Domestic Exploration for Materials

A civilization with a high standard of living is dependent on adequate supplies of many kinds of materials. Some elements are of critical importance. For example, chromium is an essential component of low-corroding stainless steels. Cobalt is needed to bond diamonds in cutting tools. The United States is dependent on outside sources for supplies of these and more than a score of other elements.

This country began the 20th century with more than its share of easily exploitable domestic resources. American prosperity and assurance of raw materials were reinforced by the results of geologic exploration elsewhere. Therefore, in the 1950's and early 1960's large parts of the world's oil and mineral reserves were owned by American companies. Most of the remaining reserves were under the control of friendly, stable governments. But great changes have occurred. The future of much of Africa is uncertain. American domination of foreign resources has ended. A long-term decline in the grade of domestic ore reserves has continued.

With an economy increasingly vulnerable to disruptions of supplies, with security of supplies uncertain, and with a diminished ability to pay for imports, intensified efforts to lessen U.S. dependence on foreign sources are needed.

Thus far there has been little action by the federal government; on balance, the government has hindered efforts to increase mineral supplies. During the past decade large areas of the most promising public lands have been closed to exploration. Funds available to the U.S. Geological Survey for mineral exploration have been modest. Support from the National Science Foundation for research on mechanisms of ore formation has been small. Industry is active in exploration, but the extent is not readily gauged.

The quest for ore deposits is handicapped by lack of knowledge of how elements are mobilized in the earth. Many of them are present in an average abundance of a few parts per million or less. But when found in ores they may have been concentrated by a factor of 10^4 or more.

Processes relevant to the genesis of ore deposits probably go back to the beginning of the solar system. Apparently this planet was assembled from heterogeneous materials and some of the heterogeneity persists on a large scale. The earth has been a laboratory in which many chemical separations have occurred. The environment of these events has changed with time. The interior of the earth was hotter in early times than it is today. When magmas reached the surface, weathering and subsequent sedimentation occurred in an oxygen-poor atmosphere. The ores in Precambrian rocks differ from those formed later and in general are more valuable. Precambrian rocks outcrop in substantial areas of Africa but form a smaller fraction of the surface of the United States. Surface rocks here are underlain by Precambrian formations, but the United States has had no systematic drilling program to examine them.

Our knowledge about later chemical events affecting mineralization is not much better. Most of the ore that has been found in this country was discovered by primitive techniques—you might say, by stumbling over it. Recently, the discovery process has been aided by results from Landsat satellites and by the concept of colliding tectonic plates, but much of the physical chemistry of the mobilization of elements remains a mystery. For example, many ores occur as insoluble sulfides. How were the cations concentrated and brought to their final position? Where did the sulfur come from? If we understood this process and others we could predict much better where and how to explore for ores.

A decade or more elapses from the time of discovery of an ore body to exploitation. If this country is not to become a pawn in an international game of materials, it must begin to develop a more vigorous materials policy.

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