thick marine and nonmarine clastic rocks, and locally many large folds, are attractive for exploration. These little explored basins are known to be petroliferous on Bristol Bay and the Gulf of Alaska and to contain major accumulations of oil and gas at Cook Inlet.

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GEOLOGIC MAP OF PACIFIC MOBILE BELT AND PACIFIC OCEAN

The first geologic map of the Pacific Ocean and the continents bordering it is the result of cooperation of the geologists from the USSR Ministry of Geology and the Academy of Sciences of the USSR. The map synthesizes geologic data obtained from many different countries. The principle used in map compilation is the determination of rock masses according to age and composition. The correlation of deposits of different ages will be shown in the Atlas of Biopaleogeographic Maps of the Pacific Superregion. In the Precambrian shield margins, local names are given. The map emphasizes the importance of Mesozoic and Cenozoic intrusive magmatism. The location of endogenic mineralization is connected with this magmatism.

Special attention is given to Cenozoic volcanic rocks. The following series are distinguished: alkaline and alkaline-earth, the series of high-aluminia basalts, calc-alkaline, tholeitic, and others. Various extrusive volcanic features are indicated by separate symbols. Radiometric age dates of oceanic basalts also are given.

The distribution of different recent complexes of sediments, clastic, argillaceous, and biogenic is shown in the ocean and marginal sea floors. The complexes, including admixture of volcanic material of different composition, have special symbols. In order to distinguish biogenic sediments, quantitative data on the most important sedimentary components ($CaCO_3$, amorphous $SiO_2$) were taken into consideration. Some sampled pre-Quaternary deposits (Cretaceous-Neogene) and young volcanic rocks in the ocean-bottom areas are included on the map. Deep-drilling data (*Glomar Challenger, etc.)* are shown as enlarged columns, in which color indicates the recovered rock ages. The distribution of manganese nodules is contoured, phosphorite outcrops (mostly pre-Quaternary) also are shown.

The Pacific mobile belt and Pacific Ocean comprise a global mineralogenetic province. Thus, the Pacific ore belt, the Pacific sulfur-bearing belt, the Pacific oil-gas belt, and others are singled out. The geologic map, especially its new international publication, is intended to be the basis for predictional estimation of the Pacific region.

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HYDROGEOLOGY OF CHEJU VOLCANIC ISLAND, KOREA

A regional groundwater study was conducted on Cheju Island off the Korean coast. Cheju Island comprises about 1,800 sq km (696 sq mi) and is elliptical in shape, with the major axis 74 km long trending in an east-northeast to west-southwest direction; the minor axis, 32 km long, trends in a southwest direction. Mount Halla (1,950 m) is the highest and central crater. Average annual precipitation is estimated to be 1,500 mm (59 in.).

Apart from three streams fed by springs there are no true perennial streams among the 30 streams in Cheju. Thus the low drainage density indicates higher infiltration of precipitation.

Cheju Island is underlain by a succession of basaltic rocks, belonging to the "Inter-Pacific province," interbedded marine sedimentary rocks, and pyroclastic rocks of recent age.

Groundwater occurs locally as perched groundwater and is the source of some springs above the 700-m contour. The existence of a main groundwater table is recognized just above sea level in coastal areas but is assumed to be present farther from the coast. The groundwater tables mostly are unconfined but locally they may be confined by the presence of an aquiclude of local extent. Ninety percent of the springs in Cheju tend to be concentrated in the coastal area.

The porosity of basalts from jointing is assumed to be larger than that from vesicles because specific yield by a pumping test reaches 0.2 and is larger than the effective porosity of the same aquifer as measured in the laboratory.

The best aquifers in Cheju are feldspar olivine basalt and interbedded pyroclastic rocks. Transmissibility ranges from 156 to 20,000 cu m/d/m (1,300 to 1,600,000 gpd/ft) and is ascribed to the irregular development of joints and interconnecting vesicles.

Storage coefficients by pumping test are 0.15-0.3 but generally are assumed to be 0.2. In some coastal areas, as Sinchoon, a confined condition was recognized by the fluctuations of the phreatic water table in harmony with tides.

Analysis of groundwater indicates that the water quality is good for all purposes, domestic, agricultural, and industrial. All groundwater belongs to the calcium-sodium bicarbonate-chloride type with total dissolved solids ranging from 50 to 150 ppm.

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GEOTHERMAL EXPLORATION IN NORTHERN CHILE

Interest in the economic development of geothermal energy has been restricted to Tarapaca and Antofagasta Provinces (18°00′S to 24°00′S) in northern Chile, where the energy requirements for industrial and mining purposes must be supplied by conventional thermal electric plants. These plants have been operated chiefly with imported oil.

Since 1968 the project to investigate the geothermal resources of the region has been carried on by the "Corporacion de Fomento de la Produccion" of Chile and the United Nations Development Program.

Geothermal investigations started with a detailed account of the thermal-springs areas of both provinces, and the most attractive geothermal areas were selected for further systematic surveys. The most important areas selected are from north to south: Jurase, Suriri, Puchuldiza, and El Tatio; all of them are in the High Cordillera of the Andes, at an elevation of about 4,300 m in areas dominated by volcanic rocks of late Tertiary and Quaternary age.

