NEW MINERAL NAMES*

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Eudialyte 3248

R.K. Rastsvetayeva, A.G. Ivanova and A.P. Khomyakov (2006) Modular structure of hypermanganese eudialyte. Dokl. Akad. Nauk, 410, 101–105 (in Russian); Dokl. Earth Sci., 410, 1075–1079 (in English).

An apparently new member of the eudialyte group, conditionally designated "eudialyte 3248" has been found in intimate intergrowths with alluaivite at the Lovozero massif, Kola Peninsula, Russia. It has a low iron content (0.5 oxide wt%), and high contents of Mn and S. The empirical formula of the mineral is $Na_{94-102.4}K_{1.5-1.92}Sr_{3.2-3.8}Ba_{0.37}Ce_{2.5-2.9}Y_{0.93-1.20}Al_{0.12-0.18}$ $Ca_{25.9-27.9}Zr_{16.8-18.1}Hf_{0.09-0.15}Fe_{0.96-1.26}Mn_{8.2-11.2}Ti_{1.08-1.35}Nb_{1.29-1.44}$ $Si_{152.9-154.8}S_{1.0-1.5}Cl_{3.8-4.9}F_{0.37}$ ($Z = 1$). Unit-cell parameters are $a = 14.179(1)$, $c = 60.67(1)$ Å, space group $R\bar{3}m$, $D_{calc} = 2.90$ g/cm³. The crystal structure was refined using 1184 observed [$F > 3\sigma(F)$, Mo$K\alpha$] single-crystal reflections to $R_{aniso} = 0.049$, using the alluaivite structure as a starting basis. Doubling of the c cell edge permitted modelling of the structure as a modulation of two layer fragments along z, giving the structural formula ($Z = 1$): $Na_{45.1}Zr_{18}[Si_{144}O_{396}(O,OH)_{36}]\{(Ca_{11.7}Na_{2.88}Ce_{2.22}Y_{1.2})\cdot$ $(Na_{16.2}Sr_{1.8})[^{V}(Mn_{7.38}Fe_{0.54})(^{VI}Na_{5.53}Ce_{0.05})][^{IV}Mn_{2.64}(Nb_{1.3}Hf_{0.15})$ $(S_{1.4}Ti_{1.3}Nb_{0.3})]\}\cdot\{(Ca_{16.2}Sr_{1.8})(Na_{15.03}K_{1.98}Ce_{0.63}Ba_{0.36})\}[^{IV}Na_{7.2}$ $^{VI}Na_{3.6}][Si_{2.16}Si_{1.5}{}^{IV}Mn_{1.08}]\}(OH)_{13.86}(O,OH)_{7.92}(H_2O)_{4.58}Cl_{3.3}$, where braces represent the contents of the different modules. The ideal formula ($Z = 3$) is: $Na_{29}Ca_{12}Zr_6[Si_{48}O_{132}(O,OH)_{12}]\{[Na]_4$ $[Si]_2\}\{[Mn]_3[Mn,Nb,Ti]_2\}(OH,H_2O,Cl)_{10}$. Common features of the crystal structure are basically those of the eudialyte structure. Highlights of the structure and differences between the modules include: (1) Predominance of Ca at $M1'$ and $M1''$ (where the "prime" and "double-prime" symbols denote modules one and two, respectively); (2) $M2'$ is occupied by ^{IV}Na, whereas $M2''$ is dominantly occupied by ^{V}Mn; (3) $M3''$ is split into three subsites along the triad axis, one dominated by ^{IV}Mn and two by ^{IV}Si; (4) $M4$ is split into three subsites, one dominated by ^{IV}Mn, one by ^{VI}Nb and the other by $^{IV}(S,Ti)$; (5) $A1$ is split into two subsites, one dominated by Na, the other Sr; (6) $A2$, $A3$, and $A4$ are unsplit and dominated by Na; (7) $A5$ is split into three Na-dominated subsites, two of which are eight-coordinated, the other five-co-

ordinated; (8) $A6'$ and $A6''$ are both occupied by Na. In summary, the key features of the modules are the predominance of Mn at $M4'$ and $M2'$ of module 1 and the presence of Na at $M2''$ and in cation sites surrounding $M2''$ of module 2. Module 1 is thus a kentbrooksite unit and module 2 is an alluaivite unit. **T.S.E.**

F-analog of schorl

A. Ertl, U. Kolitsch, S. Prowatke, M.D. Dyar, D.J. Henry (2006) The F-analog of schorl from Grasstein, Trentino–South Tyrol, Italy: crystal structure and chemistry. Eur. J. Mineral., 18, 583–588.

