ШАРЫГИНИТ, $Ca_3TiFe_2O_8$, НОВЫЙ МИНЕРАЛ ИЗ БЕЛЛЕРБЕРГА, ГЕРМАНИЯ

Юрошек Р. [1], Крюгер Х.[2], Галускина И.О.[1], Крюгер Б. [2], Джезяк Л.[3], Тернс Б.[4], Войдила Ю.[4], Кржикавский Т.[1], Паутов Л.[6], Галускин Е.В.[1]

[1]Силезский университет, Польша; [2]Университет Инсбрука, Австрия; [3]Институт геохимии, минералогии и петрологии, Варшава, Польша; [4]DLR, Германия; [5] Институт Пауля Шеррера, Швейцария; [6] Минералогический музей им. А.Е. Ферсмана РАН

SHARYGINITE, $Ca_3TiFe_2O_8$, A NEW MINERAL FROM BELLERBERG, GERMANY

Juroszek R. [1] (rafal.juroszek@op.pl), Krüger H. [2](Hannes.Krueger@uibk.ac.at), Gałuskina I.O.[1](irina.galuskina@us.edu.pl), Krüger B. [2](Biljana.Krueger@uibk.ac.at), Jeżak L. [3](l.jezak@uw.edu.pl), Ternes B.[4] (Bernd.Ternes@dlr.rlp.de), Wojdyla J.[4](justyna.wojdyla@psi.ch), Krzykawski T. [1](tomasz.krzykawski@us.edu.pl), Pautov L. [6](pla58@mail.ru), Galuskin E.V.[1] (evgeny.galuskin@us.edu.pl)

[1]University of Silesia, Faculty of Earth Sciences, Department of Geochemistry, Mineralogyand Petrography, Będzińska Sosnowiec, Poland; [2]University of Innsbruck, Institute of Mineralogy and Petrography, Innrain Innsbruck,Austria; [3]Institute of Geochemistry, Mineralogy and Petrology, University of Warsaw, al. Żwirkii Wigury Warszawa, Poland; [4]Dienstleistungszentrum ländlicher Raum (DLR) Westerwald-Osteifel-Aussenstelle Mayen,Bahnhofstrasse Mayen, Germany;[5]Swiss Light Source, Paul Scherrer Institute, Villigen, Switzerland; [6]Fersman Mineralogical Museum RAS, Moscow, Russia

Sharyginite $Ca_3(TiFe)FeO_8$, the Fe-analogue of shulamitite, $Ca_3(TiFe)AlO_8$ (Sharygin et al.,2013), and member of the anion deficient perovskites group (Mitchell et al., 2017), is a newmineral which was found in thermally-metamorphosed limestone xenoliths in the volcanicrocks of the Bellerberg, Eifel District, Germany. It was also recognized frompyrometamorphic rocks of the Hatrurim Complex (Sharygin et al., 2008) and in alteredxenoliths of the Upper Chegem Caldera (Galuskin et al., 2008). Also $Ca_3TiFe_2O_8$ is known as « Grenier phase » from synthetic material (Grenier et al., 1976). Sharyginite occurs inxenoliths, which consist of a few coloured zones characterized by different mineralassociations. High concentration of this mineral occurs in the contact zone with altered basalt.The main rock-forming minerals in zones with sharyginite are: fluorellestedite, cuspidine, fluorite, larnite and minerals of the brownmillerite-srebrodolskite and wadalite-chlormayeniteseries. Magnesioferrite, perovskite, Ni-phosphides and periclase are accessory minerals. Laterlow-temperature and secondary minerals are mainly represented by calcite, gypsum, thaumasite and unidentified Ca-hydrosilicates. Sharyginite forms flat crystals up to 100 μm inlength. Sharyginite crystals are usually filled with chlormayenite, fluorapatite and rarelycuspidine inclusions. The new mineral is dark-brown, opaque with a brown streak and hasa sub-metallic lustre. The empirical formula of sharyginte from Bellerberg volcano is asfollow:

$Ca_{3.046}(Fe^{3+}_{1.049}Ti_{0.819}Mn_{0.110}Mg_{0.016}Cr_{0.006})_{\Sigma 2.000}(Fe^{3+}_{0.765}Al_{0.222}Si_{0.033}V^{5+}_{0.003})_{1.023}O_8$. The following main bands were observed in the Raman spectrum of sharyginite (cm^{-1}): 114,145, 190, 248, 307, 389, 486, 560, 710, 752, 785 and 1415, 1475 (overtones). The band at 710cm^{-1} is the strongest band in the Raman spectrum. It is assigned to the $\nu_1(Fe^{3+}O_4)$ symmetricstretching mode. Bands at 486 and 560 cm^{-1} are ascribed to bending vibrations ($\nu_4+\nu_2$) of ($Fe^{3+}O_4$) tetrahedra. Weak bands at 752 and 785 cm^{-1} are associated with $\nu_1(AlO_4)$ and$\nu_3(Fe^{3+}O_4)$, respectively (Sharygin et al., 2013). Sharyginite crystallizes in space group *Pmc*$2_1$and has unit cell parameters a = 11.150(8) Å, b = 5.528(2)Å and c = 5.423(2)Å. The crystalstructure of sharyginite consists of double layers of $(Ti,Fe^{3+})O_6$ octahedra, which areseparated by single layers of ($Fe^{3+}O_4$) tetrahedra. An ordered arrangement of tetrahedral ($Fe^{3+}O_4$) chains is characteristic for sharyginite and synthetic $Ca_3TiFe_2O_8$ (Rodríguez-Carvajalet al., 1989). The arrangement of the tetrahedral chains is the major difference between thestructures of sharyginite and shulamitite. Shulamitite exhibit two orientations of (AlO_4)chains, which are disordered within the structure (Sharygin et al., 2013). Sharyginite formedat high-temperature. The minimum temperature of formation of some larnite rocks of theHatrurim Complex, where sharyginite was also identified, was estimated from Fe-perovskite -$Ca_3TiFe_2O_8$ mineral paragenesis, is about 1170-1200°C (Sharygin et al., 2008). Experimentaldata also indicate the formation of the $Ca_3TiFe_2O_8$ phase at high temperatures (>1000°C)(Grenier et al., 1976; Rodriguez-Carvajal et al., 1989).

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*Mitchell R.H., Welch M.D., Chakhmouradian A.R.*Nomenclature of the perovskitesupergroup: A hierarchical system of classification based on crystal structure andcomposition. // Mineralogical Magazine, 2017, No 81(3), pp.411-461.

*Rodríguez-Carvajal J., Vallet-Regí M., Calbet J.G.*Perovskite threefold superlattices:A structure determination of the A3M3O8 phase. //Materials Research Bulletin, 1989, No 24, pp. 423-430.

*Sharygin V.V., Lazic B., Armbruster T.M., Murashko M.N., Wirth R., Galuskina I.O.,Galuskin E.V., Vapnik Y., Britvin S.N., Logvinova A.M.*Shulamitite, Ca3TiFe3+AlO8 -a new perovskite related mineral from Hatrurim Basin, Israel. //European Journal ofMineralogy, 2013, No 25, pp. 97-111.Sharygin, V.V., Sokol, E.V., Vapnik, Y. Minerals of the pseudobinary perovskitebrownmillerite series from combustion metamorphic larnite rocks of the Hatrurim Formation(Israel) //Russian Geology and Geophysics, 2008, No 49, pp. 709–726.