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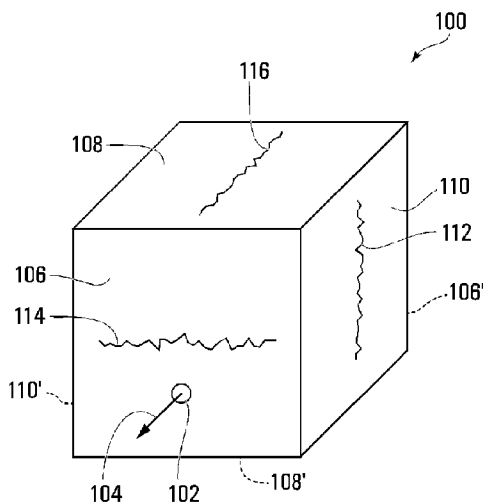
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(54) Titre : PROCEDE DE DEVELOPPEMENT D'UN RESEAU DE FRACTURES ET METHODE DE RECUPERATION D'HYDROCARBURE

(54) Title: PROCESS FOR DEVELOPING FRACTURE NETWORK AND HYDROCARBON RECOVERY METHOD



(57) **Abrégé/Abstract:**

Disclosed is a process for developing a fracture network in a hydrocarbon-bearing formation that is penetrated by a well pair comprising a first well and a second well. The process comprises injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from a longitudinal wellbore section of at least one of the first well and the second well to form the fracture network, wherein the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and (b) angularly offset from the substantially-longitudinal wellbore section of the second well. Alternative processes for developing fracture networks, based on different well configurations, are also disclosed. Methods of recovering hydrocarbons and processes for enhanced hydrocarbon recovery from hydrocarbon-bearing formations are also disclosed.

ABSTRACT

Disclosed is a process for developing a fracture network in a hydrocarbon-bearing formation that is penetrated by a well pair comprising a first well and a second well. The process comprises injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from a longitudinal wellbore section of at least one of the first well and the second well to form the fracture network, wherein the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and (b) angularly offset from the substantially-longitudinal wellbore section of the second well. Alternative processes for developing fracture networks, based on different well configurations, are also disclosed. Methods of recovering hydrocarbons and processes for enhanced hydrocarbon recovery from hydrocarbon-bearing formations are also disclosed.

PROCESS FOR DEVELOPING FRACTURE NETWORK AND HYDROCARBON RECOVERY METHOD

TECHNICAL FIELD

[0001] The present disclosure generally relates to processes for developing
5 fracture networks in hydrocarbon-bearing formations and methods for recovering
hydrocarbons therefrom. In particular, the present disclosure relates to processes
that utilize wells having longitudinal wellbore sections to develop fracture networks
in subterranean hydrocarbon-bearing formations and methods that utilize such
wells to recover hydrocarbons from subterranean hydrocarbon-bearing formations
10 in which fracture networks have been induced.

BACKGROUND

[0002] *In situ* hydrocarbon recovery involves the production of
hydrocarbons from a subterranean hydrocarbon-bearing formation. In some
cases, *in situ* hydrocarbon recovery is aided by hydraulic fracture stimulation – a
15 process that results in the formation of fractures within the subterranean
hydrocarbon-bearing formation. Hydraulic fracture stimulation is commonly
referred to as “fracturing” or “fracking”, and it involves injecting a stimulant fluid
into the hydrocarbon-bearing formation at a pressure that is sufficient to induce
localized breaking events (fractures) within the hydrocarbon-bearing formation.
20 The stimulant fluid typically comprises a propping agent. The propping agent is
intended to remain in the fractures after the fracturing process is finished. Ideally,
the propping agent maintains the geometry of the fractures such that they provide
higher-permeability paths through which injected fluids, hydrocarbons, or
combinations thereof can flow through the hydrocarbon-bearing formation. The
25 stimulant fluid is typically injected by way of a wellbore that penetrates the
hydrocarbon-bearing formation. Often, fracturing is induced at multiple points
along the wellbore. As such, the fractures typically form a three-dimensional
network (*i.e.* a fracture network) that is in fluid communication with the wellbore
through multiple points. The fracture geometry and fracture complexity of a

fracture network can be quantified by a variety of techniques known to those skilled in the art.

Fractures are generally characterised by their orientations relative to vertical and horizontal axes (*e.g.* vertical fractures and horizontal fractures). Fractures are also
5 characterized by their orientation with respect to the wellbore section from which they originate. In the case of a longitudinal wellbore section (*i.e.* a non-vertical wellbore section) that is disposed about a longitudinal wellbore axis, a fracture is said to be “transverse” if it is substantially orthogonal to the longitudinal wellbore axis. Likewise, a fracture is said to be “longitudinal” if it is not substantially
10 orthogonal to the longitudinal wellbore axis. Accordingly, a fracture network originating from a longitudinal wellbore section can be characterized as comprising substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, substantially-horizontal fractures, or a combination thereof.

[0003] Hydraulic fracture stimulation is often used in low-permeability
15 hydrocarbon-bearing formations such as those found in North America's shale gas and shale oil formations. Examples of such formations include the Montney shale formation, the Bakken formation, the Marcellus shale formation, the Barnett shale formation, the Haynesville shale formation, and the Horn River shale formation.

[0004] Known processes for developing subterranean fracture networks are
20 limited by a number of inefficiencies, and there exists an unmet need for improved processes for developing fracture networks in hydrocarbon-bearing formations. Likewise improved methods for recovering hydrocarbons from hydrocarbon-bearing formations and improved processes for enhancing hydrocarbon recovery from hydrocarbon-bearing formations are needed. In particular, improved methods
25 for recovering hydrocarbons and improved processes for enhancing hydrocarbon recovery are need for low-permeability hydrocarbon-bearing formations and/or high-permeability hydrocarbon-bearing formations that are bordered by, interbedded with, and/or interposed by low-permeability deposits.

SUMMARY

[0005] Developing a fracture network in a hydrocarbon bearing formation allows for increased hydrocarbon-bearing-formation permeability. The fracture network may comprise horizontal fractures, transverse-vertical fractures, longitudinal-vertical fractures, or a combination thereof. In the context of the present disclosure, it was found that processes for developing such fracture networks in such hydrocarbon-bearing formations benefit from offsetting at least one substantially-longitudinal wellbore section of at least one well relative to: (i) a substantially-longitudinal wellbore section of a second well; (ii) a plane defined by the maximum horizontal stress and the minimum horizontal stress; (iii) a lithofacies surface; or (iv) a combination thereof. Offsetting the at least one substantially-longitudinal wellbore section in such a way allows for modification of fracture geometry, fracture complexity, or a combination thereof within the fracture network. As it pertains to methods of recovering hydrocarbons and/or processes for enhancing hydrocarbon recovery, it was found that offsetting the at least one substantially-longitudinal wellbore section in such a way allows for modification of heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0006] The present disclosure seeks to address one or more of the un-met needs set out herein by way of four discrete technical solutions, each of which features a different well configuration.

[0007] The first technical solution features a multi-well configuration in which the longitudinal wellbore section of a first well is: (a) laterally displaced from, and (b) angularly offset from, the longitudinal wellbore section of a second well such that the longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view.

[0008] The second technical solution features a multi-well configuration in which the longitudinal wellbore section of at least one of a first well and a second

well is angularly offset from: (a) a lithofacies surface, or (b) a plane defined by the maximum-horizontal stress and the minimum-horizontal stress.

[0009] The third technical solution features a single-well configuration, and the fourth technical solution features an alternate multi-well configuration.

5 [0010] With respect to the first technical solution, select embodiments of the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-
10 vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from the substantially-longitudinal wellbore section of at least one of the first well and the
15 second well to form the fracture network, wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of the first well is: (a) laterally
20 displaced from, and (b) angularly offset from, the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify fracture geometry, fracture complexity, or a combination thereof within the fracture
25 network.

[0011] Also with respect to the first technical solution, select embodiments of the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b)
30 that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii)

a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from a substantially-longitudinal wellbore section of at least one of the first well and the
5 second well to form the fracture network, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from, and (b) angularly offset from,
10 the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

15 [0012] Also with respect to the first technical solution, select embodiments of the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i)
20 a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from the substantially-longitudinal wellbore
25 section of at least one of the first well and the second well to form the fracture network, wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-
30 longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and at least one of (b) angularly offset from at least a part of the lithofacies surface, and (c) angularly

offset from the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

[0013] Also with respect to the first technical solution, select embodiments of the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from the substantially-longitudinal wellbore section of at least one of the first well and the second well to form the fracture network, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and at least one of (b) angularly offset from at least a part of the lithofacies surface, and (c) angularly offset from the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

[0014] Also with respect to the first technical solution, select embodiments of the present disclosure relate to a method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical

stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from, and (b) angularly offset from, the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0015] Also with respect to the first technical solution, select embodiments of the present disclosure relate to a method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and recovering hydrocarbons from the

hydrocarbon-bearing formation, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from, and (b) angularly offset from, the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0016] Also with respect to the first technical solution, select embodiments of the present disclosure relate to a method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and at least one of (b) angularly offset from at least a part of the lithofacies surface, and (c) angularly offset from the substantially-longitudinal wellbore section of the second well such that the

substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0017] Also with respect to the first technical solution, select embodiments of the present disclosure relate to a method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and at least one of (b) angularly offset from at least a part of the lithofacies surface, and (c) angularly offset from the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0018] Also with respect to the first technical solution, select embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from, and (b) angularly offset from, the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0019] Also with respect to the first technical solution, select embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; wherein: the vertical

stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from, and (b) angularly offset from, the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0020] Also with respect to the first technical solution, select embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and at least one of (b) angularly offset from at least a part of the lithofacies surface, and (c) angularly offset from the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation,

hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0021] Also with respect to the first technical solution, select embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery
5 from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a
10 substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; wherein: the vertical stress is significantly greater than the
15 maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and at least one of (b) angularly offset from at least a part of
20 the lithofacies surface, and (c) angularly offset from the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation,
25 hydrocarbon capture from the formation, or a combination thereof.

[0022] With respect to the second technical solution, select embodiments of the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b)
30 that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii)

a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from the substantially-longitudinal wellbore section of at least one of the first well and the
5 second well to form the fracture network, wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of at least one of the first well
10 and the second well is angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

[0023] Also with respect to the second technical solution, select embodiments of the present disclosure relate to a process for developing a
15 fracture network in a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore
20 section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from the substantially-longitudinal wellbore section of at least one of the first well and the second well to form the fracture network, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the
25 fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of at least one of the first well and the second well is: (a) oriented relative to the maximum-horizontal stress and the minimum-horizontal stress, and (b) angularly offset from a plane defined by the
30 maximum-horizontal stress and the minimum-horizontal stress, to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

[0024] Also with respect to the second technical solution, select embodiments of the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from the substantially-longitudinal wellbore section of at least one of the first well and the second well to form the fracture network, wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of at least one of the first well and the second well is angularly offset from at least a part of the lithofacies surface to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

[0025] Also with respect to the second technical solution, select embodiments of the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from the substantially-longitudinal wellbore section of at least one of the first well and the second well to form the fracture network, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises

substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of at least one of the first well and the second well is: (a) oriented relative to the maximum-horizontal stress and the minimum-horizontal stress, and (b)

5 angularly offset from at least a part of the lithofacies surface to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

[0026] Also with respect to the second technical solution, select embodiments of the present disclosure relate to a method for recovering

10 hydrocarbons from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore

15 section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and

20 recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore

25 section of at least one of the first well and the second well is angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0027] Also with respect to the second technical solution, select

30 embodiments of the present disclosure relate to a method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that has a stress field

defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of at least one of the first well and the second well is angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0028] Also with respect to the second technical solution, select embodiments of the present disclosure relate to a method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is less than or

substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of at least one of the first well
5 and the second well is angularly offset from at least a part of the lithofacies surface to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0029] Also with respect to the second technical solution, select embodiments of the present disclosure relate to a method for recovering
10 hydrocarbons from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a
15 second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; modulating the mobility of hydrocarbons
20 within the hydrocarbon-bearing formation; and recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore
25 section of at least one of the first well and the second well is angularly offset from at least a part of the lithofacies surface to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0030] Also with respect to the second technical solution, select
30 embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that has a stress

field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of at least one of the first well and the second well is angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0031] Also with respect to the second technical solution, select embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of at least one of the first well and the second well is angularly offset from a plane defined by the maximum-horizontal stress and the

minimum-horizontal stress to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0032] Also with respect to the second technical solution, select
5 embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical
10 wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the
15 second well to form a fracture network; wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of at least one of the first well
20 and the second well is angularly offset from at least a part of the lithofacies surface to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0033] Also with respect to the second technical solution, select
25 embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a
30 second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid

comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network; wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises

5 substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section of at least one of the first well and the second well is angularly offset from at least a part of the lithofacies surface to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the

10 formation, or a combination thereof.

[0034] With respect to the third technical solution, select embodiments of the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation having a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, the process

15 comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from a substantially-longitudinal wellbore section of a well within the hydrocarbon-bearing formation to form the fracture network, wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal

20 fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section is angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

25 **[0035]** Also with respect to the third technical solution, select embodiments of the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation having a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, the process comprising: injecting a stimulant fluid comprising a propping agent into the

30 hydrocarbon-bearing formation from a substantially-longitudinal wellbore section of a well within the hydrocarbon-bearing formation to form the fracture network,

wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section is: (a) oriented relative to the maximum-horizontal stress and the minimum-horizontal stress, and (b) angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress, to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

[0036] Also with respect to the third technical solution, select embodiments of the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation comprising a lithofacies surface and a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from a substantially-longitudinal wellbore section of a well within the hydrocarbon-bearing formation to form the fracture network, wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section is angularly offset from at least a part of the lithofacies surface to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

[0037] Also with respect to the third technical solution, select embodiments of the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation comprising a lithofacies surface and a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from a substantially-longitudinal wellbore section of a well within the hydrocarbon-bearing formation to form the fracture network, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-

transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section is: (a) oriented relative to the maximum-horizontal stress and the minimum-horizontal stress, and (b) angularly offset from at least a part of the lithofacies surface to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

[0038] Also with respect to the third technical solution, select embodiments of the present disclosure relate to a method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well comprising a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section to form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section is angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0039] Also with respect to the third technical solution, select embodiments of the present disclosure relate to a method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well comprising a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing

formation via the substantially-longitudinal wellbore section to form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section is: (a) oriented relative to the maximum-horizontal stress and the minimum-horizontal stress, and (b) angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0040] Also with respect to the third technical solution, select embodiments of the present disclosure relate to a method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well comprising a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section to form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section is angularly offset from at least a part of the lithofacies surface to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0041] Also with respect to the third technical solution, select embodiments of the present disclosure relate to a method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well comprising a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section to form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section is angularly offset from at least a part of the lithofacies surface to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0042] Also with respect to the third technical solution, select embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well comprising a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section to form a fracture network; wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section is angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress to modify heat

transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0043] Also with respect to the third technical solution, select embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well comprising a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section to form a fracture network; wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section is angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0044] Also with respect to the third technical solution, select embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well comprising a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section to form a fracture network; wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section is angularly offset from at least

a part of the lithofacies surface to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0045] Also with respect to the third technical solution, select embodiments
5 of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well comprising a substantially-vertical wellbore section and a substantially-longitudinal wellbore
10 section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section to form a fracture network; wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-
15 vertical fractures, or a combination thereof, and the substantially-longitudinal wellbore section is angularly offset from at least a part of the lithofacies surface to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0046] With respect to the fourth technical solution, select embodiments of
20 the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-
25 horizontal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-horizontal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from the substantially-horizontal wellbore section of at least one of the first well and the second well to form the fracture network,
30 wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal

fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-horizontal wellbore section of at least one of the first well and the second well is angularly offset from at least a part of the lithofacies surface to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

[0047] Also with respect to the fourth technical solution, select embodiments of the present disclosure relate to a process for developing a fracture network in a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-horizontal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-horizontal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from the substantially-horizontal wellbore section of at least one of the first well and the second well to form the fracture network, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-horizontal wellbore section of at least one of the first well and the second well is: (a) oriented relative to the maximum-horizontal stress and the minimum-horizontal stress, and (b) angularly offset from at least a part of the lithofacies surface to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

[0048] Also with respect to the fourth technical solution, select embodiments of the present disclosure relate to a method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-horizontal wellbore section, and (ii) a second

- well having a substantially-vertical wellbore section and a substantially-horizontal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-horizontal wellbore section of at least one of the first well and the second well to
- 5 form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical
- 10 fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-horizontal wellbore section of at least one of the first well and the second well is angularly offset from at least a part of the lithofacies surface to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.
- 15 [0049] Also with respect to the fourth technical solution, select embodiments of the present disclosure relate to a method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is
- 20 penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-horizontal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-horizontal wellbore section, the method comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-
- 25 horizontal wellbore section of at least one of the first well and the second well to form a fracture network; modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and recovering hydrocarbons from the hydrocarbon-bearing formation, wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises
- 30 substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-horizontal wellbore section of at least one of the first well and the second well is angularly offset from

at least a part of the lithofacies surface to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0050] Also with respect to the fourth technical solution, select
5 embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical
10 wellbore section and a substantially-horizontal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-horizontal wellbore section, the process comprising: injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-horizontal wellbore section of at least one of the first well and the second well to
15 form a fracture network; wherein: the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-horizontal wellbore section of at least one of the first well and the
20 second well is angularly offset from at least a part of the lithofacies surface to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0051] Also with respect to the fourth technical solution, select
25 embodiments of the present disclosure relate to a process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-horizontal wellbore section, and (ii) a second
30 well having a substantially-vertical wellbore section and a substantially-horizontal wellbore section, the process comprising: injecting a stimulant fluid comprising a

propping agent into the hydrocarbon-bearing formation via the substantially-horizontal wellbore section of at least one of the first well and the second well to form a fracture network; wherein: the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and the substantially-horizontal wellbore section of at least one of the first well and the second well is angularly offset from at least a part of the lithofacies surface to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0052] These and other features of the present disclosure will become more apparent in the following brief description in which reference is made to the appended drawings. The appended drawings illustrate one or more embodiments of the present disclosure by way of example only and are not to be construed as limiting the scope of the present disclosure.

[0053] **FIG. 1** shows a schematic rectangular-prismatic section of a hydrocarbon-bearing formation 100 that comprises a fracture network originating from a longitudinal wellbore section 102.

[0054] **FIGS. 2A – 2H** provide schematic representations of a series of well configurations in various archetypal lithological environments. The well configurations may be suitable for developing fracture networks in hydrocarbon-bearing formations by processes according to the present disclosure. The well configurations may also be suitable for recovering hydrocarbons from hydrocarbon-bearing formations by methods according to the present disclosure. The well configurations may also be suitable for enhancing hydrocarbon recovery from hydrocarbon-bearing formations by processes according to the present disclosure.

[0055] **FIGS. 3A – 3D** provide schematic representations of a series of well configurations. The well configurations may be suitable for developing fracture

networks in hydrocarbon-bearing formations by processes according to the present disclosure. The well configurations may also be suitable for recovering hydrocarbons from hydrocarbon-bearing formations by methods according to the present disclosure. The well configurations may also be suitable for enhancing
 5 hydrocarbon recovery from hydrocarbon-bearing formations by processes according to the present disclosure. Lithological environments are not provided in **FIG. 3A – FIG. 3D** for clarity.

[0056] **FIGS. 4A and 4B** provide schematic longitudinal-elevation and horizontal-plan views, respectively, of a hydrocarbon-bearing formation that
 10 comprises a fracture network in communication with a well pair having a configuration similar to that of **FIG. 2A**.

[0057] **FIGS. 5A and 5B** provide archetypal image logs obtained (static and dynamic images, respectively) with a drilling-induced fracture occurring in a substantially T-shape in a shallow-depth cap-rock formation of an oil sands
 15 reservoir in Northern Alberta. The image logs indicate the presence of a pair of fractures.

[0058] **FIG. 6** shows a core computed tomography (CT) scan obtained at approximately the same depth as the fractures identified in the image logs of **FIGS. 5A / 5B**.

20 [0059] **FIG. 7** provides results of G-function analysis performed on a diagnostic fracture injection test (DFIT) pumped at approximately the same depth as the fractures identified in the image logs of **FIGS. 5A / 5B**.

[0060] **FIG. 8A** provides another DFIT pumped in a viscous hydrocarbon-containing formation in cold conditions the G-function analysis of **FIG. 7**. **FIG. 8B**
 25 provides results from an after closure analysis (ACA radial analysis) of the same data set.

[0061] **FIG. 9** provides an archetypal model of stress anisotropy in a computer-based lithological representation of the formation discussed in **FIGS. 8A and 8B**. The formation is penetrated by a well comprising a longitudinal

wellbore section that is angularly offset from a plane defined by the maximum-horizontal stress and the minimum horizontal stress.

[0062] **FIGS. 10A – 10C** show longitudinal-elevation, transverse-elevation, and perspective views, respectively, of a simulated fracture network that is induced from the longitudinal wellbore section of **FIG. 9**.

[0063] **FIGS. 11A – 11C** provide archetypal simulation results that contrast production-related metrics for a typical SAGD well pair in the presence and absence of the fracture network discussed in **FIGS. 10A – 10C**. Simulation results on water (steam) rates as a function of time are shown in **FIG. 11A**. Simulation results on oil rates as a function of time are shown in **FIG. 11B**. Simulation results on cumulative oil production and cumulative steam-to-oil ratios (SOR) are shown in **FIG. 11C**.

[0064] **FIGS. 12A – 12C** provide archetypal simulation results that contrast production-related metrics for a typical SAGD well pair in the presence and absence of the fracture network discussed in **FIGS. 10A – 10C**, wherein the formation further comprises a shale barrier that overlies the well pair. Simulation results on water (steam) rates as a function of time are shown in **FIG. 12A**. Simulation results on oil rates as a function of time are shown in **FIG. 12B**. Simulation results on cumulative oil production and cumulative SOR are shown in **FIG. 12C**.

DETAILED DESCRIPTION

[0065] In the present disclosure, all terms referred to in singular form are meant to encompass plural forms of the same. Likewise, all terms referred to in plural form are meant to encompass singular forms of the same. Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure pertains.

Concepts and definitions

[0066] *In situ* processes for recovering hydrocarbons from low-permeability formations or high-permeability hydrocarbon-bearing formations that are bordered by, interbedded with, and/or interposed by low-permeability deposits often involve the use of one or more wells having longitudinal wellbore sections. Hydraulic fracture stimulation can be induced from such longitudinal wellbore sections to aid in hydrocarbon recovery from low-permeability formations. Low-permeability formations – those having permeabilities of less than about 10 mD – include but are not limited to shale formations, tight sandstone formations, and coal bed formations. Low-permeability formations may be naturally fractured, or not. “Shale” is a fine-grained sedimentary rock that forms from the compaction of silt and clay-size mineral particles.

[0067] Hydraulic fracture stimulation can also be used in high-permeability formations to aid in hydrocarbon recovery. High-permeability formations – those having permeabilities of greater than about 10 mD – include but are not limited to those that are sand-dominated and that have sand facies. High-permeability formations may be naturally fractured, or not. Sand-dominated formations may have permeabilities ranging from 1,000 mD to 10,000 mD (1 to 10 D). The hydrocarbons contained in high-permeability formations may be viscous hydrocarbon. Viscous hydrocarbons may be referred to as reservoirs of heavy hydrocarbons, heavy oil, bitumen, or oil sands. *In situ* processes for recovering hydrocarbons from oil sands typically involve the use of multiple wells. Such processes are often assisted or aided by injecting a fluid (e.g. steam, solvent, or a combination thereof) through an injection well to mobilize the viscous hydrocarbons for recovery through a production well. Steam-assisted gravity drainage (SAGD) and cyclic steam stimulation (CSS) are two such processes (see, e.g.: Butler, Roger (1991), *Thermal Recovery of Oil and Bitumen*, Englewood Cliffs: Prentice-Hall).

[0068] A typical SAGD process is disclosed in Canadian Patent No. 1,130,201, in which two wells are drilled into a hydrocarbon-bearing formation. One of the wells is configured for steam (*i.e.* an injection well) and the other is

configured for the production of oil and water (*i.e.* a production well). In operation, steam injected via the injection well heats formation and condenses to an aqueous condensate. The transfer of latent heat from the steam to the formation heats the viscous hydrocarbons which increases their mobility. After sufficient heat transfer, the viscous hydrocarbons are sufficiently-mobilized to drain under the influence of gravity toward the production well along with an aqueous condensate. In this way, the injected steam creates a "steam chamber" in the formation around and above the injection well. The term "steam chamber" accordingly refers to a volume of the reservoir from which mobilized hydrocarbons have at least partially drained. Mobilized hydrocarbons are recovered continuously through the production well. The conditions of steam injection and of hydrocarbon production may be modulated to control the growth of the steam chamber.

[0069] The SAGD process has a number of shortcomings. For example, SAGD is water-use and water-treatment intensive. Accordingly, alternative processes for *in situ* hydrocarbon recovery have been proposed. Some alternative processes are aided by one or more solvents and are referred to as "solvent-aided processes" (SAPs). In some SAPs, the injection fluid may include less than about 20 % solvent and greater than about 80 % steam on a mass basis. Such processes are referred to as "steam-driven solvent-aided processes". In some SAPs, the injection fluid may include between about 20 % and about 80 % solvent on a mass basis. Such processes are referred to as "hybrid solvent-assisted processes". In some SAPs, the injection fluid may include greater than about 80 % solvent and less than about 20 % steam on a mass basis. Such processes are referred to as "substantially solvent driven" or in some cases "solvent-only / solvent-based processes".

[0070] CSS generally involves injecting steam into a formation, permitting the injected fluids to soak, and then producing fluids including mobilized hydrocarbons. A variation of CSS is described for example in Canadian Patent No. 1,144,064, wherein a hydrocarbon solvent is injected into the formation as part of the CSS process. For example, solvent-assisted processes characterized as Liquid Assisted Steam Enhanced Recovery (LASER) have been described, in

which solvents are used in conjunction with steam to enhance performance of CSS.

