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Kamphaugite-(Y) from Ashland, MA

Etienne Médard, Peter Cristofono, William A Henderson Jr

The Aggregates Industries Quarry in Ashland (Middlesex Co., Massachusetts), formerly known as the Bayer and Mingola Quarry, then the Trimount quarry, has been producing a fair amount of nice micro- to cabinet-size mineral specimens since its opening in 1948. The quarry is opened in amphibolites and gneisses crosscut by younger dikes of two-micas leucogranite. Mineralization occurs in seams or veins related to hydrothermal alteration akin to the well known European "alpine clefts". At Ashland, Jim Cahoon reported actinolite, albite, aurichalcite, biotite, bornite, calcite, chabazite, chlorite, chrysocolla, clinozoisite, epidote, fluorapatite, hematite, heulandite, hornblende, ilmenite, laumontite, magnetite, malachite, montmorillonite, muscovite, natrolite, opal, orthoclase, pickeringite, prehnite, pyrite, pyrolusite, augite, pyrrhotite, quartz, stilbite, titanite and tremolite. Babingtonite and sphalerite have also been found there.

Fig. 1. Tan-colored spherulitic aggregates of kamphaugite-(Y) from Ashland. P. Cristofono collection and photo.

Tan-colored spherules up to 1.0 mm in diameter were spotted by an unknown collector during a Boston Mineral Club fieldtrip in October 2006, and collected by Lynn Bannon and one of us (PC). The spherules were sprinkled over flat surfaces corresponding to fracture planes, and were associated with white laumontite crystals, tiny colorless stilbite crystals and white calcite masses (Fig. 1, 2). The host rock is a two-micas leucogranite. Broken spheres show a layered structure, with usually a central, compact, colorless core, then a darker beige to orange-colored band, and an external shell of radiating crystals, visible at high magnification (Fig. 3). The external shell is lightly tan-colored; in some of the smaller spherules the color even turns light cream to white.

