parameters. The multiplicity of this usage has resulted in considerable confusion with respect to the typical lithologic character, faunal composition, correlation, and time-rock nomenclature. This paper defines and restricts the lithologic character of the Blakeley Formation and records the lithologic and biologic mixing that has taken place during the deposition of this formation.

The uppermost part of Weaver's type Blakeley Formation was deposited in a nonmarine environment and is lithologically distinct from the underlying strata. It appears advisable, therefore, to restrict the Blakeley Formation to the marine-deposited strata and to rename the superjacent unit.

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REVIEW OF TRENDS IN DEVELOPMENT OF ALASKAN MINERAL RESOURCES

The exploration and development of Alaska's mineral resources have fluctuated greatly from "rushes" of activity to virtual extinction. The first attempt to mine gold in Alaska began in 1848, and by 1882 several lode mines were in production. By 1906 ten copper mines were operating in southeastern Alaska, and copper and gold have accounted for about 95 percent of all of Alaskan metallic mineral production.

During World War I, production of all metals began to decline and reached a low during the period of 1929–1933. The world-wide depression and the reevaluation to \$35 per oz in 1934 heralded a new upswing in gold production which reached an all-time high in 1940. The depletion of copper reserves and again the exigencies of another war virtually closed down metal mining in Alaska by 1944. However, military construction during and after World War II, and the discovery of oil in Cook Inlet in 1957 brought two new leaders to the minerals industry sand and gravel, and petroleum.

Of the approximately \$85 million total mineral production in Alaska in 1966 petroleum accounts for more than \$50 million, sand and gravel about \$21 million, coal about \$6 million, and gold slightly more than \$1 million.

Now a new government activity, the Heavy Metals Program, aimed principally at stimulating the production of gold and certain other critical metals appears to be ushering in a new period of interest in metallic resources. This interest is influenced strongly by continuing prospecting and discovery in nearby parts of Canada and by the mineral requirements of Japanese industry.

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ACCUMULATION OF RESERVOIR FLUIDS

The principle of differential entrapment, first published in 1953, is reviewed and updated, and geological evidence for selective trapping of oil and gas is illustrated with many kodachrome slides. This theory explains why many good traps are dry whereas adjacent structures are prolific oil fields. It explains why some traps are gas fields and contain no oil, and why gas is trapped downdip in some areas whereas oil occurs in synclines in other areas. The law of gravity explains the gravity distribution of gas, oil, and water in a reservoir, but differential entrapment explains why some oil reservoirs are stratified.

Oil and gas accumulations are modified under superimposed hydrodynamic conditions in accordance with the hydrodynamic gradient, causing tilted interfaces, spilling, and remigration. When folding and faulting are superimposed on a basin with oil and gas accumulations, the oil and gas usually remigrate into the new structures in accordance with the principle of differential entrapment, and these new accumulations conform to the existing hydrology.

Undersaturated oils, gas-oil ratios, and the origin and significance of saturation pressures are discussed.

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FRONTIERS IN MICROPALEONTOLOGY

The role of micropaleontology is expanding as need for more sophisticated exploration techniques increases. In addition to age dating and correlation, micropaleontology now provides geologists with paleoenvironmental and paleobathymetric maps to locate depocenters, predict occurrences and trends of reservoir facies, determine shore-shelf-slope relation, and establish times and location of structural growth. Faunal assemblages provide clues to unconformities, faults, missing sections, and other events otherwise not readily recognized.

Although knowledge and application of microfossils have expanded greatly in recent years, frontiers for research are numerous and challenging. Gaps still exist in our understanding of many fossils. A useful synthesis of what is known about particular groups often is lacking. Environmental controls, the significance of the rare event, and the impact of worldwide geologic events on faunas are not completely understood. Better preparation techniques and more powerful tools such as the scanning electron microscope open new vistas for analysis and understanding. EDP provides a major challenge, both in speeding the work of stratigraphers and in bringing together for their use the vast storehouse of knowledge already existing. Micropaleontology will play an increasingly important role in exploration as research resolves these challenges.

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PHOTOGEOLOGY AND GEOPHYSICS

Reducing oil-finding costs by maximum coordination and greater usage of the less expensive exploration methods is discussed. The utility of coordination, and specific gravity and photogeologic applications, are documented with pertinent illustrations.

There are many ways in which surface geology can be useful to geophysics, not only as an aid to structural interpretation, but also in refining the accuracy and improving the efficiency of geophysical methods. The vast majority of geophysical work has been accomplished in relative ignorance of the surface geology. Many specific examples of misinterpretation and waste can be attributed to a lack of consideration of surface geology. Because of this historical lack of surface-geologic consideration, there is a large reservoir of data which can be "high graded" and refined very inexpensively. Photogeology is by far the most rapid, effective, and inexpensive way to do surface geology. Possibly the geophysical tool most critically affected by the surface geology is gravity. According to Newton's First Inverse Square Law differences in density closest to the gravimeter affect it most critically. Practical ways in which gravity and seismic data can be refined by coordination with photogeology are cited, with slides to demonstrate the problems.