[0071] In the context of the present disclosure, "thermal recovery" or "thermal stimulation" refers to enhanced oil recovery techniques that involve
5 delivering thermal energy to a petroleum resource, for example to a heavy oil reservoir. There are a significant number of thermal recovery techniques other than SAGD and CSS, such as in-situ combustion, hot water flooding, steam flooding, and electrical heating. In general, thermal energy is provided to reduce the viscosity of the petroleum to facilitate production in thermal recovery
10 processes.

[0072] In the context of the present disclosure, "petroleum" is a naturally occurring mixture consisting predominantly of hydrocarbons in the gaseous, liquid or solid phase, which include various oxygen-, nitrogen- and sulfur-containing compounds and typically trace amounts of metal-containing compounds. In the
15 context of the present application, the words "petroleum", "oil", and "hydrocarbon" are generally used interchangeably to refer to mixtures of widely varying composition, as will be evident from the context in which the word is used. The production of petroleum from a reservoir necessarily involves the production of hydrocarbons, but is not limited to hydrocarbon production. Similarly, processes
20 that produce hydrocarbons from a well will generally also produce petroleum fluids that are not hydrocarbons. In accordance with this usage, a process for producing petroleum or hydrocarbons is not necessarily a process that produces exclusively petroleum or hydrocarbons, respectively.

[0073] In the context of the present disclosure "fluids", such as petroleum
25 fluids or reservoir fluids, include both liquids and gases. Natural gas is the portion of petroleum that exists either in the gaseous phase or is in solution in crude oil in natural underground reservoirs, and which is gaseous at atmospheric conditions of pressure and temperature. Natural gas may include amounts of non-hydrocarbons.

[0074] It is common practice to categorize petroleum substances of high viscosity and density into two categories, "heavy oil" and "bitumen". For example, some sources define "heavy oil" as a petroleum that has a mass density of greater than about 900 kg/m³. Bitumen is sometimes described as that portion of petroleum that exists in the semi-solid or solid phase in natural deposits, with a mass density greater than about 1000 kg/m³ and a viscosity greater than about 10,000 centipoise (cP; or 10 Pa·s) measured at original temperature in the deposit and atmospheric pressure, on a gas-free basis. Although these terms are in common use, references to heavy oil and bitumen represent categories of convenience, and there is a continuum of properties between heavy oil and bitumen.

[0075] Accordingly, references to heavy oil and/or bitumen herein include the continuum of such substances, and do not imply the existence of some fixed and universally recognized boundary between the two substances. In particular, the term "heavy oil" includes within its scope all "bitumen" including hydrocarbons that are present in semi-solid or solid form.

[0076] In the context of the present disclosure, a "reservoir" or "hydrocarbon-bearing formation" is a subsurface formation containing one or more natural accumulations of moveable hydrocarbons, which are generally confined by relatively impermeable rock. An "oil sand" reservoir is generally comprised of strata of sand or sandstone containing viscous hydrocarbons, such as bitumen. Viscous petroleum, such as bitumen, may also be found in reservoirs whose solid structure consists of carbonate material rather than sand material. Such reservoirs are sometimes referred to as "bituminous carbonates". A "zone" or "hydrocarbon-bearing zone" in a reservoir is merely an arbitrarily defined volume of the reservoir, typically characterised by some distinctive property. In various embodiments, a zone may or may not contain hydrocarbons. Different zones in a reservoir may have different permeabilities.

[0077] In the context of the present disclosure, a reservoir, a hydrocarbon-bearing formation, an oil sand reservoir, or a zone is said to be at "native reservoir temperature" when the temperature of the reservoir, the hydrocarbon-bearing

formation, the oil sand reservoir, or the zone has not been substantially influenced by a thermal process.

[0078] In the context of the present disclosure, the permeability of the hydrocarbon-bearing formation refers to the degree to which hydrocarbons can flow through the hydrocarbon-bearing formation. High-permeability hydrocarbon-bearing formations are often bordered by, interbedded with, and/or interposed by low-permeability deposits such as shale lamina and mud clasts. Inclined heterolithic strata (IHS) – heterogeneous deposits that include layers of high-permeability material and low-permeability material and that offset from their depositional plane – are one such example. IHS typically consist of repeating cycles of interbedded sand-dominated layers and mud-dominated layers. Those skilled in the art will recognize that mud-dominated layers of a wide variety of thicknesses are known, and that typical mud-dominated layers have thicknesses between about 1 cm and about 50 cm (often between about 1 cm and about 10 cm). Likewise, those skilled in the art will recognize that sand-dominated layers of a wide variety of thicknesses are known, and that typical sand-dominated layers have thicknesses between about 1 cm and about 1 m (often between about 5 cm and about 50 cm). Geophysical data suggests that, in at least some instances, IHS result from lateral growth of large-scale bedforms such as point bars. IHS are typically classified based on their volume percentage of mud-dominated material. IHS comprising greater than 30 vol.% mud-based materials are said to be mud-dominated IHS, and IHS comprising less than 30 vol.% are said to be sand-dominated IHS.

[0079] The interface between two or more lithological regions of different permeabilities is generally referred to as a lithofacies surface. Lithofacies surfaces can be identified by a variety of techniques known to those skilled in the art. In various embodiments, a hydrocarbon-bearing zone may comprise a low permeability zone in form of a consolidated rock barrier or another type of substantially-impermeable zone. Consolidated rock barriers may comprise clastic sedimentary rock (for example, a shale barrier), claystone, siltstone, mudstone, or combinations thereof. In the context of the present disclosure, a substantially-

impermeable zone is one which permits limited or no transmission of steam, hydrocarbons, or combinations thereof. Various other facies present within a hydrocarbon-bearing formation may have a permeabilities from 100 mD to 1,000 mD (various arrangements of sand and mud clasts or breccia), and mud-dominated facies can have permeabilities below 100 mD and often below 10 mD. SAGD and SAPs can become impacted when facies below 1,000 mD are present within the hydrocarbon-bearing formation, and can become considerably impacted when facies below 100mD are present.

[0080] Subterranean formations, such as subterranean hydrocarbon-bearing formations, can be characterized by their *in situ* stress fields, and it is known that the orientations of fracture networks are generally dictated by *in situ* stress fields. *In situ* stress fields are typically defined by three principal stresses: a vertical stress and two orthogonal horizontal stresses. Each of the three principle stresses has a magnitude, and the principle stress with the greatest magnitude is commonly referred to as the maximum principle stress. Likewise, the principle stress with the smallest magnitude is commonly referred to as the minimum principle stress. Basic geo-mechanical principles dictate that a fracture will propagate along a path of least resistance and that the path of least resistance tends to be substantially perpendicular to the direction of the minimum principal stress.

[0081] In non-shallow formations, the vertical stress is typically the maximum principle stress (due to the considerable mass overlying the subterranean formation), and the minimum principle stress is typically a horizontal stress (*i.e.* a minimum-horizontal stress). Consequently, in non-shallow formations, fractures tend to form fracture networks that are that are substantially-vertically oriented. Fractures that are substantially-horizontally oriented may also be formed in non-shallow formations – particularly in instances where bottom-hole testing pressures are substantially greater in magnitude than the vertical stress.

[0082] In shallow formations, the vertical stress may be the minimum principles stress. As such, fractures in shallow formations may form fracture networks that are substantially horizontally oriented. Alternatively, in shallow

formations, the magnitude of the vertical stress may be substantially equal to that of the minimum-horizontal stress. In such cases, fractures tend to form networks of both vertically-oriented and horizontally-oriented fractures.

[0083] In the context of the present disclosure, the complexity of a fracture network is defined by the number of interconnected fractures per unit volume. In other words, fracture-network complexity is synonymous with fracture-network density in the present disclosure. The complexity of a fracture network can be quantified by a variety of techniques known to those skilled in the art. In some instances, the fractures of a fracture network may extend in alternative directions or along alternative planes. In the context of the present disclosure, the geometry of a fracture can be defined by a variety of metrics including but not limited to the physical dimensions of the fracture and the amount of proppant that the fracture contains. In the context of the present disclosure, optimizing fracture geometry, fracture complexity, or a combination thereof may be characterized by production metrics (simulated or field-based) from the recovery hydrocarbons during or after the development of the fracture network.

[0084] In the context of the present disclosure, fractures may be characterized by their orientations. A fracture may be considered to be "vertically oriented", "substantially vertically oriented", "vertical", or "substantially vertical" if it has a dimension that generally aligns with a vertical stress. Likewise, a fracture may be considered to be "horizontally oriented", "substantially horizontally oriented", "horizontal", or "substantially horizontal" if it has a dimension that generally aligns with a horizontal stress plane. In the context of the present disclosure, fractures may also be characterized by their orientation with respect to the wellbore section from which they originate or from a wellbore in proximity to the fracture network. In the case of a longitudinal wellbore section that is disposed about a longitudinal wellbore axis, a fracture may be said to be "transverse" or "substantially transverse" if it is substantially orthogonal to the longitudinal wellbore axis. Likewise, a fracture may be said to be "longitudinal" or "substantially-longitudinal" if it is not substantially orthogonal to the longitudinal wellbore axis. Accordingly, a fracture network originating from a longitudinal

wellbore section can be characterized as comprising substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, substantially-horizontal fractures, or a combination thereof. Those skilled in the art will recognize that the foregoing are terms of convenience and that induced fractures
 5 often defy such simple characterizations. Accordingly, the orientation of a fracture or a fracture network should not be considered to alter the scope of the present disclosure.

[0085] In the context of the present disclosure, a stimulant fluid is “a fluid that is suitable for inducing fractures in a formation and/or for carrying a propping
 10 agent into a fracture”. Stimulant fluids may comprise additives and/or propping agents. Stimulant fluids are typically characterized by their viscosity, density, and other fluid characteristics. Categories of stimulant fluids include but are not limited to, water-based, foam-based, oil-based, acid-based, alcohol-based, emulsion-based or other-fluid-based stimulant fluids. Categories of additives include but are
 15 not limited to friction-reducing additives, fluid-loss-preventing additives, surfactant additives, clay control additives, and chemical additives. In the context of the present disclosure, “a propping agent” is a solid material that is suitable for substantially maintaining the fracture geometry of a fracture. Categories of propping agents include but are not limited to natural propping agents (such as
 20 frac-sand), synthetic propping agents (such as ceramic proppants), modified propping agents (such as resin-coated proppants), or combinations thereof.

[0086] In the context of the present disclosure, hydrocarbon-bearing formations may be characterized by their *in situ* stress fields. *In situ* stress fields may be modelled based on field data including but not limited to image-log data,
 25 core data, acoustic data, diagnostic-fracturing data, seismic data, and combinations thereof. The modelling may define a vertical stress and two horizontal stresses. In some instances, the vertical stress may be angularly off-set from a strictly vertical axis, and/or the two horizontal stresses may be angularly off-set from the horizontal plane.

30 [0087] In the context of the present disclosure, two or more wells are “substantially vertically coplanar” when they are substantially disposed about axes

that generally fall along a single plane that is oriented substantially vertically. A typical SAGD well pair is an example of a well pair that is substantially vertically coplanar. Those skilled in the art will appreciate that most wells are not drilled in a strictly linear fashion, and that wells may still be substantially vertically coplanar
5 in spite of typical directional drilling variations.

[0088] As used herein, the term "about" refers to an approximately +/-10% variation from a given value. It is to be understood that such a variation is always included in any given value provided herein, whether or not it is specifically referred to.

10 Processes and methods of the present disclosure

[0089] Developing a fracture network in a hydrocarbon bearing formation allows for increased hydrocarbon-bearing-formation permeability. The fracture network may comprise horizontal fractures, transverse-vertical fractures, longitudinal-vertical fractures, or a combination thereof. In the context of the
15 present disclosure, it was found that processes for developing such fracture networks in such hydrocarbon-bearing formations benefit from offsetting at least one substantially-longitudinal wellbore section of at least one well relative to: (i) a substantially-longitudinal wellbore section of a second well; (ii) a plane defined by the maximum horizontal stress and the minimum horizontal stress; (iii) a lithofacies
20 surface; or (iv) a combination thereof. Offsetting the at least one substantially-longitudinal wellbore section in such a way allows for modification of fracture geometry, fracture complexity, or a combination thereof within the fracture network. As it pertains to methods of recovering hydrocarbons and/or processes for enhancing hydrocarbon recovery, it was found that offsetting the at least one
25 substantially-longitudinal wellbore section in such a way allows for modification of heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

[0090] Select embodiments of the present disclosure relate to generally shallow hydrocarbon-bearing formations. In the context of the present disclosure,
30 shallow hydrocarbon-bearing formations are those in which the vertical stress is

less than or substantially equal to the maximum-horizontal stress. By way of non-limiting example, shallow hydrocarbon-bearing formations may reside at depths of less than about 600 m below the surface. Fracture networks developed in shallow formations by processes in accordance with the present disclosure may comprise

5 substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof. In particular, fracture networks developed in shallow formations by processes in accordance with the present disclosure may comprises substantially-horizontal fractures and:

10 (i) substantially-transverse-vertical fractures, (ii) substantially-longitudinal-vertical fractures, or (iii) a combination of (i) and (ii). Such fractures may intersect at a variety of angles. By way of non-limiting example, a substantially-horizontal fracture may intersect a substantially-transverse-vertical fracture or a substantially-longitudinal-vertical fractures at an angle between 0° and about 180° (preferably between about 45° and about 135° , in particular between about 80°

15 and about 100°). Fractures that intersect at angles between about 80° and about 100° are referred to herein as "T-shaped fractures" or "substantially T-shaped fractures". Processes in accordance with the present disclosure that develop T-shaped fractures may allow for modified heat transfer within the formation, modified hydrocarbon flow-rate within the formation, modified hydrocarbon

20 capture from the formation, or a combination thereof during methods of hydrocarbon recovery in accordance with present disclosure and/or processes for enhanced hydrocarbon recovery in accordance with present disclosure.

[0091] Select embodiments of the present disclosure relate to non-shallow hydrocarbon-bearing formations. In the context of the present disclosure, non-

25 shallow hydrocarbon-bearing formations are those in which the vertical stress is greater than the maximum-horizontal stress. By way of non-limiting example, non-shallow hydrocarbon-bearing formations may reside at depths greater than about 600 m below the surface. Fracture networks developed in non-shallow formations by processes in accordance with the present disclosure may comprises

30 substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof. In particular, fracture networks developed in non-shallow formations by processes in

accordance with the present disclosure may comprise substantially-transverse-vertical fractures and substantially-longitudinal-vertical fractures. Such fractures may intersect at a variety of angles. By way of non-limiting example, a substantially-transverse-vertical fracture may intersect a substantially-longitudinal-vertical fracture at an angle between 0° and about 180° (preferably between about 45° and about 135°, in particular between about 80° and about 100°). Likewise, a substantially-horizontal fracture may intersect a substantially-transverse-vertical fracture, a substantially-longitudinal-vertical fracture, or a combination thereof at an angle between 0° and about 180° (preferably between about 45° and about 135°, in particular between about 80° and about 100°). Fractures that intersect at angles between about 80° and about 100° are referred to herein as “T-shaped fractures” or “substantially T-shaped fractures”. Processes in accordance with the present disclosure that develop T-shaped fractures may allow for modified heat transfer within the formation, modified hydrocarbon flow-rate within the formation, modified hydrocarbon capture from the formation or a combination thereof during methods of hydrocarbon recovery in accordance with present disclosure and/or processes for enhanced hydrocarbon recovery in accordance with present disclosure.

[0092] Select embodiments of the present disclosure relate to multi-zone hydrocarbon-bearing formations. Such multi-zone hydrocarbon-bearing formations may be shallow, multi-zone hydrocarbon-bearing formations, or they may be non-shallow, multi-zone hydrocarbon-bearing formations. In the context of the present disclosure a “zone” or “hydrocarbon-bearing zone” in a reservoir is merely an arbitrarily defined volume of the reservoir, typically characterised by some predominant property. A zone may or may not contain hydrocarbons. A zone may be defined by its permeability. Multi-zone hydrocarbon-bearing formations may comprise unconsolidated oil sands, and/or they may comprise shales (e.g. hydrocarbon-bearing shales).

[0093] In the context of the present disclosure, a multi-zone hydrocarbon-bearing formation is one that comprises a lithofacies surface. The term “lithofacies surface” defines the interface between two or more lithological regions of different

permeabilities. Lithofacies surfaces can be identified by a variety of techniques known to those skilled in the art. By way of non-limiting example, an interface between a low-permeability zone and a high-permeability zone may form a lithofacies surface. Lithofacies surfaces may be heterogeneous or homogeneous.

- 5 [0094] Select embodiments of the present disclosure relate to multi-zone hydrocarbon-bearing formations, wherein the lithofacies surface is one in a plurality of inclined heterolithic strata. Select embodiments relate to multi-zone hydrocarbon-bearing formations that are penetrated by a longitudinal wellbore section of at least one well, wherein the longitudinal wellbore section intersects a
10 lithofacies surface at an angle of between about 0° and about 180°. In select embodiments, the lithofacies surface may be an interface between a first-hydrocarbon bearing zone and a second hydrocarbon bearing zone. In select embodiments, the first hydrocarbon bearing zone and the second hydrocarbon bearing zone may have different permeabilities. In select embodiments, at least
15 one of the first hydrocarbon-bearing zone and the second hydrocarbon-bearing zone may comprise an unconsolidated oil sand. In select embodiments, at least one of the first hydrocarbon-bearing zone and the second hydrocarbon-bearing zone comprises a consolidated rock barrier.

- [0095] Select embodiments of the present disclosure relate to single-zone
20 hydrocarbon-bearing formations. Such single-zone hydrocarbon-bearing formations may be shallow, single-zone hydrocarbon-bearing formations or they may be non-shallow, single-zone hydrocarbon-bearing formations. In the context of the present disclosure, a single-zone hydrocarbon-bearing formation is one that does not comprise a lithofacies surface in proximity to a fracture network.

- 25 [0096] In select embodiments of the present disclosure, a single-zone hydrocarbon-bearing formation may comprise an unconsolidated oil sand or shale (e.g. a hydrocarbon-bearing shale). In select embodiments, a single-zone hydrocarbon-bearing formation may be penetrated by a longitudinal wellbore section of at least one well. The longitudinal wellbore section may be disposed
30 about an axis that is substantially coplanar with the minimum-horizontal stress of the formation. Alternatively, the longitudinal wellbore section may be disposed

about an axis that is substantially coplanar with the maximum-horizontal stress of the formation.

[0097] In the context of the present disclosure, hydrocarbon-bearing formations may be: (i) shallow, single-zone hydrocarbon-bearing formations; (ii) 5 shallow, multi-zone hydrocarbon-bearing formations; (iii) non-shallow, single-zone hydrocarbon-bearing formations; or (iv) non-shallow, multi-zone hydrocarbon-bearing formations. Such formations may be penetrated by wells in a variety of well configurations in accordance with processes and methods of the present disclosure.

10 [0098] In select embodiments of the present disclosure, a hydrocarbon-bearing formation may be penetrated by a well pair comprising: (i) a first well having a vertical wellbore section and a longitudinal wellbore section, and (ii) a second well having a vertical wellbore section and a longitudinal wellbore section. the longitudinal wellbore section of the first well may be: (a) laterally displaced 15 from, and (b) angularly offset from, the longitudinal wellbore section of the second well such that the longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view. In select embodiments, the crossing pattern may consist of two acute angles that are 90° or less and two obtuse angles that are 90° or between 20 90° and about 180°. In select embodiments, the two acute angles may be between about 30° and about 60°. In select embodiments, the two obtuse angles may be between about 120° and about 150°.

[0099] In select embodiments of the present disclosure, the longitudinal wellbore section of at least one of the first well and the second well may be 25 angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress. For example, the longitudinal wellbore section of at least one of the first well and the second well may be angularly offset from the plane defined by the maximum-horizontal stress and the minimum-horizontal stress by between about 0° and about 90° (such as between about 35° and about 30 55°). In select embodiments, the longitudinal wellbore section of at least one of the first well and the second well may be angularly offset from a lithofacies surface

within the hydrocarbon-bearing formation. For example, the longitudinal wellbore section of at least one of the first well and the second well may be angularly offset from the lithofacies surface by between about 0 ° and about 180 ° (such as between about 45 ° and about 135 °).

- 5 [00100] In select embodiments of the present disclosure, the first well may comprise a plurality of toe-up wells and the second well may comprise a plurality of toe-down wells. In select embodiments, the plurality of toe-up wells and the plurality of toe-down wells may be arranged in an alternating configuration. In select embodiments, the first well and the second well may comprise a well pair
10 that is one of a plurality of well pairs. Such well pairs may originate from one well pad, or they may originate from a plurality of well pads.

[00101] In select embodiments of the present disclosure, the vertical wellbore section of the first well may be laterally displaced and longitudinally displaced from the vertical wellbore section of the second well.

- 15 [00102] In select embodiments of the present disclosure, a hydrocarbon-bearing formation may be penetrated by a well pair comprising: (i) a first well having a vertical wellbore section and a longitudinal wellbore section, and (ii) a second well having a vertical wellbore section and a longitudinal wellbore section. In select embodiments, the longitudinal wellbore section of at least one of the first
20 well and the second well may be angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress. For example, the longitudinal wellbore section of at least one of the first well and the second well may be angularly offset from the plane defined by the maximum-horizontal stress and the minimum-horizontal stress by between about 0 ° and about 90 ° (such as
25 between about 35 ° and about 55 °). In select embodiments, the longitudinal wellbore section of at least one of the first well and the second well may be angularly offset from a lithofacies surface within the hydrocarbon-bearing formation. For example, the longitudinal wellbore section of at least one of the first well and the second well may be angularly offset from the lithofacies surface by
30 between about 0 ° and about 180 ° (such as between about 45 ° and about 135 °).

[00103] In select embodiments of the present disclosure, the longitudinal wellbore section of the first well may be laterally displaced from the longitudinal wellbore section of the second well. In select embodiments, the first well and the second well may comprise a well pair that is one of a plurality of well pairs
5 originating from one or more well pads. In select embodiments, the longitudinal wellbore section of the first well and the longitudinal section of the second well may be vertically displaced and coplanar.

[00104] In select embodiments of the present disclosure, a hydrocarbon-bearing formation may be penetrated by a single well having a longitudinal
10 wellbore section. In select embodiments, the longitudinal wellbore section may be angularly offset from a plane defined by the maximum-horizontal stress and the minimum-horizontal stress. For example, the longitudinal wellbore section of the well may be angularly offset from the plane defined by the maximum-horizontal stress and the minimum-horizontal stress by between about 0 ° and about 90 °
15 (such as between about 35 ° and about 55 °). In select embodiments, the longitudinal wellbore section may be angularly offset from a lithofacies surface within the hydrocarbon-bearing formation. For example, the longitudinal wellbore section of the well may be angularly offset from the lithofacies surface by between about 0 ° and about 180 ° (such as between about 35 ° and about 55 °).

[00105] In select embodiments of the present disclosure, the longitudinal wellbore section may be in a toe-up configuration. In select embodiments, the longitudinal wellbore section may be in a toe-down configuration. In select
20 embodiments, the longitudinal wellbore section may be provided as an additional leg to an existing well. The existing well may be an existing SAGD well pair. In
25 select embodiments the longitudinal wellbore section may be provided in an inter-well region between an existing set of wells (such as in an inter-well region between an existing pair of SAGD well pairs).

[00106] In select embodiments of the present disclosure, a hydrocarbon-bearing formation may be penetrated by a well pair comprising: (i) a first well
30 having a vertical wellbore section and a horizontal wellbore section, and (ii) a second well having a vertical wellbore section and a horizontal wellbore section.

In select embodiments, at least one of the horizontal wellbore section of the first well and the horizontal section of the second well may be angularly offset from a lithofacies surface. For example, the longitudinal wellbore section of at least one of the first well and the second well may be angularly offset from the lithofacies surface by between about 0 ° and about 180 ° (such as between about 45 ° and about 135 °).

[00107] In select embodiments of the present disclosure, the horizontal wellbore section of the first well and the horizontal section of the second well may be vertically displaced and coplanar.

10 [00108] Select embodiments of the present disclosure relate to processes for developing fracture networks in hydrocarbon-bearing formations. Such embodiments utilize one or more wells in a well configuration that modifies fracture geometry and fracture complexity within the fracture network. Such hydrocarbon-bearing formations may be: (i) shallow, single-zone hydrocarbon-bearing formations; (ii) shallow, multi-zone hydrocarbon-bearing formations; (iii) non-shallow, single-zone hydrocarbon-bearing formations; or (iv) non-shallow, multi-zone hydrocarbon-bearing formations. Such hydrocarbon-bearing formations may be at native reservoir temperature or within about 20 °C of native reservoir temperature prior to the injecting of the stimulant fluid. Such hydrocarbon-bearing formations may also be at higher temperatures, as processes for developing fracture networks in accordance with the present disclosure may be employed after, concurrent with, or in proximity to thermal recovery processes. Those skilled in the art will recognize that thermal recovery processes are associated with temperatures up to about 260 °C (e.g. steam injection) which can increase formations more than 20 °C above the native reservoir temperature.

[00109] Processes for developing fracture networks in accordance with the present disclosure may comprise injecting a stimulant fluid comprising a propping agent into the formation. In select embodiments, the stimulant fluid may be a water-based stimulant fluid, a foam-based stimulant fluid, an oil-based stimulant fluid, an acid-based stimulant fluid, an alcohol-based stimulant fluid, an emulsion-based stimulant fluid or a combination thereof. In select embodiments, the

propping agent may be a natural propping agent (such as frac-sand), a synthetic propping agent (such as a ceramic proppants), a modified propping agent (such as a resin-coated proppant), or a combination thereof. In select embodiments, the stimulant fluid may further comprise an additive. The additive may be a friction-
5 reducing additive, a fluid-loss-preventing additive, a surfactant additive, a clay control additive, a chemical additive, or a combination thereof. Those skilled in the art will recognize stimulant fluids and/or propping agents that are not explicitly set out herein, but that fall within the scope of the present disclosure.

