

NEW FINDINGS OF RARE MINERALS FROM FORMER SOVIET UNION COUNTRIES

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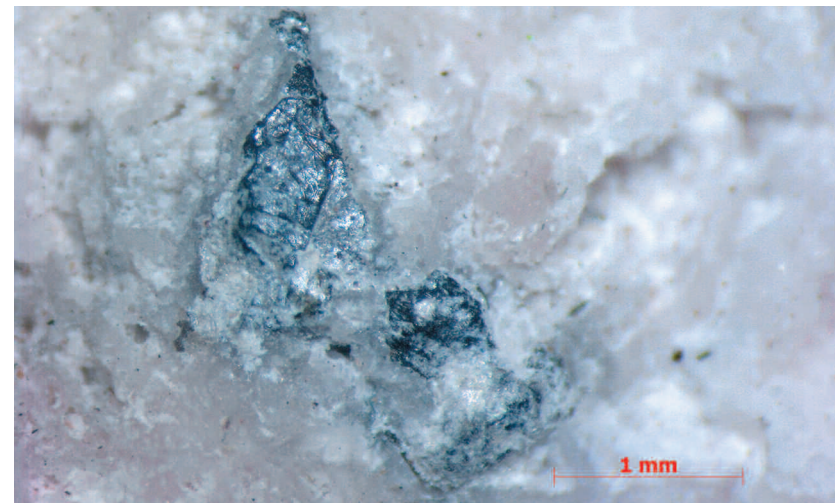
Over last few years many rare minerals have been reliably identified by us in the specimens from various deposits and occurrences in the Russian Federation, Ukraine, and Kazakhstan. The source of such findings was both new material from local mineral collectors, and old specimens from the collection of the Fersman Mineralogical Museum, Russian Academy of Sciences and private collections that were restudied by modern analytical methods.

In this paper, 51 minerals are reported; 35 of them were found in Russia or its regions for the first time. Documentation of such findings is very important in order to replenish the general list of minerals of the Russian Federation as well as regional mineral cadastres.

The described mineral species are grouped under regions, within which minerals follow in alphabetical order.

North European Part

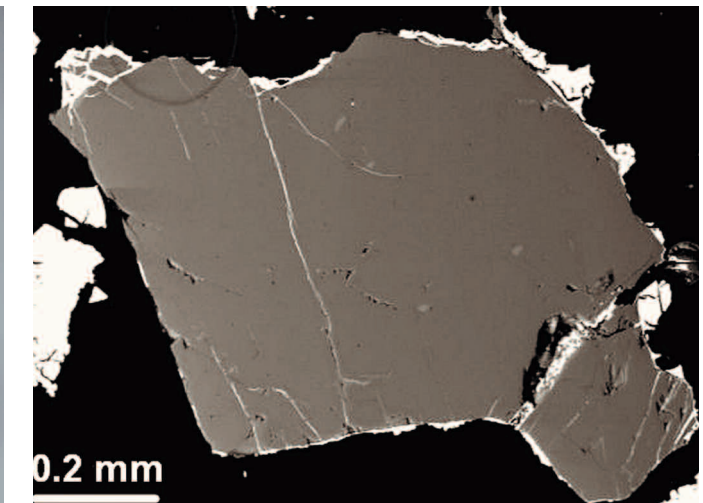
Abellaite, $\text{NaPb}_2(\text{CO}_3)_2(\text{OH})$, has been identified in the specimen from the collection of Mikhail L. Uchitel recovered from the Karnasurt underground Mine in the Lovozero alkaline massif, Lovozero District, Murmansk Oblast, Kola Peninsula. Abellaite occurs as white thin films with pearly luster coating oxidized galena embedded in pale pink natrolite (Fig. 1) in association with sphalerite, manganoneptunite, and seidite-(Ce).



