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Tetrataenite in terrestrial rock

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Abstract

Tetrataenite is an equiatomic and highly ordered, non-cubic Fe-Ni alloy mineral that forms in meteorites from the distortion of fcc taenite due to extremely slow cooling. The mineral has drawn much attention of the scientific community because of its superb magnetic properties, which may make the phase an alternative to the REE-based permanent magnets. Barring only a few passing mentions, the mineral has never been described from any terrestrial rock. Here we report the characteristics of terrestrial tetrataenite from an ophiolite-hosted Ni-bearing magnetite body from the Indo-Myanmar ranges, northeast India. Although the mineral assemblage surrounding it is very similar to that found in the meteorites, the postulated cooling regimes cannot be similar. The mineral is formed as a consequence of hydrothermal alteration of ferromagnesian minerals of the olivine and pyroxene groups. Iron and nickel were released from the silicates and precipitated in the form of Fe-Ni alloy at low temperature in extremely reducing conditions with a lack of sulfur. Our findings suggest a low-temperature hydrothermal origin of tetrataenite warrants a re-examination of the Fe-Ni phase diagram at low temperatures and puts a question mark on the age-old concept of tetrataenite formation as due solely to extremely slow cooling of fcc taenite in meteorites. It also opens up a new vista for adoption of a hydrothermal route to synthesize this rare material.

Keywords: Tetrataenite, Fe-Ni alloy, hydrothermal, terrestrial, Ni-bearing magnetite