[00110] Select embodiments of the present disclosure relate to methods for
10 recovering hydrocarbons from hydrocarbon-bearing formations. Such embodiments utilize one or more wells in a well configuration that is selected to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or combinations thereof. Such hydrocarbon-bearing formations may be: (i) shallow, single-zone hydrocarbon-
15 bearing formations; (ii) shallow, multi-zone hydrocarbon-bearing formations; (iii) non-shallow, single-zone hydrocarbon-bearing formations; or (iv) non-shallow, multi-zone hydrocarbon-bearing formations. Such hydrocarbon-bearing formations may be at native reservoir temperature prior to application of a thermal process or within about 20 °C of native reservoir temperature prior to application
20 of a thermal process.

[00111] Methods for recovering hydrocarbons in accordance with the present disclosure may comprise injecting a stimulant fluid comprising a propping agent into the formation. In select embodiments, the stimulant fluid may be a water-based stimulant fluid, a foam-based stimulant fluid, an oil-based stimulant
25 fluid, an acid-based stimulant fluid, an alcohol-based stimulant fluid, an emulsion-based stimulant fluid or a combination thereof. In select embodiments, the propping agent may be a natural propping agent (such as frac-sand), a synthetic propping agent (such as a ceramic proppants), a modified propping agent (such as a resin-coated proppant), or a combination thereof. In select embodiments, the
30 stimulant fluid may further comprise an additive. The additive may be a friction-reducing additive, a fluid-loss-preventing additive, a surfactant additive, a clay

control additive, a chemical additive, or a combination thereof. In select embodiments, hydrocarbons may have been recovered from the hydrocarbon-bearing formation prior to the injecting of the stimulant fluid. Those skilled in the art will recognize additives that are not explicitly set out herein, but that fall within
5 the scope of the present disclosure.

[00112] Methods for recovering hydrocarbons in accordance with the present disclosure may further comprise modulating the mobility of hydrocarbons within hydrocarbon-bearing formation. The modulating of the mobility of the hydrocarbons may precede – or be concurrent with – the injecting of the stimulant
10 fluid. Alternatively, the injecting of the stimulant fluid may precede the modulating of the mobility of the hydrocarbons.

[00113] In select embodiments of the present disclosure, modulating the mobility of the hydrocarbons may comprise injecting an injecting fluid into the formation. The injection fluid may be steam, solvent, or a combination thereof. In
15 select embodiments, the solvent may be a C₁-C₁₂ hydrocarbon. In select embodiments, the recovering of the hydrocarbons from the hydrocarbon-bearing formation may comprise a gravity dominated recovery process. In select embodiments, the recovering of the hydrocarbons from the hydrocarbon-bearing formation may comprise SAGD, CSS, SAP, or a solvent-based process.

20 [00114] In select embodiments of the present disclosure, the injecting of the stimulant fluid may precede the modulating of the mobility of the hydrocarbons. In select embodiments, the modulating of the mobility of the hydrocarbons may precede the injecting of the stimulant fluid..

[00115] Select embodiments of the present disclosure relate to processes
25 for enhancing hydrocarbon recovery from hydrocarbon-bearing formations. Such embodiments utilize one or more wells in a well configuration that is selected to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof. Such hydrocarbon-bearing formations may be: (i) shallow, single-zone hydrocarbon-
30 bearing formations; (ii) shallow, multi-zone hydrocarbon-bearing formations; (iii)

non-shallow, single-zone hydrocarbon-bearing formations; or (iv) non-shallow, multi-zone hydrocarbon-bearing formations. Such hydrocarbon-bearing formations may be at native reservoir temperature or within about 20 °C of native reservoir temperature prior to the injecting of the stimulant fluid.

5 [00116] Processes for enhancing hydrocarbon recovery in accordance with the present disclosure may comprise injecting a stimulant fluid comprising a propping agent into the formation. In select embodiments, the stimulant fluid may be a water-based stimulant fluid, a foam-based stimulant fluid, an oil-based stimulant fluid, an acid-based stimulant fluid, an alcohol-based stimulant fluid, an emulsion-based stimulant fluid or a combination thereof. In select embodiments, 10 the propping agent may be a natural propping agent (such as frac-sand), a synthetic propping agent (such as a ceramic proppants), a modified propping agent (such as a resin-coated proppant), or a combination thereof. In select embodiments, the stimulant fluid may further comprise an additive. The additive 15 may be a friction-reducing additive, a fluid-loss-preventing additive, a surfactant additive, a clay control additive, a chemical additive, or a combination thereof. In select embodiments, hydrocarbons may have been recovered from the hydrocarbon-bearing formation prior to the injecting of the stimulant fluid.

[00117] Embodiments of the present disclosure will now be described by 20 reference to **FIGS. 1 – 13**.

[00118] **FIG. 1** shows a schematic rectangular-prismatic section of a hydrocarbon-bearing formation 100 that comprises a fracture network originating from a longitudinal wellbore section 102. The longitudinal wellbore section 102 is disposed about a longitudinal wellbore axis 104. The rectangular-prismatic section 25 is defined in part by a pair of transverse-vertical planes 106 / 106' that intersect the longitudinal wellbore axis 104. The rectangular-prismatic section is further defined by a pair of horizontal planes 108 / 108' that are orthogonal to transverse-vertical planes 106 / 106' and that are parallel to the longitudinal wellbore axis 104. The rectangular-prismatic section is further defined by a pair of longitudinal-vertical planes 110 / 110' that are orthogonal to both the transverse-vertical planes 30 106 / 106' and the horizontal planes 108 / 108'. The fracture network comprises a

transverse-vertical fracture 112 that is substantially parallel to the transverse-vertical planes 106 / 106'. The network also comprises a horizontal fracture 114 that is substantially parallel to the horizontal planes 108 / 108'. The fracture network also comprises a longitudinal-vertical fracture 116 that is substantially
5 parallel to the longitudinal-vertical planes 110 / 110'.

[00119] **FIG. 2A – FIG. 2H** provide schematic representations of a series of well configurations in various lithological environments. The well configurations may be suitable for developing fracture networks in hydrocarbon-bearing formations by processes according to the present disclosure. The well
10 configurations may also be suitable for recovering hydrocarbons from hydrocarbon-bearing formations by methods according to the present disclosure. The well configurations may also be suitable for enhancing hydrocarbon recovery from hydrocarbon-bearing formations by processes according to the present disclosure.

15 [00120] **FIG. 2A** shows a schematic perspective view of a hydrocarbon-bearing formation 200 that comprises a first high-permeability zone 202, a second high-permeability zone 204, and a low-permeability zone 206 interlayered therebetween. The low-permeability zone 206 may be substantially impermeable to steam, hydrocarbons, or a combination thereof. The interface between the first
20 high-permeability zone 202 and the low-permeability zone 206 defines a first lithofacies surface 208. The interface between the second high-permeability zone 204 and the low-permeability zone 206 defines a second lithofacies surface 210. The first high-permeability zone 202 may have substantially the same permeability of the second high-permeability zone 204. Alternatively, the permeabilities of the
25 first high-permeability zone 202 and the second high-permeability zone 204 may be different. The hydrocarbon-bearing formation 200 is penetrated by a first well 212 and a second well 214 which is laterally displaced from the first well 212. A fracture network may be induced from the first well 212, the second well 214, or a combination thereof. Accordingly, a stimulant fluid comprising a proppant may be
30 injected from the first well 212, the second well 214, or a combination thereof. Moreover, the first well 212, the second well 214, or a combination thereof may

be equipped as an injection well, a production well, or a combination thereof. The first well 212 has a vertical wellbore section 216 and a longitudinal wellbore section 218. The second well 214 has a vertical wellbore section 220 and a longitudinal wellbore section 222. The longitudinal wellbore section 218 of the first well 212 is oriented in a toe-up configuration, and the longitudinal wellbore section 222 of the second well 214 is oriented in a toe-down configuration. Accordingly, the longitudinal wellbore section 218 of the first well 212 is angularly offset from the longitudinal wellbore section 222 of the second well 214 such that they form a crossing pattern when viewed from a longitudinal elevation view. The longitudinal wellbore sections 218 / 222 are also angularly offset from at least a part of the lithofacies surfaces 208 / 210.

[00121] **FIG. 2B** shows a schematic perspective view of a hydrocarbon-bearing formation 224 that comprises a series of low-permeability zones 226 that are interlayered with a series of high-permeability zones 228. One or more of the low-permeability zones 226 may be substantially impermeable to steam, hydrocarbons, or a combination thereof. Each of the low-permeability zones 226 may have substantially the same permeability. Alternatively, two or more of the low-permeability zones 226 may have different permeabilities. Likewise, each of the high-permeability zones 228 may have substantially the same permeability. Alternatively, two or more of the high-permeability zones 228 may have different permeabilities. The interfaces between the low-permeability zones 226 and the high-permeability zones 228 define a series of lithofacies surfaces 230. The low-permeability zones 226, the high-permeability zones 228, and the lithofacies surfaces 230 are inclined relative their depositional plane such that they form an inclined heterolithic strata (IHS). To provide greater clarity, the dimensions of at least some of the low-permeability zones 226 and/or the high-permeability zones 228 are shown at exaggerated scale in **FIG. 2B**. Those skilled in the art will recognize that IHS comprising low-permeability zones of a wide variety of thicknesses are known, and that typical IHS have low-permeability zones with thicknesses between about 1 cm and about 50 cm (often between about 1 cm and about 10 cm). Likewise, those skilled in the art will recognize that IHS comprising high-permeability zones of a wide variety of thicknesses are known, and that

typical IHS have high-permeability zones with thicknesses between about 1 cm and about 1 m (often between about 5 cm and about 50 cm). The hydrocarbon-bearing formation 224 is penetrated by a first well 232 and a second well 234 which is substantially vertically coplanar with the first well 232. A fracture network
 5 may be induced from the first well 232, the second well 234, or a combination thereof. Accordingly, a stimulant fluid comprising a proppant may be injected from the first well 232, the second well 234, or a combination thereof. Moreover, the first well 232 may be equipped as an injection well, and the second well 234 may be equipped as a production well. The first well 232 has a vertical wellbore section
 10 236 and a longitudinal wellbore section 238. The second well 234 has a vertical wellbore section 240 and a longitudinal wellbore section 242. The longitudinal wellbore section 238 of the first well 232 is oriented in a toe-up configuration, and the longitudinal wellbore section 242 of the second well 234 is oriented in a horizontal configuration. Accordingly, the longitudinal wellbore section 238 of the
 15 first well 232 is angularly offset from the longitudinal wellbore section 242 of the second well 234. The longitudinal wellbore sections 238 / 242 are also angularly offset from at least a part of the lithofacies surfaces 230.

[00122] **FIG. 2C** shows a schematic perspective view of a hydrocarbon-bearing formation 244 that comprises a high-permeability zone 246. The high-permeability zone 246 has a stress field defined by a vertical stress 248, a
 20 maximum-horizontal stress 250, and a minimum-horizontal stress 252. The stresses 246/248/252 are schematic in that they do not represent particular (or relative) magnitudes. The hydrocarbon-bearing formation 244 is penetrated by a first well 254 and a second well 256. A fracture network may be induced from the first well 254, the second well 256, or a combination thereof. Accordingly, a
 25 stimulant fluid comprising a proppant may be injected from the first well 254, the second well 256, or a combination thereof. Moreover, the first well 254 may be equipped as an injection well, and the second well 256 may be equipped as a production well. The first well 254 is substantially vertically coplanar with the second well 256. The first well 254 has a vertical wellbore section 258 and a
 30 longitudinal wellbore section 260. The second well 256 has a vertical wellbore section 262 and a longitudinal wellbore section 264. The longitudinal wellbore

section 260 of the first well 254 is oriented in a toe-up configuration, and the longitudinal wellbore section 264 of the second well 256 is oriented in a horizontal configuration. Accordingly, the longitudinal wellbore section 260 of the first well 254 is angularly offset from the longitudinal wellbore section 264 of the second well 256. The longitudinal wellbore section 260 of the first well 254 is also angularly offset from a plane defined by the maximum-horizontal stress 250 and the minimum horizontal stress 252.

[00123] **FIG. 2D** shows a schematic perspective view of a hydrocarbon-bearing formation 268 that comprises a series of low-permeability zones 270 that are interlayered by a series of high-permeability zones 272. One or more of the low-permeability zones 270 may be substantially impermeable to steam, hydrocarbons, or a combination thereof. Each of the low-permeability zones 270 may have substantially the same permeability. Alternatively, two or more of the low-permeability zones 270 may have different permeabilities. Likewise, each of the high-permeability zones 272 may have substantially the same permeability. Alternatively, two or more of the high-permeability zones 272 may have different permeabilities. The interfaces between the low-permeability zones 270 and the high-permeability zones 272 define a series of lithofacies surfaces 274. Some of the low-permeability zones 270, the high-permeability zones 272, and the lithofacies surfaces 274 are inclined relative their depositional plane such that they form an IHS. To provide greater clarity, the dimensions of at least some of the low-permeability zones 270 and the high-permeability zones 272 are shown at exaggerated scale in **FIG. 2D**. Those skilled in the art will recognize that IHS comprising low-permeability zones of a wide variety of thicknesses are known, and that typical IHS have low-permeability zones with thicknesses between about 1 cm and about 50 cm (often between about 1 cm and about 10 cm). Likewise, those skilled in the art will recognize that IHS comprising high-permeability zones of a wide variety of thicknesses are known, and that typical IHS have high-permeability zones with thicknesses between about 1 cm and about 1 m (often between about 5 cm and about 50 cm). The hydrocarbon-bearing formation 268 further comprises a high-permeability zone 276 which underlies the IHS. The hydrocarbon-bearing formation 268 is penetrated by a first well 278 and a second

well 280 which is substantially vertically coplanar with the first well 278. A fracture network may be induced from the first well 278, the second well 280, or a combination thereof. Accordingly, a stimulant fluid comprising a proppant may be injected from the first well 278, the second well 280, or a combination thereof.

5 Moreover, the first well 278 may be equipped as an injection well, and the second well 280 may be equipped as a production well. The first well 278 has a vertical wellbore section 282 and a longitudinal wellbore section 284. The second well 280 has a vertical wellbore section 286 and a longitudinal wellbore section 288. The longitudinal wellbore section 284 of the first well 278 is oriented in a toe-up

10 configuration, and the longitudinal wellbore section 288 of the second well 280 is oriented in a horizontal configuration. Accordingly, the longitudinal wellbore section 284 of the first well 278 is angularly offset from the longitudinal wellbore section 288 of the second well 280. The longitudinal wellbore section 284 of the first well 278 penetrates the IHS and is angularly offset from at least a part of the

15 lithofacies surfaces 274.

[00124] **FIG. 2E** shows a schematic perspective view of a hydrocarbon-bearing formation 290 that comprises a high-permeability zone 292. The high-permeability zone 292 has a stress field defined by a vertical stress 294, a maximum-horizontal stress 296, and a minimum-horizontal stress 298. The stresses 294/296/298 are schematic in that they do not represent particular (or

20 relative) magnitudes. The hydrocarbon-bearing formation 290 is penetrated by a first well 201, a second well 203, and a third well 205. The second well 203 and the third well 205 are each substantially vertically coplanar with the first well 201. A fracture network may be induced from the first well 201, the second well 203,

25 the third well 205, or a combination thereof. Accordingly, a stimulant fluid comprising a proppant may be injected from the first well 201, the second well 203, the third well 205, or a combination thereof. Moreover, the first well 201, the second well 203, or a combination thereof may be equipped as an injection well, and the third well 205 may be equipped as a production well. The first well 201

30 has a vertical wellbore section 207 and a longitudinal wellbore section 209. The second well 203 has a vertical wellbore section 211 and a longitudinal wellbore section 213. The third well 205 has a vertical wellbore section 215 and a

longitudinal wellbore section 217. The longitudinal wellbore section 209 of the first well 201 is oriented in a toe-up configuration. The longitudinal wellbore sections 213 / 217 of the wells 203 / 205 are oriented in a horizontal configuration as is typical of a SAGD well configuration. The longitudinal wellbore section 209 of the first well 201 is angularly offset from the longitudinal wellbore sections 213 / 217 of the wells 203 / 205. The longitudinal wellbore section 209 of the first well 201 is also angularly offset from a plane defined by the maximum-horizontal stress 296 and the minimum-horizontal stress 298.

[00125] **FIG. 2F** shows a schematic perspective view of a hydrocarbon-bearing formation 219 that comprises a series of low-permeability zones 221 that are interlayered with a series of high-permeability zones 223. One or more of the low-permeability zones 221 may be substantially impermeable to steam, hydrocarbons, or a combination thereof. Each of the low-permeability zones 221 may have substantially the same permeability. Alternatively, two or more of the low-permeability zones 221 may have different permeabilities. Likewise, each of the high-permeability zones 223 may have substantially the same permeability. Alternatively, two or more of the high-permeability zones 223 may have different permeabilities. The interfaces between the low-permeability zones 221 and the high-permeability zones 223 define a series of lithofacies surfaces 225. Some of the low-permeability zones 221, the high-permeability zones 223, and the lithofacies surfaces 225 are inclined relative their depositional plane such that they form an IHS. To provide greater clarity, the dimensions of at least some the low-permeability zones 221 and the high-permeability zones 223 are shown at exaggerated scale in **FIG. 2F**. Those skilled in the art will recognize that IHS comprising low-permeability zones of a wide variety of thicknesses are known, and that typical IHS have low-permeability zones with thicknesses between about 1 cm and about 50 cm (often between about 1 cm and about 10 cm). Likewise, those skilled in the art will recognize that IHS comprising high-permeability zones of a wide variety of thicknesses are known, and that typical IHS have high-permeability zones with thicknesses between about 1 cm and about 1 m (often between about 5 cm and about 50 cm). The hydrocarbon-bearing formation 219 further comprises is a high-permeability zone 227 which underlies the IHS. The

hydrocarbon-bearing formation 219 is penetrated by a first well 229, a second well 231, and a third well 233. The second well 231 and the third well 233 are each substantially vertically coplanar with the first well 229. A fracture network may be induced from the first well 229, the second well 231, the third well 233, or a combination thereof. Accordingly, a stimulant fluid comprising a proppant may be injected from the first well 229, the second well 231, the third well 233, or a combination thereof. Moreover, the first well 229, the second well 231, or a combination thereof may be equipped as an injection well, and the third well 233 may be equipped as a production well. The first well 229 has a vertical wellbore section 235 and a longitudinal wellbore section 237. The second well 231 has a vertical wellbore section 239 and a longitudinal wellbore section 241. The third well 233 has a vertical wellbore section 243 and a longitudinal wellbore section 245. The longitudinal wellbore section 237 of the first well 229 is oriented in a toe-up configuration. The longitudinal wellbore sections 241 / 245 of the wells 231 / 233 are oriented in a horizontal configuration as is typical of a SAGD well configuration. The longitudinal wellbore section 237 of the first well 229 is angularly offset from the longitudinal wellbore sections 241 / 245 of the wells 231 / 233. The longitudinal wellbore section 237 of the first well 229 is also angularly offset from at least a part of the lithofacies surfaces 225.

[00126] FIG. 2G shows a schematic perspective view of a hydrocarbon-bearing formation 247 that comprises a low-permeability zone 249 such as a shale gas formation or a shale oil formation. The low-permeability zone 249 may be naturally fractured, or not. The low-permeability zone 249 has a stress field defined by a vertical stress 251, a maximum-horizontal stress 253, and a minimum-horizontal stress 255. The stresses 251/253/255 are schematic in that they do not represent particular (or relative) magnitudes. The hydrocarbon-bearing formation 247 is penetrated by a first well 257 and a second well 259 which is laterally displaced from the first well 257. A fracture network may be induced from the first well 257, the second well 259, or a combination thereof. Accordingly, a stimulant fluid comprising a proppant may be injected from the first well 257, the second well 259, or a combination thereof. Moreover, the first well 257, the second well 259, or a combination thereof may be equipped as an injection well, a production

well, or a combination thereof. The first well 257 has a vertical wellbore section 261 and a longitudinal wellbore section 263 comprising a toe 265 and a heel 267. The second well 259 has a vertical wellbore section 269 and a longitudinal wellbore section 271 comprising a toe 273 and a heel 275. The longitudinal wellbore section 263 of the first well 257 is oriented in a toe-up configuration, and the longitudinal wellbore section 271 of the second well 259 is oriented in a toe-down configuration. Accordingly, the longitudinal wellbore section 263 of the first well 257 is angularly offset from the longitudinal wellbore section 271 of the second well 259 such that they form a crossing pattern when viewed from a longitudinal elevation view. The longitudinal wellbore sections 263 / 271 are also angularly offset from a plane defined by the maximum-horizontal stress 253 and the minimum-horizontal stress 255. The longitudinal wellbore sections 263 / 271 are oriented such that the toes 265 / 273 are in closer proximity than the heels 267 / 275.

15 [00127] **FIG. 2H** shows a schematic perspective view of a hydrocarbon-bearing formation 279 that comprises a first high-permeability zone 283, a second high-permeability zone 285, and a low-permeability zone 281 interlayered therebetween. The low-permeability zone 281 may be substantially impermeable to steam, hydrocarbons, or a combination thereof. The interface between the first high-permeability zone 283 and the low-permeability zone 281 defines a first lithofacies surface 287. The interface between the second high-permeability zone 285 and the low-permeability zone 281 defines a second lithofacies surface 289. The first high-permeability zone 283 may have substantially the same permeability of the second high-permeability zone 285. Alternatively, the permeabilities of the first high-permeability zone 283 and the second high-permeability zone 285 may be different. The hydrocarbon-bearing formation 279 is penetrated by a well 291. A fracture network may be induced from the well 291. Accordingly, a stimulant fluid comprising a proppant may be injected from the well 291. The well 291 may be equipped as an injection well and a production well. The well 291 has a vertical wellbore section 293 and a longitudinal wellbore section 295. The longitudinal wellbore section 295 is oriented in a toe-down configuration such that it is angularly offset from at least a part of the lithofacies surfaces 287 / 289.

[00128] **FIG. 3A – FIG. 3D** provide schematic representations of a series of well configurations. The well configurations may be suitable for developing fracture networks in hydrocarbon-bearing formations by processes according to the present disclosure. The well configurations may also be suitable for recovering hydrocarbons from hydrocarbon-bearing formations by methods according to the present disclosure. The well configurations may also be suitable for enhancing hydrocarbon recovery from hydrocarbon-bearing formations by processes according to the present disclosure. Lithological environments are not provided in **FIG. 3A – FIG. 3D** for clarity.

10 [00129] **FIG. 3A** shows a schematic perspective view of a well configuration 300 that comprises a first well 302, a second well 304, and a third well 306. A fracture network may be induced from the first well 302, the second well 304, the third well 306, or a combination thereof. Moreover, one or more of the first well 302 and the second well 304 may be equipped as a production well, and the third well 306 may be equipped as an injection well. The first well 302 comprises a vertical wellbore section 308 and a longitudinal wellbore section 310. The second well comprises a vertical wellbore section 312 and a longitudinal wellbore section 314. The third well comprises a vertical wellbore section 316 and a longitudinal wellbore section 318. The longitudinal wellbore sections 310 / 314 of the wells 302 / 304 are oriented in a horizontal configuration. The longitudinal wellbore section 318 of the third well 306 is oriented in a toe-up configuration. Accordingly, the longitudinal wellbore section 318 of the third well 306 is angularly offset from the longitudinal wellbore sections 310 / 314 of the wells 302 / 304.

[00130] **FIG. 3B** shows a schematic perspective view of a well configuration 320 that comprises a first well 322, a second well 324, a third well 326, a fourth well 328, and a fifth well 330. A fracture network may be induced from the first well 322, the second well 324, the third well 326, the fourth well 328, the fifth well 330, or a combination thereof. Accordingly, a stimulant fluid comprising a proppant may be injected from the first well 322, the second well 324, the third well 326, the fourth well 328, the fifth well 330, or a combination thereof. The first well 322, the third well 326, the fifth well 330, or a combination thereof may be equipped as an

injection well. The second well 324, the fourth well 328, or a combination thereof may be equipped as a production well. The wells 322 / 324 / 326 / 328 / 330 comprise vertical wellbore sections 332 / 334 / 336 / 338 / 340, respectively. The wells 322 / 324 / 326 / 328 / 330 further comprise longitudinal wellbore sections 342 / 344 / 346 / 348 / 350, respectively. The longitudinal wellbore sections 342 / 344 are vertically displaced and substantially vertically coplanar, such that the wells 322 / 324 comprise a typical SAGD well pair 352. Likewise, the longitudinal wellbore sections 346 / 348 are vertically displaced and substantially vertically coplanar, such that the wells 326 / 328 comprise a typical SAGD well pair 354. The well pair 352 is laterally displaced from the well pair 354, and the fifth well 330 is interposed therebetween. The longitudinal wellbore section 350 of the fifth well 330 is oriented in a toe-up configuration. Accordingly, the longitudinal wellbore section 350 of the fifth well 330 is offset relative to the longitudinal wellbore sections 342 / 344 / 346 / 348 of the wells 322 / 324 / 326 / 328. In **FIG. 3B**, the vertical wellbore sections 334, 338, and 340 are shown as aligned along a transverse-vertical plane, however this is one of many well configurations that fall within the scope of the present disclosure. For example, the vertical wellbore section 340 of the fifth well 330 may be longitudinally off-set from the transverse-vertical plane defined by the vertical wellbore sections 334 and 338 (see, e.g., the position of vertical wellbore section 376 in **FIG. 3C**).