1. White films of **abellaite** with pearly luster on lead-gray **galena** in pale pink **natrolite**. Karnasurt Mine, Lovozero alkaline massif, Kola Peninsula. Specimen: Mikhail L. Uchitel. Photo: Anatoly V. Kasatkin.

2. Segregation of **fluorcalciobriholite-fluorbriholite-(Ce)**, in which **bastnäsite-(Nd)** is identified. 3.5 x 3.5 x 3 cm. Briholitovyi Log, Western Keivy, Lovozero District, Kola Peninsula. Collected by N.I. Frishman and V.M. Kozlovskiy in the summer of 1997. Specimen: Anatoly V. Kasatkin. Photo: Anastasia D. Kasatkina.

3. Thin **bastnäsite-(Nd)** rim (white) overgrows **albite** grain (gray). White grains to the left of albite are **monazite-(Ce)**. Briholitovyi Log, Western Keivy, Lovozero District, Kola Peninsula. Back-scattered electron image: Atali A. Agakhanov.



Only Na and Pb in the ratio close to 1 : 2 were determined by electron microprobe analysis.

The hexagonal unit cell parameters calculated from the powder X-ray diffraction data are consistent with those of abellaite: $a = 13.5635(5) \text{ \AA}$, $c = 5.8938(6) \text{ \AA}$, $V = 939.01(8) \text{ \AA}^3$.

Abellaite was also identified by I.V. Pekov (personal communication) in the samples collected in August, 2017 at the Yubileinaya-2 pegmatite (level 400 m, Karnasurt Mt.) in the same Karnasurt underground Mine. Here, white with pearly luster abellaite aggregates replace galena embedded in microcline and natrolite in association with aegirine, fluorapatite, manganoneptunite, murmanite, raite, and steenstrupine-(Ce).

Abellaite is a very rare mineral; previously it was reported only at its type locality, Eureka Mine, Catalonia, Spain (Ibáñez-Insa *et al.*, 2017). Our finding of this mineral is obviously first in Russia and second in the world.

Bastnäsite-(Nd), $\text{Nd}(\text{CO}_3)\text{F}$, has been found in the specimen from the so called Briholitovyi Log located in the northern part of the Sakharyok alkaline massif, Western Keivy, Lovozero District, Murmansk Oblast, Kola Peninsula. The specimen was found by Nikolay I. Frishman and Vasily M. Kozlovskiy in the summer of 1997 and occurs as dark brown with resinous luster segregation of fluorcalciobriholite-fluorbriholite-(Ce) (Ca and REE concentrations in the mineral are around 1:1 ratio) coated by yellow earthy bastnäsite-(Ce), black annite, and pinkish to colorless albite (Fig. 2).

Bastnäsite-(Nd) occurs as veinlets and rims up to 0.08 mm thick around albite grains in association with Th,Si-bearing monazite-(Ce) and zircon (Fig. 3).

The chemical composition of bastnäsite-(Nd) is (wt.%; CO_2 and H_2O contents are calculated by stoichiometry): CaO 0.40, Y_2O_3 7.75, La_2O_3 17.66, Ce_2O_3 5.61, Pr_2O_3 6.32, Nd_2O_3 22.78, Sm_2O_3 4.73, Eu_2O_3 1.08, Gd_2O_3 3.34, Tb_2O_3 1.22, Dy_2O_3 2.13, Ho_2O_3 0.58, Er_2O_3 0.54, Yb_2O_3 0.53, CO_2 20.35, H_2O 1.91, F 4.77, O = F - 2.01, total 99.69. It corresponds to the empirical formula calculated on the basis of $\text{O} + \text{F} + \text{OH} = 4$: $(\text{Nd}_{0.29}\text{La}_{0.23}\text{Y}_{0.15}\text{Pr}_{0.08}\text{Ce}_{0.07}\text{Sm}_{0.06}\text{Gd}_{0.04}\text{Dy}_{0.02}\text{Eu}_{0.01}\text{Tb}_{0.01}\text{Ho}_{0.01}\text{Er}_{0.01}\text{Yb}_{0.01}\text{Ca}_{0.02})_{\Sigma 1.01}(\text{CO}_3)[\text{F}_{0.54}(\text{OH})_{0.46}]_{\Sigma 1.00}$.

