rium conditions (F. L. Peterson).—The success of injection operations depends primarily on injection capacity and fate of the injected waste. To evaluate these factors properly an understanding must be obtained of local hydrogeologic conditions, hydrodynamics of injection under Ghyben-Herzberg lens conditions, and possible chemical and biologic effects. Hawaiian hydrogeology is understood fairly well, and where adequate information is not available, it usually is possible to collect these data by careful field investigation. Considerable information is available from other parts of the world on the hydrodynamics of waste-water injection. However, much of this information is not directly applicable to injection in the Hawaiian environment. Particularly troublesome are the complications caused by the extreme heterogeneity of Hawaiian receiving formations and Ghyben-Herzberg lens effects. Likewise, because chemical and biologic reactions depend on the nature of the injected waste, the receiving waters, and the receiving formations, many of the data collected elsewhere are not applicable in Hawaii.

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HEAVY MINERAL SAND MINING IN AUSTRALIA

The history of the industry from its inception in 1934 at Byron Bay to the present-day projects at Eneabba is outlined. A brief description of the geologic environment and the exploration methods employed indicates how the commercial deposits are located and evaluated.

Mining methods and equipment used in the industry today including restoration of mined areas are discussed. General description of techniques and equipment used to separate the constituent minerals of the mine concentrate including transport, packaging of the finished products, and the quality control are given.

The unusual problems associated with mining in an area of high land-use demand are described as are those associated with establishing infrastructure in such remote areas as Eneabba. The contribution to the economy of the communities involved also is discussed.

The discussion of marketing includes the features associated with commodities of which Australia is practically the sole supplier (rutile and zircon), and the situation in which the competition is worldwide (ilmenite).

The many diverse uses of the products are discussed briefly as a background to the effects in the market on changing uses and changing demand.

The growing demand for the products, Australia's and the world's capacity to meet the demand, and the future of the industry are covered. The future of the individual minerals and their possible substitutes is discussed as a means of predicting the future of the heavy mineral sands industry in Australia.

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RECENT KNOWLEDGE OF HYDROCARBON POTENTIALS IN SEDIMENTARY BASINS OF INDONESIA

Although the search for hydrocarbons in Indonesia was initiated about eight decades ago, exploration work is still at a high level.

Recent studies have resulted in a new understanding of the prolific Tertiary sedimentary basins and, especially, knowledge concerning offshore sedimentary basins has been updated significantly. More important, however, is the current knowledge on the mechanism of basin formation which seems to enhance the validity and applicability of the new global tectonics to the geology of Indonesia.

The Tertiary sedimentary basins in western Indonesia previously have been described as "idiogeosynclines," situated around the periphery of a supposed landmass of pre-Tertiary age (the Sunda Shelf). Recent exploration surveys and subsequent drilling have shown that the southern part of the Sunda Shelf actually consists of many sedimentary basins and intervening uplifts. Major faults are common throughout the area and clearly control the distribution and shapes of the basins. Block faulting appears to have broken up the periphery of the Sunda Shelf at the beginning of Tertiary time. The chief crude-oil production in western Indonesia is from the regressive and deeper transgressive sand series of Oligocene-Miocene age, except in East Kalimantan where producing zones range from Eocene to Pliocene age.

Prospects have changed considerably since oil and gas in economic amount have been proved within the interbedded limestone formation of Tertiary age and additional reserves are anticipated within stratigraphic traps.

Oil and gas discoveries within deltaic sandstones, notably in East Kalimantan, have upgraded significantly the onshore and offshore potentials of the area. Carbonate rocks are becoming a prime objective in the search for oil, especially in the East Java-Madura basinal area.

Although eastern Indonesia was chiefly the site of late Paleozoic and Mesozoic sedimentation, oil has been proved only within the strata of Tertiary age, notably in the Salawati basin. Of particular importance was the recognition of the tremendous potential that reefs, and in particular Tertiary reefs, possess as hydrocarbon reservoirs. A similar basin and environmental model is anticipated for the Bintuni basin.

Scientific cruises within the last five years have indicated the presence of several potential basinal areas between the Sunda Shelf and the Sahul Shelf.

The sedimentary basins in Indonesia can be classified into grabenlike basins, present foreland basins, and basins which are in front of the present magmatic arc.

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GROUNDWATER POTENTIAL OF AREAS UNDERLAIN BY VOLCANICLASTIC ROCKS—EXAMPLES FROM INDONESIA

Many areas in Java, Indonesia, underlain by subrecent to recent volcaniclastic rocks support a dense population (more than 1,000 persons per sq km) and contain large reserves of groundwater. Three areas are typical: Yogyakarta in central Java, Bandung in west Java, and Nganjuk-Kertosono in east Java. The volcanic material is mostly of andesitic composition.

The Yogyakarta area is underlain by about 100 m of ash, sand, gravel, and coarser aggregate from the continuously active volcano Merapi. In the Bandung area, lavas and breccias from the ancient Sunda volcano are overlain by about 120 m of lahar from the volcano

Tangkubanparahu. The Nganjuk-Kertosono area is an intermontane basin filled with volcaniclastic rocks that have been washed away from the volcanoes Wilis, Anjasmoro, Pandan, and Kelut.