[00131] **FIG. 3C** shows a schematic perspective view of a well configuration 356 that comprises a first well 358, a second well 360, a third well 362, a fourth well 364, and a fifth well 366. A fracture network may be induced from the first well 358, the second well 360, the third well 362, the fourth well 364, the fifth well 366, or a combination thereof. Accordingly, a stimulant fluid comprising a proppant may be injected from the first well 358, the second well 360, the third well 362, the fourth well 364, the fifth well 366, or a combination thereof. The first well 358, the third well 362, the fifth well 366, or a combination thereof may be equipped as an injection well. The second well 360, the fourth well 364, or a combination thereof may be equipped as a production well. The wells 358 / 360 / 362 / 364 / 366 comprise vertical wellbore sections 368 / 370 / 372 / 374 / 376, respectively. The wells 358 / 360 / 362 / 364 / 366 further comprise longitudinal wellbore sections

378 / 380 / 382 / 384 / 386, respectively. The longitudinal wellbore sections 378 / 380 are substantially vertically coplanar, and that the wells 358 / 360 form a well pair 388. Likewise, the longitudinal wellbore sections 382 / 384 are substantially vertically coplanar, and that the wells 362 / 364 form a well pair 390. The fifth well
 5 366 is interposed between the well pair 388 and the well pair 390. The longitudinal wellbore section 378 of the first well 358 is oriented in a toe-up configuration, and the longitudinal wellbore section 380 of the second well 360 is oriented in a horizontal configuration. Likewise, the longitudinal wellbore section 372 of the third well 362 is oriented in a toe-up configuration, and the longitudinal wellbore section
 10 384 of the fourth well 364 is oriented in a horizontal configuration. Accordingly, the longitudinal wellbore sections 378 / 382 are angularly offset from the longitudinal wellbore sections 380 / 384. The vertical wellbore section 376 of the fifth well 366 is laterally and longitudinally displaced from the vertical wellbore sections 368 / 370 / 372 / 374. Further, the longitudinal wellbore section 386 of the fifth well 366
 15 is oriented in a toe-up configuration. As such the longitudinal wellbore section 386 is angularly offset from the longitudinal wellbore sections 378 / 380 / 382 / 384.

[00132] FIG. 3D shows a schematic perspective view of a well configuration 392 that comprises a first well 394, a second well 396, a third well 398, a fourth well 301, and a fifth well 303. The wells 394 / 396 / 398 / 301 / 303 comprise
 20 vertical wellbore sections 305 / 307 / 309 / 311 / 313, respectively. The wells 394 / 396 / 398 / 301 / 303 further comprise longitudinal wellbore sections 315 / 317 / 319 / 321 / 323, respectively. The wells 394 / 396 form a well pair 325, and the longitudinal wellbore sections 315 / 317 are horizontally oriented, vertically displaced, and substantially vertically coplanar. Likewise, the wells 398 / 301 form
 25 a well pair 327, and the longitudinal wellbore sections 319 / 321 are horizontally oriented, vertically displaced, and substantially vertically coplanar. The well pair 325 is laterally displaced from the well pair 327, and the fifth well 303 is interposed therebetween. A fracture network may be induced from the longitudinal wellbore sections 329, 323, 331, or a combination thereof. Accordingly, a stimulant fluid
 30 comprising a proppant may be injected from the longitudinal wellbore sections 329, 323, 331, or a combination thereof. After development of the fracture network, one or more of the longitudinal wellbore sections 329 / 331 may be shut off. One

or more of the longitudinal wellbore sections 315 / 319 / 323 may be equipped as an injection well. One or more of the longitudinal wellbore sections 317 / 321 may be equipped as a production well. The longitudinal wellbore section 323 of the fifth well 303 is oriented in a toe-up configuration. Accordingly, the longitudinal wellbore section 323 of the fifth well 303 is offset relative to the longitudinal wellbore sections 315 / 317 / 319 / 321 of the wells 394 / 396 / 398 / 301. The first well 394 further comprises an auxiliary longitudinal wellbore section 329. Likewise, the third well 398 further comprises an auxiliary longitudinal wellbore 331. The auxiliary longitudinal wellbores 329 / 331 are each oriented in a toe-up configuration. Accordingly, the auxiliary longitudinal wellbores 329 / 331 are angularly offset from the longitudinal wellbore sections 315 / 317 / 319 / 321.

[00133] **FIG. 4A** and **FIG. 4B** provide schematic longitudinal-elevation and horizontal-plan views, respectively, of a hydrocarbon-bearing formation 400 that comprises a fracture network in communication with a first well 402 and a second well 404. The fracture network may be induced from the first well 402, the second well 404, or a combination thereof. Accordingly, a stimulant fluid comprising a proppant may be injected from the first well 402, the second well 404, or a combination thereof. Moreover, one or more of the first well 402 and the second well 404 may be equipped as an injection well, a production well, or a combination thereof. As best seen in **FIG. 4A**, the hydrocarbon-bearing formation 400 comprises a first high-permeability zone 406, a second high-permeability zone 408, and a low-permeability zone 410 interlayered therebetween. The interface between the first high-permeability zone 406 and the low-permeability zone 410 defines a first lithofacies surface 412. The interface between the second high-permeability zone 408 and the low-permeability zone 410 defines a second lithofacies surface 414.

[00134] As best seen in **FIG. 4B**, the first well 402 is laterally displaced from the second well 404. The first well 402 has a vertical wellbore section 416 (not shown) and a longitudinal wellbore section 418. The second well 404 has a vertical wellbore section 420 (not shown) and a longitudinal wellbore section 422. The longitudinal wellbore section 418 of the first well 402 is oriented in a toe-up

configuration, and the longitudinal wellbore section 422 of the second well 404 is oriented in a toe-down configuration. Accordingly, the longitudinal wellbore section 418 of the first well 402 is angularly offset from the longitudinal wellbore section 422 of the second well 404 as best seen in **FIG. 4A**. The longitudinal wellbore sections 418 / 422 are also angularly offset from at least a part of the lithofacies surfaces 412 / 414. As best seen in **FIG. 4A**, the fracture network comprises a series of transverse-vertical fractures 424 and a series of horizontal fractures 426. As best seen in **FIG. 4B**, the fracture network further comprises a series of longitudinal-vertical fractures 428.

10 Example 1: Formation evaluation by diagnostic fracture injection testing

[00135] This example demonstrates how fracture geometry and fracture complexity of an induced fracture network can be evaluated using diagnostic fracture injection testing (DFIT) and related methods. The following data was collected from testing in a shallow-depth cap-rock formation of an oil sands reservoir in Northern Alberta. Image log data was collected using a Formation Micro-Imager (FMI). Core computed tomography (CT) data was collected using CT scanning equipment from Schlumberger. G-function analysis and after closure analysis (ACA) were performed using grid oriented hydraulic fracture extension replicator (GOHFER®) software (GOHFER® is a registered trade of Barree & Associates LLC, Lakewood, Colorado, USA). Those skilled in the art will recognize that multiple suitable alternatives to the image-logging tool, core CT scanning tool, and the DFIT/ACA tool/software noted above exist, and that such alternatives may be suitable for conducting the tests / analysis disclosed herein. Moreover, those skilled in the art will readily understand how to identify/calculate stress fields including vertical stress, maximum-horizontal stress, and minimum-horizontal stress.

[00136] Drilling-induced fracturing was effected through a series of core drillings in the formation. **FIG. 5A** and **FIG. 5B**, show archetypal image logs obtained (static and dynamic images, respectively). The image logs indicate the presence of a horizontal fracture 500 and a vertical fracture 502. The vertical

fracture 502 terminates in the horizontal fracture 500, such that they together form a substantially T-shaped fracture.

[00137] **FIG. 6** shows results from a core CT scan at the same depth as the horizontal fracture 500 shown in the image logs of **FIG. 5A** and **FIG. 5B**. In **FIG. 6**, the horizontal fracture is identified by reference number 600. The core CT scan indicates that the horizontal fracture 600 is a continuous fracture. The vertical fracture 502 identified in the images logs of **FIG. 5A** and **FIG. 5B** is not present on the core CT scan of **FIG. 6**, likely because it is a drilling-induced fracture.

[00138] G-function analysis, performed at approximately the same depth as the horizontal fracture 500 and the vertical fracture 502 shown in the image logs of **FIG. 5A** / **FIG. 5B**, confirms the presence of two fractures. Results from the G-functional analysis are provided in **FIG. 7**, where the G-function is identified by reference number 700 and the two fracture-closure signatures are identified by reference numbers 702 and 704. **FIG. 8A** provides another G-function plot in a bitumen formation from a different DFIT identified by reference number 800 in **FIG. 8A**. As identified by reference number 802, the data indicates a final closure pressure 4.76 MPa for the formation. **FIG. 8B** provides results from an ACA radial analysis of the same data set. From the results of **FIG. 8B** it was determined that the reservoir pressure was 2.76 MPa and the relative permeability to water was 1.56 mD. Additional metrics relating to from the results of **FIG. 8B** are provided in Table 1.

Table 1: Additional metrics relating to the ACA radial-analysis plot of **FIG. 8B**

ACA radial flow inputs		ACA radial flow Outputs	
closure found?	true	radial flow found?	true
time at closure (min)	25.0143	begin radial flow time (min)	7253.71
avg. perforation TVD (m)	479.75	radial pressure gradient (kPa/m)	5.6229
fluid volume pumped (m ³)	2.68925	ACA radial reservoir pressure (MPa)	2.69759
est. net pay height (m)	5.00	ACA radial Kh/mu (md m/cp)	7.80817
reservoir fluid visc. (cp)	1.00	ACA radial Kh (md m)	7.80817
		ACA radial permeability (md)	1.56163

Example 2: Stress field and fracture modeling

[00139] This example demonstrates how fracture simulations may be
5 conducted in a reservoir model to determine how to generate a fracture network having modified fracture geometry and fracture complexity.

[00140] A computer-based lithological representation of the formation
discussed in Example 1 was prepared based on data from a variety of sources
including image logs, core CT scanning, geomechanical lab data, DFIT
10 information, and other reservoir analysis. Data for generating computer-based lithological representations can be obtained from a variety of methods – details of which will be understood by those skilled in the art. A grid-oriented hydraulic fracture extension replicator was used to model stress fields and simulate fracturing events in the lithological representation. **FIG. 9** shows an archetypal
15 model of stress anisotropy in the formation. The orientations and magnitudes of the primary stress are identified by reference numerals 900 and 902. Based on the orientations and magnitudes of the stresses, a well 904 was modelled to penetrate the formation at the orientation shown. The well 904 was modeled to include a vertical wellbore section 906 and a longitudinal wellbore section 908. A
20 series of twelve fracture initiation points were modeled at intervals along the

longitudinal wellbore section 908 (identified by the symbol "x"). The longitudinal wellbore section 908 was oriented such that it was offset from a horizontal plane 910 by an angle 1.6° .

[00141] The development of a fracture network by hydraulic stimulation from the longitudinal wellbore section 908 was modeled, and archetypal results from the simulation are shown in **FIG. 10A-C**. **FIG. 10A** and **FIG. 10B** show transverse- and longitudinal-elevation views of the fracture network, respectively. As best seen in **FIG. 10A** the fracture network comprises transverse-vertical fractures. The transverse-vertical fractures are bi-wing fractures having lengths of about 100 m to about 200 m and heights of about 40 m to about 47 m. As best seen in **FIG. 10B**, the fracture network also comprises longitudinal-vertical fractures. The longitudinal-vertical fractures are bi-wing fractures having lengths of about 50 m to about 100 m and heights of about 32 m to about 38 m.

Example 3: Reservoir simulations for comparison of production metrics

[00142] This example illustrates how the presence / absence of a fracture network induced from a longitudinal wellbore section that is angularly offset from a plane defined by a maximum horizontal stress and a minimum horizontal stress impacts typical productions metrics.

[00143] In a first case, the formation discussed in Examples 1 and 2 was modelled to include a well pair in a typical SAGD configuration. In the first case, the formation did not include a fracture network. In a second case, the formation discussed in Examples 1 and 2 was modelled to include the same well pair. In the second case, the formation included the fracture network discussed in Example 2. In other words, the formation in the second case was modelled to include a fracture network induced from a longitudinal wellbore section that is angularly offset from a plane defined by a maximum horizontal stress and a minimum horizontal stress. The fractures were modelled using logarithmic local grid refinement and non-Darcy flow conditions.

[00144] Archetypal simulation results are shown in **FIG. 11A – FIG. 11C**. In **FIG 11A**, the water (steam) rate as function of time for the first case (no off-set

fracturing) is identified by reference number 1100 and the water (steam) rate as a function of time for the second case (off-set fracturing) is identified by reference number 1102. The results of **FIG. 11A** indicate that the presence of the fracture network increases the water rate by an average of 15 %. This suggests that the presence of the fracture network increase the formation's ability to accommodate higher concentrations of steam.

[00145] In **FIG 11B**, the oil-production rate as function of time for the first case (no off-set fracturing) is identified by reference number 1106 and the oil-production rate as a function of time for the second case (off-set fracturing) is identified by reference number 1108. The results of **FIG. 11B** indicate that the presence of the fracture network leads to a higher rate of oil production and an earlier peak production (by approximately 8 months). Accordingly, methods and processes of the present disclosure may result in hydrocarbon recovery with shorter start-up and ramp-up times compared with current conventional SAGD and CSS processes.

[00146] In **FIG 11C**, cumulative oil production as function of time for the first case (no off-set fracturing) is identified by reference number 1112 and the cumulative oil production as a function of time for the second case (off-set fracturing) is identified by reference number 1110. The results of **FIG. 11C** indicate that the presence of the fracture network increases the cumulative oil production by an approximately 6 %. In **FIG 11C**, the cumulative steam-to-oil ratio as function of time for the first case (no off-set fracturing) is identified by reference number 1114 and the cumulative steam-to-oil ratio as a function of time for the second case (off-set fracturing) is identified by reference number 1116. The results of **FIG. 11C** indicate that the presence of the fracture network does not substantially influence the cumulative steam-to-oil ratio.

Example 4: Reservoir simulations for comparison of production metrics in a formation comprising a shale barrier

[00147] This example illustrates how the presence / absence of a fracture network induced from a longitudinal wellbore section that is angularly offset from

a plane defined by a maximum horizontal stress and a minimum horizontal stress impacts typical productions metrics in a formation comprising a shale barrier. The formation discussed in Examples 1 and 2 was modelled to include an injection well and a production well in a typical SAGD configuration. The formation was also
 5 modelled to include a shale barrier. The shale barrier was modelled to have a longitudinal dimension of 400 m, a lateral dimension of 50 m, and a vertical dimension of 3 m. The shale barrier was modelled to be positioned about 3 m above the injection well.

[00148] In a first case, the formation was modelled such that it did not include
 10 a fracture network. In a second case, the formation was modelled to include the fracture network discussed in Example 2. In other words, the formation in the second case was modelled to include a fracture network induced from a longitudinal wellbore section that is angularly offset from a plane defined by a maximum horizontal stress and a minimum horizontal stress. The longitudinal
 15 wellbore section was also modelled to be angularly offset from the shale barrier and the lithofacies surfaces defined by the interfaces between the shale barrier and the formation. The shale barrier was modelled to overlay five out of eight fracture initiation points on the longitudinal wellbore section. The fractures were modelled using logarithmic local grid refinement and non-Darcy flow conditions.

20 [00149] Archetypal simulation results are shown in **FIG. 12A – FIG. 12C**. In **FIG 12A**, the water (steam) rate as function of time for the first case (no off-set fracturing) is identified by reference number 1200 and the water (steam) rate as a function of time for the second case (off-set fracturing) is identified by reference number 1202. The results of **FIG. 12A** indicate that the presence of the fracture
 25 network increases the water rate by an average of about 200 %. This suggests that the presence of the fracture network increase the formation's ability to accommodate higher concentrations of steam in formations partitioned by a shale barrier.

[00150] In **FIG 12B**, the oil-production rate as function of time for the first
 30 case (no off-set fracturing) is identified by reference number 1206 and the oil-production rate as a function of time for the second case (off-set fracturing) is

identified by reference number 1208. The results of **FIG. 12B** indicate that the presence of the fracture network leads to a higher rate of oil production and an earlier peak production (by approximately 400 %). Accordingly, methods and processes of the present disclosure may result in hydrocarbon recovery with shorter start-up and ramp-up times compared with current conventional SAGD and CSS processes in formations portioned by a shale barrier.

[00151] In **FIG 12C**, the cumulative oil production as function of time for the first case (no off-set fracturing) is identified by reference number 1216 and the cumulative oil production as a function of time for the second case (off-set fracturing) is identified by reference number 1214. The results of **FIG. 12C** indicate that the presence of the fracture network increases the cumulative oil production about 2.8 fold over five years. In **FIG 12C**, the cumulative steam-to-oil ratio as function of time for the first case (no off-set fracturing) is identified by reference number 1212 and the cumulative oil production as a function of time for the second case (off-set fracturing) is identified by reference number 1210. The results of **FIG. 12C** indicate that the presence of the fracture network decreases to oil cumulative steam-to-oil ratio by about 22 % at the end of five years. Accordingly, various embodiments of the present disclosure may result in higher production rates compared with current conventional SAGD and CSS processes due, in part, to fractures penetrating through zones such as shale barriers.

[00152] Although various embodiments of the disclosure are disclosed herein, many adaptations and modifications may be made within the scope of the disclosure in accordance with the common general knowledge of those skilled in this art. Such modifications include the substitution of known equivalents for any aspect of the disclosure in order to achieve the same result in substantially the same way. Numeric ranges are inclusive of the numbers defining the range. The word "comprising" is used herein as an open-ended term, substantially equivalent to the phrase "including, but not limited to", and the word "comprises" has a corresponding meaning. As used herein, the singular forms "a", "an" and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to "a thing" includes more than one such thing. Citation of

references herein is not an admission that such references are prior art to the present disclosure. The disclosure includes all embodiments and variations substantially as hereinbefore described and with reference to the examples and drawings.

5 [00153] It should be understood that the compositions and methods are described in terms of "comprising," "containing," or "including" various components or steps, the compositions and methods can also "consist essentially of or "consist of the various components and steps.

[00154] For the sake of brevity, only certain ranges are explicitly disclosed
10 herein. However, ranges from any lower limit may be combined with any upper limit to recite a range not explicitly recited, as well as, ranges from any lower limit may be combined with any other lower limit to recite a range not explicitly recited, in the same way, ranges from any upper limit may be combined with any other upper limit to recite a range not explicitly recited. Additionally, whenever a
15 numerical range with a lower limit and an upper limit is disclosed, any number and any included range falling within the range are specifically disclosed. In particular, every range of values (of the form, "from about a to about b," or, equivalently, "from approximately a to b," or, equivalently, "from approximately a-b") disclosed herein is to be understood to set forth every number and range encompassed
20 within the broader range of values even if not explicitly recited. Thus, every point or individual value may serve as its own lower or upper limit combined with any other point or individual value or any other lower or upper limit, to recite a range not explicitly recited.

[00155] Therefore, the present disclosure is well adapted to attain the ends
25 and advantages mentioned as well as those that are inherent therein. The particular embodiments disclosed above are illustrative only, as the present disclosure may be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Although individual embodiments are discussed, the disclosure covers all
30 combinations of all those embodiments. Also, the terms in the claims have their plain, ordinary meaning unless otherwise explicitly and clearly defined by the

patentee. It is therefore evident that the particular illustrative embodiments disclosed above may be altered or modified and all such variations are considered within the scope and spirit of the present disclosure.

[00156] Many obvious variations of the embodiments set out herein will
5 suggest themselves to those skilled in the art in light of the present disclosure.
Such obvious variations are within the full intended scope of the appended claims.

Claims:

1. A process for developing a fracture network in a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising:

injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from the substantially-longitudinal wellbore section of at least one of the first well and the second well to form the fracture network,

wherein:

the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and

the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from, and (b) angularly offset from, the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

2. The process of claim 1, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is less than about 90 °.

3. The process of claim 1, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is between about 30 ° and about 60 °.

4. The process of claim 1, wherein the first well comprises a plurality of toe-up wells, and the second well comprises a plurality of toe-down wells, and wherein the plurality of toe-up wells, and the plurality of toe-down wells are arranged in an alternating configuration.

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5. The process of any one of claims 1-4, wherein the substantially-longitudinal wellbore section of at least one of the first well and the second well is coplanar with the minimum-horizontal stress.
6. The process of any one of claims 1-4, wherein the substantially-longitudinal wellbore section of at least one of the first well and the second well is coplanar with the maximum-horizontal stress.
7. The process of any one of claims 1-6, wherein the vertical stress is within about 2 Mpa of the maximum horizontal stress.
8. The process of any one of claims 1-6, wherein the vertical stress is within about 1 Mpa of the maximum horizontal stress.
9. The process of any one of claims 1-8, wherein the fracture network primarily comprises substantially-horizontal fractures.
10. The process of any one of claims 1-9, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 0 ° and about 180 °.
11. The process of any one of claims 1-9, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 45 ° and about 135 °.
12. The process of any one of claims 1-9, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 80 ° and about 100 °.
13. The process of any one of claims 1-12, wherein the hydrocarbon-bearing formation is less than about 600 m below surface level.
14. A process for developing a fracture network in a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore

section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising:

injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from a substantially-longitudinal wellbore section of at least one of the first well and the second well to form the fracture network,

wherein:

the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, substantially-horizontal fractures, or a combination thereof, and

the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from, and (b) angularly offset from, the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

15. The process of claim 14, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is less than about 90 °.

16. The process of claim 14, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is between about 30 ° and about 60 °.

17. The process of claim 14, wherein the first well comprises a plurality of toe-up wells, and the second well comprises a plurality of toe-down wells, and wherein the plurality of toe-up wells, and the plurality of toe-down wells are arranged in an alternating configuration.

18. The process of any one of claims 14-17, wherein the substantially-longitudinal wellbore section of at least one of the first well and the second well is coplanar with the minimum-horizontal stress.

19. The process of any one of claims 14-17, wherein the substantially-longitudinal wellbore section of at least one of the first well and the second well is coplanar with the maximum-horizontal stress.
20. The process of any one of claims 14-19, wherein the vertical stress is at least about 20 % greater than the maximum-horizontal stress.
21. The process of any one of claims 14-19, wherein the vertical stress is at least about 60 % greater than the maximum-horizontal stress.
22. The process of any one of claims 14-21, wherein the fracture network primarily comprises substantially-transverse-vertical fractures and substantially-longitudinal-vertical fractures.
23. The process of any one of claims 14-22, wherein the substantially-transverse-vertical fractures primarily intersect the substantially-longitudinal-vertical fractures at angles between about 0 ° and about 180 °.
24. The process of any one of claims 14-22, wherein the substantially-transverse-vertical fractures primarily intersect the substantially-longitudinal-vertical fractures at angles between about 45 ° and about 135 °.
25. The process of any one of claims 14-22, wherein the substantially-transverse-vertical fractures primarily intersect the substantially-longitudinal-vertical fractures at angles between about 80 ° and about 100 °.
26. The process of any one of claims 14-25, wherein the hydrocarbon-bearing formation is greater than about 600 m below surface level.
27. A process for developing a fracture network in a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising:

injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from the substantially-longitudinal wellbore section of at least one of the first well and the second well to form the fracture network,

wherein:

the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and

the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and at least one of (b) angularly offset from at least a part of the lithofacies surface, and (c) angularly offset from the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

28. The process of claim 27, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is less than about 90 °.

29. The process of claim 27, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is between about 30 ° and about 60 °.

30. The process of claim 27, wherein the first well comprises a plurality of toe-up wells, and the second well comprises a plurality of toe-down wells, and wherein the plurality of toe-up wells, and the plurality of toe-down wells are arranged in an alternating configuration.

31. The process of any one of claims 27-30, wherein:

the lithofacies surface is an interface between a low permeability zone and a high permeability zone,

the low-permeability zone has a permeability of less than about 100 mD, and

the high-permeability zone has a permeability of at least about 1,000 mD.

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32. The process of any one of claims 27-31, wherein the substantially-longitudinal wellbore section of the first well intersects the lithofacies surface at an angle between about 0 ° and about 180 °.

33. The process of any one of claims 27-31, wherein the substantially-longitudinal wellbore section of the first well intersects the lithofacies surface at an angle between about 45 ° and about 135 °.

34. The process of any one of claims 27-33, wherein the vertical stress is within about 2 Mpa of the maximum horizontal stress.

35. The process of any one of claims 27-33, wherein the vertical stress is within about 1 Mpa of the maximum horizontal stress.

36. The process of any one of claims 27-35, wherein the fracture network primarily comprises substantially-horizontal fractures.

37. The process of any one of claims 27-36, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 0 ° and about 180 °.

38. The process of any one of claims 27-36, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 45 ° and about 135 °.

39. The process of any one of claims 27-36, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 80 ° and about 100 °.

40. The process of any one of claims 27-39, wherein the hydrocarbon-bearing formation is less than about 600 m below surface level.

41. A process for developing a fracture network in a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-

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vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising:

injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation from the substantially-longitudinal wellbore section of at least one of the first well and the second well to form the fracture network,

wherein:

the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, substantially-horizontal fractures, or a combination thereof, and

the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and at least one of (b) angularly offset from at least a part of the lithofacies surface, and (c) angularly offset from the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify fracture geometry, fracture complexity, or a combination thereof within the fracture network.

42. The process of claim 41, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is less than about 90 °.

43. The process of claim 41, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is between about 30 ° and about 60 °.

44. The process of claim 41, wherein the first well comprises a plurality of toe-up wells, and the second well comprises a plurality of toe-down wells, and wherein the plurality of toe-up wells, and the plurality of toe-down wells are arranged in an alternating configuration.

45. The process of any one of claims 41-44, wherein:

the lithofacies surface is an interface between a low permeability zone and a high permeability zone,

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the low-permeability zone has a permeability of less than about 100 mD, and

the high-permeability zone has a permeability of at least about 1,000 mD.

46. The process of any one of claims 41-45, wherein the substantially-longitudinal wellbore section of the first well intersects the lithofacies surface at an angle between about 0 ° and about 180 °.

47. The process of any one of claims 41-45, wherein the substantially-longitudinal wellbore section of the first well intersects the lithofacies surface at an angle between about 45 ° and about 135 °.

48. The process of any one of claims 41-47, wherein the vertical stress is at least about 20 % greater than the maximum-horizontal stress.

49. The process of any one of claims 41-47, wherein the vertical stress is at least about 60 % greater than the maximum-horizontal stress.

50. The process of any one of claims 41-49, wherein the fracture network primarily comprises substantially-transverse-vertical fractures and substantially-longitudinal-vertical fractures.

51. The process of any one of claims 41-50, wherein the substantially-transverse-vertical fractures primarily intersect the substantially-longitudinal-vertical fractures at angles between about 0 ° and about 180 °.

52. A method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising:

injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network;

modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and

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recovering hydrocarbons from the hydrocarbon-bearing formation,

wherein:

the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and

the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from, and (b) angularly offset from, the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

53. The process of claim 52, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is less than about 90 °.

54. The process of claim 52, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is between about 30 ° and about 60 °.

55. The process of claim 52, wherein the first well comprises a plurality of toe-up wells, and the second well comprises a plurality of toe-down wells, and wherein the plurality of toe-up wells, and the plurality of toe-down wells are arranged in an alternating configuration.

