

ABOUT THE NOMENCLATURE AND THE TYPE LOCALITY OF ELBAITE:  
A HISTORICAL REVIEW

by

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**Summary**

A lithium-tourmaline was one of three pegmatitic minerals from Utö, Sweden, in which the new alkali element lithium (Li) was determined in 1818 by Arfwedson for the first time. In 1841 Rammelsberg made the distinction between Li-containing and Li-free tourmaline. Elba Island, Italy, was one of the first localities where coloured and colourless Li-tourmalines were extensively chemically analysed. In 1850 Rammelsberg described fluorine in tourmaline for the first time. In 1870 he proved that all varieties of tourmaline contain chemically bound water. In 1889 Scharitzer proposed the substitution of (OH)<sup>-</sup> by F<sup>-</sup> in red Li-tourmaline from Schüttenhofen (today Sušice, Czech Republic). Relatively good chemical analyses of Li-tourmaline, including the light elements, were published by different authors around 1890. In 1914 Vernadsky proposed the name “*Elbait*” for Li-, Na-, and Al-rich tourmaline from Elba Island, Italy, with the simplified formula (Li,Na)HAl<sub>6</sub>B<sub>2</sub>Si<sub>4</sub>O<sub>21</sub>. Most likely the type material for (pink) elbaite with the formula ~( $\text{Na}_{0.7}\square_{0.3}$ )(Al<sub>1.9</sub>Li<sub>1.1</sub>)Al<sub>6</sub>(B<sub>0.9</sub>O<sub>3</sub>)<sub>3</sub>[Si<sub>5.9</sub>Al<sub>0.1</sub>O<sub>18</sub>](OH)<sub>3</sub>[(OH)<sub>0.6</sub>O<sub>0.4</sub>] (chemical analysis by Schaller, 1913) was found at Fonte del Prete, San Piero in Campo, Campo nell'Elba, Elba Island, Livorno Province, Tuscany, Italy. In 1933 Winchell published an updated formula for elbaite, H<sub>8</sub>Na<sub>2</sub>Li<sub>3</sub>Al<sub>3</sub>B<sub>6</sub>Al<sub>12</sub>Si<sub>12</sub>O<sub>62</sub>, which is commonly used to date written as Na(Li<sub>1.5</sub>Al<sub>1.5</sub>)Al<sub>6</sub>(BO<sub>3</sub>)<sub>3</sub>[Si<sub>6</sub>O<sub>18</sub>](OH)<sub>3</sub>(OH). The first crystal structure determination of a Li-rich tourmaline was published in 1972 by Donnay and Barton, performed on a pink elbaite from San Diego County, California, U.S.A.

**Zusammenfassung**

Ein Lithium-Turmalin war eines von drei Mineralien aus Utö, Schweden, in welchem das neue Alkali-Element Lithium (Li) im Jahr 1818 von Arfwedson bestimmt wurde. Rammelsberg unterteilte im Jahr 1841 die Turmalin-Gruppe in Li-haltige und Li-freie Turmaline. Die Insel Elba in Italien war einer der ersten Fundorte, von dem gefärbte sowie farblose Turmaline intensiv chemisch analysiert wurden. Im Jahr 1850 hat Rammelsberg zum ersten Mal Fluor im Turmalin beschrieben. Im Jahr 1870 hat er bewiesen, dass alle Turmalin-Varietäten chemisch gebundenes Wasser besitzen. Scharitzer vermutete im Jahr 1889 in rotem Li-Turmalin aus Schüttenhofen (heute Sušice, Tschechische Republik) eine Substitution von (OH)<sup>-</sup> durch F<sup>-</sup>. Bereits um das Jahr 1890 wurden von verschiedenen Autoren relativ gute chemische Analysen von Turmalinen

