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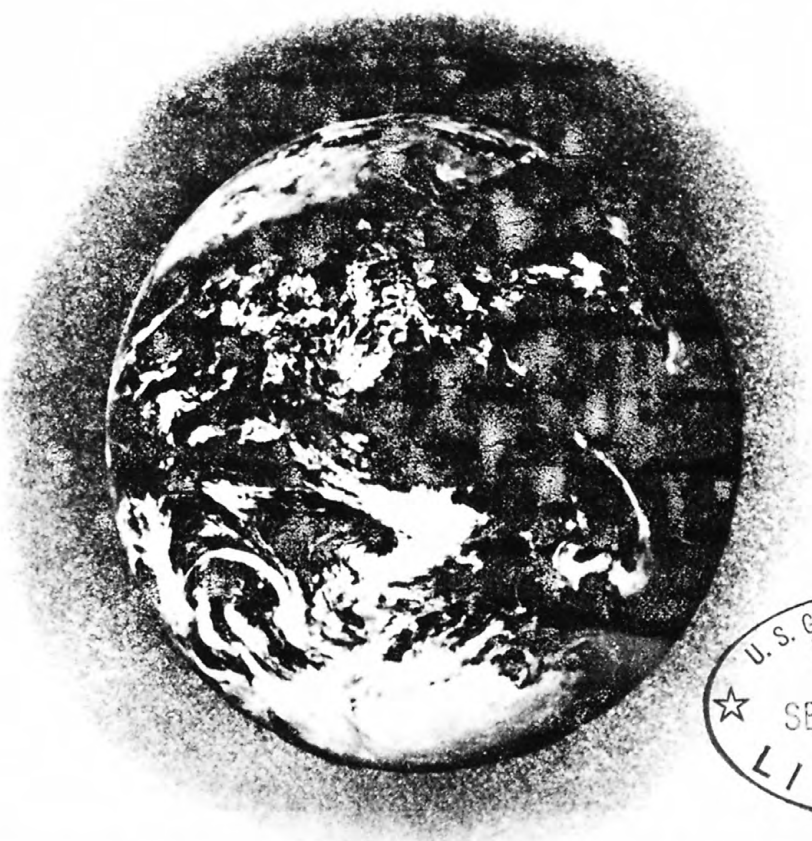
PRELIMINARY REPORT ON THE ENERGY RESOURCE POSITION OF THE REPUBLIC OF KOREA



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PRELIMINARY REPORT ON THE ENERGY RESOURCE POSITION OF THE REPUBLIC OF KOREA

By

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U.S. Geological Survey

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PRELIMINARY REPORT ON THE ENERGY RESOURCE POSITION OF THE REPUBLIC OF KOREA

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U.S. Geological Survey

INTRODUCTION

The Republic of Korea has meager resources of energy minerals. Only hydroelectric power and coal were listed as sources of energy indigenous to Korea in the report of the 1967 World Energy Conference. Small reserves of thorium have been estimated and the discovery of uranium was reported in 1977 (A. W. Noonan, Jr., U.S. Department of State, written commun., 1977). Petroleum, natural gas, and geothermal energy sources possibly exist in South Korea, but their potential for development is not considered to be great. About 55 percent of the energy in the Republic is produced from petroleum, most of which is imported as crude and is refined in-country. Domestically produced coal supplies about 32 percent of the energy demand, hydroelectric power about 4 percent, and other sources (firewood, charcoal, and dung) about 9 percent. South Korea's latest energy program stresses construction of additional hydroelectric power installations, increased production of coal, initiation of energy production by atomic reactors, onshore and offshore exploration for petroleum and natural gas, generation of energy by tidal power, and energy savings through conservation (R. A. Stella, written commun., 1977).

