HYDROGEOLOGIC RECONNAISSANCE OF THE REPUBLIC OF KOREA

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Abstract.—The Republic of Korea is underlain largely by metamorphic and intrusive igneous rocks which generally yield only small amounts of water from the weathered zone. Present ground-water supplies, mostly from unconsolidated deposits in the river valleys and coastal flatlands, can be expanded considerably.

The Republic of Korea[1] (fig. 1) is a country in which approximately 25,000,000 persons are subsisting on a land area (96,929 square kilometers) about the same size as that of the State of Indiana. Their major occupation is the cultivation of rice with which to feed the rapidly increasing population. Rice is grown in small plots, or paddies, which are flooded during the growing season principally with water diverted from streams. A severe drought during the spring of 1962 resulted in poor crops and stimulated interest in the possibility of developing ground water for supplemental irrigation. At that time no organization in South Korea was carrying on systematic ground-water investigations nor were there personnel, either local or foreign, qualified to undertake the work. As a result, the Agency for International Development, U.S. Department of State, requested the U.S. Geological Survey to make a ground-water reconnaissance and evaluate current water-supply problems. The work was done during January–March 1963.

The study revealed that ground water is used for domestic, municipal, and industrial supplies and, to a lesser extent, for irrigation but that development of this resource has proceeded with very little scientific guidance or direction. Recognizing the importance of ground-water resources and the need for their proper management, the Japanese initiated in the late 1930's a comprehensive investigation of the ground-water resources, but the program was halted abruptly by World War II and was not resumed after the war. Since World War II, water wells have been drilled by the U.S. Army, U.S. Operations Mission to Korea, drilling contractors, and Republic of Korea agencies, but largely for exploitation rather than for investigation. Although many satisfactory supplies have been developed, very little information has been obtained regarding the overall availability and the quantitative limits of the ground-water resources.

The Republic of Korea is mountainous and is cut by steep-walled river valleys and some wider rift-type structural valleys. Most of the country has an average annual rainfall of more than 1,000 millimeters; the annual precipitation at Seoul and Pusan averages 1,254 and 1,403 mm, respectively. Rainfall is heaviest during the summer months.

Igneous and metamorphic rocks are exposed throughout most of the country (fig. 2). Metamorphism has largely destroyed the primary porosity in the sedimentary rocks and, in general, no important secondary porosity has developed. The thick layer of weathered material that mantles these rocks through much of the country has sufficient permeability to sustain dug wells for domestic and rural farm use. Jointing and faulting, although present, have not resulted in any effective porosity. Small springs are found in the higher areas but usually flow only during, and for a short time following, the rainy season. Most of the springs occur at the contact of the weathered and unweathered rock.

[1] The official designation, Republic of Korea, is used interchangeably with ROK, South Korea, and Korea in accordance with common usage. All refer to that part of the Korean Peninsula south of the demilitarized zone separating the Republic of Korea from the northern, communist-controlled Peoples Republic of Korea or North Korea.

