Ice-VII inclusions in ultradeep diamonds

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We present the first evidence for inclusions of ice-VII in diamonds from southern Africa, China, North- and South-America [1]. Combining synchrotron X-ray diffraction, - X-ray fluorescence and IR spectroscopy, we show the presence of ice-VII as inclusions in diamonds that have formed at depth > 410 km to about 800 km in the Earth's mantle. What is now crystalline ice-VII, a high pressure polymorph of water-ice, was component of an aqueous fluid entrapped in the diamonds that were growing in the deep mantle. Because of the confinement by the host diamonds, the inclusions retain high pressures. The same holds for inclusions of magnesian calcite, halite, and ilmenite found in the same diamond specimens. These inclusions reflect the presence of aqueous and carbonaceous fluids in the mantle transition zone and the shallow lower mantle.

Using their current residual pressures and the equations of state, we can reconstruct their recovery paths [2,3]. Further, we can use the intersection of modelled recovery paths to better constrain the encapsulation pressure and temperature of these inclusions in diamonds.

[1] Tschauner et al. Science 359, 1136(2018)
[2] Navon et al. EPSL 464, 237 (2017)
[3] Angel et al. Am. Min. 99, 2146 (2014)