The F-analog of schorl occurs as pale brownish to pale grayish blue 1 mm prismatic crystals growing on 1 cm quartz crystals. It is also found as larger crystals intergrown with quartz. Electron microprobe analyses and Mössbauer spectroscopy for Fe of the F-rich tourmaline gave SiO_2 34.38, TiO_2 0.17, B_2O_3 10.12, Al_2O_3 31.76, Cr_2O_3 0.001, FeO_{total} 15.84, FeO 13.15, Fe_2O_3 2.99, MnO 0.89, MgO 0.07, CaO 0.02, ZnO 0.12, Na_2O 2.35, K_2O 0.04, F 1.40, H_2O 2.83, O = F –0.59, sum 99.71 wt%, corresponding to $(Na_{0.78}K_{0.01}\square_{0.21})(Fe^{2+}_{1.89}Al_{0.58}Fe^{3+}_{0.13}Mn^{2+}_{0.13}Ti^{4+}_{0.02}Mg_{0.02}Zn_{0.02}\square_{0.21})$ $(Al_{5.74}Fe^{3+}_{0.26})(Si_{5.90}Al_{0.10}O_{18})(BO_3)_3(OH)_3[F_{0.76}(OH)_{0.24}]$ based on the sum of 31 anions. The ideal formula is $[^{X}Na^{Y}Fe^{2+z}_3Al_6{}^{T}(Si_6O_{18})$ $(BO_3)_3{}^{V}(OH)_3{}^{W}(F,OH)]$. The crystals are strongly pleochroic (bluish to brownish colors).

The crystal structure of the F-analog of schorl was solved and refined by single X-ray diffraction methods, using a $0.10 \times 0.10 \times 0.13$ mm fragment to $R_1 = 0.016$ for 1682 reflections with $F_o > 4\sigma(F_o)$. The mineral is trigonal, $R3m$ with refined unit-cell parameters $a = 15.997(2)$, $c = 7.179(1)$ Å, $V = 1591.0(4)$ Å³, $Z = 3$. This mineral is the F analog of the hydroxyl end-member schorl, in the tourmaline group.

The F-rich and Fe-rich tourmaline was found at Grasstein, Sachsenklemme, Trentino, South Tyrol, Italy, in pegmatites from the Permian Brixener granite. It was found in F-saturated quartz veins associated with fluorite, axinite, epidote, pyrrhotite, molybdenite, galena, chalcopyrite, and pyrite. Fluorine was found to occupy only the W site in this tourmaline and the presence of F in Fe-rich tourmaline seems to require a significant amount of Fe^{3+} in the structure. X-site vacancies were low in the F-rich tourmaline, showing the influence of the W-site on the neighboring X-site when F is abundant. **R.R.**

Golyshevite*

N.V. Chukanov, M.M. Moiseyev, R.K. Rastsvetayeva, K.A. Rozenberg, A.E. Zadov (2005) Golyshevite $(Na,Ca)_{10}Ca_9$ $(Fe^{3+},Fe^{2+})_2Zr_3NbSi_{25}O_{72}(CO_3)(OH)_3\cdot H_2O$, and Mogovidite,

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$Na_9(Ca,Na)_6Ca_6(Fe^{3+},Fe^{2+})_2Zr_3\square Si_{25}O_{72}(CO_3)(OH,H_2O)_4$, new eudialyte-group minerals from calcium-rich agpaitic pegmatites of the Kovdor massif, Kola Peninsula. Zap. Ross. Mineral. Obshch., 134(6), 36–47 (in Russian, English abstract).

