Chapter 1

World Phosphate Reserves and Resources

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I. INTRODUCTION

A. Phosphorus in the Lithosphere

Phosphorus (P) makes up about 0.12% of the earth's crust. It is present in all soils and rocks, in water, and in plant and animal remains; and it forms complex compounds with a wide variety of elements—about 150 minerals are known that contain at least 0.44% P (1% P₂O₅). The world's supply of P comes from mineral deposits, a nonrenewable natural resource. The phosphate of almost all minable deposits is one of the minerals of the apatite group—Ca₉(PO₄,CO₃)₃(PO₄,OH)₂₋₃. A very small percentage, however, is mined from secondary Al phosphate deposits, in which the phosphate mineral was derived from apatite by weathering.

Most phosphate deposits contain silica in the form of quartz; other common diluting materials include calcite, dolomite, Fe-oxide minerals, and clay minerals. Some deposits contain diluting materials such as zeolites derived from the alteration of volcanic ash, glauconite, cristobalite, pyrite, and so on. Apatite must be separated from the gangue minerals, and methods of beneficiation have to be tailored to the suite of minerals in the phosphate rock. It is essential to determine the mineralogy as a first step in evaluating the economics of a deposit (see Chapt. 3 and 4).

Mining methods used to extract the rock will depend on the physical character of the rock and its geologic setting. If the rock is unconsolidated and flat-lying, open-pit mining methods can be used, whereas if the rock is consolidated and steeply dipping, some method of underground mining will have to be used.

The separated apatite mineral will, in all probability, be used to manufacture fertilizer. In this case the mineral species is most important. A carbonate fluorapatite, for example, is much easier to process than is a fluorapatite. The impurities in the apatite grain or phosphate pellet are important in determining the type and method used in manufacturing the fertilizer.