Table 1. Chemical composition of wodginite-group minerals from Ognevka deposit, Eastern Kazakhstan

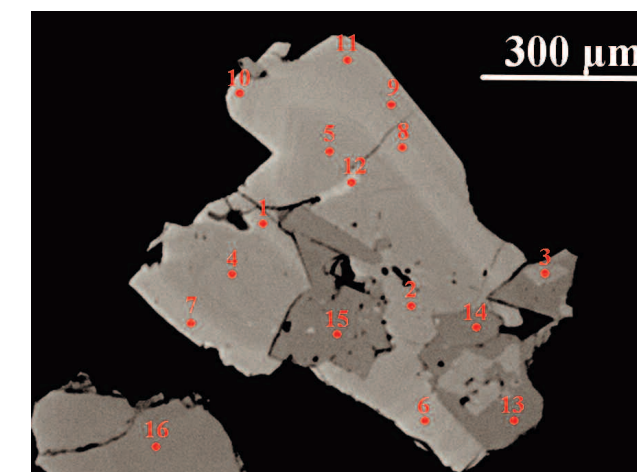
Analysis	1	2	3	4	5	6	7	8	9	10	11	n/a
component	wt. %											
MnO	6.89	8.24	8.53	8.43	8.45	5.45	5.15	5.42	5.68	5.23	4.63	6.05
FeO	4.97	3.78	3.36	3.26	3.68	6.29	6.30	6.37	6.44	6.86	7.94	3.33
Fe ₂ O ₃	1.31	1.05	2.13	2.09	1.41	0.45	0.68	0.82	0.67	0.54	1.34	1.72
TiO ₂	4.55	4.85	6.81	6.51	6.81	3.97	4.52	4.89	4.23	4.76	6.96	0.31
SnO ₂	14.48	14.68	10.02	10.82	11.19	15.82	15.02	14.78	14.86	14.32	10.12	4.94
Nb ₂ O ₅	8.53	11.56	8.80	8.48	11.37	6.49	6.41	6.92	6.97	6.78	9.27	10.69
Ta ₂ O ₅	58.99	55.81	60.48	60.65	56.76	60.29	60.97	61.96	60.37	60.85	59.59	72.93
Σ	99.72	99.97	100.13	100.24	99.67	98.76	99.05	101.16	99.22	99.34	99.85	99.97
Formula calculated on the basis of 8 O atoms and Ta + Nb = 2												
Mn	0.59	0.69	0.71	0.70	0.69	0.48	0.45	0.46	0.49	0.45	0.38	0.54
Fe ²⁺	0.42	0.31	0.28	0.27	0.30	0.54	0.54	0.53	0.55	0.59	0.65	0.29
ΣA	1.01	1.00	0.99	0.97	0.99	1.02	0.99	0.99	1.04	1.04	1.03	0.83
Fe ³⁺	0.10	0.08	0.16	0.15	0.10	0.04	0.05	0.06	0.05	0.04	0.10	0.14
Ti	0.34	0.36	0.50	0.48	0.50	0.31	0.35	0.37	0.33	0.37	0.51	0.02
Sn ⁴⁺	0.58	0.58	0.39	0.42	0.43	0.65	0.62	0.59	0.61	0.58	0.40	0.21
Ta	–	–	–	–	–	–	–	–	–	–	–	0.60
ΣB	1.02	1.02	1.05	1.05	1.03	1.00	1.02	1.02	0.99	0.99	1.01	0.97
Nb	0.39	0.51	0.39	0.38	0.50	0.30	0.30	0.31	0.32	0.31	0.41	0.51
Ta	1.61	1.49	1.61	1.62	1.50	1.70	1.70	1.69	1.68	1.69	1.59	1.49
ΣC	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
O	8	8	8	8	8	8	8	8	8	8	8	8

Notes: (1–2) wodginite, (3–5) titanowodginite, (6–10) ferrowodginite, (11) ferrotitanowodginite, (N/A) tantalowodginite. Fe/Fe₂O₃ is calculated from charge balance.

