

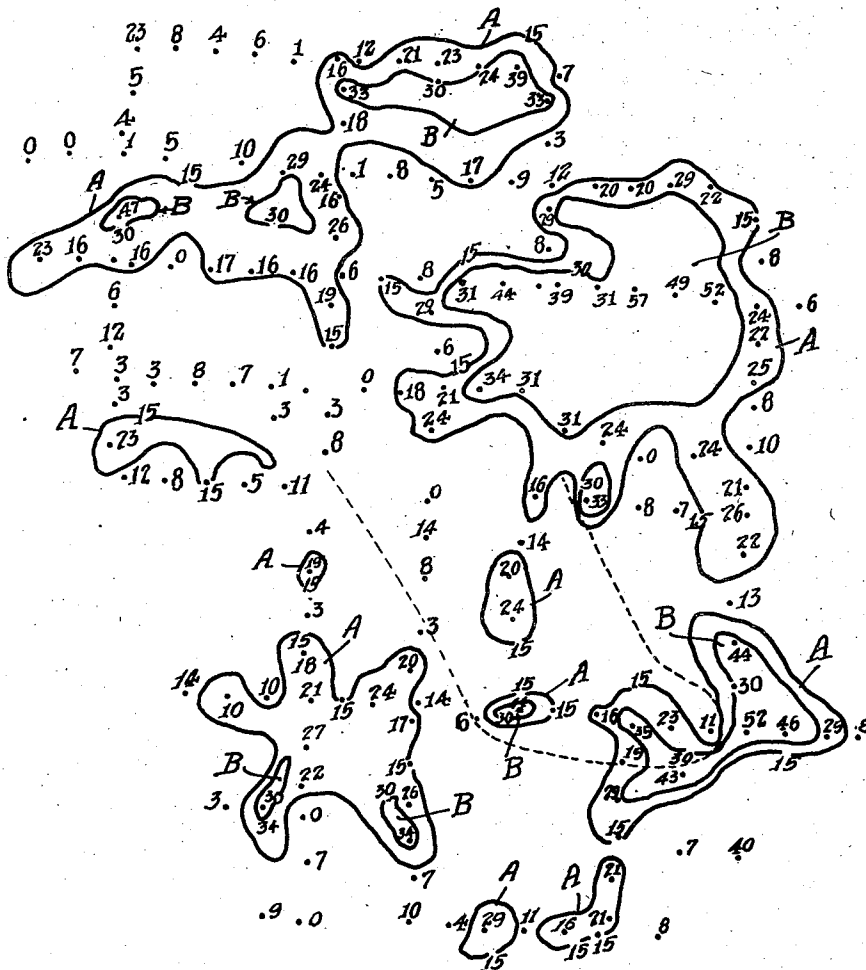
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METHOD OF SOIL ANALYSIS FOR LOCATION OF OIL DEPOSITS

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METHOD OF SOIL ANALYSIS FOR LOCATION
OF OIL DEPOSITS

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This invention relates to a process for locating petroleum deposits by collecting and analyzing soil samples. It has been found that deposits of petroleum are usually associated with the presence of hydrocarbon gases in minute traces in the surface soils immediately above, or more generally above and somewhat offset from the petroleum deposit. Quite frequently, the hydrocarbon gases are most concentrated around the edges of the geological formation containing the petroleum deposit. Efforts have been to determine the position of petroleum deposits by analyzing either samples of gases taken from the soil at or near the surface, or by analyzing samples of the soil itself taken near the surface for its hydrocarbon gas content. Upon the determination of the hydrocarbon gas content of the soil, so-called gas maps of the territory are produced upon which are located the gradient lines of equal gas content.

Attempts to locate petroleum deposits by this gas mapping method are accompanied with many difficulties. The gas content of the soil is not only dependent upon the presence of petroleum deposits below the surface but also is affected by the composition of the soil itself and its ability or lack of ability to retain or hold hydrocarbon gases. Furthermore, the collection and transportation of samples to the laboratory without alteration of the gas content is difficult and the method of analyzing for hydrocarbon gas content, usually ethane, is laborious and difficult. Furthermore, the gas content of soil located favorably with respect to an oil field in many cases is not radically different from the gas content of other soil not so located.

It is a general object of the present invention to provide a method of geochemical prospecting or for soil analysis surveying for the purpose of locating oil or petroleum deposits, which method to a material extent overcomes and eliminates the difficulties experienced with the present soil gas surveying method.