veröffentlicht. Vernadsky veranschlagte im Jahr 1914 den Namen “*Elbait*” für Li-, Na- und Al-reichen Turmalin von Elba, Italien, mit der vereinfachten Formel  $(\text{Li},\text{Na})\text{HAl}_6\text{B}_2\text{Si}_4\text{O}_{21}$ . Sehr wahrscheinlich stammt das Typ Material für (rosa) Elbait mit der Formel  $\sim(\text{Na}_{0.7}\square_{0.3})(\text{Al}_{1.9}\text{Li}_{1.1})\text{Al}_6(\text{B}_{0.9}\text{O}_3)_3[\text{Si}_{5.9}\text{Al}_{0.1}\text{O}_{18}](\text{OH})_3[(\text{OH})_{0.6}\text{O}_{0.4}]$  (chemische Analyse von Schaller, 1913) von Fonte del Prete, San Piero in Campo, Campo nell'Elba, Insel Elba, Provinz Livorno, Toskana, Italien. Winchell publizierte im Jahr 1933 eine aktualisierte Formel für Elbait,  $\text{H}_8\text{Na}_2\text{Li}_3\text{Al}_3\text{B}_6\text{Al}_{12}\text{Si}_{12}\text{O}_{62}$ , welche heute allgemein mit der Schreibweise  $\text{Na}(\text{Li}_{1.5}\text{Al}_{1.5})\text{Al}_6(\text{BO}_3)_3[\text{Si}_6\text{O}_{18}](\text{OH})_3(\text{OH})$  verwendet wird. Die erste Kristallstruktur-Bestimmung an Li-reichem Turmalin wurde im Jahr 1972 von Donnay und Barton publiziert, durchgeführt an einem rosa Elbait von San Diego County, Kalifornien, U.S.A.

## Introduction

In 1709 a gem with the alternate designations *Turmalin*, *Turmale* and *Trip* was shipped from Ceylon to the Netherlands (QUENSTEDT, 1863; KOBELL, 1864; DANA, 1868, 1892). ROMÉ DE L'ISLE (1772) described in his “*Essai de cristallographie*” for the first time that the coloured tourmaline crystals from Ceylon show crystal faces related to schorl (today presumed to be elbaite). Schorl, another member of the tourmaline group, was described relatively detailed by MATHESIJ (1562) under the title “*Sarepta oder Bergpostill*” (ERTL, 2006).

For all members of the tourmaline group, JAMESON (1816) used the name “*schorl*” in his “*A system of mineralogy*” and divided the group into the sections “*common schorl*” and “*tourmaline or precious schorl*” (today known as elbaite).

W. A. LAMPADIUS (in BREITHAUPT, 1818; see also KLAPROTH & WOLFF, 1820) and VOGEL (1818) found boron in tourmaline for the first time. Also ARFWEDSON (1818) (also written Arfwedson) described boron (as “*Boraxsäure*”) in a greenish tourmaline (described as prismatic crystals which show a striation in the length direction and which look similar to tourmaline or schorl) from Utö, Sweden. BERZELIUS (1818) described boron in reddish tourmaline (rubellite) from Utö.

## Analyses of Li-rich tourmalines from different localities

ARFWEDSON (1818) described the detection of a new element, the alkali metal lithium (as “*Lithion*”) in three minerals, petalite, spodumene and tourmaline. In his paper he reported a relatively high content of Li in a greenish (Mg-free) tourmaline from Utö, Sweden (associated with petalite and spodumene). GRUNER (1820) also published an analysis of a tourmaline with a relatively high content of Li and with a significant amount of Mg (and Fe) from Greenland. While Li-rich tourmalines are well known from the Li-pegmatites from Utö (Sweden), no Li-tourmaline is known from Greenland to date. Tourmalines from the elbaite-dravite series are in general very rare; thus it is questionable if the Li analysis given by GRUNER (1820) is correct.

GMELIN (1827) published his analyses of ten different tourmaline varieties which were performed in the years 1815-1827. He classified the tourmalines as: 1. “*Lithionhaltige Turmaline*” (Li containing tourmalines) , 2. “*Kali- und Natriumhaltige Turmaline*” (K and Na containing

tourmalines; during that time it was not easy to distinguish between these elements), 3. “*Talk-erdehaltige Turmaline*“ (Mg containing tourmalines).

