Did diamonds begin on the ancient ocean floor?

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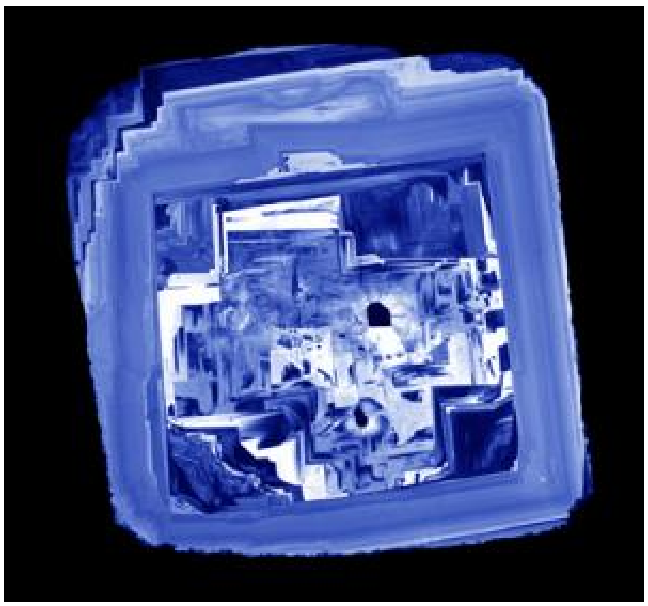

(Phys.org) —Geology professor Dan Schulze calls this singular gem from the remote Guaniamo region of Venezuela the "Picasso" diamond. The blue luminescent, high-resolution image of a diamond formed over a billion years ago reminds him of some paintings from Picasso's Blue Period. Like a cubist masterpiece, its striking irregular and anomalous features carry timeless secrets and yield new perspectives on life and the Earth's early history.

"A diamond is a time capsule. Anomalies in the chemical signature are the key to understanding the unusual conditions under which some diamonds were formed," says Schulze, an earth sciences professor in the Department of Chemical and Physical Sciences at U of T Mississauga.

Led by Schulze, an international team of scientists from Australia, Scotland, the United States and Venezuela discovered persuasive new evidence to support the idea that some diamonds, like Picasso, were formed from bacteria or algae on the ancient ocean floor. Their findings suggest these diamonds, known as eclogitic diamonds, originated as organic matter on the ancient sea floor, which was thrust down into the Earth's mantle by a geological process known as subduction. Attached to ocean floor rock deep beneath the surface, the organic carbon remnants were then transformed by extreme heat and pressure into diamonds.

The research is published in the April 2 issue of *Geology*.

Unlike the more common peridotitic diamonds, formed from inorganic carbon found deep in the Earth's mantle, the origins of eclogitic diamonds have been puzzling and controversial due to differences in their carbon signature. "Because diamonds are impermeable, they preserve inside themselves a record of the chemical and physical conditions that existed as they were formed," says Schulze, noting that tiny minerals trapped within the diamonds contain telltale clues to help solve the puzzle.

In their *Geology* study, Schulze and his colleagues deciphered this record by analyzing the oxygen composition of tiny garnet and silica grains encapsulated in eclogitic diamonds from mines in Venezuela, Australia and Botswana, and the carbon composition of the diamonds themselves. They observed a pattern of striking anomalies in the chemical signatures of both the mineral grains and diamonds that appear to explain how eclogite diamonds were formed.

The silica grains in the Picasso diamond, for example, have a high oxygen composition that matches volcanic rock hydrothermally altered at low temperatures on the ancient sea floor, but is different from typical mantle material. "There is no other place on Earth where you get these values except on the ocean floor," says Schultze. The diamond itself has a low carbon composition similar to the remains of living organisms.

The same pattern of anomalies was consistently found in over 20 diamonds from three continents. "The simplest hypothesis is that the diamonds were formed from subducted organic materials. It's not just a local phenomenon. This is a geological process that was repeated worldwide in diamonds of different ages from three different locations," explains Schulze.

His research also sheds new light on the origins of two famous diamonds in the British Crown Jewels, the Cullinan I and Cullinan II. "There is a high probability that the Cullinan diamond, the largest gem-quality diamond ever found, is an eclogitic diamond made of biogenic material," he says. "But we'll never know for sure, as we can't get the diamonds for study!"

Life may have begun on the ancient sea floor and Schulze's research suggests many of the world's diamonds originated there too. "There are some people who will never believe this. But these findings will convert more skeptics to a hypothesis that's getting harder and harder to refute," he says.

Provided by University of Toronto Mississauga