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**CHUKHROVITE-(Nd),  $\text{Ca}_3(\text{Nd,Y})\text{Al}_2(\text{SO}_4)\text{F}_{13}\cdot 12\text{H}_2\text{O}$ , A NEW MINERAL**

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In specimens from the oxidized zone of the Kara-Oba deposit (Central Kazakhstan), a new neodymium-dominant analogue of chukhrovite-(Y) and chukhrovite-(Ce) has been found; it has been named chukhrovite-(Nd). The new mineral occurs in the form of isometric grains and small crystals represented by a combination of {100} and {111} faces, with sizes ranging from 0.05 to 0.4 mm; it forms zones within the larger crystals of chukhrovite-(Y) also. Chukhrovite-(Nd) is associated with quartz, fluorite, halloysite, chukhrovite-(Y), anglesite, gearksutite, creedite, and the jarosite group minerals. The mineral is colourless, rarely white. Streak is white. Hardness is 3.5-4 on Mohs' scale. Density (meas.) is 2.42(3) g/cm<sup>3</sup>, density (calc.) is 2.42 g/cm<sup>3</sup>. The mineral is transparent, and in thin sections it has anomalous grey interference colours,  $n = 1.443(2)$  (589 nm). Chemical composition (electron microprobe instrument, wt %) is following: CaO – 20.03; Y<sub>2</sub>O<sub>3</sub> – 1.94; La<sub>2</sub>O<sub>3</sub> – 2.32; Ce<sub>2</sub>O<sub>3</sub> – 1.37; Pr<sub>2</sub>O<sub>3</sub> – 1.37; Nd<sub>2</sub>O<sub>3</sub> – 6.26; Sm<sub>2</sub>O<sub>3</sub> – 1.90; Gd<sub>2</sub>O<sub>3</sub> – 1.12; Dy<sub>2</sub>O<sub>3</sub> – 0.44; Ho<sub>2</sub>O<sub>3</sub> – 0.10; Al<sub>2</sub>O<sub>3</sub> – 12.09; SO<sub>3</sub> – 9.38; F – 28.93; H<sub>2</sub>O (by difference) – 24.93, less O = F 12.18, total 100.00 wt%. Empirical formula is  $\text{Ca}_{3.06}(\text{Nd}_{0.32}\text{Y}_{0.13}\text{La}_{0.12}\text{Sm}_{0.09}\text{Ce}_{0.07}\text{Pr}_{0.07}\text{Gd}_{0.05}\text{Dy}_{0.02}\text{Ho}_{0.01})_{0.90}\text{Al}_{2.03}\text{Si}_{1.01}\text{O}_{3.96}\text{F}_{13.06}\cdot 11.87\text{H}_2\text{O}$ . Ideal formula is  $\text{Ca}_3(\text{Nd,Y})\text{Al}_2(\text{SO}_4)\text{F}_{13}\cdot 12\text{H}_2\text{O}$ . Cubic, space group Fd3,  $a = 16.759(3)$  Å,  $V = 4707.0(1)$  Å<sup>3</sup>,  $Z = 8$ . Strong lines of X-ray powder pattern are following (d-I(hkl)): 9.7-10(111); 5.92-7(220); 3.22-8(511); 2.555-7(533); 2.240-5(642); 2.180-6(731); 1.827-5(842). The IR spectrum is as follows: 3548, 3423, 1630, 1090, 586, 465 cm<sup>-1</sup>. The type specimen of the new mineral is at the Fersman Mineralogical Museum, RAS (Moscow). 3 tables, 3 figures, and 11 references.

During the study of samples from the oxidized zone of ore deposits in Kazakhstan, a new neodymium-dominant analogue of chukhrovite-(Y) and chukhrovite-(Ce) has been found; it was named chukhrovite-(Nd)\* according to the protocol in force for names of rare-earth minerals (Levinson, 1996).

