

## **The mechanism of charge compensation in Cu-Fe-PGE thiospinels from the Penikat layered intrusion, Finland**

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### **ABSTRACT**

Thiospinels of Cu-(Fe) and platinum-group elements (PGE) are relatively abundant in the Kirakkajuppura PGE deposit of the Penikat layered complex, Finland. In actinolite-clinocllore rock that is nearly base-metal sulfide-free and relatively poor in chromite, the thiospinels occur as subhedral or anhedral grains (up to 0.4 mm). They are members of the cuprorhodsite-ferrorhodsite and cuprorhodsite-malanite series, relatively poor in cuproiridsite, and display considerable grain-to-grain variations in Cu, Fe, Pt, and Rh. Strong negative Fe-Cu, Pt(+Ir)-Fe, Rh-Cu, and Rh-Pt and strong positive Pt(+Ir)-Cu and Rh-Fe correlations in these thiospinels are indicative of a coupled substitution: Fe-for-Cu substitution in the tetrahedral (A) sites causes an excess in formal positive charge, which is compensated by Rh-for-(Pt+Ir) substitution in the octahedral (B) sites. Probable valence states in the Fe-free and Fe-rich end-members of the solid-solution series at Penikat are  $\text{Cu}^+[\text{Rh}^{3+}(\text{Pt},\text{Ir})^{4+}]_2\text{S}_4^{2-}$  and  $(\text{Fe}_{0.5}^{3+}\text{Cu}_{0.5}^+)\text{Rh}_2^3\text{S}_4^{2-}$ , and these suggest the heterovalent substitution scheme  $^A\text{Fe}^{3+} + 2 ^B\text{Rh}^{3+} \rightarrow ^A\text{Cu}^+ + 2 ^B\text{Pt}^{4+} (+2 \text{Ir}^{4+})$  to incorporate Fe in the ferrorhodsite-rich end member.