Placer

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Historic postcard, titled "Gold Mining in California," showing various methods of gold recovery from placer deposits, including dredging, hydraulic mining, and panning. Postcard courtesy Arthur E. Smith.

As noted in previous discussions of hypogene, supergene, and hydrothermal deposits, water plays an intimate role in the formation of many types of minerals and mineral deposits in Earth's crust. The involvement of water in some mineral deposits, however, is solely as an agent of transport and segregation of minerals that have been weathered out of the rock in which they originally formed. An important example of this is the placer deposit.

Flowing water has the ability to separate transported particles based on their weight. The maximum particle weight that a current can transport depends on its velocity; thus, as current velocities increase so does the maximum particle weight. For example, a rapidly flowing river, swollen by a recent rainstorm, can transport much heavier objects than it can during normal, slower, flow conditions. As the stream flow returns to normal, the current velocity falls, and heavier objects are deposited because there is no longer enough energy in the current to move them. Lighter objects, which can still be moved by the water flow, are carried away—thus, transported objects are separated by their weight. This process is known as *sorting*.

Silicate minerals constitute most alluvial sediment on Earth. Because the weight of an object is equal to its density times its volume (or size) and because the densities of most common silicates are approximately the same, the process of sorting leads to segregation of most sediments by size. In contrast, when a much denser mineral—such as gold—is deposited by a stream, it is found as smaller grains associated with larger, less-dense silicate mineral grains as a result of sorting. A concentration of desirable minerals in a localized sedimentary deposit, which most often forms as a result of sorting, is known as a *placer* or *placer deposit*.

Minerals that are amenable to placer formation must, in general, be chemically and physically stable in the wet and highly abrasive environments found in streams and other settings with flowing water, such as beaches. Thus, properties such as malleability, a high degree of hardness, poor cleavage, and chemical inertness are favorable. Examples of minerals that are concentrated in and mined from placer deposits include native metals, such as gold and platinum; gem minerals, such as diamond and sapphire; and ore minerals, such as cassiterite (an ore of tin) and ilmenite (an ore of titanium). For all of these minerals, placer deposits are globally significant. For example, about 80 percent of the world's tin deposits occur as unconsolidated placer deposits in riverbeds and on the seafloor. The largest concentration is in the widespread tin belt of Southeast Asia, which stretches from China in the north, through the Malay Peninsula (in Thailand, Burma, and Malaysia), to the islands of Indonesia in the south. Furthermore, it is estimated that placer and paleoplacer deposits have been the source of more than two-thirds of all the gold ever mined.

Geologists commonly reserve the term *placer* for unconsolidated sediment—materials that have not been lithified. If a placer has undergone the necessary processes to turn into a sedimentary rock, it is known as a *paleoplacer*, or fossil plac-

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er. An exception to the discussion above is an *eluvial placer*, also a concentration of desirable minerals in a localized sedimentary deposit. However, rather than being concentrated by hydraulic sorting, the minerals were concentrated in the preexisting rock (*protolith*) and were weathered out of that rock but were not transported away from the weathered remains of their source rock.

In this and the previous issue of *Rocks & Minerals*, numerous articles on gold and gold deposits have been published in conjunction with the golden anniversary of the Tucson Gem and Mineral Show. Several of these, including articles by Mark Mauthner (this issue) and Michael Leibov (next issue), discuss gold placers. For further information on the physics of sorting and sedimentary deposits, a standard sedimentology text such as Boggs (2001) is a good source. Reviews of regional placer deposits are abundant, and Macdonald (1983) is a good review of many aspects of placer deposits and their development.

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