56. The process of any one of claims 52-55, wherein the substantially-longitudinal wellbore section of at least one of the first well and the second well is coplanar with the minimum-horizontal stress.

57. The process of any one of claims 52-55, wherein the substantially-longitudinal wellbore section of at least one of the first well and the second well is coplanar with the maximum-horizontal stress.

58. The process of any one of claims 52-57, wherein the vertical stress is within about 2 Mpa of the maximum horizontal stress.

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59. The process of any one of claims 52-57, wherein the vertical stress is within about 1 Mpa of the maximum horizontal stress.

60. The process of any one of claims 52-59, wherein the fracture network primarily comprises substantially-horizontal fractures.

61. The process of any one of claims 52-60, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 0 ° and about 180 °.

62. The process of any one of claims 52-60, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 45 ° and about 135 °.

63. The process of any one of claims 52-60, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 80 ° and about 100 °.

64. The process of any one of claims 52-63, wherein the hydrocarbon-bearing formation is less than about 600 m below surface level.

65. The process of any one of claims 52-64, wherein the injecting of the stimulant fluid precedes the modulating the mobility of the hydrocarbons.

66. The process of any one of claims 52-64, wherein the modulating the mobility of the hydrocarbons precedes the injecting of the stimulant fluid.

67. The process of any one of claims 52-66, wherein modulating the mobility of the hydrocarbons comprises injecting a hydrocarbon-mobilizing fluid into the hydrocarbon-bearing formation.

68. A method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising:

injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network;

modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and

recovering hydrocarbons from the hydrocarbon-bearing formation,

wherein:

the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, substantially-horizontal fractures, or a combination thereof, and

the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from, and (b) angularly offset from, the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

69. The process of claim 68, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is less than about 90 °.

70. The process of claim 68, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is between about 30 ° and about 60 °.

71. The process of claim 68, wherein the first well comprises a plurality of toe-up wells, and the second well comprises a plurality of toe-down wells, and wherein the plurality of toe-up wells, and the plurality of toe-down wells are arranged in an alternating configuration.

72. The process of any one of claims 68-71, wherein the substantially-longitudinal wellbore section of at least one of the first well and the second well is coplanar with the minimum-horizontal stress.

73. The process of any one of claims 68-71, wherein the substantially-longitudinal wellbore section of at least one of the first well and the second well is coplanar with the maximum-horizontal stress.

74. The process of any one of claims 68-73, wherein the vertical stress is at least about 20 % greater than the maximum-horizontal stress.

75. The process of any one of claims 68-73, wherein the vertical stress is at least about 60 % greater than the maximum-horizontal stress.

76. The process of any one of claims 68-75, wherein the fracture network primarily comprises substantially-transverse-vertical fractures and substantially-longitudinal-vertical fractures.

77. The process of any one of claims 68-76, wherein the substantially-transverse-vertical fractures primarily intersect the substantially-longitudinal-vertical fractures at angles between about 0 ° and about 180 °.

78. The process of any one of claims 68-77, wherein the injecting of the stimulant fluid precedes the modulating the mobility of the hydrocarbons.

79. The process of any one of claims 68-77, wherein the modulating the mobility of the hydrocarbons precedes the injecting of the stimulant fluid.

80. The process of any one of claims 68-79, wherein modulating the mobility of the hydrocarbons comprises injecting a hydrocarbon-mobilizing fluid into the hydrocarbon-bearing formation.

81. A method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising:

injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network;

modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and

recovering hydrocarbons from the hydrocarbon-bearing formation,

wherein:

the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and

the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and at least one of (b) angularly offset from at least a part of the lithofacies surface, and (c) angularly offset from the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

82. The process of claim 81, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is less than about 90 °.

83. The process of claim 81, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is between about 30 ° and about 60 °.

84. The process of claim 81, wherein the first well comprises a plurality of toe-up wells, and the second well comprises a plurality of toe-down wells, and wherein the plurality of toe-up wells, and the plurality of toe-down wells are arranged in an alternating configuration.

85. The process of any one of claims 81-84, wherein:

the lithofacies surface is an interface between a low permeability zone and a high permeability zone,

the low-permeability zone has a permeability of less than about 100 mD, and

the high-permeability zone has a permeability of at least about 1,000 mD.

86. The process of any one of claims 81-85, wherein the substantially-longitudinal wellbore section of the first well intersects the lithofacies surface at an angle between about 0 ° and about 180 °.

87. The process of any one of claims 81-85, wherein the substantially-longitudinal wellbore section of the first well intersects the lithofacies surface at an angle between about 45 ° and about 135 °.

88. The process of any one of claims 81-87, wherein the vertical stress is within about 2 Mpa of the maximum horizontal stress.

89. The process of any one of claims 81-87, wherein the vertical stress is within about 1 Mpa of the maximum horizontal stress.

90. The process of any one of claims 81-89, wherein the fracture network primarily comprises substantially-horizontal fractures.

91. The process of any one of claims 81-90, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 0 ° and about 180 °.

92. The process of any one of claims 81-90, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 45 ° and about 135 °.

93. The process of any one of claims 81-90, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 80 ° and about 100 °.

94. The process of any one of claims 81-93, wherein the hydrocarbon-bearing formation is less than about 600 m below surface level.

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95. The process of any one of claims 81-94, wherein the injecting of the stimulant fluid precedes the modulating the mobility of the hydrocarbons.

96. The process of any one of claims 81-94, wherein the modulating the mobility of the hydrocarbons precedes the injecting of the stimulant fluid.

97. The process of any one of claims 81-96, wherein modulating the mobility of the hydrocarbons comprises injecting a hydrocarbon-mobilizing fluid into the hydrocarbon-bearing formation.

98. A method for recovering hydrocarbons from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising:

injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network;

modulating the mobility of hydrocarbons within the hydrocarbon-bearing formation; and

recovering hydrocarbons from the hydrocarbon-bearing formation,

wherein:

the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, substantially-horizontal fractures, or a combination thereof, and

the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and at least one of (b) angularly offset from at least a part of the lithofacies surface, and (c) angularly offset from the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well

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form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

99. The process of claim 98, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is less than about 90 °.

100. The process of claim 98, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is between about 30 ° and about 60 °.

101. The process of claim 98, wherein the first well comprises a plurality of toe-up wells, and the second well comprises a plurality of toe-down wells, and wherein the plurality of toe-up wells, and the plurality of toe-down wells are arranged in an alternating configuration.

102. The process of any one of claims 98-101, wherein:

the lithofacies surface is an interface between a low permeability zone and a high permeability zone,

the low-permeability zone has a permeability of less than about 100 mD, and

the high-permeability zone has a permeability of at least about 1,000 mD.

103. The process of any one of claims 98-102, wherein the substantially-longitudinal wellbore section of the first well intersects the lithofacies surface at an angle between about 0 ° and about 180 °.

104. The process of any one of claims 98-102, wherein the substantially-longitudinal wellbore section of the first well intersects the lithofacies surface at an angle between about 45 ° and about 135 °.

105. The process of any one of claims 98-104, wherein the vertical stress is at least about 20 % greater than the maximum-horizontal stress.

106. The process of any one of claims 98-104, wherein the vertical stress is at least about 60 % greater than the maximum-horizontal stress.

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107. The process of any one of claims 98-106, wherein the fracture network primarily comprises substantially-transverse-vertical fractures and substantially-longitudinal-vertical fractures.

108. The process of any one of claims 98-107, wherein the substantially-transverse-vertical fractures primarily intersect the substantially-longitudinal-vertical fractures at angles between about 0 ° and about 180 °.

109. The process of any one of claims 98-108, wherein the injecting of the stimulant fluid precedes the modulating the mobility of the hydrocarbons.

110. The process of any one of claims 98-108, wherein the modulating the mobility of the hydrocarbons precedes the injecting of the stimulant fluid.

111. The process of any one of claims 98-110, wherein modulating the mobility of the hydrocarbons comprises injecting a hydrocarbon-mobilizing fluid into the hydrocarbon-bearing formation.

112. A process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the method comprising:

injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network;

wherein:

the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and

the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from, and (b) angularly offset from, the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the

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longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

113. The process of claim 112, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is less than about 90 °.

114. The process of claim 112, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is between about 30 ° and about 60 °.

115. The process of claim 112, wherein the first well comprises a plurality of toe-up wells, and the second well comprises a plurality of toe-down wells, and wherein the plurality of toe-up wells, and the plurality of toe-down wells are arranged in an alternating configuration.

116. The process of any one of claims 112-115, wherein the substantially-longitudinal wellbore section of at least one of the first well and the second well is coplanar with the minimum-horizontal stress.

117. The process of any one of claims 112-115, wherein the substantially-longitudinal wellbore section of at least one of the first well and the second well is coplanar with the maximum-horizontal stress.

118. The process of any one of claims 112-117, wherein the vertical stress is within about 2 Mpa of the maximum horizontal stress.

119. The process of any one of claims 112-117, wherein the vertical stress is within about 1 Mpa of the maximum horizontal stress.

120. The process of any one of claims 112-119, wherein the fracture network primarily comprises substantially-horizontal fractures.

121. The process of any one of claims 112-120, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 0 ° and about 180 °.

122. The process of any one of claims 112-120, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 45 ° and about 135 °.

123. The process of any one of claims 112-120, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 80 ° and about 100 °.

124. The process of any one of claims 112-123, wherein the hydrocarbon-bearing formation is less than about 600 m below surface level.

125. A process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (b) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising:

injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network;

wherein:

the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, substantially-horizontal fractures, or a combination thereof, and

the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from, and (b) angularly offset from, the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

126. The process of claim 125, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is less than about 90 °.

127. The process of claim 125, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is between about 30 ° and about 60 °.

128. The process of claim 125, wherein the first well comprises a plurality of toe-up wells, and the second well comprises a plurality of toe-down wells, and wherein the plurality of toe-up wells, and the plurality of toe-down wells are arranged in an alternating configuration.

129. The process of any one of claims 125-128, wherein the substantially-longitudinal wellbore section of at least one of the first well and the second well is coplanar with the minimum-horizontal stress.

130. The process of any one of claims 125-128, wherein the substantially-longitudinal wellbore section of at least one of the first well and the second well is coplanar with the maximum-horizontal stress.

131. The process of any one of claims 125-130, wherein the vertical stress is at least about 20 % greater than the maximum-horizontal stress.

132. The process of any one of claims 125-130, wherein the vertical stress is at least about 60 % greater than the maximum-horizontal stress.

133. The process of any one of claims 125-132, wherein the fracture network primarily comprises substantially-transverse-vertical fractures and substantially-longitudinal-vertical fractures.

134. The process of any one of claims 125-133, wherein the substantially-transverse-vertical fractures primarily intersect the substantially-longitudinal-vertical fractures at angles between about 0 ° and about 180 °.

135. A process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore

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section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising:

injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network;

wherein:

the vertical stress is less than or substantially equal to the maximum-horizontal stress and the fracture network comprises substantially-horizontal fractures, substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, or a combination thereof, and

the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and at least one of (b) angularly offset from at least a part of the lithofacies surface, and (c) angularly offset from the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

136. The process of claim 135, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is less than about 90 °.

137. The process of claim 135, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is between about 30 ° and about 60 °.

138. The process of claim 135, wherein the first well comprises a plurality of toe-up wells, and the second well comprises a plurality of toe-down wells, and wherein the plurality of toe-up wells, and the plurality of toe-down wells are arranged in an alternating configuration.

139. The process of any one of claims 135-138, wherein:

the lithofacies surface is an interface between a low permeability zone and a high permeability zone,

the low-permeability zone has a permeability of less than about 100 mD, and

the high-permeability zone has a permeability of at least about 1,000 mD.

140. The process of any one of claims 135-139, wherein the substantially-longitudinal wellbore section of the first well intersects the lithofacies surface at an angle between about 0 ° and about 180 °.

141. The process of any one of claims 135-139, wherein the substantially-longitudinal wellbore section of the first well intersects the lithofacies surface at an angle between about 45 ° and about 135 °.

142. The process of any one of claims 135-141, wherein the vertical stress is within about 2 Mpa of the maximum horizontal stress.

143. The process of any one of claims 135-141, wherein the vertical stress is within about 1 Mpa of the maximum horizontal stress.

144. The process of any one of claims 135-143, wherein the fracture network primarily comprises substantially-horizontal fractures.

145. The process of any one of claims 135-144, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 0 ° and about 180 °.

146. The process of any one of claims 135-144, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 45 ° and about 135 °.

147. The process of any one of claims 135-144, wherein the substantially-horizontal fractures primarily intersect the substantially-transverse-vertical fractures or the substantially-longitudinal-vertical fractures at angles between about 80 ° and about 100 °.

148. The process of any one of claims 135-147, wherein the hydrocarbon-bearing formation is less than about 600 m below surface level.

149. A process for enhancing hydrocarbon recovery from a hydrocarbon-bearing formation: (a) that comprises a lithofacies surface, (b) that has a stress field defined by a vertical stress, a maximum-horizontal stress, and a minimum-horizontal stress, and (c) that is penetrated by a well pair comprising: (i) a first well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, and (ii) a second well having a substantially-vertical wellbore section and a substantially-longitudinal wellbore section, the process comprising:

injecting a stimulant fluid comprising a propping agent into the hydrocarbon-bearing formation via the substantially-longitudinal wellbore section of at least one of the first well and the second well to form a fracture network;

wherein:

the vertical stress is significantly greater than the maximum-horizontal stress and the fracture network comprises substantially-transverse-vertical fractures, substantially-longitudinal-vertical fractures, substantially-horizontal fractures, or a combination thereof, and

the substantially-longitudinal wellbore section of the first well is: (a) laterally displaced from the substantially-longitudinal wellbore section of the second well, and at least one of (b) angularly offset from at least a part of the lithofacies surface, and (c) angularly offset from the substantially-longitudinal wellbore section of the second well such that the substantially-longitudinal wellbore section of the first well and the longitudinal wellbore of the second well form a crossing pattern as viewed from a longitudinal elevation view, to modify heat transfer within the formation, hydrocarbon-flow rate within the formation, hydrocarbon capture from the formation, or a combination thereof.

150. The process of claim 149, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is less than about 90 °.

151. The process of claim 149, wherein the substantially-longitudinal wellbore section of the first well is angularly offset from the substantially-longitudinal wellbore section of the second well by an angle that is between about 30 ° and about 60 °.

152. The process of claim 149, wherein the first well comprises a plurality of toe-up wells, and the second well comprises a plurality of toe-down wells, and wherein the plurality of toe-up wells, and the plurality of toe-down wells are arranged in an alternating configuration.

153. The process of any one of claims 149-152, wherein:

the lithofacies surface is an interface between a low permeability zone and a high permeability zone,

the low-permeability zone has a permeability of less than about 100 mD, and

the high-permeability zone has a permeability of at least about 1,000 mD.

154. The process of any one of claims 149-153, wherein the substantially-longitudinal wellbore section of the first well intersects the lithofacies surface at an angle between about 0 ° and about 180 °.

155. The process of any one of claims 149-153, wherein the substantially-longitudinal wellbore section of the first well intersects the lithofacies surface at an angle between about 45 ° and about 135 °.

156. The process of any one of claims 149-155, wherein the vertical stress is at least about 20 % greater than the maximum-horizontal stress.

157. The process of any one of claims 149-155, wherein the vertical stress is at least about 60 % greater than the maximum-horizontal stress.

158. The process of any one of claims 149-157, wherein the fracture network primarily comprises substantially-transverse-vertical fractures and substantially-longitudinal-vertical fractures.

159. The process of any one of claims 149-158, wherein the substantially-transverse-vertical fractures primarily intersect the substantially-longitudinal-vertical fractures at angles between about 0 ° and about 180 °.

