Meteorite yields carbon crystals harder than diamond

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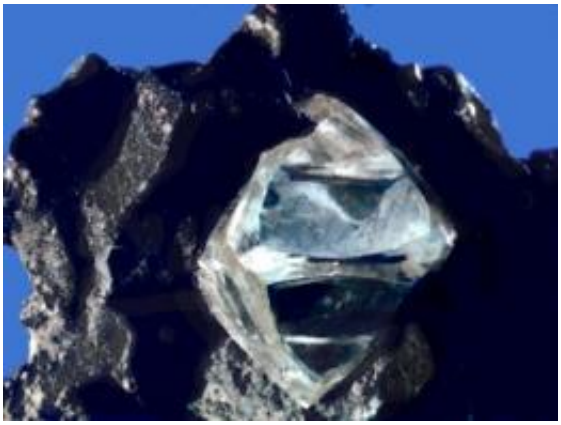

Nearly octahedral diamond crystal in matrix. Image: Wikimedia Commons

(PhysOrg.com) -- Two new types of ultra-hard carbon crystals have been found by researchers investigating the ureilite class Haverö meteorite that crashed to Earth in Finland in 1971. Ureilite meteorites are carbon-rich and known to contain graphite and diamonds.

The super-hard diamonds were created when graphite in the meteorite experienced the intense heat and pressure of entering the Earth's atmosphere and crashing into the ground. The graphite layers would have been heated and shocked enough to create bonds between them, in much the same way as humans manufacture diamonds.

The new carbon crystals were too small to test for precise hardness but

they are known to be harder than normal diamonds because the researchers found them by using a diamond paste to polish a slice of the meteorite. The crystals were raised more than 10 µm above the polished surface, which meant they were harder than the diamonds in the polishing paste. The researchers had seen carbon crystals that resisted the diamond polishing in one direction before, but the new crystals were unaffected when polished in every direction.

The scientists then used an array of mineralogical instruments, including microscopy, spectroscopy and energy-dispersive X-rays among others, to study the structure of the crystals. This allowed them to identify them as representing two new carbon polymorphs or diamond polytypes.

One is an ultra-hard rhombohedral carbon polymorph similar to diamond, while the other is a 21R diamond polytype ultra-hard diamond. The existence of ultra-hard diamonds had been predicted decades ago, but they have never before been found in nature. The novel form consists of fused graphite sheets similar to artificial diamond.

Professor Tristan Ferroir, leader of the research team from the Université de Lyon in France, said the discovery was accidental, but they had thought an examination of the meteorite would “lead to new findings on the carbon system."

Professor Ferroir said there is currently no way to compare the structure of the new crystals to boron nitride and lonsdaleite, the artificially manufactured ultra-hard diamonds, but the findings help scientists gain a better understanding of carbon polymorphs and give them new materials to investigate and perhaps synthesize. They also show the carbon system is more complex than previously thought.

The findings on the new diamond were published in the *Earth and Planetary Science Letters* journal on February 15.

More information: dx.doi.org/10.1016/j.epsl.2009.12.015