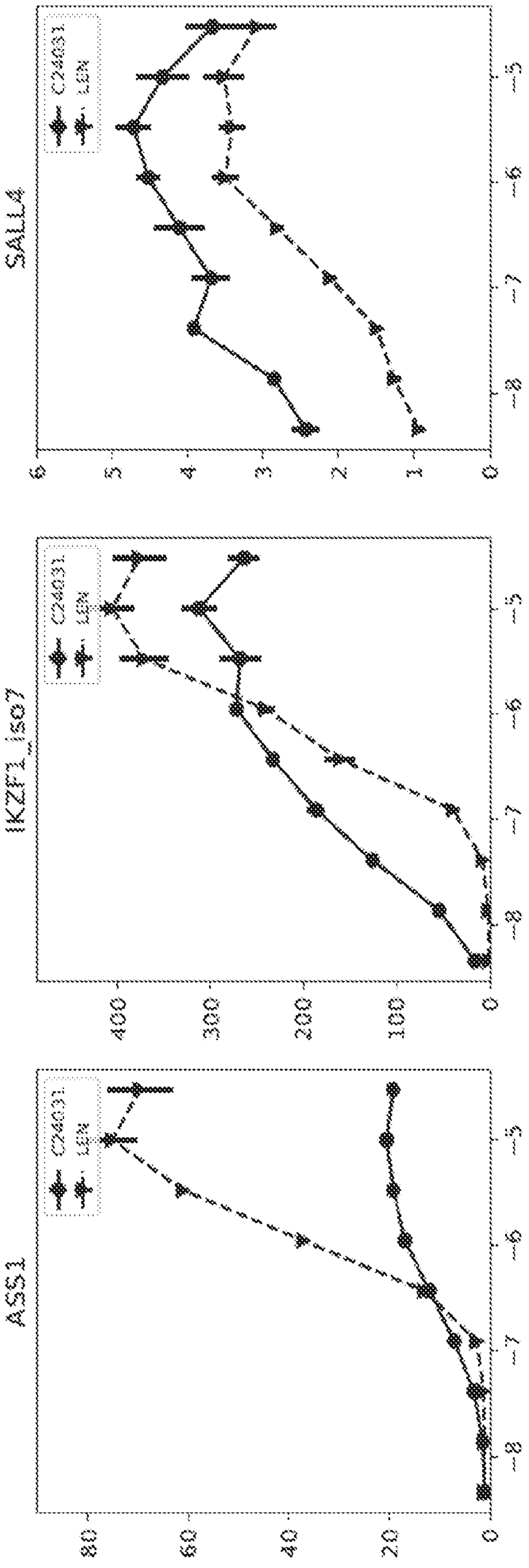

SALL4
IKZF1_iso7
ASS1
C24031
DMSO
0
1
2
3
4
5
6
100
200
300
400
20
40
60
80
-2
-3
-5
-6
-7

FIG. 7D

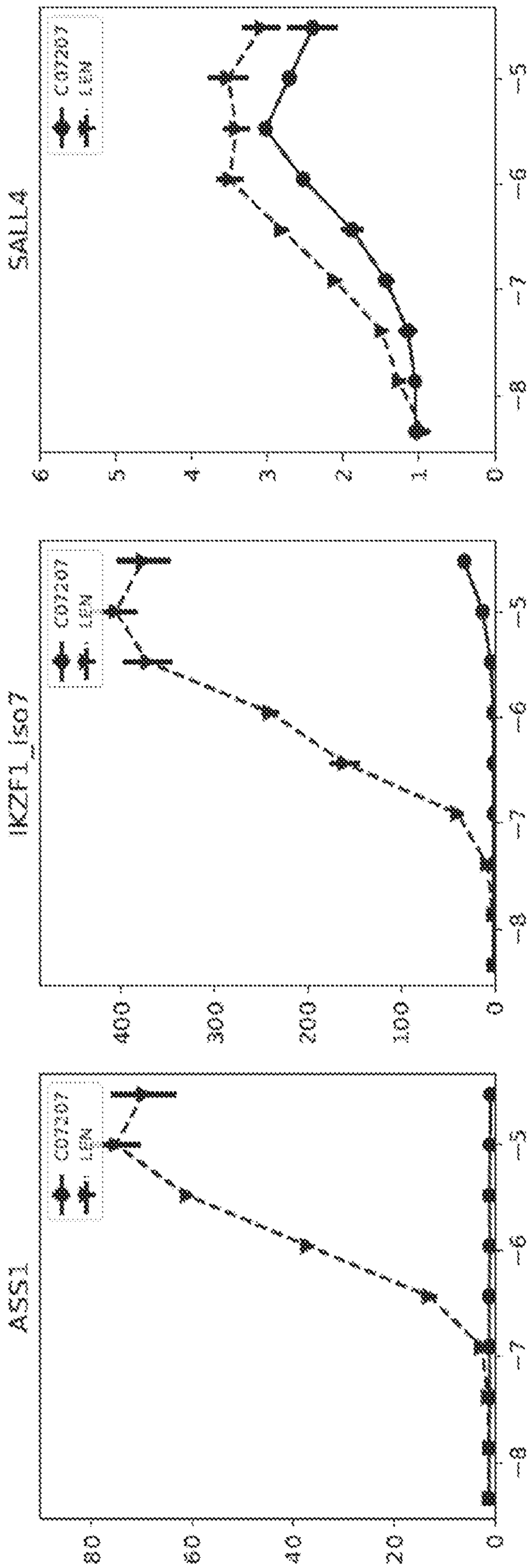

SALL4
IKZF1_iso3
ASS1
CD7287
LEM
0
100
200
300
400
0
20
40
60
80
3
4
5
6
7
8

FIG. 71

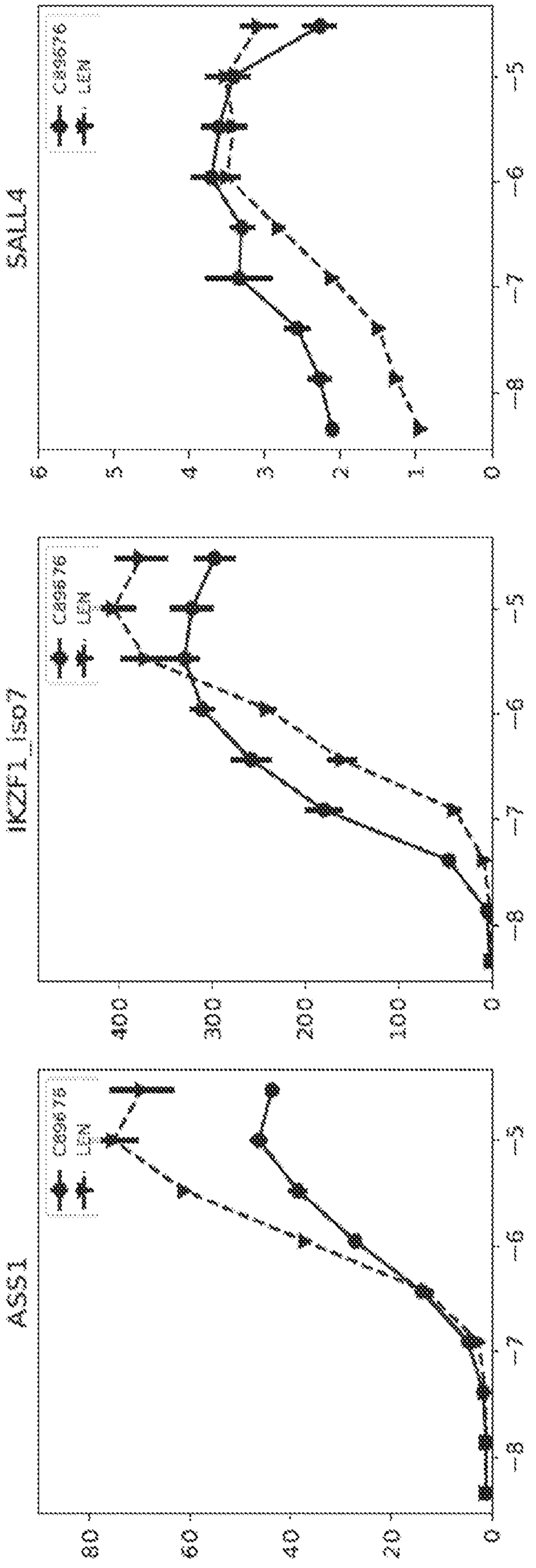

SALL4
C89676
LEN
0
1
2
3
4
5
6
7
8
IKZF1_iso7
0
100
200
300
400
ASS1
0
20
40
60
80

FIG. 72

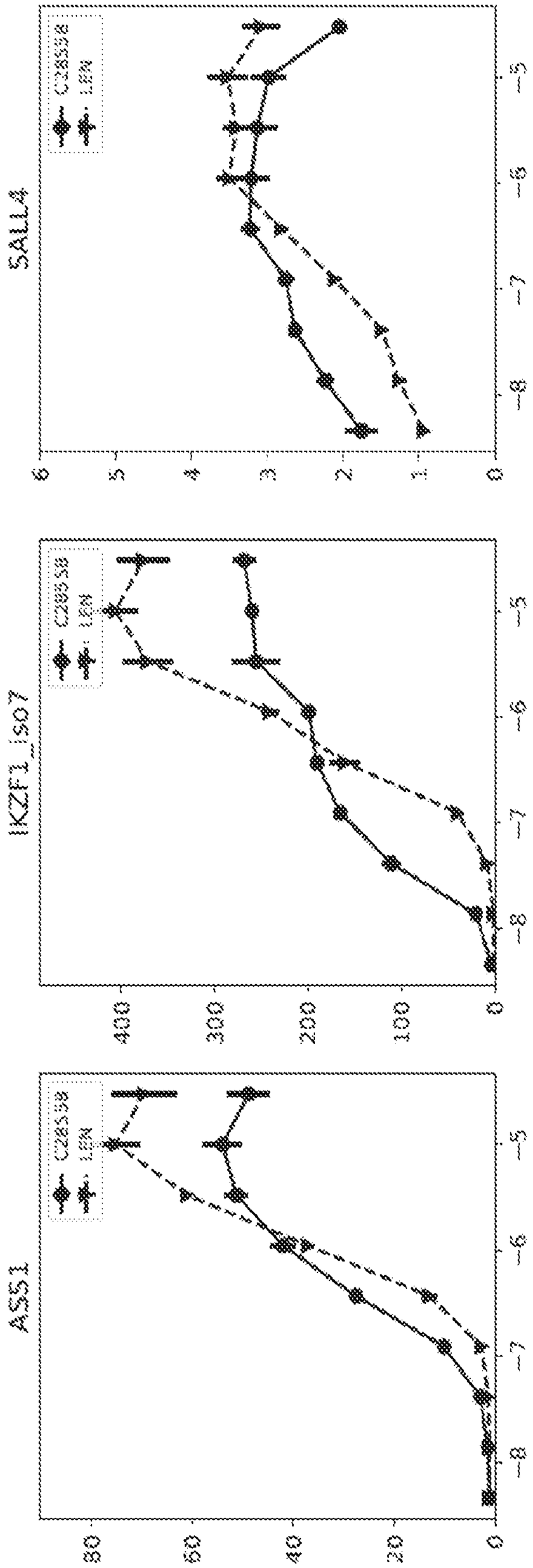


FIG. 73

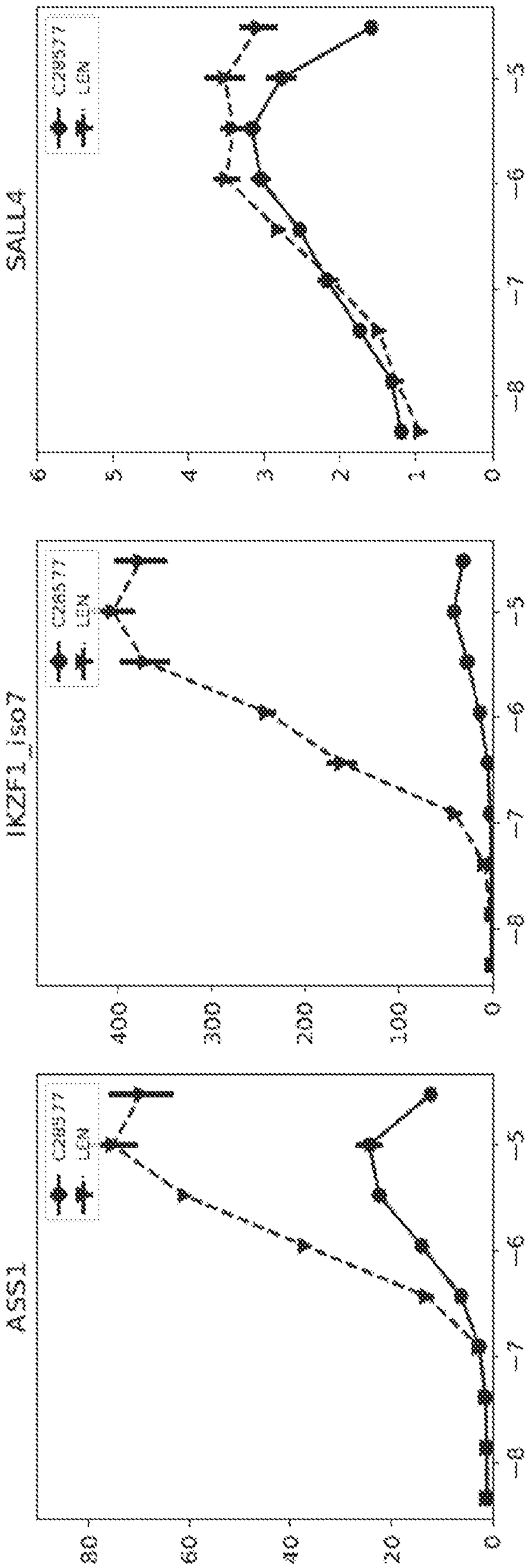

SALL4
CZ65377
LEN
0
1
2
3
4
5
6
5
6
7
8
IKZF1_iso7
CZ65377
LEN
0
100
200
300
400
5
6
7
8
ASS1
CZ65377
LEN
0
20
40
60
80
5
6
7
8

FIG. 74

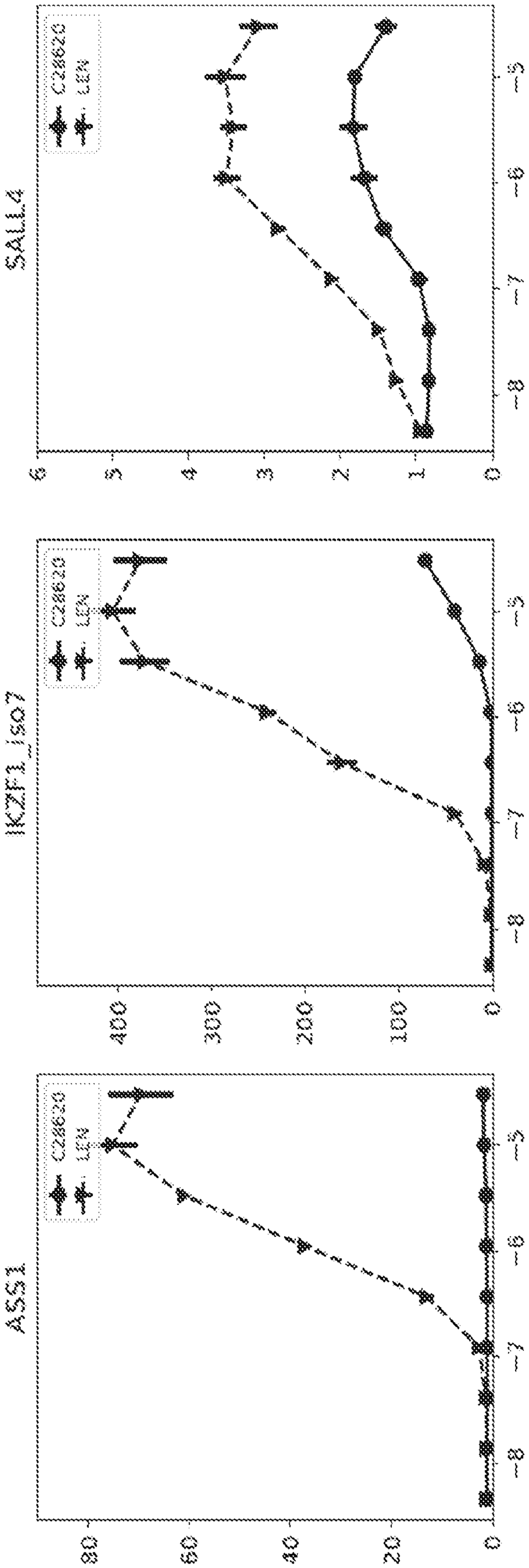

SALL4
IKZF1_iso7
ASS1
C2B620
LEN
0
1
2
3
4
5
6
100
200
300
400
0
20
40
60
80
~2
~3
~5
~6
~7
~8

FIG. 75

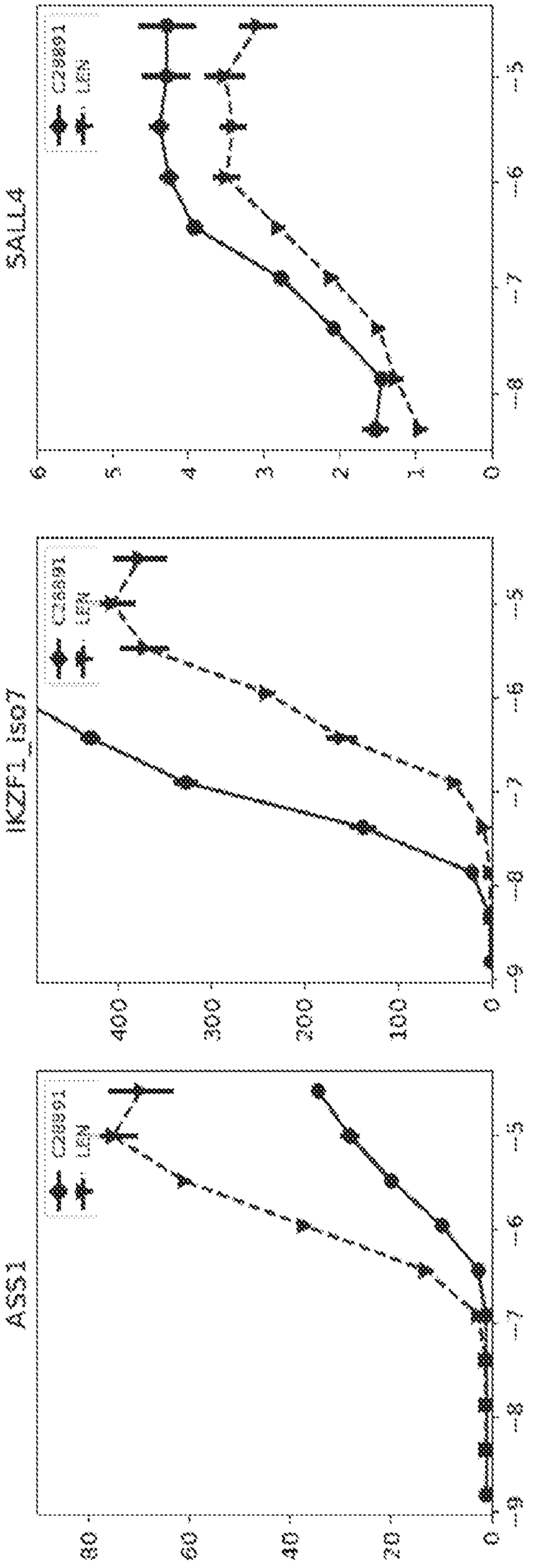


FIG. 76

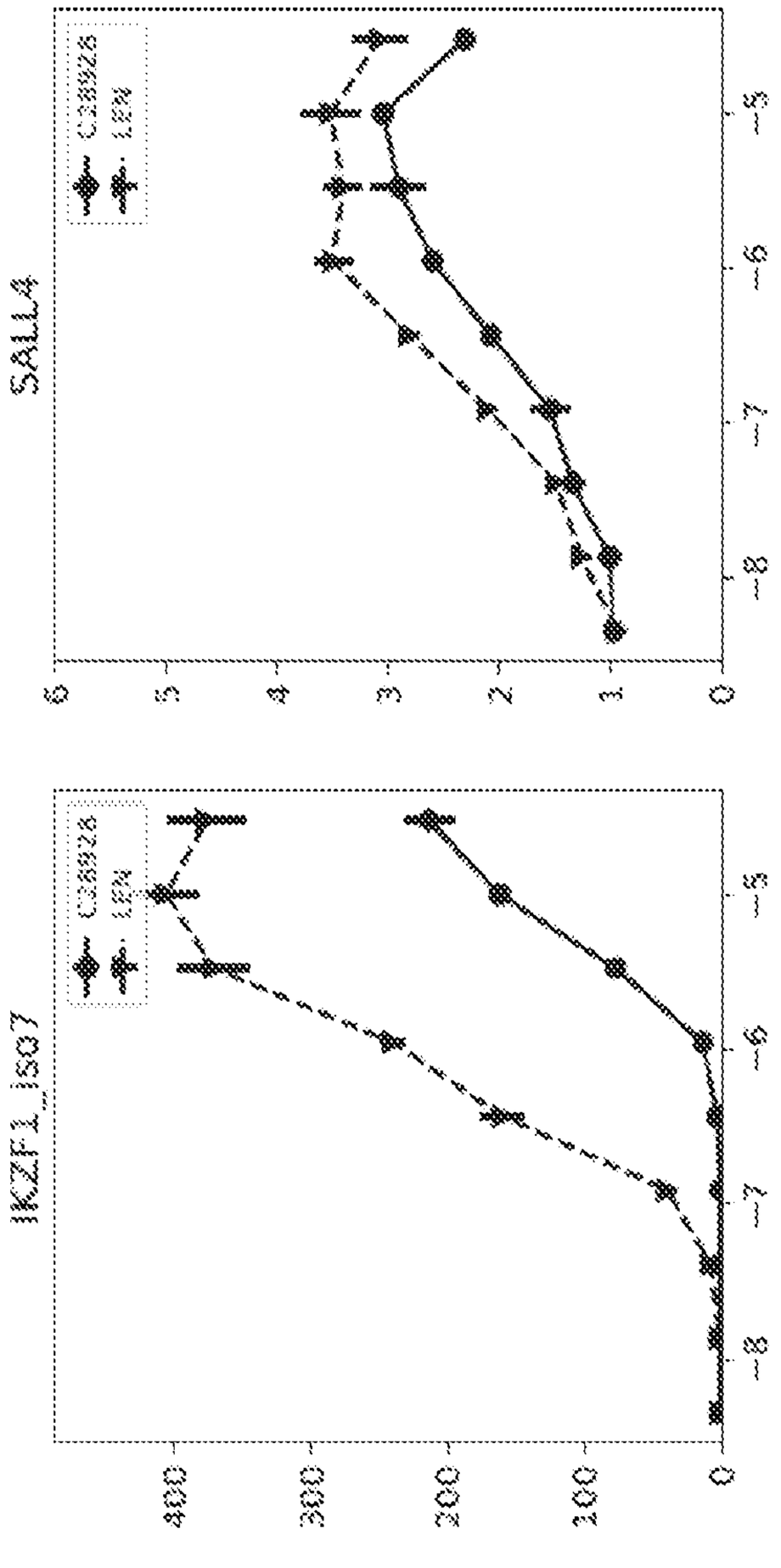

SALL4
IKZF1_iso37
AS51
C3
LEN
0
100
200
300
400
0
20
40
60
80
3
5
6
7
8

FIG. 77

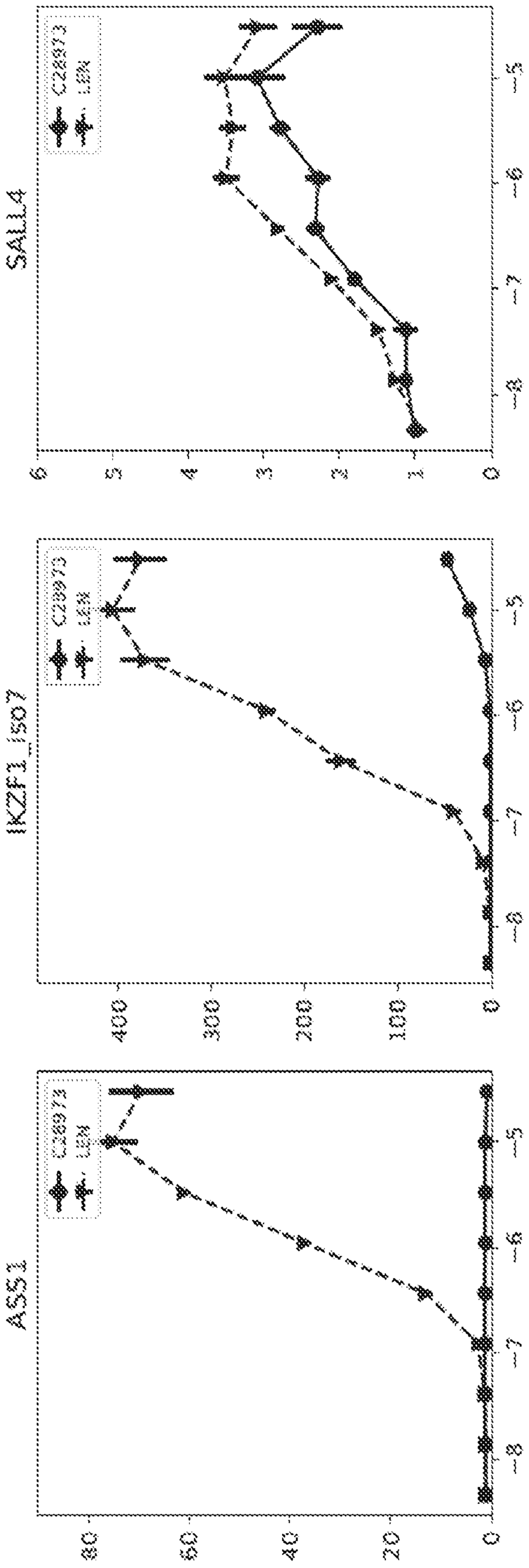

SALL4
IKZF1_iso2
ASS1
C28973
UEM
0
1
2
3
4
5
6
100
200
300
400
20
40
60
80
—5
—6
—7
—8

FIG. 78

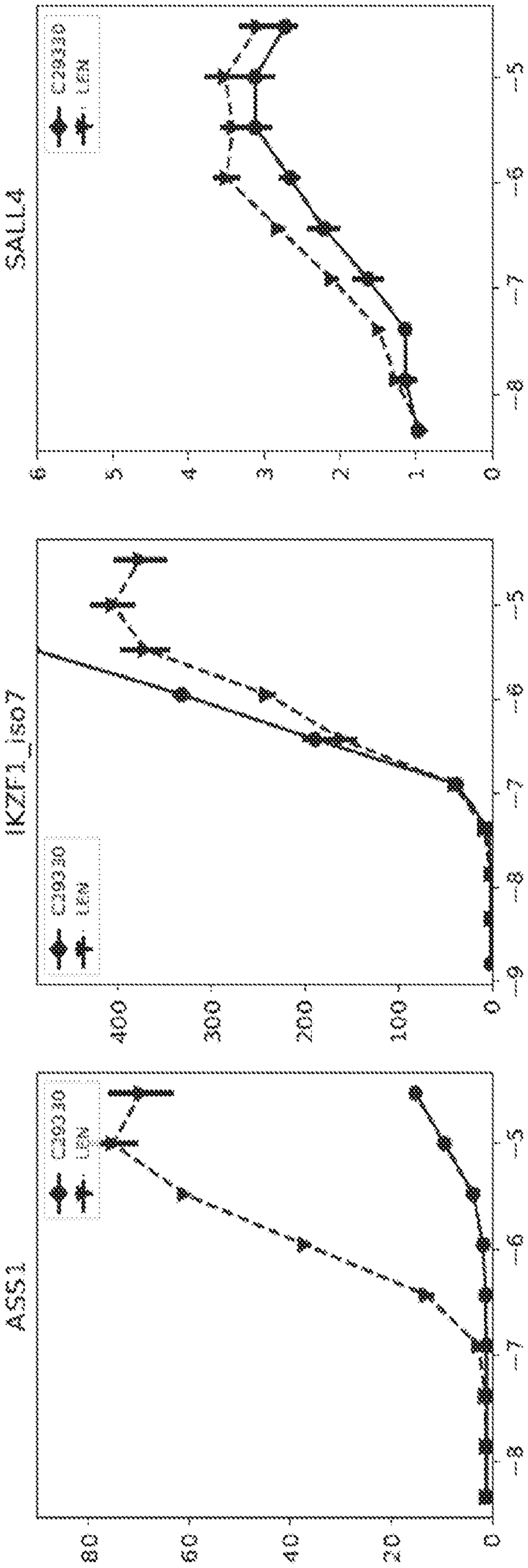

SALL4
IKZF1_iso7
AS53
C29330
LEN
0
1
2
3
4
5
6
7
8
100
200
300
400
20
40
60
80

FIG. 79

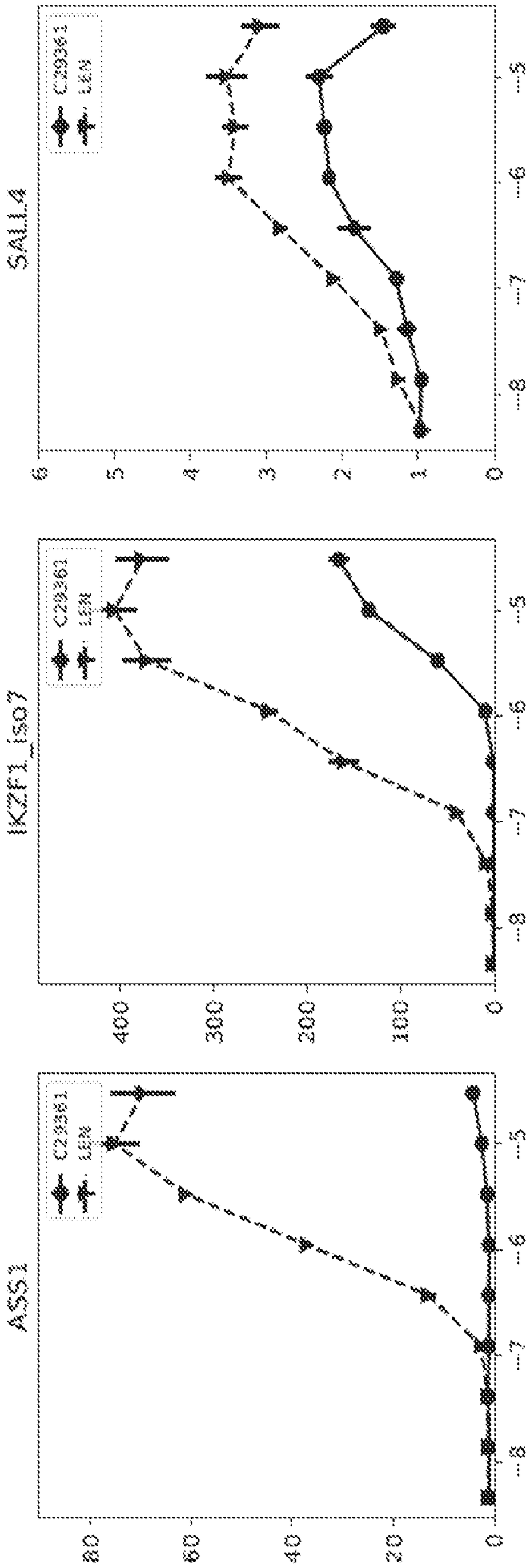

SALL4
IKZF1_iso7
ASS1
C29361
LEN
0
1
2
3
4
5
6
7
8
0
100
300
300
400
0
20
40
60
80

FIG. 8D

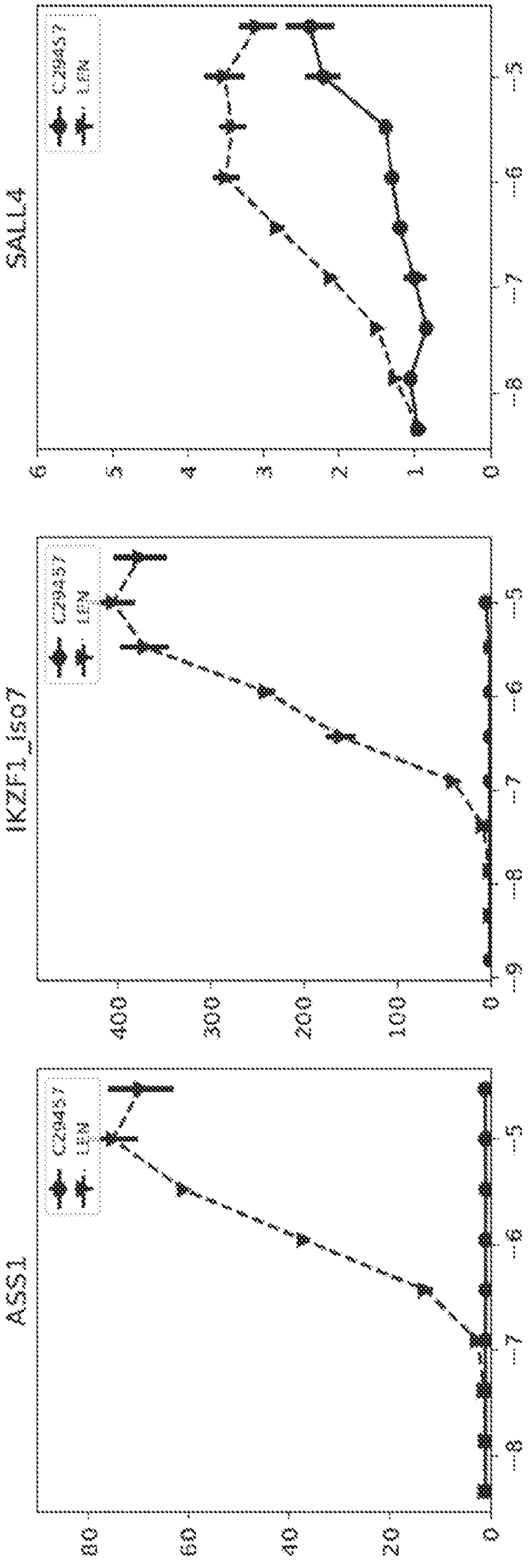

SALL4
IKZF1_isoT
ASS1
C29457
LEN
0
1
2
3
4
5
6
7
8
9
100
200
300
400
20
40
60
80

FIG. 81

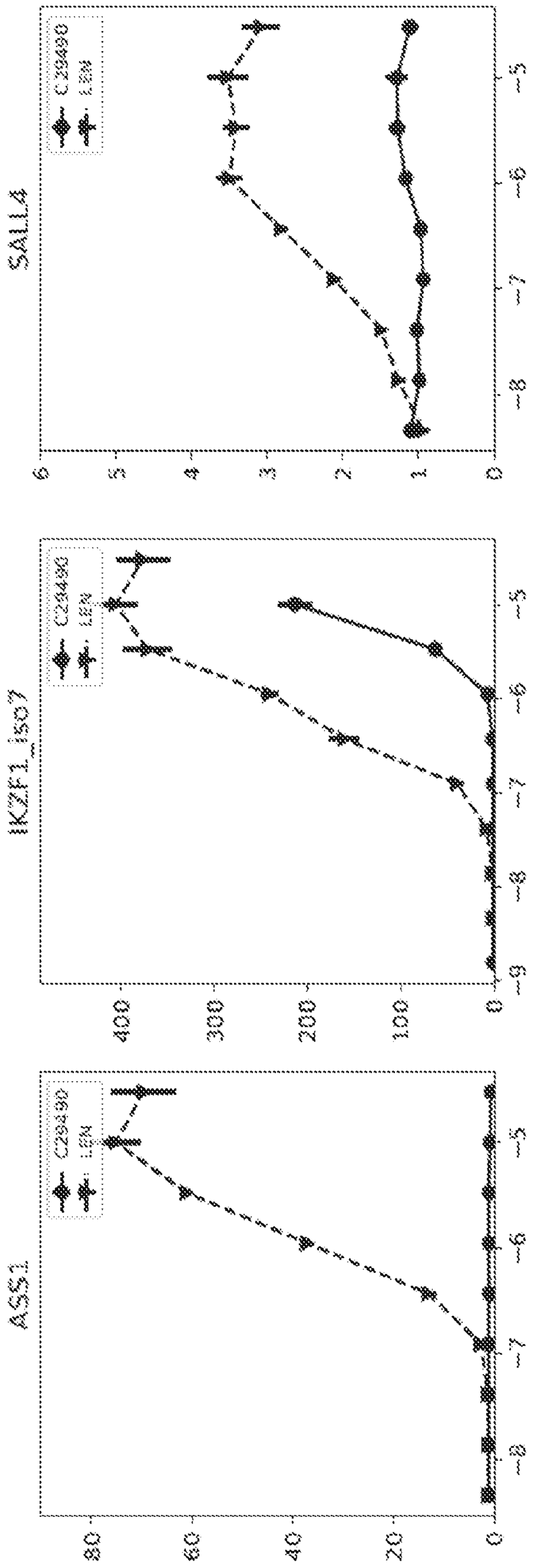

SALL4
C29490
IgG
0
1
2
3
4
5
6
7
8
IKZF1_iso7
C29490
IgG
0
100
200
300
400
3
5
6
7
8
ASS1
C29490
IgG
0
20
40
60
80
2
5
6
7
8