The new species golyshevite occurs in the northern face of the Mica quarry in pegmatite no. 10 of the Kovdor massif, Kola Peninsula, Russia, in association with orthoclase, pectolite, calcite, pseudomorphs of thompsonite-Ca after cancrinite, and aegirine-augite. It is dark reddish brown in hand sample, with a white streak and glassy luster, and can make up to 70% of the host rock. Crystals (to 2 cm long) are tabular to idiomorphic; the forms {001}, {101}, and {012} are dominant. Brittle, imperfect {001} cleavage, conchoidal fracture, Mohs' hardness 5.5, D_{meas} = 2.89(1), D_{calc} = 2.889 g/cm³. Uniaxial (–), weakly pleochroic (colorless to yellow), ε = 1.618(2), ω = 1.628(1). Analysis by electron microprobe, IR spectroscopy, Mössbauer spectroscopy, and thermogravimetric studies gives the average composition: Na_2O 9.19, K_2O 0.46, CaO 17.24, MnO 0.69, FeO 1.19, Fe_2O_3 4.44, Al_2O_3 0.14, La_2O_3 0.15, Ce_2O_3 0.29, SiO_2 48.74, ZrO_2 12.03, Nb_2O_5 2.63, Cl 0.24, H_2O 1.30, CO_2 1.52, O = Cl –0.05, total 100.20 wt%, resulting in the formula $(Na_{9.02}Ca_{0.43}K_{0.30})_{\Sigma 9.75}$ $(Ca_{5.92}Ce_{0.05}La_{0.03})_{\Sigma 6.00}(Fe^{3+}_{1.69}Fe^{2+}_{0.50}Mn_{0.29})_{\Sigma 2.48}Zr_{2.97}(Si_{0.66}Nb_{0.60}Al_{0.08})$ $Si_{24}O_{72}(OH)_{2.37}(CO_3)_{1.05}Cl_{0.21} \cdot 1.01H_2O$ (based on 24.66 Si), or ideally $(Na, Ca)_{10}Ca_9(Fe^{3+}, Fe^{2+})_2Zr_3NbSi_{25}O_{72}(CO_3)(OH)_3 \cdot H_2O$. The mineral is trigonal, space group $R3m$, a = 14.231(3), c = 29.984(8) Å (single-crystal diffractometry). The strongest lines in the X-ray powder diffractogram are [d Å, $I\%$ (hkl)]: 4.30, 53 (205); 3.200, 46 (208); 2.971, 78 (315, 135); 2.848, 100 (404); 2.597, 43 (143); 2.055, 51 (32 10, 23 10). Crystal-structure analysis is presented elsewhere (Rozenberg et al., 2005, Kristallografiya, 50, 539–543); the mineral possesses the basic features of the eudialyte structure. Golyshevite is a member of the eudialyte group, essentially a CO_3-dominant analog of feklichevite with Si > Nb at $M3$. The presence of this calcium-rich mineral species in its host agpaitic pegmatite is a reflection of the "hybrid" nature of the pegmatite, i.e., via contamination from the calcite carbonatite that hosts the pegmatite. Type material has been deposited with the A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow (catalog no. 3220/1).

Discussion. No data is presented on compositional zoning in the mineral. **T.S.E.**

HYPERZIRCONIUM SULFATE ANALOG OF EUDIALYTE

R.K. Rastsvetaeva, N.V. Chukanov and I.A. Verin (2006) Crystal structure of Hyperzirconium sulphate analog of eudialyte. Dokl. Akad. Nauk, 409, 807–811 (in Russian); Dokl. Earth Sci., 409A, 985–989 (in English).

A calcium-poor and zirconium- and sulfate-rich member of the eudialyte group has been found in an ultra-agpaitic pegmatite at Mt. Alluaiv of the Lovozero massif, Kola Peninsula, Russia. It's empirical formula and range in composition (Z = 3) is: $Na_{14-17}K_{0.2-0.4}Sr_{0-0.6}REE_{0.2-0.6}Ca_{2.6-2.9}Zr_{3.9-4.8}Fe_{0.4-1.3}Mn_{1.5-1.8}Ti_{0.2-0.4}$ $Nb_{0-0.6}Si_{25}S_{0.3-0.5}Cl_{0.2-0.5}F_{0.4}(O,OH)_x \cdot nH_2O$, where $x \sim 75$ and n ~ 1. The ideal formula is $Na_{15}[Ca_3(Mn,Fe)_3]Zr_3[Zr,Na]_3[Si,Nb]$ $[S,Ti,Si][Si_3O_9]_2[Si_9O_{27}]_2 (O,OH)_5(Cl,F,H_2O)$. Cell parameters a

