

## **Eskolaite associated with diamond from the Udachnaya kimberlite pipe, Yakutia, Russia**

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### **ABSTRACT**

The mineral eskolaite ( $\text{Cr}_2\text{O}_3$ ) has been discovered in association with natural diamond from the Udachnaya pipe in Yakutia, where it is intergrown with an octahedral diamond, mostly as an inclusion in the diamond, but also exposed at its surface. A detailed study was performed on fragments extracted from the outer surface of the diamond, using single-crystal X-ray diffraction (XRD), high-resolution electron microscopy (HRTEM), analytical electron microscopy (AEM), including line-scan and elemental-mapping, EMP, and SIMS. These applied techniques confirmed the nature of the eskolaite with 86.8 wt%  $\text{Cr}_2\text{O}_3$  and notable impurities of  $\text{TiO}_2$  (3.99 wt%),  $\text{Al}_2\text{O}_3$  (2.00 wt%),  $\text{Fe}_2\text{O}_3$  (5.83 wt%), and  $\text{MgO}$  (1.11 wt%). Trace elements, including V (4900 ppm), Mn (129 ppm), Zr (56 ppm), and Nb (32 ppm) were also detected. The entire range of REE is just at or below the limits of detection. A small picrochromite inclusion ( $X_{\text{Mg}}$  81.2;  $Y_{\text{Cr}}$  94.7) was detected in the eskolaite; its chemistry is typical of chromite diamond inclusions. It also contains minute inclusions of perovskite, corundum, and an unidentified Ti-phase. Nano-sized cavities in picrochromite were determined to consist of carbonate and quench products, including Si, Mg, Ca, P, K, and Cl. This may represent relics of the diamond-forming metasomatic fluids. The eskolaite, containing a picrochromite inclusion, was formed at high pressure within the diamond stability field from C-O-H-bearing fluids containing Ca, K, Cl, P, and possibly even peridotitic (U-type) oxides and silicates.

**Keywords:** Diamond association, intergrowth, eskolaite, picrochromite, Udachnaya kimberlite pipe, Yakutia, Russia