zation genetically related to granitic igneous rocks. Regional geologic structure and the lithology of country rocks are the most important factors controlling localization and deposition of fluorite.

In some replacement fluorite deposits, both the fluorite and the country rocks have very similar visual characteristics. Microscopic study of thin sections can be of assistance in solving the problems of identification, quality control, and beneficiation of crude fluorite.

Experiments using geophysical methods for locating fluorite deposits have been introduced into exploration work. Gravimeter and magnetometer studies have been applied to the deposits, but they have been found useful only in broadly outlining local structures. Unfortunately, fluorite cannot be detected directly by these methods.

Until now, only easily worked surface fluorite has been mined at the several known deposits. Intensive exploration, underground mining, and sophisticated beneficiation facilities are needed to maintain high-production levels.

Estimated potential reserves of metallurgical-grade fluorite in Thailand are thought to exceed 11,500,000 metric tons.

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ANTARCTICA: UNPROSPECTED AND UNEXPLOITED CONTINENT

Antarctica is a storehouse of mineral wealth. All other continents are. There is no reason to believe that Antarctica is unique in this respect. The continent was discovered about 150 years ago. Because of the unfavorable environment and high costs, exploration proceeded slowly and intermittently for a century. Since 1957 multi-nation efforts have revealed a fairly complete knowledge of the geomorphology, structure, and general geology of the continent. A program of detailed geologic surveying and prospecting is needed. In the not too distant future the natural resources of Antarctica will be in demand.

Antarctica is a difficult continent to explore. Over 90% of it is located within the Antarctic Circle. Approximately 95% of the continent is buried beneath ice sheets some of which exceed 3,000 m in thickness. The climate is severe and the field and shipping seasons are short. All supplies and equipment must be shipped in; the continent provides nothing.

East Antarctica is an ancient shield composed of a Precambrian basement under locally thick deposits of Devonian-Jurassic terrestrial sedimentary rocks. West Antarctica is an archipelago composed of segments of deformed Precambrian and Paleozoic continental crust. The late Mesozoic Circum-Pacific orogeny resulted in the emplacement of granitic plutons in coastal West Antarctica. Volcanism has occurred along the Pacific margin since the middle Tertiary.

Deposits of minerals containing such metals as chromium, cobalt, copper, gold, iron, lead, manganese, molybdenum, nickel, silver, tin, uranium, vanadium, and zinc have been noted. Nonmetallic deposits include beryl, micas, and coal. Offshore deposits of petroleum and natural gas are possibilities.

Under a treaty signed by 16 nations, operations in Antarctica are restricted to exploration and research. There are political aspects to be considered, but surely they can be resolved and the program of exploration and prospecting can proceed at an accelerated rate.

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COAL IN ALASKA

Estimates indicate that Alaska contains 130 billion tons of coal of different rank and age distributed over approximately 33 million acres. Commercial coal production began in Alaska in 1916, but peaked after World War II, and today less than a million tons are produced annually. Only the Nenana coalfield is currently active.

The northern coal province includes several coalfields of Cretaceous age with a reserve potential of 120 billion tons of high-volatile B and C bituminous and subbituminous coals. In central Alaska, 7 billion tons of subbituminous coal and lignite are estimated in the Nenana coalfield and in associated Tertiary coal basins. The Broad Pass, Susitna, Matanuska, and Kenai coalfields of south-central Alaska may contain 3 billion tons of high-volatile B bituminous and lesser rank coal.

Subbituminous coal and lignite of Late Cretaceous and Tertiary age are present at Hereenden Bay, Chignik, and Unga Island on the Alaska Peninsula, along the Yukon River, and on the Seward Peninsula, but their extents are poorly known. Low-volatile, high-rank bituminous coal is present in the Bering River coalfield, southeast Alaska, but is highly deformed and no reliable resource estimates exist. Coal deposits of Paleozoic age are local in northwest Alaska and on the upper Yukon River. Some of the coals of the Bering River coalfield and of the northwest part of the northern coal province may have coking potential; all Alaska coals are low in sulfur.

Development of the Alaskan coals has been restricted because of land-status problems, hostile environment, inaccessibility, and high costs of exploration and production. Probably only strip mining can be competitive with other energy sources.

Future planning should include investigation of potential coking coals, large-scale strip and underground mining, in situ gasification and development of chemical industries utilizing low-rank coal.

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PETROLEUM POTENTIAL ON CONTINENTAL RISE OFF CENTRAL CALIFORNIA

The JOIDES program has demonstrated the technical feasibility of drilling in the deep ocean. However, except for petroleum shows in the Sigsbee Knolls in the Gulf of Mexico, there is no firm evidence of petroleum reservoirs in the deep ocean beyond the limits of the continental slope to require economic use of such technology.

Emery suggested the possibility of vast petroleum resources in deep water adjacent to the continents in areas of hemipelagic sedimentation. One such area adjacent to the United States is the continental rise off California between Point Conception and Cape Mendocino, which covers 200,000 sq km and consists of three major submarine fans, the Arguello, Monterey, and Delgada, at depths of about 3,000 m to 4,500 m.

The fans are composed of continental debris carried down submarine canyons and deposited on the fan through a system of branching and meandering sub-