FIG. 82

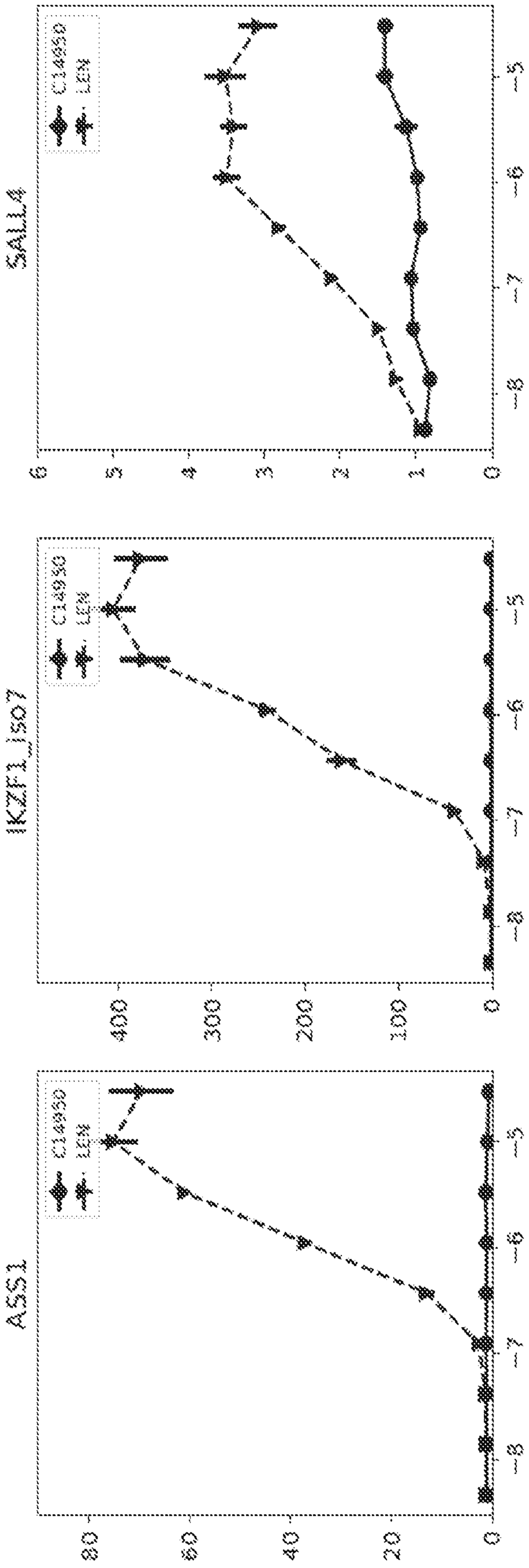


FIG. 83

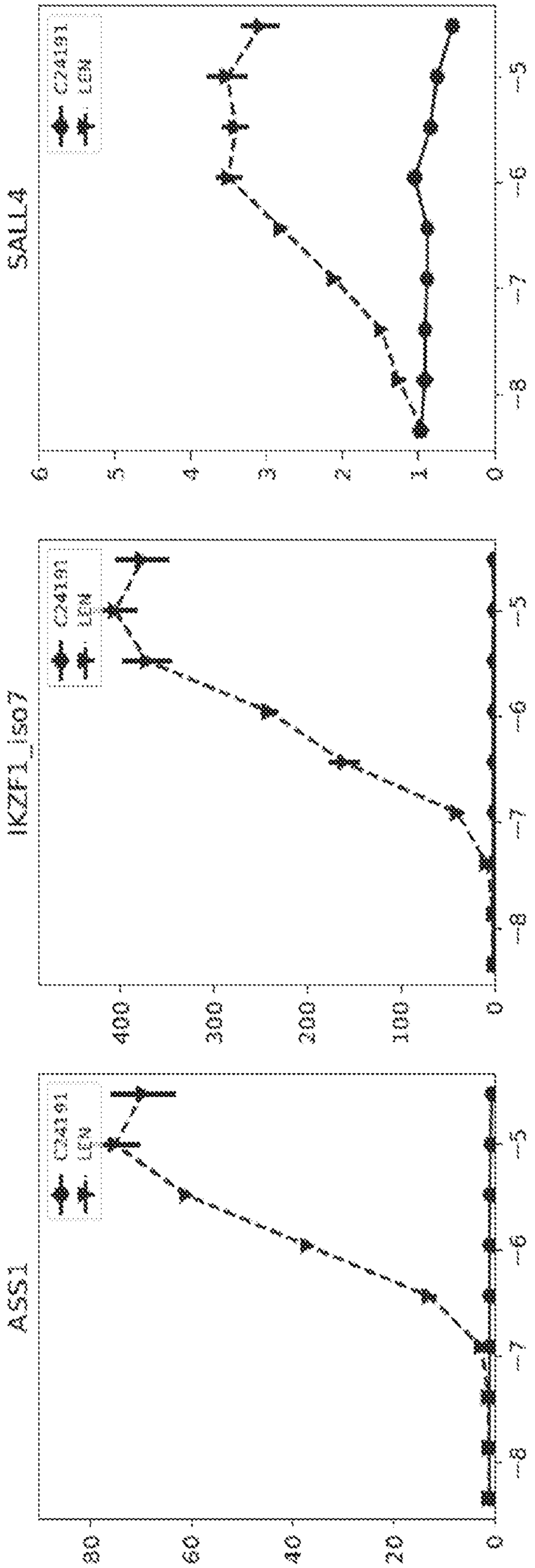

SALL4
IKZF1_iso7
ASS1
C24191
LEM
0
1
2
3
4
5
6
100
200
300
400
0
20
40
60
80
-2
-3
-5
-6
-7
-8

FIG. 84

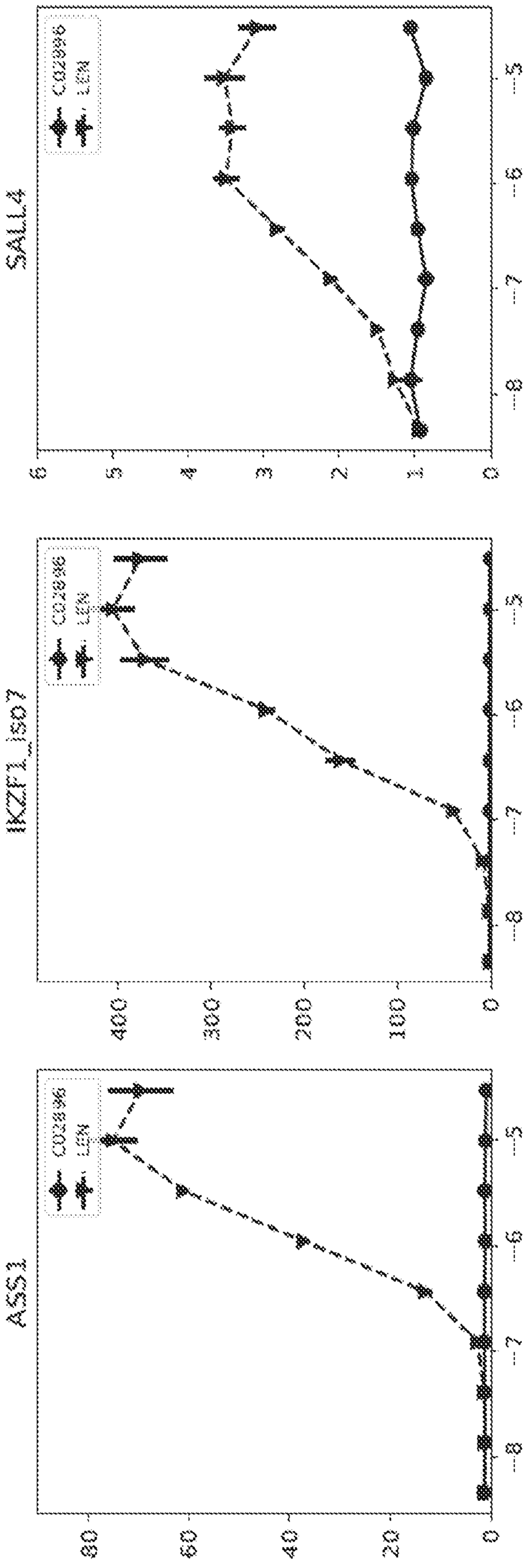

SALL4
IKZF1_iso7
AS53
CD28pos
LEN
0
1
2
3
4
5
6
7
8
100
200
300
400
20
40
60
80

FIG. 85

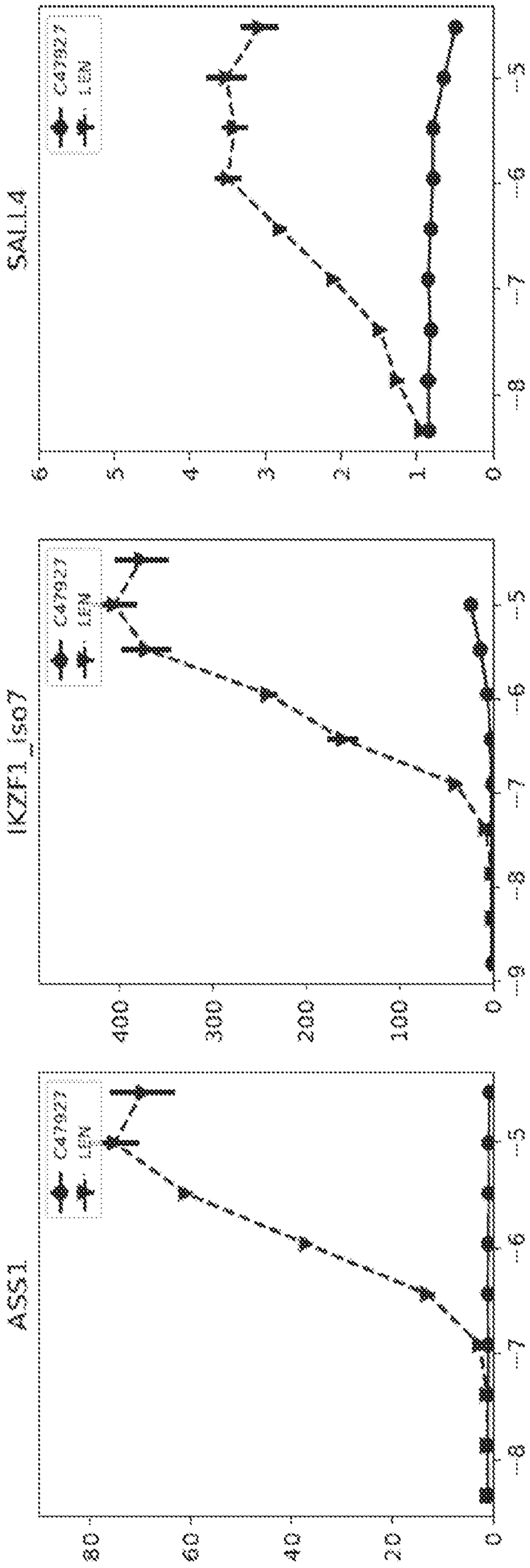

SALL4
IKZF1_iso37
ASS1
C47927
LEN
0
100
200
300
400
0
20
40
60
80
5
6
7
8

FIG. 86

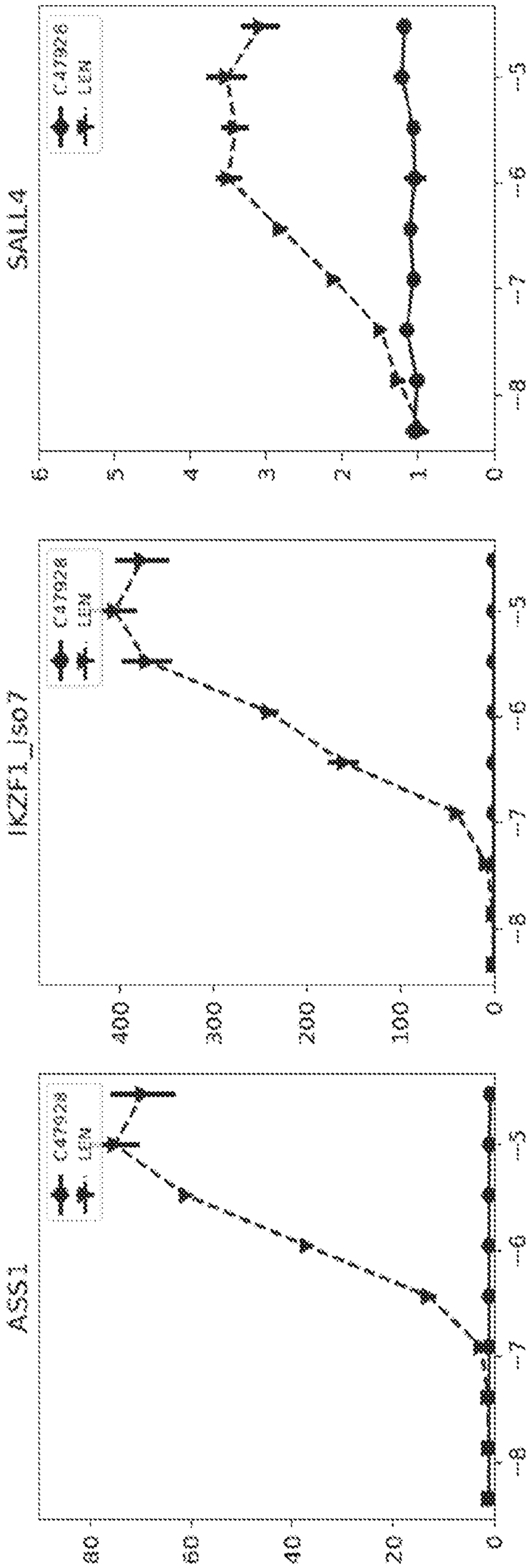

SALL4
IKZF1_isoT
ASS1
C47926
LEN
0
1
2
3
4
5
6
7
8
100
200
300
400
20
40
60
80

FIG. 87

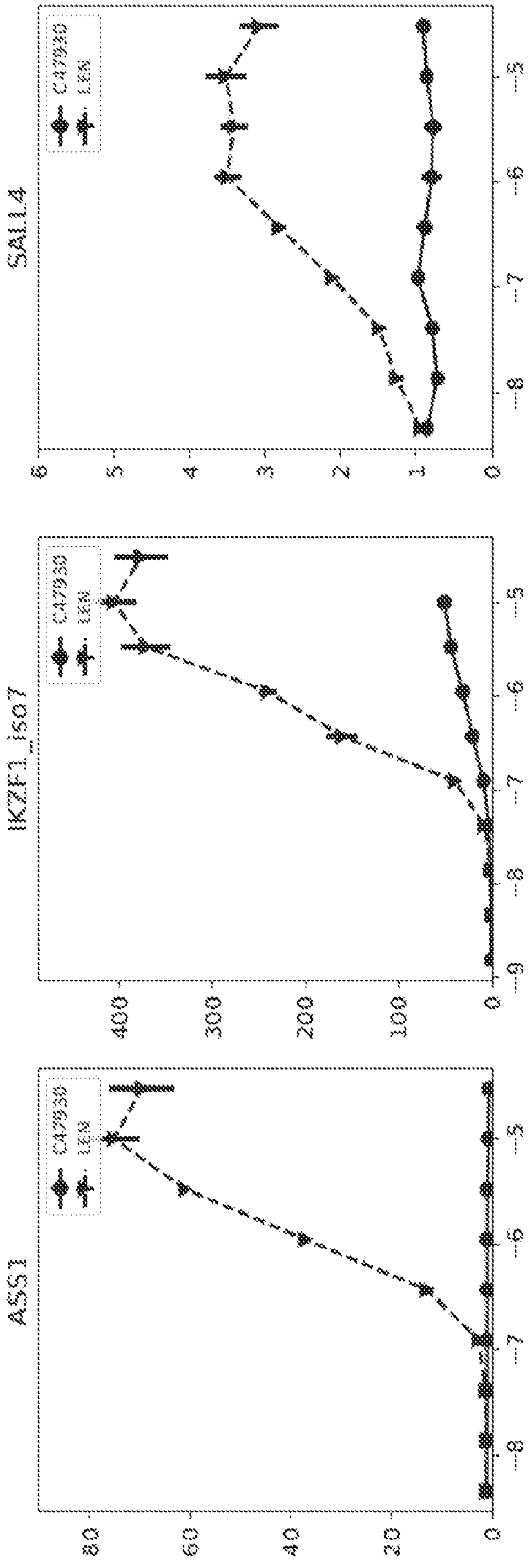

SALL4
IKZF1_iso7
ASS1
CAT936
LEN
0
100
200
300
400
0
1
2
3
4
5
6
0
20
40
60
80
5
6
7
8

FIG. 8B

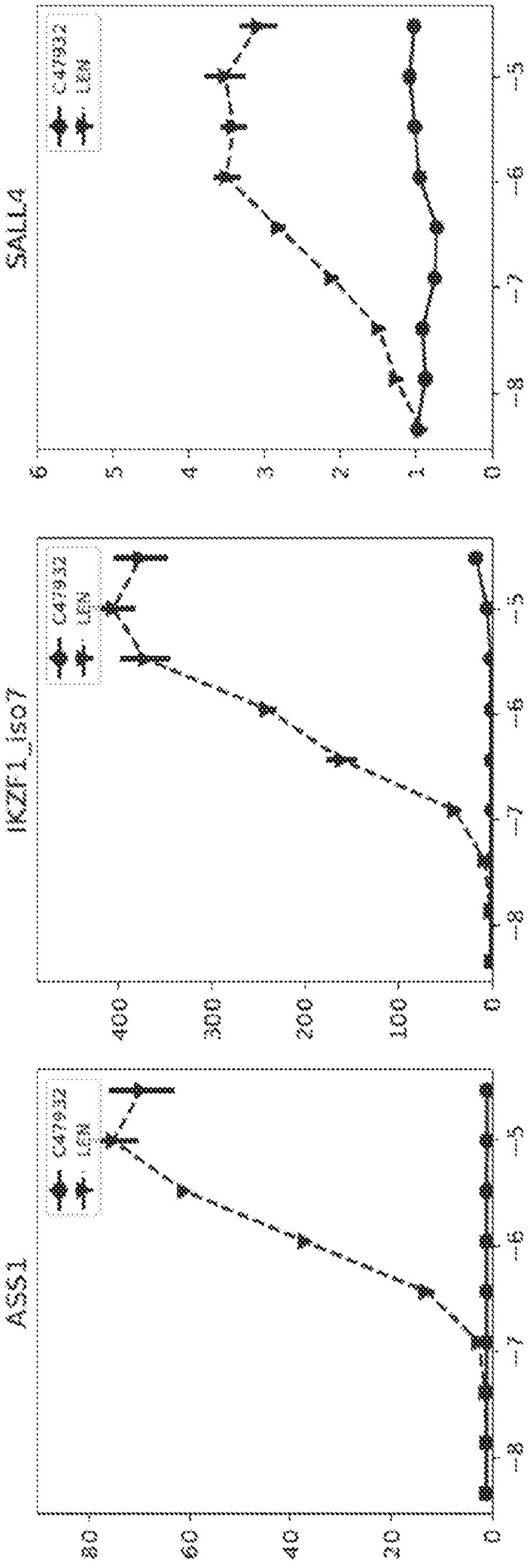

SALL4
IKZF1_isoT
ASS1
C4T932
LEN
0
100
200
300
400
0
20
40
60
80
2
3
4
5
6
7
8

FIG. 89

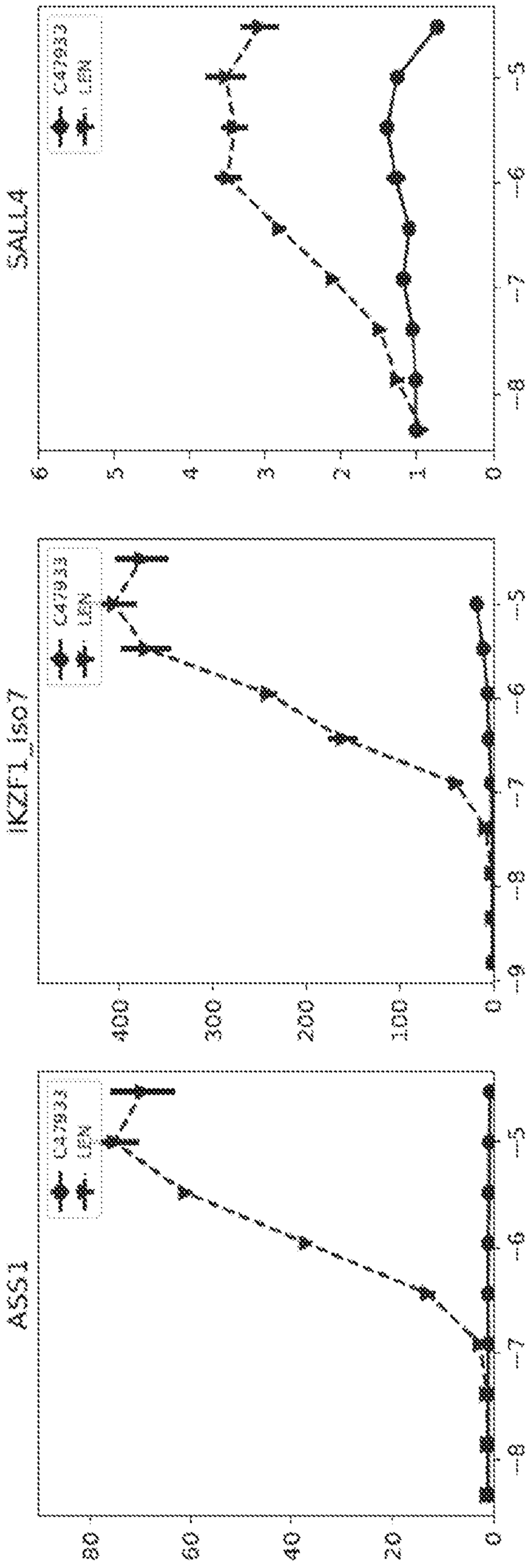

SALL4
CA7933
LEN
IKZF1_iso7
ASS1
0
100
200
300
400
20
40
60
80
3
4
5
6
7
8

FIG. 9D

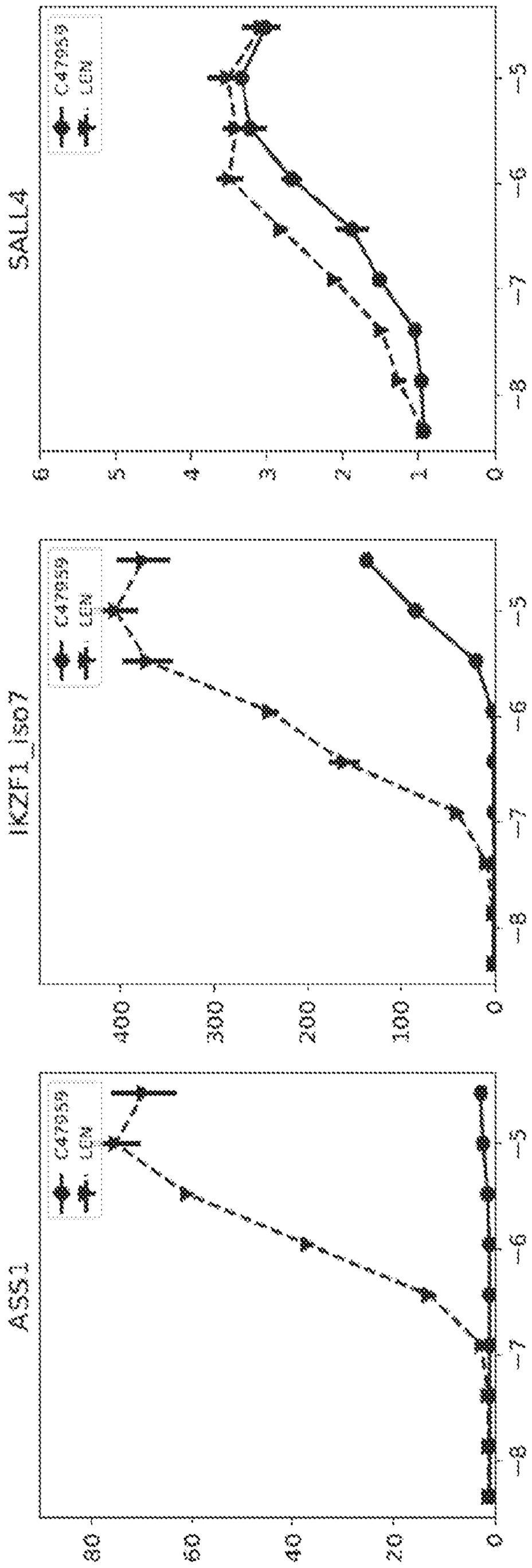

SALL4
IKZF1_iso7
ASS1
C479559
LGM
0
1
2
3
4
5
6
7
8
100
200
300
400
20
40
60
80

FIG. 91

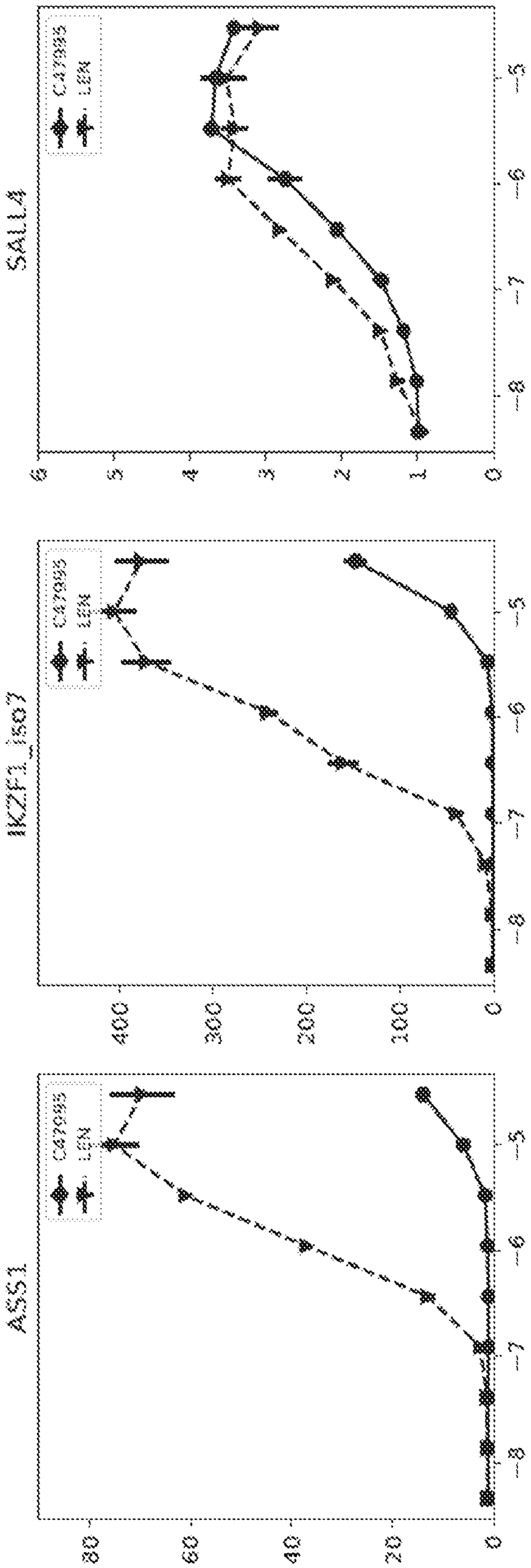


FIG. 92

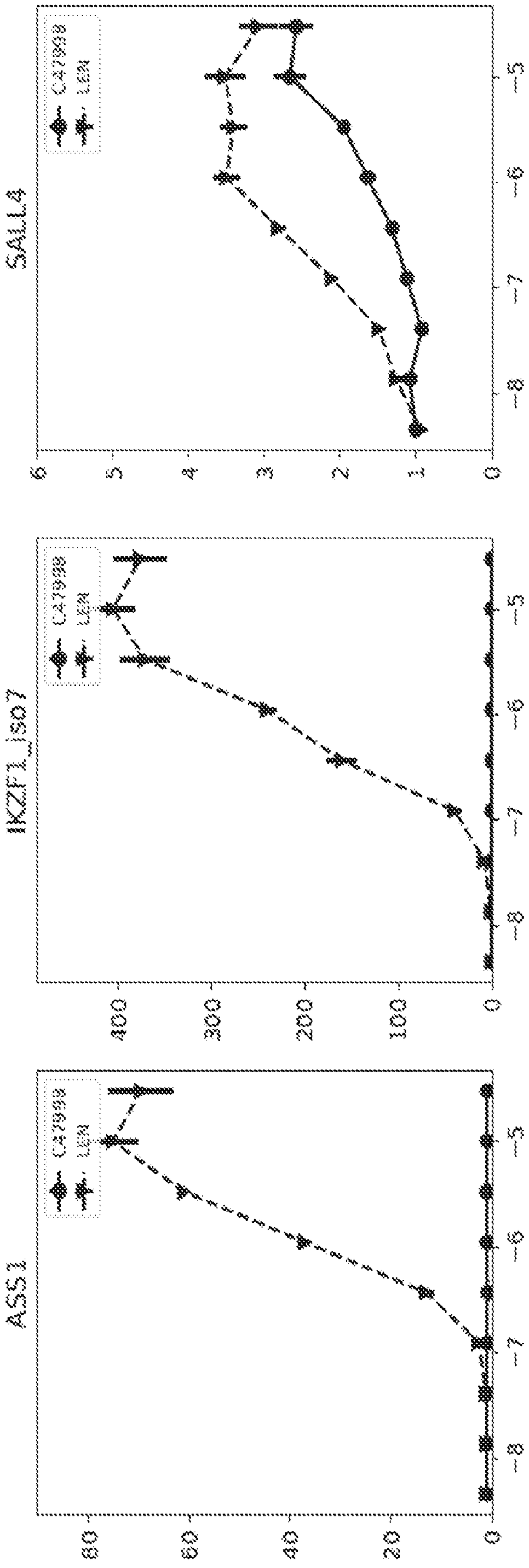

SALL4
IKZF1_iso7
ASS1
C47939
LEM
6
5
4
3
2
1
0
400
300
200
100
0
80
60
40
20
0
-3
-5
-6
-7
-8

FIG. 93

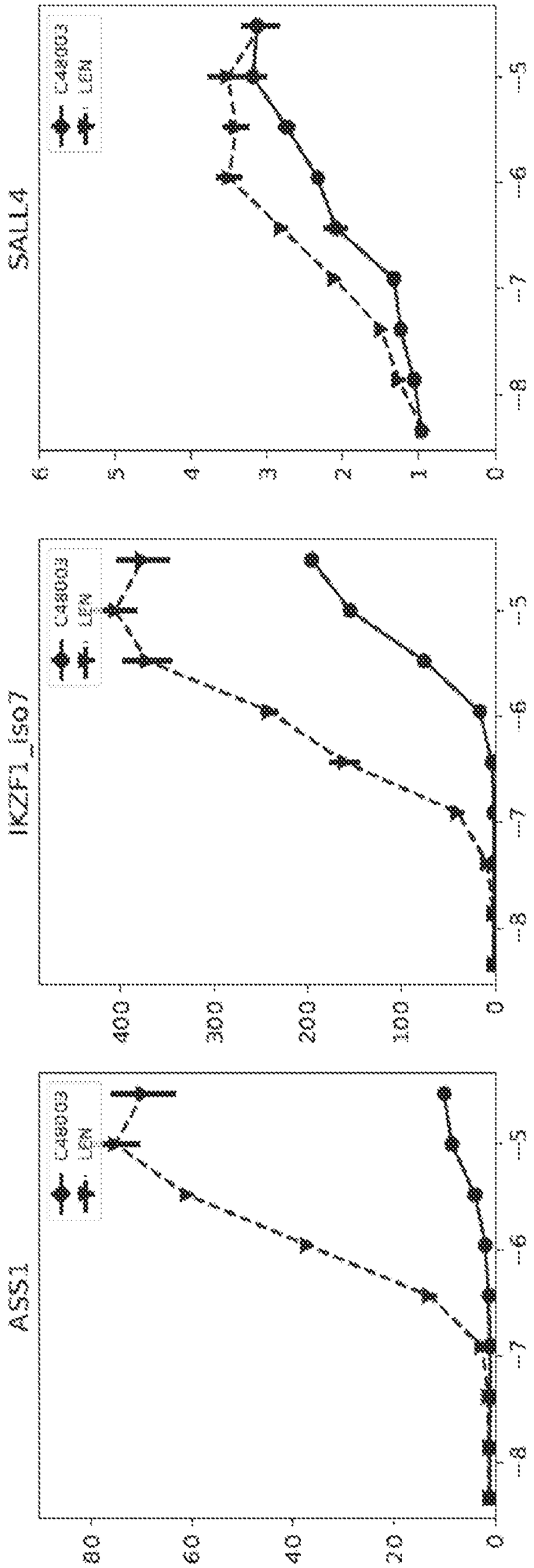

SALL4
IKZF1_iso7
ASS1
CA46B03
LEM
0
100
200
300
400
0
20
40
60
80
3
4
5
6
7
8

FIG. 94

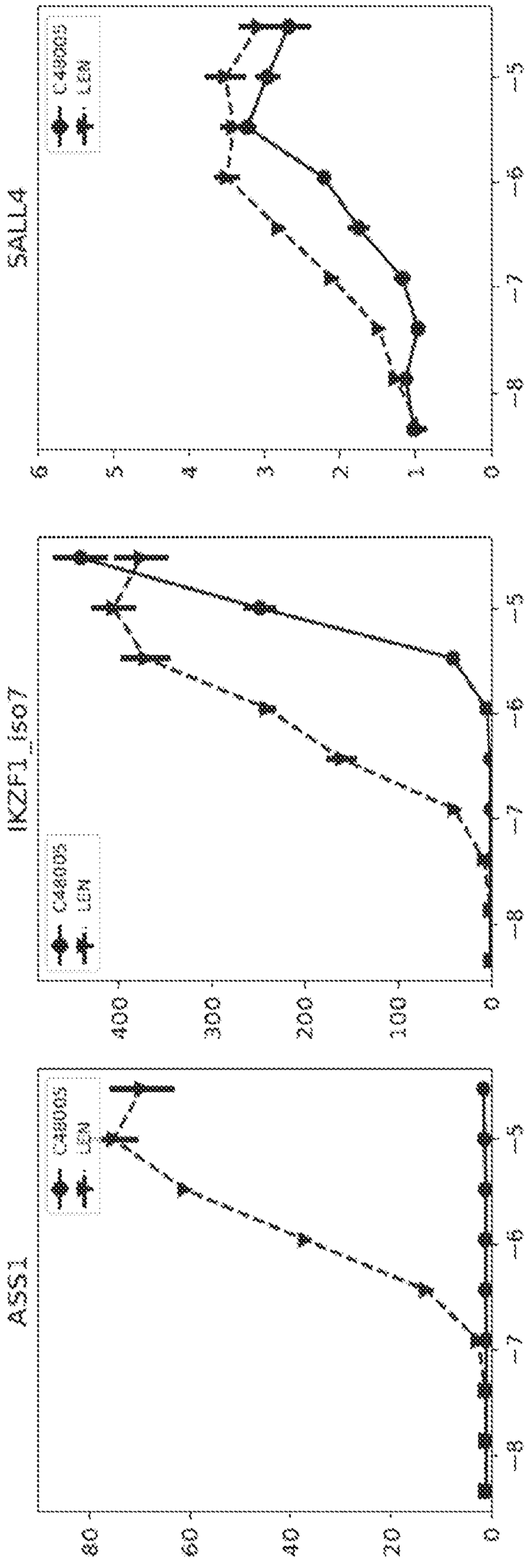

SALL4
IKZF1_ISO7
ASS1
Cabozo
LDN
0
2
3
4
5
100
200
300
400
40
60
80
-5
-6
-7
-8

FIG. 95

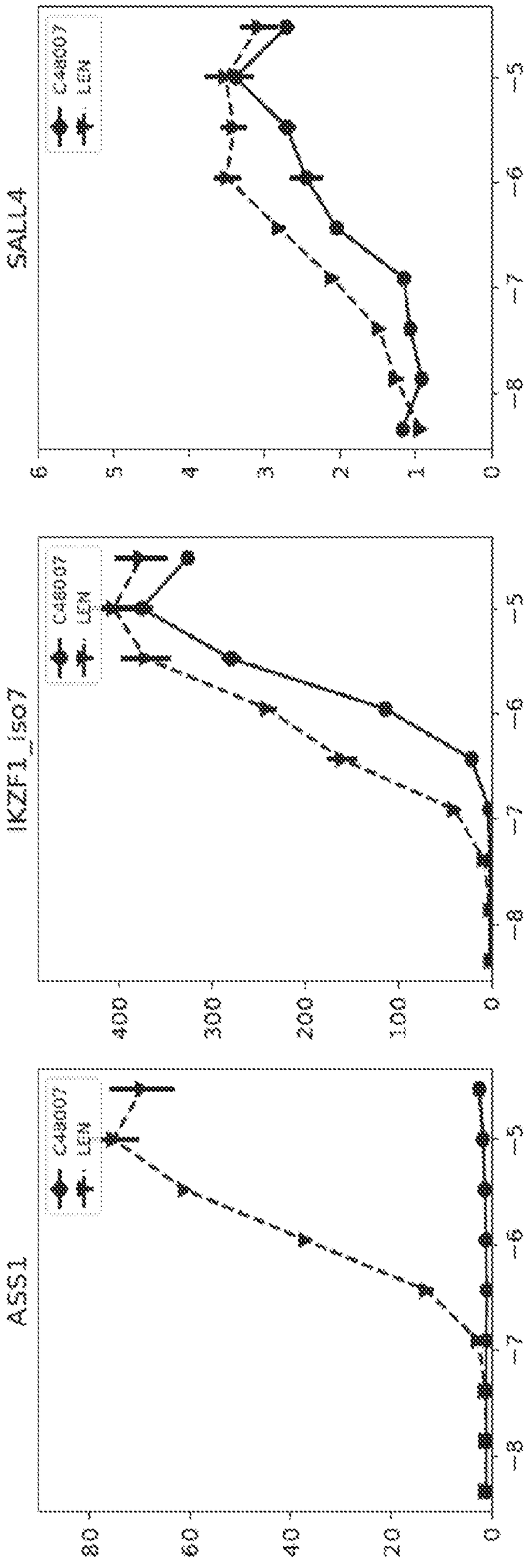

SALL4
IKZF1_ISO7
ASS1
C4B007
LEN
0
1
2
3
4
5
6
100
200
300
400
0
20
40
60
80
~3
~5
~6
~7
~8

FIG. 96

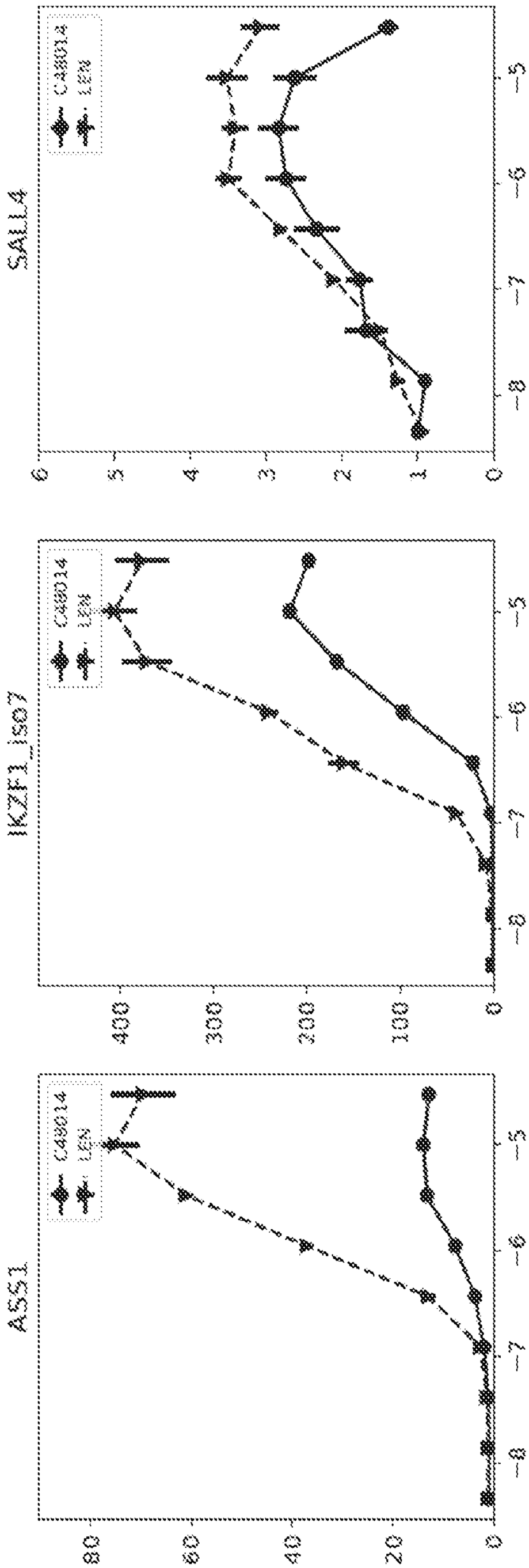