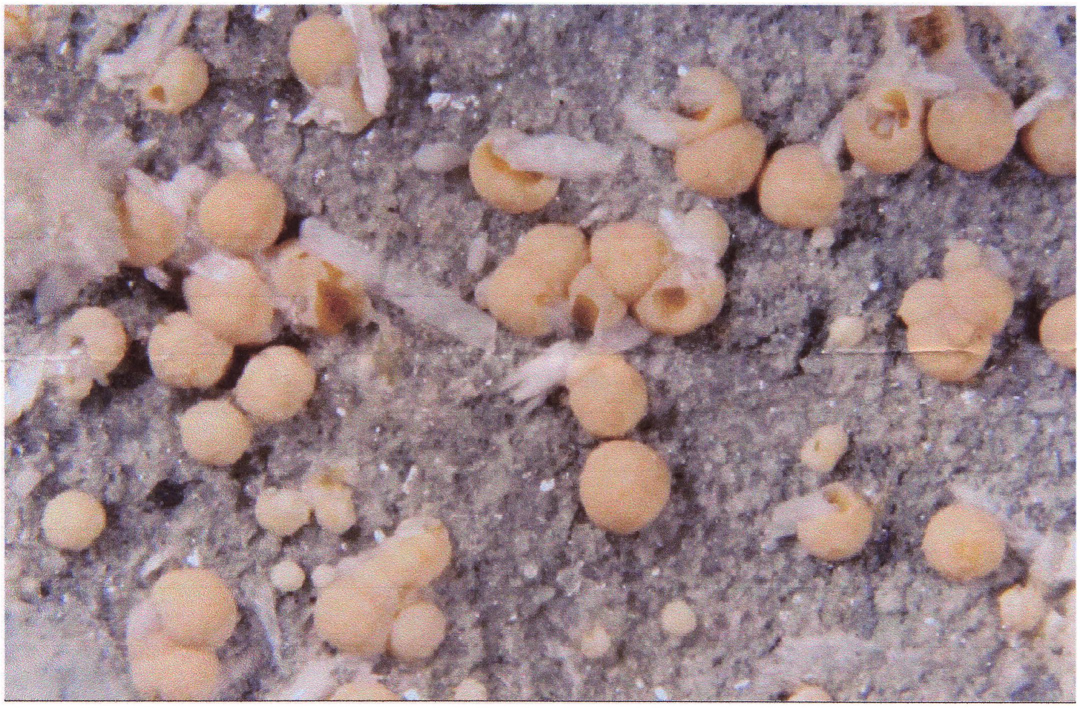

Fig. 2. (above) Close view of tan-colored kamphaugite-(Y) spheres associated with white laumontite and colorless stilbite. P. & E. Médard collection, photo by E. Médard.

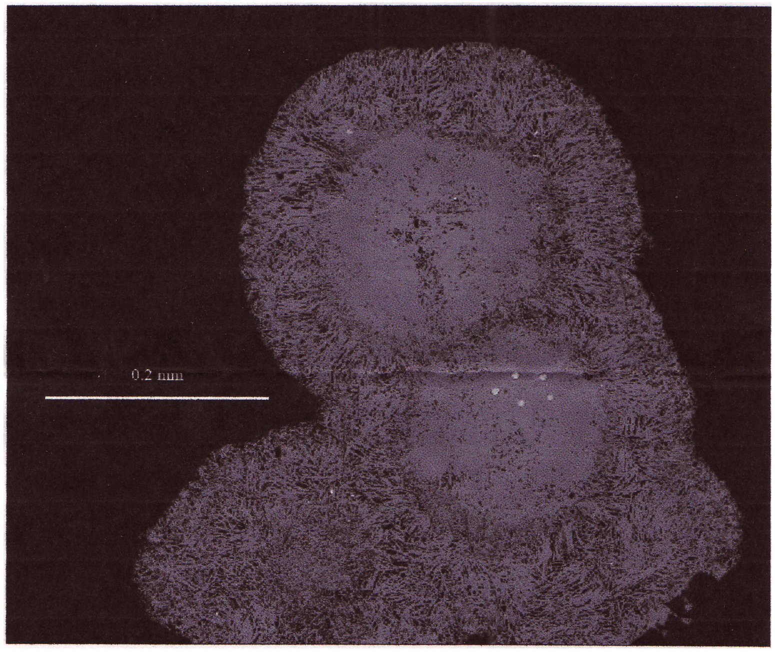

Fig. 3. (left) Back-scattered electron SEM image of an equatorial section of kamphaugite-(Y) aggregates.

The mineral reacts strongly with effervescence to cold diluted HCl, suggesting it belongs to the carbonate class. The EDS spectrum indicates large amounts of Ca and Y, with minor quantities of Rare Earth Elements (Fig. 4). No other heavy element is present in significant quantity; however, the EDS technique cannot detect elements lighter than fluorine, which include H, Li, Be, B, C, and O. Strong decomposition of the mineral under the electron beam further suggests the presence of –OH and/or H_2O groups. The unknown mineral is thus a hydrated carbonate of Y and Ca, with minor REE. There are only three such minerals reported in the literature: kamphaugite-(Y), kimuraite-(Y), and lokkaite-(Y). The habit and mineral association strongly suggest kamphaugite-(Y). Optical properties of the mineral were determined on broken out sheaves of crystals. For light vibrating tangentially to the hemispheres, the index of refraction was between 1.623 and 1.648; for light vibrating radially, the index was between 1.648 and 1.664. Reported indices for kamphaugite-(Y) in the original publication (Raade and Brastad 1993) are $\alpha = 1.627$, $\beta = \gamma = 1.663$, consistent with our measurements. Taken together, all these observations strongly suggest that the unknown is kamphaugite-(Y), although only an XRD pattern would give a definitive identification.

