

## KAMPHAUGITE-(Y), A RARE HYDROUS Ca-Y-CARBONATE MINERAL FROM SZARVASKŐ, BÜKK MOUNTAINS, HUNGARY

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### Known localities of kamphaugite-(Y)

Kamphaugite-(Y) – ideally  $\text{Ca}_2\text{Y}_2(\text{CO}_3)_4(\text{OH})_2 \cdot 3\text{H}_2\text{O}$  – was first described by RAADE & BRASTAD (1993) from Hørtækollen, Oslo region, Norway. The Hørtækollen deposit is a contact metamorphic skarn deposit, where kamphaugite-(Y) is a late-stage phase in cavities of the rock. There are two other occurrences of the mineral in Norway: a) Høydalen granite pegmatite, Tørdal (RAADE *et al.*, 1993); b) Tangen pegmatite quarry, Kragerø.

Outside Norway some additional localities of kamphaugite-(Y) are known: 1) A Ca-Y-carbonate mineral was recorded and identified as “tengerite” by STEPANOV (1961) from an undefined locality in Kazakhstan. 2) An unnamed Ca-Y-carbonate was discovered in a quartz-barite vein within the carbonatized Goudini volcano, Transvaal, South Africa (VERWOERD, 1963). 3) The next locality is in the Evans-Lou pegmatite, Quebec, Canada (HOGARTH, 1972), where it was designated as UN-21. According to RAADE & BRASTAD (1993) the Ca-Y-carbonate minerals from the three localities given above represent kamphaugite-(Y). Recently kamphaugite-(Y) was recorded by GAMBONI & GAMBONI (1998) from Cala Francese, La Maddalena Island, Italy. There are some other unpublished localities of kamphaugite-(Y) without any additional data, e. g. Paratoo copper mine, Yunta, Olary Province, South Australia; Mt. Ploshkaya, Keyvy, Kola Peninsula, Russia.

### Kamphaugite-(Y) from Szarvaskő

In Hungary kamphaugite-(Y) was found in the Tóberc quarry (formerly Forgalmi mine) at Szarvaskő, Bükk Mountains. It forms white globular aggregates up to 0.5 mm in diameter and white coatings on the walls of fissures of granite. Globular aggregates consist of 10–20  $\mu\text{m}$  sized thick tabular crystals on {001}.

Kamphaugite-(Y) is tetragonal with space group  $P4_12_1$  (RØMMING *et al.*, 1993). Observed reflections on the X-ray powder pattern of Szarvaskő specimen are [d in Å (int., hkl)]: 6.344 (s, 102), 5.438 (w, 004), 5.126 (w, 111), 4.405 (m, 104), 3.534 (m, 202), 3.295 (w, 211), 3.198 (w, 212), 2.906 (m, 107), 2.835 (m, 214), 2.742 (m, 008), 2.637 (s, 220), 2.449 (w, 216), 2.033 (mw, 322), 1.926 (w, 324) and 1.890 (ms, 228). The experimental pattern was obtained with a 114.6 mm Gandolfi camera using  $\text{CuK}_\alpha$  radiation. Unit cell data are  $a = 7.515 \text{ \AA}$ ,  $c = 21.898 \text{ \AA}$ ,  $V = 1236.5 \text{ \AA}^3$ .

Six chemical analyses were carried out with JEOL JXA-733 electron microprobe operated at 20 kV and 40 nA.  $\text{H}_2\text{O}$  and  $\text{CO}_2$  couldn't be directly determined because the amount of available material was very limited. A representative analytical result is the following (in weight per cent): CaO 20.07,  $\text{Y}_2\text{O}_3$  29.72,  $\text{La}_2\text{O}_3$  0.10,  $\text{Ce}_2\text{O}_3$  0.93,  $\text{Pr}_2\text{O}_3$  0.33,  $\text{Nd}_2\text{O}_3$  2.13,  $\text{Sm}_2\text{O}_3$  1.55,  $\text{Eu}_2\text{O}_3$  0.53,  $\text{Gd}_2\text{O}_3$  3.26,  $\text{Tb}_2\text{O}_3$

0.63,  $\text{Dy}_2\text{O}_3$  4.91,  $\text{Ho}_2\text{O}_3$  0.99,  $\text{Er}_2\text{O}_3$  2.74,  $\text{Tm}_2\text{O}_3$  0.50,  $\text{Yb}_2\text{O}_3$  1.65,  $\text{Lu}_2\text{O}_3$  0.43,  $\Sigma$  70.47, which corresponds to  $\text{Ca}_{1.94}(\text{Y}_{1.43}\text{Dy}_{0.14}\text{Gd}_{0.10}\text{Er}_{0.08}\text{Nd}_{0.07}\text{Sm}_{0.05}\text{Yb}_{0.05}\text{Ce}_{0.03}\text{Ho}_{0.03}\text{Eu}_{0.02}\text{Tb}_{0.02}\text{Pr}_{0.01}\text{Tm}_{0.01}\text{Lu}_{0.01})_{\Sigma=2.05}(\text{CO}_3)_{4.03}(\text{OH})_{1.97} \cdot x\text{H}_2\text{O}$ , where  $x = -1.94$ .  $\text{CO}_3$  and OH were calculated from charge balance and  $\text{H}_2\text{O}$  was calculated from the difference.

We can't determine the degree of hydration of the Szarvaskő kamphaugite-(Y) from the electron microprobe analyses, because ca. 10 wt%  $\text{CO}_2$  and  $\text{H}_2\text{O}$  eliminated from the sample when it decomposed under the electron beam. From the chemical analyses a formula with  $3\text{H}_2\text{O}$  per  $4\text{CO}_3$  has been proposed by RAADE & BRASTAD (1993), but only  $2\text{H}_2\text{O}$  is implied from the structural investigation (RØMMING *et al.*, 1993). The 004 and 008 reflections of the XRD powder diagrams may have strongly variable intensities probably depending on water content. For the kamphaugite-(Y) with a lower water content the 004 reflection is always clearly visible and 008 is strongly enhanced, whereas the 004 reflection may or may not be visible on X-ray films for water-rich kamphaugite-(Y) (RØMMING *et al.*, 1993). Because on the X-ray film of kamphaugite-(Y) from Szarvaskő the 004 reflection is visible and 008 is rather strong, this mineral contains probably less than  $3\text{H}_2\text{O}$  per formula unit.

In Szarvaskő kamphaugite-(Y) is a low temperature late stage mineral formed in the fissures of metagranite. There are not any other members of this low temperature paragenesis except for calcite, however, it is never associated with kamphaugite-(Y). The only primary REE-mineral of metagranite is an REE-bearing epidote group mineral (allanite?), which could be the source of yttrium in the hydrothermal system.

Investigated kamphaugite-(Y) sample from Szarvaskő is preserved in the mineral collection of Herman Ottó Museum (Miskolc, Hungary) under catalogue number 25257.

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