FIG. 97

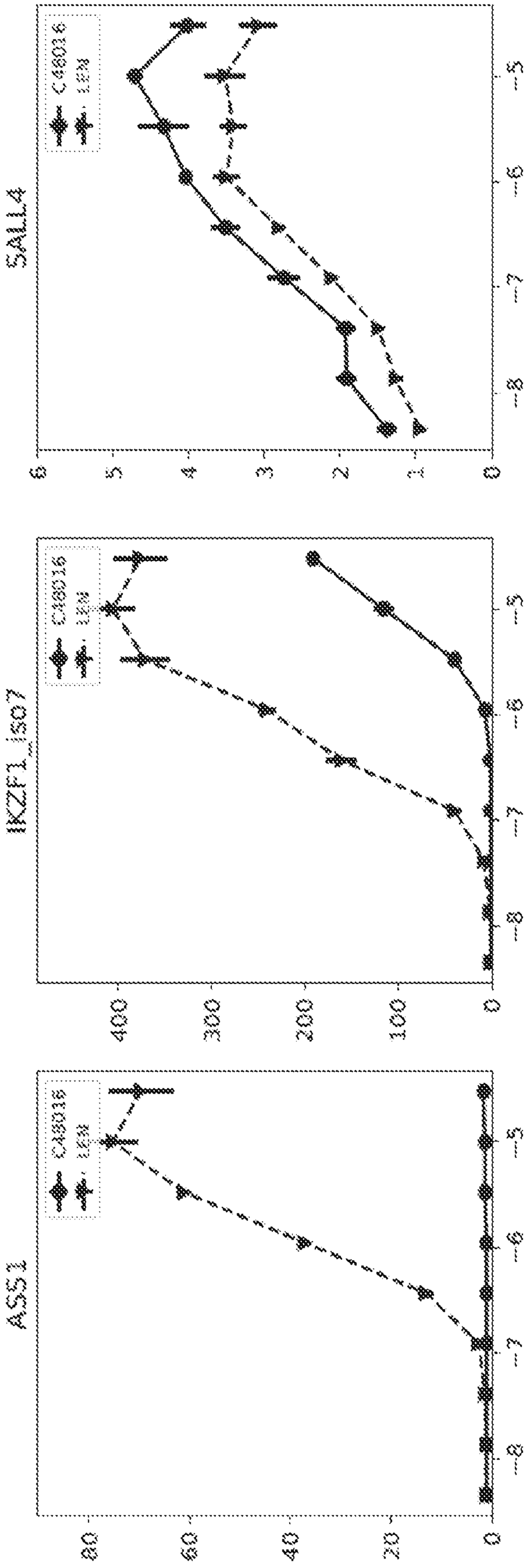


FIG. 98

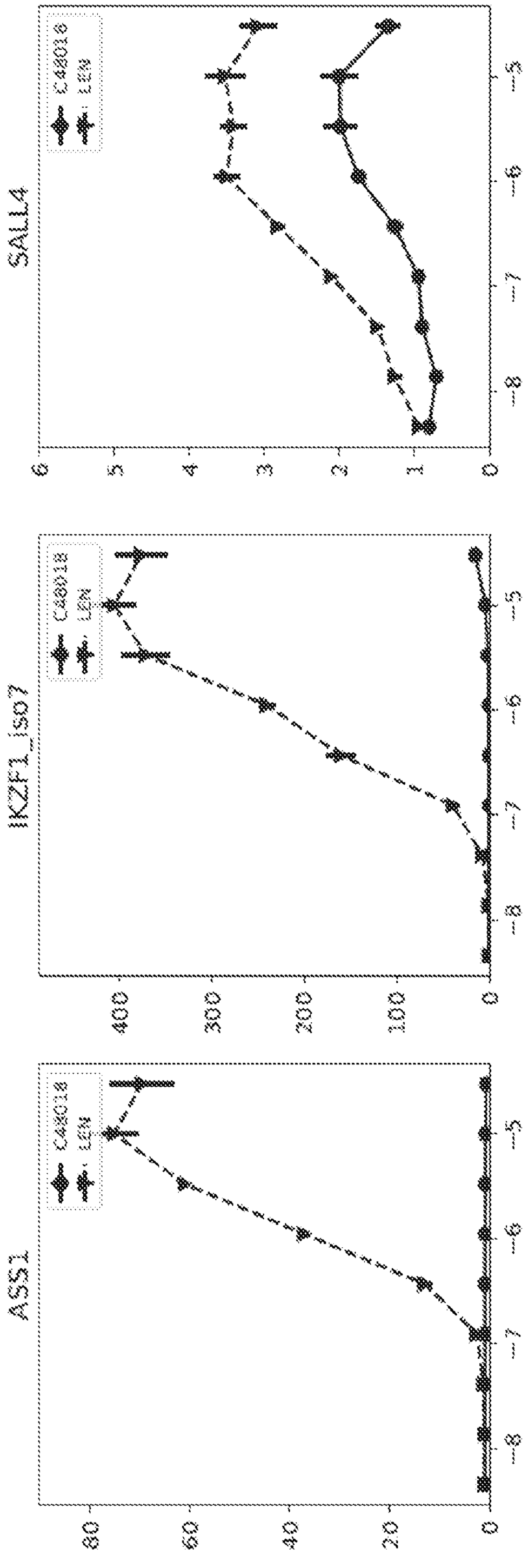

SALL4
IKZF1_iso7
ASS1
Cas9/18
LGN
0
1
2
3
4
5
6
100
200
300
400
20
40
60
80
-8
-7
-6
-5

FIG. 99

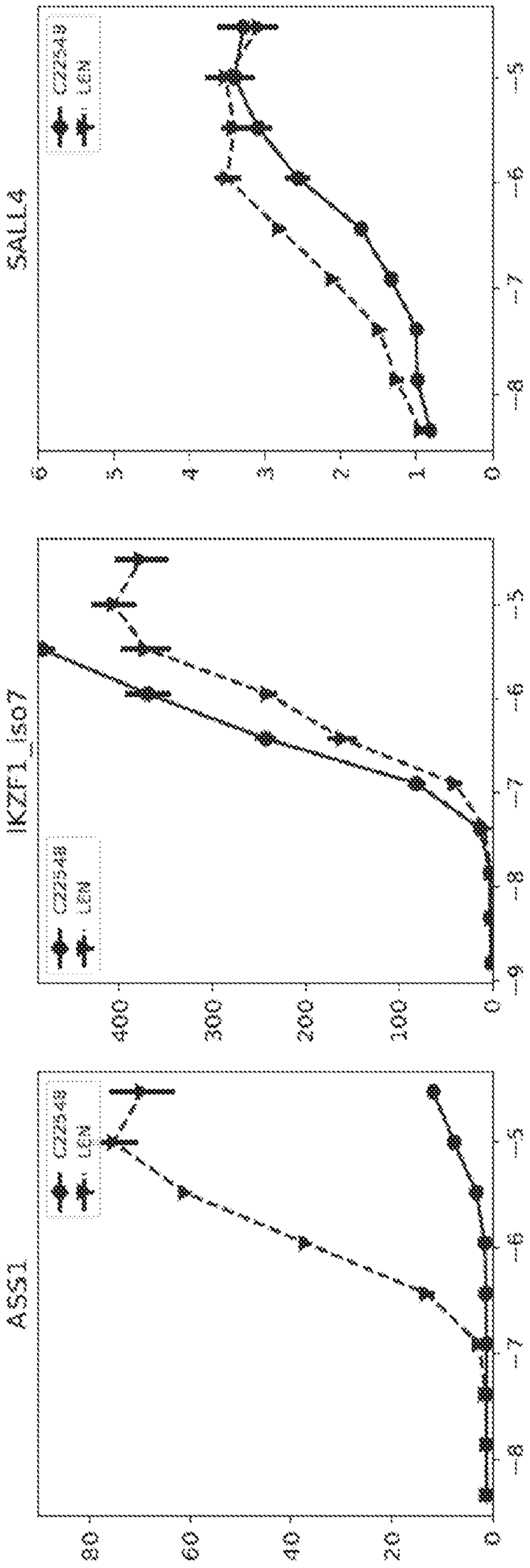

SALL4
CZ2548
LEN
0
1
2
3
4
5
-5
-6
-7
-8
IKZF1_isO7
0
100
200
300
400
-5
-6
-7
-8
-9
AS521
0
20
40
60
80
-5
-6
-7
-8

FIG. 100

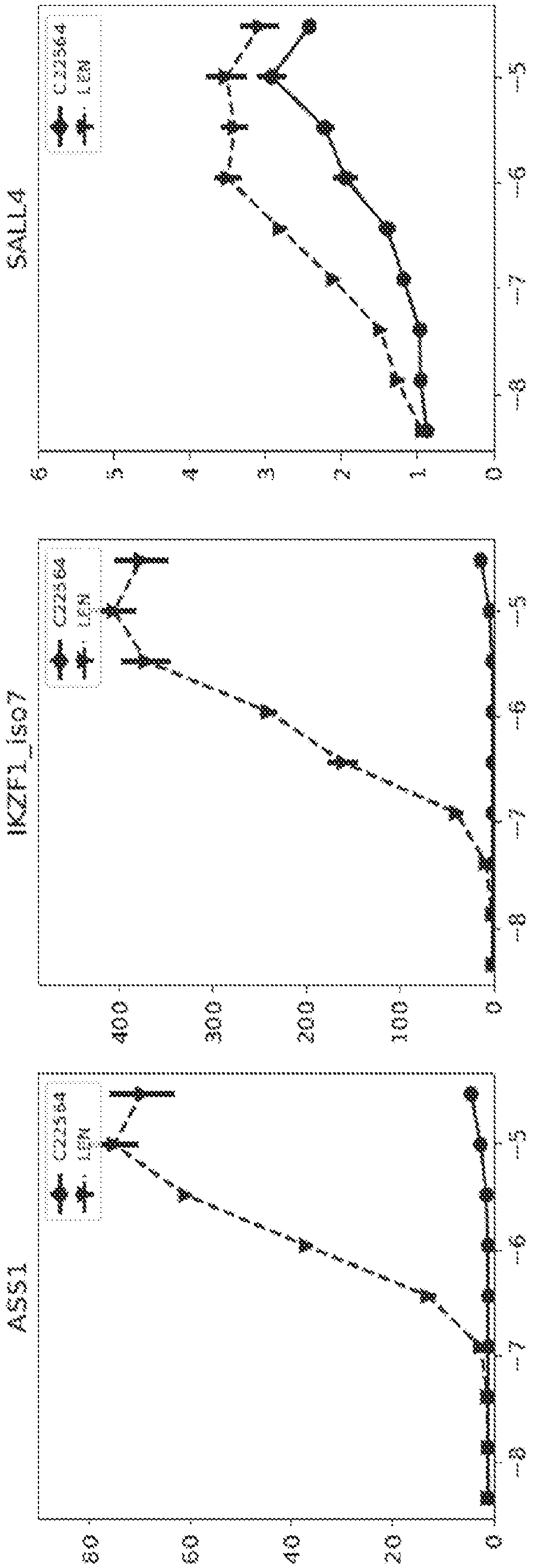

SALL4
IKZF1_iso7
ASS1
C22364
LEM
0
1
2
3
4
5
6
100
200
300
400
0
20
40
60
80
-5
-6
-7
-8

FIG. 101

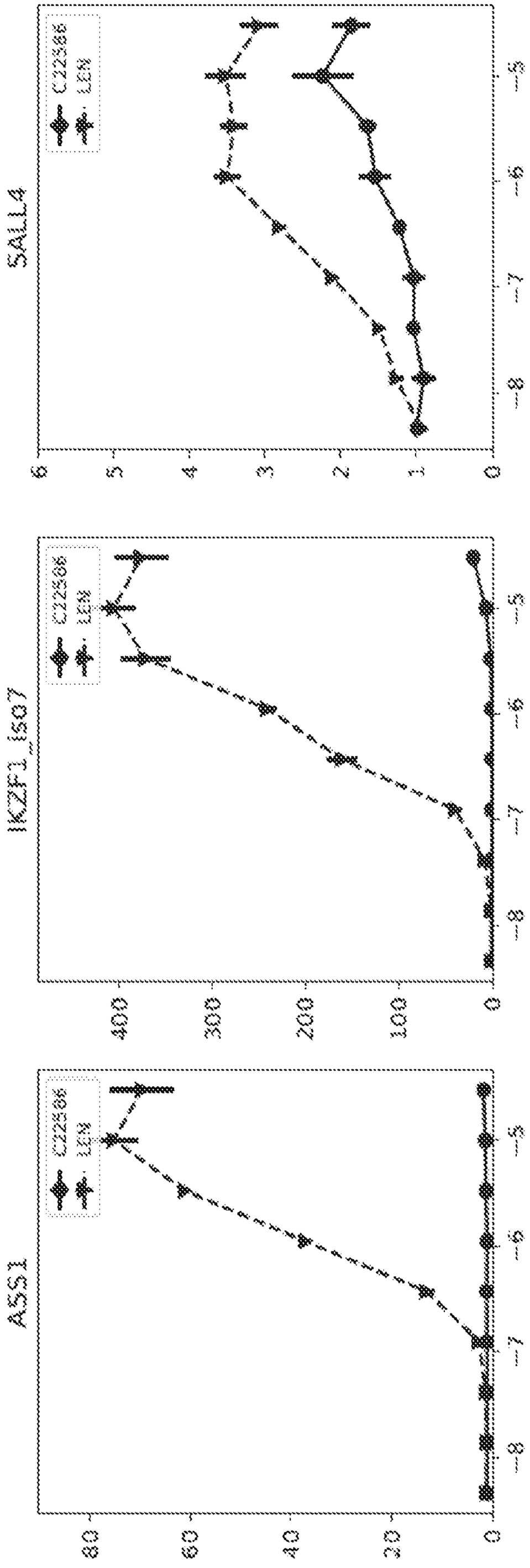


FIG. 102

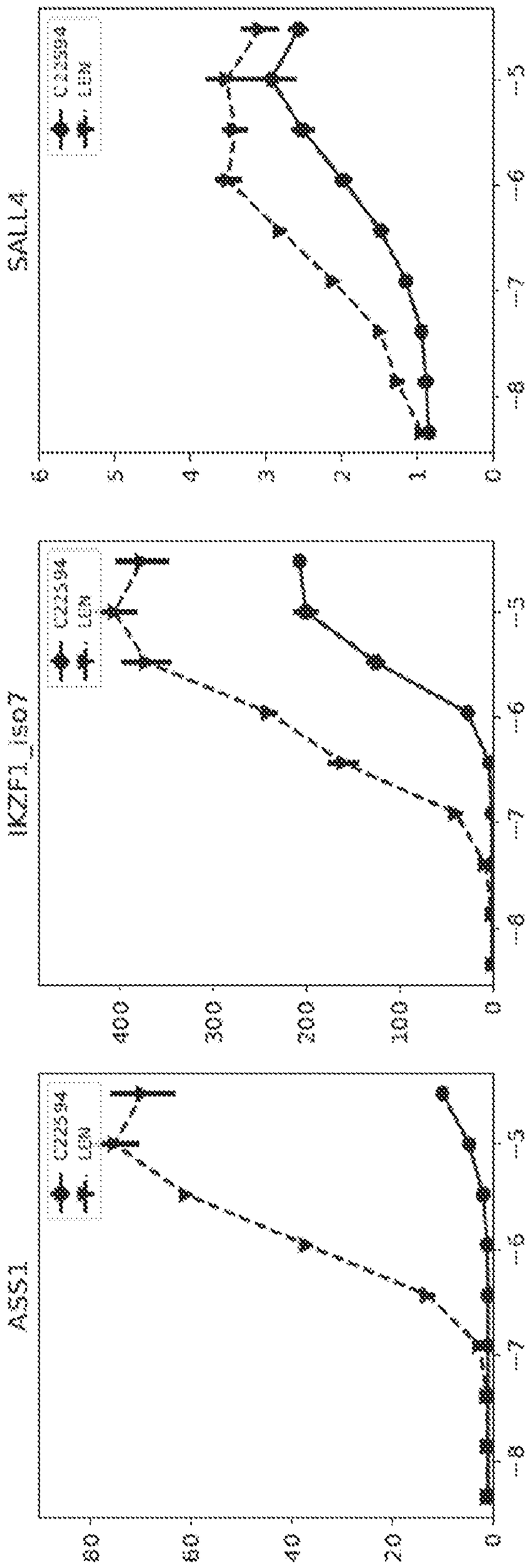

SALL4
IKZF1_iso7
ASS1
C225S4
L8%
0
1
2
3
4
5
6
100
200
300
400
20
40
60
80
3
5
6
7
8

FIG. 103

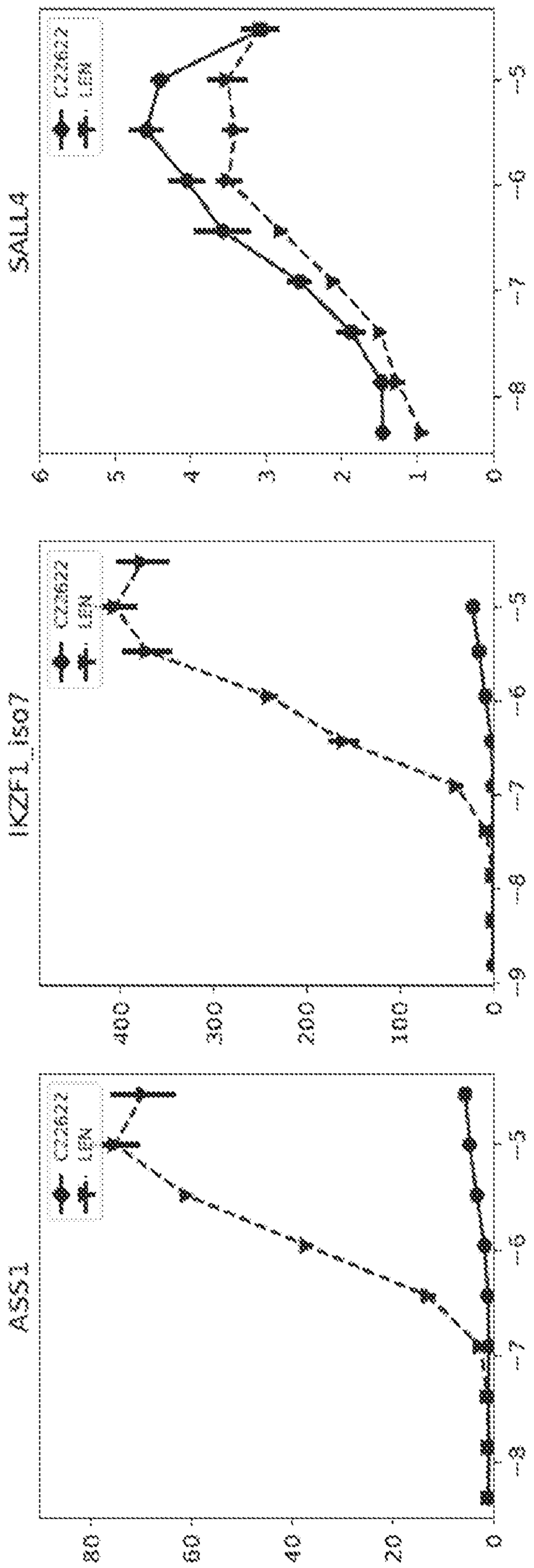

SALL4
IKZF1_iso7
ASS1
CC220622
LEN
0
1
2
3
4
5
6
0
100
200
300
400
0
20
40
60
80
-5
-6
-7
-8
-9

FIG. 104

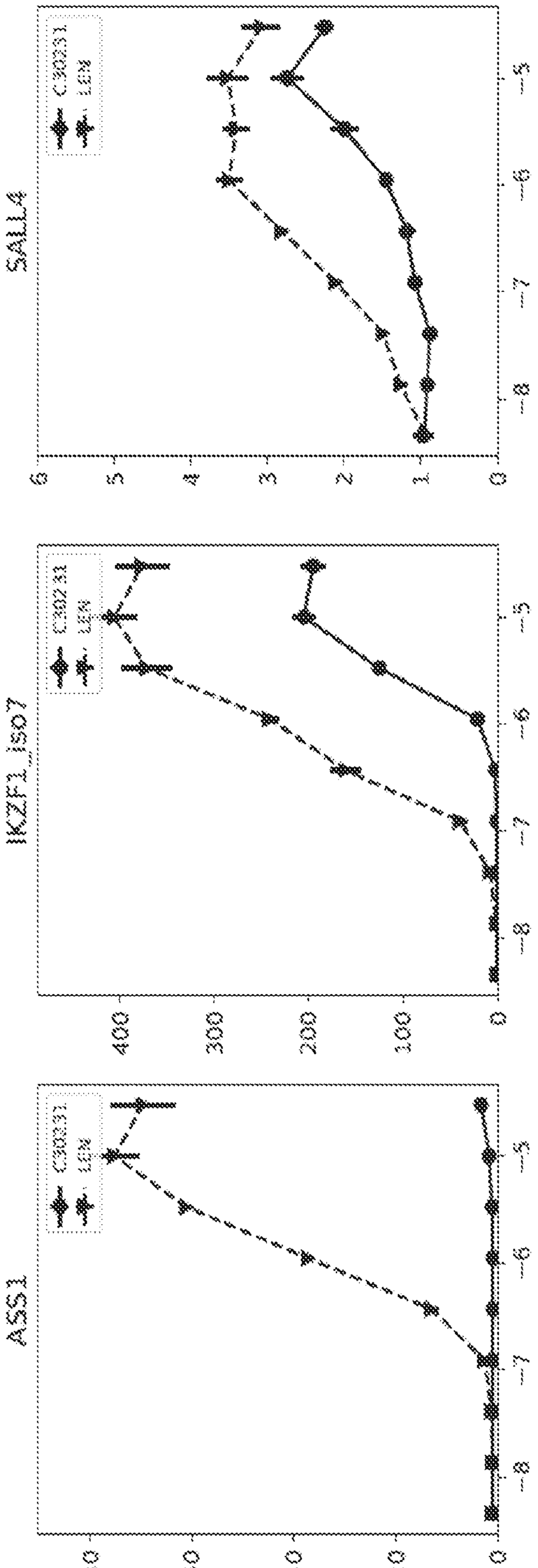


FIG. 105

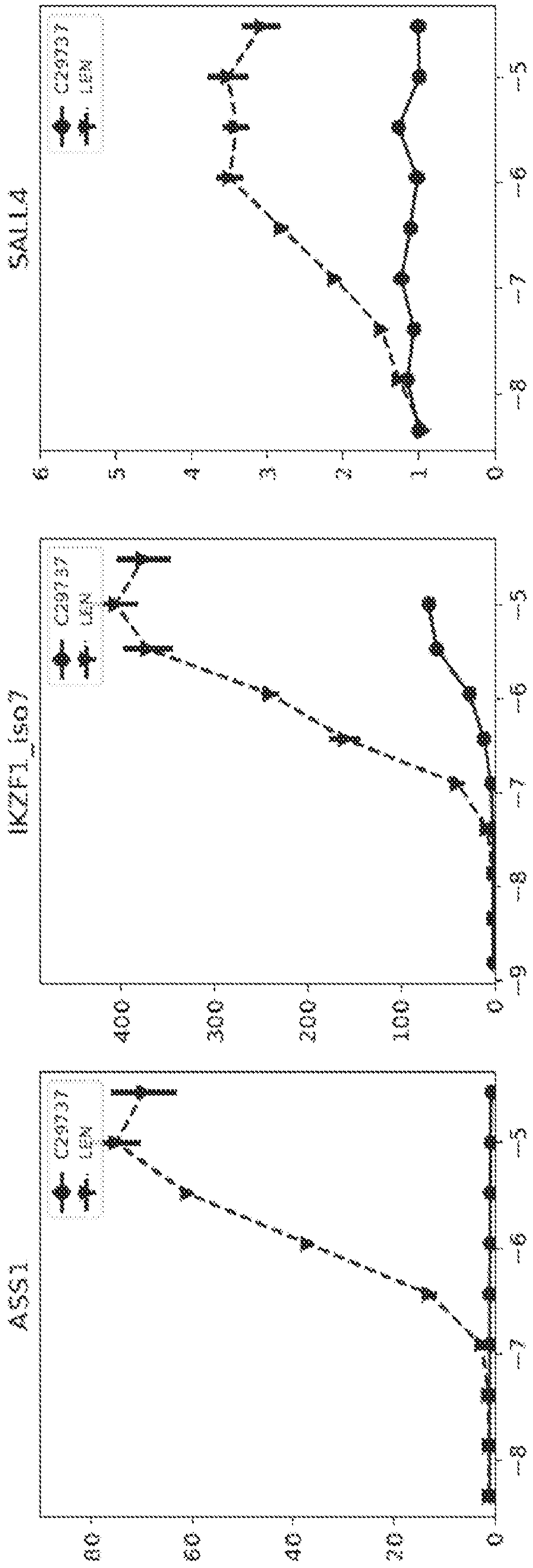

SALL4
IKZF1_ISO7
ASS1
C29737
LEN
5
6
7
8
9
0
1
2
3
4
5
6
0
100
200
300
400
0
20
40
60
80

FIG. 10G

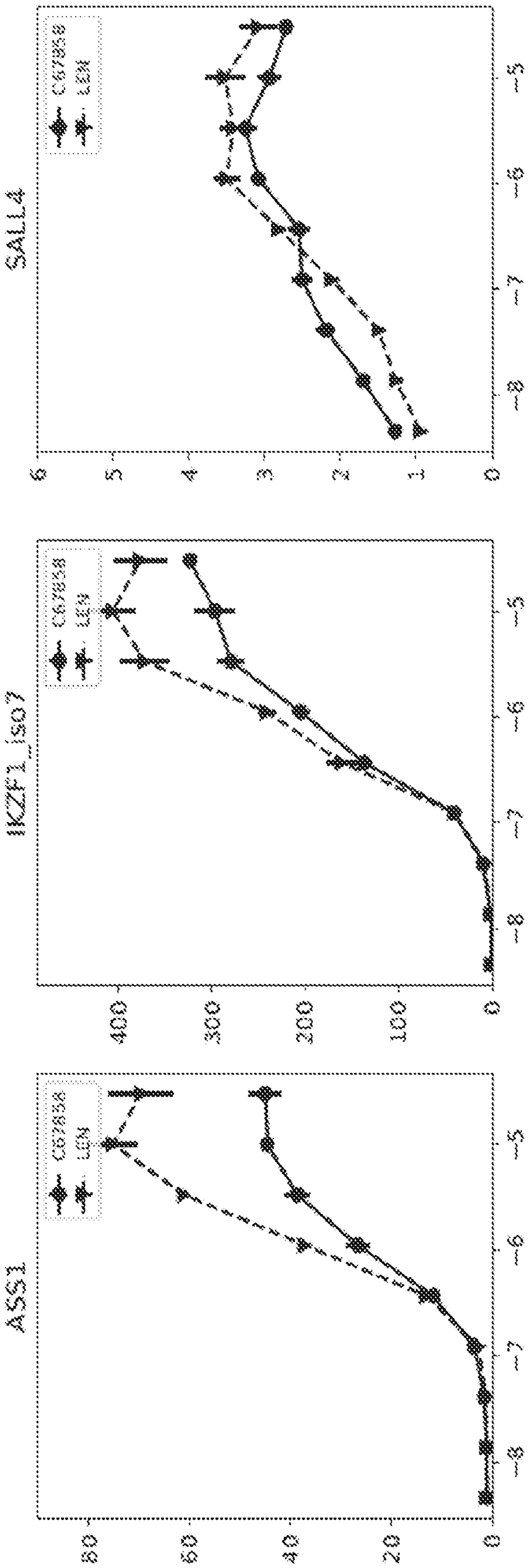

SALL4
IKZF1_iso7
ASS1
C6786
LEM
0
1
2
3
4
5
6
0
100
200
300
400
0
20
40
60
5
6
7
8

FIG. 107

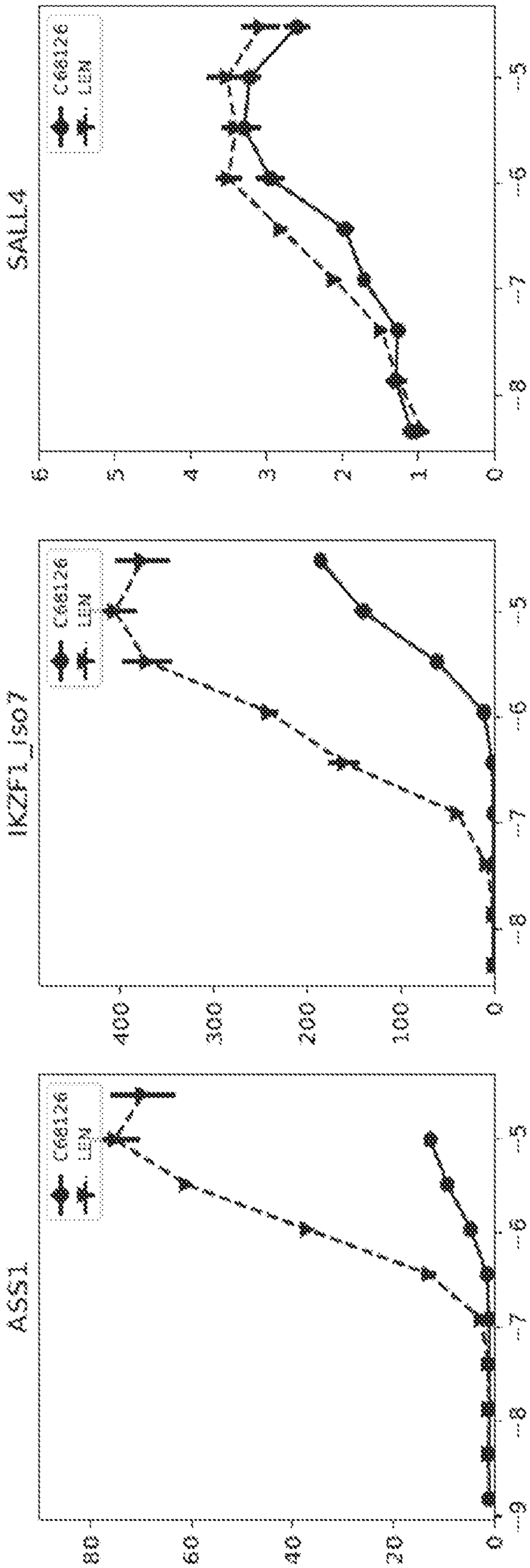

SALL4
IKZF1_iso7
ASS1
C68126
LEM
0
100
200
300
400
0
20
40
60
80
3
4
5
6
7
8
9

FIG. 10B

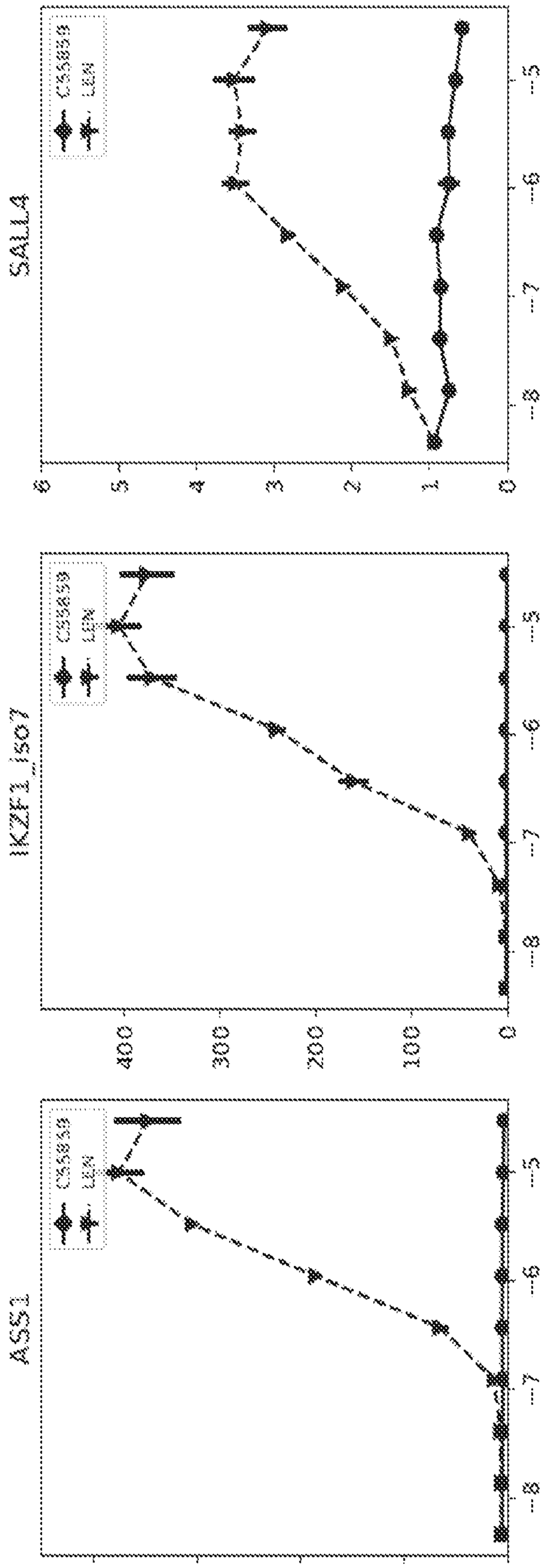

SALL4
IKZF1_iso7
ASS1
CS58653
Ligk
0
1
2
3
4
5
6
100
200
300
400
40
60
80
-5
-6
-7
-8

FIG. 10J

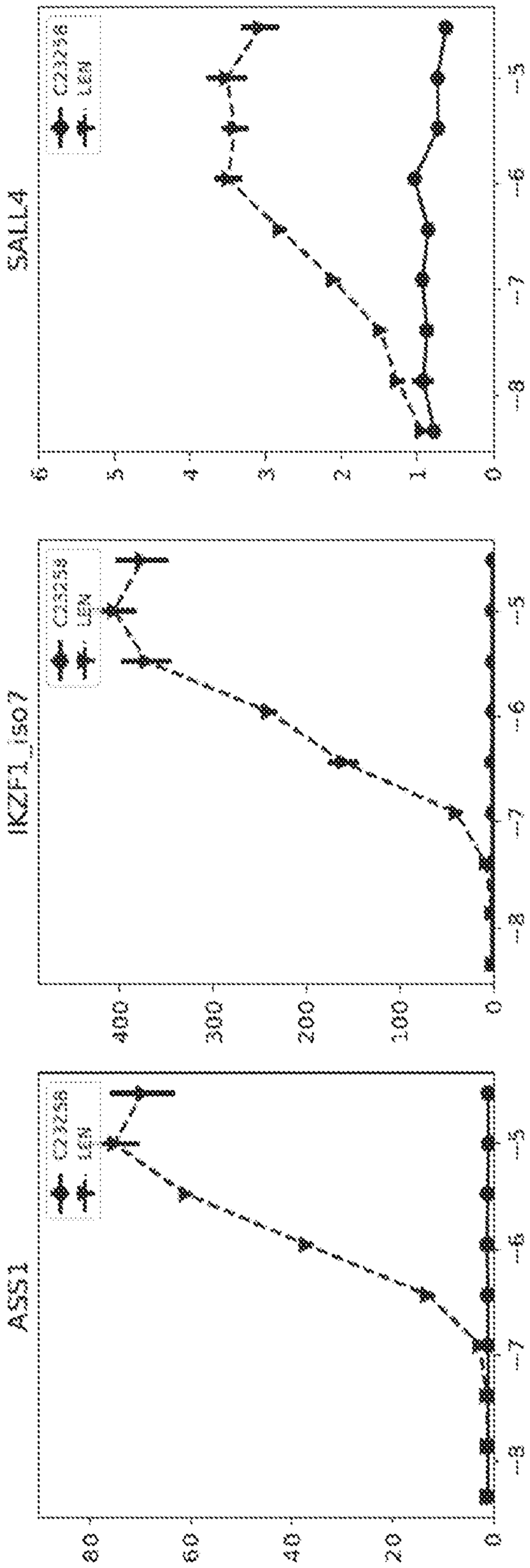

SALL4
IKZF1_iso2
ASS1
CC220
LEN
0
1
2
3
4
5
100
200
300
400
20
40
60
80
-2
-3
-4
-5
-6
-7
-8

FIG. 110

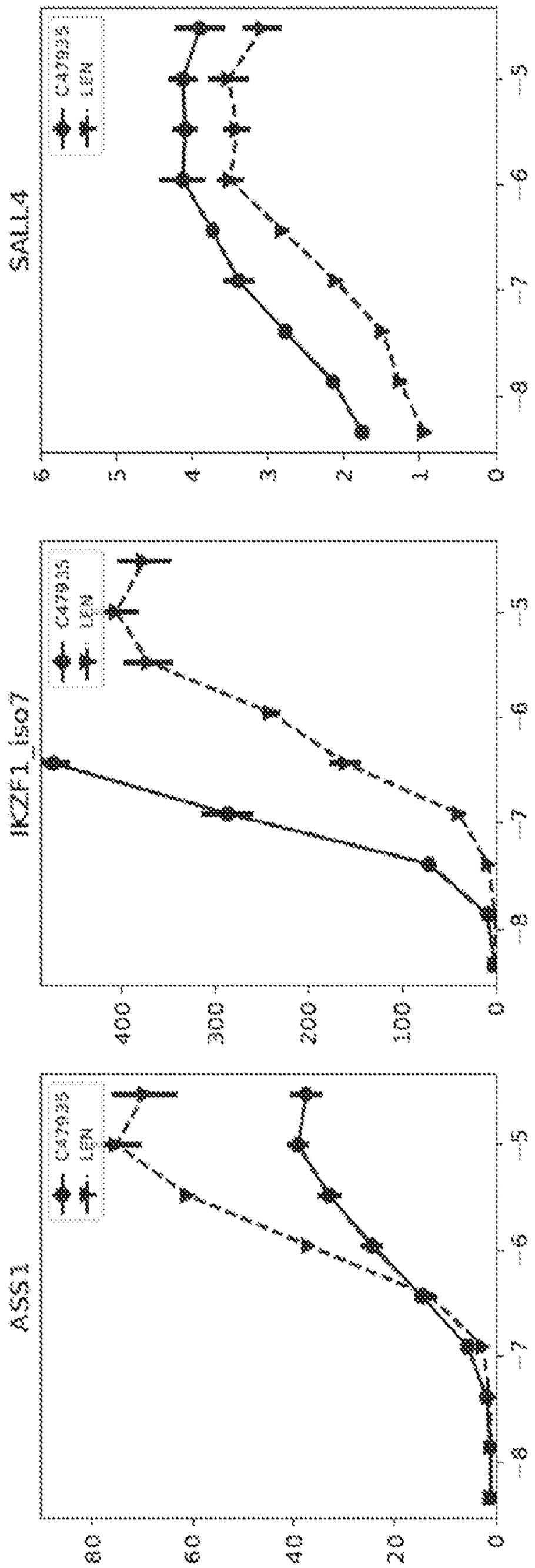

SALL4
CA2936
LEN
0
1
2
3
4
5
5
6
7
8
IKZF1_isoY
CA2936
LEN
0
100
200
300
400
3
5
7
8
ASS1
CA2936
LEN
0
20
40
60
80
5
6
7
8

