THE MINERAL INDUSTRY OF

ANTARTICA

By David B. Doan

A large continent having an area of about 14 million square kilometers, Antarctica lies almost entirely within the Antarctic Circle. It is virtually surrounded by deep ocean basins and supports an ice sheet varying from 1,500 to about 3,900 meters thick.¹ Through a period of years, geophysical studies have revealed a fairly complete physiographic picture beneath the ice cover. West Antarctica is connected to the main part of the continent by a mountain chain rising well above sea level, though largely masked by ice and snow. The mountains of Marie Byrd Land are a large island mass whose surrounding ice extends well below sea level. The bedrock of most of East Antarctica apparently rises above sea level, with the high ranges of the Transantarctic Mountains and Queen Maud Land extending far above sea level.

The Antarctic continent, with its accompanying continental ice sheet and widely distributed mountain glaciers, is unique at the planetary surface, being at once the coldest area on earth, the least inhabited continent, the southern pole, and the locus of the greatest impoundment of fresh water on earth. Moreover, it has a distinct fauna and flora, relating evidently both to temperature and the uniqueness of the land mass as a major continent. Exploration began piecemeal and by accident in the early 1800's, primarily by whale and seal hunters, and increased gradually toward the so-called Heroic Era, from 1894 to the late 1920's. During this 35-year period, explorers from a number of countries established bases, planted their flags at the pole, and made claims of land on behalf of their countries. Starting in the 1940's, geopolitical interest and contention rose sharply. By the early 1960's, scientifically sophisticated bases were established and overland expeditions mounted by many countries.² Intentions may have been diverse but most countries maintained a public posture of scientific objectivity. Accommodation among countries, however, evidently became desirable.

International Policies and Programs

The Antarctica Treaty, signed in December 1959, took effect in June 1961, and established for at least 30 years a legal framework for peaceful use, scientific research, and suspension of territorial claims. Administration has been carried out through consultative member meetings, the 14th and latest meeting having been held in Rio de Janeiro, Brazil, in October 1987.³

Consultative (voting) members include claimant nations, who claim somewhat overlapping portions of Antarctica as

national territory, and nonclaimant nations, who have made no claims to Antarctic territory, although among the latter the United States and the former Soviet Union have reserved that right and also do not recognize the claims of others.

Argentina and Chile are signatories of the 1961 Antarctica Treaty and are among the seven countries making claims on Antarctic territories. The other

five claimant nations are Australia, Britain, France, New Zealand, and Norway.

In October 1985, Uruguay achieved Consultative Party status within the Treaty. Cuba and Peru are acceding (nonvoting) members. Argentina and Chile maintain research stations in Antarctica. Of all the claimant nations, Argentina has had the longest presence in Antarctica, starting in 1904. Argentina and Chile have signed an agreement, the Convention on the Regulation of Antarctic Mineral Resources Activities (CRAMRA), negotiated by the Antarctica Treaty nations during 1982-88.

In 1990, two concurrent resolutions were passed by the U.S. Congress: House of Representatives Concurrent Resolution 109 and Senate Concurrent Resolution 26, both of which declared that it is U.S. policy to pursue an indefinite or permanent ban on commercial mineral development activities in Antarctica. Both resolutions received widespread bipartisan support as well as the backing of major environmental groups.

The Madrid Antarctica Treaty Conference, held in Spain in June 1991, saw near unanimity among the consultative and nonclaimant nations concerning a 50-year protected future for Antarctica. The United States, however, acceeded to a compromise stating, in effect, that any of the parties wishing to mine after 50 years may do so only if agreed to by three-quarters of the 26 consultative nations.

These matters having been settled, attention of most of the consultative and acceding nations turned to environmental problems and issues during ensuing years. Procedures for environmental monitoring were discussed at a meeting in Buenos Aires, and the activities most likely to have environmental consequences were considered to be, in order of significance: station and airstrip construction and operations; waste water and sewage disposal; incineration of waste; power and heat generation; human activities affecting native fauna and flora; scientific research activities; and accidents causing fuel spills or other types of evironmental contamination. Recommendations were taken up on the establishment of environmental monitoring techniques and programs to be considered in detail in future meetings.

Mineral Potential

What is known of the geology of Antarctica, together with additional evidence from a great many mineral prospects in the small proportion of rocks actually exposed, suggests that a significant potential for the occurrence of mineral deposits occurs in various parts of the continent.⁴ Geologic work pointing to this conclusion has been published by geologists from Argentina, Australia, Canada, China, Germany, New Zealand, Norway, South Africa, the United Kingdom, the United States, and the former U.S.S.R. Known metalliferous fold belts in Africa, Australia, and South America appear to have continuations in Antarctica, based on general concepts of plate tectonics. Although much evidence is circumstantial, a reasonable basis exists for projecting various highprobability areas of ore-grade mineralization in Antarctica.

