Fluorocronite, the natural analogue of $\beta$-PbF$_2$, from the Sakha Republic, Russian Federation

STUART J. MILLS$^{1,2,3,*}$, PAVEL M. KARTASHOV$^4$, GENNADII N. GAMYANIN$^4$, PAMELA S. WHITFIELD$^5$, ARNT KERN$^6$, HUGUES GUERAULT$^6$, ANTHONY R. KAMPF$^3$ and MATI RAUDSEPP$^1$

1 Department of Earth and Ocean Sciences, University of British Columbia, Vancouver BC, Canada V6T 1Z4
2 Geosciences, Museum Victoria, GPO Box 666, Melbourne 3001, VIC, Australia
3 Mineral Sciences Department, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, CA 90007, USA
4 Institute of Geology Ore Deposits, Petrography, Mineralogy and Geochemistry (IGEM) of Russian Academy of Sciences, Staromonetnyi perulok 35, 109017 Moscow, Russia
5 Institute for Chemical Process and Environmental Technology, National Research Council of Canada, 1200 Montreal Road, Ottawa, ON, K1A 0R6 Canada
6 Bruker AXS GmbH, Östliche Rheinbrückenstrasse 49, Karlsruhe, 76187 Germany

Abstract: Fluorocronite (фторрокронит), ideally PbF$_2$, is a new mineral (IMA2010–023), from the Kupol’noe deposit, Sarychev range, Sakha Republic, Russian Federation. It occurs intimately mixed with cassiterite and a potentially new Sn oxy-hydroxide with the composition Sn$_4$O(OH,F)$_6$, and is found in direct association with quartz, anglesite, cerussite, galena, hocartite, bindheimite and chlorargyrite. Fluorocronite forms flattened, leaf-like microcrystals up to about 20 $\mu$m across. The main form observed is {100}, while {111} may also be present. The crystals are translucent and white with a pearly lustre. The streak is also white and Mohs hardness is between 3 and 4 (estimated). No parting or twinning was observed. Fluorocronite has prefect cleavage on {111} by analogy with other minerals with the fluorite structure type. Crystals are optically isotropic; however, the refractive index could not be measured due to the small size of the crystals. The empirical formula (based on 3 apfu) is Pb$_{0.98}$F$_{2.02}$. The simplified formula is PbF$_2$.

Fluorocronite is cubic, space group $Fm\overline{3}m$, with $a = 5.9306(5)$ Å, $V = 208.59(5)$ Å$^3$ and $Z = 4$. Fluorocronite is isostructural with fluorite. The five strongest lines in the powder X-ray diffraction pattern are $d_{obs}$ in Å (hkl): 3.437 (100) (111); 2.976 (46) (002); 2.103 (44) (022); 1.794 (42) (311); 1.717 (21) (222). The name is in relation to the composition; fluoro (for fluorine) and cron (крон, the alchemical name for lead).

Key-words: fluorocronite, Kupol’noe, Sakha Republic, $\beta$-PbF$_2$, new mineral, fluorite group.

1. Introduction

Lead(II) fluoride (also known as lead difluoride and plumbous fluoride) is an air-stable, partially water-soluble fluoride, which has a number of uses in material sciences. PbF$_2$ is used as a component in the manufacture of low-melting glasses (e.g. Shibata et al., 1980), phosphors in television picture tubes (Schulman et al., 1953) and as a catalyst for the manufacture of picoline (Minato & Yasuda, 1976). Structurally PbF$_2$ has both $\alpha$ and $\beta$ forms; the former known both synthetically and in the mineral laurelite (Pb$_7$F$_{12}$Cl$_2$), which has the $\alpha$-PbF$_2$ structure but differs from $\alpha$-PbF$_2$ only in having some Cl substituting for F (Merlino et al., 1996). Here, we report the outcome of investigations of natural $\beta$-PbF$_2$.

The type specimen and associated material was collected in the 1990s by one of the authors (GNG) at the Kupol’noe Ag–Sn deposit. The mineral is named in relation to the composition; fluoro (for fluorine) and cron (крон, the alchemical name for lead). The Russian Cyrillic spelling for the mineral is фторрокронит. The mineral and name have been approved by the IMA–CNMNC (IMA 2010–023). One co-type specimen is housed in the collections of the Fersman Mineralogical Museum, catalogue number 3987/1 and another is in the collections of Mineral Sciences Department, Natural History Museum of Los Angeles County, catalogue number 63316.

2. Geological setting, occurrence and paragenesis

The Kupol’noe Ag–Sn deposit is located on the eastern slope of the northern part of Sarychev range, within the Eimyu stream basin (a tributary of the Nera river), 130 km...