Deposits of petroleum almost universally contain appreciable quantities of sulphur compounds. I have discovered that the surface soils above or about deposits of the petroleum contain sulphides in significant quantities, and by analyzing samples of the soil taken at the surface or a few feet below the surface for their sulphide content a much improved soil analysis survey for petroleum is provided. Under the same conditions that hydrocarbon gases, such as ethane, may pass from a deeply disposed petroleum deposit to adjacent surface soils, so, also,

apparently there pass to such surface soils sulphur compounds from the petroleum deposits. Said sulphur compounds are to an extent at least combined with the ingredients of the soil to partially fix the sulphur as sulphides content in the soil, even though the soil may be of sufficiently porous content to not long retain substantial quantities of hydrocarbon gases, such as ethane.

Accordingly, by the process of my invention, a more reliable indication of the positions and locations of petroleum deposits is provided which is not so dependent upon the physical nature of the overlying soil, i. e., its porosity, etc. Furthermore, the quantities of sulphide found in the surface soils above petroleum deposits are much greater in magnitude than the deposits of ethane, and the differentiation between the sulphide content of soils adjacent the petroleum deposits and other soils is often much more pronounced than in the corresponding case where analyses are made from ethane.

Further advantages of the method of the present invention reside in the fact that the care necessary to be given samples of the soil while they are to be transported to the laboratory is less in a case where analysis is to be made for sulphide than where analysis is to be made for gas; and, moreover, the analyses necessary to determine the sulphide content of soil are much simpler to perform, so that the cost of analyzing soil for sulphide is materially below that of analyzing soil for ethane.

Various additional objects and advantages of the present invention will be apparent from the following description of a preferred form or example of a method of determining petroleum deposits, including the analysis of soil samples for sulphide embodying the present invention. For this purpose, I hereinafter describe a process in connection with the accompanying drawing.

In the drawing there is indicated an example of soil analysis chart resulting from the use of a process of my invention.

In the use of the process of the present invention, samples of the soil to be analyzed are taken either at the surface of the ground or, more preferably, at a short distance—for example, three to ten feet below the surface of the ground. It is recommended that the uniform practice with respect to obtaining soil samples should be used, such, for example, as obtaining all samples at a distance of three feet from the surface. Examples of soil should be taken at suitable intervals, such as five or six samples per linear mile to be sur-

veyed. No particular orderly procedure of taking samples for the purpose of the survey need be followed. It is sufficient only that enough samples be taken from the territory in question so that the result of the analyses of such samples will enable a reconstruction of the lines of equal sulphide content within the fields. The more usual practice is to take samples along a number of lines which may be spaced half a mile apart, after which further samples more closely taken may be gathered with respect to those areas of the field where analysis indicates significant deposits of sulphide may be present. The accompanying drawing indicates, for example, a satisfactory procedure with respect to gathering samples; each of the dots appearing on the drawing representing locations at which samples were taken, and the figures adjacent such dots corresponding to the sulphide content of the soil expressed in parts per million of sulphur.

As will be apparent from an examination of the accompanying drawing, samples were taken along several lines, and thereafter additional samples were taken in some of the more significant areas. Upon analysis of the soil for sulphide, the sulphide content indicated by the analysis is placed on the map of the territory in question, and thereafter one may draw lines through the map where the analysis indicates corresponding high levels with respect to the sulphide content. In the accompanying drawing, for example, the potential lines A are drawn through areas apparently containing 15 parts per million of sulphur as sulphide, while lines marked B are correspondingly drawn through areas containing 30 parts per million. In interpreting the results secured, in general the variation of the sulphide content of a given area is much more significant than the absolute values of sulphide content obtained. As analyses for sulphide content are taken over an area, the figures obtained are generally comparatively low over an unproductive area. Over the center of an oil productive area the values obtained in certain cases will be uniformly high, while in other cases the values over the center of an oil formation may be comparatively low and high values obtained only around or adjacent the edges of the productive area. In such cases as the latter the limits of the productive area will generally be designated by the lines of equal sulphide content being grouped in the form of a rough halo surrounding the productive area. For example, in the case of the attached drawing, the known productive area is that partially enclosed by the dotted lines and from which it can be seen how the halo lines of high sulphide content are roughly grouped about the edges of the productive zone. A portion of the area is still unproved as to production, as indicated by the break in the dotted lines. In certain cases the area of high sulphide content may be laterally displaced from the oil productive area. In determining the optimum places for drilling the results obtained by the process of the present invention can with advantage be correlated with respect to the known geological structure of the surrounding area. The two together frequently indicate the optimum drilling sights.