RAMMELSBURG (1841) quoted analyses from GMELIN (1827) which he believed were the best analyses available at that time and distinguished between two main groups and several subspecies (ERTL, 2006).

I. “*Lithionfreie Turmaline*“ (Li-free tourmaline)

1. “*Magnesia-Turmalin*“ (Mg-tourmaline; today known as dravite; ERTL, 2007)
2. “*Magnesia-Eisen-Turmalin*“ (Mg-Fe-tourmaline)
3. “*Eisen-Turmalin*“ (Fe-tourmaline)

II. “*Lithionhaltige Turmaline*“ (Li-containing tourmaline)

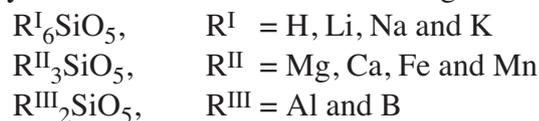
1. “*Eisen-Mangan-Turmalin*“ (Fe-Mn-tourmaline)
2. “*Mangan-Turmalin*“ (Mn-tourmaline)

HERMANN (1845) distinguished between “*Schörl*“, “*Achroït*“, and “*Rubellit*“. He described colourless Li-tourmaline (achroite) from “St. Pietro in Campo” (should be San Piero in Campo) on Elba Island, Italy, with the simplified formula  $R_2O + (B,C)O_2 + 3(Al_2O_3 + 3SiO_2)$  ( $R = Li, Na, K$ ). The recalculated formula (recalculated by the author as are all other recalculated formulae), based on Si = 6 apfu, is  $(Li, Na, K)_{1.3}(B, C)_{0.7}Al_4Si_6O_{20}$ .

RAMMELSBURG (1850a, 1850b) was the first to find fluorine in tourmaline (he analysed thirty different samples). He described further that a part of the oxygen can be substituted by fluorine. He also analysed some Li-containing tourmalines from Elba Island (Italy), from Paris (Maine, U.S.A.) and Chesterfield (Massachusetts, U.S.A.), from Brazil, from Schaitansk near Mursinsk (Urals Region, Russia), and from Rozena (today Rožná, Czech Republic).

KOBELL (1864, p. 523) reported in his „Geschichte der Mineralogie“ about the history of the nomenclature of “tourmalines” retrospective to the year 1703.

In revisions of his publications, RAMMELSBURG (1870a, 1870b) presented analyses of about thirty tourmalines already published under RAMMELSBURG (1850a, 1850b) that substantiated that all varieties of tourmaline contain chemically bound water. RAMMELSBURG (1870a, 1870b) concluded on the basis of analyses in RAMMELSBURG (1850a, 1850b, 1860) that tourmaline may be referred to the three following silicate types:



RAMMELSBURG (1875) reported the chemical analysis of a colourless tourmaline from Elba Island, Italy, and mentioned that this tourmaline is very close to the endmember of an “*Alkali-Turmalin*” with the simplified formula  $R^I_6Al_6B_2Si_9O_{45}$  ( $R^I = H, Li, Na, \text{ and } K$ ). The recalculated formula, based on Si = 6 apfu, is  $(H, Li, Na, K)_4Al_4B_{1.3}Si_6O_{30}$ . “*Lithionhaltiger Turmalin*” was referred by RAMMELSBURG (1890) to the formula  $R^I_6Al_{12}B_4Si_8O_{40}$ . The recalculated formula, based on Si = 6 apfu, gives for the this Li-tourmaline  $(H, Li, Na)_{4.5}Al_9B_3Si_6O_{30}$ .