GEOLOGIC SETTING

South Korea contains an area of 98,478 square kilometers of land and inland waters. The Korean peninsula is composed for the most part of Precambrian granite and granitic gneiss that were intruded by granite batholiths during a period of major deformation in the late Mesozoic

(Andrews and others, 1957). Marine sedimentary rocks of Cambro-Ordovician and Carboniferous ages, and mainly terrestrial coal-bearing strata of Permian to Triassic and Jurassic ages are widely distributed throughout the north-northeast-trending Ogcheon geosyncline that extends across most of the length of South Korea and northward into North Korea (Reedman and Um, 1975). During the Mesozoic, intense deformation produced complicated folds, intricate thrust and normal faults, and metamorphism of the rock units (Andrews and others, 1957). Cretaceous terrestrial sedimentary rocks cover a large area in southeastern Korea, and nonmarine, lignite-bearing Tertiary (Miocene) strata are in scattered smaller areas along the eastern coast of the Republic (Reedman and Um, 1975).

STATUS AND POTENTIAL OF ENERGY RESOURCES

Hydropower

The mountainous terrain and the well-developed network of rivers provide Korea with exceptional water power potential. Total available hydroelectric power resources in South Korea are estimated to be 2,966 million (10^6) kilowatts; in 1977 hydroelectric generating facilities in operation had a capacity of 770,000 kilowatts, about 43 percent of the economically feasible proven resources of 1,785 million kilowatts (R. A. Stella, written commun., 1977). About 70 percent of the hydroelectric power installations are on the upper part of the Han River; other principle facilities are along the Somjin River. These installations produce about 15 percent of the electricity generated in the Republic; thermal plants fired mostly by oil, but occasionally by coal, generate most of the electricity that is consumed in the larger cities. Seven new

hydroelectric plants with a combined capacity of 806,000 kilowatts are scheduled for construction and are expected to be operable by the mid-1980's. By the year 2000, anticipated production of energy by hydropower is projected to be 4 million kilowatts--about 20 percent of the nation's power needs at that time (R. A. Stella, written commun., 1977).

Coal

Coal is South Korea's most plentiful energy-mineral resource. It consists mostly of anthracite and a small, as yet unexplored and unestimated amount of lignite. Estimates of the total anthracite resource in the ground range from 1.4 to 1.5 billion (10^9) metric tonnes (World Energy Conf., 1977; R. A. Stella, written commun., 1977). Of this amount, as much as 600 million tonnes is estimated to be recoverable on the basis of present technology. Anthracite production in 1977 was about 17.3 million tonnes; the 5-year energy plan projects 1981 production at 24 million tonnes, but the anticipated demand at that time may be as high as 31 million tonnes (R. A. Stella, written commun., 1977). Practically all anthracite produced in South Korea is used domestically, primarily for space heating. Problems related to the anthracite's high ash content, low heating values, high mining costs, and special firebox requirements make it less desirable than bituminous coal for thermal power-plant fuel. Studies are underway, however, to test the feasibility of using fuel composed of a mixture of oil and anthracite in electricity generating plants. The Republic imports almost 775,000 tonnes of coal annually; most is coking coal for the iron and steel industry, but some is steam coal (Chin, 1978).

Anthracite is interbedded with rocks of Permian age in nine producing coalfields scattered across the peninsula northeastward from south of Kwangju (Honam field) to Kangnung (Fig. 1). Anthracite beds in Jurassic strata have also been exploited at two fields, one along the coast west of Taejon and the other near the northern border north of Seoul. The anthracite is interbedded with rocks typical of coal measures (sandstone, siltstone, dark shale, and limestone) that have been altered to quartzitic and slaty varieties by low-grade metamorphism. Three or four beds of anthracite ranging from less than one to about 4 meters in thickness are present in each coalfield. However, because of the intense Mesozoic deformation which is believed to have caused the metamorphism of the coal to anthracite or higher rank, the beds are discontinuous and of variable thickness, having been squeezed into lenticular masses, and in particular are over-thickened on crests and troughs of folds (Andrews and others, 1957, p. 8). Also, because of the intense deformation, bedding in the coal has been destroyed; the anthracite contains pods and lenses of shaley coal, shale, bone, graphite, and country rock that are generally impossible to separate from the coal during mining (Andrews and others, 1957, p. 38). Consequently, the anthracite as mined is high in ash (20-65 percent) and low in heating value (4,400-10,000 Btu), almost an inverse relationship. Washed and cleaned samples of anthracite from processing plants have ash contents as low as 14 percent and Btu values as high as 11,800. Korean anthracite, similar to that in Pennsylvania, has low contents of volctile matter, moisture, and sulfur.