= 14.192(5), c = 30.20(1) Å, space group $R3$, D_{calc} = 2.88 g/cm³. The crystal structure has been refined from 2455 observed [$F >$ $5\sigma(F)$, Mo$K\alpha$] single-crystal data to $R_{aniso.}$ = 0.049. It shows the basic features of the eudialyte structure of three- and nine-membered rings of silicate tetrahedra and six-membered rings of RO_6 octahedra, which are cross-linked by ZrO_6 octahedra. Specific features of the structure include: (1) twelve A sites/subsites are dominated by Na except for $A4c$, which is dominated by Sr; (2) two distinct populations of $R^{2+}O_6$ octahedra, one dominated by Ca, the other, Mn; (3) spill-over of excess Zr to the $M2$ site, which is partly four-coordinated, partly five-coordinated; (4) splitting of the $M3$ site into two subsites, one occupied by Ti and Si, the other S; (5) splitting of the $M4$ site into three subsites, one occupied by Nb, the other two by Si. The structure is most similar to the eudialyte-group mineral raslakite. **T.S.E.**

HIGHLY CATION-ORDERED MEMBER OF THE LABUNTSOVITE GROUP

A.A. Zolotarev, Jr., S.V. Krivovichev, V.N. Yakovenchuk, Ya.A. Pakhomovsky, N.I. Organova, and T. Armbruster (2006) High degree of cation ordering in the structure of a new mineral of the labuntsovite group. Dokl. Akad. Nauk, 410, 86–90 (in Russian); Dokl. Earth Sci., 410, 1062–1065 (in English).

An apparently new member of the labuntsovite group has been found in a hydrothermal vein in the Khibiny massif, Kola Peninsula, Russia. Its average chemical composition is K_2O 6.96, Na_2O 2.64, BaO 10.42, FeO 0.48, MgO 0.34, MnO 1.24, TiO_2 22.26, Nb_2O_5 3.59, SiO_2 39.68, H_2O 12.39 (by difference), total 100 wt%, giving the semi-empirical formula $Na_{2.06}K_{3.58}Ba_{1.65}$ $(H_2O)_{1.58}(Mn_{0.42}Mg_{0.20}Fe^{2+}_{0.16})[Ti_{6.75}Nb_{0.65}(OH_{0.9}O_{0.1})_8(Si_4O_{12})_4] \cdot 1$ $1.5H_2O$. Space group $I2/m$, a = 14.278(1), b = 13.778(1), c = 15.592(2) Å, β = 116.76(1)°. The structure was solved and refined using 3349 observed [$F > 4\sigma(F)$] single-crystal data to $R1$ = 0.049, $wR2$ = 0.143. Pertinent features of the crystal structure are (1) three independent octahedral sites for Ti; (2) four independent tetrahedral sites for Si; (3) ordering of cations between the C and D sites (a first for labuntsovite-group minerals); in addition C and D are split into two subsites each, with Ba > H_2O at C1, H_2O > Ba at C2, $\square$ > Mn + Mg at D1 and Mn > $\square$ > Mg at D2. The mineral is essentially a highly cation-ordered variant of lemmleinite-Ba; however, the diffuse nature of reflections that double c indicates that ordering is incomplete. **T.S.E.**

LUOBUSAITE*

W. Bai, N. Shi, Q. Fang, G.Li, M. Xiong, J. Yang, H. Rong (2006) Luobusaite: A New Mineral. Acta Geologica Sinica, 80, no. 5, 656–659.

