Most of us learned at a very early stage in our geologic education that there are three major types of rocks: igneous, sedimentary, and metamorphic. There is another group of rocks, however, that is important to mineral collectors, mineralogists, and economic geologists and that does not fit well into the defining characteristics of these three categories. This type of rock forms by the precipitation of minerals from water at elevated temperature (fig. 1). Such mineral deposits (or rocks) are known as hydrothermal (meaning “hot water”; usually between 50° and 700°C) and can be considered a fourth major rock type.4

As one can imagine, there are many different geological processes by which, and environments in which, hot waters can be generated; thus, there are many types of hydrothermal mineral deposits. These are usually differentiated by the origin and characteristics of the water involved in their formation. However, several other important characteristics define hydrothermal mineral deposits, including (1) the source of dissolved solutes, which ultimately precipitate and form minerals; (2) the heat source for increased water temperature; (3) the cause and mechanisms of fluid migration; and (4) the cause of mineral precipitation.

Four or five distinct types of water are involved in hydrothermal deposits, including magmatic water, evolved from magmas; metamorphic water, produced by dehydration reactions during heating of hydrous minerals such as clays; connate water, trapped within sediment pores during deposition and burial that has extensively reacted with surrounding sedimentary minerals; and meteoric water, recently involved in atmospheric circulation, including rain, river, and lake and ground waters (fig. 2). Some scientists lump ocean water with meteoric, whereas others regard it as a separate type of water in hydrothermal systems. Traditionally, hydrothermal deposits have been classified based on the water type involved. However, modern studies have shown that the mixing of multiple water sources is common.

Hydrothermal deposits are always hosted by or emplaced in other rock types. In general, there are two styles of emplacement. In one, precipitation of the hydrothermal minerals occurs in a restricted space, such as in fractures, fracture zones, solution cavities, or pockets. Thus, it is easy to see how rocks from the resulting deposit can be physically separated from the country rock or host rock. In the second case, the hydrothermal precipitates may be disseminated throughout the host rock by crystallizing within fine pore spaces or along grain boundaries in the host rock. Thus, it may not be possible to physically separate a distinct hydrothermal rock; instead, the end result is a modified or altered host rock.

Transport of hydrothermal solutions through rocks takes place along pathways of highest permeability. These pathways can sometimes be large free spaces into which minerals can grow unrestricted by their surroundings. This is one of the prerequisites to the formation of crystals with well-developed faces and high degrees of morphologic perfection. Thus,

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4The Eagle’s Nest mine in Placer County, California, is an example of a gold deposit that is hydrothermal in origin. For photos of specimens from this mine, see the article titled “From Whence Your Gold,” by Robert B. Cook, and the “Let’s Get It Right” column by John White, in this issue.
hydrothermal deposits are frequently sources of mineral specimens desirable to collectors and to mineralogists interested in morphology and crystal growth processes.

Because of the economic significance of hydrothermal deposits (one of the most important classes of ore deposits is hydrothermal deposits), there is considerable literature on all aspects of these systems. Two very good textbooks that are recommended for further reading on the subject are Barnes (1997) and Misra (1999). Also, a good discussion of the role of water in mineral specimen formation can be found in Robinson and Scovil (1994).

REFERENCES