Little is known of the characteristics and extent of the Miocene lignite deposits that lie along the southeast and east coasts of South Korea (Fig. 1).

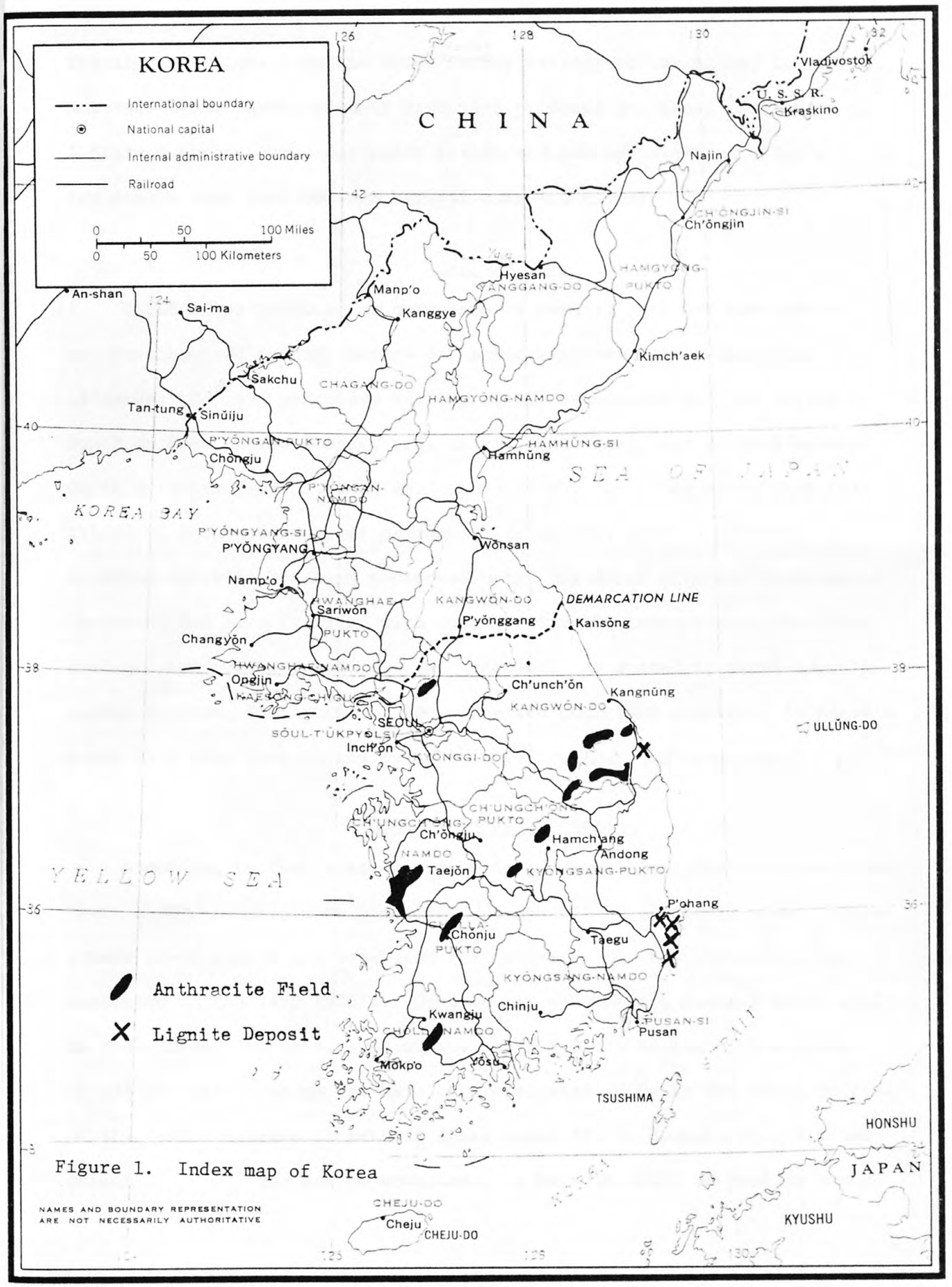

Figure 1. Index map of Korea

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The lignite ranges from the brown, woody variety to the black, low-moisture type. Small amounts have been produced for local use. Many lignite deposits are under paddy fields and are exploited only for a few months each year between harvest time and winter.

Oil and gas

South Korea produces no petroleum or natural gas, but the Mesozoic and Tertiary sedimentary basins are being explored both onshore and offshore. In 1975 petroleum was reportedly discovered at 1500 meters depth onshore in the P'ohang area on the east coast, and at 2800 meters depth offshore from Cheju Island (Chin, 1978). Drilling since then has failed to define commercial production (Fletcher, 1978). Offshore drilling activity has been postponed until the Joint Offshore Development Agreement has been ratified with Japan. Offshore lease blocks have been relinquished by the major foreign companies. As stated in South Korea's energy program, "any contribution of native petroleum resources to Korea's needs is a long time in the future" (R. A. Stella, written commun., 1977).

Nuclear energy minerals

According to the latest energy program, Korean officials believe that their most promising development of energy will be in atomic power. Five atomic power plants are scheduled for construction, the earliest to be completed in the late 1970's. Development of domestic nuclear fuels will be undertaken. To date, approximately 7.6 million tonnes of low-grade (0.045 percent) uranium ore have been estimated to be in the black slates of the Ockchon strata in central South Korea (A. W. Noonan, Jr., written commun., 1977). The ore is considered to be sufficient to produce enough