RIGGS (1888) gave analyses of different tourmalines from several localities. Amongst others, the chemical data for colourless, pink and green Li-bearing to Li-rich tourmalines from Maine, U.S.A. and Minas Gerais, Brazil, were listed. He proposed the following special formulae for the three “varieties”:

I. “*Lithia tourmaline*”:  $12\text{SiO}_2, 3\text{B}_2\text{O}_3, 4\text{H}_2\text{O}, 8\text{Al}_2\text{O}_3, 2(\text{Na,Li})_2\text{O}$

II. “*Iron tourmaline*”:  $12\text{SiO}_2, 3\text{B}_2\text{O}_3, 4\text{H}_2\text{O}, 7\text{Al}_2\text{O}_3, 4\text{FeO}, \text{Na}_2\text{O}$

III. “*Magnesian tourmaline*”:  $12\text{SiO}_2, 3\text{B}_2\text{O}_3, 4\text{H}_2\text{O}, 5\text{Al}_2\text{O}_3, 28/3\text{MgO}, 2/3\text{Na}_2\text{O}$

The recalculated formula, based on Si = 6 apfu, gives for the “*Lithia tourmaline*”  $\text{Si}_6\text{B}_3\text{H}_4\text{Al}_8(\text{Na,Li})_2\text{O}_{31.5}$ .

In the 19<sup>th</sup> century the main location for colourless tourmalines was Elba Island (Italy), the main locations for pale red tourmaline were Elba Island (Italy), and Rožná (Czech Republic), for green tourmaline Penig in Saxony (Germany), the Urals Region (Russia), Massachusetts and Maine (U.S.A.), and bluish tourmaline was known from Utö (Sweden) and Brazil (MEYERS KONVERSATIONS-LEXIKON, 1888; p. 940-941).

SCHARIZER (1889) described Li-rich red and cyan coloured tourmalines from a pegmatite near the town Schüttenhofen (today Sušice, Bohemia, Czech Republic). For a red tourmaline he gave the simplified formula  $(\text{Na,K,Li})_4\text{Al}_4\text{Al}_{12}\text{Si}_{12}\text{B}_4(\text{OH,F})_{10}\text{O}_{51}$  [the recalculated formula, based on Si = 6 apfu, is  $(\text{Na,K,Li})_2\text{Al}_2\text{Al}_6\text{Si}_6\text{B}_2(\text{OH,F})_5\text{O}_{25.5}$ ]. He proposed the name “*Lithion-tourmalin*” for Li-rich tourmaline with the simplified formula  $(\text{Na,Li,K})_4\text{Al}_{16}\text{Si}_{12}\text{B}_6\text{H}_8\text{O}_{63}$ . The recalculated formula, based on Si = 6 apfu, is  $(\text{Na,Li,K})_2\text{Al}_8\text{Si}_6\text{B}_3\text{H}_4\text{O}_{31.5}$ .

JANNASCH & KALB (1889) proposed the following formula for Li-tourmaline:  $24\text{SiO}_2 \cdot 6\text{B}_2\text{O}_3 \cdot 15\text{Al}_2\text{O}_3 \cdot 4\text{FeO} \cdot 4(\text{Li}_2\text{O}, \text{Na}_2\text{O}) \cdot 7\text{H}_2\text{O}$ . The recalculated formula, based on Si = 6 apfu, is  $\text{Si}_6\text{B}_3\text{Al}_{7.5}\text{Fe}(\text{Li,Na})_2\text{H}_{3.5}\text{O}_{31.5}$ .

E. S. DANA specified three different tourmaline types in „The system of mineralogy“ (DANA, 1892, p. 556) together with the related general formulae: “*Lithium Tourmaline*“, “*Iron Tourmaline*“ and “*Magnesium Tourmaline*“ (similar to RIGGS, 1888).

JANNASCH (in HINTZE, 1897) proposed an updated formula (compared to JANNASCH & KALB, 1889) for Li-tourmaline:  $\text{Si}_{12}\text{O}_{63}\text{B}_6\text{Al}_{15}(\text{Na,Li})_4\text{H}_7$ . The recalculated formula, for Si = 6 apfu, is  $\text{Si}_6\text{O}_{31.5}\text{B}_3\text{Al}_{7.5}(\text{Na,Li})_2\text{H}_{3.5}$ .