FIG. 111

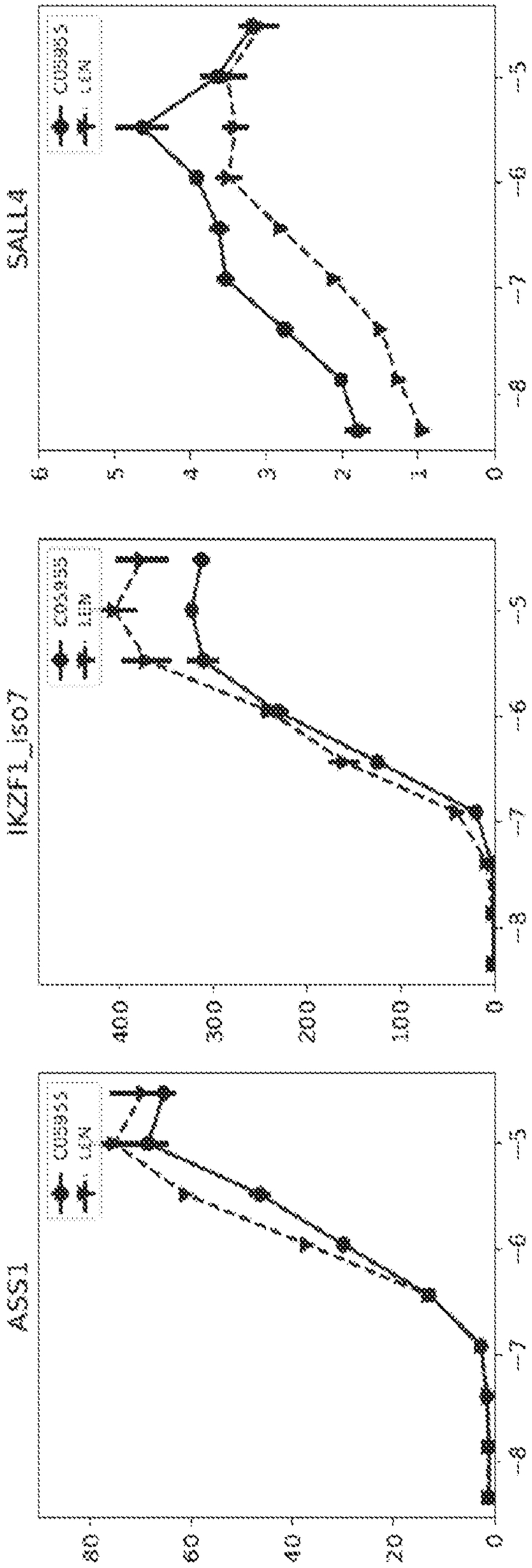

SALL4
IKZF1_iso7
ASS1
CUB955
LEN
0
1
2
3
4
5
6
0
100
200
300
400
0
20
40
60
-3
-4
-5
-6
-7
-8

FIG. 112

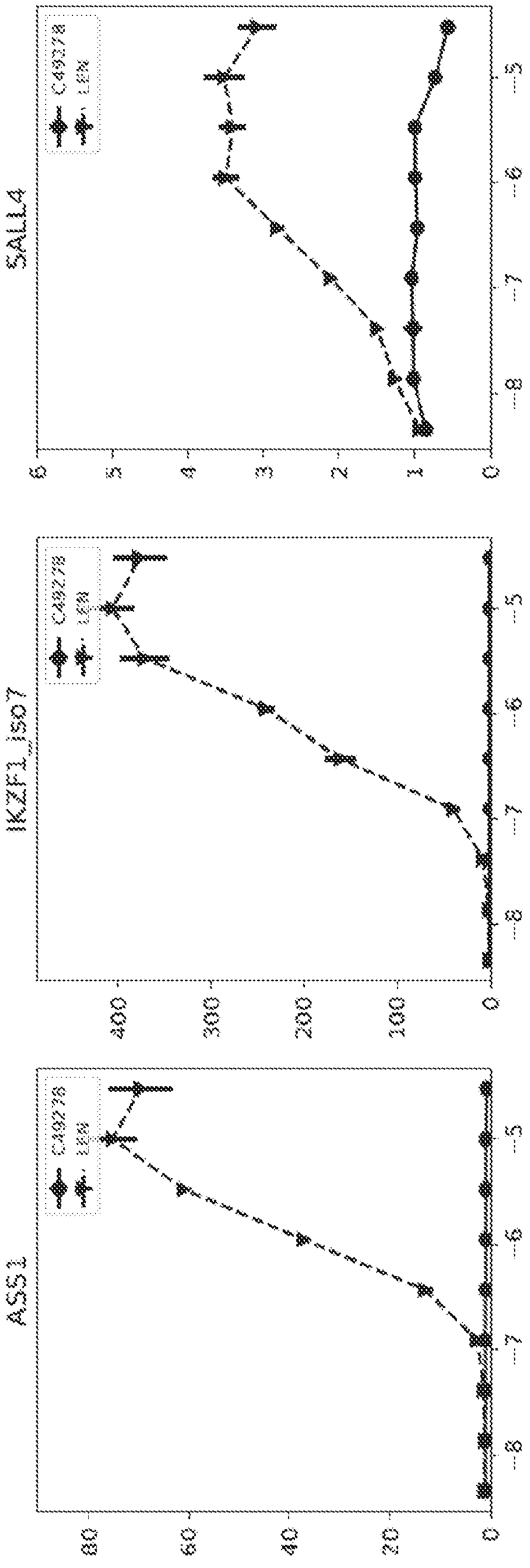

SALL4
IKZF1_iso7
ASS1
Cas9/TS
LEN
0
1
2
3
4
5
6
7
8
0
100
200
300
400
0
20
40
60
80

FIG. 113

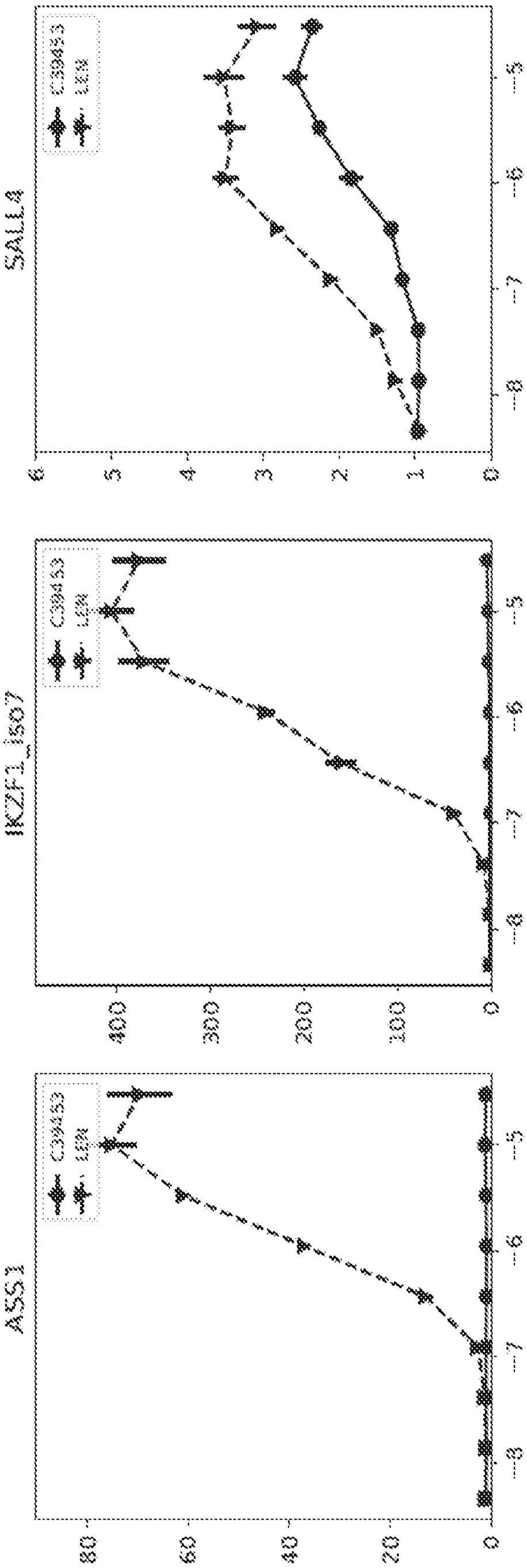

SALL4
C39453
Log2
0
1
2
3
4
5
6
-3
-5
-6
-7
-8
IKZF1_ISO7
C39453
Log2
0
100
200
300
400
-3
-5
-6
-7
-8
ASS1
C39453
Log2
0
20
40
60
80
-3

FIG. 114

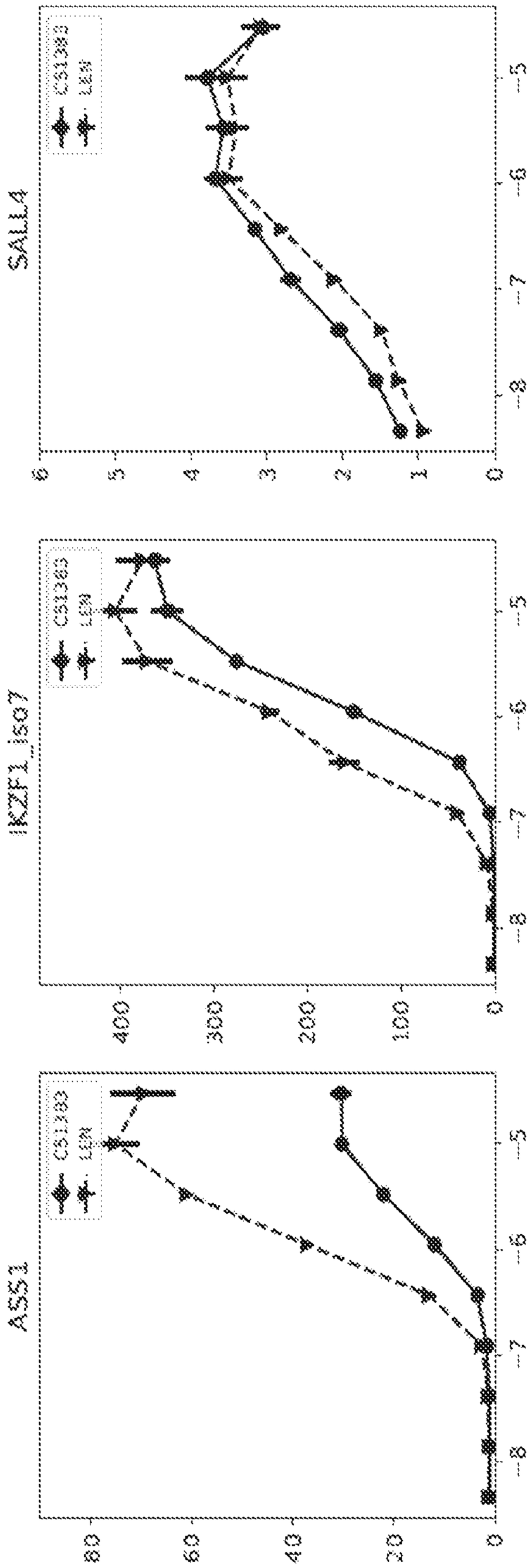

SALL4
IKZF1_iso7
ASS1
C51383
LEN
0
100
200
300
400
0
20
40
60
80
-2
-3
-4
-5
-6
-7
-8

FIG. 11S

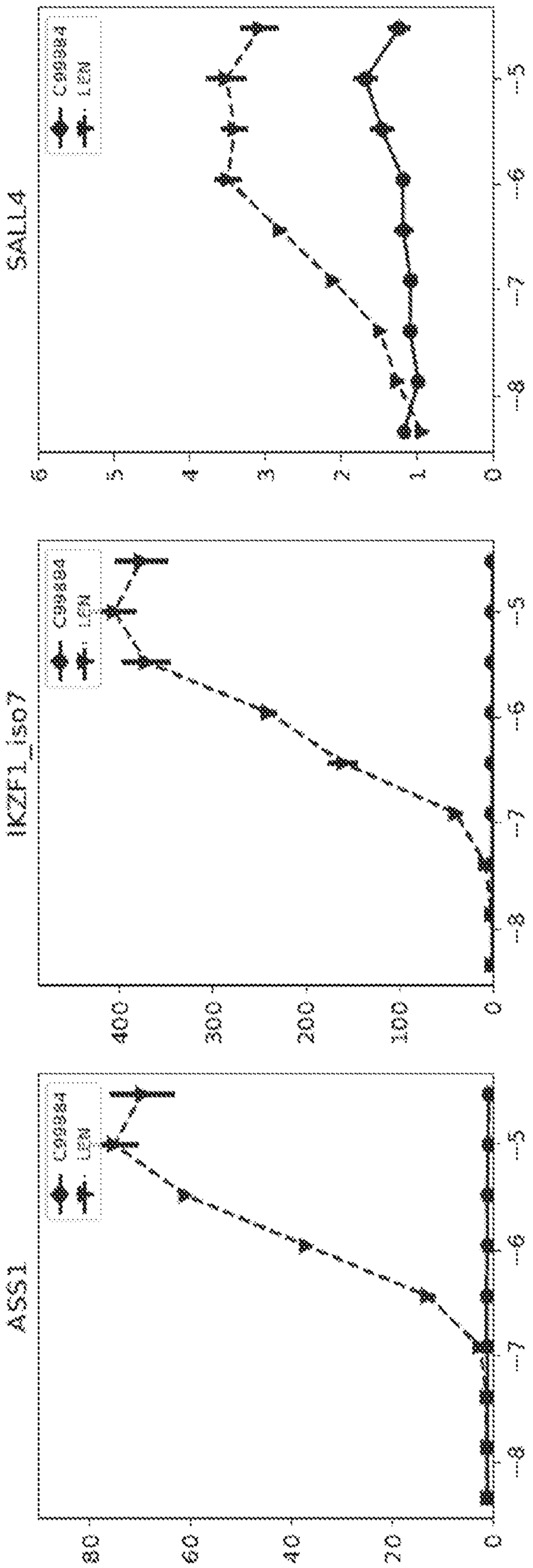

SALL4
IKZF1_iso7
ASS1
C99384
LCM
0
100
200
300
400
0
20
40
60
80
5
6
7
8

FIG. 116

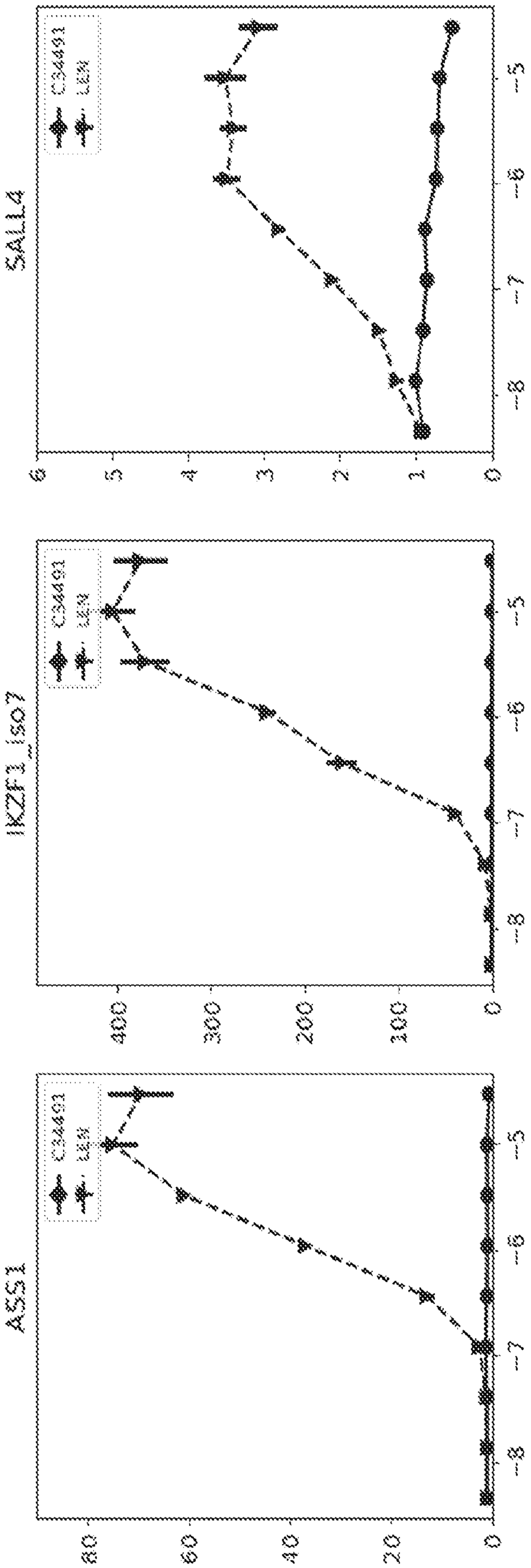

SALL4
C34491
DMSO
0
1
2
3
4
5
-8
-7
-6
-5
IKZF1_iso7
0
100
200
300
400
ASS1
0
20
40
60
80

FIG. 117

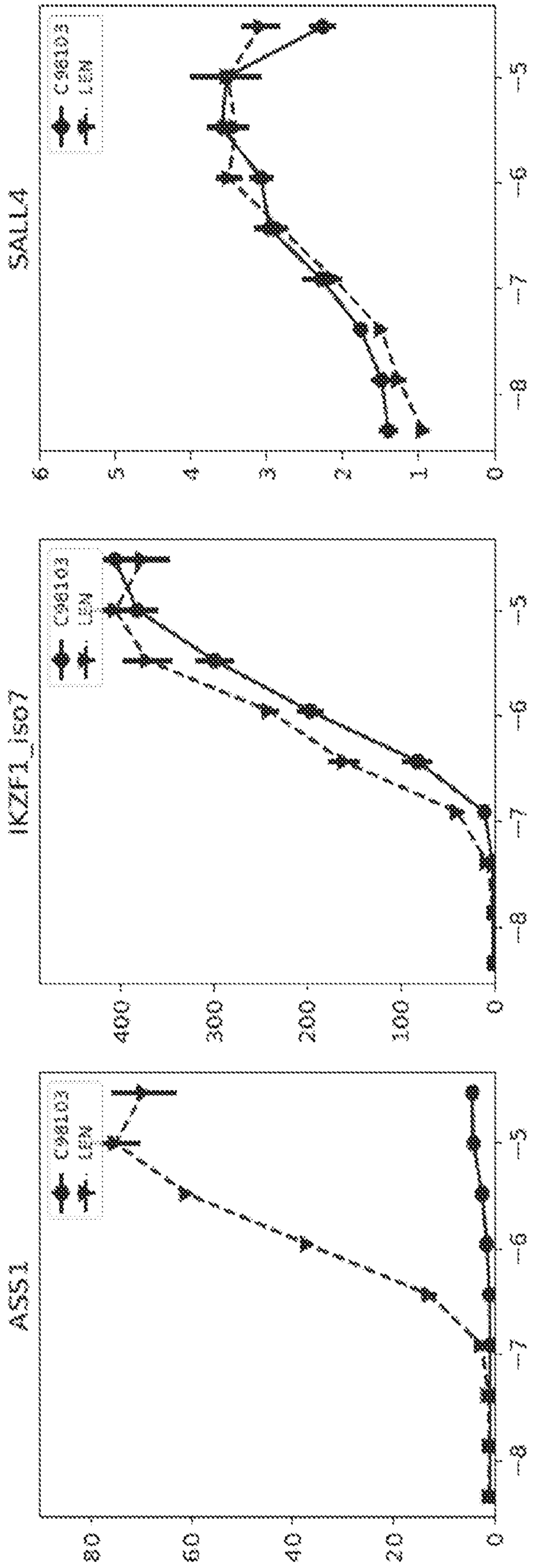

SALL4
IKZF1_iso7
ASS1
CS6103
LEN
0
1
2
3
4
5
6
100
200
300
400
0
20
40
60
80
5
6
7
8

FIG. 11B

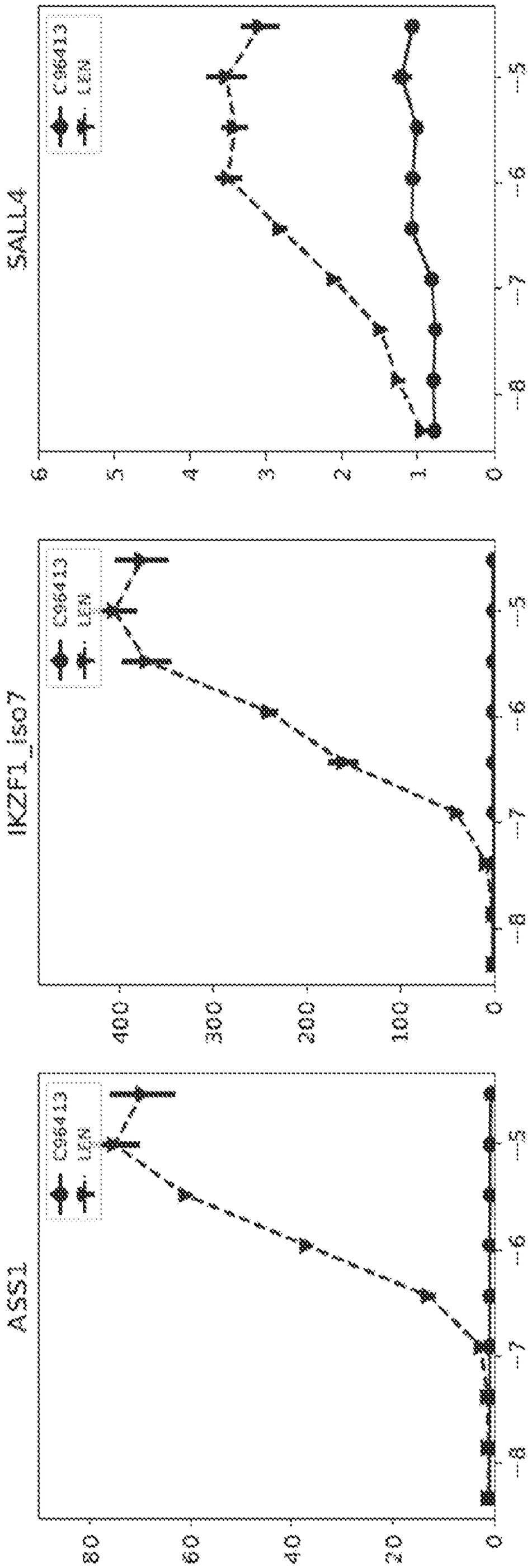

SALL4
IKZF1_iso7
AS51
CC96413
LEN
5
6
7
8
0
100
200
300
400
0
20
40
60
80

FIG. 119

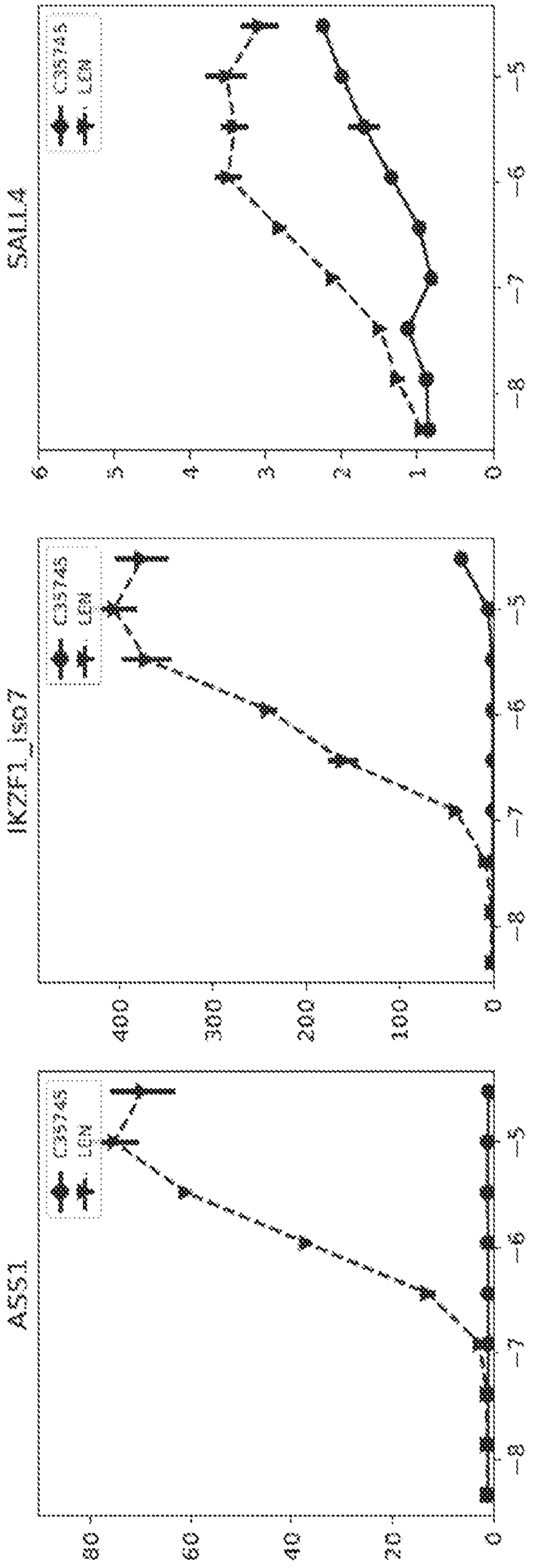

SALL4
IKZF1_iso7
ASS1
C35745
LEM
0
1
2
3
4
5
6
100
200
300
400
20
40
60
80
−2
−3
−5
−6
−7
−8

FIG. 120

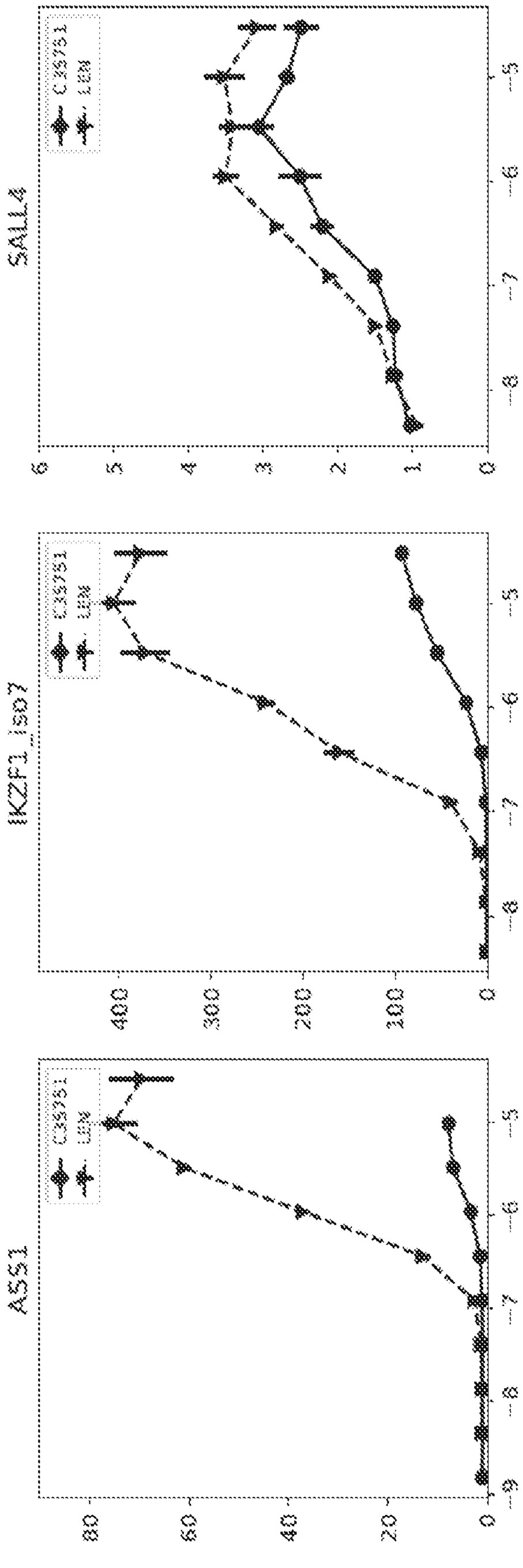

SALL4
IKZF1_isoT
ASS1
C39381
LDH
0
1
2
3
4
5
6
7
8
9
100
200
300
400
20
40
60
80

FIG. 121

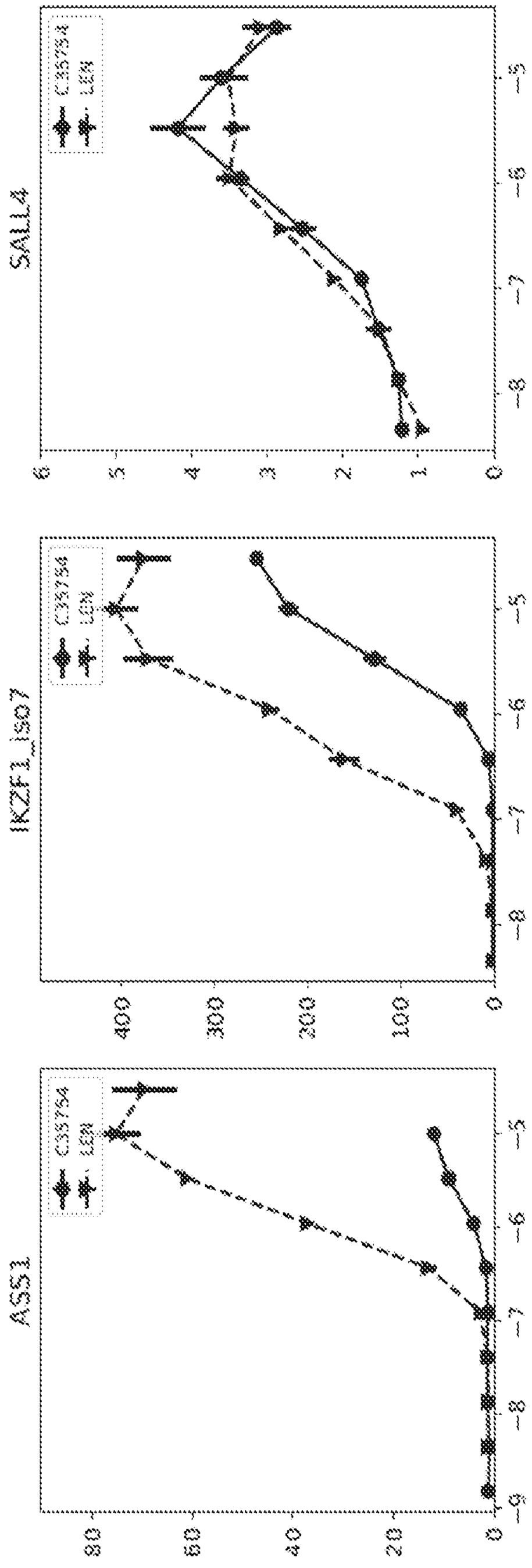

SALL4
C35794
LEN
IKZF1_iso7
C35794
LEN
ASS1
C35794
LEN
0
100
200
300
400
0
1
2
3
4
5
6
0
20
40
60
80
−5
−6
−7
−8
−9

FIG. 122

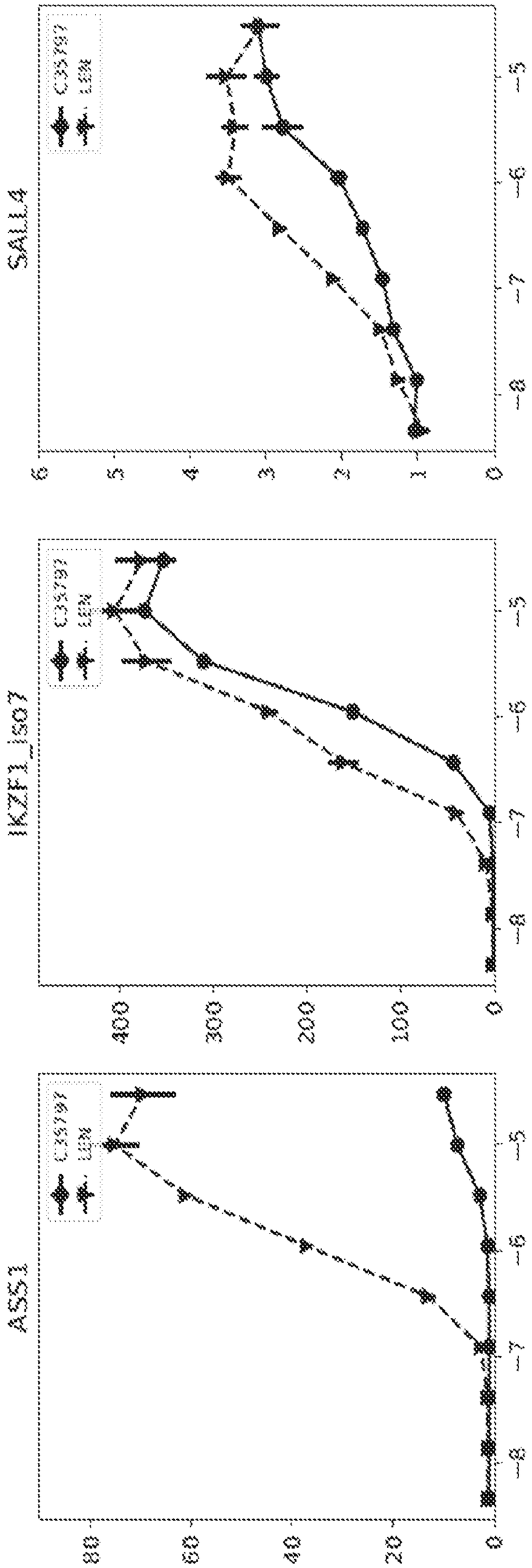


FIG. 123

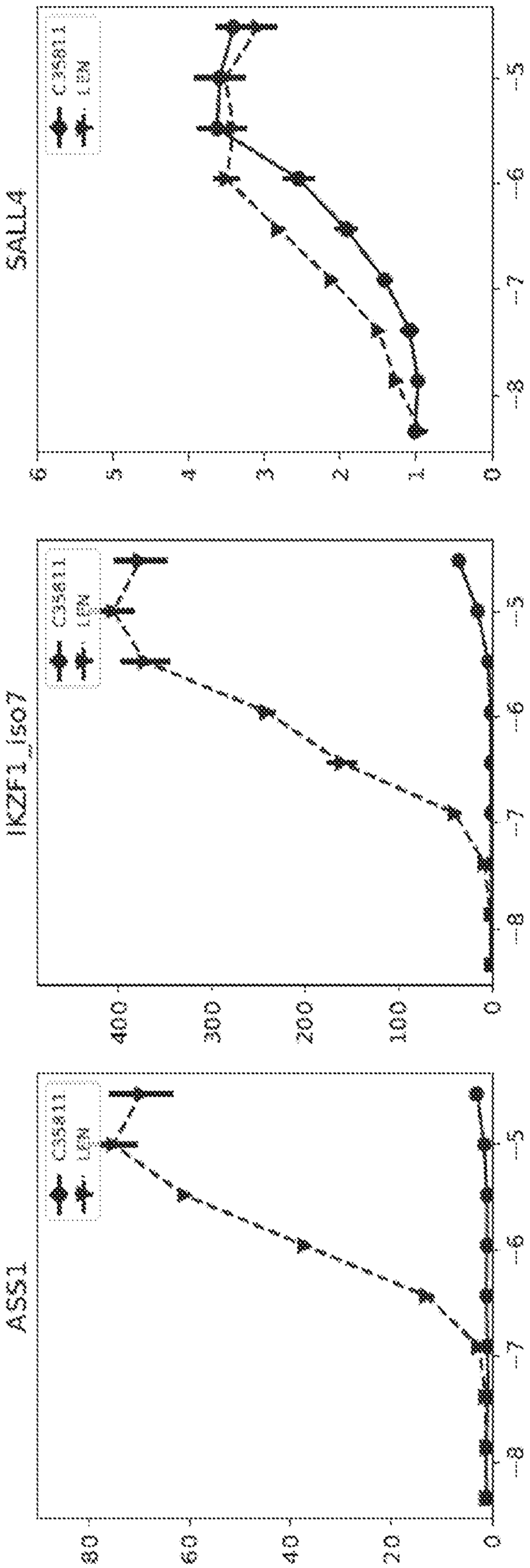

SALL4
IKZF1_iso7
ASS1
C35611
LEM
0
100
200
300
400
0
20
40
60
80
2
3
4
5
6
7
8

FIG. 124

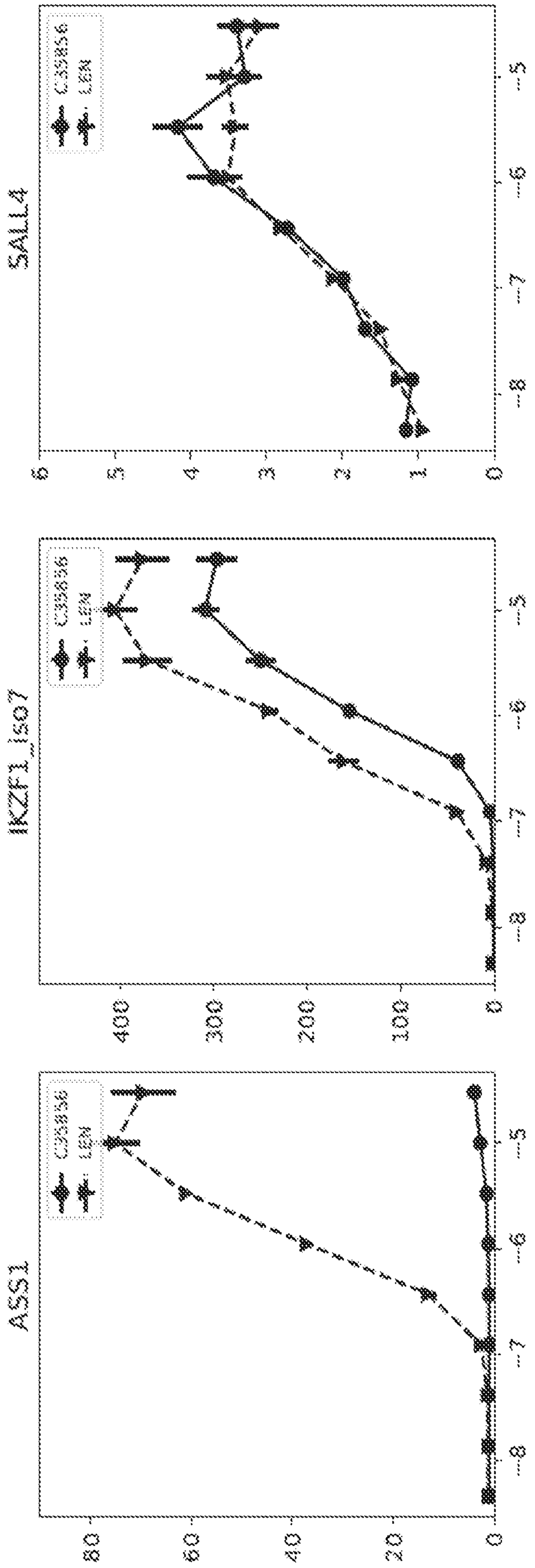


FIG. 125

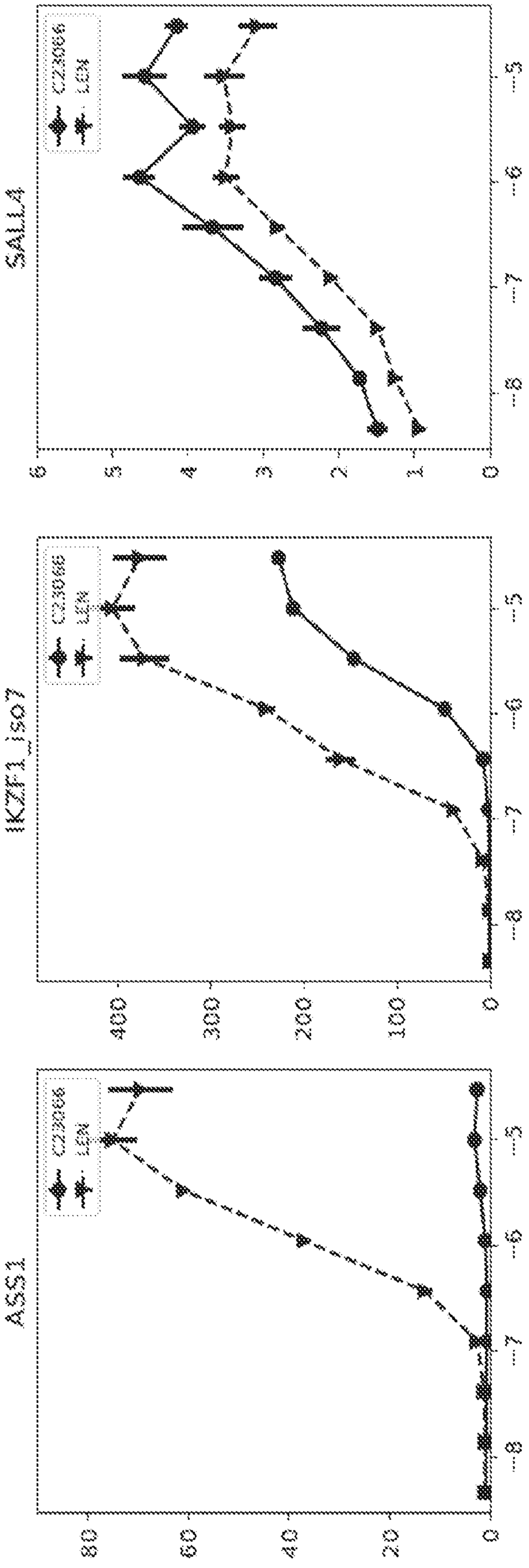

SALL4
CZ30666
LEN
0
1
2
3
4
5
6
7
8
IKZF1_iso7
CZ30666
LEN
0
100
200
300
400
2
3
6
7
8
AS51
CZ30666
LEN
0
20
40
60
80
2
3
6
7
8