**Occurrence and mineral assemblages**

Chukhrovite-(Nd) has been found in specimens from the oxidized zone of a molybdenum-tungsten deposit in Kara-Oba (Central Kazakhstan). The Kara-Oba ore field is located on the northeastern flank of the Chu-Iliisk ore belt in the central part of a volcano-tectonic structure. The deposit is connected with the multiphase Late Permian (260 ± 5 Ma) intrusive massif of leucocratic granites breaking the effusive-fragmental series of Lower-Middle Devonian. There are four types of ore veins of different age at the deposit: molybdenite-quartz, wolframite-quartz, huebnerite-sulphide-quartz, and quartz-fluorite. Except for the latter type, the veins are accompanied by the zones of circum-vein greisens. The geology and mineralogy of the deposit have

been considered in a number of publications (Shcherba, 1960; Ermilova *et al.*, 1960; Ermilova, 1964; Shcherba *et al.*, 1988; *etc.*). Chukhrovite-(Y) from the oxidized zone of this deposit was described as chukhrovite by L.P. Ermilova with co-authors (1960).

We have found chukhrovite-(Nd) in the specimens formed by columnar milky-white quartz. Within the quartz there are small (up to 5 mm in length) lamellar grains of huebnerite. In numerous small cavities and interstices of columnar quartz crystals, are powdery and microcrystalline crusts of jarosite, poorly shaped crystals of anglesite (up to 4 mm in size), druses of small crystals of creedite, massive snowy-white fine-grained aggregations of gearksutite or halloysite are often observed. In these specimens chukhrovite-(Nd) is presented by aggregations of isometric colourless grains and small, often poorly shaped crystals formed seemingly by a combination of cubic and octahedral faces (Fig. 1), with sizes ranging from 0.05 to 0.4 mm. Examining thin sections of chukhrovite-(Nd) grains and crystals from this association in COMPO and AEI modes, it was not possible to reveal any zoning or sectoring of mineral individuals.

\* It was submitted and recommended for publication by the RMS (Russian Mineralogical Society), Commission on New Minerals and Mineral Names and approved by the IMA Commission on New Minerals and Mineral Names on August 5, 2004.