The powder X-ray diffraction pattern of one large grain and calculated monoclinic unit cell parameters [$a = 9.50(3) \text{ \AA}$, $b = 11.46(4) \text{ \AA}$, $c = 5.132(19) \text{ \AA}$, $\beta = 90.0(3)^\circ$, $V = 559(3) \text{ \AA}^3$] undoubtedly show the wodginite structure type.

While wodginite was mentioned in the post-Soviet area at several deposits of Russia and Kazakhstan (including Ognevka), we could not find in the literature any analyses corresponding to ferrowodginite, titanowodginite, and ferrotitanowodginite for the minerals found at the territory of the former Soviet Union. Particular attention worth our finding of ferrotitanowodginite, certainly the rarest mineral of this group in nature. Previously, this mineral was reported only in granite pegmatites La Viquita and San Elias in Argentina (Galliski *et al.*, 1999), and in Marko pegmatite in Canada (Tindle *et al.*, 1998).

With regard to tantalowodginite, despite it was approved by the Commission on New Minerals, Nomenclature, and Classification of IMA as individual mineral species only in 2017, the corresponding compositions were known long before. For example, in 2000s, Igor V. Pekov identified tantalowodginite in the sample collected in 1940s from one of the pegmatites in the Kalba Range and in the material from the Vishnyakovskoe Ta-Li deposit, East Sayan, Tayshet District, Irkutsk Oblast (personal communication). The sample of tantalowodgnite from the Vishnyakovskoe deposit donated by Dmitry I. Belakovskiy in 2003 is now de-



62. Dark brown to black pods composed of fine grains of cassiterite, wodginite-group (titanowodginite, wodginite, ferrowodginite, ferrotitanowodginite and tantalowodginite), and microlite-group (fluorocalciomicrolite, fluornatromicrolite) minerals in association with white feldspar. 6 x 4 x 3.5 cm. Ognevka deposit, Kalba Range, Ulanskiy District, Eastern Kazakhstan. Collected in 1970s. Specimen: Anatoly V. Kasatkin. Photo: Anastasia D. Kasatkina.

63. Chemically zoned grain consisting of wodginite-group minerals: (1, 2) wodginite, (3–5) titanowodginite, (6–10) ferrowodginite, (11) ferrotitanowodginite, (12) fluorocalciomicrolite, and (13–16) cassiterite. Points 1–11 correspond to numbers in Table 1. Ognevka deposit, Kalba Range, Ulanskiy District, Eastern Kazakhstan. Back-scattered electron image: Anatoly V. Kasatkin.

posited in the collection of the Fersman Mineralogical Museum, Russian Academy of Sciences under the #91254. We analytically confirmed the identification of the mineral as tantalowodginite in 2016.

Conclusions

Most findings described in this paper would not have been possible without fruitful cooperation of the author with both professional mineralogists and mineral amateurs, who regularly provide samples from their collections for identification. We are convinced that the continuation of such cooperation and careful study of old specimens deposited in the museum collections by modern analytical techniques will obviously ensure the further success in searching of rare minerals and updating the mineral cadastres of Russia and whole post-Soviet area by new mineral species.

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The author expresses his deep appreciation to all these people.