FIG. 126

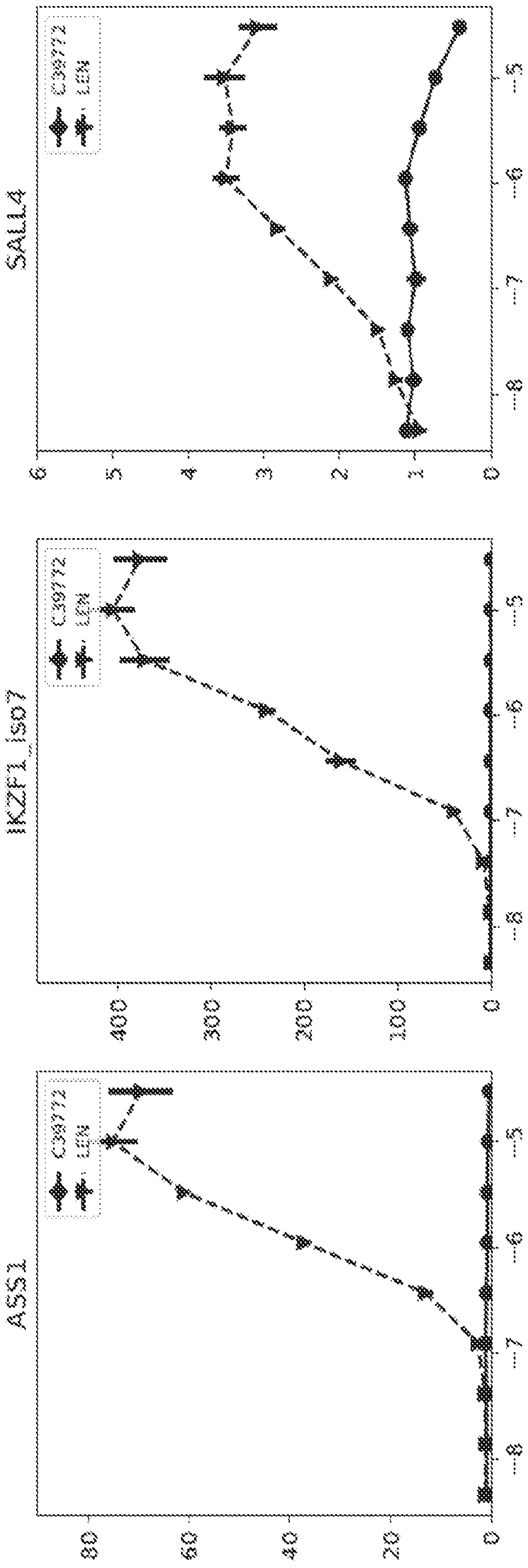

SALL4
IKZF1_iso7
ASS1
C39772
LEN
0
1
2
3
4
5
6
0
100
200
300
400
0
20
40
60
80
5
6
7
8

FIG. 127

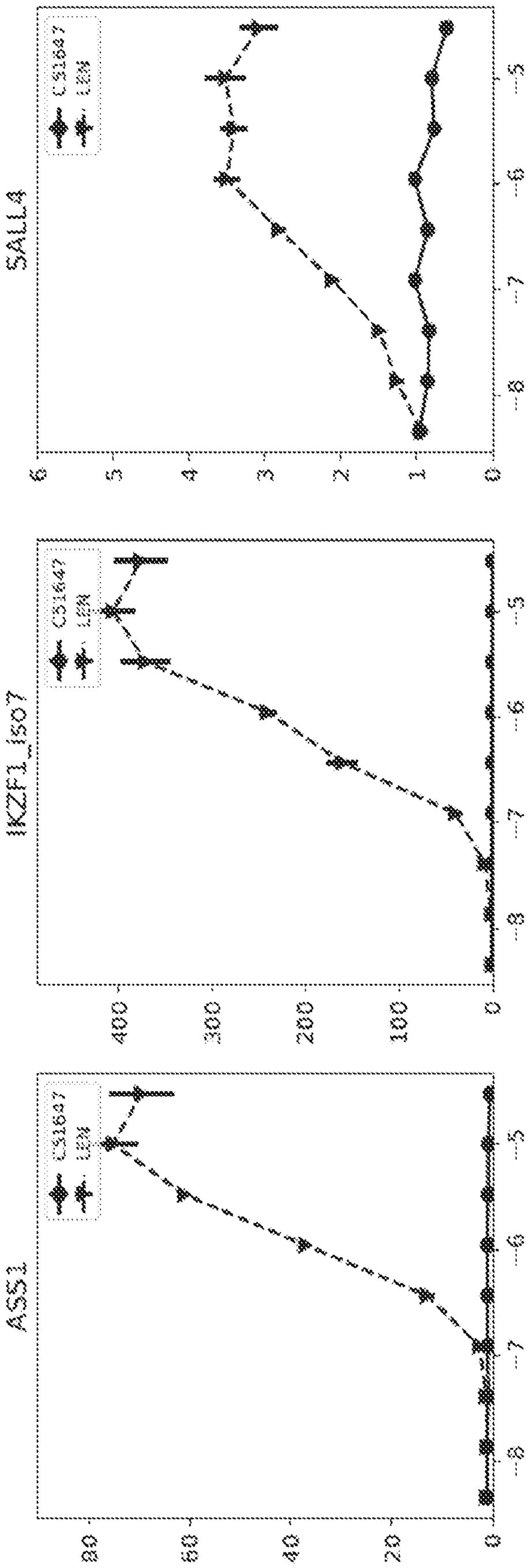

SALL4
IKZF1_ISO7
ASS1
CS1647
LEN
0
1
2
3
4
5
6
7
8
100
200
300
400
20
40
60
80

FIG. 12B

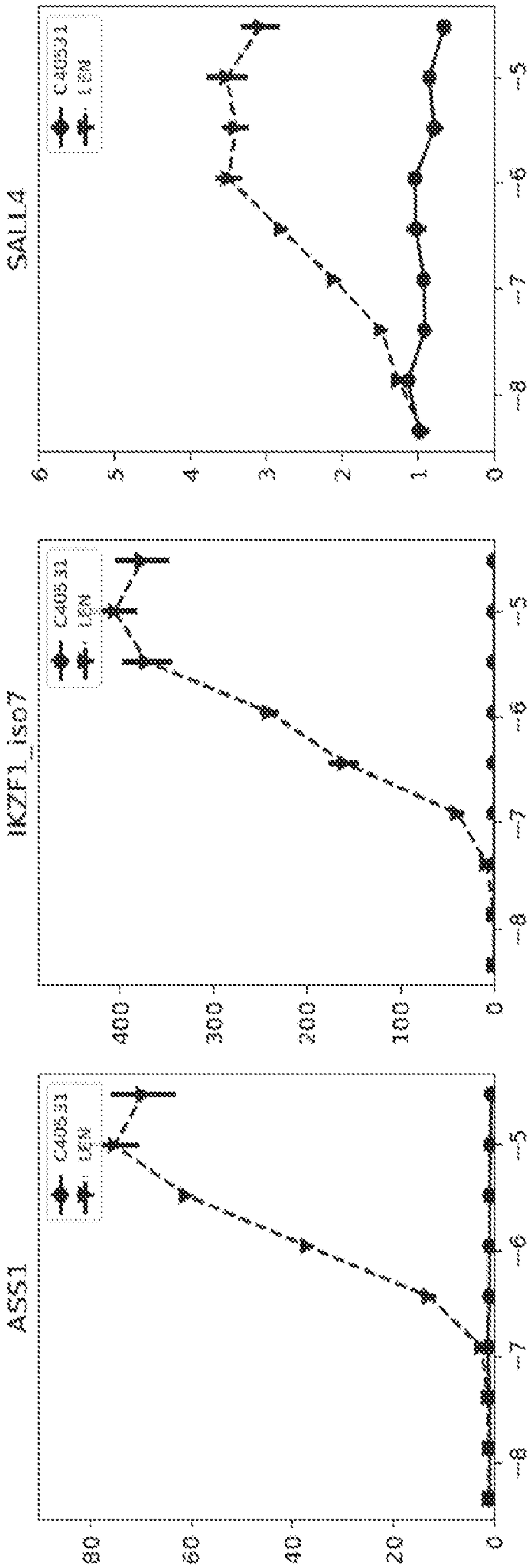

SALL4
IKZF1_iso7
ASS1
C4053 3
LEM
0
1
2
3
4
5
6
7
8
0
100
200
300
400
0
20
40
60
80

FIG. 129

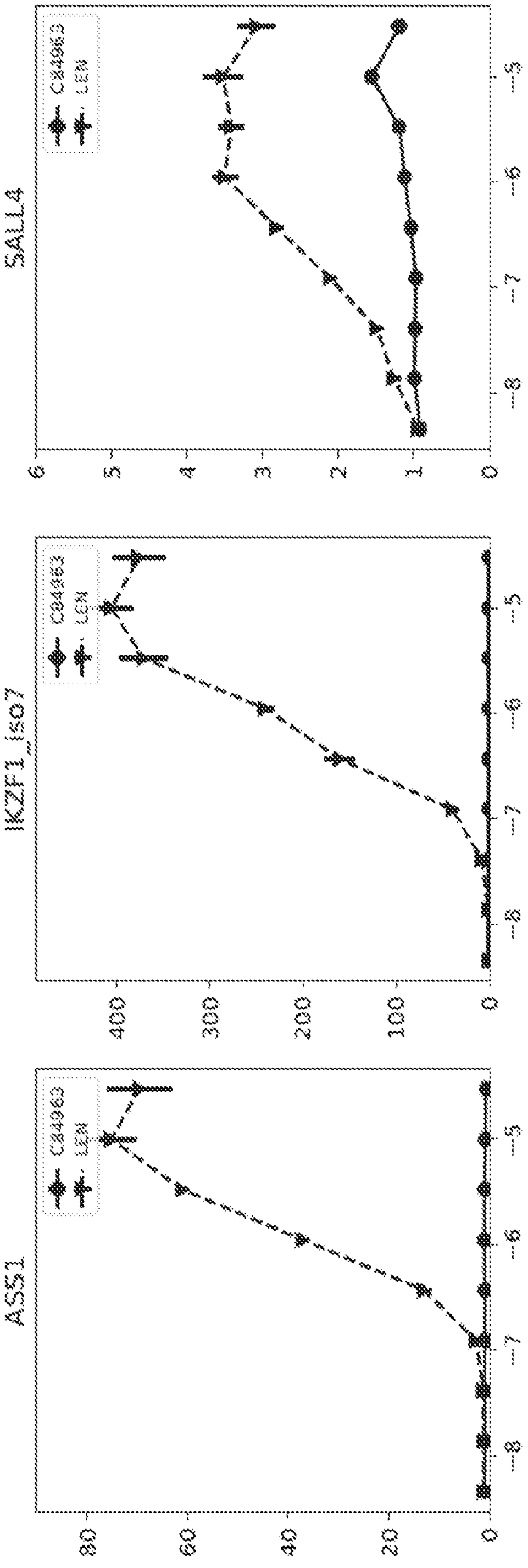

SALL4
IKZF1_iso7
ASS1
C84963
LEN
-5
-6
-7
-8
0
2
3
4
5
6
0
100
200
300
400
0
20
40
60
80

FIG. 130

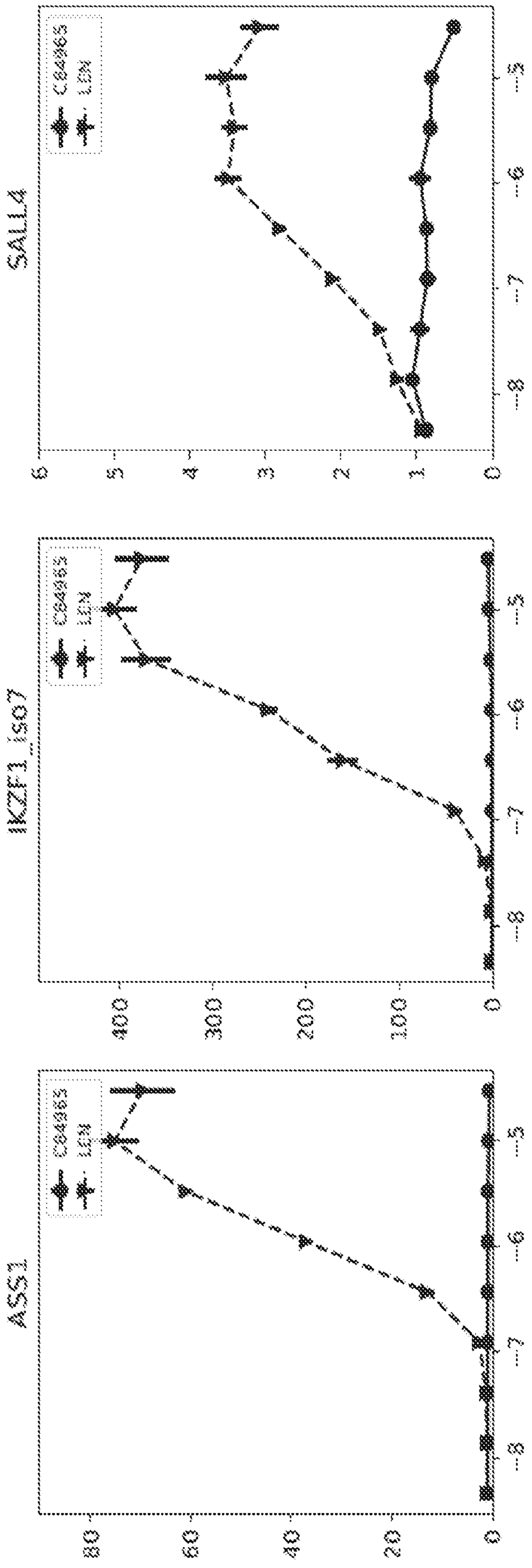

SALL4
IKZF1_iso7
ASS1
CB4363
KIT
5
6
7
8
0
1
2
3
4
5
6
7
8
0
100
200
300
400
0
20
40
60
80

FIG. 131

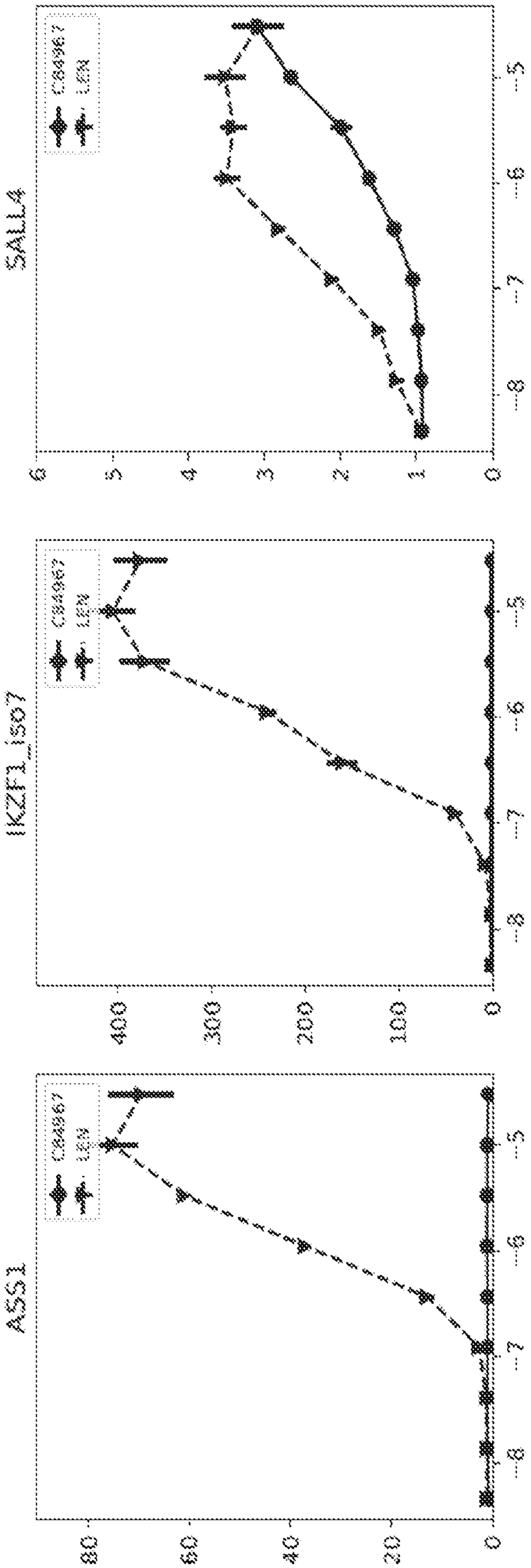

SALL4
IKZF3_iso7
ASS1
CB4856
LSJ1
0
100
200
300
400
0
20
40
60
80
0
1
2
3
4
5
6
3
4
5
6
7
8

FIG. 132

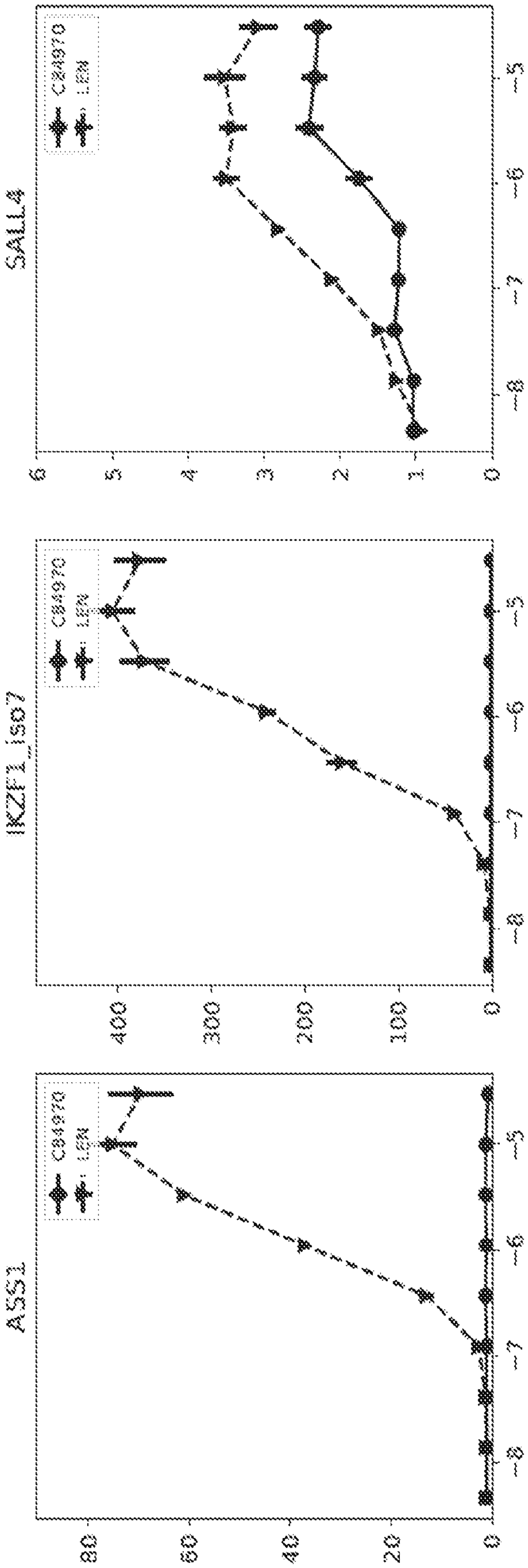

SALL4
IKZF1_iso7
AS51
CB4970
LEN
0
1
2
3
4
5
6
100
200
300
400
0
20
40
60
80
−8
−7
−6
−5

FIG. 133

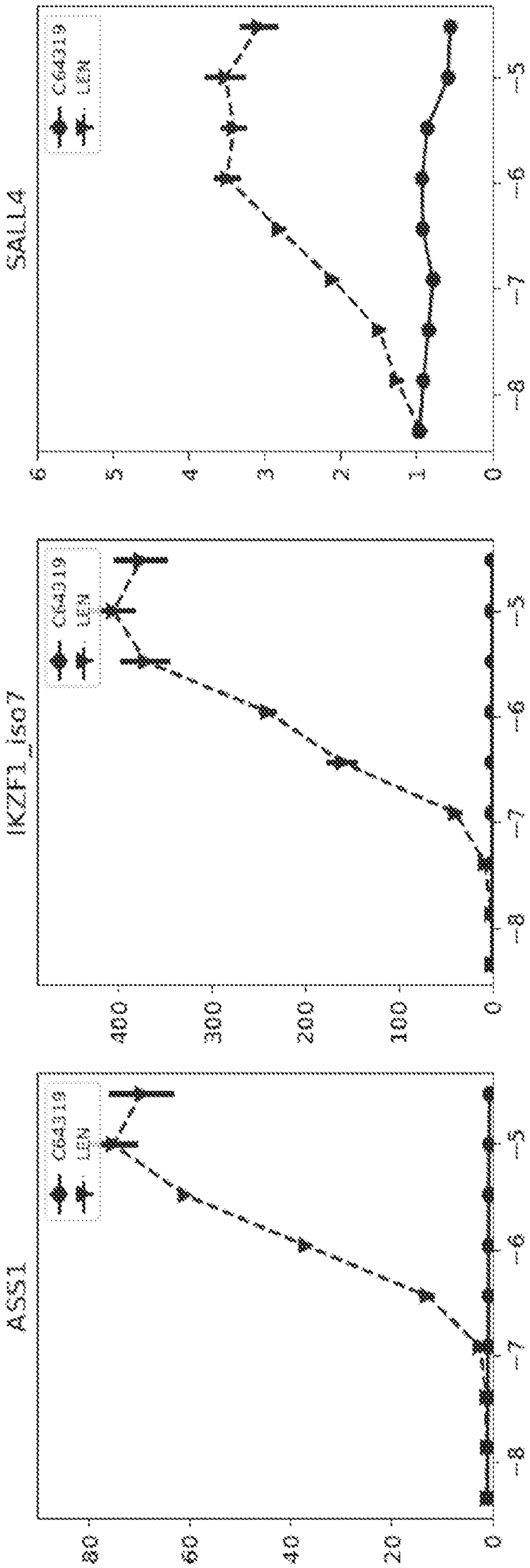


FIG. 134

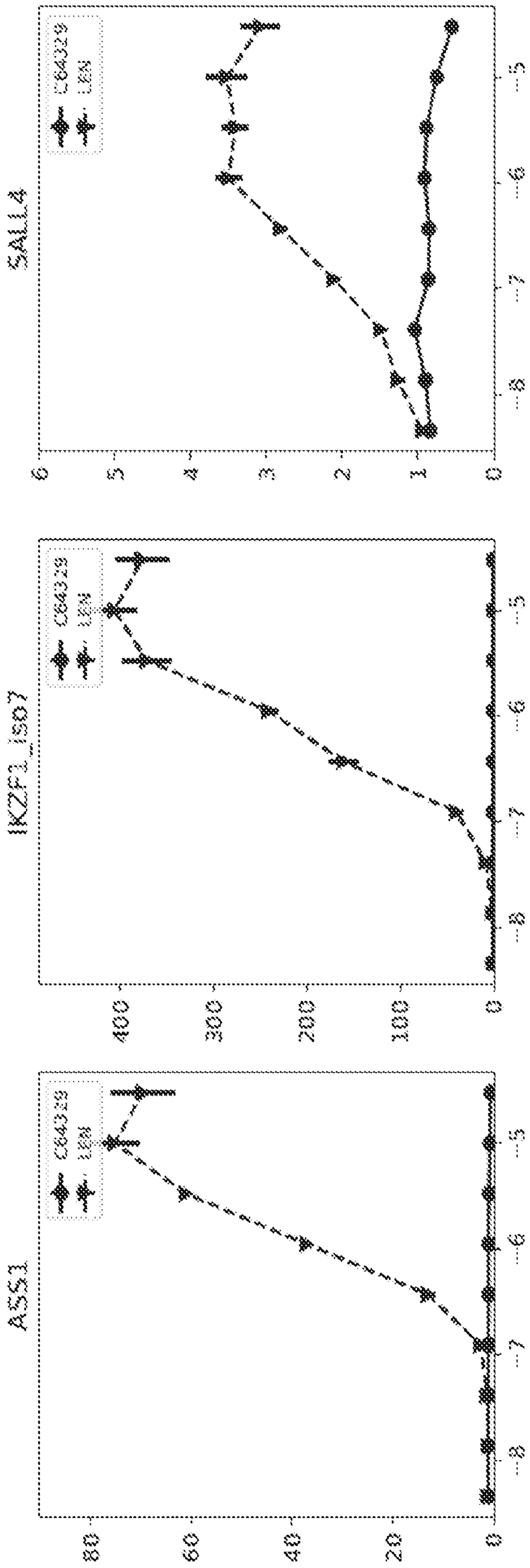

SALL4
IKZF3_isoB7
ASS3
C64329
LEN
0
1000
2000
3000
4000
0
20
40
60
80
-5
-6
-7
-8

FIG. 135

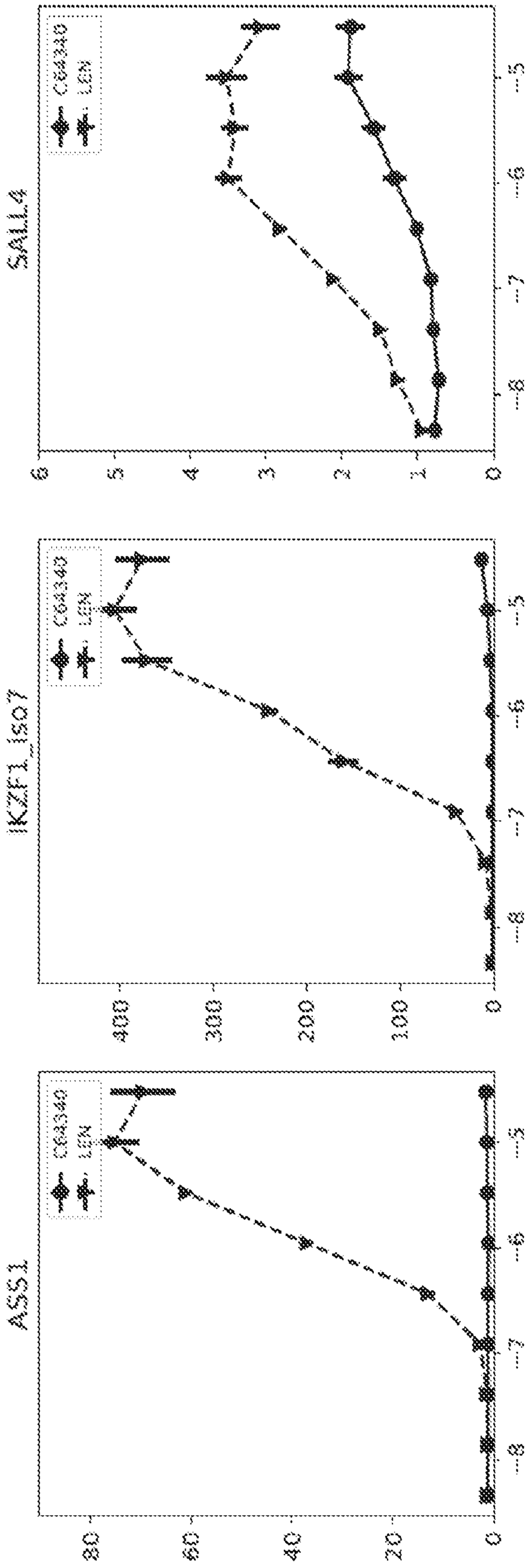

SALL4
C64340
LEN
0
1
2
3
4
5
6
7
8
IKZF1_isoT
C64340
LEN
0
100
200
300
400
5
6
7
8
ASS1
C64340
LEN
0
20
40
60
80
5
6
7
8

FIG. 136

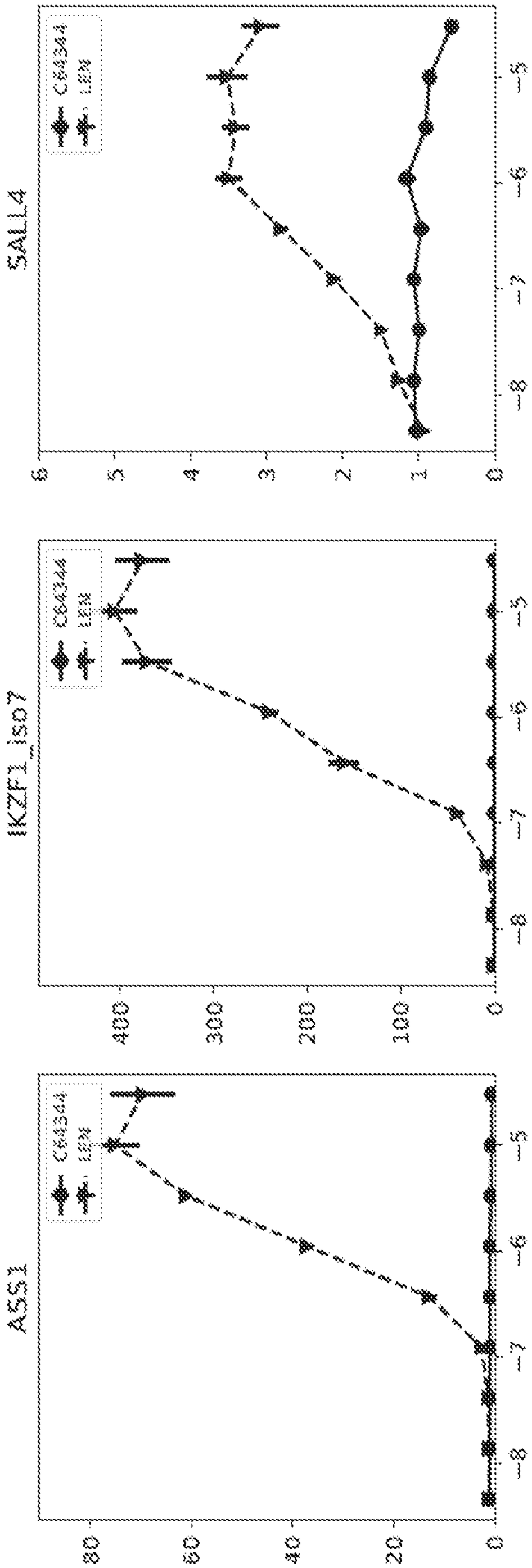

SALL4
IKZF1_iso7
ASS1
C64344
LEM
-5
-6
-7
-8
0
1
2
3
4
5
6
100
200
300
400
20
40
60
80

FIG. 137

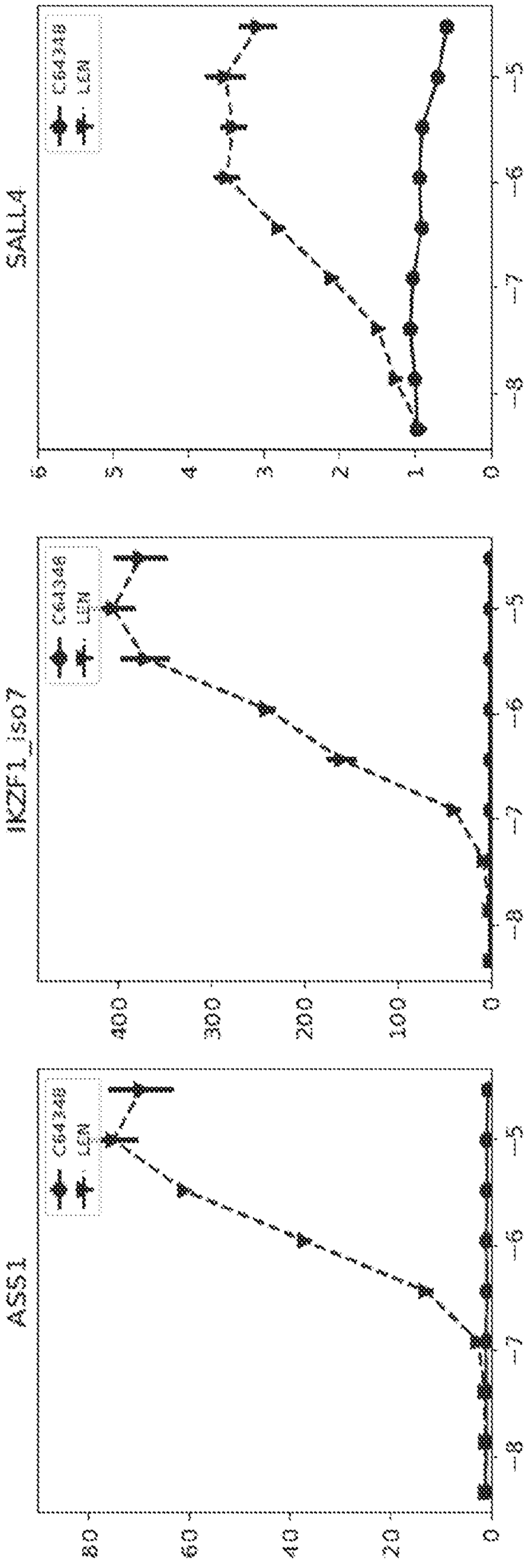


FIG. 138

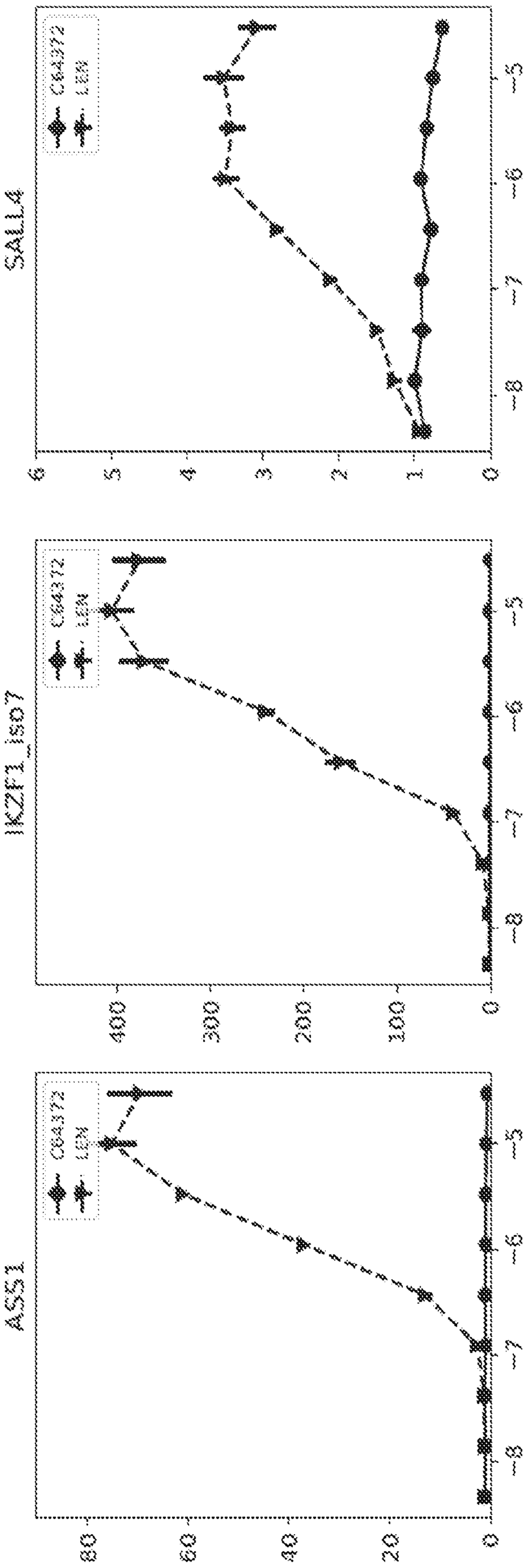

SALL4
IKZF1_iso7
AS531
C643372
LEN
0
1
2
3
4
5
6
7
8
100
200
300
400
0
20
40
60
80
~3
~6
~7
~8

FIG. 139

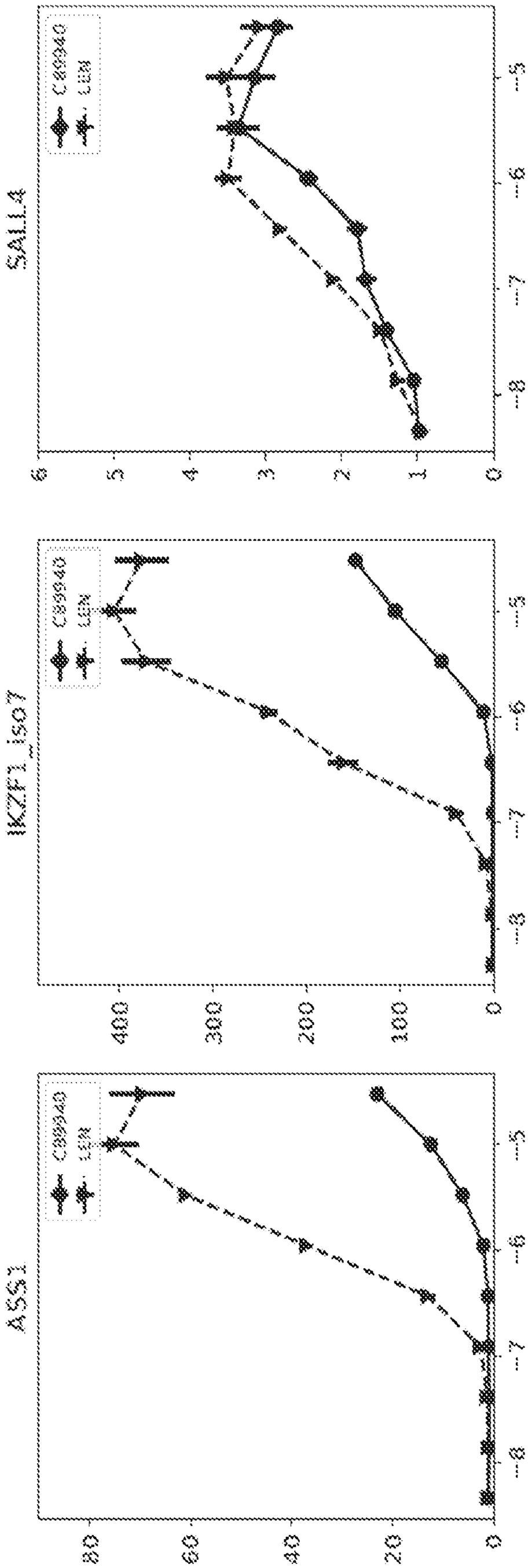

SALL4
IKZF1_iso7
ASS1
CB9940
Ctrl
-3
-6
-7
-8
0
1
2
3
4
5
6
100
200
300
400
20
40
60
80

