# Fluids in Yakutian and Indian diamonds.


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Studies of fluids trapped in micro-inclusions in diamonds from Africa have demonstrated the existence of a wide range of fluid compositions, spanning the full range from a carbonatitic end-member, rich in CaO, FeO, MgO, $K_2O$, and carbonates to a hydrous end-member, rich in $SiO_2$, $K_2O$, $Al_2O_3$, and water (Schrauder and Navon, 1994). Here, we report the composition of the major oxides and volatile species of fluids trapped in six diamonds from Yakutia, and four from India.

## Samples and techniques

The ten diamonds reported here are of fibrous internal texture and cubic morphology (variety III of Orlov, 1977), and are similar to African cubic diamonds. Polished slices, 0.2–1 mm in thickness were cleaned in HF and HCl and were rinsed with water and ethanol. They were mounted on 300μm aperture for infrared analysis (Nicolet 740 FTIR spectrometer with MCT-B detector), and were carbon-coated prior to electron microprobe analysis (JEOL JXA 8600 Superprobe with Tracor Northern energy dispersive system, 15 KeV, 50 nA). Backscattered-electron imaging was used for identifying shallow, subsurface inclusions. Analyses were performed following the procedure of Schrauder and Navon (1994). The total oxide content per analysis of individual inclusion varied between 1–35 wt% (average 7 wt%) with carbon making the difference.

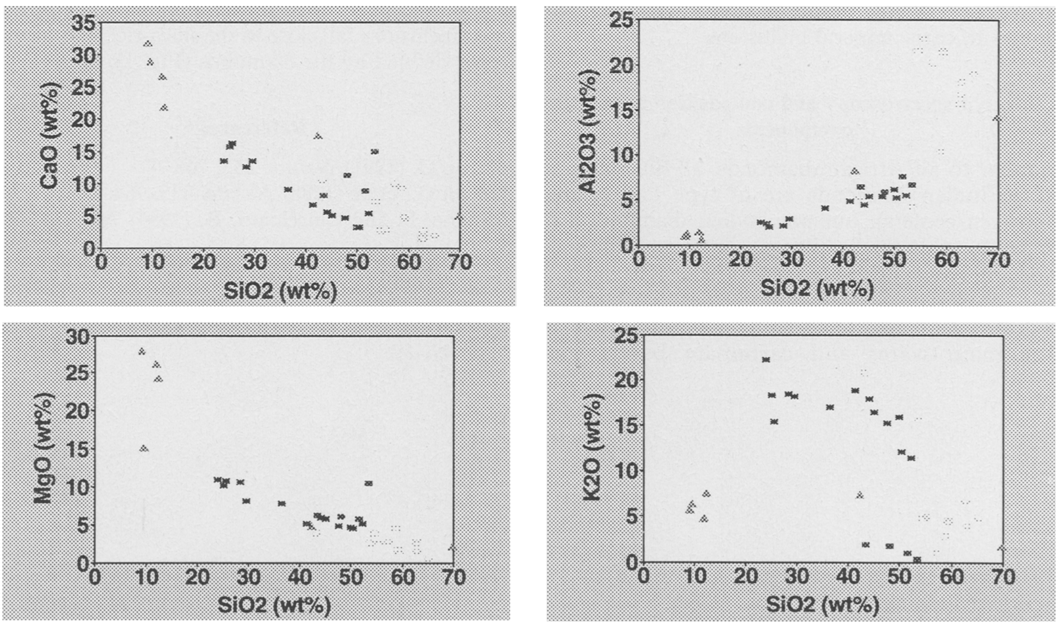


Fig. 1. Chemistry of fluids trapped in diamonds and mantle derived melt inclusions. Triangles - Yakutia, Solid squares - India, Asterisks - Botswana, open squares - melt inclusion in silicate minerals.

### Composition of major oxides

The majority of the inclusions in any individual diamond define a tight compositional range. However, the average compositions of the different diamonds do differ from each other. The compositions of the six Siberian diamonds span a wider range than the Botswanan diamonds reported by Schrauder and Navon (1994). $SiO_2$ vary between 9 and 70 wt% of the volatile-free fraction (Fig.1). $Al_2O_3$ correlates positively with $SiO_2$. The correlation line falls close to that defined by the Botswanan set, with somewhat higher slope. Cao, FeO, MgO, and $P_2O_5$ show negative correlation with $SiO_2$. The trends are similar to those of the Botswanan set, with CaO values somewhat higher CaO contents for given $SiO_2$ value. Three of the $SiO_2$-poor diamonds have higher MgO and lower FeO contents compares with the Botswanan line. The main difference is in the $K_2O$ content, which is much lower than the Botswanan set. The sodium content of the silica poor diamonds is also exceptionally high. The four diamonds of the Indian set have tighter $SiO_2$ content (43–53%), and fall close to the correlation lines defined by the Botswanan and Siberian diamonds. Only their $K_2O$ contents are lower than those of the other diamonds, and their FeO contents somewhat higher. One of the Indian cubes also carry micrometer-size grains of pyroxene (Di-Jd). None of the other cubes was found to carry mineral inclusions.

### Infrared spectroscopy and composition of volatile components

Similar to all African diamonds, all Siberian and three Indian diamonds are of type IaA (paired nitrogen centers), but one Indian diamond is of type Ib, with single nitrogen centers. Additional spectral bands due to the micro-inclusions indicate the presence of water molecules, carbonates, silicates and apatite. The peak-height ratios of the main water and carbonate bands vary significantly and correlates with the $SiO_2$ content of the diamonds. The positions of the other carbonate bands fit the spectra of dolomite-ankerite series, but final identification must take into account possible pressure shifts. Quartz absorption bands in an Indian diamond are shifted to 783 and 808 $cm^{-1}$, indicating internal pressures in the inclusions of about 15 kbar (c.f., Navon, 1991).

### Discussion

Fluid compositions in the Indian and Yakutian diamonds reported here fall close to the trend defined by African diamonds. The Yakutian set, extends the range of compositions towards both the carbonatitic and the hydrous end-member compositions. The four Indian diamonds fall in a tighter, intermediate range of compositions. Both sets are characterized by much lower potassium content and $K_2O/Na_2O$ ratios in comparison with the African diamonds. The occurrence of jadeitic clinopyroxene within an Indian diamond adds to existing observations connecting the fluid-bearing, variety III diamonds to the eclogitic paragenesis. This connection may also account for the relatively low Mg# of most diamonds. We also note the similarity of the fluid composition to that of melt inclusions in megacrysts and mantle xenoliths (Solovova *et al.*, 1989; Schiano and Clocchiatti, 1994). Except for their higher alumina content, the melt inclusions fall close to the silica-rich end of the trend defined by the diamonds (Fig. 1).

### References

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