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Metallogenesis in Latin America

The mines of Latin America have contributed to the economies of other regions for more than 400 years. At first the treasures were silver and gold; today they include copper, iron, aluminum, tin, molybdenum, lead, zinc, and other substances. The flow will continue for a long time. For example, Chile is known to have as much as 30 percent of the world's copper reserves. The great mine at Chuquicamata has 8000 million tons of copper ore with a cutoff grade of 0.5 percent copper. How this and other ore deposits were formed and how this knowledge can be used to guide further exploration were the subjects of a symposium held in Mexico City on 4 to 6 February.* The occasion brought together about 150 experts from the Western Hemisphere and included leading geologists from most of the Latin American countries. The meeting provided an opportunity to assess the quality of the scientists involved and the state of development of their science.

Most of the valuable elements of the earth's crust are present with an average abundance of some parts per million or less. But during billions of years the earth has acted as a great chemical laboratory. Each major process such as creation of magma, spreading of tectonic plates, mountain building, weathering, erosion, and sedimentation has been accompanied by chemical separations leading to concentration factors of as much as 1000 or more over the earth's average abundance. Because of the complexity of events, a good understanding of how ore deposits formed has been long in coming. Most ore has been discovered by noting surface indications of the presence of an ore body.

During the symposium two themes were repeatedly mentioned. One was the correlation of type of ore deposit with geological province and the second was the role of geological events. These are not novel ideas but they are proving to be very useful guides in finding and interpreting occurrences of specific kinds of ores. Six metallogenetic provinces in Mexico are recognized that represent different intervals in time and space. For example, in Baja California the rocks are granitic; their age is 93 million years. To the north they have ores containing tungsten, iron, lead, and copper. In the southern half of the peninsula most ore deposits contain gold, silver, and arsenic. An east-west belt of neovolcanic rocks that lie just north of Mexico City has ore deposits that contain lead, zinc, silver, gold, and mercury.

South America has many provinces and major mineral resources. Perhaps the most striking feature is the mineralization associated with the Andes. These mountains were emplaced in a series of events that took place over about 180 million years. Within the Andes different provinces have different ages and different mineral assemblages. In Chile copper is important, while in Bolivia tin is unusually abundant and much silver has been found in Peru. Although most of the vast area of Brazil is comparatively unexplored, great reserves of ores have been discovered by Brazilian and North American geologists in rocks that range in age from earliest Precambrian to Recent. Again, there are striking correlations of composition with age and geological province. Similar comments are applicable to occurrences in Venezuela, Guyana, the Caribbean islands, and Central America.

Attendance at the symposium led to the following observations. (i) Latin American geologists are competent and they are likely to find additional reserves of minerals. (ii) Economic geology is rapidly becoming a science rather than an art. (iii) Through use of tools such as remote sensing, isotope measurements, radiometric dating, and geochemistry, hidden ore bodies of great importance are likely to be discovered. Although the United States may have problems in paying for imports, the prognosis is good that most elements will be adequately available for decades to come.

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