Alphabetical Index of Minerals

Mineral	Formula	Locality	Find in Russia	Find in world
1 Abellaite	NaPb ₂ (CO ₃) ₂ (OH)	Karnasurt Mine, Lovozero alkaline massif, Kola Peninsula, Russia	First	Second
2 Alpersite*	(Mg,Cu)SO ₄ •7H ₂ O	Petropavlovskiy Quarry near Petropavlovka Village, Simferopol District, Crimea Peninsula, Russia	First	
3 Armenite	BaCa ₂ Al ₆ Si ₉ O ₃₀ •2H ₂ O	Vorontsovskoe Au deposit, Krasnoturinsk Mining District, Sverdlovskaya Oblast, Northern Urals, Russia	First	
4 Balkanite	Cu ₉ Ag ₅ HgS ₈	Badzhiravka deposit, Krasnyi Chikoy District, Zabaykal'skiy Krai, Siberia, Russia	First	
5 Bastnäsitate-(Nd)	Nd(CO ₃)F	Britholitovyi Log, Western Keivy, Lovozero District, Kola Peninsula, Russia	First	
6 Bianchite	ZnSO ₄ •6H ₂ O	Muzhievo deposit, Beregovo District, Zakarpatskaya Oblast, Ukraine		
7 Boyleite	ZnSO ₄ •4H ₂ O	Muzhievo deposit, Beregovo District, Zakarpatskaya Oblast, Ukraine		
8 Burckhardtite	Pb ₂ (Fe ³⁺ Te ⁶⁺)[AlSi ₃ O ₈] ₆	Aginskoe Au deposit, Bystrinskiy District, Kamchatskiy Krai, Far East, Russia	First	Fourth
9 Butlerite	Fe ³⁺ (SO ₄)(OH)•2H ₂ O	Irokinda Mine, Muyskiy District, Republic of Buryatia, Siberia, Russia		
10 Chabazite-Mg	(Mg _{0.2} K _{0.5} Ca _{0.5} Na _{0.1})[Al ₃ Si ₉ O ₂₄]•10H ₂ O	Makar-Ruz Occurrence, Rai-Iz massif, Polar Urals, Yamalo-Nenetskiy AO, Tyumen Oblast, Russia	First	Third
11 Chapmanite	Fe ³⁺ Sb ³⁺ (SiO ₄) ₂ (OH)	Vorontsovskoe Au deposit, Krasnoturinsk Mining District, Sverdlovskaya Oblast, Northern Urals, Russia	First	
12 Choloalite	CuPb(TeO ₃) ₂	Aginskoye Ore Body, Aginskoe Au deposit, Bystrinskiy District, Kamchatskiy Krai, Far East, Russia	First	
13 Claudetite	As ₂ O ₃	Vorontsovskoe Au deposit, Krasnoturinsk Mining District, Sverdlovskaya Oblast, Northern Urals, Russia	First	
14 Cornwallite	Cu ₃ (AsO ₄) ₂ (OH) ₄	Aginskoe Cu-Pb-Zn deposit, Aginskiy District, Zabaykal'skiy Krai, Siberia, Russia	Second	
