

Ertlite, NaAl₃Al₆(Si₄B₂O₁₈)(BO₃)₃(OH)₃O, a new mineral species of the tourmaline supergroup

JAN CEMPÍREK^{1,†}, ERIK JONSSON^{2,3}, LENKA SKŘÁPKOVÁ^{1,4,*}, RADEK ŠKODA¹, UWE KOLITSCH^{5,6}, RENATA ČOPJAKOVÁ¹, LEE A. GROAT⁷, ANTHONY R. KAMPF^{8,‡}, AARON J. LUSSIER⁹, FRANK C. HAWTHORNE¹⁰, JAKUB HAIFLER¹, MARKÉTA HOLÁ¹¹, AND MARTIN ENDE^{6,§}

¹Department of Geological Sciences, Faculty of Science, Masaryk University, Kotlářská 2, 61137 Brno, Czech Republic

²Geological Survey of Sweden, Department of Mineral Resources, Box 670, SE-751 28 Uppsala, Sweden

³SERC, Department of Earth Sciences, Uppsala University, Villavägen 16, SE-752 36 Uppsala, Sweden

⁴Department of Mineralogy, Petrology and Economic Geology, Faculty of Natural Sciences, Comenius University in Bratislava, Ilkovicova 6, 842 15, Bratislava, Slovak Republic

⁵Mineralogisch-Petrographische Abt., Naturhistorisches Museum, Burggring 7, A-1010 Vienna, Austria

⁶Institut für Mineralogie und Kristallographie, Universität Wien, Josef-Holaubek-Platz 2, A-1090 Vienna, Austria

⁷Department of Earth, Ocean & Atmospheric Sciences, University of British Columbia, 2020-2207 Main Mall, Vancouver, British Columbia V6T 1Z4, Canada

⁸Mineral Sciences Department, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007, U.S.A.

⁹Canadian Museum of Nature, P.O. Box 3443, Station D, Ottawa, Ontario K1P 6P4, Canada

¹⁰Department of Earth Sciences, University of Manitoba, 125 Dysart Road, Winnipeg, Manitoba R3T 2N2, Canada

¹¹Department of Chemistry, Faculty of Science, Masaryk University, Kotlářská 2, 61137 Brno, Czech Republic

ABSTRACT

Ertlite, ideally NaAl₃Al₆(Si₄B₂O₁₈)(BO₃)₃(OH)₃O, is a new, very B-rich mineral of the tourmaline supergroup. It was found at two localities: the holotype in the Sahatany Valley, central Madagascar, and a cotype specimen from Sakangyi, Mogok Township, Mandalay Region, Myanmar. At both localities, the mineral occurs as a late-stage hydrothermal phase in open pockets within highly fractionated, B-rich granitic pegmatites. The holotype occurs as pink to brownish gray or near colorless euhedral crystals and aggregates, up to 10 mm in diameter, with vitreous luster, conchoidal fracture, and white streak. The mineral is uniaxial (–). Holotype ertlite has a Mohs hardness of ca. 7–8, a calculated density of 3.128 g·cm^{–3} and an superior compatibility index (1 – K_P/K_C = 0.018). Cotype ertlite has a Mohs hardness of ca. 7–8, a calculated density of 3.135 g·cm^{–3} and a superior compatibility index (1 – K_P/K_C = 0.001). Ertlite has trigonal symmetry, space group *R3m*, with *a* = 15.6509(8) Å, *c* = 7.0406(5) Å, *V* = 1493.55(19) Å³ (holotype) and *a* = 15.590(2) Å, *c* = 7.009(1) Å, *V* = 1475.3(4) Å³ (cotype, with the lowest unit-cell volume ever recorded for a natural tourmaline); *Z* = 3. The crystal structures were refined to *R*₁ = 2.01% and 3.74%, respectively, using room-temperature data sets collected with MoK α radiation. Crystal-chemical analysis obtained using electron probe microanalysis, laser ablation inductively coupled plasma mass spectroscopy, Raman spectroscopy, and crystal structure refinement resulted in the following empirical holotype and cotype formulas, respectively: ^X(Na_{0.573}Ca_{0.220}□_{0.207})_{Σ1.000} ^Y(Al_{2.760}Li_{0.187}Mn_{0.051}Ti_{0.002})_{Σ3.000} ^Z(Al_{6.000}) ^T(Si_{4.526}B_{1.419}Al_{0.055})_{Σ6.000}O₁₈ ^B(BO₃)₃ ^V(OH_{2.669}O_{0.331})_{Σ3.000} ^W(O_{0.786}OH_{0.188}F_{0.026})_{Σ1.000} (holotype); ^X(Na_{0.743}Ca_{0.109}□_{0.146}K_{0.002})_{Σ1.000} ^Y(Al_{2.836}Li_{0.144}Mn_{0.002}Fe_{0.010})_{Σ2.992} ^Z(Al_{6.000}) ^T(Si_{4.053}B_{1.955})_{Σ6.008}O₁₈ ^B(BO₃)₃ ^V(OH)_{3.000} ^W(O_{0.716}OH_{0.245}F_{0.039})_{Σ1.000} (cotype). Ertlite is an oxy-species that belongs to the sodic group of the tourmaline supergroup. The closest end-member compositions of valid tourmaline species are: olenite by the coupled substitution ^TSi⁴⁺ + ^VO^{2–} → ^TB³⁺ + ^VOH[–] accompanied by the disorder exchange ^VO^{2–} + ^WOH[–] → ^VOH[–] + ^WO^{2–}, alumino-oxy-rossmanite by the coupled substitution ^X□ + ^TSi⁴⁺ + ^TAl³⁺ → ^XNa⁺ + 2(^TB³⁺), and darrellhenryite by the coupled substitution ^YLi⁺ + 2(^TSi⁴⁺) → ^YAl³⁺ + 2(^TB³⁺). Ertlite was approved by the IMA-CNMNC (IMA 2023-086); the name honors the tourmaline specialist Andreas Ertl-Winand. Ertlite is closely related to synthetic excess-boron tourmalines. Holotype ertlite formed during a late stage of open pocket crystallization in a highly fractionated granitic pegmatite dike of lithium-cesium-tantalum-enriched type (LCT-type) of likely Pan-African age. Cotype ertlite crystallized in a very similar pegmatite environment.

Keywords: Ertlite, tourmaline, new mineral species, tetrahedrally coordinated boron, crystal structure, electron probe microanalysis, LA-ICP-MS, LCT pegmatite

* Corresponding author E-mail: lenkas@sci.muni.cz Orcid <https://orcid.org/0009-0002-6437-7109>

† Orcid <https://orcid.org/0000-0003-3180-9534>

‡ Orcid <https://orcid.org/0000-0001-8084-2563>

§ Present address: Institut für Geowissenschaften und Geographie, Universität Halle, Von-Seckendorff-Platz 3, D-06120 Halle (Saale), Germany.