Luobusaite is found as irregular microcrystalline grains, 0.1 to 0.2 mm in size. The studied material was recovered from a crushed and sieved fraction, and minerals were separated using magnetic, electric and heavy liquid separation methods. It is steel gray with a black streak, metallic luster, is opaque and non-fluorescent. The mineral has a Mohs hardness of 7 and microindentation VHN100 of 1012-1145 (mean 1086) kg mm², it is brittle with conchoidal fracture and has no apparent cleavage. Electron microprobe analyses (average of 8 analyses) gave Si 55.24, Fe 44.40, Al 0.63, Cr 0.06, sum 100.33 wt% corresponding

to $Fe_{0.83}Si_2$ based on 2 atoms of Si. Reflectance percentages for R_{min} and R_{max} are 49.63 (400 nm), 44.41 (470 nm), 46.46 (540 nm), 49.71 (580 nm), 46.89 (650 nm), 47.74 (700 nm)

Single-crystal data was not acquired due to the lack of suitable material. Luobusaite is orthorhombic, *Cmca*, with unit-cell parameters refined from X-ray diffraction data $a = 9.784(14)$, $b = 7.784(5)$, $c = 7.829(7)$ Å, $V = 601.7(9)$ Å^3, $Z = 16$, $D_{calc} = 4.55$ g/cm^3. The strongest lines of the X-ray diffraction pattern (SMART APEX with CCD detector Mo$K\alpha$, 17 lines) include 3.06(80,220), 2.849(20,221), 2.402(25,312), 1.977(40,313), 1.889(60,041), 1.865(40,114), 1.844(100,422). Luobusaite is a part of a Fe-Si phase series including minerals such as gupeiite, xifengite, suessite, hapkeite, fersilicite and ferdisilicite from which it differs clearly by either its chemical composition, crystal system, space group or unit-cell parameters. It has a similar X-ray diffraction pattern to synthetic orthorhombic FeSi$_2$.

The mineral is from the Luobusa mine in a podiform chromitite of ophiolite 200 km southeast of Lhasa, in the Indus-Yarlung Zangbo suture zone in Tibet, China. Luobusaite is associated with diamond, moissanite, coesite, wustite, CrC, PGEM, Si-Fe alloys, base metal alloys, silicates, and various native elements. The mineral is named after the locality. Type material has been deposited at the Geological Museum of China. **R.R.**

MOGOVIDITE*

N.V. Chukanov, M.M. Moiseyev, R.K. Rastsvetayeva, K.A. Rozenberg, A.E. Zadov (2005) Golyshevite $(Na,Ca)_{10}Ca_9$ $(Fe^{3+},Fe^{2+})_2Zr_3NbSi_{25}O_{72}(CO_3)(OH)_3\cdot H_2O$, and Mogovidite, $Na_9(Ca,Na)_6Ca_6(Fe^{3+},Fe^{2+})_2Zr_3\square Si_{25}O_{72}(CO_3)(OH,H_2O)_4$, new eudialyte-group minerals from calcium-rich agpaitic pegmatites of the Kovdor massif, Kola Peninsula. Zap. Ross. Mineral. Obshch., 134(6), 36–47 (in Russian, English abstract).

The holotype sample of the new species mogovidite occurs in a narrow (<1 cm thick) nepheline-pectolite vein within the fine-grained ijolite of the northern face of the iron-ore quarry at the 115 m horizon of the Kovdor massif, Kola Peninsula, Russia. Other minerals in the vein are aegirine-augite, zircon, titanite, humite, andradite, scolecite and calcite. It is dark reddish brown in hand sample, with a white streak and glassy luster. Crystals (to 2 cm long) are tabular, less commonly idiomorphic; {001}, {101}, and {012} are dominant. Brittle, imperfect {001} cleavage, conchoidal fracture, Mohs' hardness 5.5, $D_{meas} = 2.90$, $D_{calc} = 2.908$ g/cm^3. Uniaxial (–), weakly pleochroic (colorless to yellow), $\varepsilon = 1.611(2)$, $\omega = 1.618(1)$. Analysis by electron microprobe, IR spectroscopy, Mössbauer spectroscopy and thermogravimetric studies gives the average composition: Na$_2$O 9.78, K$_2$O 0.36, CaO 18.03, MnO 0.68, FeO 1.32, Fe$_2$O$_3$ 3.78, La$_2$O$_3$ 0.15, Ce$_2$O$_3$ 0.28, SiO$_2$ 47.49, TiO$_2$ 0.23, ZrO$_2$ 11.90, Nb$_2$O$_5$ 1.72, Cl 0.52, H$_2$O 1.25, CO$_2$ 1.42, O = Cl –0.12, total 98.82 wt%, resulting in the empirical formula $(Na_{9.87}Ca_{4.05}K_{0.24}Ce_{0.06}La_{0.03})_{\Sigma14.25}(Ca_{6.00}Fe^{3+}_{1.48}Fe^{2+}_{0.58}$ $Mn_{0.30}Zr_{3.02}Ti_{0.09})_{\Sigma11.47}(Nb_{0.40}Si_{0.71})_{\Sigma1.11}Si_{24}O_{72}(OH)_{2.86}(CO_3)_{1.03}Cl_{0.46}$ $\cdot0.74H_2O$ (based on 24.71 Si), or ideally $Na_9(Ca,Na)_6Ca_6(Fe^{3+},$ $Fe^{2+})_2Zr_3\square Si_{25}O_{72}(CO_3)(OH,H_2O)_4$. The mineral is trigonal, space group $R3m$, $a = 14.232(3)$, $c = 30.210(3)$ Å (single-crystal diffractometry). The strongest lines in the X-ray powder diffractogram are [d Å, I% (hkl)]: 4.31, 64 (205); 3.213, 100 (208, 306,

