

## New Mineral Names\*

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## AKLIMAITE\*

A.E. Zadov, I.V. Pekov, N.V. Zubkova, V.M. Gazeev, N.V. Chukanov, V.O. Yapaskurt, P.M. Kartashov, E.V. Galuskin, I.O. Galuskina, N.N. Pertzov, A.G. Gurbanov, and D.Yu. Pushcharovsky (2012) Aklimaite,  $\text{Ca}_4[\text{Si}_2\text{O}_5(\text{OH})_2](\text{OH})_4 \cdot 5\text{H}_2\text{O}$ , a new natural hydrosilicate from Lakargi area (the North Caucasus, Russia). *Zap. Ross. Mineral. Obsch.*, 141(2), 21–31 (in Russian, English abstract).

N.V. Zubkova, I.V. Pekov, D.Yu. Pushcharovsky, A.E. Zadov, and N.V. Chukanov (2012) The crystal structure of aklimaite,  $\text{Ca}_4[\text{Si}_2\text{O}_5(\text{OH})_2](\text{OH})_4 \cdot 5\text{H}_2\text{O}$ . *Zeitschrift für Kristallographie*, 228, 452–455.

A new mineral aklimaite,  $\text{Ca}_4[\text{Si}_2\text{O}_5(\text{OH})_2](\text{OH})_4 \cdot 5\text{H}_2\text{O}$  with a new structure type, has been discovered in the xenolith of skarned limestone in ignimbrite at Upper Chegem (Verkhnechegemskaya) Caldera near the Lakargi Mt. in interfluvial of Chegem and Kenstanta Rivers, Kabardino-Balkaria, Northern Caucasus, Russia. The mineral found in a single specimen in xenolith no. 1 in porcelain looking altered lamite skarn with wadalite, hydrogarnets, and calcium members of humite group. Aklimaite occurs in a fracture and forms intergrown spherulites 3 and 5 mm in diameter sitting on fine fibrous spherulites of bultfonteinite and covered with colorless isometric crystals of ettringite. The rest of the cavity's volume filled with spherulites of afwillite. Aklimaite crystals in spherulites are columnar or lath-shaped up  $3 \times 0.1 \times 0.01$  mm in size, flattened by (001) and elongate along [010]. The mineral is colorless or light-pinkish and vitreous. It is brittle with Mohs hardness 3–4; the cleavage is perfect by {001}.  $D_{\text{meas}} = 2.20(1)$ ;  $D_{\text{calc}} = 2.274$  g/cm<sup>3</sup>. The lower value of  $D_{\text{meas}}$  caused by the presence of micro cavities in blocky crystals. Aklimaite is optically biaxial negative,  $2V_{\text{obs}} > 70^\circ$ ,  $2V_{\text{calc}} = 78^\circ$ ;  $\alpha = 1.548(2)$ ,  $\beta = 1.551(3)$ ,  $\gamma = 1.553(2)$ ;  $Z = b$ . IR spectra were obtained using Specord-75IR spectrometer. The major absorption bands are (cm<sup>-1</sup>; strongest lines underscored, sh = shoulder): 3575sh, 3510, 3300 (O-H stretching vibrations), 1650 (deformation vibration of H<sub>2</sub>O), 1430, 1280 (Si-OH vibrations), 1015, 965, 900 (Si-O stretching vibrations), 833, 728 (supposed deformation vibrations Ca···O-H), 685, 650, 621 (deformation vibration O-Si-O),

529, 492, 463sh (superimposed deformation vibration Si-O-Si, stretching vibration Ca-O and libration vibration H<sub>2</sub>O). Raman spectra is given and discussed. Chemical composition was determined by MPA in EDS and WDS modes. The average (range) of 9 analysis gave: Na<sub>2</sub>O 0.06 (0.03–0.09), K<sub>2</sub>O 0.02 (0–0.03), CaO 45.39 (43.0–47.4), MnO 0.01 (0–0.03), FeO 0.02 (0–0.07), SiO<sub>2</sub> 24.23 (22.9–25.3), SO<sub>3</sub> 0.04 (0–0.10), F 3.22 (2.8–3.5), H<sub>2</sub>O<sub>calc</sub> 27.40, –O=F<sub>2</sub> –1.36, total 99.03 wt%. The content of other elements heavier than O was below detection limit. The absence of CO<sub>2</sub> confirmed by IR data. The ratio O<sup>2-</sup>/(OH) calculated based on structural data. Empirical formula, calculated on the basis of Si = 2 with O + OH + F = 16, is:  $(\text{Ca}_{4.02}\text{Na}_{0.01})_{\Sigma 4.03}[\text{Si}_{2.00}\text{O}_{5.07}(\text{OH})_{1.93}][(\text{OH})_{3.16}\text{F}_{0.84}]_{\Sigma 4.00} \cdot 5\text{H}_2\text{O}$ . Idealized formula is:  $\text{Ca}_4[\text{Si}_2\text{O}_5(\text{OH})_2](\text{OH})_4 \cdot 5\text{H}_2\text{O}$ . X-ray powder diffraction data were obtained by Gandolphi method using single-crystal diffractometer Stoe IPDS II with IP detector (MoK $\alpha$  radiation). The strongest lines on the diffraction pattern [ $d_{\text{obs}}$  in angstroms ( $I_{\text{obs}}\%$ ,  $hkl$ )] are: 11.64 (100, 001), 8.30 (10,  $\bar{2}01$ ), 3.073 (20,  $\bar{4}04$ ,  $\bar{3}11$ ), 2.948 (32, 310, 203), 2.901 (11, 004), 2.576 (10,  $\bar{2}05$ ,  $\bar{4}05$ ), 2.320 (12, 005, 510) with refined unit-cell parameters of  $a = 16.91(4)$ ,  $b = 3.666(4)$ ,  $c = 13.08(3)$  Å,  $\beta = 117.4(2)^\circ$ ,  $V = 720(3)$  Å<sup>3</sup>. The single-crystal X-ray data for aklimaite were obtained using Xcalibur S CCD diffractometer (MoK $\alpha$  radiation). The mineral is monoclinic,  $C2/m$ ,  $a = 16.907(5)$ ,  $b = 3.6528(8)$ ,  $c = 13.068(4)$  Å,  $\beta = 117.25(4)^\circ$ ,  $V = 717.5(4)$  Å<sup>3</sup>,  $Z = 2$ . The crystal structure was solved by direct methods and refined to  $R = 0.1100$  for 1196 unique reflections with  $I > 2\sigma(I)$ . Aklimaite is a representative of the new structure type. It is a sorosilicate with disilicate groups  $[\text{Si}_2\text{O}_5(\text{OH})_2]$ . Its structure based on corrugated layers formed by extended along b edge-sharing  $\text{Ca}1\text{O}_4(\text{OH})_2$  octahedra alternating with seven-vertex polyhedra  $\text{Ca}2\text{O}_4(\text{OH})_2(\text{OH}, \text{H}_2\text{O})$ , which are connected by common edges with another type of seven-coordinated polyhedra  $\text{Ca}3(\text{OH})(\text{OH}, \text{H}_2\text{O})_4(\text{H}_2\text{O})_2$ . Diorthogroups  $\text{Si}_2\text{O}_5(\text{OH})_2$  form interrupted chains in which they are related by hydrogen bonds and sharing edge O–O with Ca2 polyhedra of the layers. The name was derived from a Turkish women's name, "Aklima", which means bright by the mind. There is a double allusion to light color of the mineral and to the challenge of study complex crystal structure on imperfect crystal. The Turkish name had been chosen because of the population in the area. Both the mineral and its name have been approved by the IMA CNMNC (IMA 2011-050). The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **D.B.**

