Basic concepts which are well documented in the published literature are necessary to the comprehensive application of geomorphology, and are discussed.

Geomorphic analysis is concerned primarily with the determining of the degree of influence which the structure and lithology of the surface rocks have had on the morphological development of the area. The four basic categories of this approach, generally in order of their importance, are:

1. Drainage analysis
2. Land form analysis
3. Fracture pattern analysis, and
4. Tonal characteristic analysis

Although more stress may be placed on one of the above categories in a given area, a comprehensive analysis includes consideration of all of them. Drainage analysis is usually the most important, and drainage terminology carries a structural connotation. The terms consequent, resequent, subsequent, and obsequent can be used in a structural sense. All these streams can be related to the original consequent surface, which is the initial slope of the land surface upon regression of a sea. All streams are lazy and take the direction of least resistance; thus, all streams controlled by folding definitely migrate down dip and all streams controlled by faulting are linear in nature. The greatest deterent to the structural analysis of drainage is the homogeneity of surface rocks.

Photogeology and geomorphology are not the panacea for all exploration activity. They are tools which will be of value to each geologist only if he coordinates his interpretations of subsurface and geophysical data with them.

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John M. Hunt and Parke A. Dickey, Jersey Production Research Corp., Tulsa, Oklahoma and Tulsa University, Tulsa, Oklahoma

"Petroleum Technology in Russia"

Abstract

Geochemical Research

The USSR has embarked on a major program of geochemical research and the use of geochemistry in field operations. At present there are about 30 institutes doing geological, geophysical, and geochemical research. Some of these are attached to the operating branches of the industry and primarily do applied research. Other institutes conduct more basic and fundamental studies or work on problems of general application. These are directly under the Ministry of Geology. About 25 per cent of the research is in geochemistry, half of which is on surface methods and half on subsurface. In addition, geochemical research is carried out in the Academy of Science Institutes, the Ministry of Fuels, and the University of Moscow. In 1962 there were about 1,000 field parties looking for oil and gas. Some 60 per cent of these are in geophysics and the rest in geology, geochemistry and logging.

Research in surface geochemistry is concerned with such problems as rates of diffusion and filtration of hydrocarbons through sedimentary rocks, micro-

biological detection of hydrocarbons, and the evaluation of radiometric, organic, and inorganic anomalies at the surface.

There is considerable disagreement in the USSR concerning the value of making analyses of surface soil samples for traces of hydrocarbons, bacteria, and radioactivity. Only 10 per cent of the geochemical field parties are engaged in surface geochemical surveys, and these are mostly on a research basis rather than actual prospecting. Most studies have been in arid areas such as around Volgograd, Baku, and Turkmenia. In addition to soils, waters from springs and shallow wells are analyzed for traces of hydrocarbons.

In general, the Soviet scientists seem to be using more manpower and trying to develop more geochemical parameters for field use than US oil companies. They suffer from a shortage of good, high-precision analytical tools for their research program. Although many of their scientists are ingenious at improvising, their equipment does not come up to US standards. On the other hand, their scientists are well trained and thoroughly familiar with the world literature on their fields. The established facts of petroleum geochemistry, such as the organic nature of source beds and the detection of hydrocarbons in sediments and subsurface waters, are understood and taken into account in exploration programs. Thus the practical application of geochemistry in exploration is much more widespread than in the US.

Drilling and Production Practice

The old oil fields of the Baku area have been extended eastward halfway across the Caspian Sea, following the Caucasus uplift. About 60 km from shore a diapiric anticline has pushed up the Pliocene to form a shoal, called Neftaniye Kameny or Oil Rocks. This structure is 10 km long and 4 km wide and it is the center of a great offshore producing operation. On piles driven into the soft bedrock, are built industrial areas, power plants, compressor stations, and living accommodations for 4,000 people.

The wells are drilled directionally, 18 to 22 holes from each platform. The platforms are connected by piers over which ordinary wheeled servicing equipment can be driven. There are 20 pay sands with oils of different API gravity but with a common water table, and bottomhole pressure. The pressure is maintained by injecting 140,000 bbl per day of filtered Caspian water into the water zone through 75 wells at 1,500 psi. The oil production is 130,000 bbl per day.

Most of Russia's oil production comes from the Volga-Ural area, which is a large Paleozoic basin just west of the Ural Mountains. The main production is from sands in the Upper Devonian. Most of the drilling in this area is done with the turbodrill, which performs better in hard than in soft formations. However, it is also used in the offshore operations because it is easier to deviate holes. A well near Tuimazy using the turbodrill in formations about like those in Oklahoma had drilled 700 meters in 4 days averaging 55 meters per bit. They were drilling with water, using only one pump which was putting out 30 liters per second. The bit was rotating 800 to 1,000 revolutions per minute. The rig was equipped with automatic tongs which greatly speeded up round trips.

At Shkapova a deeper field wildcat was using the electrodrill. Electricity at 1,500 volts is carried down 7-inch drill pipe by 3-conductor rubber-covered cables mounted concentrically. A finger with three rings on it slips into a sheath as the pipe is made up, and the mud pressure causes a good seal. This well was using a mudlogger with an automatically programmed gas chromatograph, which seemed very modern in design and instrumentation.

The engineers were alert, able, and intelligent. Questions and answers showed that they understood their problems thoroughly and were not just technicians.

The Russian equipment is lighter and plainer than American. We were told by some European drillers that it is mechanically inferior and more apt to break down. However, technologically, the Russians appear to be fully on a par with the US, and in some respects are using more advanced drilling techniques than we are.

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James M. Forgotson, Jr., Pan American Petroleum Corporation, Tulsa, Oklahoma

"The Application of Digital Computers to Exploration Operations"

Abstract

The use of digital computers in exploration is oriented toward furnishing the geologist an additional tool. The applications presented here are primarily geological and can be used now on current projects as data are being determined.

Data processing is often merely a system for rapid recall of information and as such is being investigated as a means of handling scout information. Regardless of the procedure used to record the data and the completeness of the files, the idea is to record engineering and exploration data in a systematic manner, to store the recorded data on cards or tape and to develop computer filing, sorting and retrieval systems to handle large volumes of data.

Well locations, formation tops, rock type, thicknesses within a stratigraphic interval, and paleontological data obtained in current studies can be recorded in numerical form on cards or tape for computer input. From such input the computer can calculate structure, isopach, and various types of lithofacies, biofacies, and environmental data for map preparation. Card or tape computer output can be printed rapidly on data sheets and then plotted manually on maps or automatic plotting equipment may be used to print the output directly on base maps.

The use of electronic computers makes practical the computations necessary to distinguish between trends, or large-scale effects such as regional dip, influencing an entire region under consideration, and anomalies or small-scale effects influencing only small parts of a region. These computations that would require several months to do manually can be performed in several minutes by a high speed computer.

The use of electronic computers for quantitative electrical log analysis makes the analysis of many horizons in hundreds or even thousands of wells practical. These data may be used for exploration purposes and for more