PENFIELD & FOOTE (1899) discussed the analyses of RAMMELSBERG (1850a, 1850b, 1870a, 1870b) and published new analyses including one for green Li-rich tourmaline from Haddam Neck (Connecticut, U.S.A.). They noticed that the water contents of the analyzed tourmaline samples which were originally published by RAMMELSBERG (1870a, 1870b) were too low. PENFIELD & FOOTE (1899) further give a general formula for Li-tourmaline with  $(\text{H,Li,Na,K})_9\text{Al}_3(\text{B,OH})_2\text{Si}_4\text{O}_{19}$ . The recalculated formula, for Si = 6 apfu, is  $(\text{H,Li,Na,K})_{13.5}\text{Al}_{4.5}(\text{B,OH})_3\text{Si}_6\text{O}_{28.5}$ .

W. T. SCHALLER (1913) gave the chemical analysis and morphological details of pale red Li-rich tourmaline crystals from Elba Island (Italy), of red and pale green tourmaline crystals from

the Himalaya Mine (Mesa Grande, California, U.S.A.), of green tourmaline from Haddam Neck (Connecticut, U.S.A.), of blue Li-rich and Fe-bearing tourmaline crystals from the Pala Chief Mine (California, U.S.A.), of black Fe-rich tourmaline crystals from the Surprise Mine (Ramona District, California, U.S.A.), and finally black Fe-rich and Mg-bearing tourmaline from Lost Valley (California, U.S.A.). He proposed two components for “Lithiumtourmalin” (Li-rich tourmaline): for red tourmaline from the Himalaya Mine he gave the idealized formula  $12\text{SiO}_2 \cdot 3\text{B}_2\text{O}_3 \cdot 8\text{Al}_2\text{O}_3 \cdot 3(\text{Li}_2\text{O}, \text{Na}_2\text{O}, \text{H}_2\text{O}) \cdot 3\text{H}_2\text{O}$  and for pale red tourmaline from Elba he gave the formulae  $12\text{SiO}_2 \cdot 3\text{B}_2\text{O}_3 \cdot 8\text{Al}_2\text{O}_3 \cdot 3(\text{Li}_2\text{O}, \text{Na}_2\text{O}, \text{H}_2\text{O}) \cdot 3\text{H}_2\text{O}$  and  $12\text{SiO}_2 \cdot 3\text{B}_2\text{O}_3 \cdot 9\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ . To express the general composition of Li-tourmaline he gave four components with the following special formulae:

- 1)  $12\text{SiO}_2 \cdot 3\text{B}_2\text{O}_3 \cdot 9\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$  (recalculated:  $\text{Si}_6\text{B}_3\text{Al}_9\text{H}_3\text{O}_{31.5}$ )
- 2)  $12\text{SiO}_2 \cdot 3\text{B}_2\text{O}_3 \cdot 8\text{Al}_2\text{O}_3 \cdot 3\text{Li}_2\text{O} \cdot 3\text{H}_2\text{O}$  (recalculated:  $\text{Si}_6\text{B}_3\text{Al}_8\text{Li}_3\text{H}_3\text{O}_{31.5}$ )
- 3)  $12\text{SiO}_2 \cdot 3\text{B}_2\text{O}_3 \cdot 8\text{Al}_2\text{O}_3 \cdot 3\text{Na}_2\text{O} \cdot 3\text{H}_2\text{O}$  (recalculated:  $\text{Si}_6\text{B}_3\text{Al}_8\text{Na}_3\text{H}_3\text{O}_{31.5}$ )
- 4)  $12\text{SiO}_2 \cdot 3\text{B}_2\text{O}_3 \cdot 8\text{Al}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$  (recalculated:  $\text{Si}_6\text{B}_3\text{Al}_8\text{H}_6\text{O}_{31.5}$ )

SCHALLER (1913) further noticed that the maximum value for  $\text{Al}_2\text{O}_3$  with ~44 wt% (and no Fe and Mg) for all investigated tourmalines was found in Li-tourmaline.