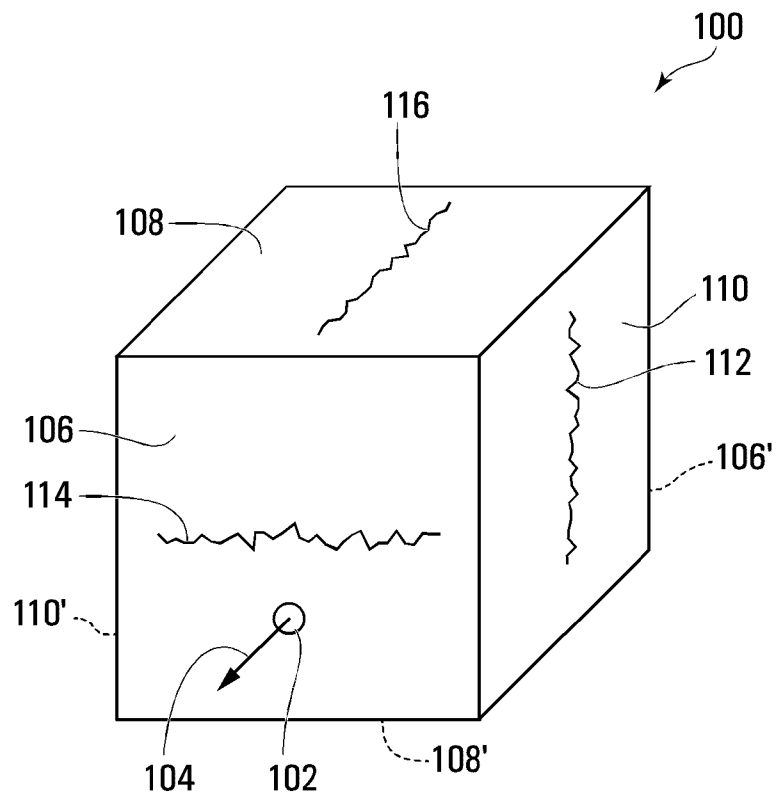


FIG. 1

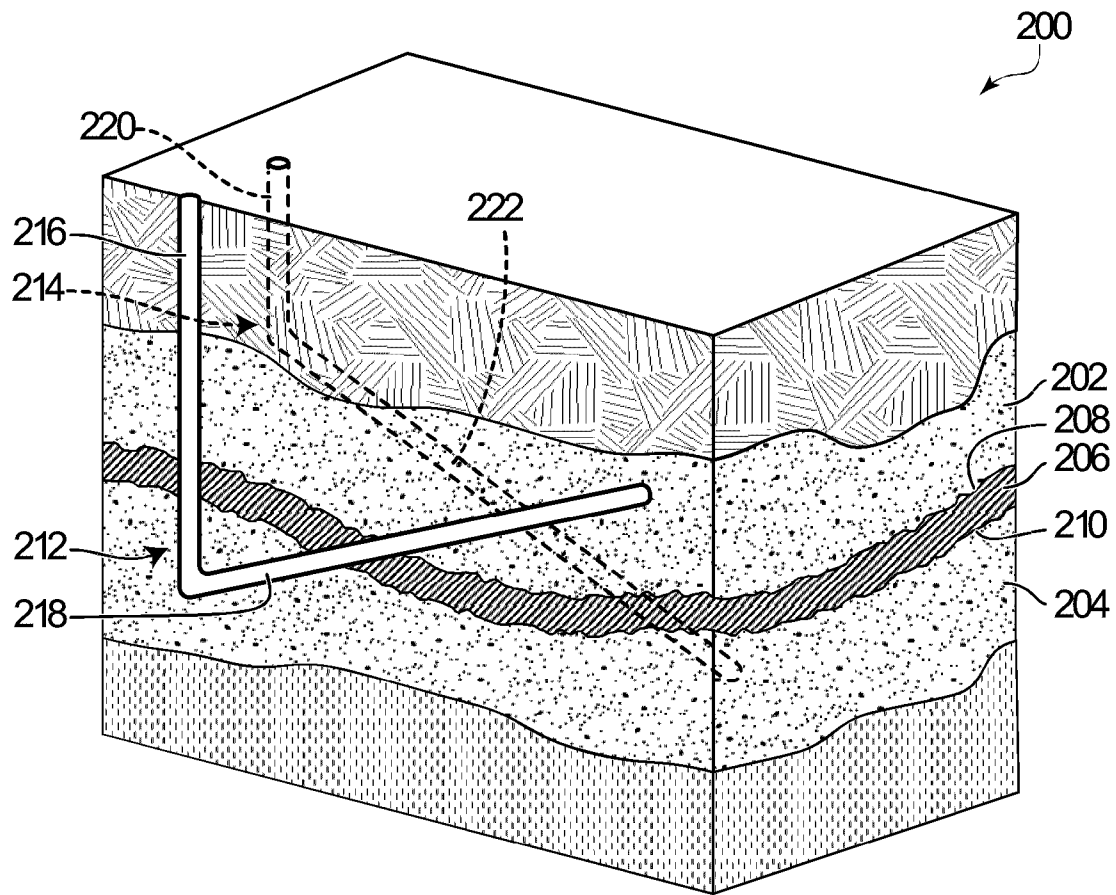


FIG. 2A

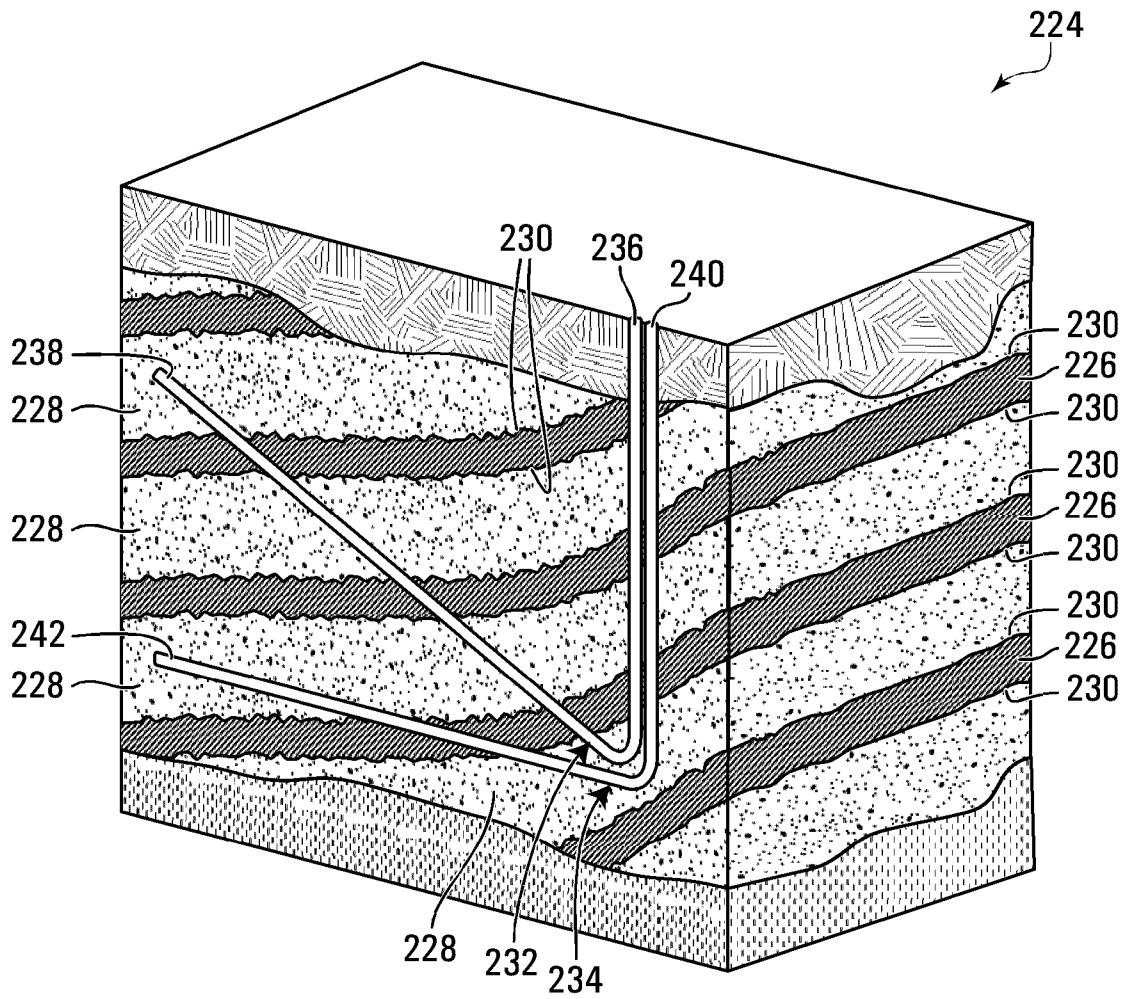


FIG. 2B

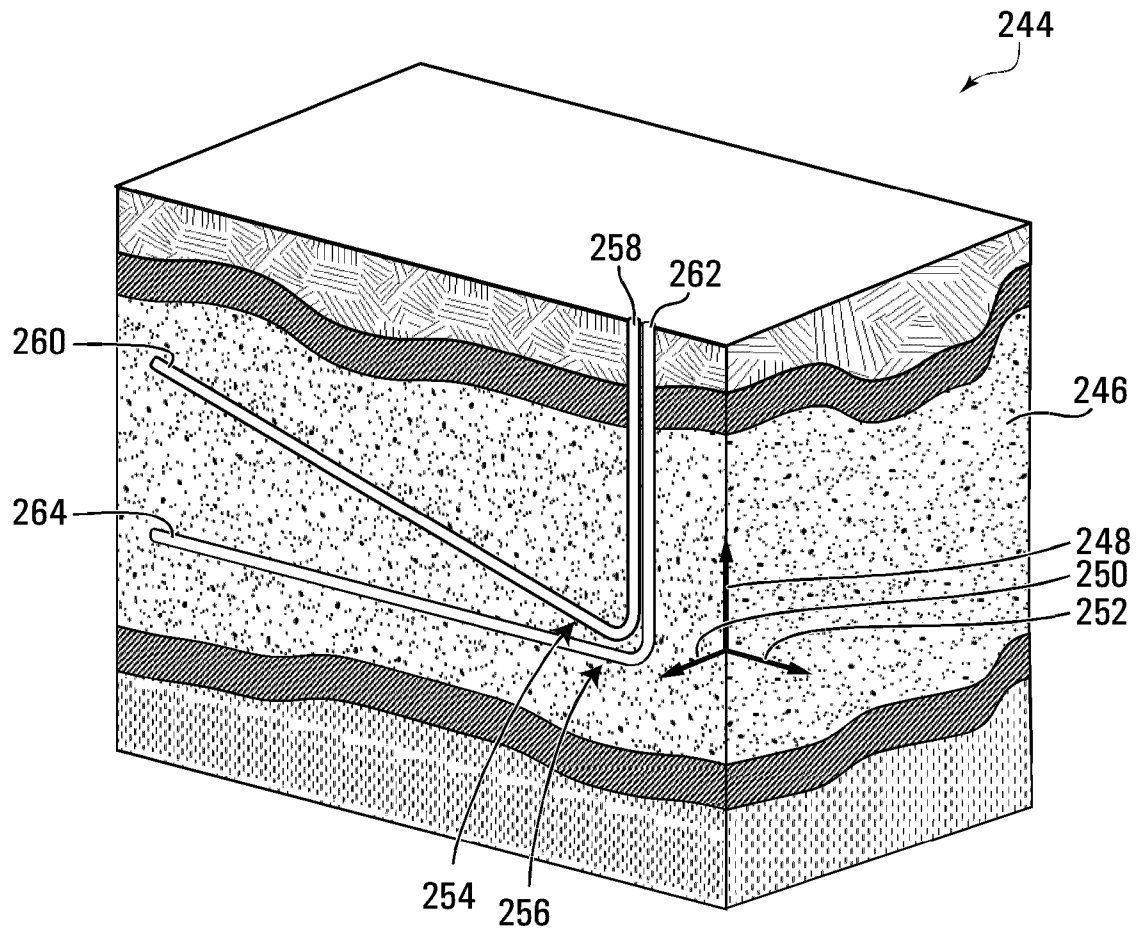


FIG. 2C

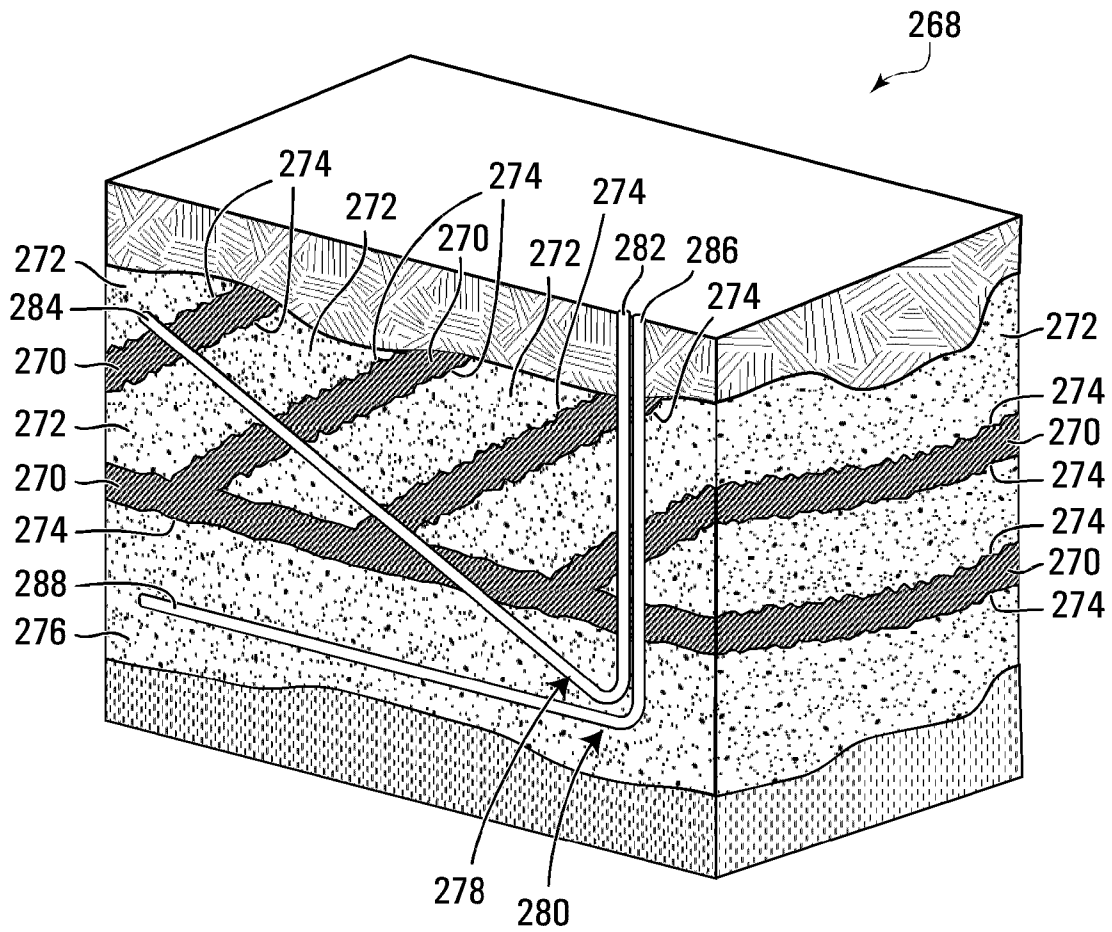


FIG. 2D

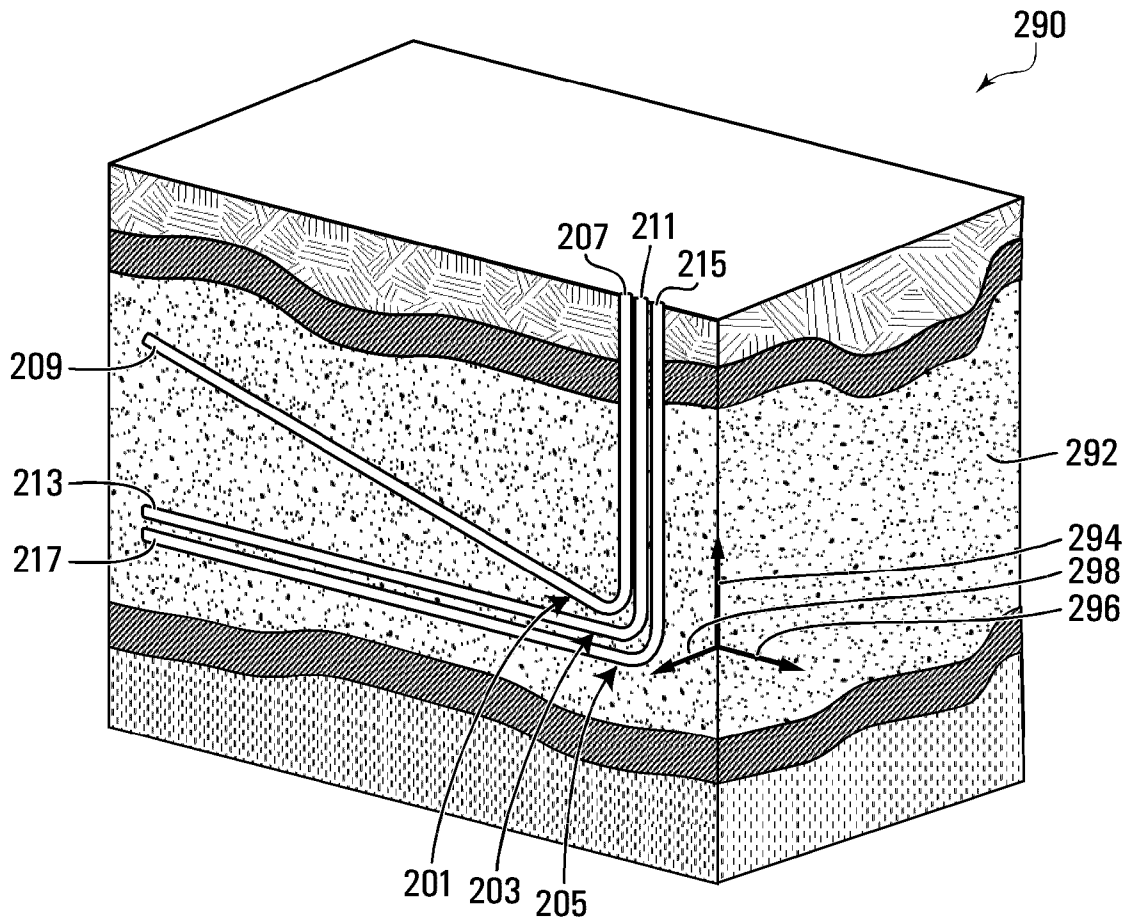


FIG. 2E

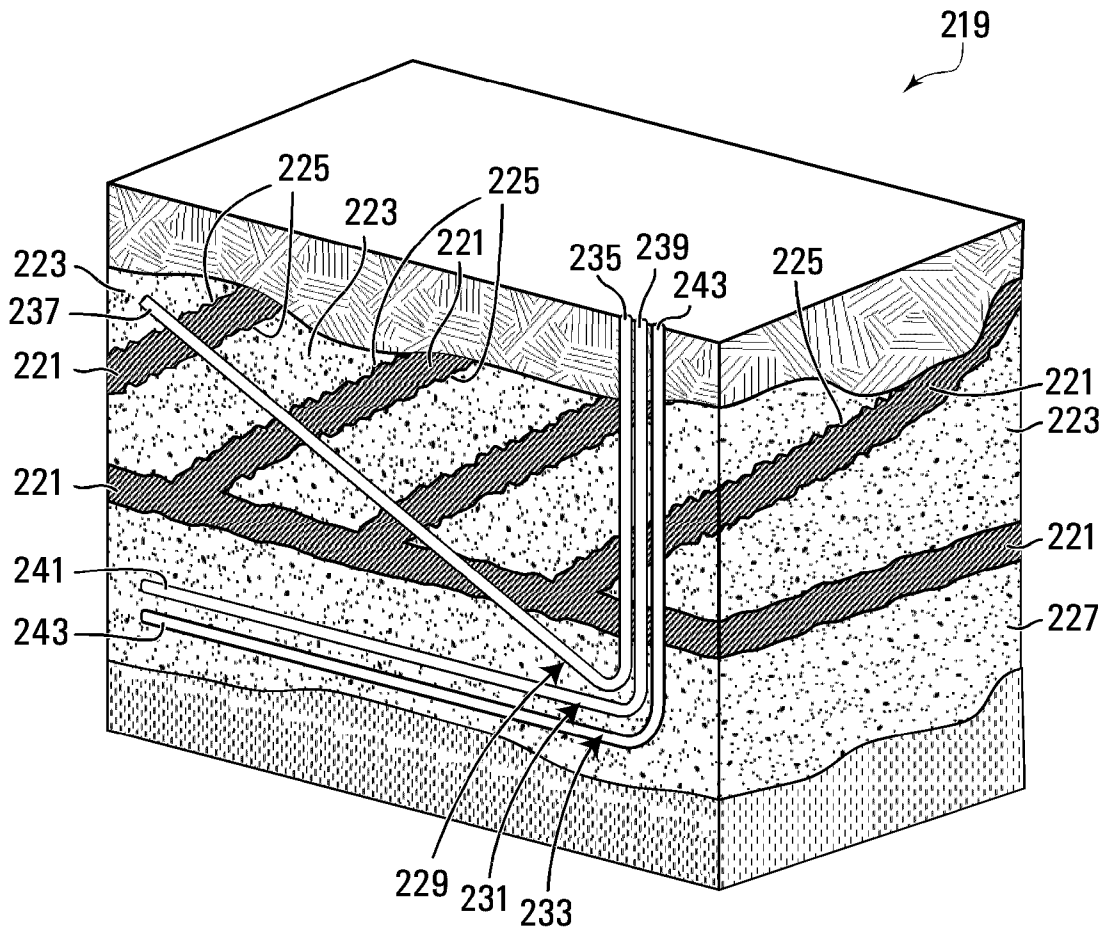


FIG. 2F

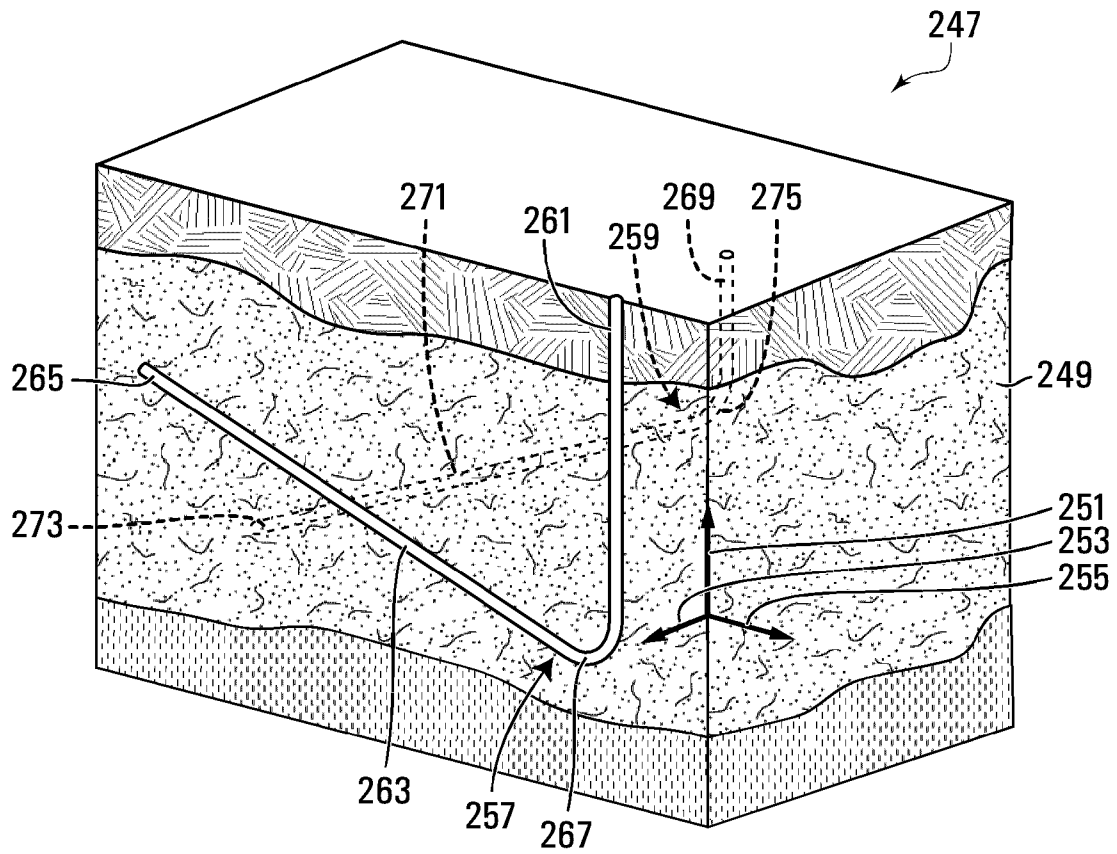


FIG. 2G

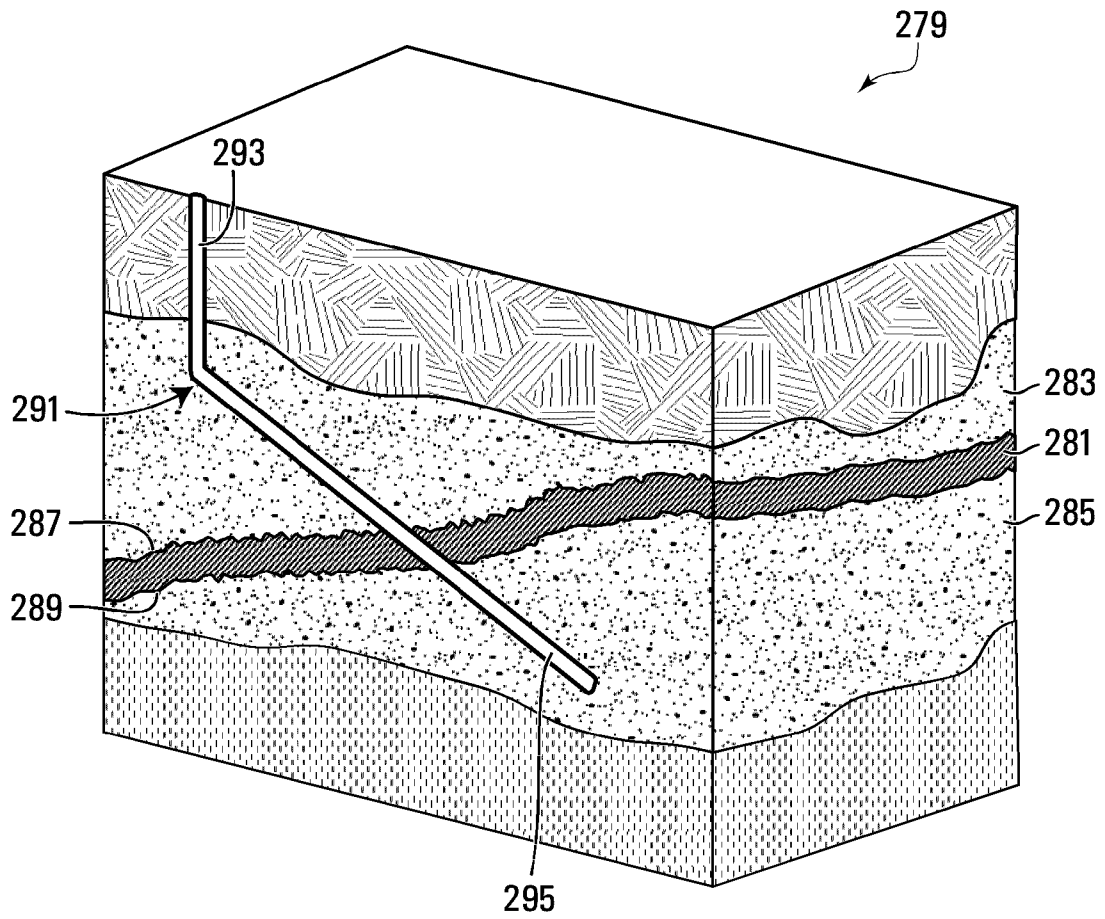


FIG. 2H



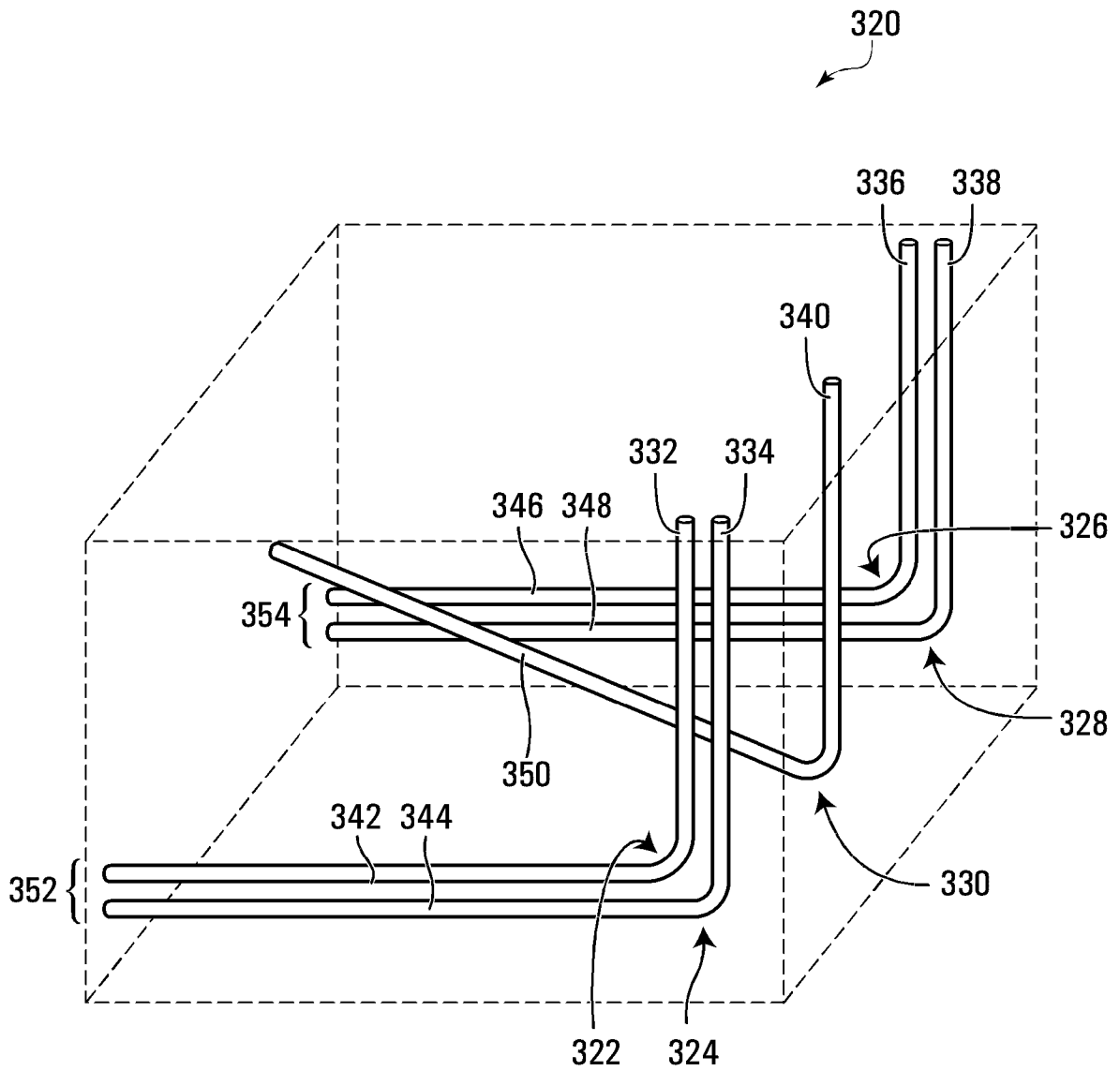


FIG. 3B

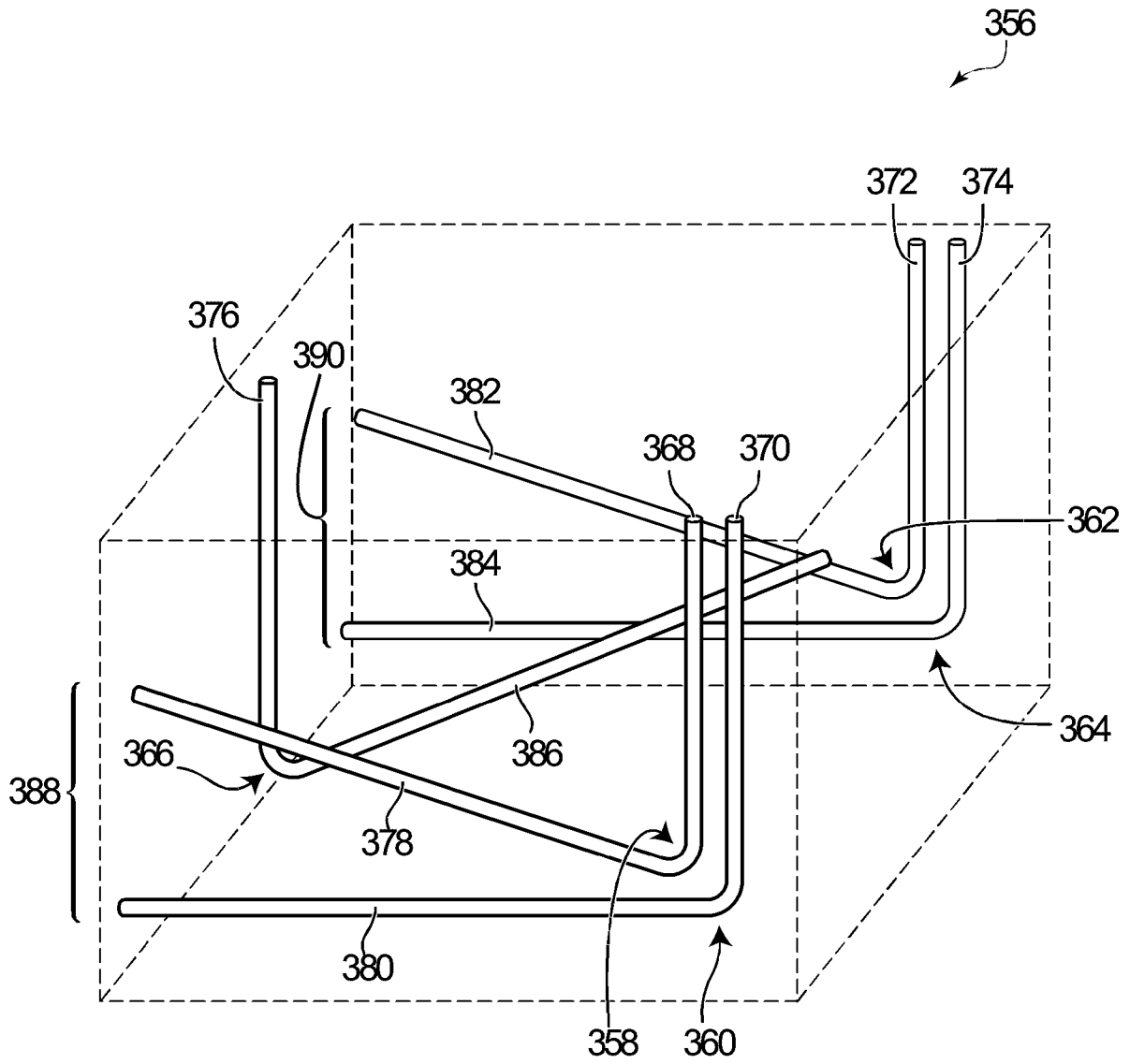


FIG. 3C

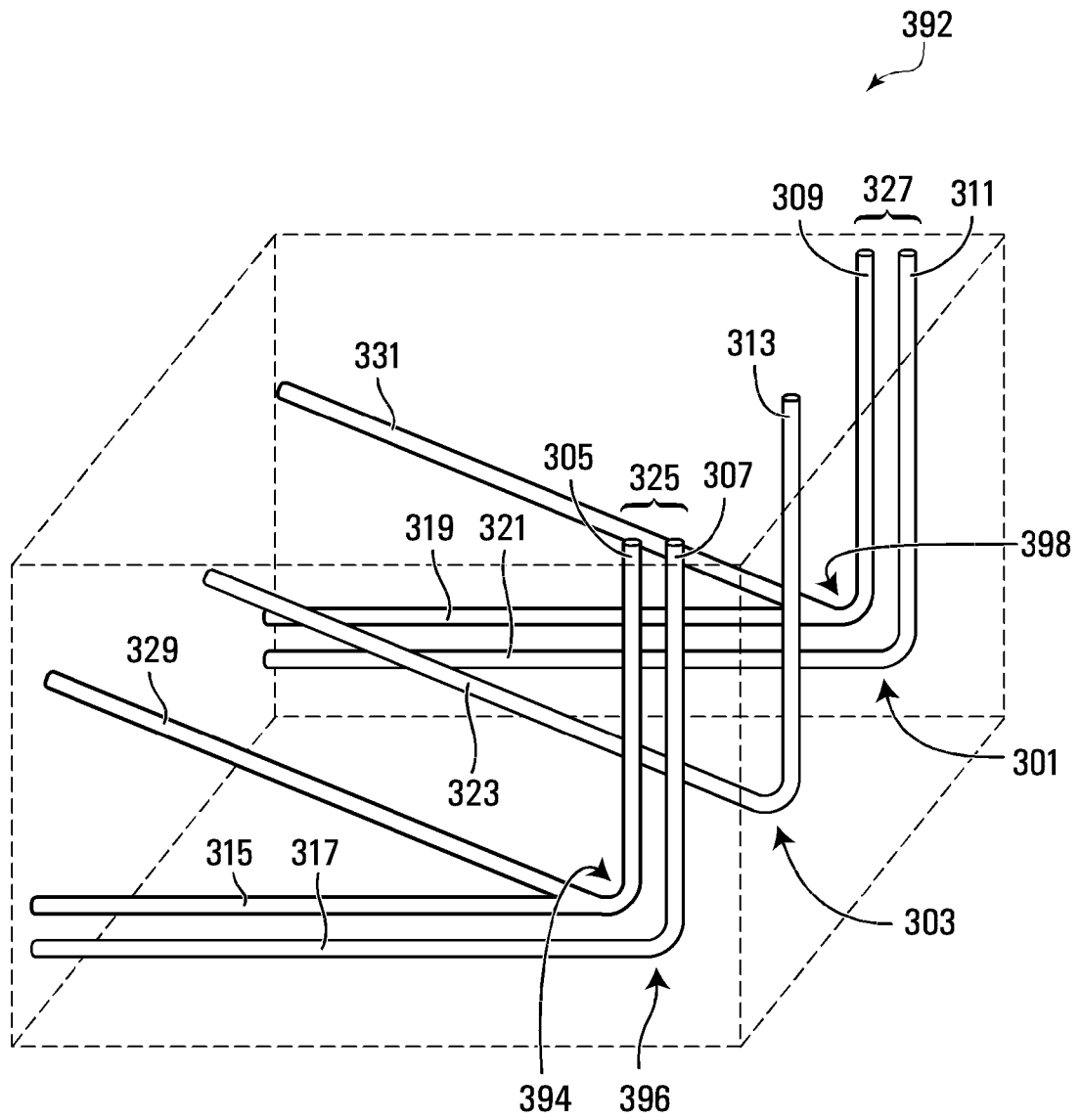