036); 3.027, 65 (119, $\bar{1}$19, 042); 2.977, 91 (315, 13$\bar{5}$); 2.859, 79 (404). Crystal-structure analysis is presented elsewhere [Rozenberg et al., 2005, Dokl. Ross. Akad. Nauk, 400(5)]; the mineral possesses the basic features of the eudialyte structure. Golyshevite is a member of the eudialyte group, a CO$_3$-dominant analog of feklichevite with site vacancies dominant at $M3$. Like golyshevite, the presence of this calcium-rich mineral species in agpaitic pegmatites is anticipated to be a reflection of the "hybrid" nature of the pegmatites, i.e., via contamination from surrounding rocks.

In addition, mogovidite also occurs in the dumps at the Mica quarry, pegmatite no. 10 of the Kovdor massif, in samples of agpaitic pegmatite that also contain cancrinite, hedenbergite, pectolite, thompsonite-Ca, and calcite. It has the composition Na$_2$O 10.16, K$_2$O 0.58, CaO 18.13, MnO 0.57, FeO 4.53, ZrO$_2$ 11.74, Nb$_2$O$_5$ 1.70, SiO$_2$ 49.63, Cl 0.31, O = Cl$_2$ –0.07, total 97.28, which gives the empirical formula: $Na_{9.92}K_{0.38}Ca_{9.78}Fe_{1.91}Mn_{0.24}$ $Zr_{2.89}Nb_{0.39}Si_{25}O_{72}(CO_3)_{>1}(OH, F, O, H_2O)_x$ (per 25 Si atoms).

Type material has been deposited with the A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow (catalog nos. 3221/1 and 3290/1).

Discussion. No data are presented on compositional zoning in the mineral. The extremely similar Na:Ca ratios for mogovidite from ijolite-hosted pegmatite veins vs. mogovidite from veins hosted by calcite carbonatite seem to contradict to the authors' genetic model. **T.S.E.**

NEW DATA

EPIDOTE GROUP*

T. Armbruster, P. Bonazzi, M. Akasaka, V. Bermanec, C. Chopin, R. Gieré, S. Heuss-Assbichler, A. Liebscher, S. Menchetti, Y. Pan, M. Pasero (2006) Recommended nomenclature of epidote-group minerals. Eur. J. Mineral., 18, 551–567.

The recommended nomenclature presented here is the result of the work of the IMA-CNMMN Subcommittee on Epidote-Group Mineral Nomenclature, which was established in 2003. The Subcommittee presents obvious problems with the epidote group, a historical synopsis, and finally a recommended nomenclature which will minimize proliferation of unrelated mineral names, and which will provide a simple scheme to derive a species name for any epidote-group mineral based on electron-microprobe data. The general formula for any epidote-group mineral is given as $A_2M_3[T_2O_7][TO_4](O,F)(OH,O)$. All species are monoclinic, space group $P2_1/m$. Zoisite is an orthorhombic polymorph of clinozoisite and is thus not considered a member of the epidote-group. Three main subgroups are recognized:

1. Clinozoisite subgroup: members are derived from the mineral clinozoisite $Ca_2Al_3[Si_2O_7][SiO_4]O(OH)$ by homovalent substitutions only.