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THERMODYNAMIC AND GEOCHEMICAL CHARACTERIS-TICS OF SALTON SEA GEOTHERMAL SYSTEM

The Salton Sea geothermal area is in a rift valley of the San Andreas fault system in southern California. The geothermal reservoir consists of more than 2,000 ft of arkosic sandstone containing interstitial concentrated NaCl-CaCl2-KCl brines. No steam is present underground. The sandstone is overlain by shale from the surface to a depth of 2,000-3,000 ft. The temperature in the subsurface exceeds 300°C at 3,000 ft and 360°C at 7,000 ft. Thermal convection of pore fluids in the sandstone appears to be the primary mechanism of heat transfer in the reservoir. The salinity and temperature of the pore fluids decrease outward from the center of the geothermal reservoir. The enthalpy of the brines in the reservoir ranges from 220 to 275 cal/g, which is 45-90 cal/g less than the enthalpy of pure water at equivalent temperatures and pressures. Although the origin of the brines is obscure, it appears likely that they formed by evaporation of Colorado River water originally trapped in the pore spaces of the reservoir sands.

Thermodynamic calculations indicate that reaction of the interstitial brines with the sediments in the geothermal reservoir (which is below 3,000 ft) has resulted in substantial mass transfer (more than 40 g/1,000 g of water) during metamorphism. Geochemical considerations suggest that the reservoir fluids in the geothermal system are in chemical equilibrium with the mineral assemblage in the enclosing rocks. Chemical reactions between the original pore fluid in the rock and the sedimentary mineral assemblage have led to a relatively low pH and enrichment of K, Ca, Fe cations, and other constituents in the aqueous phase. The total dissolved solids in the brine have been concentrated by removal of water from the system.

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PETROLEUM PROSPECTING IN RELATIVELY UNEXPLORED AREAS

A definition of "relatively unexplored" is considered to apply where definitely closed traps have not been tested adequately to evaluate the potential of a geologic province. This covers a wide range of situations.

Most areas onshore have at least some geologic information available. Recent interest in offshore-shelf regions opens a new dimension of competitive exploration where commonly nothing is known about the geology.

There are three exploration approaches that apply to any program: (1) application of all scientific knowledge to what details are already known; to determine where prospects should be; (2) analogy; finding geological conditions that resemble known productive situations, and (3) "bird-dogging"; searching for prospects without pre-existing knowledge or reason to favor one area over another.

Parentis, New Guinea, Dineh bi Keyah, and other areas provide examples of these approaches.

Geologic interest is led to a particular area in several ways: (1) situations favorable for oil generation (i.e., oil seepages, source bed criteria), (2) available geologic information, (3) trend projection, (4) application of reasonable hypothesis where no other information is available, (5) technological change, (6) economic change, and (7) political change.

Examples of these exploration leads are drawn from Nigeria, Libya, Egypt, Indonesia, Australia, South America, and the North Sea.

KISTLER, R. B., J. C. PAULSEN, AND L. L. THOMAS, United States Borax and Chemical Corp., Boron, Calif.

SLOPE STABILITY MONITORING AT BORON

A unique seismic monitoring system is being used at the Boron open pit mine to aid in the early detection of potential slope stability problems. The system was developed in a joint venture between U.S.BORAX and the U.S. Bureau of Mines. The main components of the system are a bore-hole geophone or electromechanical transducer, an amplifier, and a strip-chart recorder. The subaudible rock noises caused by minute readjustments of the rock in the slope during mining are recorded. Stable slopes have a low seismic noise level whereas a high noise level indicates a potentially unstable slope before there is any physical evidence of slope failure. The disturbances generally increase in number and magnitude as slope stability decreases. The same technique also is used to determine the effectiveness of corrective action.

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REVIEW OF ELK HILLS OIL FIELD, KERN COUNTY, CALIFORNIA

The Elk Hills oil field, generally regarded as the third largest oil field in the United States, is in southwestern Kern County, California, on the west side of the San Joaquin Valley. It is on a large surface anticline that extends into the valley from the Temblor Range on the west. Most of the oil is in lenticular sandstones of Miocene and Pliocene ages, and stratigraphic conditions control the position of the oil on the structure. The Elk Hills field is also Naval Petroleum Reserve No. 1 and, for that reason, production is restricted. The field is a unitized operation of the U.S. Navy and Standard Oil Company of California. The Elk Hills field has not been fully explored, but has recoverable reserves presently estimated at more than 1 billion bbl.

LAUGHBAUM, GRAYDON H., JR., Union Oil Company of California, Anchorage, Alaska

OIL FIELDS OF COOK INLET, ALASKA

Significant increases in petroleum production continue in the Cook Inlet basin of Alaska, moving the state closer to being the fifth leading oil producer in