Some copper-bearing plutons on the Antarctic peninsula have distinct similarities to the Andean porphyry copper bodies. The Dufek Massif, a major intrusion near the African end of the Transantarctic Mountains, bears some resemblance to, and is potentially larger than, the Bushveld Complex in South Africa. Although the geology of the two complexes is comparable, they are different in geologic age.⁵

Based on geologic structure and geophysical evidence, a clear possibility exists that petroleum reserves are likely to be present, particularly offshore in such thick sedimentary basins as those of the Amery Ice Shelf, Filchner Ice Shelf, Ronne Ice Shelf, Ross Sea and Ice Shelf, and the Weddell Sea.⁶ Shows of petroleum and natural gas were encountered during the U.S. Deep Sea Drilling Program Leg 28 in 1973 on the continental shelf in the Ross Sea area.⁷ The discovery of hydrocarbons along the Atlantic coasts of Africa and South America, the east coast of India, and the south coast of Australia underscores the possibility of similar accumulations along the coasts of Antarctica that were once in proximity⁸ to these petroliferous margins of other continents.

Infrastructure

The infrastructure of Antarctica consists of temporary and permanent scientific stations that have been established originally by Argentina, Australia, Chile, France, the Federal Republic of Germany, Great Britain, India, Japan, New Zealand, the Republic of South Africa, the United States, and the U.S.S.R. Names of the countries have changed in some cases, but these stations are, or have been, supplied by ships and airplanes using about 39 different temporary airstrips. There are no true port facilities, only offshore anchorage. Antarctica has no indigenous inhabitants. The total number of foreign inhabitants varies up to about 4,000, depending on the time of year.

Outlook

Zealand, in June 1988 sought, among other things, to regulate a controlled, rational approach to future mineral exploration activities in the Antarctic. Three years later, however, the Madrid conference ultimately agreed to a 50year moratorium on mineral exploration and mining, thus defining the outlook for the foreseeable future. Antarctica's remoteness, its harsh climate, the ice coverage of 98% of its surface, the question of suitable mining-related technology, the abundance of minerals elsewhere, and the opposition of environmentalists and conservationists are additional factors that would affect any efforts toward mineral extraction or development.

⁴Rowley, Peter D., Paul D. Williams, and Douglas E. Pride. Mineral Occurrences of Antarctica, *in* U.S. Geological Survey Circular 909, in cooperation with the National Science Foundation, 1983, p. 25 et seq.

Ford, Arthur B. The Dufek Intrusion of Antarctica and a Survey of its Minor Metals and Possible Resources, *in* U.S. Geological Survey Circular 909, in cooperation with the National Science Foundation, 1983, p. 51-75.

⁶Cooper, Alan K., Frederick J. Davey, and Karl Hinz, (Office of Marine Geology, U.S. Geological Survey). Ross Sea-- Geology, Hydrocarbon Potential, Oil and Gas Journal, Nov. 7, 1988, pp. 54-58, and Nov. 14, 1988, pp.118-125.

⁷Hayes, D. E., and L. A. Frakes. General Synthesis, Deep Sea Drilling Project Leg 28, in Initial Reports of the Deep Sea Drilling Project: v. 28, Washington DC, U.S. Government Printing Office, pp. 919-941.

⁸Various reconstructions have been proposed since 1968; one of these is shown in footnote 1, above.

Major Sources of Information

National Science Foundation

- Office of Polar Programs
- 1401 Wilson Blvd.
- Arlington, Virginia 20192
- Telephone 703-306-103
- U.S. Geological Survey Scientific Committee on Antarctic Research (SCAR) Library
- Has airphotos, maps, charts, and satellite images

12201 Sunrise Valley Drive

Reston, Virginia 20192

Telephone: 703-648-6600

Major Publications

- American Geophysical Union, Washington, DC: Mineral Resources Potential of Antarctica, 1990, 310 pp.
- Hodgson, Bryan. Antarctica: A Land of Isolation No More, National Geographic Magazine, Apr. 1990, pp. 2-51.
- Oxford Science Publications (Clarendon Press), Oxford, England: Minerals and Mining in Antarctica, 1985, 127 pp.
- Tingey, R. J., (Editor). Geology of Antarctica, Oxford University Press, 1991a, 710 pp.

¹Unless otherwise noted, this and other geological or geophysical information is taken from Petroleum and Mineral Resources of Antarctica. Behrendt, John C., Editor, U.S. Geological Survey Circular 909, in cooperation with the National Science Foundation, Washington, DC, 1983, p. 7 et seq.

²National Geographic Society. Antarctica, Atlas Plate 65 (heavily annotated), 1:9,820,800 scale, Feb. 1963, Washington DC.

³U.S. Department of State. Various telegrams, beginning June 1988 until Sept. 1991, regarding Antarctica treaty negotiations.