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Principles of Sedimentology and Stratigraphy

Sam Boggs Jr.

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Sedimentology and Stratigraphy
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Further Readings

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Other Chemical/Biochemical and Carbonaceous Sedimentary Rocks

Other Chemical/Biochemical and Carbonaceous Sedimentary Rocks

1 INTRODUCTION

In addition to carbonate rocks, the chemical/biochemical sedimentary rocks include a diverse group of rocks of which some (evaporites and iron-rich sedimentary rocks) form mainly by chemical processes and others (cherts and phosphorites) form largely through biogenic processes. Although volumetrically less significant than carbonate rocks, these sedimentary rocks are extremely important both as economic resources and as indicators of specialized paleoenvironments. Evaporite deposits such as gypsum, halite (rock salt), and trona (sodium carbonate) are mined for industrial and agricultural purposes. The iron-rich sedimentary rocks are iron ores that have enormous worldwide economic significance as a source for most of our iron. Sedimentary phosphorites are the major source of commercial phosphates used for fertilizers and chemical purposes. Even the siliceous sedimentary rocks may have some economic value in the semiconductor industry.

Aside from their economic value, these chemical/biochemical rocks are extremely interesting because they indicate past environmental conditions that appear to be uncommon on Earth today—or perhaps we simply do not recognize the modern counterparts of these ancient environments. For example, we know of no place on Earth where massive sedimentary iron deposits, of the type common in late Precambrian rocks, are forming today. Nor do we fully understand the mechanism of iron deposition or the source of the enormous amount of iron present in iron-rich sedimentary rocks. Likewise, the mechanisms by which low levels of phosphorus in ocean water become concentrated a millionfold to form phosphorite deposits is only partially understood. In this chapter, we look at the characteristics of these enigmatic sedimentary rocks and discuss some of the more interesting aspects of their origin.

We also briefly examine the characteristics and origins of the carbonaceous sedimentary rocks—rocks that contain significant amounts (>~10 percent) of organic carbon. Together with petroleum and natural gas, these organic-rich rocks, which include coals and oil shales, are the source of our fossil fuels. Fossil fuels currently supply most of the world's energy needs; therefore, commercial interest in exploiting carbonaceous sedimentary rocks is understandably high. Geologists are further interested in the origin of these rocks, particularly the processes and conditions that allow preservation of such high levels of organic matter. The average organic content of other sedimentary rocks is only about 1.5 percent.

2 EVAPORITES

The term **evaporites** is used for all deposits, such as salt deposits, that are composed of minerals that originally precipitated from saline solutions concentrated by solar evaporation. Because of their generally high solubility and their susceptibility to deformation, many of these evaporates have subsequently been diagenetically or secondarily altered in various ways during burial. Thus, there are few completely "primary" evaporite beds older than about the 25 million years (Warren, 1999, 1). Evaporites occur in rocks of most ages, including the Precambrian, but they are particularly common in Cambrian, Permian, Jurassic, and Miocene successions (Ronov et al., 1980). Although the total volume of evaporites in the geologic record is much less than that of carbonate rocks, some individual evaporite deposits, such as the Miocene Messinian of the Mediterranean region, reach thicknesses exceeding 1 km. Evaporites form under both marine and nonmarine conditions; however, marine evaporites tend to be thicker and more laterally extensive than nonmarine evaporites and are of greater geologic interest.

Evaporite deposits are composed dominantly of various proportions of halite (rock salt), anhydrite, and gypsum. Although approximately 80 minerals have been reported from evaporite deposits (Stewart, 1963; Warren, 1999), only about a dozen of these minerals are common enough to be considered important evaporite rock formers. Evaporite minerals are commonly classified into those of marine origin and those of nonmarine origin, although Hardie (1991) suggests that identifying the marine or nonmarine origin of evaporites on the basis of their mineralogy and chemistry may not be entirely justified.