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DISCOVERY OF NEW MEMBERS OF ATACAMAITE FAMILY: IYOITE AND MISAKIITE

Two new minerals of the atacamite family, named "iyoite" and "misakiite", were found and recently described by myself and 8 colleagues (Nishio-Hamane et al. 2017). These two new minerals were simultaneously found from a boulder on the beach near the Oku mine, Ikata, Sadamisaki Peninsula, Ehime Prefecture (Shikoku, Japan). Historically, Ehime Prefecture and the Sadamisaki Peninsula have been colloquially referred to "Iyo" and "Misaki," respectively; the Sadamisaki Peninsula faces the sea of Iyo Nada and the sea of Misaki Nada. Hence, the new minerals, which are botallackite-type $MnCuCl(OH)_3$ and kapellasite-type $Cu_3Mn(OH)_6Cl_2$, have respectively been named iyoite and misakiite. The minerals and their names have been approved by the International Mineralogical Association's Commission on New Minerals, Nomenclature and Classification (#2013-130 for iyoite; #2013-131 for misakiite).

Iyoite is pale green in color and forms radial and dendritic aggregates consisting of blade-like crystals (Fig. 1). These blades are typically 100–200 µm in length. Dendritic iyoite aggregates are often accompanied by misakiite at the front edge of the aggregate (Fig. 2). Iyoite [$MnCuCl(OH)_3$] is isostructural with botallackite [$Cu_2Cl(OH)_3$], with manganese and copper being ordered in the structure. Iyoite is the first case that ordering of another metal has been shown to occur in the botallackite structure.

Misakiite is emerald green in color and occurs as hexagonal plates 20–50 µm in diameter (Fig. 3). Misakiite also occurs as blade-like crystals elongated parallel to *a*-axis and, in this morphology, is often found at the end of an iyoite dendrite (Fig. 2). Misakiite [$Cu_3Mn(OH)_6Cl_2$] can be considered as a Mn analogue of kapellasite [$Cu_3Zn(OH)_6Cl_2$]. In the misakiite structure, Mn- and Cu-centered octahedra form triangular and kagome lattices, respectively.

Figure 1 Blade-like crystals of iyoite occurring as pale-green radial aggregates.

Figure 2 Dendritic aggregate of iyoite plus hexagonal and blade-like crystals of misakiite.

Figure 3 Emerald-green hexagonal crystals of misakiite.

Iyoite and misakiite have closely related structures and occur in close association with one another (Fig .2). The formation of both new minerals should be very simple: the reaction of seawater with naturally occurring manganese ore that itself contains native copper. However, these minerals have proved to be a challenge to produce synthetically. Misakiite has been synthesized using a hydrothermal method, but iyoite has yet not been synthesized. Iyoite and misakiite are new minerals that make you feel the complexity of nature.

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REFERENCE

Nishio-Hamane D and 8 coauthors (2017) Iyoite, $MnCuCl(OH)_3$, and misakiite, $Cu_3Mn(OH)_6Cl_2$: new members of the atacamite family from Sadamisaki Peninsula, Ehime Prefecture, Japan. Mineralogical Magazine 81: 485-498

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