

Geology and metallogeny of the Giant Huoshaoyun zinc-lead deposit, Karakorum Range, northwestern Tibet

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The Huoshaoyun zinc-lead deposit is a newly discovered giant deposit in the Karakorum Range, northwestern Tibet, China. The deposit consists of zinc-lead carbonate and lead-zinc sulfide orebodies. It is a zinc-lead carbonate-dominated deposit and contains 62 million tonnes of zinc-lead carbonate ore at 20.85% Zn and 4.98% Pb, and 3 million tonnes of lead-zinc sulfide ore at 23.75% Pb and 2.68% Zn. The zinc-lead carbonate mineralization is composed of smithsonite and cerussite with laminated, massive, and vein-type ore textures. Lead-zinc sulfide mineralization is mainly composed of galena and sphalerite with laminated, breccia-hosted and vein-type ore textures. The laminated sulfide orebody occurs at the top of the deposit, whereas the zinc-lead carbonate orebodies are located below the laminated sulfide orebody. Lead-zinc sulfide veins cut the laminated zinc-lead carbonate ores and limestone. The carbonate ores contain typical sedimentary structures and textures, including rhythmic layering, as well as oolitic and rhombic textures. The sulfide ores also have sedimentary structures and textures, such as graded banding structure. Calcite crystals of wallrock limestone have isotopic compositions of $d^{18}\text{O}$ ranging from 23.92 to 24.57‰ and $d^{13}\text{C}$ ranging from 1.89 to 2.73‰. Smithsonite crystals within the deposit have isotopic compositions of $d^{18}\text{O}$ ranging from 20.37 to 23.52‰ and $d^{13}\text{C}$ ranging from 0.78 to 4.11‰. Cerussite crystals of the deposit have a $d^{18}\text{O}$ isotopic signature of 8.90 to 16.46‰ and $d^{13}\text{C}$ of -7.28 to 1.19‰. These carbon and oxygen-isotopic signatures suggest various compositions with supergene zinc-lead carbonates. The sulfur-isotopic compositions of the lead-zinc sulfides range from -6.78 to +11.38‰, suggesting that the ore-forming fluids for the lead-zinc sulfides possibly originated from H_2S -bearing seawater and a SO_2 -bearing hydrothermal fluid. Two ore-forming events involved in the formation of the Huoshaoyun deposit, are an early zinc-lead carbonate stage and a late lead-zinc sulfide stage. The Huoshaoyun deposit is a carbonate-hosted zinc-lead carbonate-dominated deposit with sedimentary features, and the zinc-lead carbonate ores are primary and not supergene non-sulfide mineralization.