### First description of elbaite and the type locality

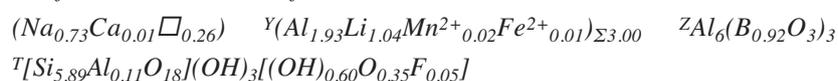
Vladimir Ivanovich VERNADSKY (1914) suggested the name “*Elbait*” for a pale red tourmaline from Elba Island (Italy), with the formula  $(\text{Li}, \text{Na})\text{HA}\text{Al}_6\text{B}_2\text{Si}_4\text{O}_{21}$  (simplified as  $\text{M}^{1+}\text{HA}\text{Al}_6\text{B}_2\text{Si}_4\text{O}_{21}$ ) on the basis of the description and analysis in SCHALLER (1913, sample no. 1, Tab. 1). The recalculated formula, for Si = 6 apfu, is  $(\text{Li}, \text{Na})_{1.5}\text{H}_{1.5}\text{Al}_9\text{B}_3\text{Si}_6\text{O}_{31.5}$ . He noticed that tourmalines from most localities present a solution between different endmembers (including Fe- and Mg-tourmaline) but that the pink tourmaline from Elba Island (Italy), presents nearly the idealized composition for elbaite. He mentioned also that tourmalines with a high elbaite component, as is the case for the pink tourmaline from Elba Island (Italy), are always rich in Na and Li. He discussed further theoretical models for the crystal structure of elbaite and also for Fe- and Mg-tourmaline. BLACKBURN & DENNEN (1997) quoted the year of this publication (VERNADSKY, 1914) as 1913. However, Vernadsky finished his article in June 1913 but it was published finally in 1914. SCHALLER (1913) also gave the measured density for the pale red (nearly colourless) Li-tourmalines from Elba as 3.043-3.050 g/cm<sup>3</sup>, and the indices of refraction (for two crystals) as  $n_w = 1.650-1.652$ ,  $n_e = 1.630$ .

	Wt.%
SiO <sub>2</sub>	37.89
B <sub>2</sub> O <sub>3</sub>	10.28
Al <sub>2</sub> O <sub>3</sub>	43.85
TiO <sub>2</sub>	0.04
FeO	0.11
MnO	0.11
CaO	0.07
MgO	n.d.
K <sub>2</sub> O	n.d.
Na <sub>2</sub> O	2.43
Li <sub>2</sub> O	1.66
H <sub>2</sub> O	3.47
F	0.10
O≡F	-0.04
Total sum	99.97

Table 1

Chemical composition of pale red (almost colourless) Li-tourmaline from Elba (SCHALLER, 1913). N.d. = not detected.

The formula is calculated for Y+Z+T = 15 cations:



WINCHELL (1933) described Li-tourmaline with the formula  $H_8Na_2Li_3Al_3B_6Al_{12}Si_{12}O_{62}$  as elbaite and discussed the relationship to other tourmaline compositions. The recalculated formula, for Si = 6 apfu, is  $H_4NaLi_{1.5}Al_{1.5}B_3Al_6Si_6O_{31}$ . This formula is identical with the endmember formula which is now commonly used for elbaite:  $Na(Li_{1.5}Al_{1.5})Al_6B_3Si_6O_{27}(OH)_4$  (e.g., HAWTHORNE & HENRY, 1999).

