Electron scanning reveals that fibrous and gem quality diamonds form from the same kinds of carbonate-containing fluids

April 15 2016, by Bob Yirka

This is a collection of 0.02, 0.03 and 0.04 carat solitaire diamonds weighing in total 5.36 carats. Credit: Swamibu/Wikipedia

(Phys.org)—A pair of researchers with The Hebrew University of Jerusalem has found evidence that suggests both gem quality and fibrous diamonds form from the same types of fluids. In their paper published in *Earth and Planetary Science Letters*, Brooke Matat Jablon and Oded Navon, describe their experiments with beams of electrons and multiple diamonds, both gem quality and fibrous, what they found and why they now believe all diamonds have a common source.

For many years geologists and other scientists have debated whether cloudy diamonds, known as fibrous, developed under the same conditions as gem quality diamonds, with many arguing that the process must have been different to account for such obvious differences between the two. Scientists have known for many years, that the reason fibrous diamonds are cloudy, is because they have carbonates in them, bits of the same types of materials that is found in shells—known as inclusions. Gem quality diamonds were thought to be very near perfect, which meant they had no inclusions. Now, it appears such thinking was wrong as the research pair found evidence of extremely small inclusions in every diamond they studied, regardless of type or quality.

To find inclusions in gem quality diamonds, the researchers used electron scanning techniques to search in ways that had never been tried before, focusing most intently along borders. Among the inclusions found were multiple instances of material that was identical to that found in carbonate-bearing fluids that have been typically found in fibrous diamonds. This, the team suggests, indicates very strongly that the diamonds all came about from the same source, namely carbon material deep under the crust that was subject to extreme pressure. They do suggest that the timeframe involved likely played a role determining which type of diamond was formed. Fibrous diamonds, they suggest formed relatively quickly, on the order of just a few million years, while gem quality diamonds appear to have taken from one to three and a half billion years.

The team notes that their findings also suggest that our planet must have maintained diamond-forming conditions for billions of years, which suggests plate tectonics would have been occurring that long as well.

More information: Brooke Matat Jablon, Most diamonds were created equal, *Earth and Planetary Science Letters* (2016). DOI: 10.1016/j.epsl.2016.03.013

Abstract

Diamonds crystallize deep in the mantle (>150 km), leaving their carbon sources and the mechanism of their crystallization debatable. They can form from elemental carbon, by oxidation of reduced species (e.g. methane) or reduction of oxidized ones (e.g. carbonate-bearing minerals or melts), in response to decreasing carbon solubility in melts or fluids or due to changes in pH. The mechanism of formation is clear for fibrous diamonds that grew from the carbonate-bearing fluids trapped in their microinclusions. However, these diamonds look different and, based on their lower level of nitrogen aggregation, are much younger than most monocrystalline (MC) diamonds.

In the first systematic search for microinclusions in MC diamonds we examined twinned crystals (macles), assuming that during their growth, microinclusions were trapped along the twinning plane. Visible mineral inclusions (>10 μm) and nitrogen aggregation levels in these clear macles are similar to other MC diamonds.

We found 32 microinclusions along the twinning planes in eight out of 30 diamonds. Eight inclusions are orthopyroxene; four contain >50% K2O (probably as K2(Mg, Ca)(CO3)2); but the major element compositions of the remaining 20 are similar to those of carbonate-bearing high-density fluids (HDFs) found in fibrous diamonds. We conclude that the source of carbon for these macles and for most diamonds is carbonate-bearing HDFs similar to those found here and in fibrous diamonds. Combined with the old ages of MC diamonds (up to 3.5 Ga), our new findings suggest that carbonates have been introduced

into the reduced lithospheric mantle since the Archaean and that the mechanism of diamond formation is the same for most diamonds.

Via ScienceNews

Citation: Electron scanning reveals that fibrous and gem quality diamonds form from the same kinds of carbonate-containing fluids (2016, April 15) retrieved 26 April 2024 from https://phys.org/news/2016-04-electron-scanning-reveals-fibrous-gem.html