enriched uranium to be cost-competitive with international supplies in the 1980's. Reserves of more than 300,000 tonnes of thorium oxide (5 percent) have been estimated in areas of monazite in granitic gneiss (A. W. Noonan, Jr., written commun., 1977).

Geothermal power

Geothermal potential in the area aroung Pusan is mentioned as a possible energy source in the energy program of the Republic of Korea (A. W. Noonan, Jr., written commun., 1977). However, no supportive published data could be located on which to evaluate this possibility.

Tidal power

The harnessing of tidal power in seven bays on the west coast of South Korea, such as at Wolmi-do off Inch'on where tides reach heights of 9 meters, is being considered as an alternative source of energy. High construction costs and the need to develop super-low-head turbines present obstacles to development. However, one tidal plant having 400,000 kilowatts capacity is scheduled to be operable in 1986 (R. A. Stella, written commun., 1977).

CONCLUSIONS

The Republic of Korea's immediate potential to develop energy resources likely rests mainly with hydroelectric power installations, increased coal production and processing, and possibly atomic power plants. The other energy sources, petroleum, natural gas, geothermal, and tidal, if developed, appear to be long-range measures.

REFERENCES CITED

Andrews, D. A., and others, 1957, Coalfields of the Republic of Korea: U.S. Geological Survey Bulletin 1041, Chapters A through E, 99 p.

Chin, E., 1978, The mineral industry of the Republic of Korea: U.S. Bureau of Mines Minerals Yearbook, 1975,v.III, p. 623-632.

Fletcher, G. L., 1978, South Korea in Petroleum developments in Far East in 1977: American Association Petroleum Geologists Bulletin,v.62, no. 10, p. 1987-1988.

Reedman, A. J. and Um, S. H., 1975, The Geology of Korea: Geological and Mineral Institute of Korea, 139 p.

World Energy Conference, 1977, Survey of energy resources, 1976: Copyright 1977 by the World Energy Conference, London (selling agent: R & R Clark, Ltd., Edinburgh).