\* All minerals marked with an asterisk have been approved by the IMA CNMNC. E-mail: ktait@rom.on.ca

**DAVINCIITE\***

- A.P. Khomyakov, G.N. Nechelyustov, R.K. Rastsvetaeva, and K.A. Rozenberg (2012) Davinciite,  $\text{Na}_{12}\text{K}_3\text{Ca}_6\text{Fe}^{2+}_3\text{Zr}_3(\text{Si}_{26}\text{O}_{73}\text{OH})\text{Cl}_2$ , a new K, Na-ordered mineral of the eudialyte group from the Khibiny alkaline massif, Kola Peninsula, Russia. *Zap. Ross. Mineral. Obsch.*, 141, 2, 10–21 (in Russian, English abstract).
- R.K. Rastsvetaeva, K.A. Rozenberg, and A.P. Khomyakov (2009) Crystal structure of high-silica K,Na-ordered acentric eudialyte analogue. *Doklady Akademii Nauk* 424, 1, 53–56 (in Russian). English translation: *Doklady Chemistry* (2009), 424, 11–14.

The new mineral davinciite (third known potassium member of the eudialyte group) was discovered at the Rasvumchorr Mt., Khibiny massif, Kola Peninsula, Russia. It was found in a hyperalkaline pegmatite up to 3 m thick in urtite rocks under apatite ore. The pegmatite mainly consists of coarse-grained aggregate of nepheline, sodalite, potassium feldspar, aegirine-diopside, aenigmatite, and alkaline amphibole. Associated minerals in interstitials between or as pseudomorphs after the main minerals are: fibrous aegirine, lamprophyllite, lomonosovite, shcherbakovite, delhayelite, pectolite, natrolite villiaumite, natrite, thermonatrite, nacaphite, phosinaite, ol ympite, rasvumite, djerfisherite, sphalerite, galena, molybdenite, and rastsvetaevite. The last one forms aggregates of grains (0.3–2 cm), which serve as a matrix where the smaller isometric grains (0.3–2 mm) of davinciite are sporadically distributed. Davinciite has mostly the same orientation as a host light pink rastsvetaevite and can be easily distinguished by the dark lilac color. The mineral is transparent; vitreous; the streak is white. Mohs hardness 5; brittle. No cleavage or parting were observed. The fracture is conchoidal.  $D_{\text{meas}} = 2.82(2)$ ,  $D_{\text{calc}} = 2.848 \text{ g/cm}^3$ . Optically uniaxial, positive,  $N_o = 1.603(2)$ ,  $N_e = 1.605(2)$ ; non-pleochroic; non-fluorescent under UV light. The mineral slowly dissolves and gelatinizes in the 50% solutions of HCl and  $\text{HNO}_3$ . The major absorption bands of IR spectrum are ( $\text{cm}^{-1}$ , s–strong, w–weak): 3590w, 3450w, 3350w, 1650w, 1046s, 1021s, 989s, 967s, 930s, 738s, 699, 657, 544s, 480s, 450s. Chemical composition was determined using JEOL Superprobe 733 (WDS). Water content calculated using structural data. The average (range) of five analysis in each of five grains gave:  $\text{Na}_2\text{O}$  12.69 (12.31–13.03),  $\text{K}_2\text{O}$  3.53 (3.40–3.71),  $\text{CaO}$  11.02 (10.90–11.08),  $\text{SrO}$  0.98 (0.90–1.11),  $\text{BaO}$  0.15 (0.10–0.23),  $\text{FeO}$  5.33 (5.19–5.51),  $\text{MnO}$  0.37 (0.34–0.40),  $\text{Al}_2\text{O}_3$  0.07 (0.06–0.07),  $\text{SiO}_2$  51.20 (50.91–51.39),  $\text{TiO}_2$  0.39 (0.26–0.52),  $\text{ZrO}_2$  11.33 (11.21–11.40),  $\text{HfO}_2$  0.21 (0.17–0.23),  $\text{Nb}_2\text{O}_5$  0.09 (0.08–0.10),  $\text{Cl}$  1.89 (1.82–2.01),  $\text{H}_2\text{O}$  0.93,  $-\text{O}=\text{Cl}_2$  –0.43, total 99.75. The empirical formula (based on  $\text{Si}+\text{Al}+\text{Zr}+\text{Hf}+\text{Ti}+\text{Nb}=29$ ) assuming Fe as  $\text{FeO}$  is:  $(\text{Na}_{11.75}\text{Sr}_{0.29}\text{Ba}_{0.03})_{\Sigma 12.07}(\text{K}_{2.28}\text{Na}_{0.72})_{\Sigma 