15 Feitknechtite	Mn ³⁺ O(OH)	Zmeinogorskoe Mn deposit, Chebarkul District, Chelyabinsk Oblast, Southern Urals, Russia	Second	
16 Ferri-fluoro-nyboite	NaNa ₂ (Mg ₃ Fe ³⁺)(AlSi ₉ O ₂₂)F ₂	Vein #124, Vishnevye Mountains, Kasli District, Chelyabinsk Oblast, Southern Urals, Russia	First	First
17 Ferrihollandite	Ba(Mn ⁶⁺ Fe ³⁺) ₂ O ₁₆	Murzinskoe-1 Au deposit, Krasnoshchyokovo District, Altayskiy Krai, Siberia, Russia	First	Fifth
18 Ferri-kaersutite	NaCa ₂ (Mg ₃ Fe ³⁺ Ti)(Al ₂ Si ₆ O ₂₂)O ₂	Uluk-Tyuk Stream, Patynskiy gabbro-syenite pluton, Tashtagol District, Kemerovo Oblast, Siberia, Russia	First	
19 Ferrotitanowodginitite	Fe ²⁺ Sn ⁴⁺ Ta ₂ O ₈	Ognevka deposit, Kalba Range, Ulanskiy District, Eastern Kazakhstan		Fourth
20 Ferrowodginitite	Fe ²⁺ Sn ⁴⁺ Ta ₂ O ₈	Ognevka deposit, Kalba Range, Ulanskiy District, Eastern Kazakhstan		
21 Fluor-schorl	NaFe ²⁺ Al ₆ Si ₆ O ₁₈ (BO ₃) ₃ (OH) ₃ F	Sherlovyy pegmatite, 2.5 km West from the Taiginka Village, Kyshtym District, Chelyabinsk Oblast, Southern Urals, Russia	First	
22 Foordite	Sn ²⁺ (Nb,Ta) ₂ O ₆	Bakennoe Ta deposit, Kalba Range, Ulanskiy District, Eastern Kazakhstan		Third
23 Getchellite	AsSbS ₃	Vorontsovskoe gold deposit, Krasnoturinsk Mining District, Sverdlovskaya Oblast, Northern Urals, Russia	First	
24 Hinsdalite	PbAl ₃ (PO ₄)(SO ₄)(OH) ₆	South Kontrolnyi area, Kontrolnoe Au deposit, Uchaly District, Republic of Bashkortostan, Southern Urals, Russia	Third	
25 Julgoldite-(Fe ³⁺)	Ca ₂ Fe ³⁺ (Fe ³⁺) ₂ Si ₂ O ₇ (SiO ₄)O(OH)•H ₂ O	Pervomaiskiy Quarry near Trudolyubovka Village, Bakhchisarai District, Crimea Peninsula, Russia	First	
26 Julgoldite-(Mg)	Ca ₂ Mg(Fe ³⁺) ₂ Si ₂ O ₇ (SiO ₄)O(OH) ₂ •H ₂ O	Pervomaiskiy Quarry near Trudolyubovka Village, Bakhchisarai District, Crimea Peninsula, Russia	First	First

