field in the United States, is in the northern Coast Ranges of California about 75 mi north of San Francisco. In the Salton Sea area of the Imperial Valley, California, large flows of steam and geothermal fluids have been obtained, currently uneconomic because of high-mineral content. Twenty miles south of the Mexican border in the same basin, the Cerro Prieto geothermal field produces 75 megawatts and appears to be capable of supplying energy for considerably more power. In the Valles Caldera, near Los Alamos, New Mexico, discovery of a new field has been indicated by recent exploratory drilling. Flows of hot water and flashed steam have been recorded in several areas in Nevada, none of which have proved commercial.

Exploration for geothermal resources is in the early stage of activity. A total of 149 exploratory wells has been drilled in 55 different areas. Many of these wells were shallow and not adequately tested. It is too early to predict what the success ratio will be until deeper and more conclusive tests are drilled. To January 1974, exploration has been hampered by the unavailability of public lands, which cover well over half of the prospective territory.

Leasing activity during the last few years, coupled with geologic and geophysical work by private industry, and successful utilization of 150 to 225°C waters by the heat-exchange method, suggest that there will be an extensive exploration-drilling program in the next few years that should shed much light on the amount of geothermal reserves present in the southwestern United States and how significant a part this form of energy will play in our total energy picture.

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PALEOZOIC AND MESOZOIC COAL IN KOREA

Coals produced in Korea are anthracite and very small amounts of Tertiary lignite. The anthracite coal beds are intercalated in the Permo-Carboniferous, the Jurassic, and the Cretaceous Systems, but the most productive beds are in the Permian. The 11 anthracite coal fields in southern Korea, the Gangneung, Jeongseon, Samcheog, Yeongweol, Danyang, Mungyeong, Bo-eun, Jeonbug, and Honam, are aligned in a zone from the northeast coast to the southwest end of the Korean Peninsula—the Ogcheon geosynclinal zone. The Chungnam and the Gyeonggi coal fields are outside this zone. Anthracite reserves in southern Korea are estimated at 1,400,000,000 metric tons, and 90% is from the Permo-Carboniferous, and the remainder from the Mesozoic. Annual production of anthracite coal in Korea has been 10,000,000 to 14,000,000 metric tons for the past several years. Calorific value of the Paleozoic anthracite is 5,500 to 6,000 calories and Mesozoic coal 5,000 to 5,500 calories with some exceptions of 6,000 to 6,500 calories. Prospecting for the anthracite beds is being carried out by detailed geologic and geophysical survey, core boring, and drifting.

The problem of increasing the coal production may be solved by: (1) development of low-grade anthracite beds not now being mined; (2) exploitation of the buried coal beds which are covered structurally with older rocks, and covered by younger rocks; (3) development of the coal beds which extend from land to the subsea; (4) conduct of more detailed geologic and geophysical surveys; and (5) evaluation of the Tertiary lignite not now being mined.

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PETROLEUM POTENTIAL OF KOREAN OFFSHORE

Major offshore areas widely developed around the Korean Peninsula are in the Yellow Sea off the west coast, East China Sea off the south coast, and in narrow belts in the Japan Sea off the east coast. Geologic and geophysical surveys in these Korean offshore areas have been carried out since 1966 by the Geological and Mineral Institute of Korea (GMIK) and since 1969 by oil companies who obtained concessions on seven blocks from the Korean government.

The GMIK has conducted reconnaissance seismic and magnetic surveys for general study of submarine geology. Oil companies have conducted preliminary and detail seismic, magnetic, and gravimetric surveys. Wildcat drilling was started in 1972 and four holes were drilled by three oil companies.

Submarine geology of the offshore area can be summarized as follows. The Yellow Sea area has Tertiary sedimentary rocks with thicknesses of more than 1,000 m with several basin structures separated by uplifted basement or intrusive igneous rocks.

The East China Sea and southern part of Japan Sea have Tertiary sedimentary rocks with thicknesses of more than 2,000 m with northeast-southwest zonal structure and folded and faulted structures in Tertiary beds.

In the Japan Sea area Tertiary sedimentary rock in Pohang offshore area is less than 1,000 m thick and extends northward almost 100 km. Sedimentary rocks, more than 3,000 m thick and of probable Cenozoic age, are present on the continental slope.

Petroleum potentials in offshore Tertiary strata must be studied further before final conclusions can be reached. Even so, rocks with high-organic content occur in the Yellow Sea area, and in the East China Sea and the Japan Sea areas good reservoir rock and potential structures for hydrocarbon accumulation have been detected. Further drilling work is recommended to discover hydrocarbons and to reevaluate the submarine geology and structure.

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MINERAL RESOURCES OF KOREA

The most productive mineral resources, except fuel, in South Korea are gold, silver, lead, zinc, copper, tungsten, molybdenum, iron, fluorite, graphite, kaolin, talc, and pyrophyllite. These mineral deposits are related closely to the geologic settings and tectonic patterns of the peninsula.

South Korea is divided tectonically into four segments. The Kyonggi-Ryongnam massif is composed of Precambrian schists and gneisses and constitutes a base for the succeeding formations. The Okcheon geosynclinal zone in the Kyonggi-Ryongnam massif stretches from southwest to northeast diagonally across the peninsula in a direction known as the Sinian direction. Its northeastern part is composed primarily of Paleozoic to early Mesozoic sedimentary formations and the southwestern part of the late Precambrian Okcheon metamorphic series. The Kyongsang basin occupies the southeast and southwest of the peninsula and is 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