FIG. 14O

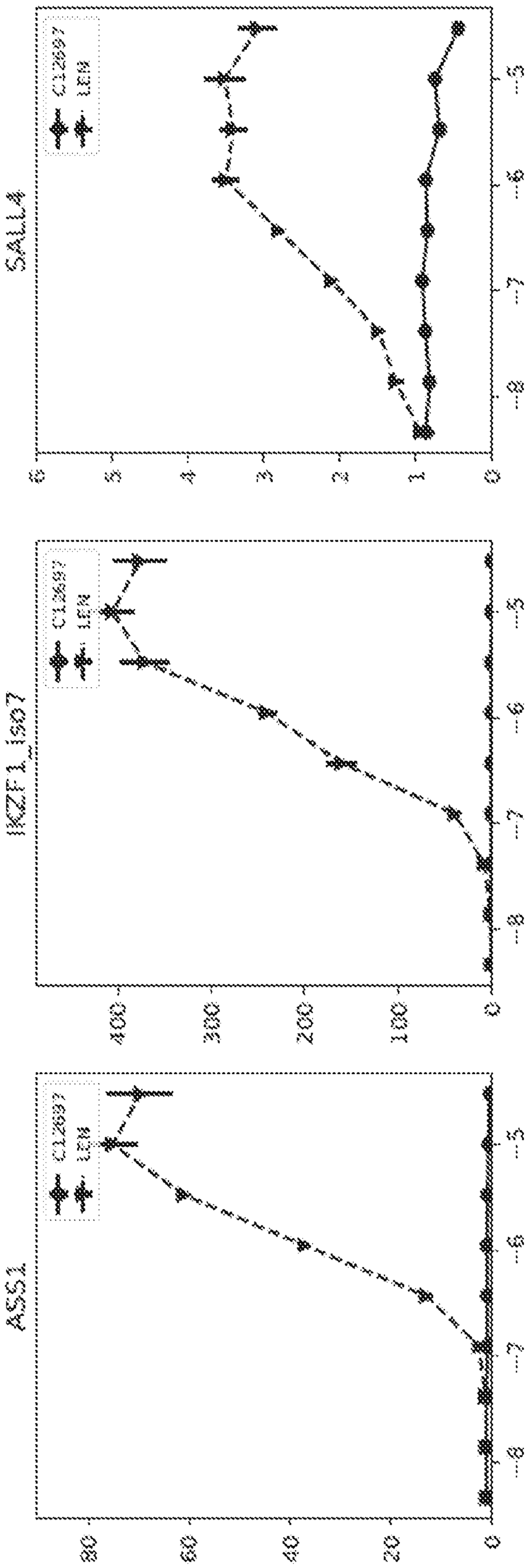


FIG. 141

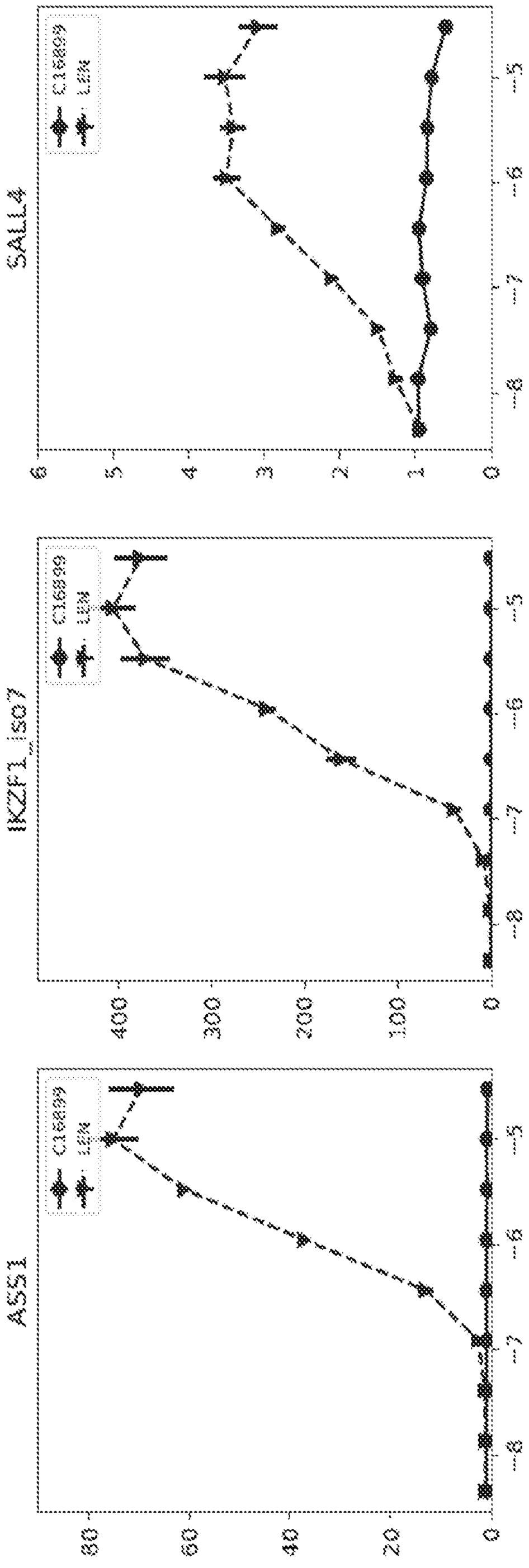

SALL4
IKZF1_iso7
AS51
C16899
LEN
0
1
2
3
4
5
6
-5
-6
-7
-8
100
200
300
400
20
40
60
80

FIG. 142

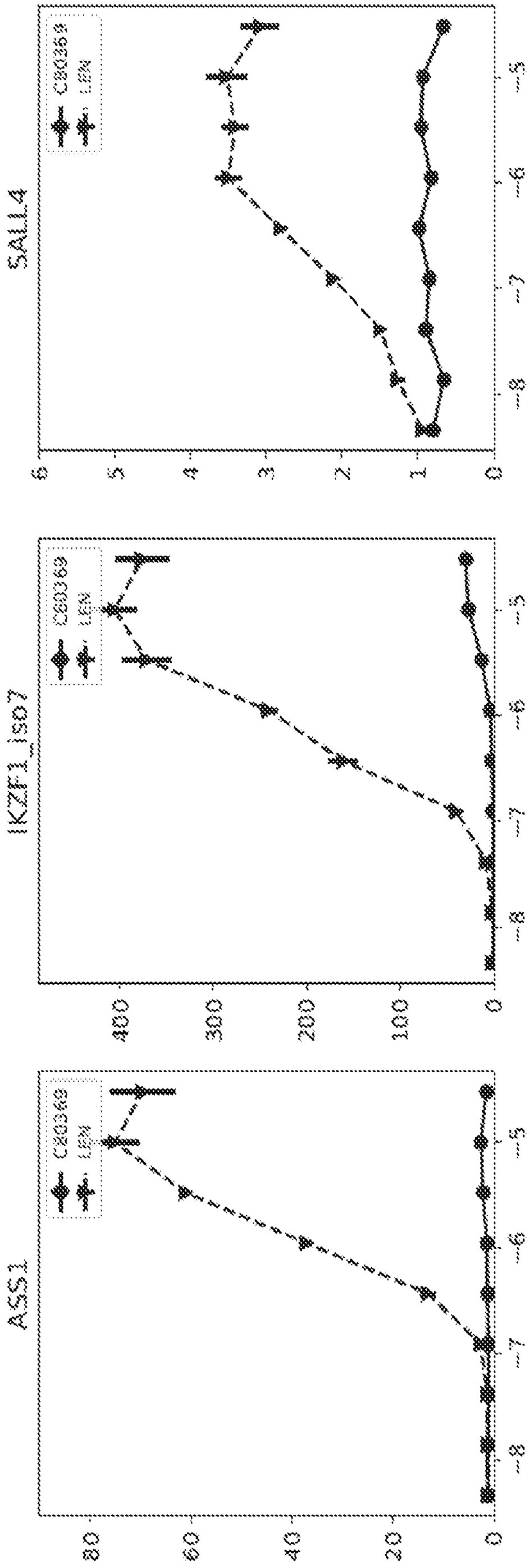

SALL4
C80369
LEN
0
1
2
3
4
5
6
-5
-6
-7
-8
IKZF1_iso7
C80369
LEN
0
100
200
300
400
-5
-6
-7
-8
ASS1
C80369
LEN
0
20
40
60
80
-5
-6
-7
-8