3.00}\text{Ca}_{5.99}(\text{Fe}_{2.26}\text{Mn}_{0.16})_{\Sigma 2.42}(\text{Zr}_{2.80}\text{Ti}_{0.15}\text{Hf}_{0.03}\text{Nb}_{0.02})_{\Sigma 3.00}(\text{Si}_{1.96}\text{Al}_{0.04})_{\Sigma 2.00}[\text{Si}_3\text{O}_9]_2[\text{Si}_9\text{O}_{27}]_2[(\text{OH})_{1.42}\text{O}_{0.58}]_{\Sigma 2.00}[\text{Cl}_{0.62}(\text{H}_2\text{O})_{0.38}]_{\Sigma 2.00}\cdot 0.48\text{H}_2\text{O}$ . The simplified formula:  $\text{Na}_{12}\text{K}_3\text{Ca}_6\text{Fe}^{2+}_3\text{Zr}_3(\text{Si}_{26}\text{O}_{73}\text{OH})\text{Cl}_2$ . Powder X-ray data were obtained using powder diffractometer X'Pert PRO Analytical (CuK $\alpha$  radiation). The strongest lines of the diffraction pattern [ $d_{\text{obs}}$  in Å ( $I_{\text{obs}}\%$ ,  $hkl$ )] include: 6.415 (54, 104), 5.720 (36, 202), 4.309 (66, 205), 3.207 (63, 208), 3.162(43, 217), 2.981 (100, 315), 2.860 (96, 404), 2.595(37, 309). Davinciite is

trigonal, the unit-cell parameters are  $a = 14.292$  and  $c = 30.027$  Å. Single-crystal X-ray data were collected using single-crystal diffractometer Bruker SMART 1000 CCD (MoK $\alpha$  radiation). The crystal structure was solved by direct methods in acentric space group and refined to  $R = 0.039$  for 1427 unique reflections with  $F_o > 3\sigma(F)$ . The unit-cell parameters are:  $a = 14.2956(2)$ ,  $c = 30.0228(5)$  Å,  $V = 5313.6(2)$  Å<sup>3</sup>, space group  $R3m$ ,  $Z = 3$ . The crystal structure of davinciite has 12 layers and is very close to one of two 12-layered fragments of rastsvetaevite modular structure. In this fragment, as in davinciite, the positions N3 and N4 of the eudialyte-group structural formula are predominantly occupied by K and Na, respectively. That is the main cause of centrosymmetry breakdown. The main structural features of davinciite are reflected in its crystal-chemical formula:  $\text{Na}_9[\text{K}_{2.3}\text{Na}_{0.7}][\text{Na}_{2.7}\text{Sr}_{0.3}][\text{Ca}_6][\text{Fe}^{4+}_{2.25}\text{Mn}^{6+}_{0.15}][\text{Zr}_{2.8}\text{Ti}_{0.2}][\text{Si}_i(\text{OH})_i][\text{Si}_1(\text{OH})_1][\text{Si}_9(\text{OH})_{27}]_2[\text{Si}_3\text{O}_9]_2\text{Cl}_{1.6}(\text{OH})_{0.3}\cdot 0.9\text{H}_2\text{O}$ . The position of davinciite in the crystal-chemical systematic of the eudialyte group, its relationships with other group members (acentric eudialyte, andrianovite, kentbrooksit, and potential new minerals of the group) are discussed as well as localization of the mineral in magmatic rocks of Khibiny alkaline massif and its formation and transformation to other minerals. The mineral was named for Leonardo da Vinci (1452–1519), famous Italian scientist, painter, sculptor, and an architect. There is also an allusion of acentric mineral structure to the fact that Leonardo da Vinci has widely used asymmetry in his artwork. Both the mineral and its name have been approved by the IMA CNMNC (IMA 2011-019). Type specimens are deposited at the Fersman Mineralogical Museum RAS, Moscow, Russia. **D.B.**

**MENZERITE-(Y)**

- E.S. Grew, J.H. Marsh, M.G. Yates, B. Lazic, T. Armbruster, A. Locock, S.W. Bell, M.D. Dyer, and H-J. Bernhardt (2010) Menzerite-(Y), a new species,  $\{(\text{Y,REE})(\text{Ca,Fe}^{2+})_2\}[(\text{Mg,Fe}^{2+})(\text{Fe}^{3+},\text{Al})](\text{Si}_3\text{O}_{12})$ , from a felsic granulite, Parry Sound, Ontario, and a new garnet end-member,  $\{\text{Y}_2\text{Ca}\}[\text{Mg}_2](\text{Si}_3\text{O}_{12})$ . *Canadian Mineralogist*, 48, 1171–1193.

