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Geophysical Tool Advances Prospecting

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DALLAS-Occasionally one is overwhelmed by society's myriad technological advancements. We would feel relieved by some continuity and permanence, yet are aware that business reality demands improved, cost effective methods. Consequently, we must always seek such change to remain on top of our games.

One such innovation is the PetroSonde instrument. It is new technology that is attracting the attention not only of the oil and gas industry, but also that of other resource exploration industries.

The instrument is a geophysical prospecting tool that causes no environmental damage, and is unaffected by underground utilities. The Petro-Sonde has proven to be effective for determining the depth, thickness and content of hydrocarbon reservoirs without drilling a well. Its resolution capabilities are unmatched by any prospecting technique except drilling.

The expense involved in applying the Petro-Sonde technology varies from lease to lease, but oil and gas companies are now simulating the drilling and logging of six to eight wells a day, in many cases, for a few thousand dollars.

Electrotelluric Principles

The principles behind the PetroSonde technology are based on electrotellurics. The instrument is a passive receiver that detects and analyzes the electrical field present at the earth's surface. Electromagnetic energy penetrates the earth, and upon striking planes of contrasting conductivity, reradiates toward the surface. The reradiated electromagnetic fields reach the surface electrical field with frequencies diagnostic of their depth of origin. The various subsurface conditions prevailing at each depth, such as type of lithology, porosity, and the presence of hydrocarbons and water, impart to the re-radiations recognizable distortions which permit the identification of those conditions.

In order to obtain this information, the Petro-Sonde is tuned to the required depth interval by a frequency dial. The specific frequency distortions are transduced into audible signals which a trained geologist recognizes and records.

A single geologist is required to operate the Petro-Sonde instrument. The unit's size and weight allow extreme flexibility in its transport and use. An operator can easily hand carry the Petro-Sonde into areas inaccessible by vehicle. The Petro-Sonde's totally passive nature, with no induced energy source, further allows access to areas prohibitive to other types of geophysical surveys.

The technology's depth ranges to 40,000 feet, and the instrument may be set to investigate any specific vertical interval, Le., 5,000-5,500 feet directly beneath a surface point. Data is available immediately, and is presented in a graphical format on the same vertical scale as a conventional downhole log. Signal changes recorded on the Petro-Sonde log correspond to lithology, porosity, and fluid contacts. Signal characteristics provide relative resistivity data.

Positive identification of a lithology can be provided by the Petro-Sonde when correlated with the resistivity values of a known geologic section. Readings at several stations allow three-dimensional definition of a prospective formation. The presence of oil. gas and water can be determined in many situations, however, content interpretation is qualitative and usually first requires calibrating to geologic knowns.

Use In Early Evaluation

The Petro-Sonde has been used successfully from the early stages of exploration to the evaluation and development of a reservoir. Existing well control permits the Petro-Sonde geologist to calibrate the instrument for depth and to establish a recognizable pattern that corresponds to the target lithology, hydrocarbon reservoir, and marker beds. Once the pattern is identified at the calibration station. a series of readings taken over an area can reveal, by correlation, the structural features and/or distribution of the hydrocarbon reservoir. The lateral extent of a channel sand can be defined across a lease. The same is true of porosity development within a carbonate sequence. In a structural play, formation tops can be mapped by tracing and correlating marker beds.

Information concerning reservoir content, hydrocarbon distribution, depositional environments, and subsurface structure can be obtained. Isopach, structure maps, cross sections, and three-dimensional diagrams can be generated using Petro-Sonde data. Correlation of the Petro-Sonde logs with other electrical logs allows construction of complete subsurface maps before oil and gas wells are drilled.

The most effective application of this technology is to augment a number of subsurface data points provided by existing well control. For example, with a number of Petro-Sonde survey stations located around a discovery well, it is possible to delineate precisely the effective limits of the reservoir.

Over one 12-month span, there were more than 100 oil and gas wells drilled using Petro-Sonde technology in conjunction with other subsurface data. Of those wells, there was an excellent correlation 75 percent of the time between the Petro-Sonde calls and the downhole log results regarding depth of lithologic contacts, formation thickness, and reservoir presence and content.

The majority of work performed with this technology has been in Texas and Oklahoma, however, Dallas-based Geophysics International Corp. has also used the technology in the Gulf Coast Basin in South Texas, the Williston Basin in North Dakota. and the Sacramento Basin in California, Michigan, Illinois, and the Appalachian Basin.

Geophysics' Petro-Sonde client base includes 35 of the ail *and* Gas *Journal's* 1985 top 400 companies. in addition to scores of small and mid size independent exploration companies. A Canadian-based oil concern has scheduled to apply Petro-Sonde technology in Africa.

Future use and development of the Petro-Sonde is very promising, in oil and gas as well as in other subsurface exploration applications. The PetroSonde provides a cost effective, fast. and accurate method of identifying lithologies. fluids and minerals at selected depths without having to drill. The technology can reduce significantly the number of exploratory holes needed in subsurface evaluations.

With the thought of maintaining profits at $15-a-barrel oil on all exploration companies' minds, a new technology such as the Petro-Sonde may be what we all need to weather the storm.