The first crystal structure determination of tourmaline was reported by HAMBURGER & DONNAY (1948). ITO & SADANAGA (1951) carried out a structure determination on a tourmaline which was cited as elbaite but which seems to belong to the schorl-dravite solid solution (DONNAY & BARTON, 1972). The first crystal structure determination of an elbaite (Li-rich tourmaline) with composition  $(Na_{1.69}Mn_{0.45}Ca_{0.42}\square_{0.38}B_{0.05}K_{0.01})_{\Sigma 3.00}(Al_{4.78}Li_{3.74}Mn_{0.39}Fe^{2+}_{0.09})_{\Sigma 9.00}Al_{18.00}B_{9.00}(Si_{17.94}B_{0.06})[O_{82.57}(OH)_{8.62}F_{1.81}]$  and lattice parameters  $a = 15.838(1)$ ,  $c = 7.1032(2)$  Å ( $R = 4.2\%$  for 1142 observed, symmetry-independent reflections) was published by DONNAY & BARTON (1972). This gem-quality elbaite with a pink colour originates from San Diego County (California, U.S.A.). The recalculated formula, based on  $Y+Z+T+B = 18$  cations, is  $^X(Na_{0.56}Ca_{0.14}\square_{0.30})^Y(Al_{1.46}Li_{1.23}Mn_{0.28}Fe^{2+}_{0.03})_{\Sigma 3.00}^ZAl_6(BO_3)_3^T[Si_{5.93}Al_{0.06}B_{0.01}O_{18}][OH]_{2.85}F_{0.60}O_{0.55}$  (for the definition of the different sites see HAWTHORNE & HENRY, 1999). The proposed amount of OH seems too low (>5 mol.%) for this F-rich elbaite, because usually elbaite has >3(OH).

The mineral name elbaite was grandfathered by the International Mineralogical Association (IMA) as being valid prior to 1959. The name elbaite was proposed for the first time by VERNADSKY (1914) for a Li-, Al-, and, Na-rich tourmaline from Elba Island, Italy. This proposed name was eventually accepted by the scientific community (e.g., CUSHMAN, 1918; PUTNAM, 1925; SIMPSON, 1925; SHANNON, 1926; WINCHELL & WINCHELL, 1927; WINCHELL, 1933; ROGERS & KERR, 1933). Hence, the locality “Elba Island, Italy” is the type locality for elbaite. No specific details about the locality, other than Elba Island, were given in this publication. In the database MINDAT.ORG (2008) is the type locality given (with a reference that only cites Elba with no more details) as Fonte del Prete, San Piero in Campo, Campo nell'Elba, Elba Island, Livorno Province, Tuscany, Italy. ZIRKEL (1898) noted that red tourmaline was found at San Piero in Campo on Elba Island, Italy. But he also gave no more details about the locality. However, because the composition published by SCHALLER (1913) is very low in fluorine (Tab. 1), the given chemical composition of the pink Li-tourmaline could be a composition of an elbaite from Fonte del Prete. Such low F content in tourmaline is typical of Elba pegmatites with abundant lepidolite (pers. comm. Federico Pezzotta, 2008). Very likely in such pegmatites F is partitioned in micas. Pegmatites with very little lepidolite (when present), such as the ones in Grotta d'Oggi and La Speranza, produce elbaite crystals with moderate to high F contents (pers. comm. Federico Pezzotta, 2008).

Comprehensive recent volumes about the minerals from Elba are published by ORLANDI & PEZZOTTA (1996) and PEZZOTTA (2005). A compilation of the geology, of the mining history and references of publications on tourmaline from Elba is given by PEZZOTTA (2005). The conclusion can be drawn that it is most likely that the type material for elbaite was found at Fonte del Prete, San Piero in Campo, Campo nell'Elba, Elba Island, Livorno Province, Tuscany, Italy.

As “type material” VERNADSKY (1914) has chosen a Li- and Al-rich, Fe- and Mn-poor, Na-rich, Ca-poor, OH-rich and F-poor tourmaline, described from SCHALLER (1913), which was in fact a very good choice for elbaite, because the composition is very close to the endmember (see Tab. 1).

### Discussion of the proposed elbaite formulae

Table 2 presents the simplified tourmaline formulae for Li-rich tourmaline (today known as elbaite), recalculated for Si = 6 apfu by using the formulae originally given by various authors. During that time mineralogists thought that Na, K and Li could substitute for hydrogen. RIGGS (1888) and SCHARIZER (1889) proposed formulae that were very close to the elbaite endmember formula that is used today (HAWTHORNE & HENRY, 1999).

