High-pressure minerals as inclusions in diamonds

Oliver Tschauner
University of Nevada in Las Vegas

During their growth diamonds entrap minerals that were present in their surrounding or that are cogenetic. Entrapment of minerals or fluids is not uncommon in igneous or metamorphic minerals such as, quartz, garnets, olivine, yet, diamond as hosting phase is particular in a few aspects: A) diamond is chemically rather inert. Except for very light elements and C itself no chemical exchange takes place between host and inclusion. B) Because of its high yield strength and low compressibility diamond may sustain high remnant stresses from inclusions entrapped at high pressure. C) Diamonds form in subducted slabs and in the mantle below 150 and down to about 700, perhaps 900 km depth. Hence, some diamonds contain inclusions from the transition zone (TZ) and the lower mantle (LM). Their depth of formation constrains the depth of the Earth's global carbon-cycle.

In this talk I focus on inclusions from the TZ and LM. Few such inclusions have been discovered. I recapitulate the geophysical and -chemical implications but focus on two more 'technical' aspects: I shall try to establish a morphology of these inclusions, which are mostly not visible optically, in terms of their properties as probed through X-rays: crystallite sizes, strain, texture, the role of retrograde transitions. Then I discuss the reconstruction of the entrapment pressures and temperatures and the role of the viscoelasticity of diamond. Each point will be illustrated by examples.