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Genesis of the Doğankuzu and Mortaş Bauxite Deposits, Taurides, Turkey: Separation of Al, Fe, and Mn and Implications for Passive Margin Metallogeny

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Abstract

The Taurides region of Turkey is host to a number of important bauxite, Al-rich laterite, and Mn deposits. The most important bauxite deposits, Doğankuzu and Mortaş, are karst-related, unconformity-type deposits in Upper Cretaceous limestone. The bottom contact of the bauxite ore is undulatory, and bauxite fills depressions and sinkholes in the footwall limestone, whereas its top surface is concordant with the hanging-wall limestone. The thickness of the bauxite varies from 1 to 40 m and consists of böhmite, hematite, pyrite, marcasite, anatase, diaspore, gypsum, kaolinite, and smectite. The strata-bound, sulfide- and sulfate-bearing, low-grade lower part of the bauxite ore bed contains pyrite pseudomorphs after hematite and is deep red in outcrop owing to supergene oxidation. The lower part of the bauxite body contains local intercalations of calcareous conglomerate that formed in fault-controlled depressions and sinkholes. Bauxite ore is overlain by fine-grained Fe sulfide-bearing and calcareous claystone and argillaceous limestone, which are in turn overlain by massive, compact limestone of Santonian age. That 50-m-thick limestone is in turn overlain by well-bedded bioclastic limestone of Campanian or Maastrichtian age, rich with rudist fossils. Fracture fillings in the bauxite orebody are up to 1 m thick and consist of bluish-gray-green pyrite and marcasite (20%) with böhmite, diaspore, and anatase. These sulfide veins crosscut and offset the strata-bound sulfide zones. Sulfur for the sulfides was derived from the bacterial reduction of seawater sulfate, and Fe was derived from alteration of oxides in the bauxite. Iron sulfides do not occur within either the immediately underlying or overlying limestone.

The platform limestone and shale that host the bauxite deposits formed at a passive margin of the Tethys Ocean. Extensive vegetation developed on land as the result of a humid climate, thereby creating thick and acidic soils and enhancing the transport of large amounts of organic matter to the ocean. Alteration of the organic matter provided CO_2 that contributed to formation of a relatively ^{12}C-rich marine footwall limestone. Relative sea-level fall resulted from strike-slip faulting associated with closure of the ocean and local uplift of the passive margin. That uplift resulted in karstification and bauxite formation in topographic lows, as represented by the Doğankuzu and Mortaş deposits. During stage 1 of bauxite formation, Al, Fe, Mn, and Ti were mobilized from deeply weathered aluminosilicate parent rock under acidic conditions and accumulated as hydroxides at the limestone surface owing to an increase in pH. During stage 2, Al, Fe, and Ti oxides and clays from the incipient bauxite (bauxitic soil) were transported as detrital phases and accumulated in the fault-controlled depressions and sinkholes. During stage 3, the bauxitic material was concentrated by repeated desilicification, which resulted in the transport of Si and Mn to the ocean through a well-developed karst drainage system. The transported Mn was deposited in offshore muds as Mn carbonates. The sulfides also formed in stage 3 during early diagenesis. Transgression into the foreland basin resulted from shortening of the ocean basin and nappe emplacement during the latest Cretaceous. During that time bioclastic limestone was deposited on the nappe ramp, which overlapped bauxite accumulation.