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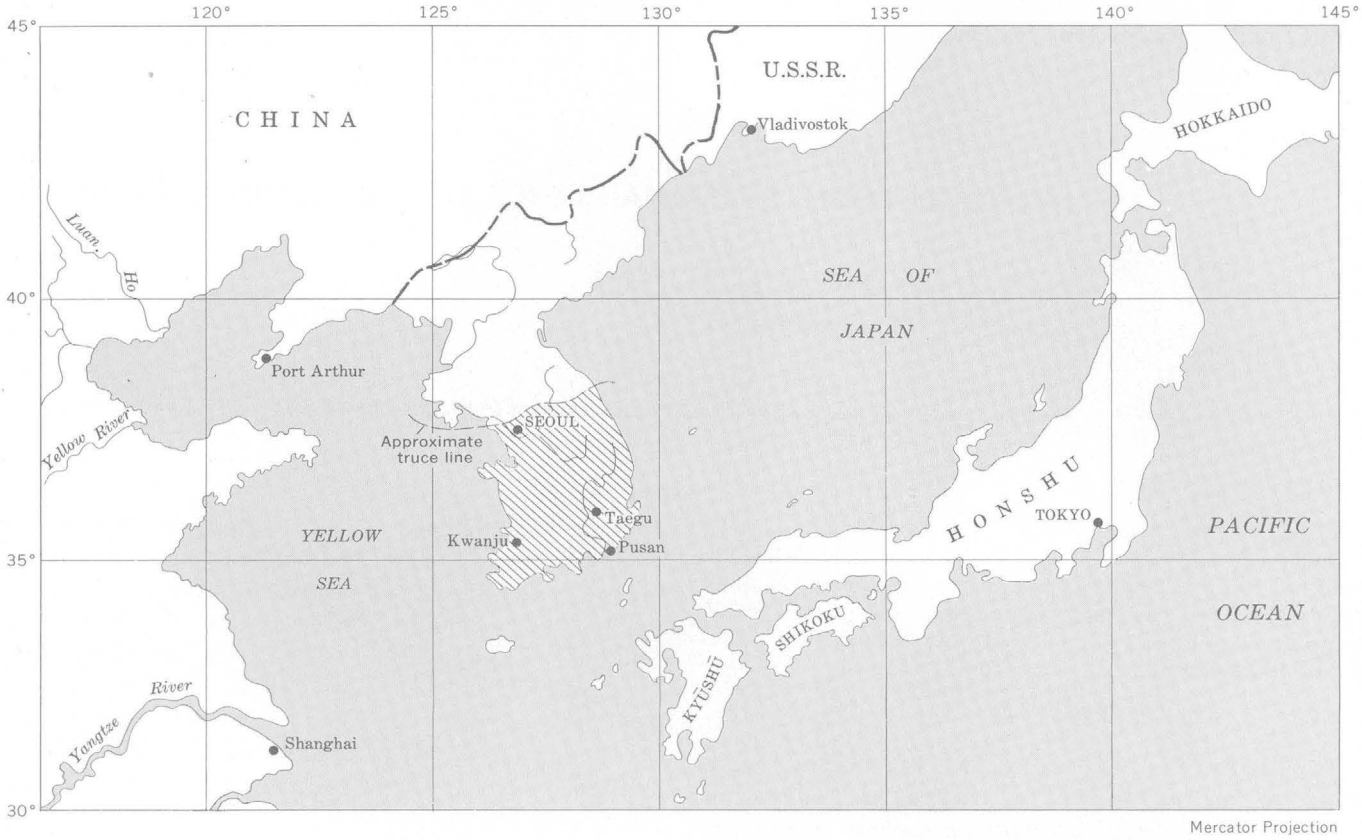

FIGURE 1.—Map showing location of the Republic of Korea (diagonal lines).

Mesozoic rocks consisting of shale, sandstone, and siltstone are present in the southeastern part of the country. They have a reported maximum thickness of 20,500 meters in the Taegu area (Kobayashi, 1953, p. 233) and are gently folded. The axes of the folds are oriented in a general northwest direction, and the rocks are cut by faults trending in the same direction. The nature of the rocks and the structural features in the Taegu area suggest that the rocks contain ground water under artesian conditions (fig. 2). However, exploratory drilling would be required to determine the availability of artesian water supplies.

Unconsolidated Pleistocene and Recent alluvial deposits resting on bedrock underlie the floors of the steep-walled flat-bottomed valleys. The broad flatlands along the west coast of the country also are underlain by unconsolidated sediments that rest on bedrock. Hills of intrusive and metamorphic rocks projecting upward through the coastal unconsolidated sediments indicate that the bedrock surface is irregular and probably was produced by erosion. The alluvial and coastal deposits are not only the current source of most of the large ground-water supplies but also the best potential source; their areal distribution is shown on figure 2.

