CRYSTALLOGRAPHY, RAMAN AND IR SPECTROSCOPY OF PERHAMITE – AN INTERESTING SILICO-PHOSPHATE

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Perhamite, $Ca_3Al_7(SiO_4)_2(PO_4)_4(OH)_6 \cdot 16.5H_2O$, is an interesting silico-phosphate found in pegmatitic veins and rock phosphate deposits in the United States, Germany and Australia (MILLS, 2003). Its combination of mixed anion, hydroxyl and water units make it ideal for an integrated Raman and IR study. The crystal structure has also recently been revised giving new insight into the framework of this mineral. Perhamite morphology consists of very thin intergrown platelets that can form a variety of habits such as stalagmite-like aggregates and rosettes generally less than 40 μm across.

The structure of perhamite is related to that of the crandallite-group minerals and the chain silicate vlasovite. A disordered region of vlasovite-like $(Si,Al)_4O_{11}$ ribbons together with water molecules is sandwiched between blocks of ordered crandallite-type structure.

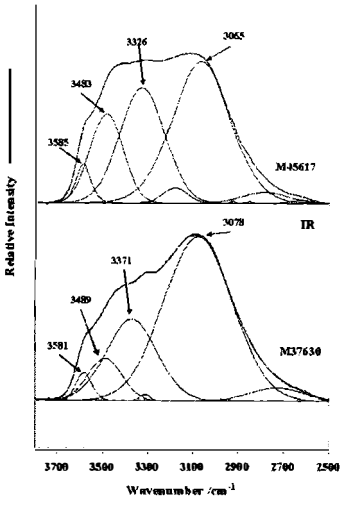

Fig. 1. Infrared spectra of perhamite samples M37630 and M45617 in the hydroxyl stretching region

Raman spectroscopy of perhamite has revealed intense bands in the regions 1110–1130 and 966–996 cm^{-1} In these regions the SiO_4 and PO_4 symmetric stretching modes can be found. Other bands observed in the range 1005–1096 cm^{-1} are attributed to the ν_3 antisymmetric bending modes of PO_4. Bands in the low-wavenumber region are assigned to the ν_4 and ν_2 out-of-plane bending modes of the SiO_4 and PO_4 units.

Infrared spectroscopy in the hydroxyl-stretching region (Fig. 1) shows a number of overlapping bands which are observed in the range 3581–3078 cm^{-1} These wavenumbers enable an estimation to be made of the hydrogen bond distances and correspond to 3.176(0), 2.880(5), 2.779(6), 2.749(3), 2.668(1) and 2.599(7) Å. An arbitrary cut-off point of 2.74 Å (based upon the wavenumber 3300 cm^{-1}) was used to distinguish the weak hydrogen bonding from the strong hydrogen bonds.

References

MILLS, S.J. (2003): Aust. J. Mineral., **9**: 41-43.