

Classification, Genesis, and Exploration Guides for Nonsulfide Zinc Deposits

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Abstract

Nonsulfide zinc deposits, popularly but incorrectly termed “zinc oxide” deposits, are becoming attractive exploration targets owing to new developments in hydrometallurgy. They are divided into two major geologic types—supergene and hypogene deposits. Supergene deposits are the most common type of nonsulfide zinc deposit and are distributed worldwide. The vast majority occur in carbonate host rocks owing to the high reactivity of carbonate minerals with the acidic, oxidized, zinc-rich fluids derived from the oxidative destruction of sphalerite-bearing sulfide bodies. Formation of these deposits depends upon the size and mineralogy of the preexisting zinc occurrence, vertical displacement of the water table, rate of water table descent through tectonic uplift and/or arid climatic conditions, wall-rock fracture density, and a suitable neutralizing trap site. Weathering of Mississippi Valley-type and high-temperature carbonate replacement-type zinc deposits may generate significant supergene nonsulfide zinc deposits, but the weathering of pyrite-rich, sedimentary exhalative, and volcanogenic massive sulfide deposits is much less likely to form economic supergene zinc deposits. Three subtypes of supergene nonsulfide zinc deposits are recognized—direct replacement, wall-rock replacement, and residual and karst-fill deposits. Hypogene nonsulfide zinc deposits are more poorly known owing to the paucity of examples; however, two major subtypes are recognized: structurally controlled, replacement bodies and manganese-rich, exhalative(?) stratiform bodies. The structurally controlled bodies contain willemite and variable amounts of sphalerite, are hematitic, and are generally associated with hydrothermal dolomitization. Stratiform, manganese-rich, nonsulfide zinc deposits appear to be end members of a spectrum of deposits that include base metal-poor stratiform manganese deposits and sulfide-dominant Broken Hill-type deposits. Hypogene nonsulfide zinc deposits appear to have formed owing to the mixing of a reduced, low- to moderate-temperature (80°–200°C), zinc-rich, sulfur-poor fluid with an oxidized, sulfur-poor fluid.

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