FIG. 3D

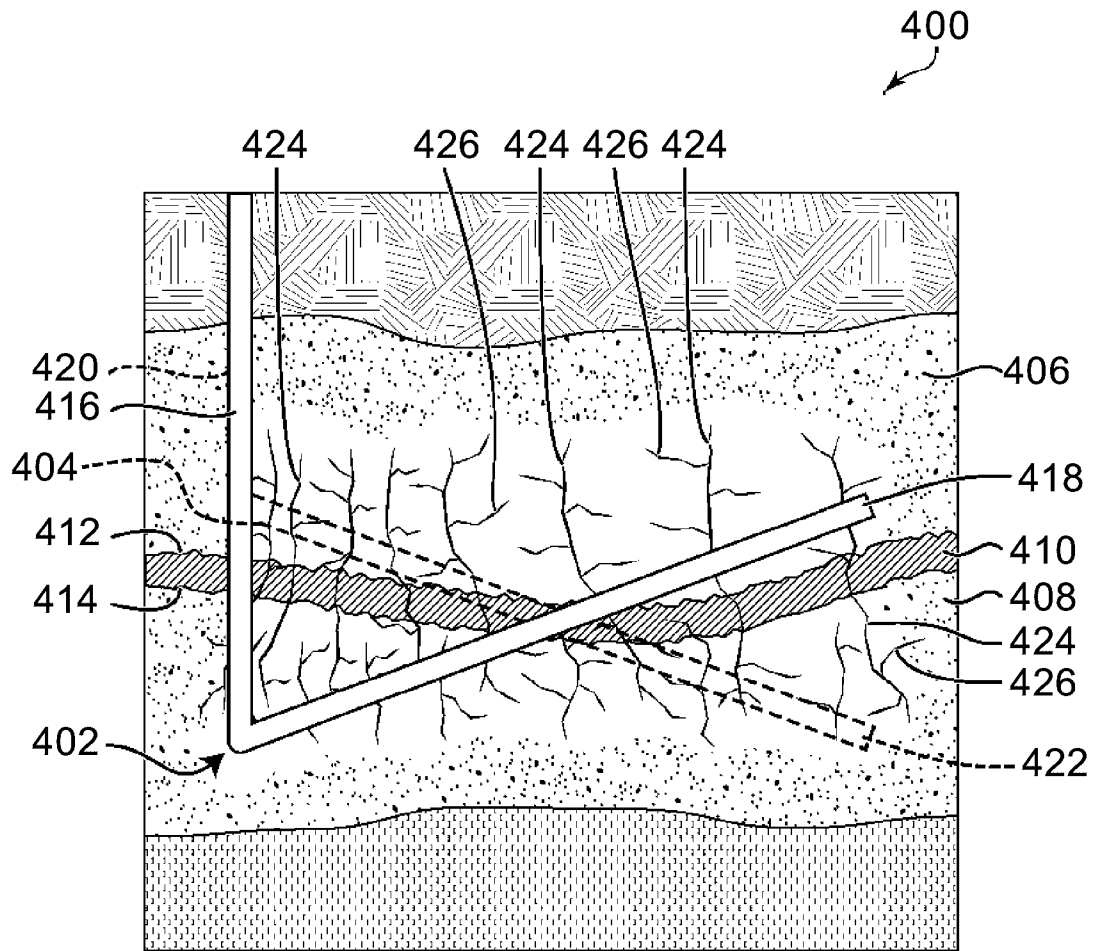


FIG. 4A

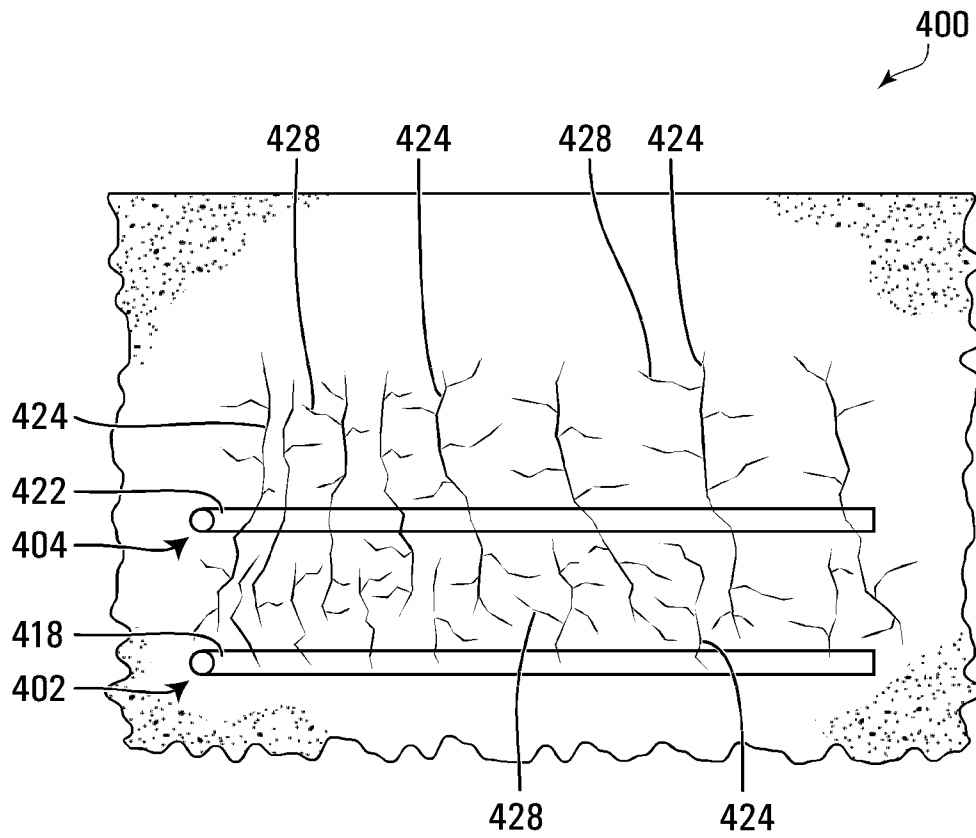


FIG. 4B

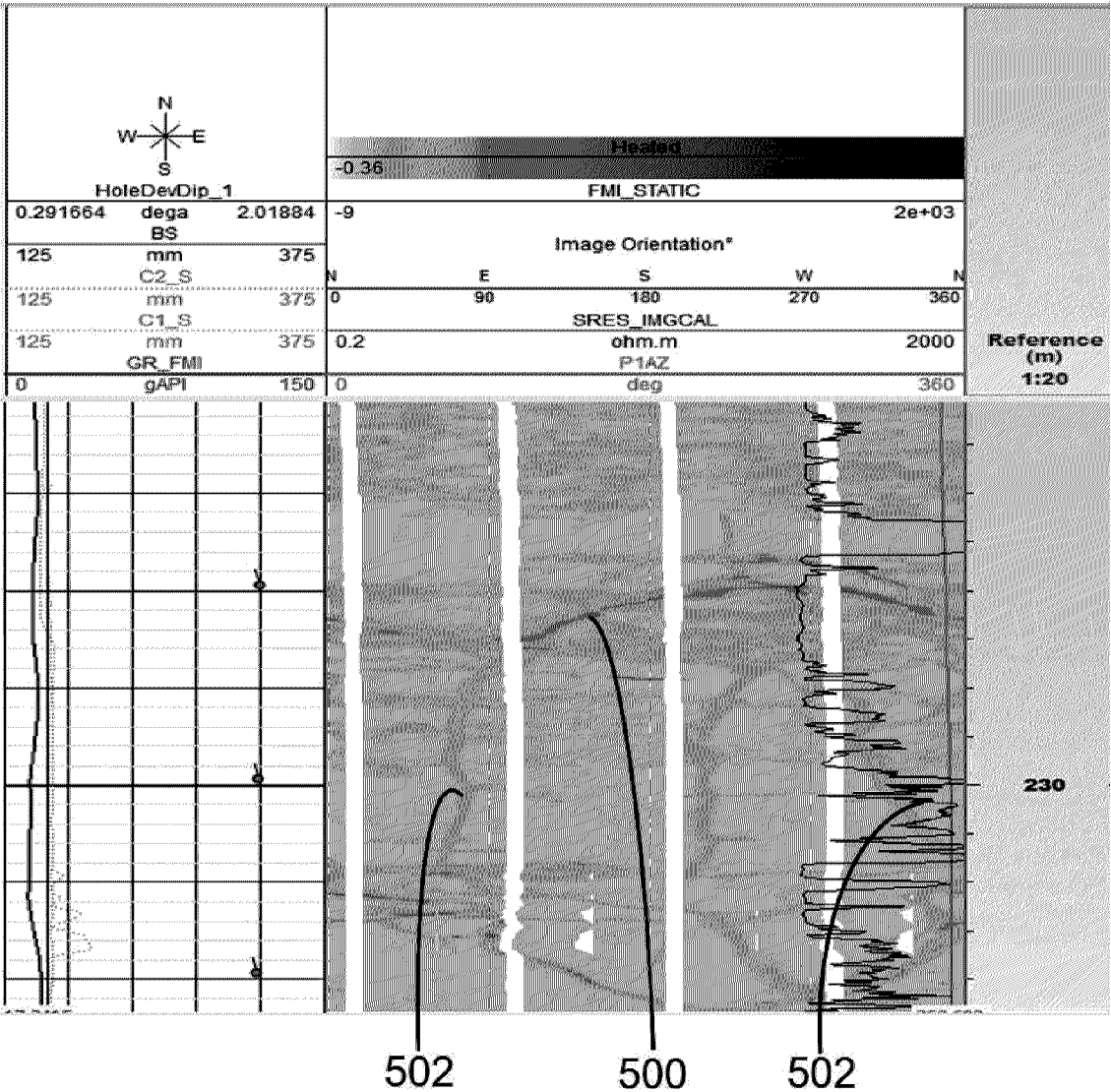


FIG. 5A

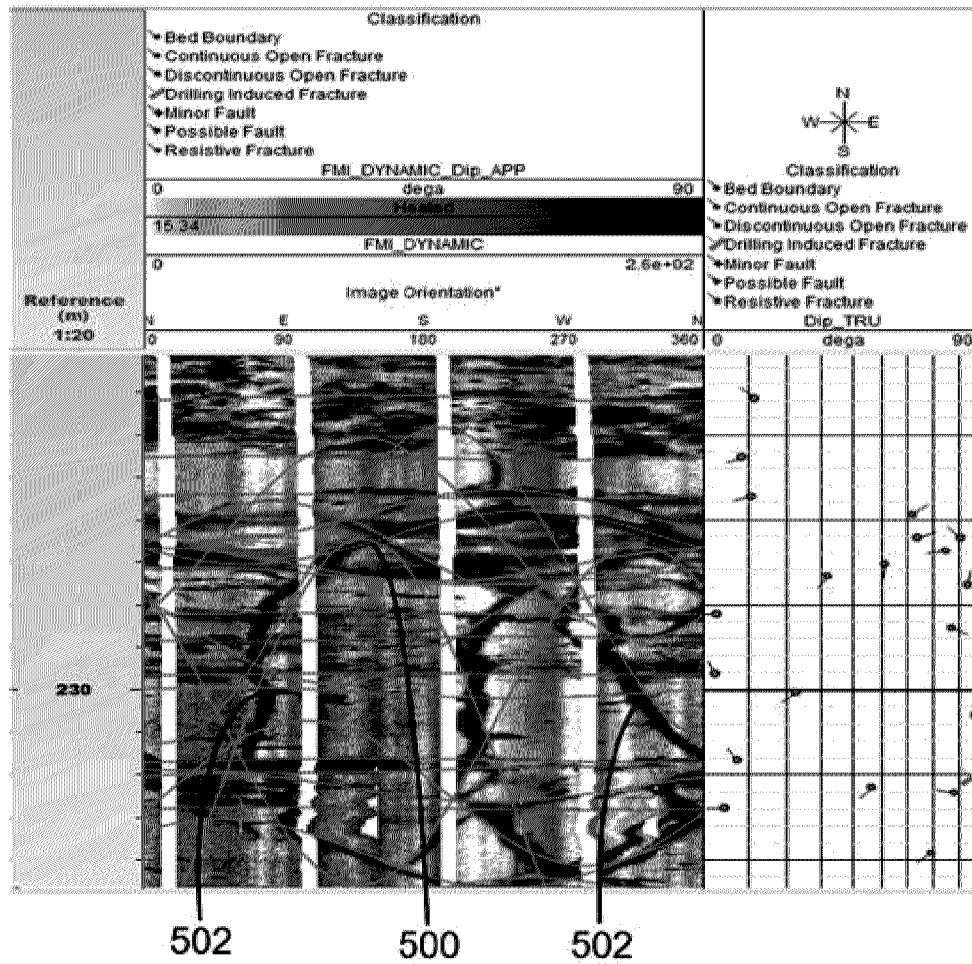


FIG. 5B

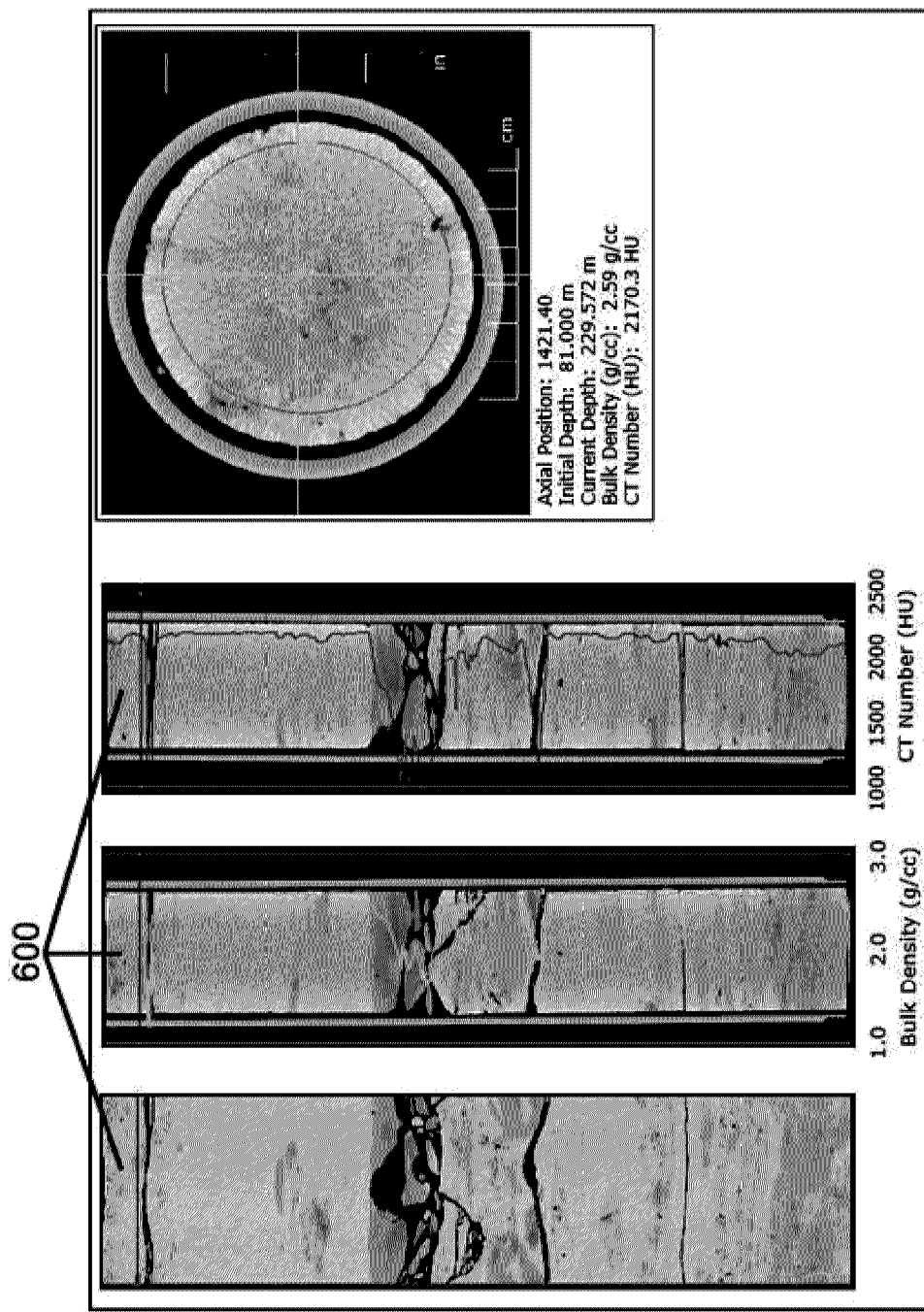


FIG. 6

G -Function Analysis

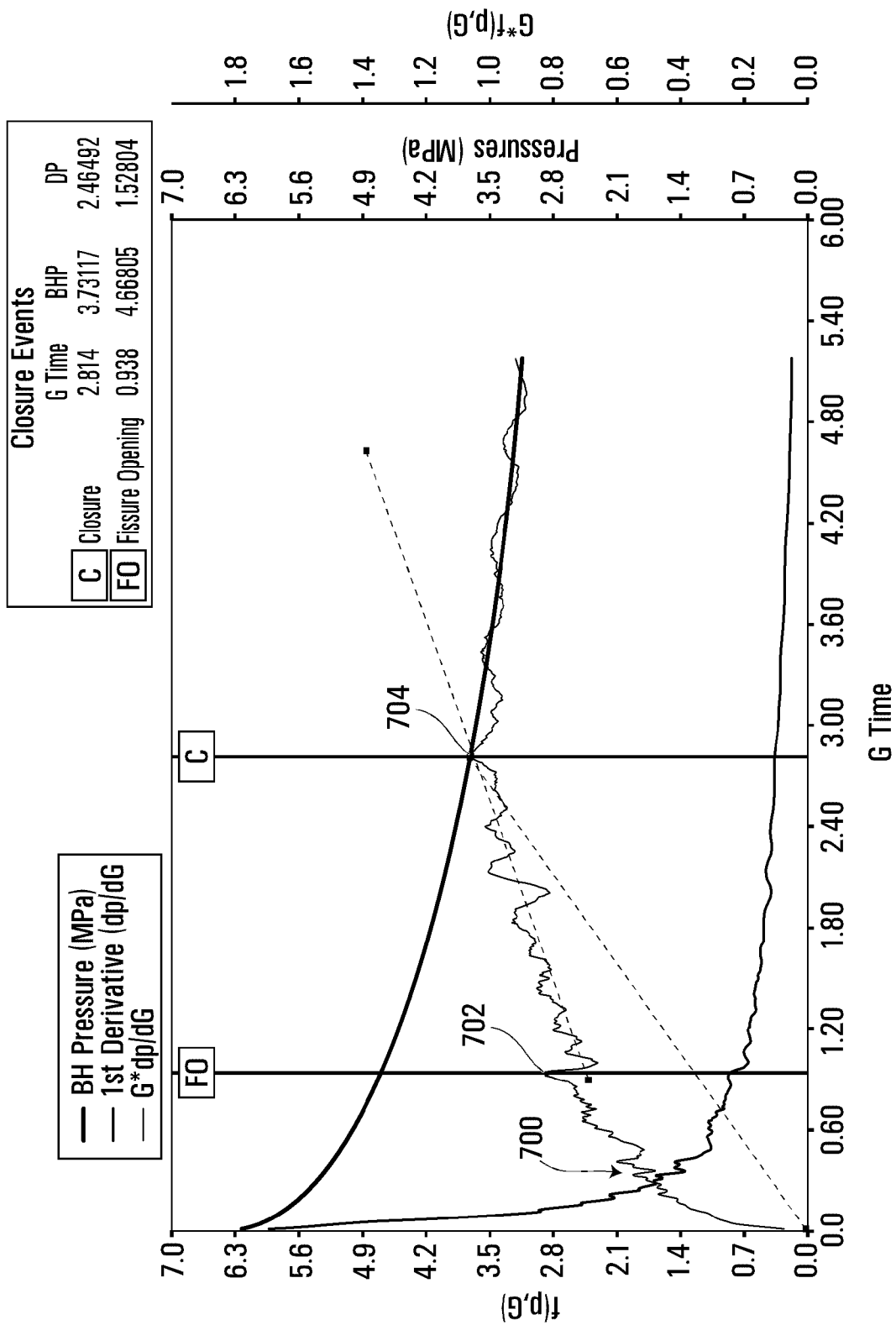


FIG. 7

G -Function Analysis

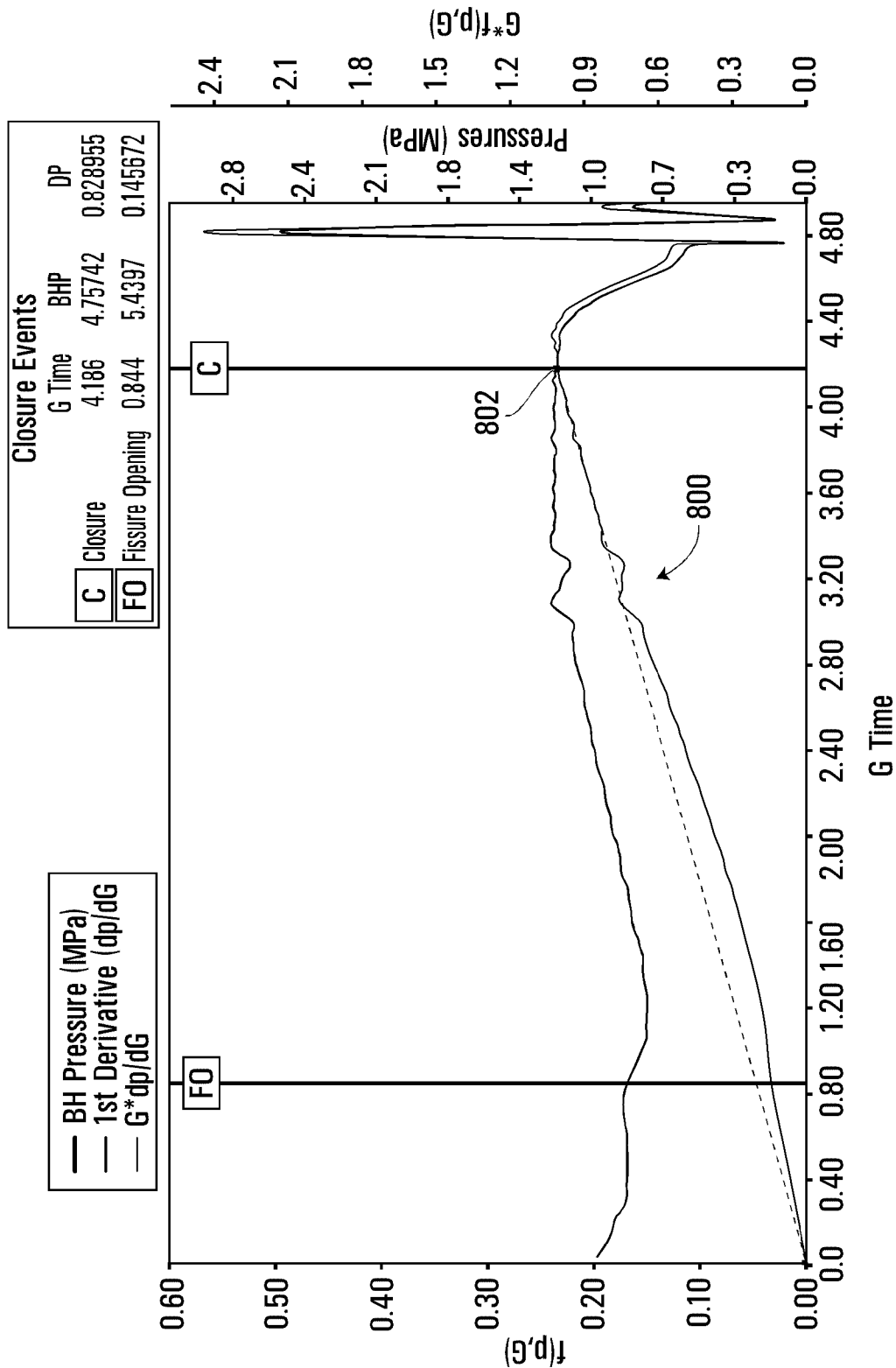


FIG. 8A

ACA Radial Analysis

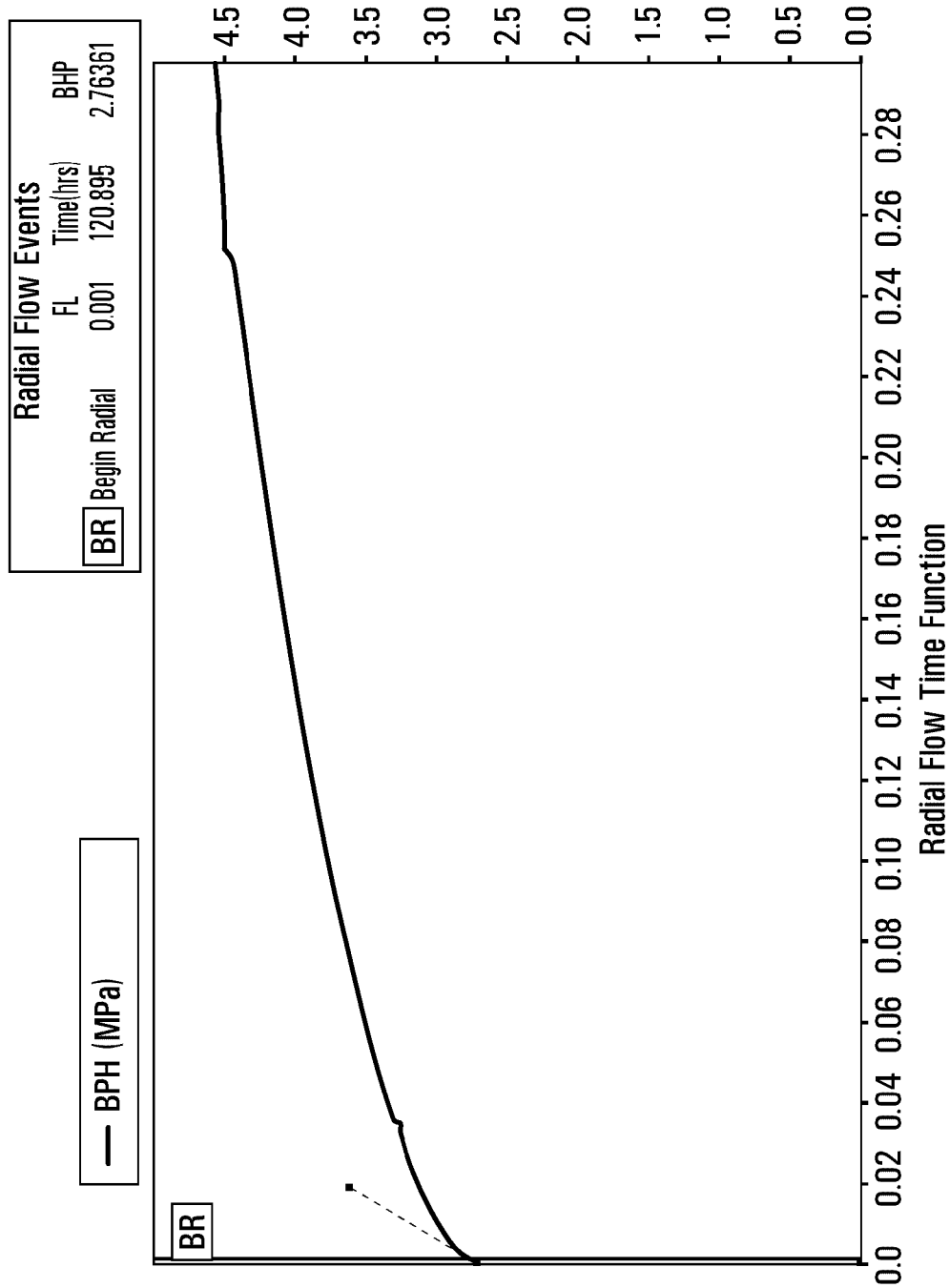


FIG. 8B

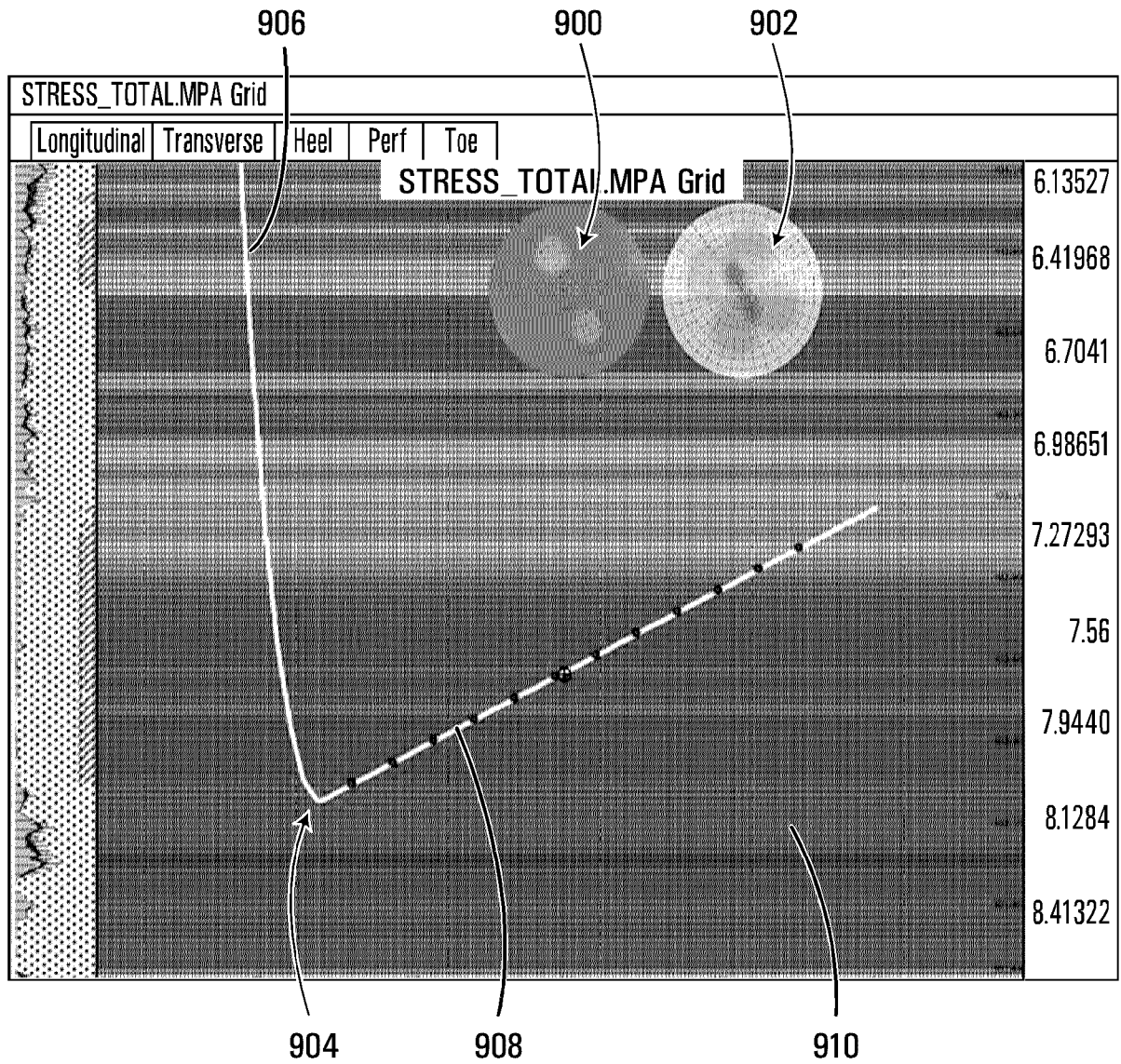


FIG. 9



Date reçue/Date Received 2021-02-03

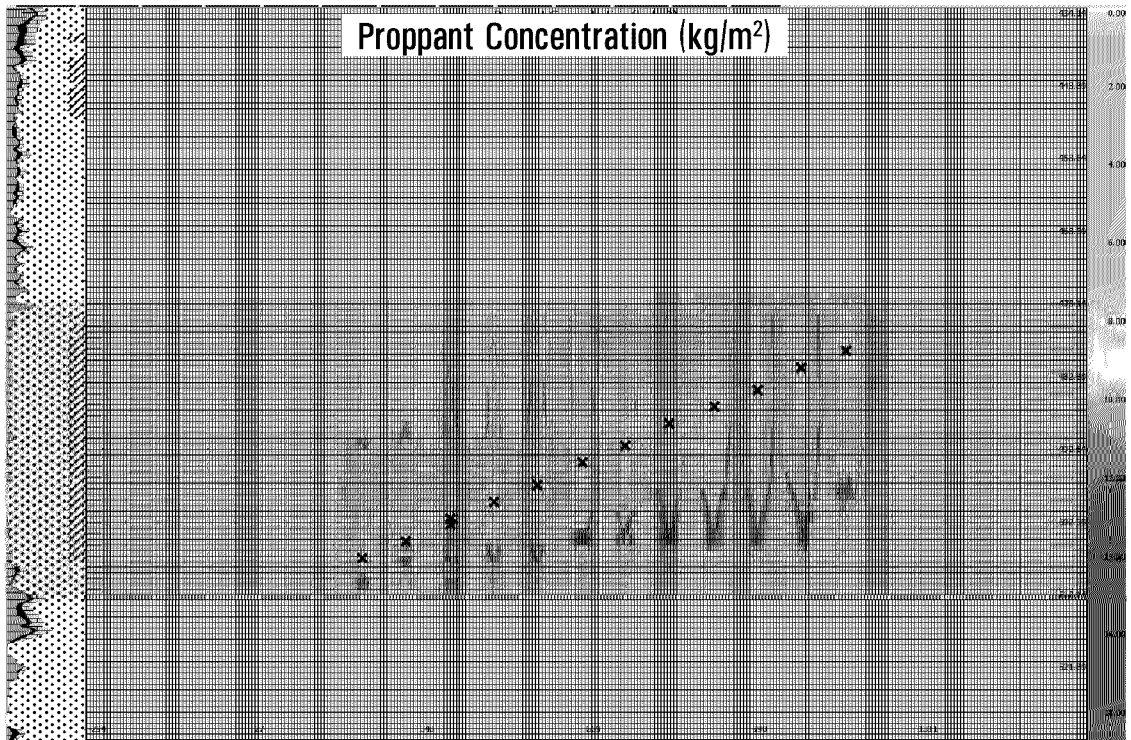