Geologic, geophysical, and geochemical investigations have been carried out at Puchuldiza and El Tatio geothermal fields. At El Tatio, six exploration holes (4 in. diameter) were drilled to a depth of 600-700 m.

These holes showed a promising geothermal potential and a first program of seven to ten production drill holes was undertaken to obtain enough steam to install a geothermal power plant with an initial capacity of 25 or 50 M.W. The possibility of freshwater production from this field also has been considered.

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COAL RESOURCES OF CANADIAN CORDILLERA

The Canadian cordillera is estimated to contain 87 billion tons of coal categorized as measured, indicated, and inferred and all ranks of coal are represented. The most important coal deposits are within a narrow belt, not exceeding 35 mi in width, that extends along the extreme eastern edge of the cordillera from lat. 49°00′ northwestward for 600 mi to approximately lat. 56°00′.

The coal-bearing formations are Late Jurassic-Early Cretaceous in age and have been subjected to severe tectonism so that the seams are inclined at all angles, folded, contorted, and displaced by faults, some of which involve lateral movements of up to 30 mi. Much of the coal in this belt is a high-quality metallurgical type and currently some 8 million tons of this type of coal are produced and shipped annually to Japan.

Other coal deposits are in widely distributed areas throughout the cordillera. They generally are confined to small areas, the more accessible of which mainly are mined out and the remainder have undergone little or no exploration. The coals range in age from Late Jurassic to Tertiary and vary in rank from lignitic to anthracitic but none are known to be of metallurgic quality. The more important of these deposits appear to be the Hat Creek coalfield of south-central British Columbia and the Groundhog coalfield of north-central British Columbia. The Hat Creek deposit is of Tertiary age and contains at least five lignitic seams having a total aggregate thickness in excess of 2,000 ft. The Groundhog coalfield contains low-volatile bituminous and anthracitic coal of Late Jurassic-Early Cretaceous age. Limited exploration of the southern part has shown it to be structurally complex and the coal is generally high in ash. The northern part is believed to be disturbed and seems to offer better opportunity for exploration of which there is none to date. No significant coal deposits are known in the immediate coastal area of the cordillera.

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OCCURRENCE AND DEVELOPMENT OF SEDIMENTARY MANGANESE ORE, GROOTE EYLANDT, NORTHERN AUSTRALIA

One of the world's major deposits of high-grade sedimentary manganese ore is on Groote Eylandt in the western section of the Gulf of Carpentaria in northern Australia.

Production and marketing of the ore commenced in 1966 after establishment of mining and treatment equipment together with ancillary facilities such as housing, roads, port facilities, water, and power supply. Subsequently further detailed exploration, development, and metallurgical work resulted in the construction of a comprehensive ore-treatment and beneficiation plant and additional handling facilities.

Current production capacity is of the order of 1.25 million tons of manganese ore per annum, of which 80% is exported. A new expansion program will provide for a production capacity of the order of 2 million tons per annum by the end of 1975, and bring the total capital expenditure on the developments to approximately $65 million.

The manganese ore is a tabular bed approximately of 13 sq mi. It crops out adjacent to the western coastline of Groote Eylandt, and is covered by soft Tertiary and recent sediments.

The ore exhibits varied physical characteristics ranging from fine loose powdery material to unconsolidated oolites and pisolites and to massive laterite and cemented boulders of pisolites. It ranges in thickness from 0.5 to over 15 m, and is present over a 45-m stratigraphic interval of sediments.

Marine arenaceous Foraminifera of Early Cretaceous age have been identified from within the ore zone and no apparent tectonic deformation of the zone has occurred.

The deposit has the appearance of having been formed under shallow-water conditions, being associated with typical shallow-water sediments including unconsolidated clays and sands containing typical shallow-marine (inner sublittoral) faunal assemblages.

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IRON ORE DEPOSITS OF WESTERN AUSTRALIA—GEOLOGY AND DEVELOPMENT

Although iron ore deposits were recorded in Western Australia as early as 1888, not until 1960 were the economic and political conditions conducive to assessment of their potential. Since that time, regional geologic mapping and intensive local evaluation have increased the total reserves from 275 to 24,000 million tons of ore containing 55% or more iron. This ore is of three main types: hematite enrichment, pisolitic limonite, and sedimentary ores. These contribute to production in the approximate porportions 20:2:1, whereas the equivalent proportions for reserves are 200:70:1.

Hematite enrichment ore formed by selective replacement by hematite, probably during Proterozoic time, of a banded iron-formation (BIF) host. Although such ore bodies are widespread in Archean (>2,500 m.y.) BIFs of the Yilgarn and Pilbara blocks, the largest ore bodies, exceeding 1 billion tons, are in the lower Proterozoic (*c.*2,000 m.y.) BIFs of the Hamersley iron province. Ore bodies of this type show stratigraphic and structural control. The ore is hematite with a variable admixture of late goethite. Pisolitic limonite ore, which forms sheets capping elongate sinuous mesas along rivers draining the Hamersley iron province, was formed during the Tertiary in the flat beds of a sluggish paleodrainage system which is closely paralleled by present drainage lines. Sedimentary iron ore is represented by concentrations of supposedly clastic hematite within folded Proterozoic (1,800 m.y.) sediments of the Yampi Sound area.

With a good overseas market available in Japan, export of ore commenced in 1966 and has risen rapidly to 73 million tons in 1973. In the earlier years of