

Re-definition, nomenclature and crystal-chemistry of the hellandite group

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ABSTRACT

Detailed X-ray single-crystal structure refinements and complete (SIMS + EMPA) microprobe chemical analyses of a series of non-metamict samples of hellandite recently found in Latium (Italy), together with a critical re-evaluation of the existing data on hellandite, allow a better understanding of the crystal-chemistry of the hellandite group. Relative to the crystal structure determined by Mellini and Merlino (1977) for a Y-rich sample from Predazzo (Italy), a new tetrahedrally coordinated site has been detected; this may be fully, or in part, occupied by Li and Be. These cations occur at the center of the tetrahedral cavity where the H atom, which is bonded to the O5 O atom, protrudes; thus the H content in hellandite is constrained to values $\leq 2 - (\text{Li} + \text{Be} + \text{F})$.

A new general formula for hellandite-group minerals is proposed: $X_4Y_2ZT_2[B_4Si_4O_{22}]W_2$, where X = Na, Ca, Y, LREE³⁺ at the eightfold-coordinated M3 and M4 sites; Y = Ca, Y, HREE³⁺, Th⁴⁺, U⁴⁺ at the eightfold-coordinated M2 site; Z = Al, Mn³⁺, Fe³⁺, Ti⁴⁺ at the octahedral M1 site; T = □ (vacancy), Li, Be at the new tetrahedrally coordinated site; and W = OH, F, O²⁻ at the O5 site. Eight root end-member compositions were identified; four of these correspond to known compositions: hellandite-(REE), tadzhikite-(REE), and two new minerals, mottanaite-(Ce) and ciprianiite, which are described in a companion paper (Della Ventura et al. 2002). The root-name tadzhikite must be used for samples with Ti⁴⁺ > 0.5 apfu, with no reference to the OH content.

Hellandite is an REE mineral. Rare-earth elements occur at two distinct sites (M2 and M4), with a strong preference for M2 (particularly HREE). Thus, one or two Levinson modifiers can be added to the root name to correctly describe the species. A sequence of incorporation based on crystal-chemical arguments is provided and allows evaluation of the site populations for nomenclature purposes.

This redefinition of the hellandite group and the new nomenclature rules have been approved by the IMA Commission on New Minerals and Mineral names (code 00-F).