made up of a thick series of Jurassic terrestrial sedimentary and andesitic rocks. A few small Tertiary basins are scattered in the eastern coastal area and in Cheju Island, and are composed of marine sedimentary and basaltic rocks.

Jurassic Daebo granites intrude the Kyonggi-Ryongnam massif and the Okcheon zone in the Sinian direction, whereas Late Cretaceous Bulkuksa granites are scattered randomly in the Kyongsang basin.

Most of the mineral deposits are related to the acidic intrusives and are classified chiefly as hypothermal to mesothermal vein and metasomatic replacement deposits, depending on the predominance of structural or lithologic control. In Precambrian terranes gold-silver, lead-zinc, tungsten, molybdenum, and fluorite are present as vein deposits, and tungsten and iron deposits as metasomatic replacements, except for the Precambrian iron formation, graphite, and talc.

In the Paleozoic terranes, gold-silver, lead-zinc, tungsten, and iron deposits are metasomatic-replacement type although some gold-silver deposits may be vein type. In the Mesozoic terranes, iron, copper and lead-zinc veins are common in the andesitic rocks and cherty slate, whereas pyrophyllite deposits are in acidic tuffs as a result of post-igneous activities.

These mineralized areas, except the Kyongsang basin, are grouped into belts trending subparallel with the Sinian direction and generally show a rough zoning defined by the general gradient of genetic temperatures. The metallogenic epochs of these deposits are classified into four stages: Precambrian, Paleozoic, Jurassic to Early Cretaceous, and Late Cretaceous to early Tertiary.

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STRATIFORM AND STRATABOUND METAL CONCENTRATIONS IN AUSTRALIA

Australia is well endowed with stratiform and stratabound metal deposits, mainly sulfides. The known deposits of this type include concentrations of lead-zinc-silver, copper, copper-gold, copper-zinc-lead, tin, nickel, tungsten, gold, uranium, iron ore, and one of manganese. The last excepted, these are all Precambrian or Paleozoic in age.

Some of the names have become known to the world: Mount Morgan, Mount Lyell, Broken Hill, Mount Isa. Some of them cropped out prominently and were found 90 to 100 years ago. Some less obvious deposits have been found only in recent years after the area had been mined for the same or other metals for many decades.

As elsewhere in the world, these stratiform concentrations include some metal deposits of first magnitude, containing from millions up to tens of millions of tons of metal in high-grade deposits. The oldest deposits are still in full production today and some have contributed greatly to the development of the industry and the economy.

The search for new deposits of this type in Broken Hill led, 20 years ago, to the development of new concepts of origin and occurrence of these stratiform (as distinct from the classical vein-type) deposits. They now are regarded as normal if unusual products of the geologic history of their environments and as exhibiting world wide patterns of occurrence which are relevant to the potential of rocks of certain types and ages.

These concepts and patterns have provided new stimulus for study of the paleogeographic, chemical, and biologic conditions of these geologically ancient times.

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STRUCTURAL FORMATIONAL ANALYSIS OF NORTHWEST PACIFIC REGION

No abstract available.

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TECTONIC FRAMEWORK OF PETROLIFEROUS ROCKS IN ALASKA

Alaska, comprising 3.6 x 10^6 sq km (about 28%) of the land, shelf, and upper continental slope of the United States, has been estimated by the U.S. Geological Survey to contain about 20% of total petroleum liquids and natural gas resources of the nation. Some 15 billion bbl of petroleum liquids and about 31 trillion cu ft of natural gas have been discovered.

In northern Alaska, Paleozoic and Mesozoic shelf and slope deposits and some ophiolitic rocks of the Brooks Range orogen were thrust northward over the depressed south margin of the Paleozoic and Mesozoic Barrow platform, on which a foredeep (the Colville geosyncline) developed in Early Cretaceous time. Cretaceous and Tertiary sediments from the Brooks Range filled this foredeep and prograded northwest and northeast to form the Chukchi and Colville delta systems and to fill the Camden coastal basin.

A series of arc-trench systems developed on oceanic rocks in southern Alaska during the Jurassic and Cretaceous. These arcs were subparallel with the Mesozoic continental margin of southern Alaska. Between the arcs and the metamorphic (continental) terranes of east-central Alaska and the southern Brooks Range, a large marginal ocean basin received thick Jurassic and Cretaceous volcanic and detrital deposits. These deposits were extensively deformed and disrupted by widespread mid-Jurassic to Tertiary plutonism, Late Cretaceous and early Tertiary ("Laramide") oroclinal bending, wrench faulting, and arc-related compression.

The Laramide events "continentalized" the late Mesozoic marginal basin deposits and welded them to the older continental terranes. Subsequent sedimentation was more localized and nonmarine, except in basins along the Pacific, Arctic, and Bering coasts where thick mixed marine and nonmarine sections are present. The active Aleutian arc and associated Queen Charlotte transform-fault system were superimposed obliquely across the southern continental margin of Alaska in early Cenozoic time and have since dominated structural and depositional patterns in southern Alaska.

The largest petroleum reserves in Alaska and the best prospects for additional large discoveries are in northern Alaska, where an extensive terrane is underlain by upper Paleozoic to Tertiary shelf and slope clastic and carbonate deposits. The pre-Tertiary arc and marginal-sea deposits in southern and interior Alaska are either too intensely deformed or too low in porosity to offer more than modest local prospects. The Tertiary coastal onshore and offshore basins with

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.