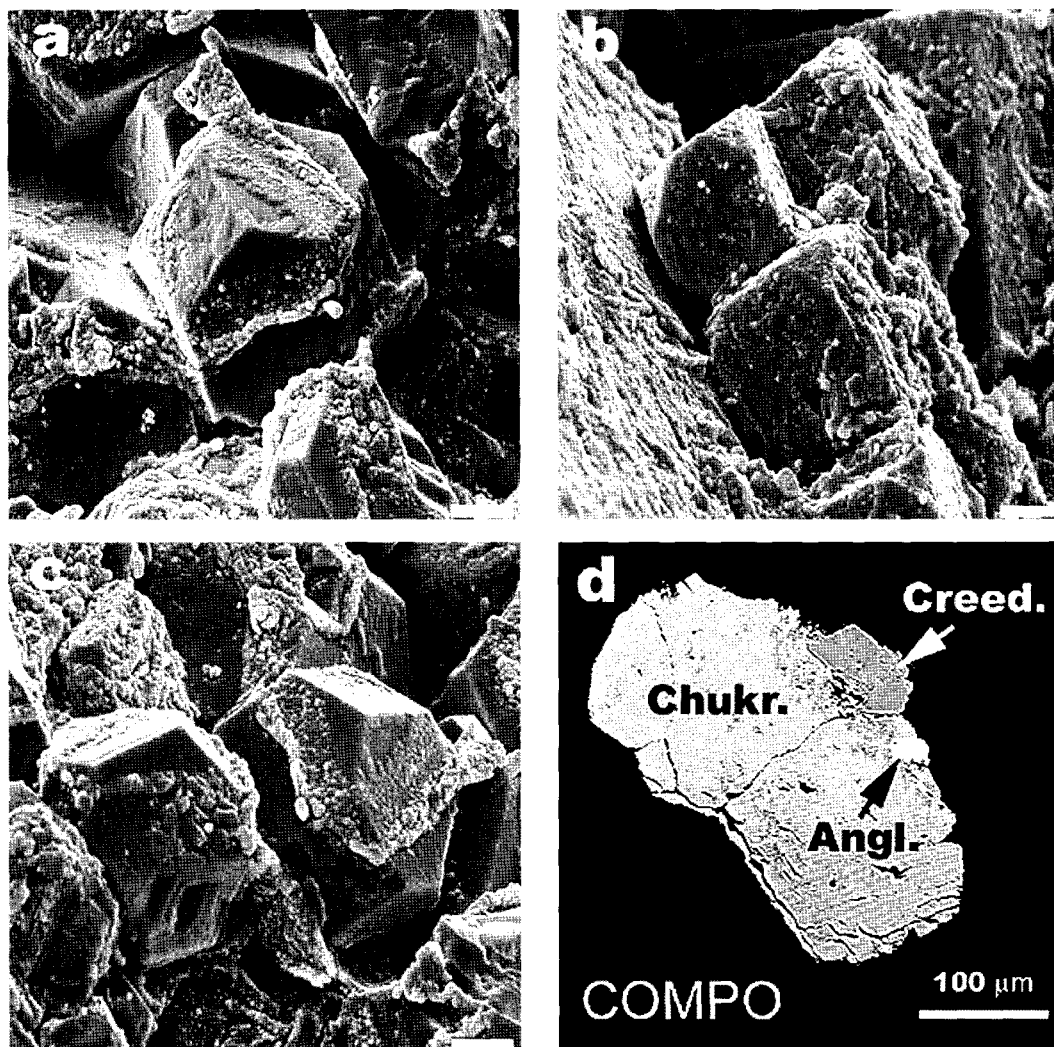


Table 1. Chemical composition of chukhrovite-(Nd) and chukhrovite-(Y)

Constituent	1		2	3
	Chukhrovite-(Nd) wt %	range	Chukhrovite-(Nd) wt %	Chukhrovite-(Y) wt %
CaO	20.03	19.19–20.73	19.89	21.41
Y <sub>2</sub> O <sub>3</sub>	1.94	1.52–2.71	2.37	5.44
La <sub>2</sub> O <sub>3</sub>	2.32	1.91–2.86	2.50	1.04
Ce <sub>2</sub> O <sub>3</sub>	1.37	1.06–1.67	3.36	2.12
Pr <sub>2</sub> O <sub>3</sub>	1.37	1.22–1.59	1.01	0.17
Nd <sub>2</sub> O <sub>3</sub>	6.26	5.45–6.58	5.28	2.31
Sm <sub>2</sub> O <sub>3</sub>	1.90	1.75–2.21	1.35	1.07
Gd <sub>2</sub> O <sub>3</sub>	1.12	0.67–1.47	0.69	0.83
Dy <sub>2</sub> O <sub>3</sub>	0.44	0.20–0.68	0.25	0.89
Ho <sub>2</sub> O <sub>3</sub>	0.10	0.03–0.26	0.07	n.d.
Al <sub>2</sub> O <sub>3</sub>	12.09	11.74–12.42		
SO <sub>3</sub>	9.38	9.03–9.87		
F	28.93	28.48–29.37		
H <sub>2</sub> O (by difference)	24.93			
-F=O	-12.18			
<b>Total</b>	<b>100.00</b>			

Fig 1. a, b, c – general view of chukhrovite-(Nd) crystals. SEM photo. Scale bar length is 10 µm; d – intergrowths of chukhrovite-(Nd) (Chukr.) with creedite (Creed) and anglesite (Angl)

**Note:**

1 – average value calculated by 8 analyses and fluctuation of values for non-zonal grains of mineral from the first specimen; 2, 3 – incomplete electron microprobe analyses of zoned-sectioned grain of chukhrovite from the second specimen (sample # 1208, V.I. Stepanov's collection, FMM). Analyses numbers correspond to points marked on the Figure 2. Analyses by L.A. Pautov.