2. Allanite subgroup: REE-rich minerals that may be derived from the mineral clinozoisite by homovalent substitutions and *one* couple heterovalent substitution.

3. Dollaseite subgroup: REE-rich minerals that may be derived from the mineral clinozoisite by homovalent substitutions and *two* coupled heterovalent substitutions.

A mineral name can be assigned only after determination of

the proper subgroup by assessing the dominant cation valence at M3, M1, and A2. In addition, the dominant valence on O4 (X$^-$ or X^{2-}) must be determined. Several old epidote-group mineral names have been reviewed and revised. Formal guidelines and examples are provided in the report. **P.C.P.**

OTWAYITE*, PARAOTWAYITE*

R.L. Frost, M.L. Weier, W.N. Martens, S.J. Mills (2006) The hydroxylated nickel carbonates otwayite and paraotwayite—a SEM, EDX, and vibrational spectroscopic study. Neus. Jb. Mineral. Abh., 183, 107–116.

Otwayite, ideally $Ni_2(OH)_2CO_3 \cdot H_2O$, and paraotwayite, ideally $Ni(OH)_{2-x}(SO_4,CO_3)_{0.5x}$ (where x ~ 0.6), were first described from the Otway Ni prospect, 23 km north of the town of Nullagine, Pilbara region, Western Australia. Otwayite and paraotwayite are virtually undistinguishable in hand sample. Single-crystal studies of the two minerals have not been performed due to their fibrous habit. This study utilizes SEM, EDX and vibrational spectroscopy (Raman, FTIR) to characterize the species. Otwayite appears fractured in SEM images, whereas paraotwayite shows a porous, network texture. EDX analyses of otwayite (semi-quantitative) gave NiO 60.1, CO_3^{2-} 26.7, and SO_4^{2-} 3.4, sum 90.2 wt%, corresponding to the formula $Ni_2(OH)_2(CO_3)_{0.88}(SO_4)_{0.12} \cdot H_2O$. EDX analyses of paraotwayite (semi-quantitative) gave NiO 57.8, SO_4^{2-} 22.27, CO_3^{2-} 13.92, sum 93.99 wt%, corresponding to the formula $Ni(OH)_{1.4}(SO_4,CO_3)_{0.3}$. It is suggested that paraotwayite forms through the replacement of carbonate by sulfate via the reaction $Ni_2(OH)_2(CO_3) \cdot H_2O + H_2SO_4 \rightarrow Ni(OH)_{2-x}(SO_4,CO_3)_{0.5x} + nH_2O + nCO_2$ (where x ~ 0.6). The pore-like habit of paraotwayite maybe be the result of evolution of carbon dioxide via the above reaction. Extensive FTIR and Raman spectroscopy studies were performed and are deemed to be useful in the identification of otwayite and paraotwayite, and as a means of determining the approximate ratio of CO_3^{2-} and SO_4^{2-}, therefore determining the position of the species in the otwayite-paraotwayite solid solution. **P.C.P.**

PERHAMITE*

S. Mills, G. Mumme, I. Grey, P. Bordet (2006) The crystal structure of perhamite. Mineral. Mag., 70, 201–209.

Perhamite was encountered at the Moculta quarry, Mount Lofty Ranges, South Australia, where it occurs as crandallite-like bladed rosettes on a matrix of apatite and quartz. Crystal quality precluded single-crystal structure analysis; however, crystals of perhamite from the Emmons pegmatite, Greenwood, Maine were sufficient for structure analysis. Four electron microprobe analyses of perhamite samples from the Emmons quarry gave an average of P_2O_5 21.24, CaO 11.66, SiO_2 13.47, Al_2O_3 29.33, H_2O (by diff.) 24.2 wt%, very similar to the analysis of the type sample from the Bell pit, Newry, Maine. Upper-level precession photographs about c^* show trigonal symmetry. Single-crystal X-ray intensity data collection involving a CCD