Artesian conditions are not distinct at Yogyakarta, but potential artesian basins underlie both the Bandung and the Nganjuk-Kertosono areas. In the latter a clay layer of lacustrine-paludal origin acts as a confining bed. Specific capacities at Yogyakarta average between 0.5 and 5 l/second/m of drawdown. Water-bearing parts in the lower breccias and lavas at Bandung have a specific capacity between 0.5 and 1 l/second/m of drawdown, whereas the specific capacity of the aquifers in the overlying lahars range between 1 and 5 l. A piezometric surface about 10 m above the ground is measured at wells drilled to the upper zone. Specific capacities in the Nganjuk-Kertosono area vary considerably depending upon the material which was derived from several sources.

Groundwater is expected to be used increasingly in the three areas for domestic purposes, for irrigation, and by industry.

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GROUNDWATER POTENTIAL OF LIMESTONE TERRANES—EXAMPLES FROM INDONESIA

The groundwater potentials of the areas of Gunung Kidul, central Java, and Lenteng on Madura Island are typical of limestone terranes in Indonesia.

In the Gunung Kidul area, southward dipping middle Miocene limestone, about 200 m thick, is deeply dissected by solution channels which probably follow fractures. The whole area exhibits a typical karst morphology. Baron spring on the south coast of Java has a dry- and rainy-season discharge that fluctuates between 6 and 20 cu m per second. This spring is thought to be the main outlet through which the area is drained.

Two groups of aquifers are present in the Lenteng area, one between 8 and 70 m below ground surface and the second below 228 m. In the proximity of Lenteng Village the groundwater potential of the upper group is 0.33 cu m per second.

Both areas have a relatively dense population (about 400 persons per sq km), but the groundwater potential at present is practically untapped.

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GEOLOGIC STRUCTURAL SYNTHESIS OF PACIFIC AREA AS BASIS FOR ESTABLISHING REGULARITIES OF DISTRIBUTION OF MINERAL RESOURCES

Geologic studies of the Pacific Ocean and its margins have advanced in the Soviet Union. Some of the results are presented on the unique published maps. (a) Tectonic Map of Eurasia, scale 1:5,000,000 (1966); (b) Geological Map of the Pacific Mobile Belt and the Pacific, scale 1:10,000,000 (1973); and (c) Tectonic Map of the Pacific Segment of the Earth, scale 1:10,000,000 (1970). Moreover, many maps and books have been published which deal with the geology and mineral resources of the northwestern segment of the Pacific including the eastern USSR.

A geologic map synthesizes the data on stratigraphy, age, and composition of sedimentary, volcanic, and intrusive rocks on the Pacific continental margins, in the island arcs, and on the Pacific Ocean floor. The arrangement of geologic complexes of different age and character reflects various styles of tectonic systems on the inner structure: ancient platform—perioceanic belt—ocean. A regular rejuvenation of geologic complexes from continental nuclei toward the ocean is indicated. The map also shows that the distribution of sediment types on the Pacific floor is determined by such factors as climatic zonation, position of zones of upwelling and subsidence of waters, and depth of the ocean; whereas, in the perioceanic zones, a tectonic factor influencing intensity of supply of terrigenous and volcanic material is especially important.

The tectonic map presents the structural formation of the Pacific area which is divided into four principal categories: folding zones of the ocean margins, recent geosynclinal zones, thalassogenes (large parts of the oceanic floor), and the East Pacific mobile belt. The structural analysis, on the whole, shows that plate tectonics fails to explain the constitution of the Pacific area. This hypothesis does not conform to the concept of the Circum-Pacific belt as the earth's structural zone of planetary importance. However, horizontal movements of rather large blocks and sheets of the Earth's crust are real.

The geologic-structural synthesis creates the basis for general metallogenic constructions. Further studies on concentric zonation in the arrangement of ore deposits around the Pacific Ocean appear promising. The zone adjacent to the ocean is rich in gold and copper; the next continentward zone is characterized by rich deposits of tin and tungsten (in addition to gold) in Asia, and lead and zinc in North America. The ophiolitic belts are characterized by peculiar complexes of metals. Study of morphologic and geodynamic properties of ore-controlling faults poses a special problem.

The ocean floor is characterized by extensive accummulations of manganese-polymetallic ores and locally by metasomatic phosphorites.

The geologic-structural synthesis is important for prediction of oil and gas prospects. About 140 actual and possible gas and oil basins have been recorded in the Pacific margins. Most of them are associated with depressions and basins within folded zones and oceanic depressions. The basins in the perioceanic sector are composed mostly of Cenozoic deposits; the main productive strata are Miocene to Pliocene in age. Oil and gas already have been detected in about half of the basins.

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DEPOSITS OF BOLIVIAN TIN BELT

It is surprising that the Bolivian tin belt does not cross the national frontiers either north into Peru or south into Argentina. Lithologic and tectonic controls can explain this anomaly. The length of the belt is about 1,000 km.

Three metallogenetic cycles of different age can be distinguished. The oldest is in the northern part of the High Cordillera and is related to pegmatites and pneumatolytic veins in granitic batholiths of Triassic-Jurassic age. South of the latitude of La Paz is the Miocene metallogenetic cycle with its abundant tin and wolframite veins, from the vicinity of Viloco to Colquiri. South