Menzerite-(Y) (IMA 2009-050) is a new garnet species corresponding to a new Y-dominant end-member  $\{\text{Y}_2\text{Ca}\}[\text{Mg}_2](\text{Si}_3\text{O}_{12})$ . The most Y-rich crystal analysed (electron microprobe, WDS) has a formula  $(\text{Y}_{0.83}\text{Gd}_{0.01}\text{Dy}_{0.05}\text{Ho}_{0.02}\text{Er}_{0.07}\text{Tm}_{0.01}\text{Yb}_{0.06}\text{Lu}_{0.02}\text{Ca}_{1.37}\text{Fe}^{2+}_{0.49}\text{Mn}_{0.07})[\text{Mg}_{0.55}\text{Fe}^{2+}_{0.42}\text{Fe}^{3+}_{0.58}\text{Al}_{0.35}\text{V}_{0.01}\text{Sc}_{0.01}\text{Ti}_{0.08}](\text{Si}_{2.82}\text{Al}_{0.18})\text{O}_{12}$ . The absence of Si and the dominance of divalent cations with  $\text{Mg} > \text{Fe}^{2+}$  at the octahedrally coordinated Y-site is diagnostic of menzerite-(Y). The garnet is in a felsic granulite of the Grenville Province at Bonnet Island, Parry Sound, Ontario. It occurs as composite euhedral crystals in which it forms distinct dark reddish-brown cores surrounded by paler almandine rims, with optically and compositionally sharp interfaces between the two garnets. Crystal structure refinement on a small ( $48 \times 10^{-6} \text{ mm}^3$ ) composite crystal using single-crystal XRD. While menzerite-(Y) and almandine components are discrete, there was significant overlap of diffraction patterns that required careful treatment and data reduction procedures for both components, as discussed in detail by the authors. Structures of menzerite-(Y) and almandine were refined to final agreement indices  $R_1/wR_2 = 0.030/0.044$  and  $0.052/0.130$ , respectively. An attempt

was made to determine  $\text{Fe}^{2+}/\text{Fe}^{3+}$  using X-ray absorption spectroscopy (micro-XANES), but this was not entirely satisfactory and only broadly agreed with the  $\text{Fe}^{2+}/\text{Fe}^{3+}$  inferred from stoichiometry based upon EMPA. However, XANES did show that  $\text{Fe}^{3+}/\Sigma\text{Fe}$  is significantly lower in almandine than in coexisting menzerite-(Y). Menzerite-(Y) is cubic, space group  $Ia\bar{3}d$  ( $Z = 4$ ). The  $a$  parameters of menzerite-(Y) and almandine refined from the single-crystal study are 11.9947(6) and 11.6598(8) Å, respectively ( $Z = 4$ ). No powder XRD data were collected, due to the paucity of material available. However, calculated powder diffraction data are reported for which the most significant  $d_{hkl}$  are [ $d$  in Å ( $I\%$ ,  $hkl$ )]: 2.6821 (100, 420), 1.6029 (44, 642), 2.9987 (36, 400), 2.4484 (422), 1.6634 (30, 640), 1.3087 (18, 842), 2.1899 (17, 521), 1.9458 (17, 532), 1.7313 (13, 444). Microtextures indicate that menzerite-(Y) is an early formed phase that was preserved by being armored by almandine and, in some cases, K-feldspar. Menzerite-(Y) was never seen to be in contact with other major phases including magnetite, quartz, ilmenite, ferrosilite, and oligoclase, indicating that is likely unstable when these minerals formed. There is no evidence for the stable coexistence of almandine and menzerite-(Y): it only occurs as a discrete overgrowth on menzerite-(Y). Physical properties were difficult to measure due to the small grain-size. The refractive index is 1.84(2) at 580 nm. The Gladstone-Dale index is 0.003 (excellent). **M.D.W.**

#### SCHÜLLERITE\*

N.V. Chukanov, R.K. Rastsvetaeva, S.N. Britvin, A.A. Viryus, D.I. Belakovskiy, I.V. Pekov, S.M. Aksenov, and B. Ternes (2011) Schüllerite,  $\text{Ba}_2\text{Na}(\text{Mn,Ca})(\text{Fe}^{3+},\text{Mg,Fe}^{2+})_2\text{Ti}_2(\text{Si}_2\text{O}_7)_2(\text{O,F})_4$ , a new mineral from Eifel volcanic region, Germany. Zap. Ross. Mineral. Obshch., 140(1), 67–75 (in Russian, English abstract). English translation: Geol. Ore Deposits, (2011), 53(8), 767–774.

R.K. Rastsvetaeva, S.M. Aksenov, and N.V. Chukanov. (2011) Crystal structure of schüllerite, a new mineral of the heterophyllosilicate family. Doklady Akademii Nauk, 437, 4, 499–503 (in Russian). English translation: Doklady Chemistry (2011), 437, 90–94.

