ABSTRACT

NEAR SURFACE GEOCHEMICAL EVIDENCE AFFORDED BY ΔC, $\int$13C, and TRACE METAL ANALYSIS INDICATED HYDROCARBON ACCUMULATIONS.

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In the United States, geochemical prospecting for hydrocarbons has had an erratic history of application and research. The methods of various service companies as well as oil companies have been credited in whole or in part with some discoveries, but to date geochemical prospecting is not generally accepted as a commercial prospecting tool.

For over 40 years Geochemical Surveys, Inc., of Dallas, Texas has been developing a sophisticated geochemical technology which is now making valuable, though unpublicized, contributions to petroleum exploration. This has been accomplished through the application of its ΔC analysis, carbon-isotope analysis and trace metal analysis as applied to investigations of prospective oil and gas fields.

It is important to remember that petroleum exploration, using any tool, is first, last, and always a geological problem. Even mountains of technological information, be it geophysical, geochemical, or biological, will be useless, until a method is formulated with a governing law or theory, and can be expressed in relation to its geological significance.

The trap, reservoir, source rocks, and associated fluids are the four basic aspects of any oil and gas occurrance with which explorationists traditionally concern themselves. These four elements or aspects are the initiators of the near-surface manifestations that the geochemists measure. To the layman, the chief criticism of all geochemical prospecting for hydrocarbons is that there is no satisfactory law or theory to tie the surface geochemical manifestations with the underlying hydrocarbon accumulations. However, it has now been proven through successful application over known producing oil and gas fields that, (1) vertical migration of hydrocarbons from underlying

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petroleum accumulations do migrate into the near-surface soils and sediments, (2) these hydrocarbons do cause a surface alteration that is detected by the ΔC method of analysis, (3) carbon-isotope measurements indicate where diagenetic pore-filling cements, yielding highly depleted $\Delta 13C$ values, which are usually identical to those of the hydrocarbons in the underlying accumulations, and (4) vertically migrating hydrocarbons absorbed on clay particles as films have a positive or negative affinity for certain trace metals. These trace metals will exhibit geochemical halos which agree with the ΔC halos. Those trace metals not having any affinity for organic matter, are found to precipitate in an apical or solid pattern over the underlying petroleum accumulations.

Several case histories are presented to illustrate ΔC, $\int 13C$, and trace metal analyses that exhibit geochemical halos over producing oil and gas fields.

Geochemical methods of exploration, as a whole, are basically sound in principle and have found their greatest utility when used in conjunction with the other geological and geophysical desciplines. However, one major advantage of geochemical hydrocarbon prospecting over geophysical and geological methods is that a geochemical anomaly (halo) is present over <u>all</u> traps, when hydrocarbons are present in the trap.