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Hematite Orebodies Formed by Multiple Geological Events: A Case Study from the Akatani Deposit, Niigata Prefecture, Japan

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The Akatani hematite deposit in northern Japan is associated with Cretaceous skarn and Miocene hydrothermal mineralization and has a complex history of mineralization, showing the occurrences of diverse hydrothermal minerals such as iron-oxide, skarn, dolostone, and hydrothermal altered minerals like chlorite and kaolinite. We conducted petrographic descriptions and trace element analysis of hematite to identify the formation process of the deposit. The host rock of the Akatani deposit consists of Early Jurassic limestone and mudstone covered or intruded by Late Cretaceous granites (LCG, ilmenite-series) and Middle Miocene rhyolitic rocks (MMR). The hematite orebodies associated with LCG are characterized by the presence of skarn minerals such as andradite and clinopyroxene. The hematite in the distal skarn coexists with andradite and formed by replacing clinopyroxene. Most hematite in the skarn is altered to magnetite. In contrast, hematite orebodies present between MMR and dolostone and in Fe chlorite zones between MMR and skarn are characterized by the presence of siderite and/or kaolinite together with chalcopyrite, pyrite, barite, and/or fluorapatite. The hematite associated with LCG is rich in granitophile elements such as Sn and Mo, poor in REEs (~13 ppm), and shows no correlation between Mn+Zn and Mg, whereas that associated with MMR is poor in granitophile elements, rich in REEs (~40 ppm), and shows a strong positive correlation between Mn+Zn and Mg. Based on these observations, we conclude that the Akatani hematite orebodies formed by multiple mineralization processes form Cretaceous to Miocene.