The Carboniferous Shikebutai Iron Deposit in Western Tianshan, NW China: Petrology, Fe–O–C–Si Isotopes and Implications for Iron Pathways

Xiuqing Yang
Chang'an Univeristy, Xi'an, China

Submarine volcanic-hosted iron deposits are important sources of iron ore in NW China. Here we present the petrological characteristics and coupled Fe–O, C and Si isotope data on iron ores from the Shikebutai submarine volcanic-hosted hematite deposit in Western Tianshan region. Several stratiform and lenticular hematite-dominated orebodies occur in Carboniferous submarine volcano-sedimentary sequences in this region. The ores are mainly composed of hematite, quartz, and minor siderite with distinct alternating iron-rich and silica-rich bands. The hematite shows $\delta^{56}Fe$ and $\delta^{18}O$ values in the range of -0.31‰ to +0.80‰ and +2.2‰ to +7.0‰, respectively, and the jasper yields $\delta^{30}Si$ values of -1.90‰ to -1.20‰. Iron and Si were both derived from hydrothermal fluids related to submarine magmatism/volcanism. The Fe-bearing minerals in the Shikebutai deposit define distinct formation pathways. Hematite is the primary dehydrated Fe(III)-oxyhydroxide, and the Fe isotope data indicate fractionation resulting from the partial oxidation of Fe(II). The O isotope data reflect inheritance from the submarine hydrothermal fluids source. Jasper was produced during co-precipitation of silica adsorbed onto the Fe(III)-oxyhydroxides. The siderite-rich iron ore/volcaniclastic rock samples with a high and variable total organic carbon content (0.14%–5.57%), show negative $\delta^{13}C$ values (-3.0‰ to -1.1‰) and light $\delta^{56}Fe$ values (-1.11‰ to -0.84‰). Our isotope data, together with the common occurrence of hematite inclusions in siderite suggest that siderite was mainly produced by microbial dissimilatory iron reduction (DIR) during diagenesis. The geological, petrological, and isotopic data suggest that the Carboniferous Shikebutai deposit was precipitated through chemical and biogenic processes.