Reference	Simplified Formula							
HERMANN (1845)	(Li,Na,K) <sub>1.3</sub>	-	Al <sub>4</sub>	-	(B,C) <sub>0.7</sub>	Si <sub>6</sub>	O <sub>20</sub>	
RAMMELSBERG (1875)	(H,Li,Na,K) <sub>4</sub>		Al <sub>4</sub>	-	B <sub>1.3</sub>	Si <sub>6</sub>	O <sub>30</sub>	
RIGGS (1888)	(Na,Li) <sub>2</sub>	H <sub>4</sub>	Al <sub>8</sub>	-	B <sub>3</sub>	Si <sub>6</sub>	O <sub>31.5</sub>	
SCHARIZER (1889)	(Na,Li,K) <sub>2</sub>	H <sub>4</sub>	Al <sub>8</sub>	-	B <sub>3</sub>	Si <sub>6</sub>	O <sub>31.5</sub>	
JANNASCH & KALB (1889)	(Li,Na) <sub>2</sub>	H <sub>3.5</sub>	Al <sub>7.5</sub>	Fe	B <sub>3</sub>	Si <sub>6</sub>	O <sub>31.5</sub>	
RAMMELSBERG (1890)	(H,Li,Na) <sub>4.5</sub>		Al <sub>9</sub>	-	B <sub>3</sub>	Si <sub>6</sub>	O <sub>30</sub>	
HINTZE (1897)	(Na,Li) <sub>2</sub>	H <sub>3.5</sub>	Al <sub>7.5</sub>	-	B <sub>3</sub>	Si <sub>6</sub>	O <sub>31.5</sub>	
PENFIELD & FOOTE (1899)	(H,Li,Na,K) <sub>13.5</sub>		Al <sub>4.5</sub>	-	(B,OH) <sub>3</sub>	Si <sub>6</sub>	O <sub>28.5</sub>	
VERNADSKY (1914)	(Li,Na) <sub>1.5</sub>	H <sub>1.5</sub>	Al <sub>9</sub>	-	B <sub>3</sub>	Si <sub>6</sub>	O <sub>31.5</sub>	
WINCHELL (1933)	<b>Na</b>	<b>Li<sub>1.5</sub></b>	<b>H<sub>4</sub></b>	<b>Al<sub>7.5</sub></b>	-	<b>B<sub>3</sub></b>	<b>Si<sub>6</sub></b>	<b>O<sub>31</sub></b>

Table 2

*Tourmaline formulae for Li-rich tourmaline (today known as elbaite), recalculated for Si = 6 apfu by using the originally given formulae from the cited references.*

JANNASCH & KALB (1889) also noted a significant Fe content in their samples. Hence, their formula reflects an intermediate member of the elbaite-schorl series. In his proposed simplified formula RAMMELSBERG (1890) gave an Al content that is too high relative to the Si value; the value for H+Li+Na is too low. HINTZE (1897) proposed a formula that is also very close to the elbaite endmember formula known today. PENFIELD & FOOTE (1899) gave a value for H+Li+Na+K that is twice as high as it is in the elbaite endmember formula used today. It is not clear why they proposed such a high value but they have a relatively low value for Al. A possible explanation could be that the water values used for the formula calculation were too high. PENFIELD & FOOTE (1899) further proposed an OH substitution for B that has not been confirmed to date.

The elbaite formula published by VERNADSKY (1914) was significantly too low in the OH content and slightly too low in the Al content. It is not clear why he suggested such a low OH value, because he mainly interpreted the chemical data from SCHALLER (1913), and Schaller himself reported a correct OH value. Finally, WINCHELL (1933) proposed an elbaite endmember formula which is still valid. The conclusion can be drawn that by around 1890 relatively good chemical data on Li-tourmaline (elbaite) were already available.

### **Other use of the name elbaite**

GIESECKE (1832) cited in the catalogue (cat. no. 23) of a new collection of minerals in the museum of the Royal Dublin Society the name “elbaite” as an obsolete synonym for ilvaite (from Ilva, the Latin name for the island) from Elba (CHESTER, 1896).

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