FIG. 143

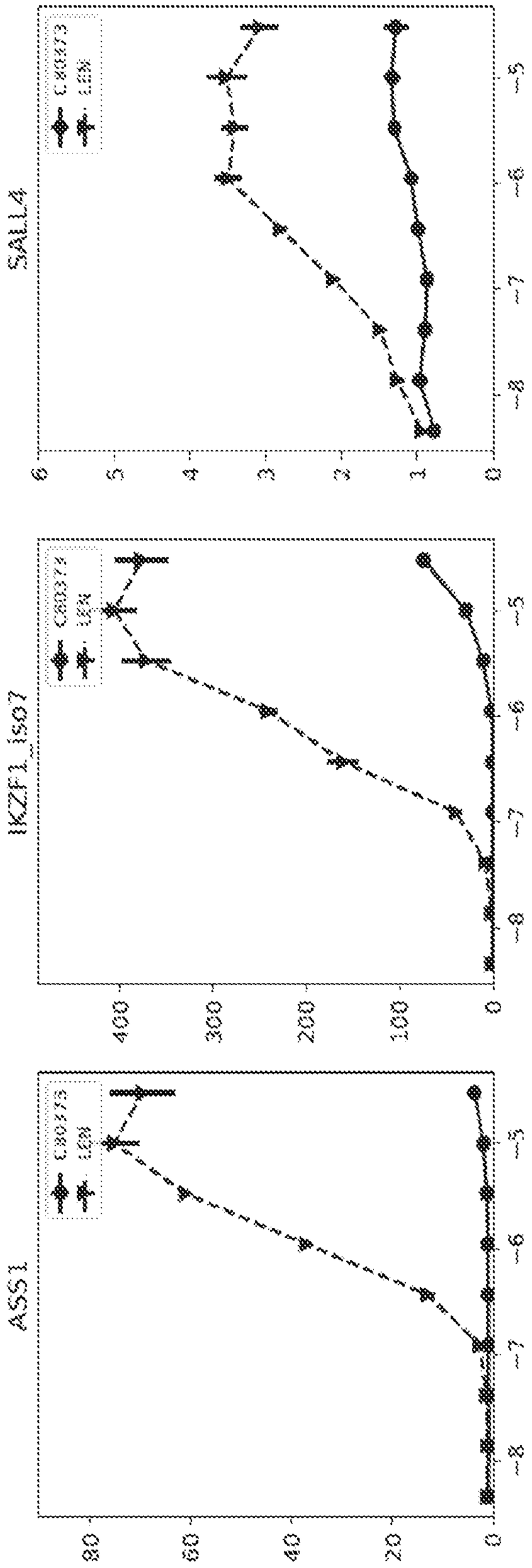


FIG. 144

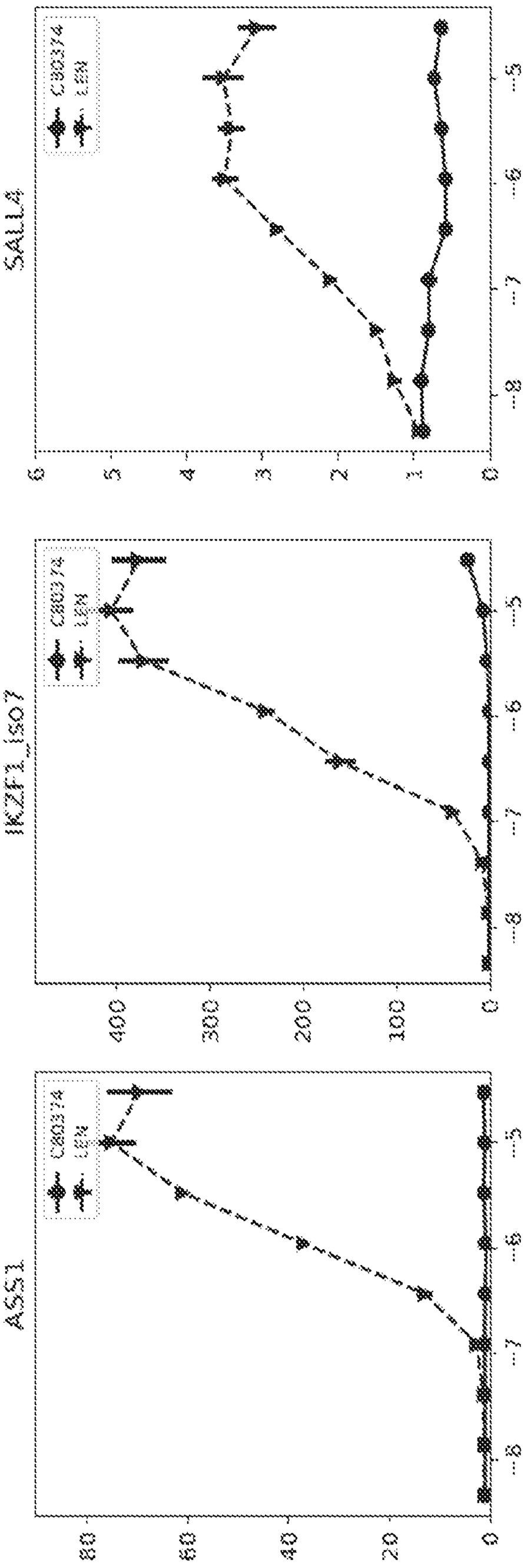


FIG. 145

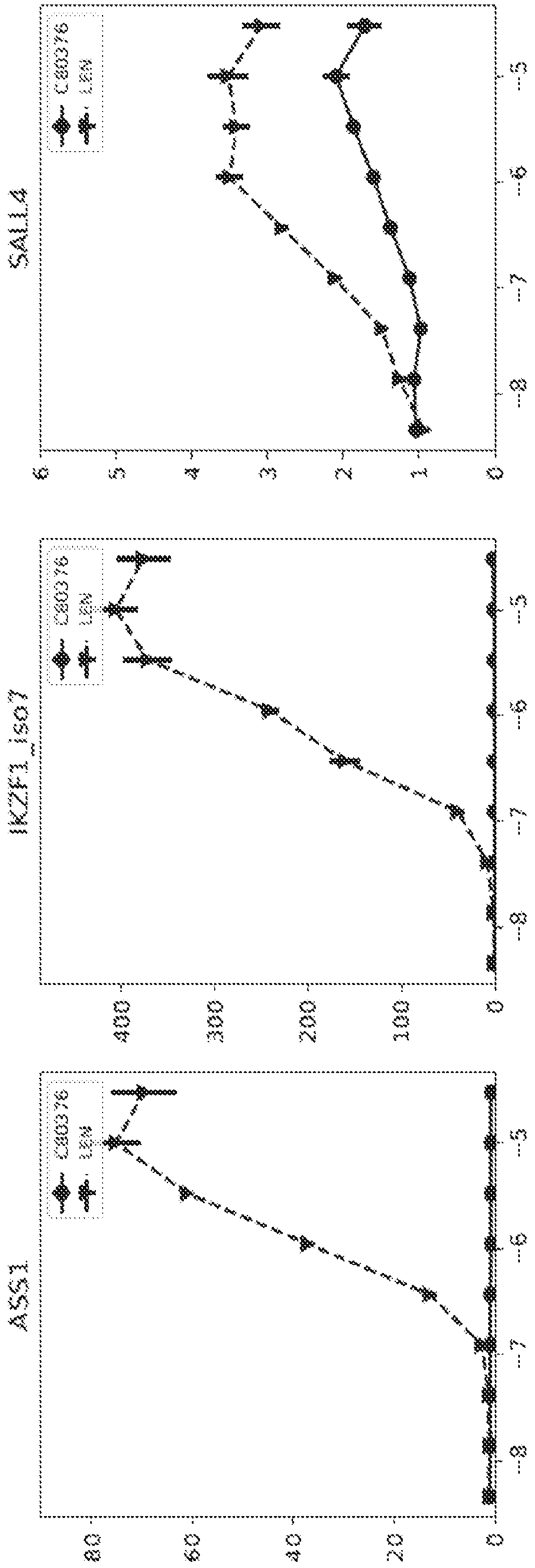

SALL4
IKZF1_iso1
ASS1
C80376
LEN
0
100
200
300
400
0
20
40
60
80
2
3
4
5
6
7
8

FIG. 146

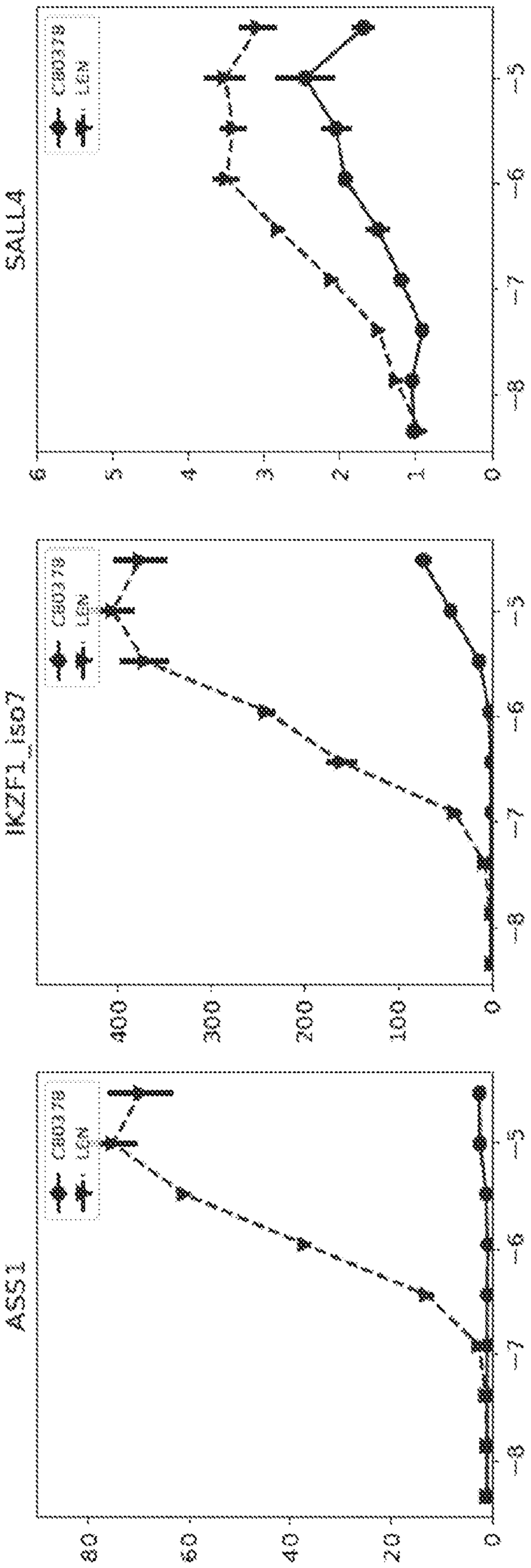

SALL4
IKZF1_iso7
ASS1
CB038.78
LGK
0
100
200
300
400
0
1
2
3
4
5
6
-5
-6
-7
-8

FIG. 147

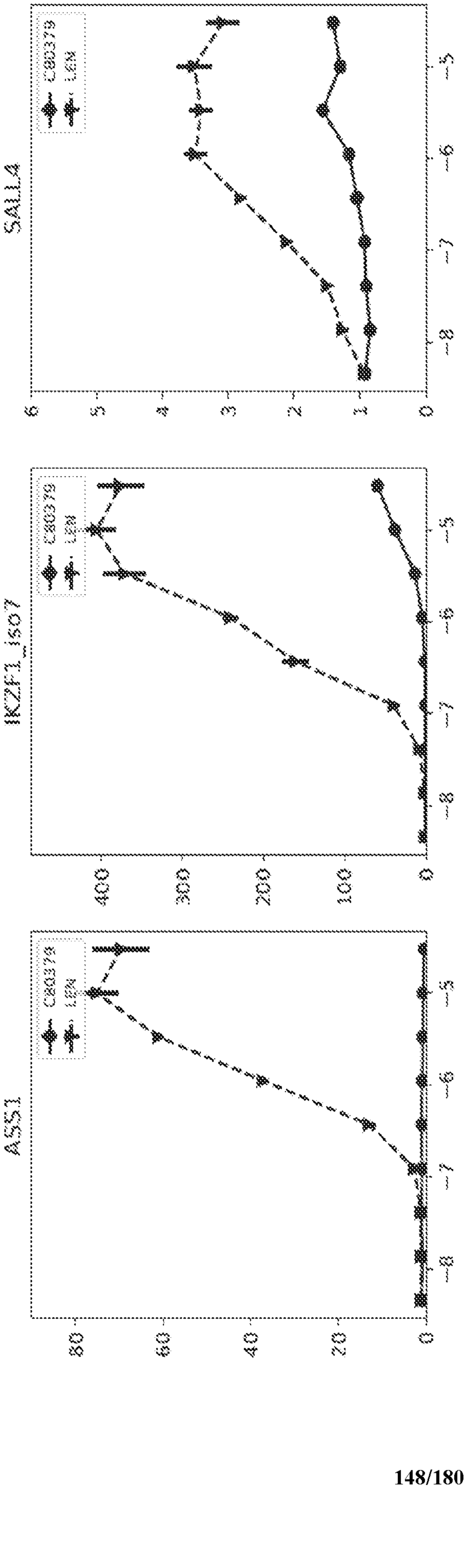

SALL4
IKZF1_iso7
A553T
CB0379
LEM
0
100
200
300
400
60
40
20
0
-2
-3
-5
-6
-7
-8

FIG. 148

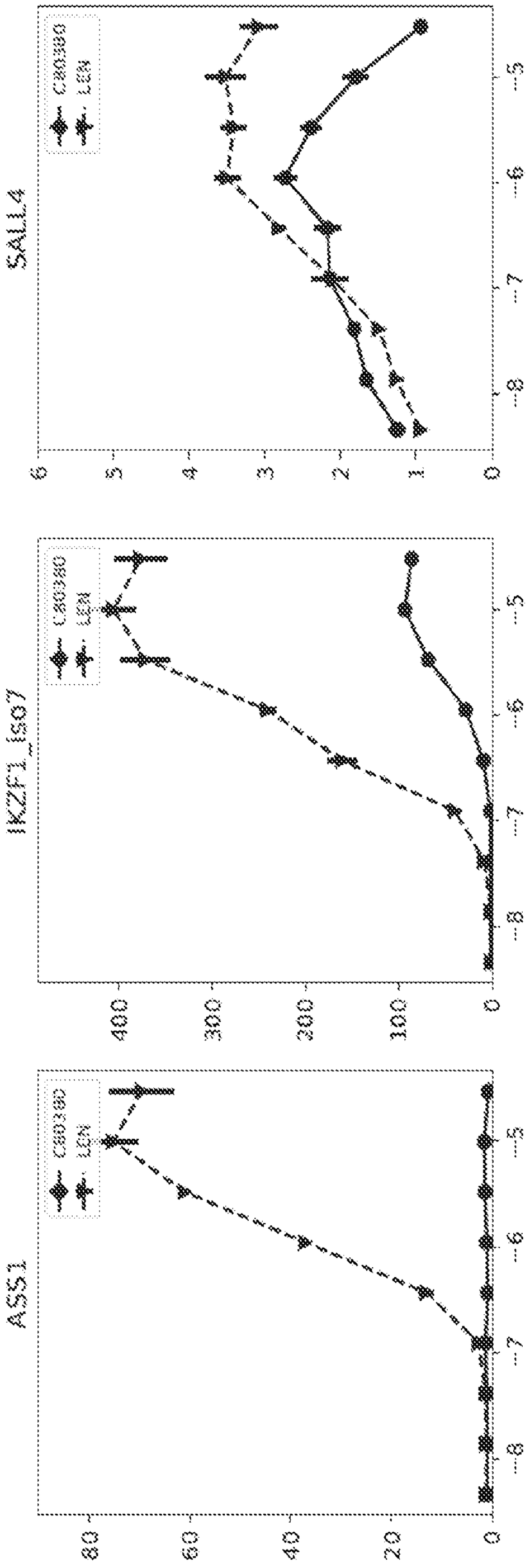

SALL4
IKZF1_ISO7
ASS1
CB03380
LEN
0
1
2
3
4
5
6
7
8
100
200
300
400
20
40
60
80

FIG. 149

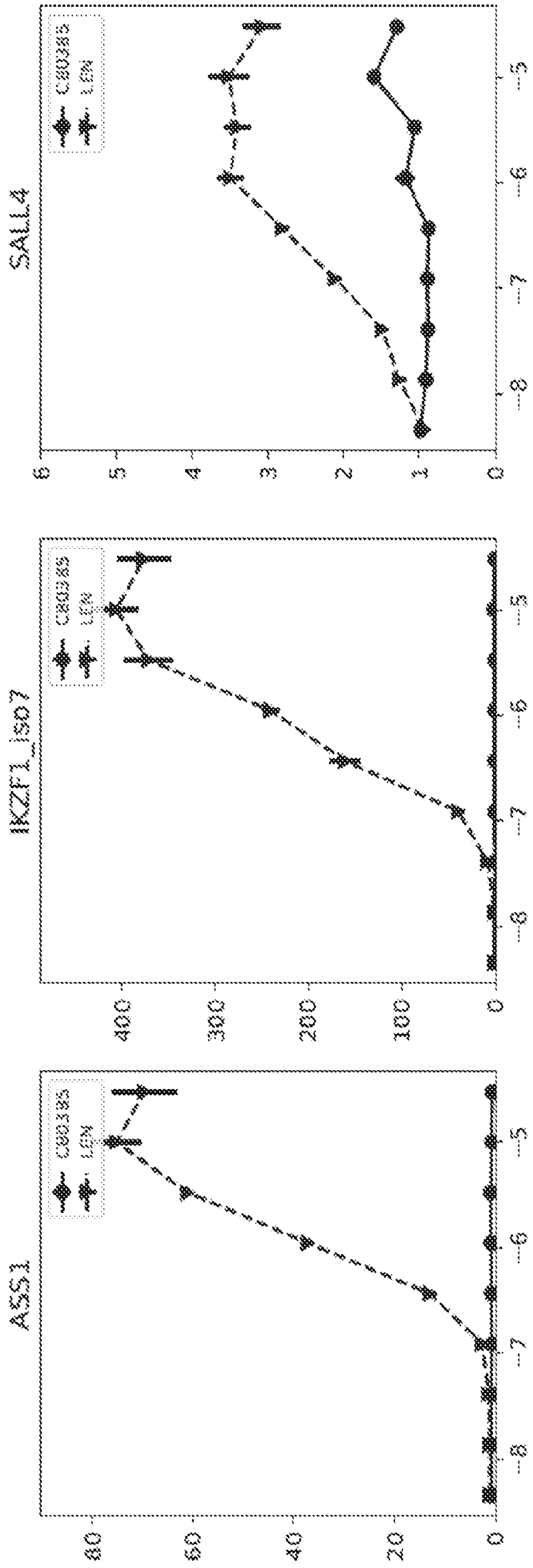

SALL4
IKZF1_isoT
ASS1
CB03385
LEM
0
100
200
300
400
0
20
40
60
80
3
4
5
6
7
8

FIG. 150

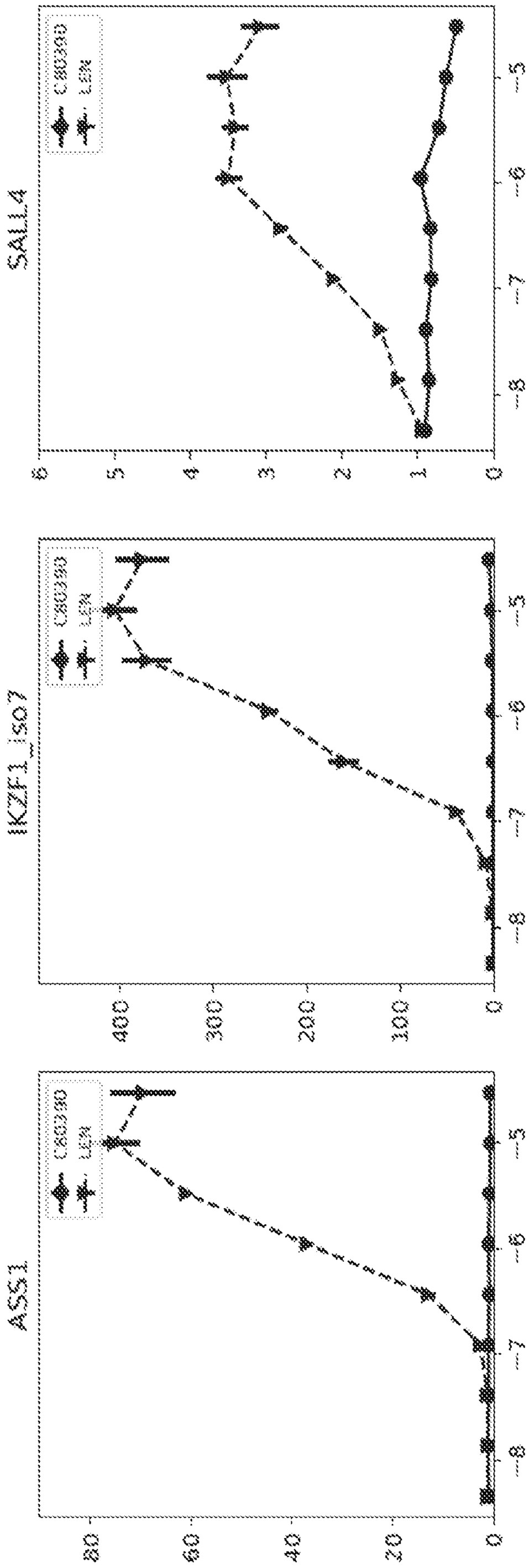

SALL4
IKZF1_iso7
ASS1
CB039-30
LEN
0
1
2
3
4
5
6
7
8
0
100
200
300
400
0
20
40
60
80

FIG. 151

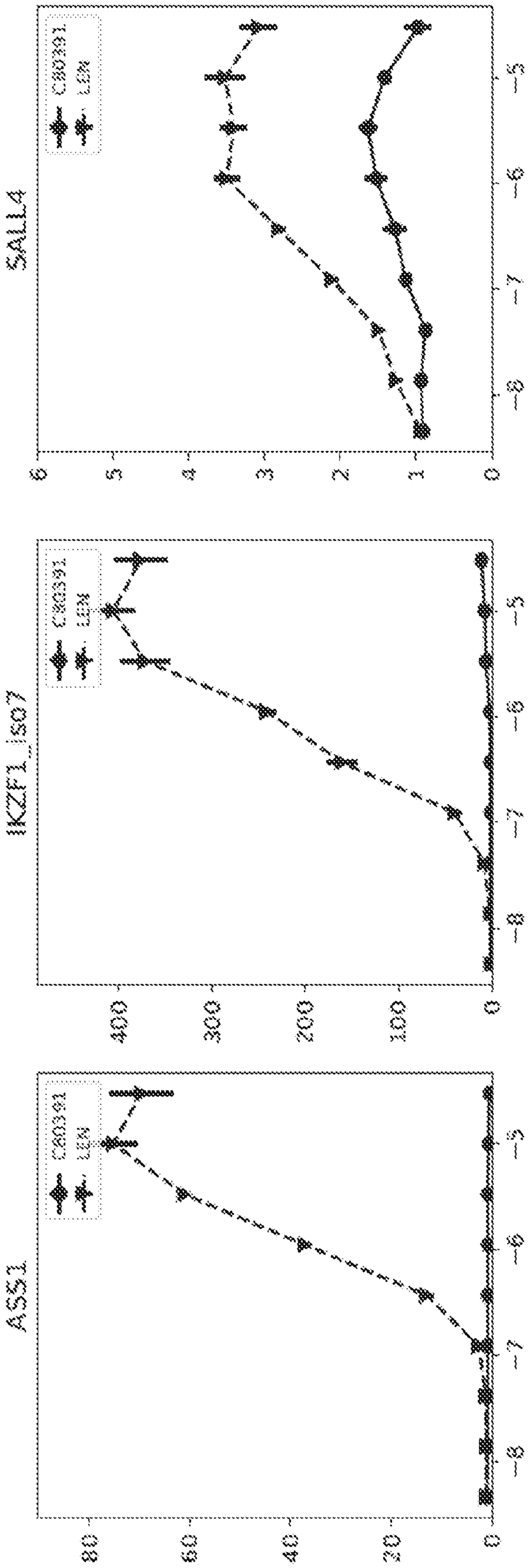

SALL4
IKZF1_iso7
ASS1
CR03391
LEN
6
5
4
3
2
1
0
-5
-6
-7
-8
400
300
200
100
0
80
60
40
20
0

FIG. 152

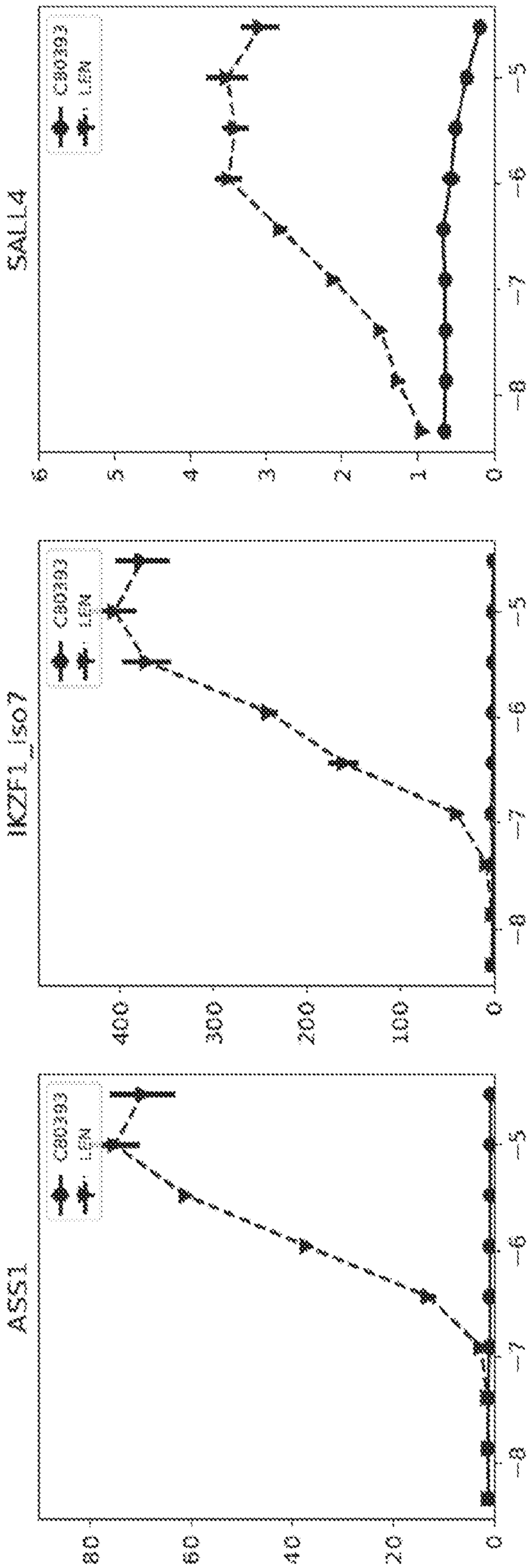

SALL4
IKZF1_iso7
ASS1
CB0283
LEM
6
5
4
3
2
1
0
400
300
200
100
80
60
40
20
7
8

FIG. 153

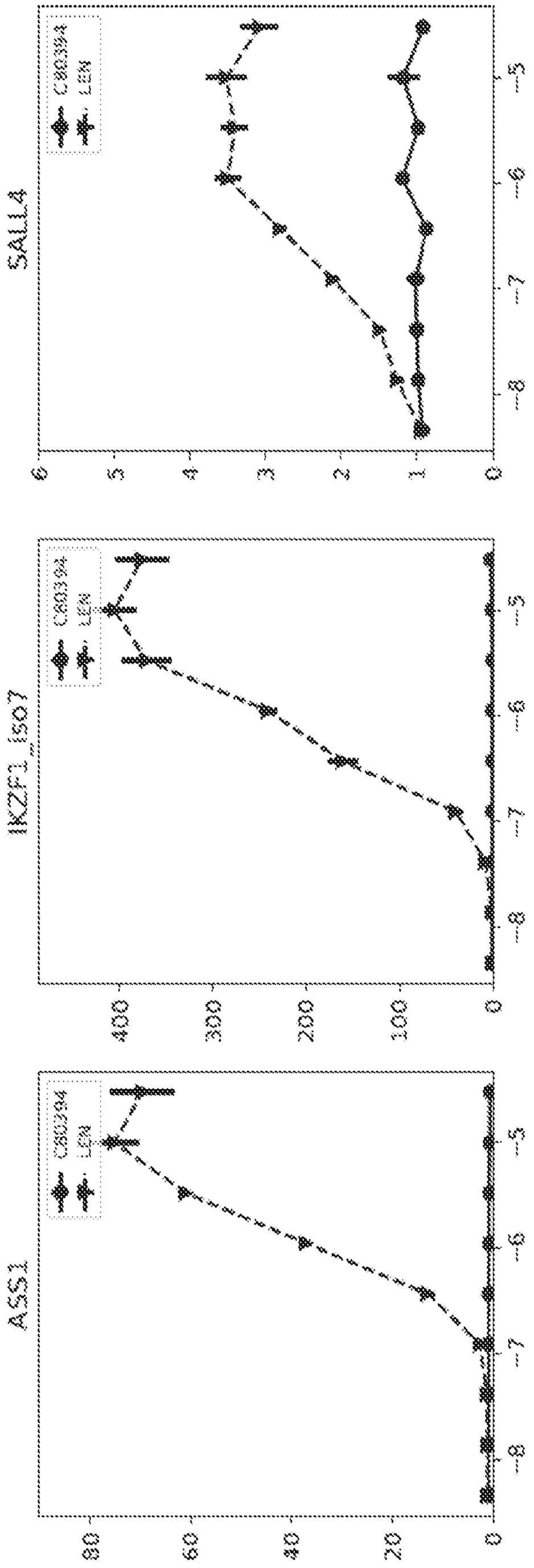

SALL4
IKZF1_iso7
ASS1
CB03394
LEM
5
6
7
8
0
1
2
3
4
100
200
300
400
20
40
60
80

FIG. 154

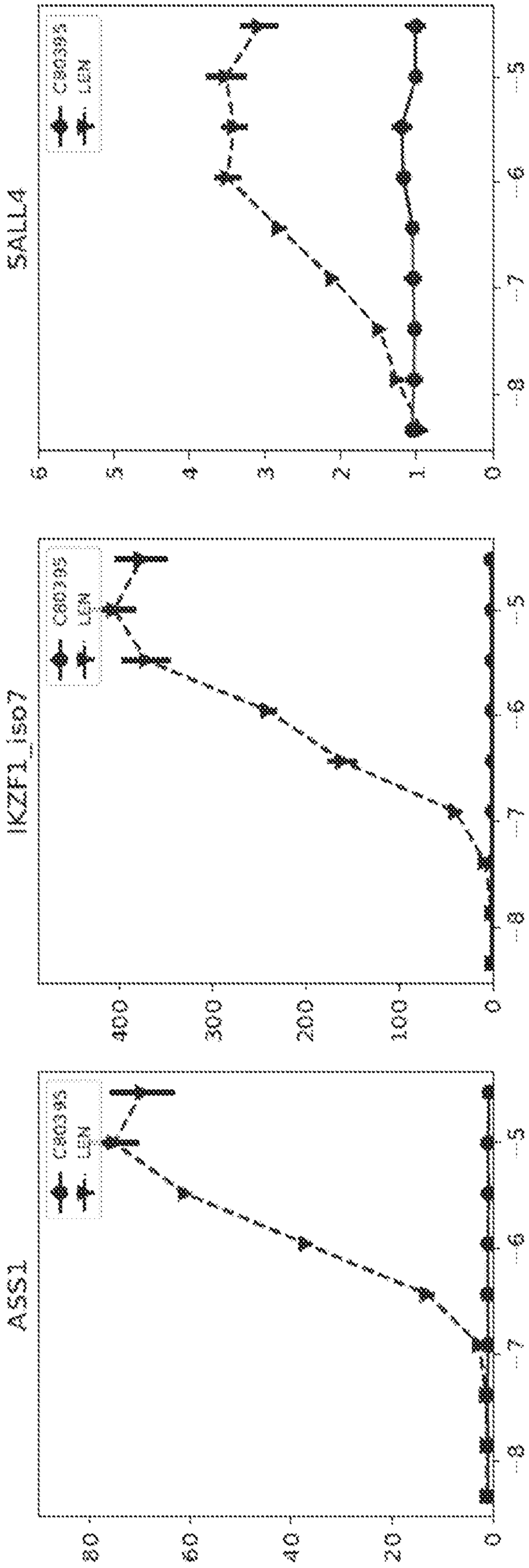


FIG. 155

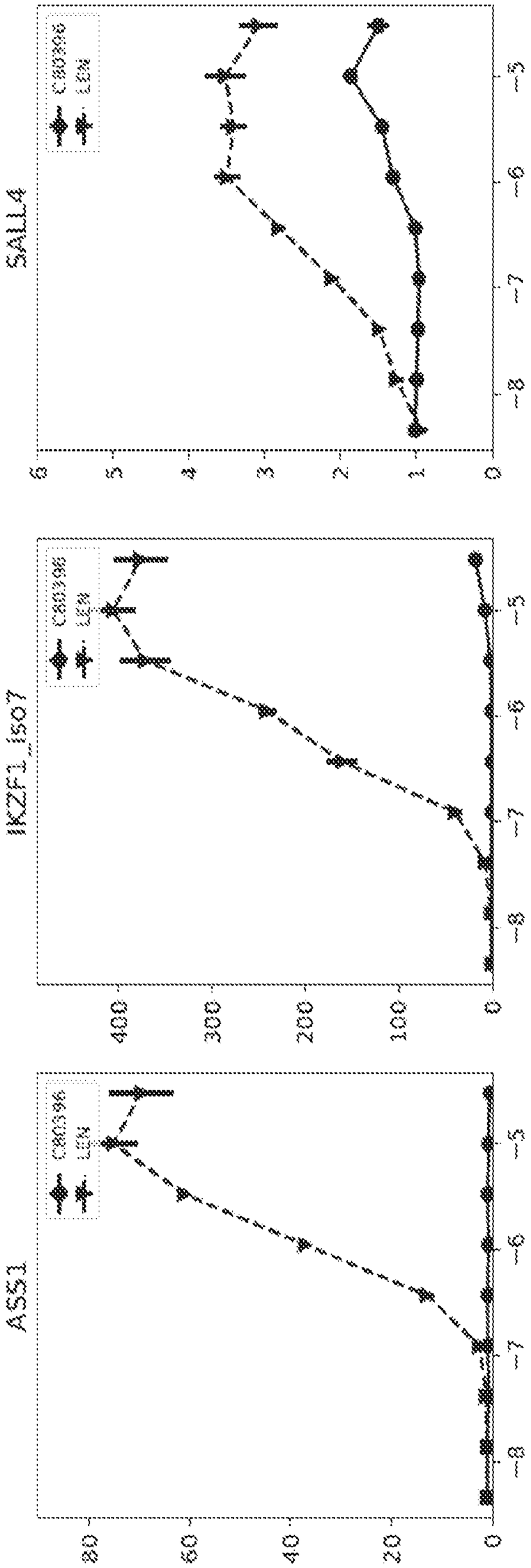

SALL4
CB0396
LEM
0
1
2
3
4
5
6
7
8
9
IKZF1_ISO7
CB0396
LEM
0
100
200
300
400
5
6
7
8
AS51
CB0396
LEM
0
20
40
60
80
5
6
7
8

FIG. 156

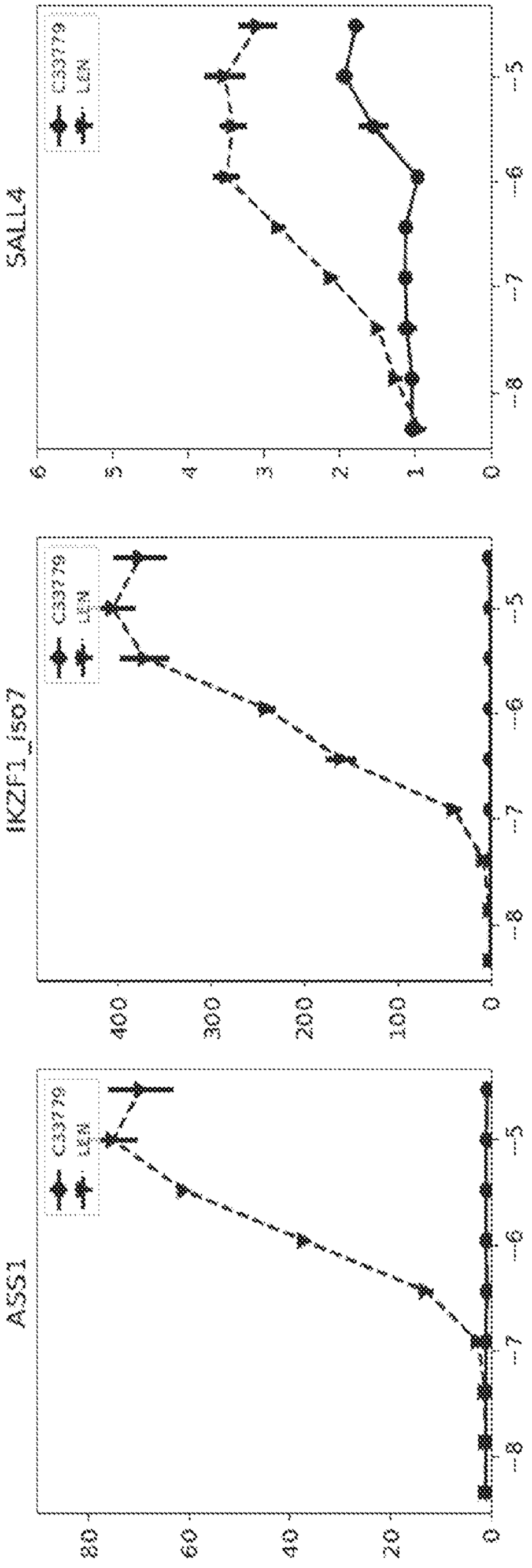
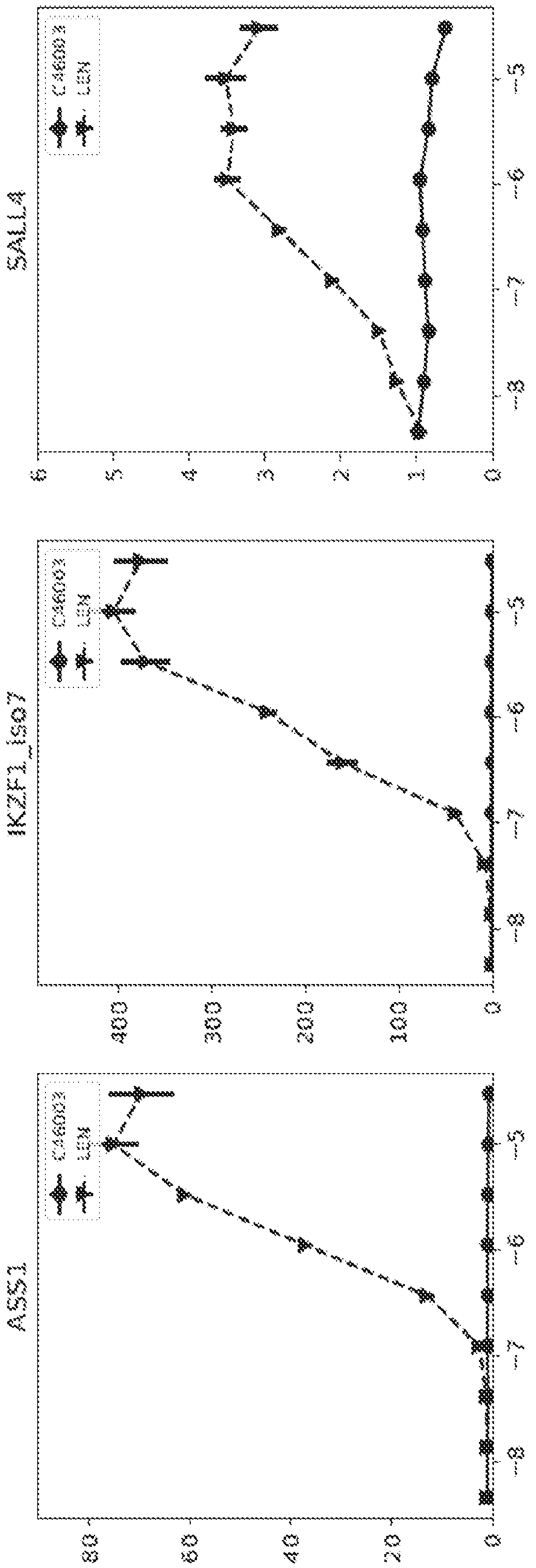

SALL4
IKZF1_iso7
ASS1
C33779
LBM
0
1
2
3
4
5
6
100
200
300
400
0
20
40
60
80
5
6
7
8

FIG. 157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ASS1
C4600X2
LEN
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2
3
4
5
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-3
-4
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-6
-7
-8
-9

FIG. 158

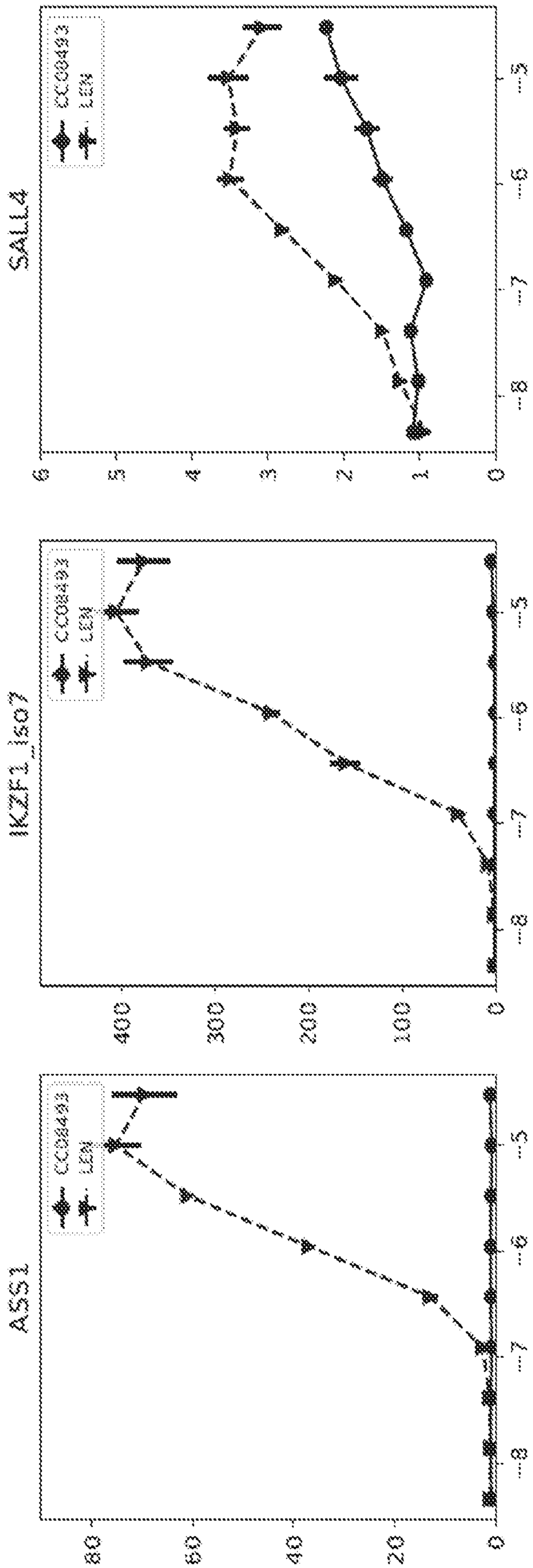
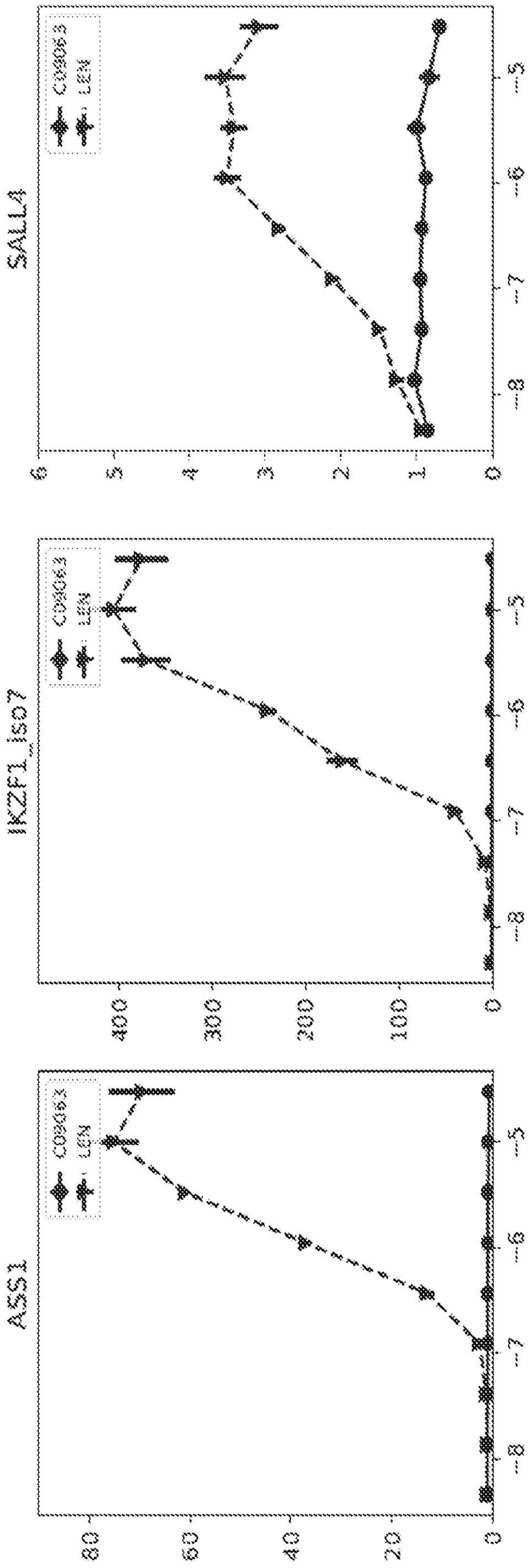


FIG. 159


SALL4
IKZF1_iso7
ASS1
COS963
LEM
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3
4
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6
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8
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300
400
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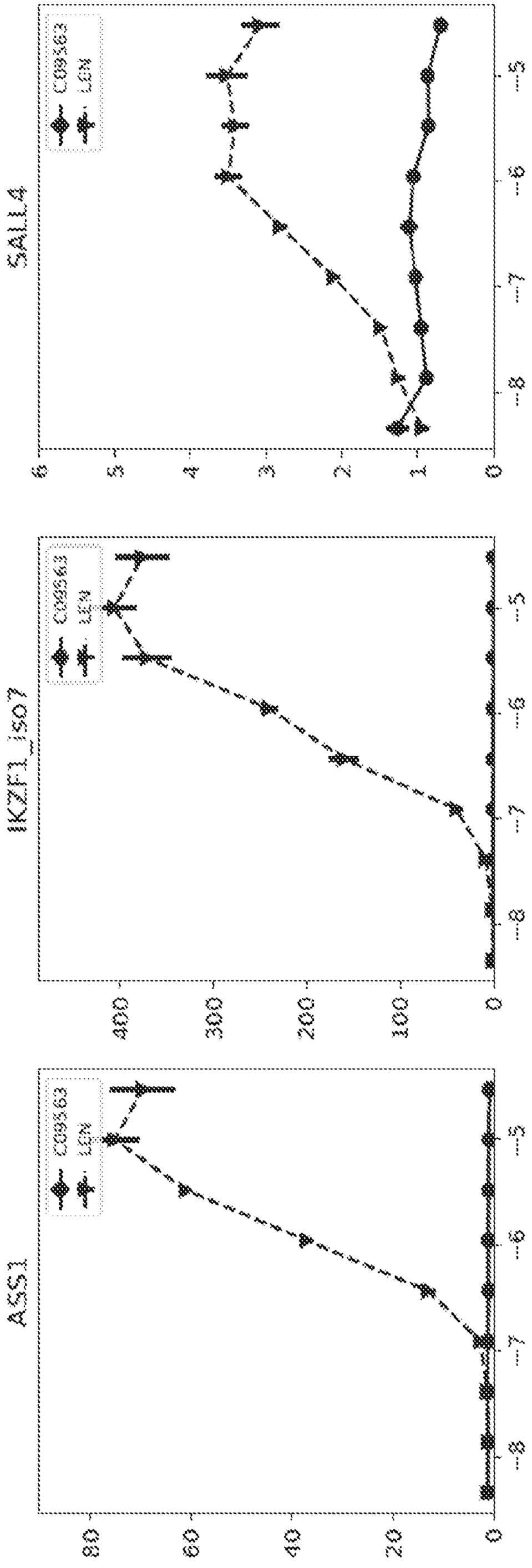
40
60
80

FIG. 160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ASS1
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4
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6
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20
40
60
80

FIG. 161

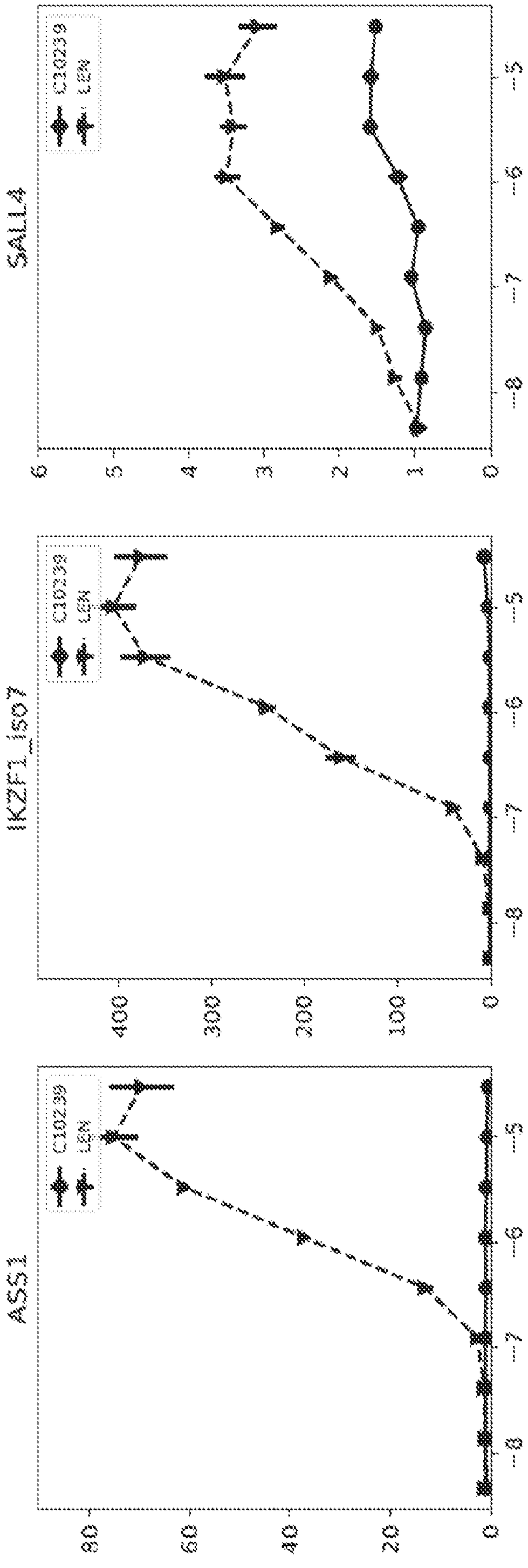
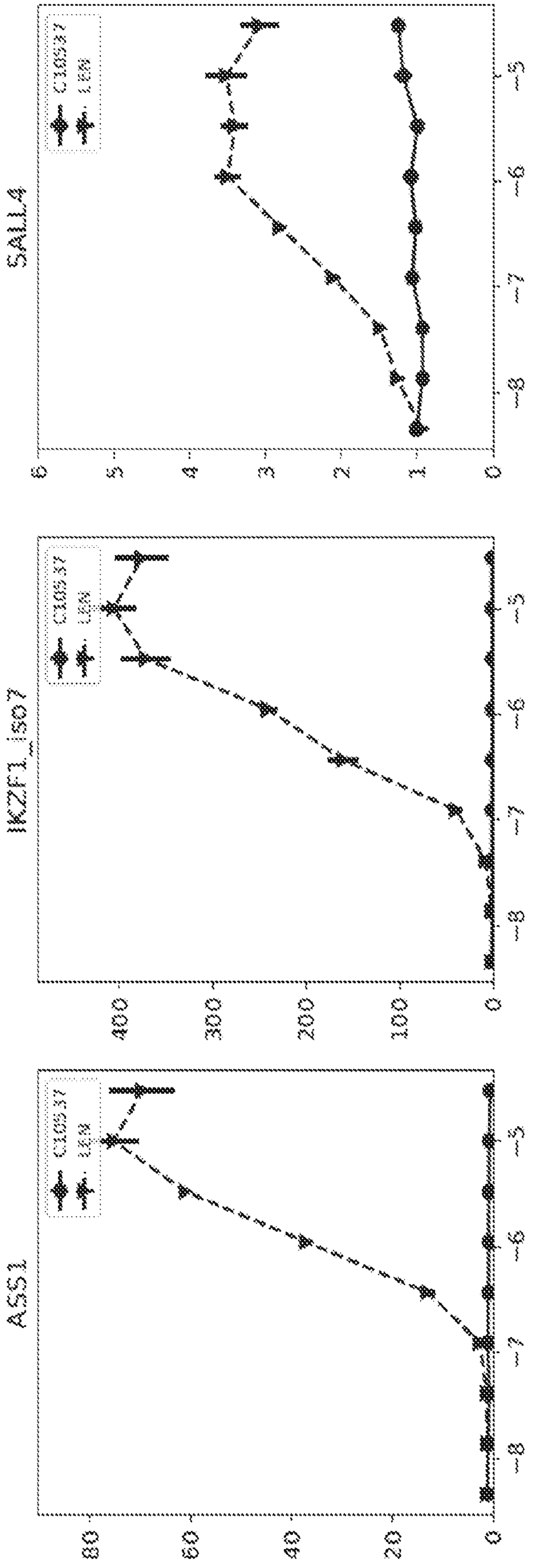


FIG. 162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ASS1
C1695.37
LK99
0
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4
5
6
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300
400
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40
60
80

FIG. 163

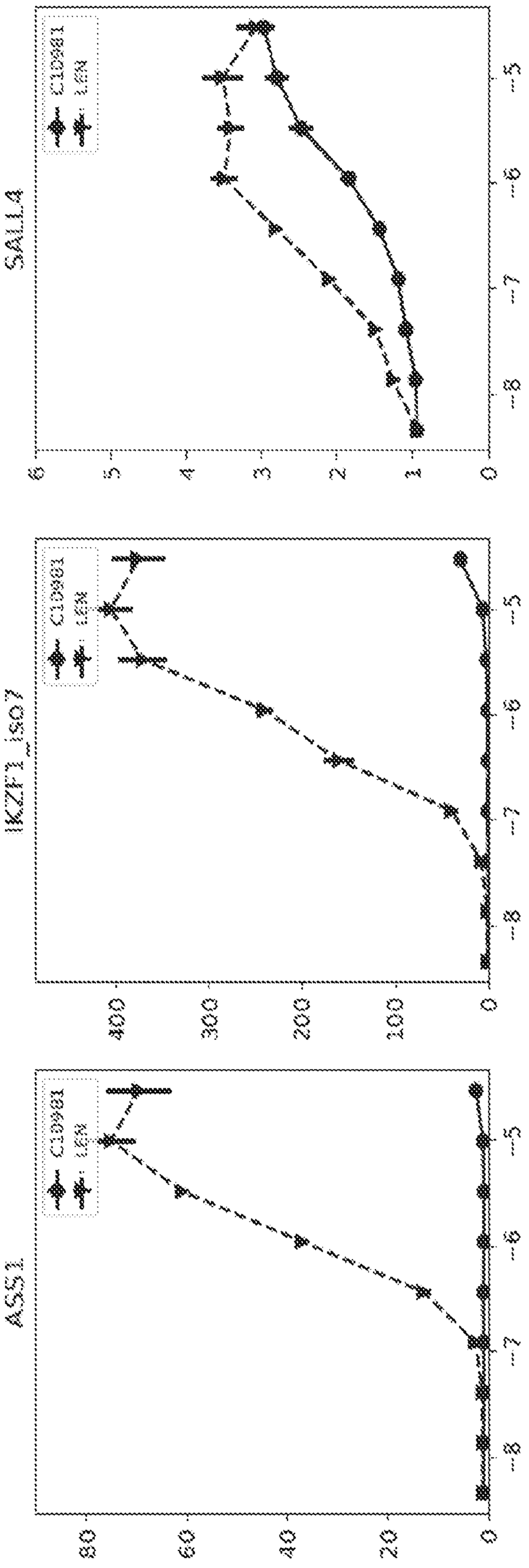
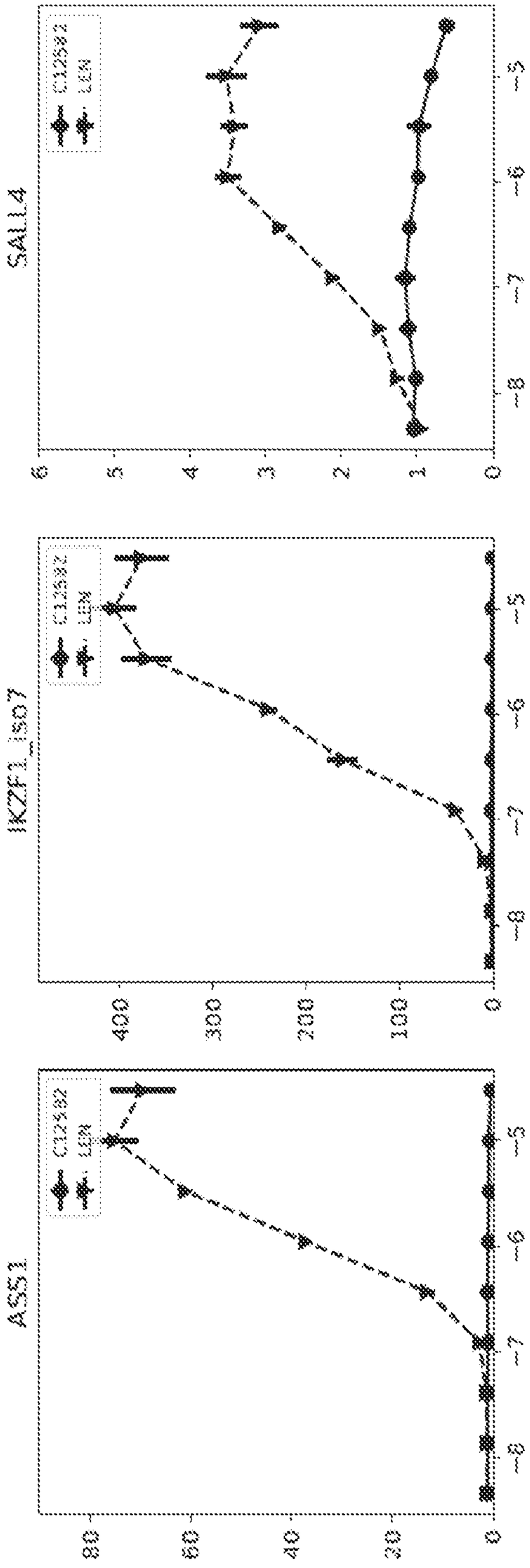


FIG. 164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C126382
LEM
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60
80

FIG. 16S

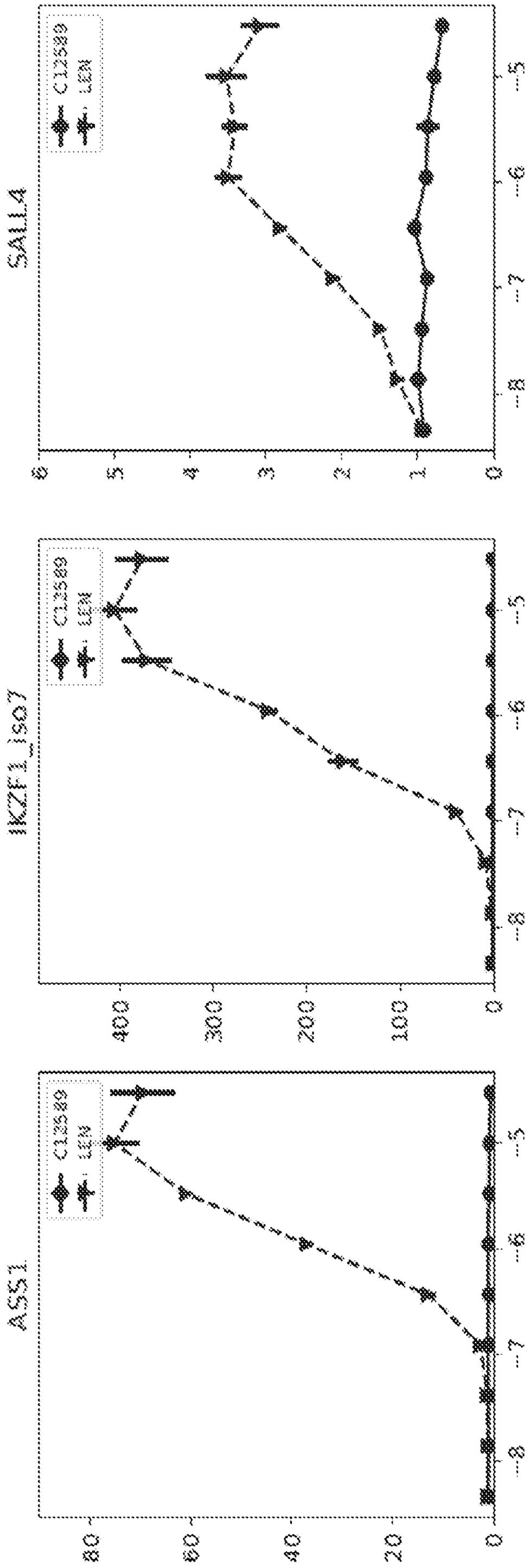
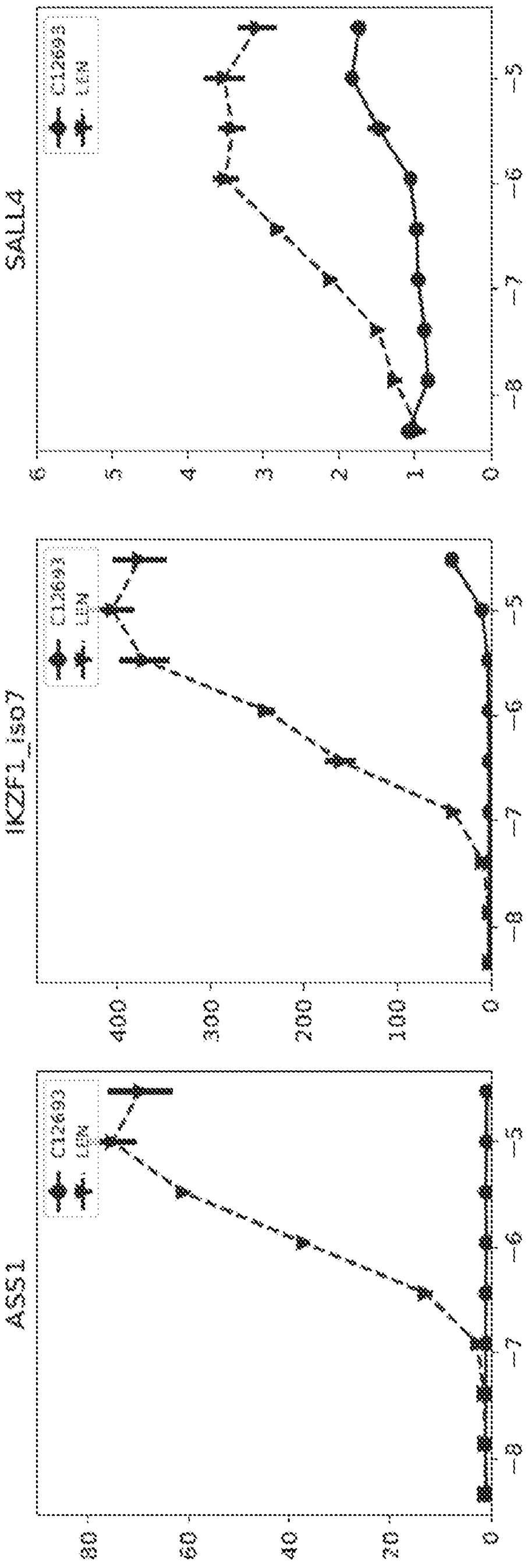