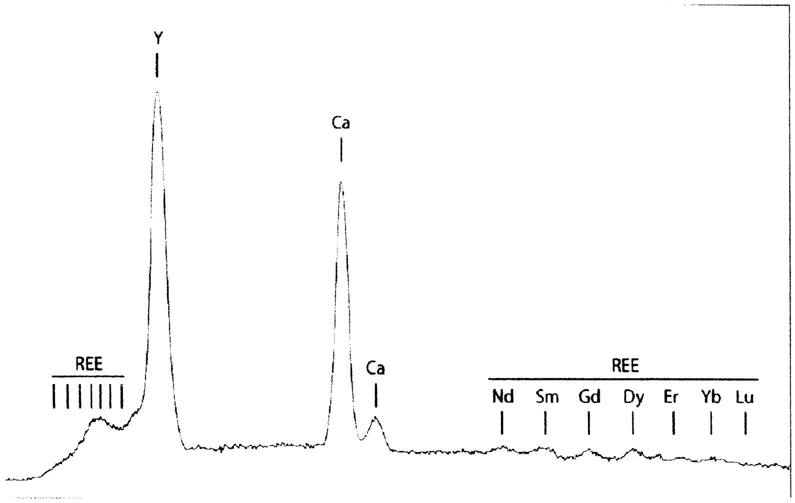

Fig. 4. EDS spectrum of the kamphaugite-(Y) from Ashland.

Kamphaugite-(Y) - $Ca(Y,REE)(CO_3)_2(OH).H_2O$ - was formally described in 1993 by Raade and Brastad from Norwegian material. This rare Y mineral has been reported in at least eleven occurrences so far: the Høydalen granitic pegmatite, the Hørtekolen skarn deposit and the Tangen pegmatite quarry, all three in Norway, a metasomatically altered alkali granite in Kazakhstan, a locality in Transvaal (South Africa), the Evans-Lou pegmatite in Québec (Canada), the Calla Francese Quarry on La Maddalena Island (Italy), the Rössling uranium Mine (Namibia), the Paratoo copper deposit (Australia), the Szarvaskö granite (Hungary), and the La Cabrera granitic pluton (Spain). We initially thought that the Aggregate Industries Quarry was the first reported occurrence in the United States. However, we later found on the web a reference to kamphaugite-(Y) and kainosite-(Y) from the Gronci-Ellis granite quarry, Mount-Desert Island, Hancock Co., Maine. Kamphaugite-(Y) might actually be much more frequent since those tiny spheres can be easily overlooked. Without the insistence of Lynn Bannon, our samples might indeed have ended up in the "crappy unknowns not worth caring for" category.

Kamphaugite-(Y) forms as a late-stage mineral, as a result of low-temperature hydrothermal alteration of other yttrium-bearing minerals in granitic rocks. The Ashland occurrence closely compares to the well-described occurrences at Calla Francese (Gamboni and Gamboni 1998, Gamboni 2003) and La Cabrera (Gonzales del Tánago et al. 2006). In all three occurrences it is closely associated with calcite, laumontite, and stilbite, minerals characteristic of low-temperature hydrothermal crystallization. Oxygen isotope studies on samples from La Cabrera (Gonzales del Tánago et al. 2006) suggest temperatures of formation lower than 50 °C. Hydrothermal activity is characterized by percolating downward groundwater which interacts with warm rock at depth and comes back as ascending hydrothermal solutions. Water leaches mobile elements like yttrium from the host rocks, and reprecipitates them in the seams and cavities. The primary source of yttrium could be gadolinite, zircon, garnet, xenotime, or monazite... At La Cabrera and Cala Francese, other secondary yttrium minerals have also been found, including agardite-(Y), bastnäsite-(Y), hellandite-(Y), kainosite-(Y), tveitite-(Y), and thalenite-(Y).

We invite you to look closely at your Ashland material and at samples from other "alpine-cleft" localities. Secondary yttrium minerals may not be as rare as previously thought...

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