Present-day deposits in stream valleys consist mostly of sand and silt. Gravel is being deposited by streams

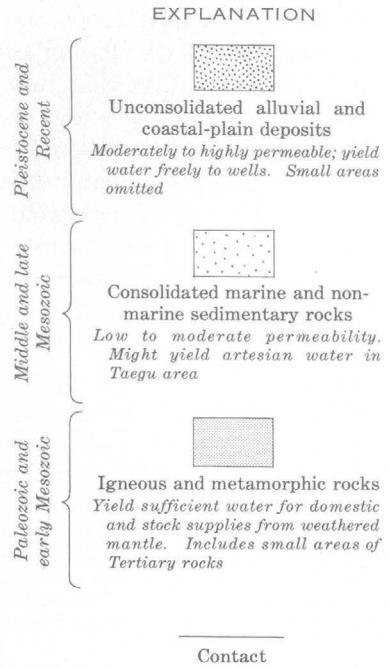

FIGURE 2.—Explanation.

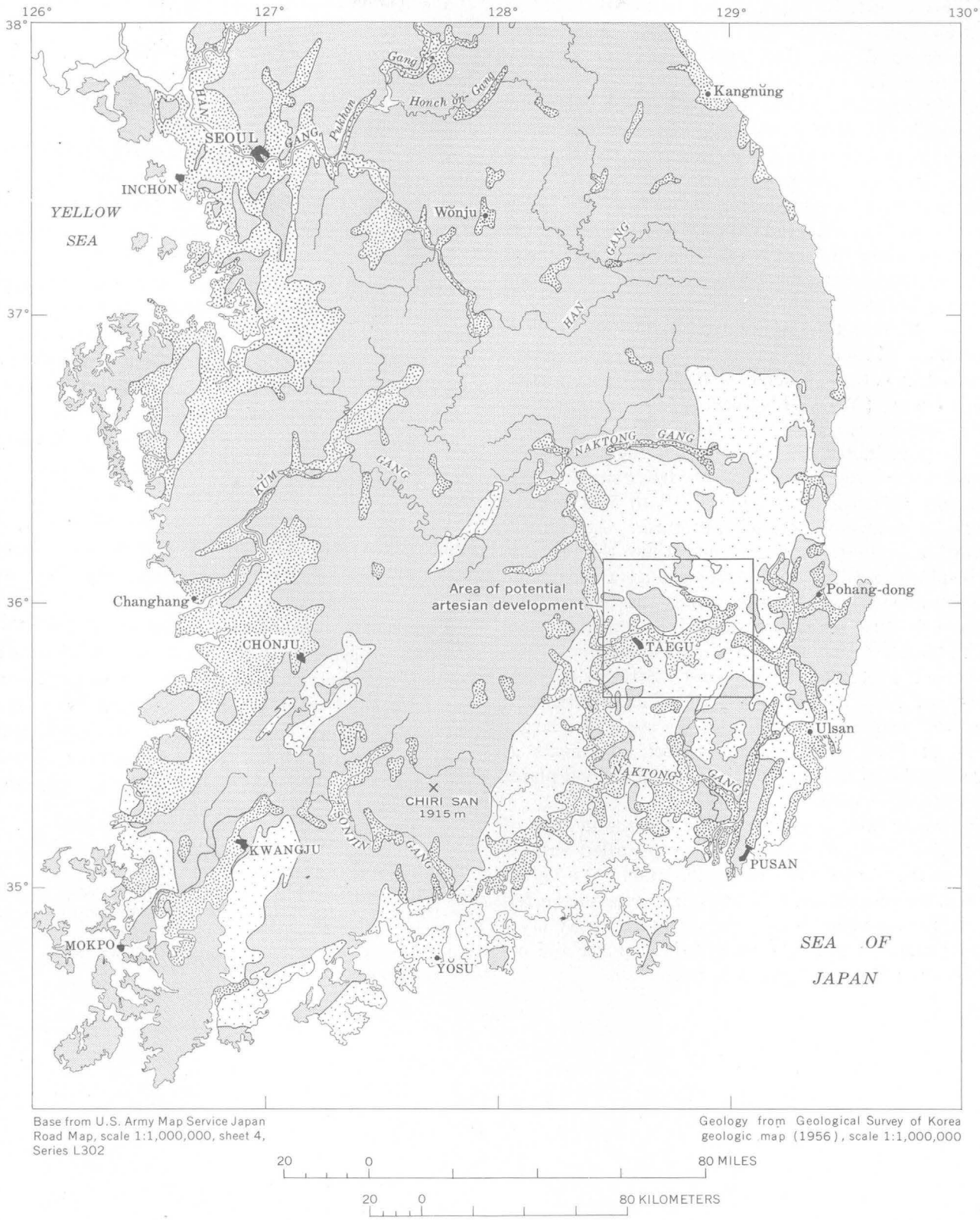

FIGURE 2.—Geologic map showing areas of ground-water availability in the Republic of Korea south of the 38th parallel.

at higher elevations only, mostly in and adjacent to the high chain of mountains that extends southeasterly across South Korea. The streams carry heavy loads of sediment during floods, and the major streams are gradually aggrading their lower reaches. Deltas are being built by streams discharging into the Pacific Ocean along the south coast and into the shallow Yellow Sea along the west coast.

Some information regarding the nature and thickness of the unconsolidated deposits and the occurrence of ground water in them has been obtained as a result of the various development programs. In the drilling of wells, bedrock commonly is reached at depths of less than 35 m, although one well drilled by the U.S. Operations Mission to Korea near Changhang was bottomed in valley-fill deposits at a depth of approximately 75 m (M. K. Fletcher, oral communication, 1963), and several wells have been drilled 45 to 60 m into unconsolidated sediments along the west coast. Owing to the irregularity of the bedrock surface, bedrock may be reached at depths of 3 to 5 m even in places far from any bedrock exposures. Apparently during or following Pleistocene time the Korean Peninsula was tilted southwestward as a block and the old erosion surface was partly buried by predominantly fine sediments carried by streams from the highlands to the east. Widespread tidal mudflats are present along the western coast. Streams crossing the coastal plain carry heavy loads of suspended sediment and meander sluggishly to the sea. The larger rivers, at flood stage, transport rock fragments as large as pebbles and deposit them on their flood plains and in their channels.