area detector (295 K; Mo$K\alpha$; 847 total unique reflections, 618 unique observed [$F > 4\sigma(F)$] reflections; $R_1 = 0.070$, R_{1obs} 0.044, $wR_2 = 0.157$) gave $a = 7.021(1)$, $c = 20.218$ Å, average space group $P\bar{3}m1$, $D_{calc} = 2.49$ g/cm^3. The crystal structure consists of ordered blocks of a well-defined crandallite-type structure separated by ill-defined, disordered regions. The crandallite-type region shows six-coordinated Al and four-coordinated P; the disordered region shows TO_4 tetrahedra predominantly occupied by Si, and is cross-linked to the crandallite region by tetrahedra predominantly occupied by Al. Corner linking of the AlO_4 and SiO_4 tetrahedra results in 4-member rings that are interconnected in (001) planes to form chains. Framework connectivity between the crandallite and disordered regions results in zeolitic cavities occupied by Ca and H_2O. The average structure combined with the chemical analysis indicates that the formula of perhamite is $(Ca,Sr)_3Al_{7.7}Si_3P_4O_{23.5}(OH)_{14.1} \cdot 8H_2O$. The authors discuss two possibilities for local ordering in the disordered region of the structure. One of these involves a non-centrosymmetric arrangement of AlO_4 and SiO_4 tetrahedra; the other involves five-coordinated Si. At the present it is not possible to state which model is more likely. **T.S.E.**

ZN-RICH KUPLETSKITE

P.C. Piilonen, I.V. Pekov, M. Back. T. Steede, R.A. Gault (2006) Crystal-structure refinement of a Zn-rich kupletskite from Mont Saint-Hilaire, Quebec, with contributions to the geochemistry of zinc in peralkaline environments. Mineral. Mag., 70, 565–578.

The chemistry and crystal structure of a unique Zn-rich kupletskite: $(K_{1.55}Na_{0.21}Rb_{0.09}Sr_{0.01})_{\Sigma1.86}(Na_{0.82}Ca_{0.18})_{\Sigma1.00}(Mn_{4.72}Zn_{1.66}Na_{0.41}Mg_{0.12}Fe^{2+}_{0.09})_{\Sigma7.00}(Ti_{1.85}Nb_{0.11}Hf_{0.03})_{\Sigma1.99}(Si_{7.99}Al_{0.12})_{\Sigma8.11}O_{26}(OH)_4(F_{0.77}OH_{0.23})_{\Sigma1.00}$, from analkaline pegmatite at Mont Saint-Hilaire, Quebec, Canada has been determined. Zn-rich kupletskite is triclinic, $P1$, $a = 5.3765(4)$, $b = 11.8893(11)$, $c = 11.6997(10)$ Å, $\alpha = 113.070(3)$, $\beta = 94.775(2)$, $\gamma = 103.089(3)°$, $R1 = 0.0570$ for 3757 observed reflections with $F_o > 4\sigma(F_o)$. From the single-crystal X-ray diffraction refinement, it is clear that Zn^{2+} shows a preference for the smaller, *trans M*4 site (69%), yet is distributed amongst all three octahedral sites coordinated by 4 O^{2-} and 2 OH$^-$ (M2 58% and M3 60%). Of note is the lack of Zn in M1, the larger and least-distorted of the four crystallographic sites, with an asymmetric anionic arrangement of 5 O^{2-} and 1 OH$^-$. The preference of Zn for octahedral sites coordinated by mixed ligands (O and OH) is characteristic of its behavior in alkaline systems, in contrast to granitic systems where Zn tends to favor four-coordinated, OH- and H_2O-free sites with only one ligand species (O, S, Cl, B, I). In alkaline systems, [4]Zn is only present in early sphalerite or in late-stage zeolite-like minerals. The bulk of Zn in alkaline systems is present as discrete [6]Zn phases such as members of the astrophyllite, labuntsovite, milarite and nordite groups, a result of the formation of network-forming $Zn(OH)^{42-}$ complexes inthe low-temperature, low-f_{S_2}, high-alkalinity, and highly oxidizing systems. **P.C.P.**