Two important differences between the soil survey method of the present invention and the ethane method should be noted. In the method of the present invention, analysis for sulphide content of soils within the same locality showed a variation of sulphur content in the

form of sulphide from 0 parts per million to nearly 60 parts per million. Analyses of soil samples from the same location for ethane content showed a variation in ethane content of only from one part per billion to approximately 10 parts per billion, and in most cases indicated that the boundaries had to be speculated upon through the difference between soils analyzing from 5 to 6 parts per billion of ethane as compared with other soils analyzing 3 or 4 parts per billion. Thus, in the case of the sulphide determination process of the present invention, there is not only a greater difference between soil samples containing high sulphide than those containing low sulphur, but the quantity of sulphide in the soil in the form of sulphide is a thousandfold greater than the ethane content.

The sulphur content of the soil is mostly combined as sulphides and sulphates and the sulphur content may be determined by any usual and preferred method of analyzing for sulphides or sulphates, or both.

While various methods may be employed for analyzing soil samples for sulphide content, for illustration the following method of analysis has been found eminently satisfactory. In the preferred method of analysis of soil samples for sulphide, 20 grams of the sample are placed in 100 cc. round bottom flask attached to a reflux condenser, and 50 cc. of 8 normal sulphuric acid added. The flask is then heated while a side tube on the flask permits a current of nitrogen to pass upwardly through the condenser carrying with it any H_2S hydrogen sulphide evolved from the soil. Across the top of the condenser is fastened a piece of paper containing lead acetate, which will react with the hydrogen sulphide produced to form a disc spot of lead sulphide. The lead acetate preferably should be slightly acidic to prevent the formation of lead carbonate from any carbon dioxide present. The contents of the flask should be boiled about 20 minutes. The spot of lead sulphide collected on the paper is then compared with standards prepared by heating known amounts of sulphide in a blank soil sample.

The analysis above described is exceedingly economical. One analyst may run 100 of such analyses per day.

While I have described my invention in connection with its preferred form, it is to be understood that the invention is not necessarily limited in all of its claims to the examples given, particularly with respect to the specific method of determining sulphide, and the invention includes all such changes and modifications as come within the scope of the appended claims.

I claim:

1. A method of geochemical survey for petroleum deposits, which comprises taking samples of soil at spaced intervals over the area to be surveyed, determining the sulphide content of said soil samples, and determining the location of petroleum deposits by selecting the significant high sulphide values and correlating the same with reference to the locations at which samples yielding such significant high values were obtained.

2. A method of geochemical survey for petroleum deposits, which comprises taking samples of soil at spaced intervals over the area to be surveyed, determining the sulphide content of such samples, and determining the location of petroleum deposits by selecting the significant high sulphide values and plotting in the form

of a map of the area surveyed equal contour lines through such significant high values so as to indicate the location of the petroleum deposits.

3. A method of geochemical survey for petroleum, which comprises taking soil samples at spaced intervals over the area to be surveyed, liberating hydrogen sulphide from said samples for the determination of the sulphide content, and determining the location of petroleum deposits by selecting from the analyses made those of significant high value as compared with the low background values obtained, preparing a map of the territory surveyed, and drawing enclosure lines on said map embracing said significant high values.

4. A method of geochemical survey for the location of petroleum, which comprises taking soil samples at intervals over the area to be surveyed, determining the sulphide content of such samples, and determining the presence of petroleum deposits by steps including the selection of the analyses having significant high values

from those analyses representing low background values, plotting the area surveyed, and enclosing on said plot by enclosure lines of equal sulphide content the points at which significant high sulphide values were obtained so as to thereby determine the location of such petroleum deposits.

5. A method of geochemical exploration for subterranean petroliferous deposits which comprises collecting samples of soil at spaced points in the area to be investigated at a depth several feet below the surface, said depth being sufficient to eliminate the effect of surface conditions, determining the sulphide content of the respective samples, and determining the location of petroliferous deposits by selecting the significant high sulphide values and correlating the same with reference to the locations at which samples yielding such significant high values were obtained.

6. A method according to claim 5 in which the samples are laterally spaced from each other and are collected at a depth of about ten feet.

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