

# High-density fluids in twinned monocrystalline diamonds

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Monocrystalline (MC) diamonds commonly carry silicate and sulfide inclusions that tell us the ages, pressures, temperatures and rock types where diamonds form, but provide little information about the formation of the diamond itself. Fibrous diamonds trapped microinclusions with high-density fluids (HDFs) and probably grew from the HDFs they trapped. But such HDFs were found in only 2 MC diamonds. This rarity, the different textures and nitrogen aggregation state (only A centers in fibrous diamonds vs. presence of appreciable proportion of B centers in most MC diamonds) leaves the formation of MC diamonds an open question. We conducted a systematic study of 35 twinned diamonds from the Venetia and the Voorspoed Mines and selected 19 with high  $B/(A+B)$  ratio. Close examination of the diamonds with secondary- and back-scattered-electron imaging found 31 microinclusions in 8 of the diamonds, touching or lying very close to the twinning plane. Accounting for the area we scanned in all diamonds and the depth of penetration, this corresponds to  $\sim 20$  ppb of inclusions next to the twinning plane and, most probably, even less in the bulk diamond. EPMA analysis found sub-micrometer inclusions (total oxides and Cl  $< 3.1$  wt%). Eight inclusions, rich in  $\text{SiO}_2$ ,  $\text{MgO}$  and some  $\text{FeO}$  are interpreted as orthopyroxenes, indicating that the two host diamonds belong to the peridotitic suite. Thirteen inclusions in four Venetian diamonds carry inclusions rich in  $\text{MgO}$ ,  $\text{CaO}$  and  $\text{K}_2\text{O}$  with lesser  $\text{FeO}$  and  $\text{SiO}_2$ . This composition is similar to that of high-Mg carbonatitic HDFs in fibrous diamonds. Three inclusions carry  $\text{K}_2\text{O}$ , Cl and  $\text{CaO}$  and are similar to saline HDFs. The composition of three inclusions is similar to low-Mg carbonatites and a single inclusion is silicic. Three inclusions carry more than 60%  $\text{K}_2\text{O}$ , more than in any known HDF. The finding of microinclusions that are similar in composition to HDFs trapped in fibrous diamonds joins a few earlier sporadic indications of the role of HDFs in diamond formation. The fact that a systematic examination of 19 clear, MC macles with high aggregation state of nitrogen yielded HDFs in 8 of these diamonds strongly suggests that most diamonds grew from such carbonate-bearing fluids. Their better habit led to the exclusion of most of the fluid, but some was still trapped along the twinning plane.