* Might be not alpersite but a new phase MgSO₄•7H₂O.

Mineral	Formula	Locality	Find in Russia	Find in world
27 Kettnerite	CaBi(CO ₃)OF	East Kounrad Mine, Aktogay District, Karaganda Oblast, North Balkhash Region, Kazakhstan		
28 Lisiguangite	PtCuBiS ₃	Srednyaya Padma U-V deposit, Zaonezhskiy Peninsula, Medvezhyegorsk District, Southern Karelia, Russia	First	Second
29 Minrecordite	CaZn(CO ₃) ₂	Kurbinskoe polymetallic occurrence, Khorinsk District, Republic of Buryatia, Siberia, Russia	First	
30 Mixite	BiCu ₆ (AsO ₄) ₃ (OH) ₆ •3H ₂ O	Lukavaya Hill, Sherlovaya Gora, Borzya District, Zabaykal'skiy Krai, Siberia, Russia	First	
31 Mohite	Cu ₂ SnS ₃	Khinganskoe deposit, Obluch'e District, Jewish Autonomous Oblast, Far East, Russia	First	
32 Orlymanite	Ca ₄ Mn ²⁺ Si ₈ O ₂₀ (OH) ₆ •2H ₂ O	Pervomaiskiy Quarry near Trudolyubovka Village, Bakhchisarai District, Crimea Peninsula, Russia	First	Third
33 Oxy-dravite	Na(MgAl) ₂ MgAl ₅ (Si ₆ O ₁₈)(BO ₃) ₃ (OH) ₃ O	Prishosseynaya Pit at Karabash-Kyshtym road near the exit to Taiginka settlement, Kyshtym District, Chelyabinsk Oblast, Southern Urals, Russia		
34 Oxyphlogopite	K(Mg,Ti,Fe) ₃ [(Si,Al) ₄ O ₁₀](O,F) ₂	District of the Bartoy paleovolcano group, Bartoy Valley, Dzhida District, Republic of Buryatia, Siberia, Russia	First	
35 Parádsasvárite	Zn ₂ (CO ₃)(OH) ₂	Verkhniy Mine, Dalnegorsk, Primorskiy Krai, Far East, Russia	First	Second
36 Perhamite	Ca ₃ Al _{7.7} Si ₃ P ₄ O _{23.5} (OH) _{14.1} •8H ₂ O	Eremkinskiy Quarry, 15 km West from Plast city, Chelyabinsk Oblast, Southern Urals, Russia**	First	
37 Petitjeanite	Zn ₂ (CO ₃)(OH) ₂	Placers on the Tatarka riverhead, Yeniseyskiy Ridge, Severo-Yeniseyskiy District, Krasnoyarsk Krai, Siberia, Russia	First	
38 Rhodium	(Rh,Pt)	Placer of the Veresovka River, near Kos'ya settlement, Nizhneturinsk Mining District, Sverdlovskaya Oblast, Middle Urals, Russia	First	
39 Rossovskiyite	(Fe,Ta)(Nb,Ti)O ₄	Dumortieritovaya Pit, 10 km north-west from Karabash city, Uvildy Lake, Chelyabinsk Oblast, Southern Urals, Russia	First	Second
40 Tantalowodginitite	(Mn ²⁺ □ _{0.5})TaTa ₂ O ₈	Ognevka deposit, Kalba Range, Ulanskiy District, Eastern Kazakhstan		
41 Tintinaite	Pb ₁₀ Cu ₂ (Sb,Bi) ₁₆ S ₃₅	Kochkar Au deposit, Plast District, Chelyabinsk Oblast, Southern Urals, Russia	Second	
42 Titanowodginitite	Mn ²⁺ TiTa ₂ O ₈	Ognevka deposit, Kalba Range, Ulanskiy District, Eastern Kazakhstan		
43 Wakabayashilite	(As,Sb) ₆ As ₄ S ₁₄	Vorontsovskoe gold deposit, Krasnoturinsk Mining District, Sverdlovskaya Oblast, Northern Urals, Russia	Second	
44 Windhoekite	Ca ₂ Fe ³⁺ (Si ₈ O ₂₀)(OH) ₄ •10H ₂ O	Pervomaiskiy Quarry near Trudolyubovka Village, Bakhchisarai District, Crimea Peninsula, Russia	First	Second
45 Wittichenite	Cu ₃ BiS ₃	Sosedka vein, Malkhan pegmatite field, Krasnyi Chikoy District, Zabaykal'skiy Krai, Siberia, Russia		
46 Wodginitite	Mn ²⁺ Sn ⁴⁺ Ta ₂ O ₈	Ognevka deposit, Kalba Range, Ulanskiy District, Eastern Kazakhstan		
47 Yangzhumingite	KMg _{2.5} (Si ₄ O ₁₀)F ₂	Ermakovskoe Be deposit, Kizhinga District, Republic of Buryatia, Siberia, Russia	First	Fourth
48 Yuanjiangite	AuSn	Kazakovskaya placer, Nerchinsk District, Zabaykal'skiy Krai, Siberia, Russia	First?	
49 Yukonite	Ca ₂ Fe ³⁺ (AsO ₄) ₃ (OH) ₄ •4H ₂ O	Khovu-Aksy deposit, Chedi-Kholskiy District, Republic of Tuva, Siberia, Russia	Second	
50 Zincocopiapite	ZnFe ³⁺ (SO ₄)(OH) ₂ •20H ₂ O	Muzhievo deposit, Beregovo District, Zakarpatskaya Oblast, Ukraine		
51 Zincovoltaitite	K ₂ Zn ₅ Fe ³⁺ Al(SO ₄) ₁₂ •18H ₂ O	Muzhievo deposit, Beregovo District, Zakarpatskaya Oblast, Ukraine		Third

** More probable locality is Svetlinskoe Au deposit, Chelyabinsk Oblast, Southern Urals.