



Spinel from tuffites of the Bulkur anticline: comparative analysis of macro- and microcrysts

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The northeastern Siberian platform is famous for a unique association of placer diamonds including specific diamond varieties (V-VII, following the classification by L.Yu. Orlov (1973)). Such diamonds have been found in none of the kimberlite pipes of Yakutia. The petrochemical nature of the primary source for these placer deposits and the conditions of their formation in the mantle are as yet poorly understood. Diamonds with a large amount of associate minerals such as garnets and chrome-spinels occur in the basal horizon of the volcanogenic-sedimentary rocks aged at 226-228 Ma (U-Pb zircon dating, Grakhanov, Smelov, 2011).

This paper presents the results of studying spinel macrocrysts and microcrysts from the tuffites' ground-mass. The analyses were performed on a JEOL JSM 64800 LV scanning electron microscope with an Oxford INCA Energy Dispersive Spectrometer at the Diamond and Precious Metals Geology Institute, SB RAS.

Chemically, the microcrystal spinels are characterized by a wide range of their major components: 17.14-56.53 wt% Cr₂O₃, 3.57-24.96 wt% Al₂O₃, 0.82-11.32 wt% TiO₂, and 1.74-13.31 wt% MgO. Comparison between the microcrystal spinels from the tuffites and those from the Yakutian Kimberlite Province (YaKP) showed that the bulk of the spinels belong to high-Cr and medium-Cr picrochromites that are also typical of the diamondiferous kimberlites in the region. On the diagrams after Mitchel and Bergman (1991) they tend to the lamprophyric rocks trend.

Chemical composition of the macrocrystal spinels also exhibits large variations: 24.9-60.5 wt% Cr₂O₃, 4.32-8.99 wt% TiO₂ (with rare grains containing less than 1 wt%), 1.39-36.06 wt% Al₂O₃, and 13.53-55.67 wt% Fe(total). There is no essential difference in composition between the macrocrystal spinels with inclusions and those without them. For comparison, we plotted on various diagrams the compositions of spinels from the highly diamondiferous Mir pipe. It was found that compositions of spinels from the tuffites and the highly diamondiferous kimberlites differ greatly: spinels from the Mir pipe exhibit a direct relationship between the Al₂O₃ and Cr₂O₃ contents; no such trend is observed for the spinels from the tuffites but they are much higher in TiO₂. A few of the studied macrocrystals can confidently be assigned to the trend of diamondiferous kimberlites, but the bulk of them form a separate group, which indicates that spinels from the tuffites of the Bulkur anticline had a different source.

We have studied melt inclusions of rounded form in the spinels. They are 2-30 μm in size and polymineralic in composition. They contain olivine, pyroxene, an aluminosilicate phase (glass?) with K₂O (or Na₂O) content up to 8 wt.%.

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