A new heterophyllosilicate schüllerite was discovered in the basalt quarry Löhley, in the Eifel volcanic region, near the village Üdersdorf, Rheinland-Pfalz (Rhineland-Palatinate), Germany. The mineral was found in miarolitic cavities in alkaline basalt in the late pneumatolitic association, which includes nepheline, leucite, augite, phlogopite, magnetite, titanite, fersnoite, fluorapatite, perovskite, and pyrochlore. Schüllerite forms brown flattened crystals up to  $0.5 \times 1 \times 2$  mm and their intergrowths up to 2 mm or oriented growths with lamprophyllite-group mineral. The streak is white. The mineral has perfect cleavage on  $\{001\}$ , is brittle with Mohs hardness of 3–4. Density was not measured.  $D_{\text{calc}} = 3.974 \text{ g/cm}^3$ . Schüllerite is optically biaxial, negative,  $\alpha = 1.756(3)$ ,  $\beta = 1.773(4)$ ,  $\gamma = 1.780(4)$ ,  $2V = 40(20)^\circ$ . Dispersion of optical axes is weak,  $r < v$ . Pleochroism is medium,  $X > Y > Z$  (brown to dark brown),  $Z \wedge c = 20^\circ$ . IR spectrum significantly differs from other heterophyllosilicates. The main absorption bands ( $\text{cm}^{-1}$ ,  $s = \text{strong}$ ,  $sh = \text{shoulder}$ ) are: 1013, 950sh, 892s, 849s (Si–O stretching vibrations), 670sh, 654 (bending vibra-

tions O–Si–O of  $\text{Si}_2\text{O}_7$ ), 570, 526 (Ti–O stretching vibrations in polyhedra  $\text{TiO}_5$ ), 454s, 389s (superposition of stretching and bending vibrations Si–O–Si in octahedra centered by  $\text{Fe}^{3+}$ ,  $\text{Fe}^{2+}$ , Mn, Mg, Ca). No bands due to  $\text{OH}^-$ ,  $\text{CO}_3^{2-}$ , or  $\text{H}_2\text{O}$  present. The data for the chemical composition were obtained using microprobe Tescan Vega II XMU with EDS. The content of  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$  determined by the ratio of intensities  $I(\text{FeK}\beta_3)/I(\text{FeK}\beta_1)$  the X-ray spectrum. The average (range) of five analyses (WDS) is (wt%):  $\text{Na}_2\text{O}$  3.55 (3.26–3.72),  $\text{K}_2\text{O}$  0.55 (0.45–0.62),  $\text{MgO}$  3.89 (3.77–4.05),  $\text{CaO}$  2.62 (2.42–2.91),  $\text{SrO}$  1.99 (1.55–2.39),  $\text{BaO}$  28.09 (27.28–29.30),  $\text{FeO}$  3.43,  $\text{Fe}_2\text{O}_3$  8.89 (12.62–12.80 for  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$  as  $\text{FeO}$ ),  $\text{Al}_2\text{O}_3$  1.33 (1.21–1.48),  $\text{TiO}_2$  11.17 (10.97–11.35),  $\text{Nb}_2\text{O}_5$  2.45 (2.10–2.88),  $\text{SiO}_2$  26.12 (26.00–26.29), F 2.12 (1.85–2.38),  $-\text{O}=\text{F}_2$  –0.89, total 98.98. P, S, V, Cr, Ni, Zn, Y, Zr, Ln, Th, and U were not detected. The empirical formula based on  $\text{O} + \text{F} = 18$  is  $(\text{Ba}_{1.68}\text{Sr}_{0.18}\text{K}_{0.11}\text{Na}_{1.05}\text{Ca}_{0.43}\text{Mn}_{0.47}\text{Mg}_{0.88}\text{Fe}_{0.44}^{2+}\text{Fe}_{1.02}^{3+}\text{Ti}_{1.28}\text{Nb}_{0.17}\text{Al}_{0.24})_{\Sigma 7.95}\text{Si}_{3.98}\text{O}_{16.98}\text{F}_{1.02}$ . The idealized formula based on structural data is  $(\text{Mn,Ca})(\text{Fe}^{3+},\text{Mg,Fe}^{2+})_2\text{Ti}_2(\text{Si}_2\text{O}_7)_2(\text{O,F})_4$ . Powder X-ray diffraction data were obtained by Gandolfi method using a Stoe IPDS II diffractometer with image plate detector ( $\text{MoK}\alpha$  radiation). The strongest lines of the diffraction pattern [ $d_{\text{obs}}$  (Å) ( $I_{\text{obs}}\%$ ,  $hkl$ )] are: 9.96(29, 001), 3.542(28, 111), 3.490(27, 020), 3.308(45, 003), 3.203(29, 013), 2.867(29, 120, 112), 2.791(100,  $1\bar{2}\bar{1}$ ), 2.664(46, 200), 2.609(36, 103, 121), 2.144(52,  $2\bar{2}\bar{1}$ ). The triclinic unit-cell parameters refined from the powder data are:  $a = 5.409(8)$ ,  $b = 7.060(11)$ ,  $c = 10.214(15)$  Å,  $\alpha = 99.59(4)$ ,  $\beta = 99.66(4)$ ,  $\gamma = 90.06(6)^\circ$ ,  $V = 379.0(4)$  Å<sup>3</sup>. Single-crystal X-ray data were collected using Xcalibur Oxford Diffraction ( $\text{MoK}\alpha$  radiation). The crystal structure of schüllerite was refined to  $R = 3.7\%$  for space group  $P1$  with unit-cell parameters:  $a = 5.4027(1)$ ,  $b = 7.066(4)$ ,  $c = 10.2178(1)$  Å,  $\alpha = 99.816(1)$ ,  $\beta = 99.624(1)$ ,  $\gamma = 90.084(1)^\circ$ ,  $V = 378.75(2)$  Å<sup>3</sup>,  $Z = 1$ . Schüllerite has a heterophyllosilicate structure with isolated HOH-type layers where octahedral O sheet has 4 octahedral positions occupied by Na, Mn,  $\text{Fe}^{3+}$ , and  $\text{Fe}^{2+}$  while heteropolyhedral H-sheets are composed of two different diorthogroups  $\text{Si}_2\text{O}_7$  linked by two different Ti square pyramids. Ba is located between HOH layers in two structural positions with coordination numbers of 11. Schüllerite is structurally related to lamprophyllite-group minerals, but differs from them by the topology of HOH layers. The mineral was named in honor of Willi Schüller (born 1953), prominent mineral collector and specialist in mineralogy of Eifel. He found and provided that mineral for study. Both the mineral and name have been approved by the IMA CNMNC (IMA 2010-035) Type specimens are deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **D.B.**