FIG. 166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4
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6
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400
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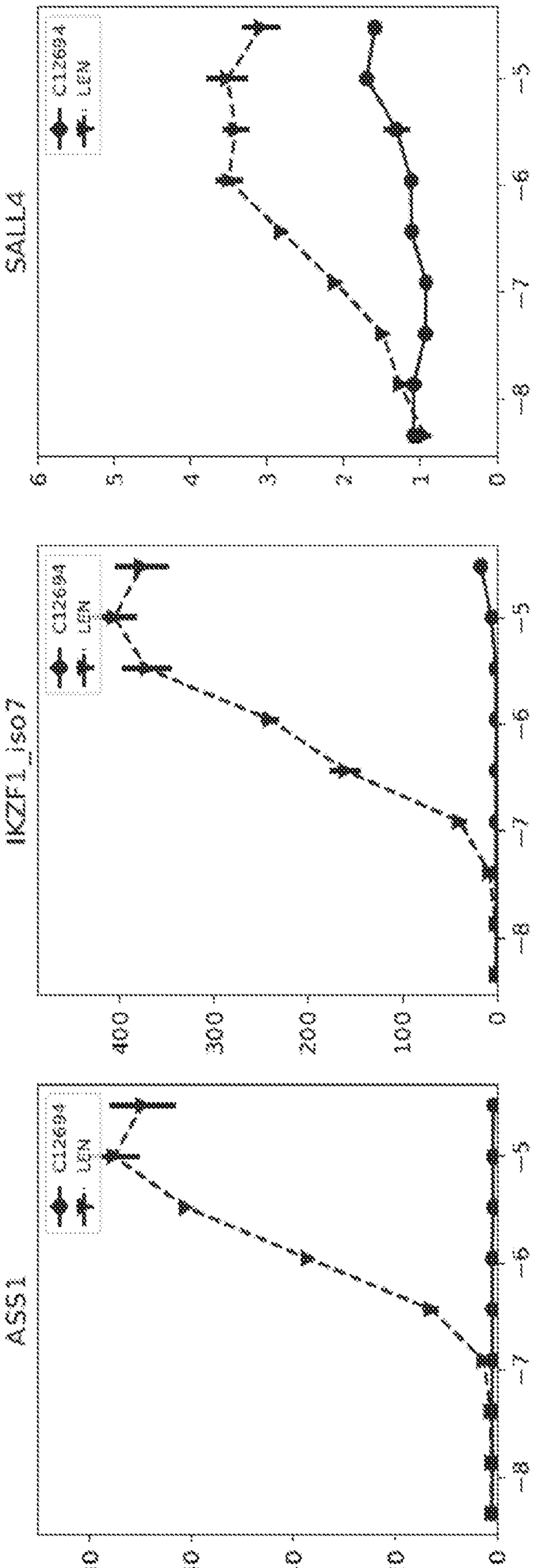
40
60
80
-8
-7
-6
-5
-4
-3
-2

FIG. 167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ASS1
C12694
LEM
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20
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-7
-8

FIG. 168

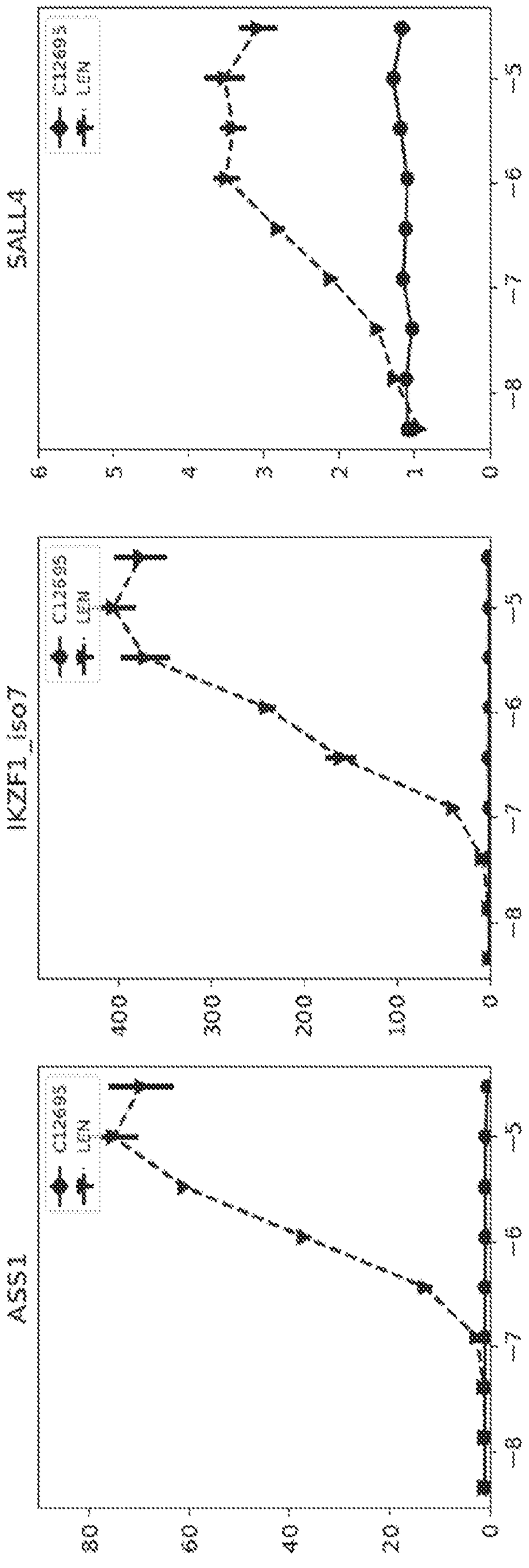
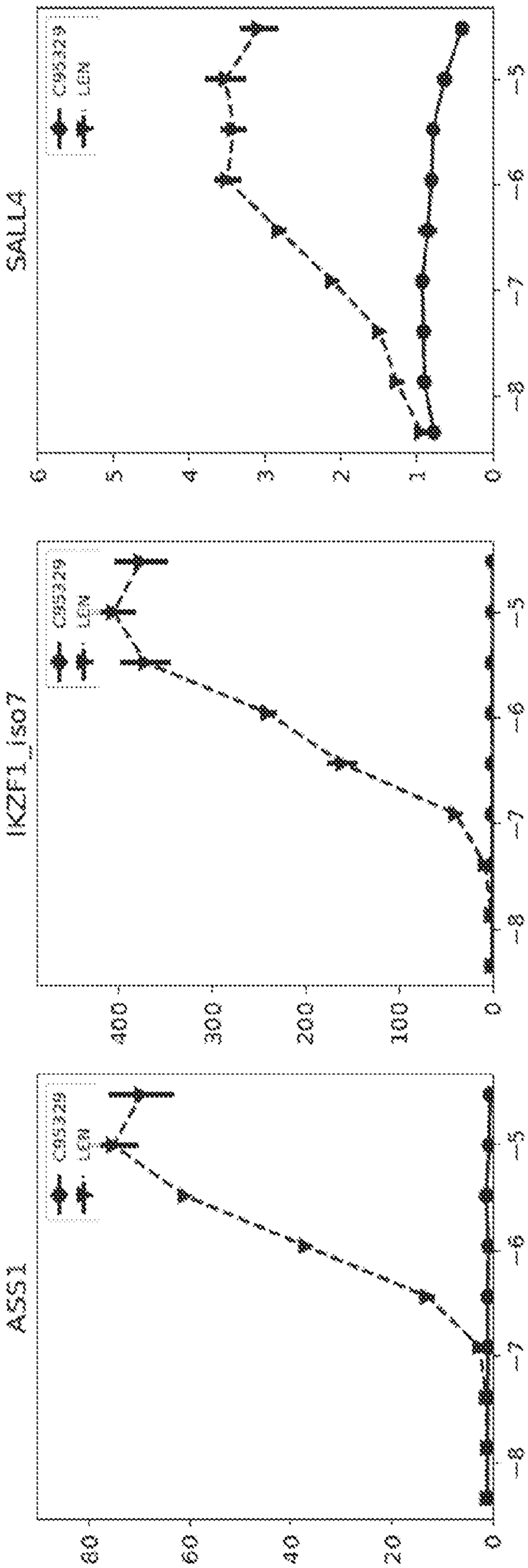


FIG. 16D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ASS1
CB5328
LGN
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60
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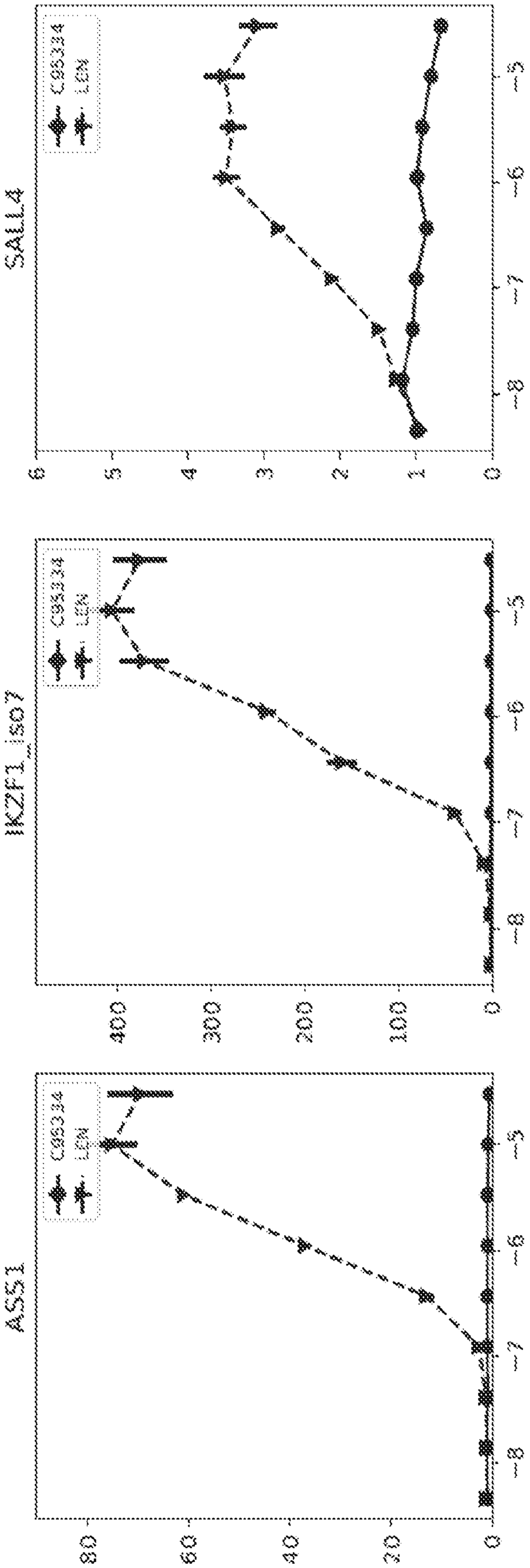
300
400

FIG. 17O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2
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5
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8
IKZF1_iso2
CS5334
LEN
0
100
200
300
400
2
3
5
6
8
ASXL1
CS5334
LEN
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20
40
60
80
2
3
5
6
8

FIG. 171

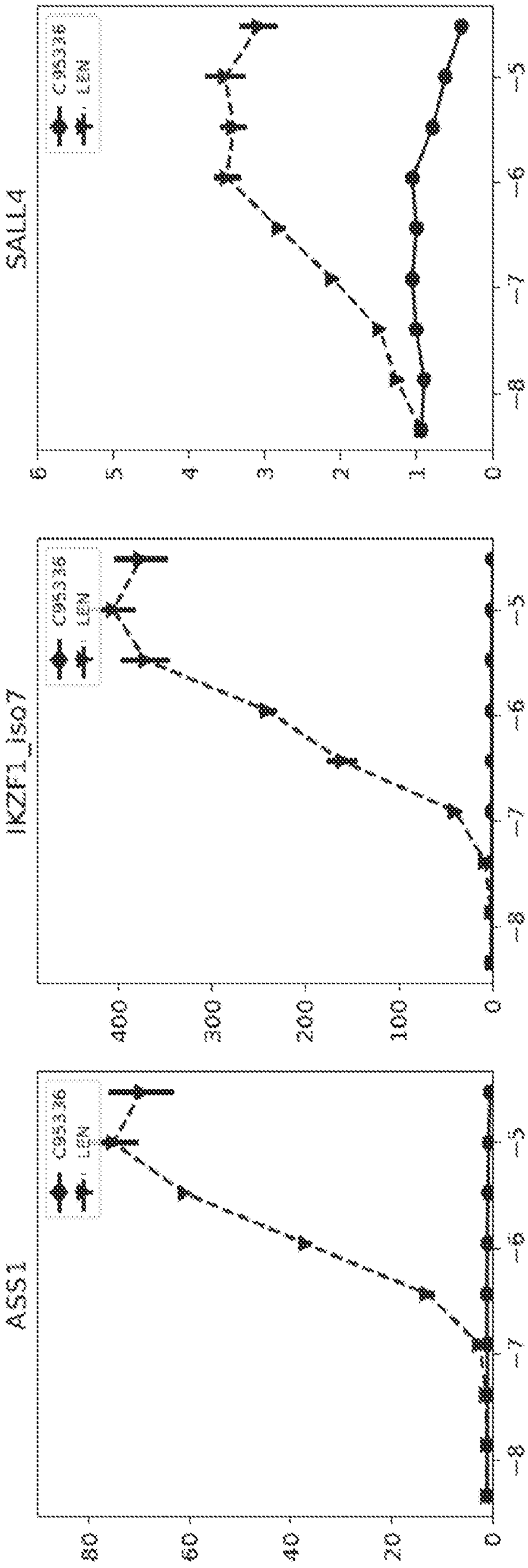


FIG. 172

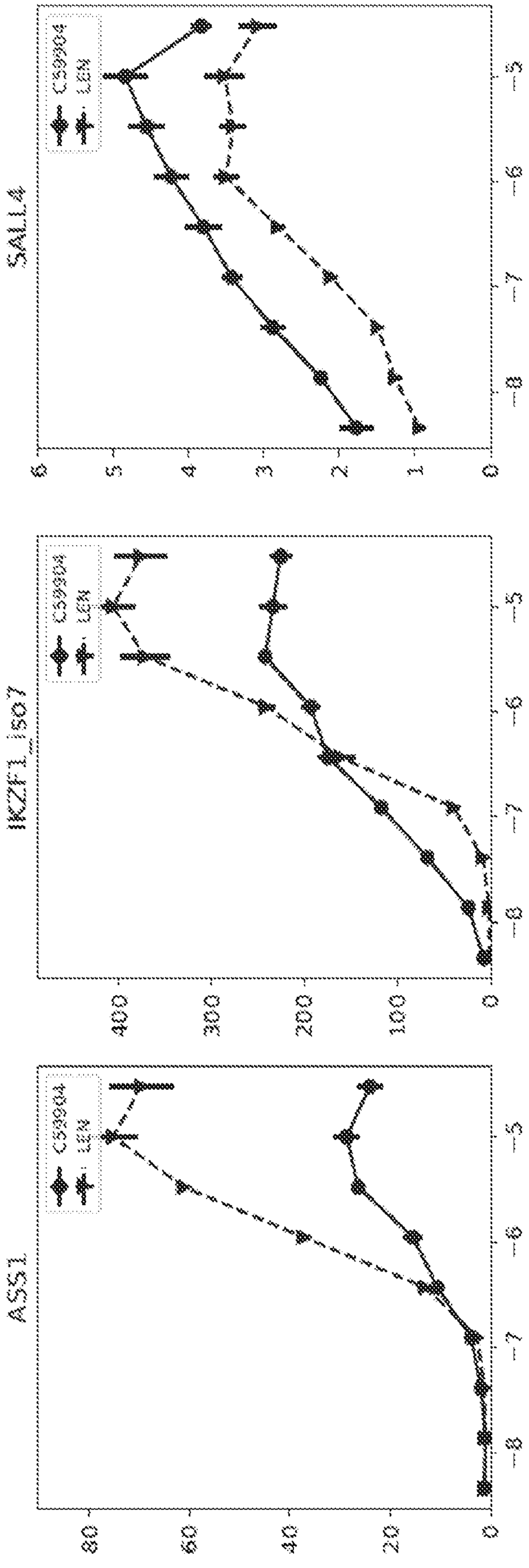
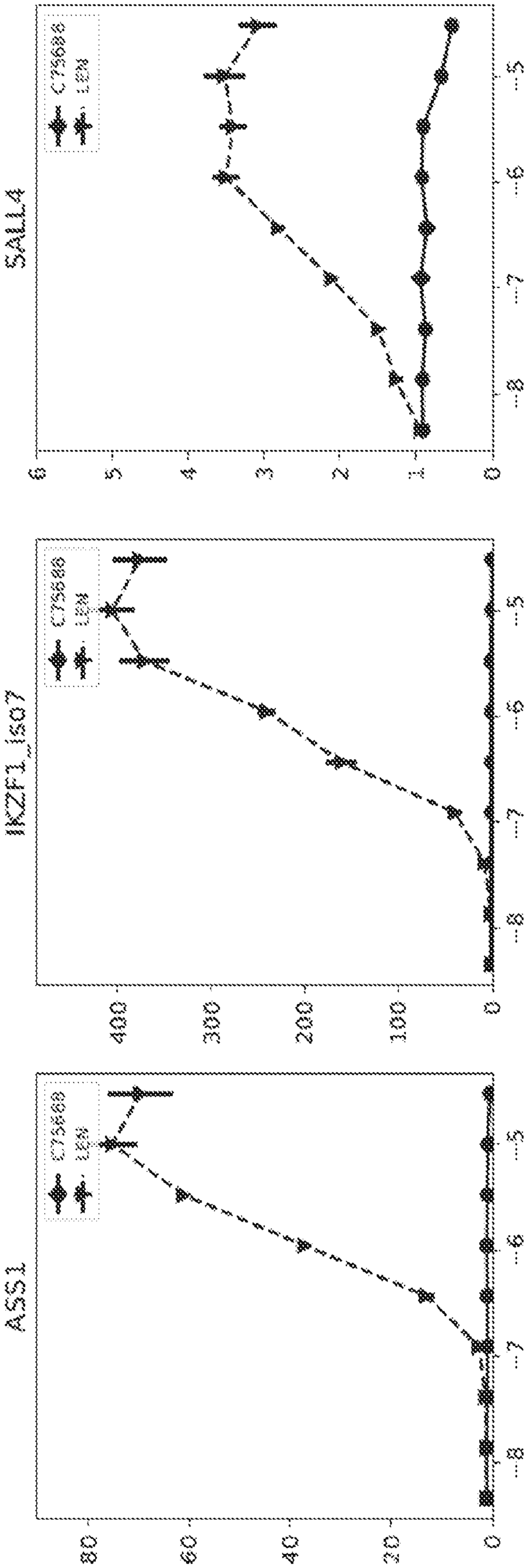


FIG. 173


SALL4
IKZF1_isoform1
ASS1
CTS6688
LEM
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100
200
300
400
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20
40
60
80
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4
5
6
7
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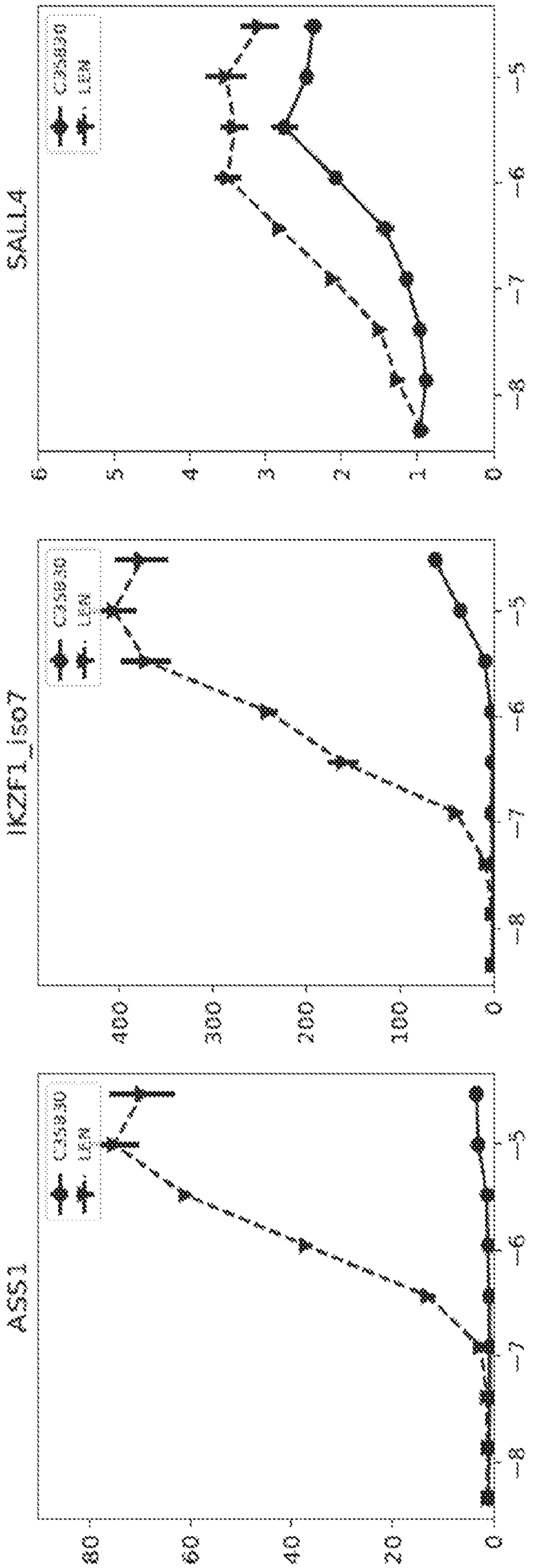
FIG. 174


SALL4
IKZF1_iso7
ASS1
C3538
L82
C3538
L82
C3538
L82
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1
2
3
4
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6
100
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400
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20
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60
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-3
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-7
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FIG. 175

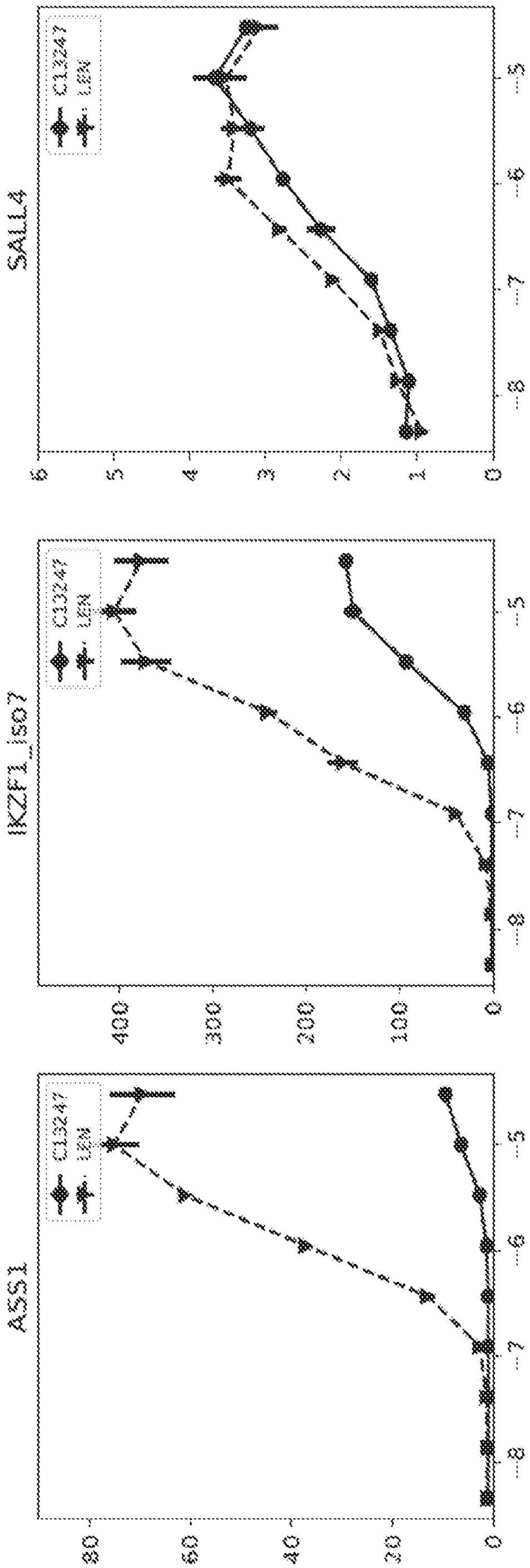


FIG. 176

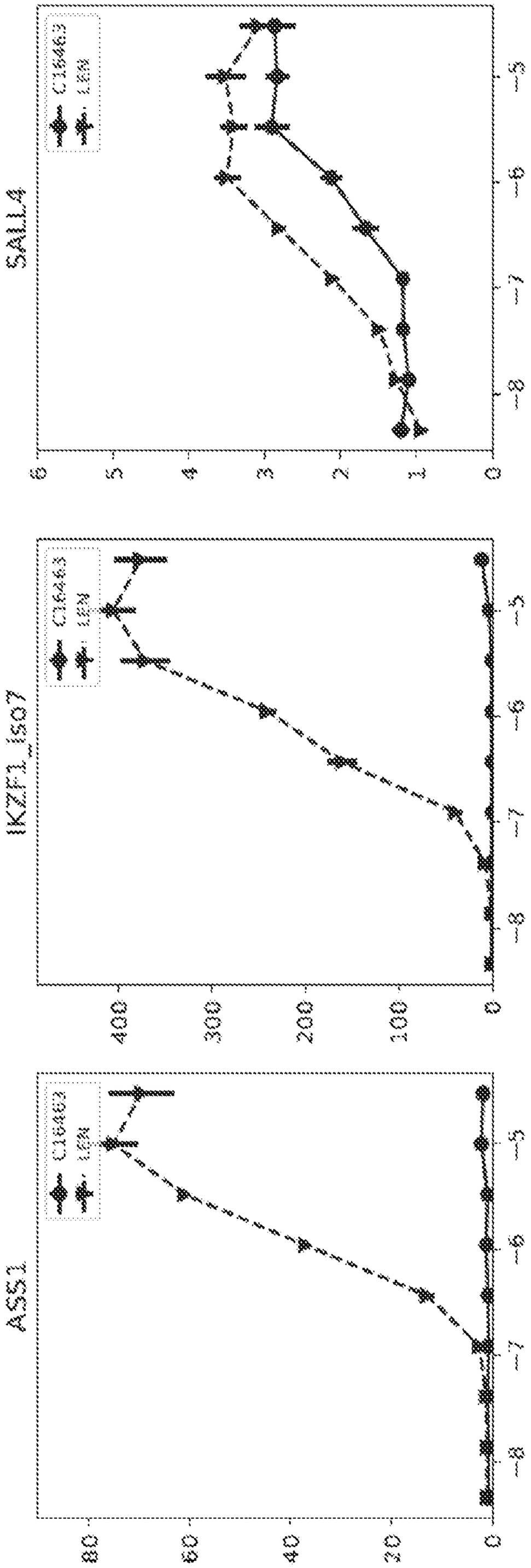


FIG. 177

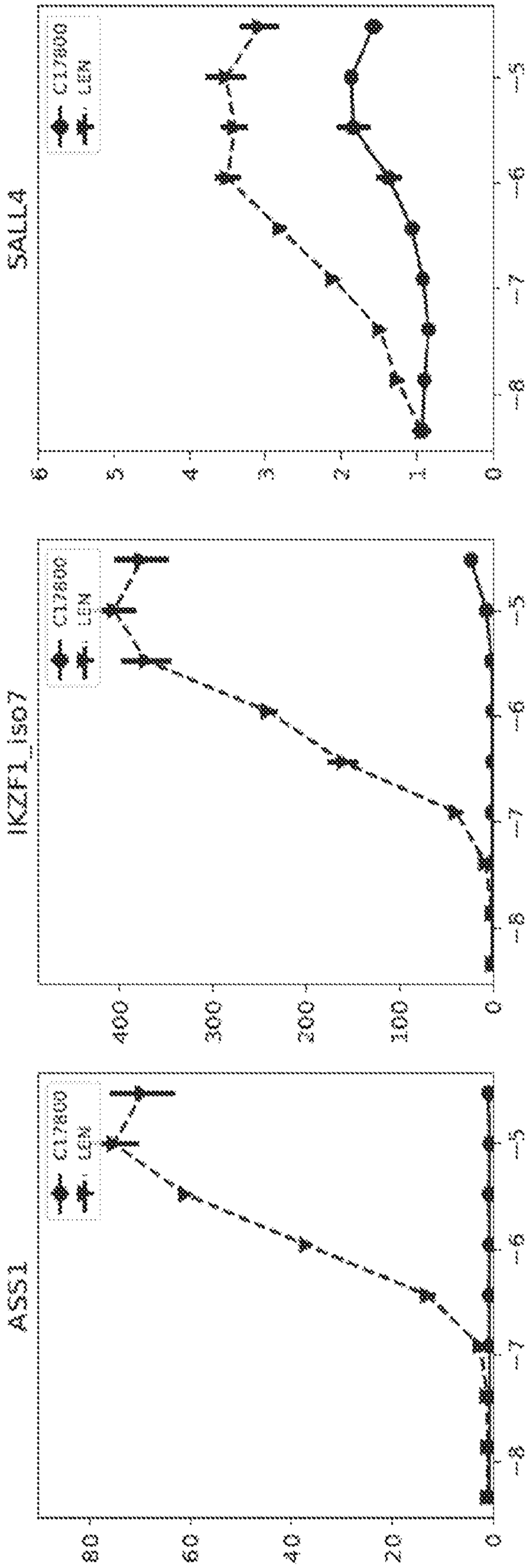
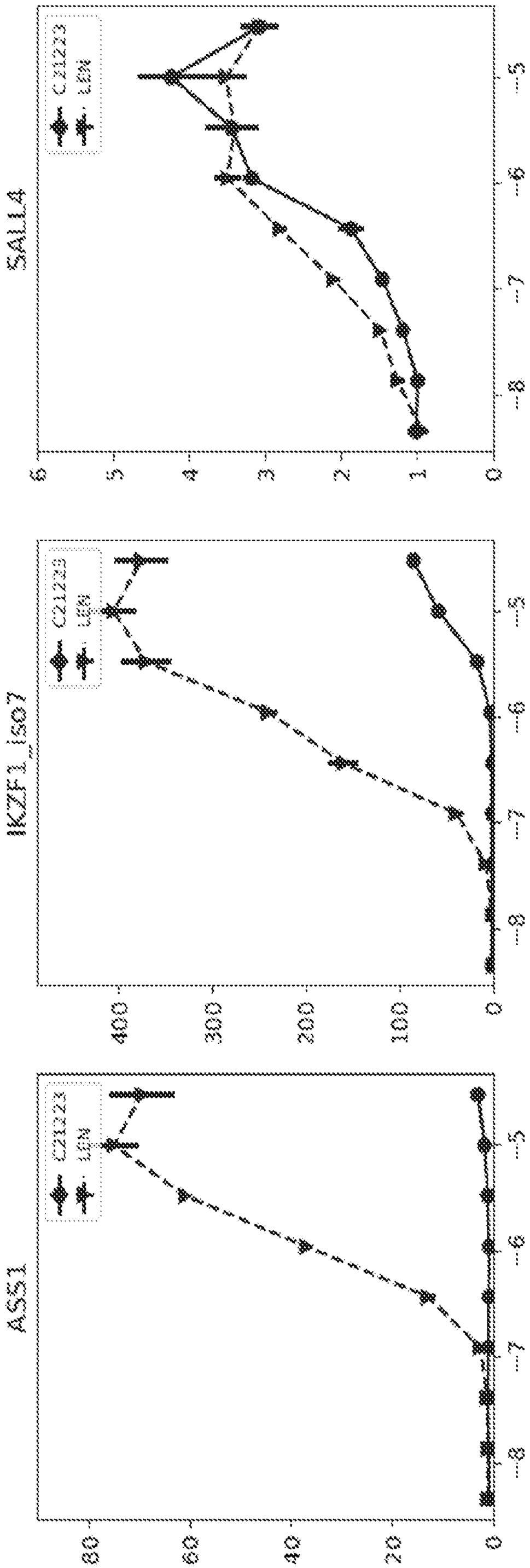


FIG. 178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ASS1
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LEN
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1
2
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100
200
300
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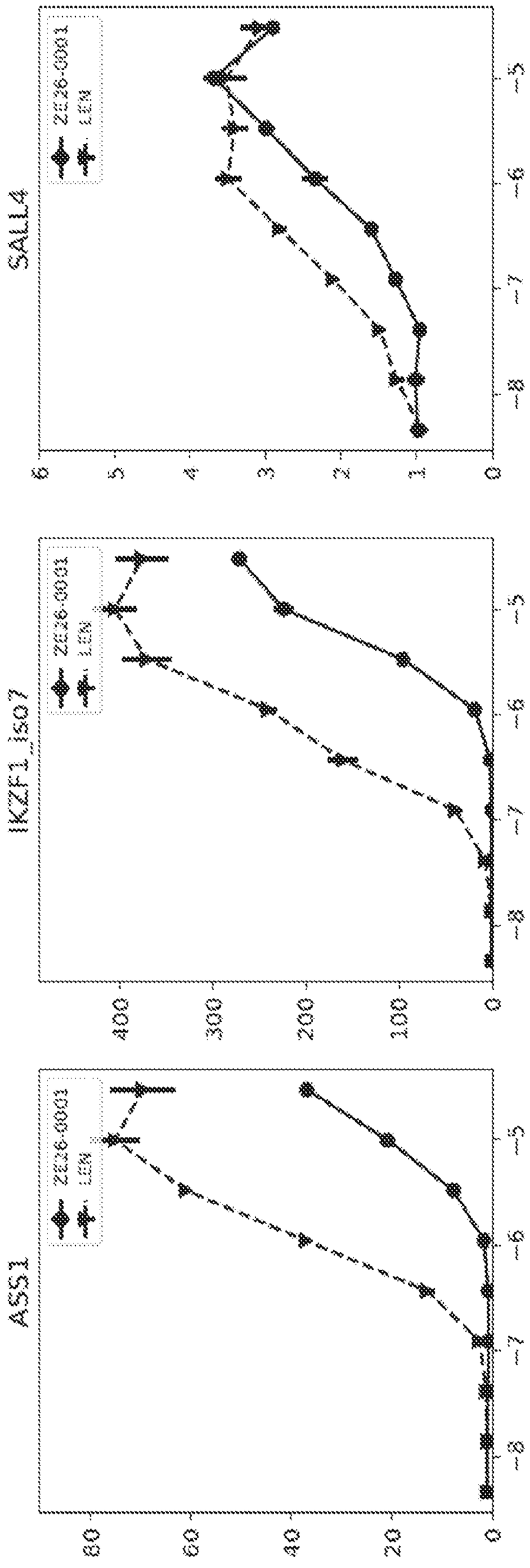
20
40
60
80

FIG. 179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ZE26-0003
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5.00
6.00
0
20
40
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200
300
400
-3
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-6
-7
-8

FIG. 18D

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/65303

A. CLASSIFICATION OF SUBJECT MATTER

IPC - A61K 31/506; A61K 45/06 (2021.01)

CPC - A61K 31/506; A61K 45/06; A61K 47/665; C07D 413/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2017/197051 A1 (C4 Therapeutics, Inc.) 16 November 2017 (16.11.2017); p490	1-2, and 15-16
A	CN 107739389 A (Univ East China Normal) 27 February 2018 (27.02.2018); p2	1-2, and 15-16
A	Pubmed Compound Record for CID 141341744, '3-[7-(4-Heptoxyphenyl)-3-oxo-1H-isoindol-2-yl]piperidine-2,6-dione', U.S. National Library of Medicine, 06 December 2019 (06.12.2019), pages1-8 (https://pubchem.ncbi.nlm.nih.gov/compound/141341744); p2	1-2, and 15-16
A	WO 2018/106870 A1 (Icahn School Of Medicine At Mount Sinai) 14 June 2018 (14.06.2018); entire document	1-2, and 15-16
P/A	Yang et al. 'A Cell-Based Target Engagement Assay for the Identification of Cereblon E3 Ubiquitin Ligase Ligands and Their Application in HDAC6 Degraders', Cell Chemistry Biology, 14 May 2020 (14.05.2020), Vol.27, pages866-876; entire document	1-2, and 15-16

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 February 2021 (16.02.2021)	APR 21 2021
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee Young Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 20/65303

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

(See Supplemental Box)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1(in part), 2, 15(in part), and 16

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/US 20/65303

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I+: Claims 1-16 directed to a compound of Formula I, II, III, IV, V, VI, VII, VIII, IX, or X, or a pharmaceutically acceptable salt thereof. The compound of Formula I, II, III, IV, V, VI, VII, VIII, IX, or X will be searched to the extent that it encompasses the compound of Formula I, or a pharmaceutically acceptable salt thereof, wherein R1 is aryl, which may be optionally substituted with 1 or more RW groups as allowed by valence; RW at each occurrence is independently H. It is believed that claims 1(in part), 2, 15(in part), and 16 read on this first named invention, and thus these claims will be searched without fee. Applicant is invited to elect additional compounds of claim 1, wherein each additional compound elected will require one additional invention fee. Applicants must specify the claims that encompass any additionally elected compound. Applicants must further indicate, if applicable, the claims which encompass the first named invention, if different than what was indicated above for this group. Failure to clearly identify how any paid additional invention fees are to be applied to the '+' group(s) will result in only the first claimed invention to be searched. Additionally, an exemplary election wherein different actual variables are selected is suggested. An exemplary election would be the compound of Formula II, or a pharmaceutically acceptable salt thereof, wherein R2 is -N(R5)-(CH2)m-X-(CH2)n-R6, which may be optionally substituted with 1 or more RW groups as allowed by valence; R5 at each occurrence is independently H; R6 at each occurrence is independently OH; RW at each occurrence is independently H; X is a bond; m is; n is 0 (i.e., claims 1(in part), 4, and 16).

Group II: claims 17-25 directed to a method of treating a disease or modulating protein comprising administering the composition of claim 16 to a subject in need thereof.

The group of inventions listed above do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features:

Group I+ includes the technical feature of a unique compound of Formula I, II, III, IV, V, VI, VII, VIII, IX, or X, or a pharmaceutically acceptable salt thereof containing the same, which is not required by any other invention of Group I+.

Group II includes the technical feature of a method of treating a disease or modulating protein, not required by Group I+.

Common technical features:

The inventions of Group I+ share the technical feature of compound of Formula I, II, III, IV, V, VI, VII, VIII, IX, or X, or a pharmaceutically acceptable salt thereof containing the same.

Groups I+ and II share the technical feature of a compound of Formula I, II, III, IV, V, VI, VII, VIII, IX, or X, or a pharmaceutically acceptable salt thereof.

These shared technical features, however, do not provide a contribution over the prior art, as being anticipated by WO 2018/106870 A1 to Icahn School Of Medicine At Mount Sinai (hereinafter 'Icahn'). Icahn discloses a compound of Formula IV or a pharmaceutically acceptable salt thereof in claim 7, wherein: R4 is halo (p126, Scheme 25. "Intermediate 22").

As said compound and compositions were known in the art at the time of the invention, these cannot be considered special technical features that would otherwise unify the inventions of Groups I+ and II.

The inventions of Group I+ and II thus lack unity under PCT Rule 13.