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GEOLOGY AND EXPLORATION IN PHILIPPINE ISLANDS

The Philippine Archipelago located along the border between the sialic Asiatic mainland and the simatic Pacific basin forms the southern segment of the western circum-Pacific mobile belt. Typical island arc features are well developed in the southern part of the Archipelago.

Most of the Philippine islands appear to be closely related geologically and to have geologic affinities with Taiwan, Borneo, and the other islands of the Indonesian Archipelago. These affinities include similarities in the quartz-deficient basement suites and in ages and characteristics of younger sediments.

Thick accumulations of sediments of Miocene and Pliocene ages are present in most large Philippine basins. Paleo-environmental studies of the Central Valley basin in Luzon have established that the basal deposits were deposited in paralic environments. These sediments grade upward into bathyal deposits which, in turn, grade upward into paralic and continental deposits. Richly organic, bathyal mudstones are possible source beds and the coarser clastic facies (both paralic deposits and turbidites) as well as biohermal limestones have reservoir rock characteristics in outcrop. Other basins with comparable marine sections have Eocene and possibly Cretaceous objectives.

The Philippine rift, the major structural feature in the Philippines, resembles the San Andreas rift in California. It can be traced southward from Northern Luzon through Mindanao. Structural trends are oblique to the rift with the expectable orientation of secondary structures arising from left-lateral movement along the rift. The amount of displacement is not known.

Many oil seepages originating in Miocene and Eocene rocks were investigated during the initial phase of Philippine exploration. Although some companies continue these operations, several are using modern techniques to evaluate deeper prospects. Three discoveries have been made in sandstones and a limestone of Miocene age. The results of drilling to date suggest that delineation of potential reservoirs is the most difficult task confronting exploration in the Philippines.

The Republic of the Philippines is now spending about 90 million dollars annually for imports of crude oil. The internal demand is accelerating and foreign exchange reserves are low. A major disovery will alleviate this serious financial problem.

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HEAVY MINERALS OF PRE-MORRISON JURASSIC ROCKS, LUCERO UPLIFT, NORTHWESTERN NEW MEXICO

A heavy-mineral study was made of the following formations in the Lucero uplift: Triassic: Chinle Formation and Wingate Sandstone; Jurassic: Carmel Formation, Entrada Sandstone, Todilto Formation (not analyzed), Summerville Formation, Bluff Sandstone, and Morrison Formation; Cretaceous: Dakota Sandstone. Emphasis was placed on the pre-Morrison Jurassic rocks.

Heavy minerals identified from these rocks consist dominantly of zircon, garnet, tourmaline, rutile, and several opaque minerals, and very minor epidote, biotite, staurolite, and apatite. This limited suite of mostly rounded, stable heavy minerals indicates that the rocks concerned are multicycle sediments, and agrees with the conclusion previously derived from utilizing other stratigraphic tools in studying these rocks. Thus, in this respect, the usefulness of heavy minerals as a stratigraphic tool is demonstrated.

Furthermore, the pre-Morrison part of the section, in which relatively abundant amounts of magnetite-ilmenite occur, is readily distinguishable from the Morrison Formation in which these minerals are virtually absent. When the pre-Morrison Jurassic rocks are viewed in sequence, it appears that the Carmel and lower Entrada are characterized by a low zircon-garnet and high magnetite-ilmenite content, the upper Entrada by a high zircon-garnet and low magnetite-ilmenite content, and the Summerville and Bluff by a high zircon-low garnet and variable magnetite-ilmenite content. Nevertheless, with the exception of the upper Entrada, the differences in per cent distribution of the heavy minerals are not sufficient to unequivocally characterize any single pre-Morrison unit. Thus, in this respect, the heavy minerals are not as useful a stratigraphic tool as they might be if the suite were mineralogically more varied.

Prior to the determination of the heavy-mineral content by using standard techniques of counting individual grains, an attempt was made to estimate the heavy-mineral content. A comparison of the results of the two methods shows that, even with a simple suite of easily identifiable heavy minerals, an estimated per cent distribution is not reliable and does not justify the apparent saving in time.

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CALCIUM CARBONATE FROM NON-CORALLINE ALGAE

In addition to the red or crustose coralline algae, some other simple marine algae secrete carbonate in tropical seas. Secretion of aragonite by *Halimeda discoidea* Decaisne, a calcareous green alga, and *Padina japonica* Yamada, a calcareous brown alga, was investigated in shallow Hawaiian waters. Along traverses between reef and shore, *Padina* is most abundant close to shore, whereas *Halimeda* flourishes in the deepest water, generally midway between shore and reef front. In *Padina*, the proportion of calcium carbonate to total body weight is inversely proportional to abundance of the algae on the sea floor, whereas for *Halimeda* the proportion is directly related to relative abundance. For *Halimeda* as much as 70 per cent of the body weight may be aragonite.

Production of calcium carbonate and of total organic material has been compared for shallow water specimens, for specimens dredged from deeper water, and for calcareous and noncalcareous algae described by Doty recently. Aragonite secreted by algae contributes an important volume of material for subsequent diagenesis in tropical carbonate sediments that are ultimately converted to limestones.

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ORIGIN AND DISTRIBUTION OF DEEP-SEA SAND-SILT LAYERS IN NORTHEAST PACIFIC

The cores of sediments in the northeast Pacific Ocean, collected by the University of Washington, contain several sand-silt layers. Most of the layers and cores occur at locations 500–700 miles from the shores and at