#### VOLASCHIOITE

C. Biagioni, E. Bonnacorsi, and P. Orlandi (2011) Volaschioite,  $\text{Fe}_4(\text{SO}_4)\text{O}_2(\text{OH})_6 \cdot 2\text{H}_2\text{O}$ , a new mineral species from Forno-volasco, Apuan Alps, Tuscany, Italy. Canadian Mineralogist, 49, 605–614.

Volaschioite (IMA 2010-005), ideally  $\text{Fe}_4(\text{SO}_4)\text{O}_2(\text{OH})_6 \cdot 2\text{H}_2\text{O}$ , occurs as an oxidation product of pyrite in a magnetite-pyrite ore in the Apuan Alps near Forno-volasco, Tuscany, Italy. It occurs as radial clusters of transparent, yellowish-orange bladed crystals

up to 0.1 mm long and <0.005 mm thick, in association with microcrystalline pyrite, fibroferrite, goethite, melanterite, and römèrite. The mineral is brittle, has a perfect {100} cleavage. Crystals are elongate || [010]. Volaschioite is strongly pleochroic: red [010], yellowish-orange (010). Measured refractive indices are reported as being >1.68, and the calculated mean RI is 1.90. The empirical formula determined by EDS (O = 14) and with H<sub>2</sub>O calculated by difference, due to scarcity of material is Fe<sub>4.16</sub>(SO<sub>4</sub>)<sub>0.92</sub>O<sub>2.32</sub>(OH)<sub>6</sub>·2H<sub>2</sub>O, leading to a simplified formula Fe<sub>4</sub>(SO<sub>4</sub>)O<sub>2</sub>(OH)<sub>6</sub>·2H<sub>2</sub>O. The Raman spectrum has absorption bands due to SO<sub>4</sub> stretching modes, with possible splitting of the n<sub>1</sub> modes at 1005 and 1055 cm<sup>-1</sup>, and of the n<sub>2</sub> modes at 408 and 453 cm<sup>-1</sup>, although the authors point out that it is difficult to interpret this spectrum in detail. There was no clear spectroscopic evidence for H<sub>2</sub>O.

The crystal structure was determined by single-crystal X-ray diffraction using synchrotron radiation (Elettra, Trieste, Italy) on a very small crystal 0.07 × 0.01 × 0.005 mm<sup>3</sup>. Volaschioite is monoclinic, space group *C2/m*, *a* = 18.068(4), *b* = 3.058(1), *c* = 10.929(2) Å, *V* = 535.8(2) Å<sup>3</sup> (*Z* = 2). The three strongest peaks X-ray powder-diffraction lines [*d*<sub>obs</sub> in Å (*I*<sub>obs</sub>%, *hkl*)] are: 8.03 (100, 200), 4.37 (24, 202), 3.989 (22, 400). The structure was refined to final agreement indices *R*1 = 0.064 and *wR*2 = 0.156, *GooF* = 1.109. The asymmetric unit comprises two Fe atoms, seven oxygen atoms, and one H<sub>2</sub>O molecule. Three of the O atoms are OH groups. The volaschioite structure is composed of ribbons of pairs of edge-sharing FeO<sub>3</sub>(OH)<sub>3</sub> and FeO(OH)<sub>5</sub> octahedra extending || [010]. Each ribbon is composed of one or other types of octahedra. One oxygen site is 50% O, 50% H<sub>2</sub>O and another is half-occupied. Ribbons are connected to each other by corner sharing of octahedra to form a corrugated sheet || (100). Sulfate groups and H<sub>2</sub>O molecules occupy the interlayer. The refined structure is recognized as a disordered average, as two sulfate groups occur only 3 Å apart. It is proposed that the real ordered structure involves an alternation of sulfate and H<sub>2</sub>O groups || [010], implying a doubling of *b*. The reconstructed diffraction patterns show weak reflections and streaking that could relate to a 2*b* supercell. A hydrogen-bonding scheme is presented that is based upon the ordered structure. The structure topology of volaschioite is new; no other natural sulphate has an analogous structure. **M.D.W.**

#### VLADIMIRIVANOVITE\*

A.N. Sapozhnikov, E.V. Kaneva, D.I. Cherepanov, L.F. Suvorova, V.I. Levitsky, L.A. Ivanova, and L.Z. Reznitsky (2011) Vladimirivanovite, Na<sub>6</sub>Ca<sub>2</sub>[Al<sub>6</sub>Si<sub>6</sub>O<sub>24</sub>](SO<sub>4</sub>,S<sub>3</sub>,S<sub>2</sub>,Cl)<sub>2</sub>·H<sub>2</sub>O—a new mineral of the sodalite group. *Zap. Ross. Mineral. Obshch.*, 140(5), 36–45 (in Russian, English abstract).