FIG. 10B

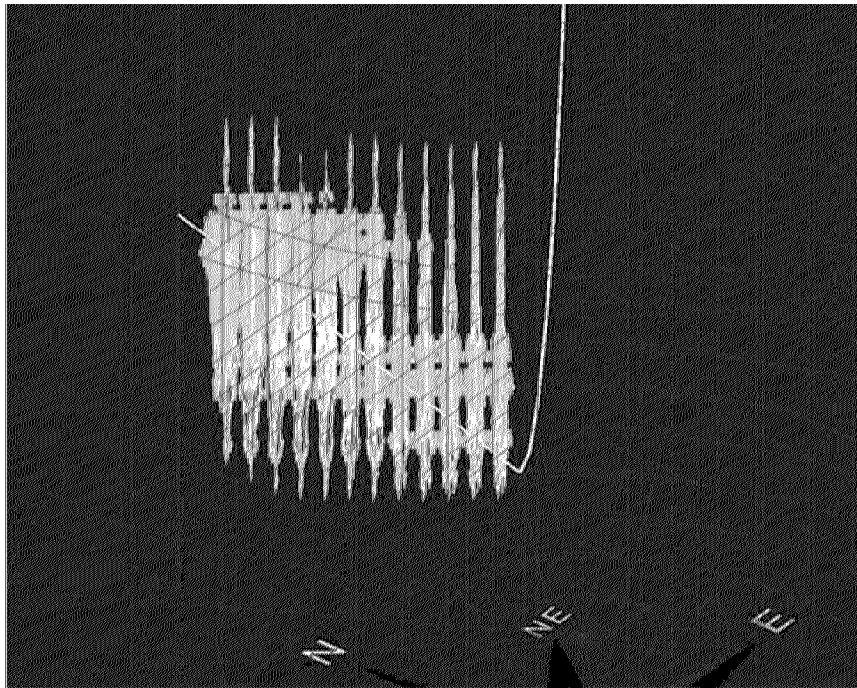


FIG. 10C

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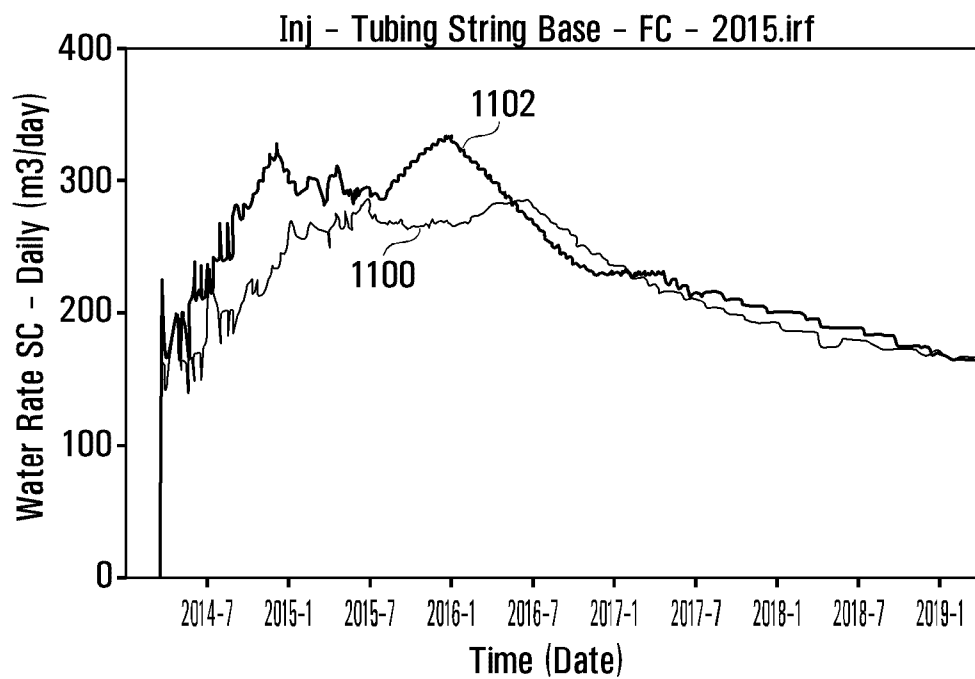


FIG. 11A

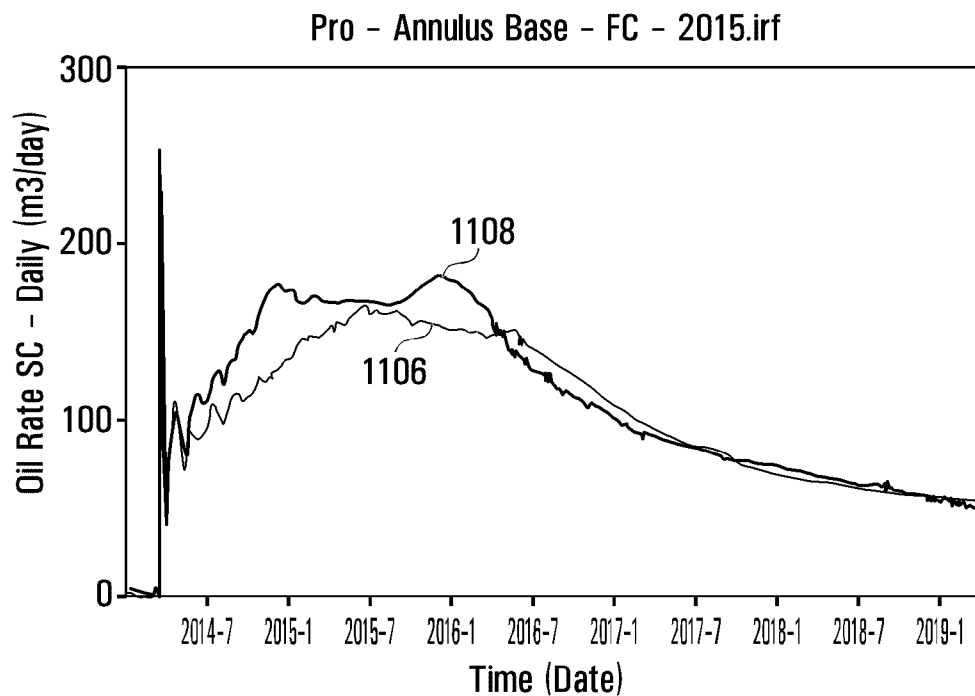


FIG. 11B

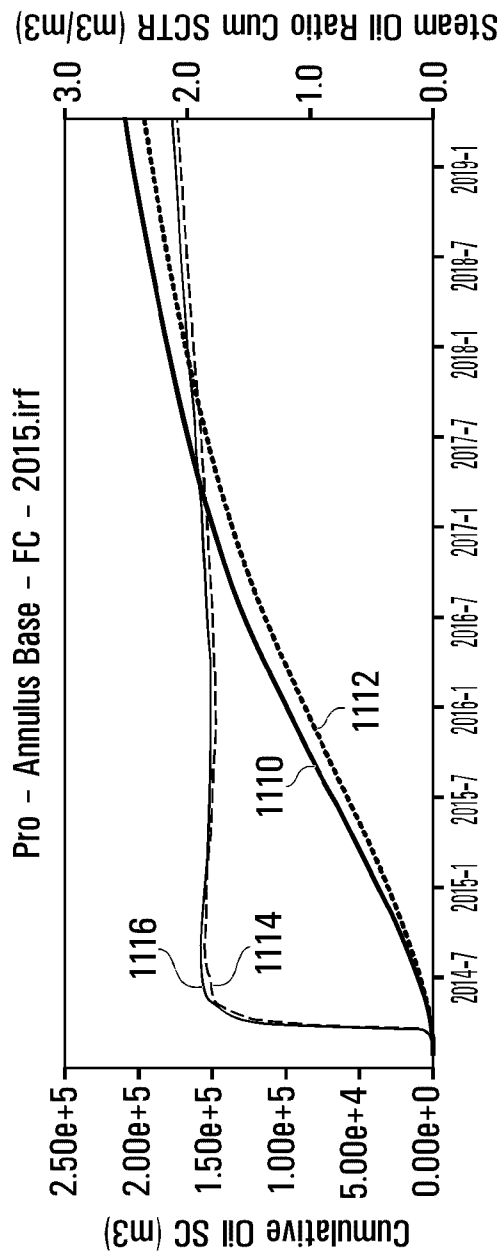


FIG. 11C

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Inj - Tubing String Base - FC - 2015_BIGshale_aboveinj_SOR3.0.irf

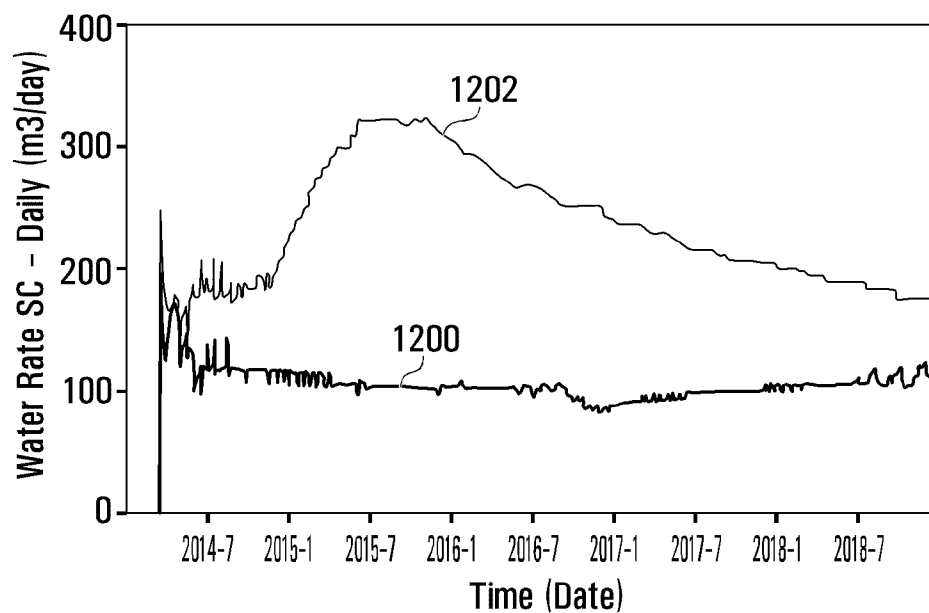


FIG. 12A

Pro - Annulus Base - FC - 2015_BIGshale_aboveinj_SOR3.0.irf

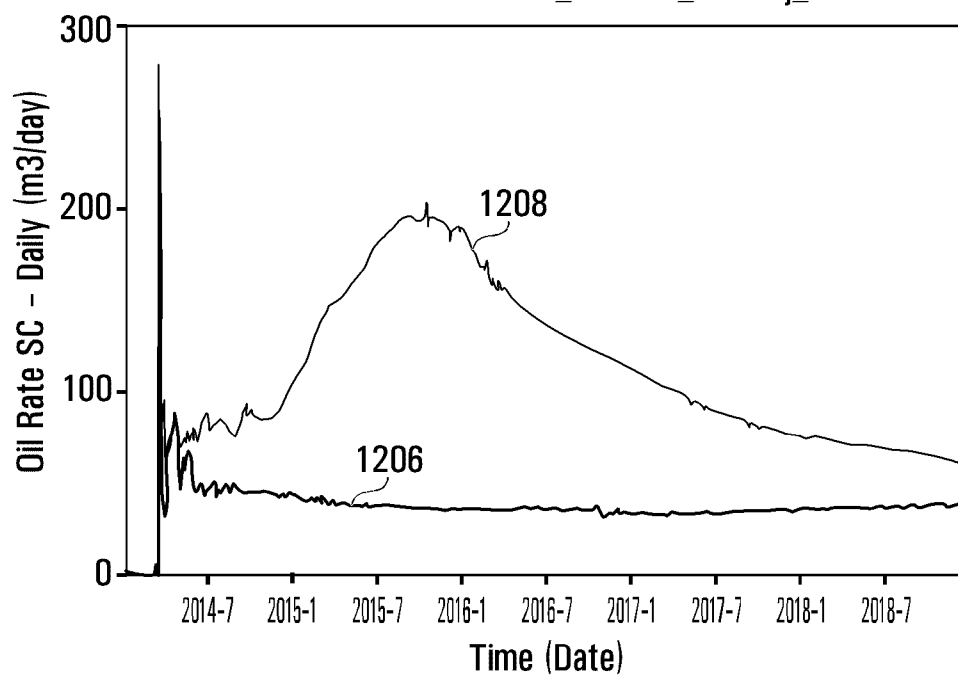


FIG. 12B

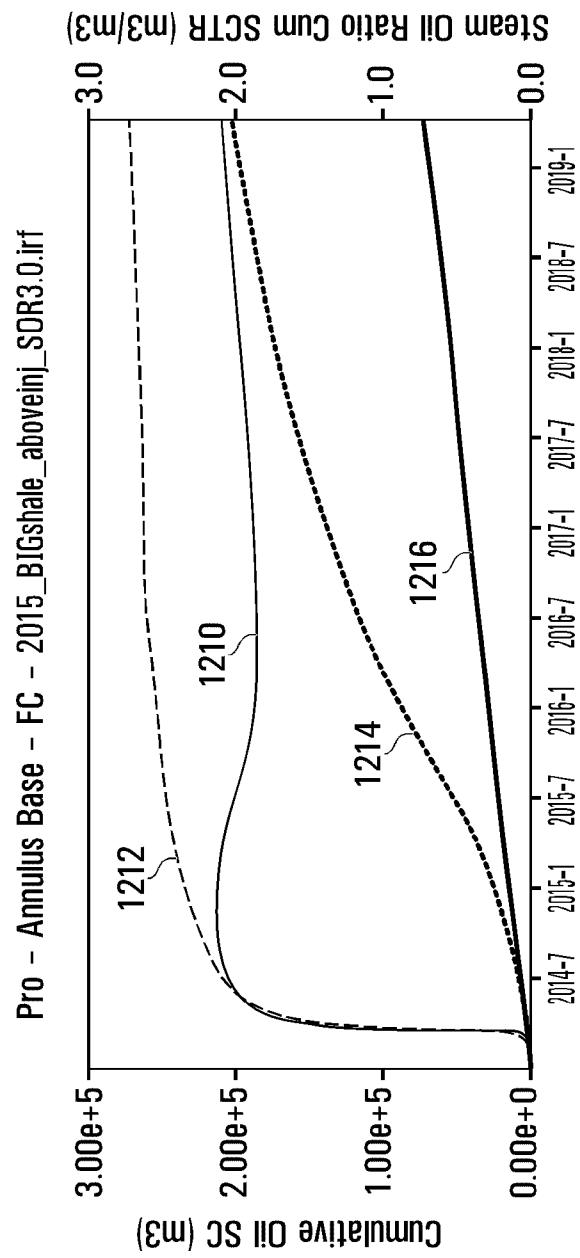


FIG. 12C