The water table is near the land surface in most of the coastal flatlands and in the steep-walled valleys. Some of the deeper wells in the flatlands tap both the water-table aquifer and an underlying artesian aquifer. The artesian aquifer is confined above by a clay layer that separates it from the water-table aquifer and below by the bedrock on which it rests.

The yields of wells tapping the unconsolidated deposits range from 1 to 25 liters per second. However, the permeability, extent, and thickness of these deposits indicate that with proper construction and careful development, wells yielding 50 to 100 l per second could be drilled in many places.

Most of the nonmountainous parts of the country are covered by rice paddies. Constructed so that seepage losses are minimal, the paddies have a floor of impermeable clay. Therefore, even though they are kept flooded much of the year, the paddies are not considered to be a significant source of recharge to underlying aquifers. Most of the recharge probably results from influent seepage through river beds and from infiltration of flood waters and precipitation on uncultivated flood plains. Because artificial withdrawal of ground water is on such a small scale, fluctuations of the water table are due largely to natural causes. Extensive development of the ground water in unconsolidated deposits along stream courses would probably induce recharge by influent seepage from the streams and thereby lessen the amount of fresh water discharged into the sea. The effect would be more pronounced during the times of low flow.

Population increase and industrial growth in the Republic of Korea will require fuller utilization of the country's water resources. Moderate to large quantities of ground water can be developed from the unconsolidated deposits and possibly from sedimentary bedrock aquifers. Any such development should be preceded by, and based on, the results of detailed hydrogeologic studies.

REFERENCES

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