A new mineral of the sodalite group, vladimirivanovite has been first found in 1991 in Lyajvardara lazurite deposit of South-Western Pamir, Tajikistan. It was originally described as orthorhombic structural variety of lazurite (Sapozhnikov et al. 1993). A new find of the same mineral at Tultuy lazurite deposit (at South-West of Lake Baikal, Irkutsk region, Russia) allowed reconsidering it as a new species. In both localities vladimirivanovite found in highly metamorphosed rocks of granulite facies

at the contacts of dolomite marbles with granites. It is closely associated with lazurite, calcite, afghanite, tounkite, phlogopite, and marialite. The mineral forms a rims around lazurite up to 3 mm thick, veinlets in lazurite or aggregates with grain size 3–4 mm, rarely up to 2 cm, in marbles. At one of area at Tultuy deposit vladimirivanovite is predominant while lazurite itself is absent. Vladimirivanovite is dark blue to ink-blue (light blue or green-blue at Lyajvardara), spotty with a blue streak. The luster is vitreous to greasy; translucent. The distinct cleavage on {010} cause the stepped fracture. Mohs hardness 5–5.5, VHN<sub>50</sub> = 575 (522–604) kg/mm<sup>2</sup>; brittle. *D*<sub>meas</sub> = 2.48(3), *D*<sub>calc</sub> = 2.436 g/cm<sup>3</sup>. Vladimirivanovite is optically biaxial, negative; 2*V*<sub>meas</sub> = 63(1)°, 2*V*<sub>calc</sub> = 66°; refractive indexes varies even in one grain: α = 1.502–1.507, β = 1.509–1.514, γ = 1.512–1.517. The mineral is pleochroic from light to dark blue *Z* = *Y* > *X*; non fluorescent; dissolves in HCl and HNO<sub>3</sub> producing H<sub>2</sub>S. The thermogravimetry study (40–1450 °C in Ar) was combined with analysis of the thermolysis gas products by the quadrupole mass spectrometer. That study shows H<sub>2</sub>O loss under 500 °C (1 wt%) and CO<sub>2</sub> loss (1.4 wt%) at 500–580 °C (assigned to admixed calcite). Exothermic effect at 1020–1125 and endothermic effects at 1125–1310 and at 1310–1450 °C are all accompanied with SO<sub>2</sub> escaping. The weight loss is 1.4, 6.7, and 3.6%, respectively. The IR spectrum of vladimirivanovite differs from that one of lazurite. The main absorption bands (cm<sup>-1</sup>) are: 3435, 1627, 1417, 1140, 1112, 1000, 719, 699, 645, 613, 449, 432sh, 394. The Raman spectrum given confirms the presence of S<sub>3</sub> radical. The chemical composition data were obtained using microprobe JXA-8200 (WDS). The average of 15 analysis gave (S by wet chemistry, H<sub>2</sub>O by TGA): SiO<sub>2</sub> 32.59 (31.91–33.61), Al<sub>2</sub>O<sub>3</sub> 27.39 (27.08–27.73), CaO 7.66 (7.21–7.82), Na<sub>2</sub>O 17.74 (17.43–18.05), K<sub>2</sub>O <0.04, SO<sub>3</sub> 11.37, S 1.94, Cl 0.12 (0.10–0.13), H<sub>2</sub>O 1.0, O=Cl –0.03, O=S –0.16; total 99.62 wt%. The empirical formula based on Si + Al = 12 and polysulfide anions portioned according to charge balance is Na<sub>6.36</sub>Ca<sub>1.52</sub>(Si<sub>6.03</sub>Al<sub>5.97</sub>)<sub>Σ12</sub>O<sub>23.99</sub>(SO<sub>4</sub>)<sub>1.58</sub>(S<sub>3</sub>)<sub>0.17</sub>(S<sub>2</sub>)<sub>0.08</sub>Cl<sub>0.04</sub>·0.62H<sub>2</sub>O; the idealized formula is Na<sub>6</sub>Ca<sub>2</sub>[Al<sub>6</sub>Si<sub>6</sub>O<sub>24</sub>](SO<sub>4</sub>,S<sub>3</sub>,S<sub>2</sub>,Cl)<sub>2</sub>·H<sub>2</sub>O. Powder X-ray diffraction data were obtained using diffractometer D8 ADVANCED (Cu radiation). The strongest lines of the diffraction pattern [*d*<sub>obs</sub> (Å) (*I*<sub>obs</sub>%, *hkl*)] are: 6.61 (5, 015), 6.43 (11, 020, 006), 3.71 (100, 119, 133), 2.875 (12, 046, 02.12), 2.623 (30, 20.12, 240), 2.428 (6, 246, 22.12), 2.273 (6, 04.12), 2.141 (14, 159, 13.15), 1.783 (9, 06.12, 04.18), 1.606 (6, 080, 00.24). The single-crystal X-ray data for vladimirivanovite were obtained using Enraf-Nonius diffractometer (MoKα radiation). Crystal structure has been solved by direct methods on a single crystal from Lyajvardara deposit and refined to *R* = 0.068 for 1460 reflections with *F* > 3σ(*F*) (Evsyunin et al. 1998). The mineral is orthorhombic, *Pnaa*, *a* = 9.053(3), *b* = 12.837(3), *c* = 38.445(10) Å, *V* = 4468 Å<sup>3</sup>, *Z* = 6. The crystal structure of vladimirivanovite is related to that of cubic lazurite. The parameters of an orthorhombic cell are related to cubic cell of lazurite as: *a* = *a*<sub>cub</sub>, *b* ≈ *a*<sub>cub</sub>√2, *c* ≈ *a*<sub>cub</sub>3√2. In vladimirivanovite Si and Al are ordered in tetrahedral positions of the framework. Ca is dominant in one position in framework cavities, Na occupies eight positions and two positions are shared by Ca and Na. Three types of sulfur radicals that replaced chlorine atoms in the sodalite-type structure are established. Vladimirivanovite is named in memory

of Russian mineralogist and geochemist Vladimir Georgievich Ivanov (1947–2002). Both the mineral and the name have been approved by the IMA CNMNC (IMA 2010-070). Type specimen of the mineral is deposited in Mineralogical Museum of Sankt-Petersburg State University, Russia. **D.B.**

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 V.G. Evsyunin, R.K. Rastsvetaeva, A.N. Sapozhnikov, and A.A. Kashaev (1998) Modulated structure of orthorhombic lazurite. *Kristallografiya* 43, 1057–1060 (in Russian); English translation: *Crystallography Reports*, 43, 999–1002.

#### UNNAMED ZEOLITE: UM2010-05-SiO:AlCaHK†

- F. Stoppa, F. Scordari, E. Mesto, V.V. Sharygin, and G. Bortolozzi (2010) Calcium-aluminum-silicate-hydrate “cement” phases and rare Ca-zeolite association at Colle Fabbri, Central Italy. *Cent. Eur. J. Geosci.* 2(2), 175–187.

The mineral occurs with other rare zeolites in a zone of hydrothermal mineralization in argillitic rocks intruded and pyrometamorphosed to a very high temperature in a volcanic neck that is now occupied by a Ca-rich, alkaline kalsilite-leucite-wollastonite-melilitolite plug. Designated “Mineral X2a” it has a formula  $\text{Ca}_5\text{K}_2\text{Al}_{11}\text{Si}_{21}\text{O}_{64} \cdot 18.4\text{H}_2\text{O}$ , based on two microprobe analyses. Thus it has close similarities to merlinoite  $[(\text{K}, \text{Ca}, \text{Na}, \text{Ba}, \text{Sr})_7(\text{Al}_9\text{Si}_{23})\text{O}_{64} \cdot 22\text{H}_2\text{O}]$  and is likely the Ca-dominant analogue of that mineral. It is also very similar to UM1990-82-SiO:AlBaCaHKNaSr and to UM1987-18-SiO:AlCaHKNa, which both occur in petrologically comparable situations. Like merlinoite, the mineral is orthorhombic but was assigned to space group  $P2_12_12_1$ . Cell dimensions are  $a = 14.368(3)$ ,  $b = 14.394(4)$ ,  $c = 9.952 \text{ \AA}$  (cf. 14.082, 14.143, 9.975 Å, respectively, for merlinoite). It can be assumed that the mineral is colorless in thin section. A detailed structural study needs to be carried out. **D.G.W.S.**

† For a complete listing of all IMA-validated unnamed minerals and their codes, see: <http://pubsites.uws.edu.au/ima-cnmnc/Valid2012.pdf>

#### UNNAMED Na-Mg-Ba-PHOSPHATE: UKI-2010-(PO:BaMgNa)†

- D.R. Zozulya, Y.E. Savchenko, K. Kullerud, E.K. Ravna, and L.M. Lyalina (2010) The unique Ti-Ba-P accessory mineralization of the ultrapotassic Kvaløya dike, Northern Norway. *Zap. Ross. Mineral. Obshch.*, 139(2), 101–112 (in Russian, English abstract).

This phosphate has been found as an accessory mineral in an ultrapotassic lamproite dike on Kvaløya Island, northern Norway. It occurs as tiny prismatic grains. The composition (mean and range of three analyses in wt%) is Na<sub>2</sub>O 15.46 (14.71–16.23), MgO 9.43 (9.29–9.66), Al<sub>2</sub>O<sub>3</sub> 0.12 (0.07–0.18), SiO<sub>2</sub> 0.42 (0.28–0.60), P<sub>2</sub>O<sub>5</sub> 34.12 (33.94–34.44), K<sub>2</sub>O 0.18 (0.14–0.24), CaO 0.18 (0.15–0.23), V<sub>2</sub>O<sub>5</sub> 0.07 (0.07–0.07), MnO 0.38 (0.31–0.44), FeO 0.44 (0.36–0.53), SrO 1.64 (1.45–1.74), BaO 37.43 (36.51–38.41), total 99.87 (99.54–100.40) indicating a simplified formula: Na<sub>2</sub>MgBa(PO<sub>4</sub>)<sub>2</sub>. Only compositional information was reported. There appear to be similarities to minerals of the arrojadite group. **D.G.W.S.**

#### UNNAMED AG-SULFOSELENIDE:

##### UM2010-07-S:AgCuSe†

- K.A. Novoselov, V.A. Kotlyarov, and E.V. Belogub (2010) Silver Sulfoselenide from Ore of the Valunisty Au–Ag Deposit, Chukchi Peninsula. *Zap. Ross. Mineral. Obshch.*, 139(6), 56–61 (in Russian, English abstract). *Geol. Ore Deposits* 52(8), 811–814 (2010; in English).

The unnamed mineral was found in mineralised quartz–adularia veins, cutting Au–Ag ores where it is associated with chalcopyrite, electrum, galena, sphalerite, and replaces arsenopolybasite. It occurs as opaque, homogeneous, anhedral grains up to 0.2 mm in size. In reflected light the mineral is gray. The reflectivity is moderate and it exhibits no anisotropy or birefractance. The microindentation hardness is very low.

The composition (mean and range of 11 analyses in wt%) is S 10.13 (8.4–11.34), Cu 1.52 (0.43–2.06), Se 12.03 (9.41–16.33), Ag 76.01 (72.98–78.27), As 0.03 (0–0.32), total 99.71 (99.38–100.07) with fits very closely the formula (Ag,Cu)<sub>14</sub>S<sub>6</sub>Se<sub>3</sub>. No other quantitative data were reported. **D.G.W.S.**