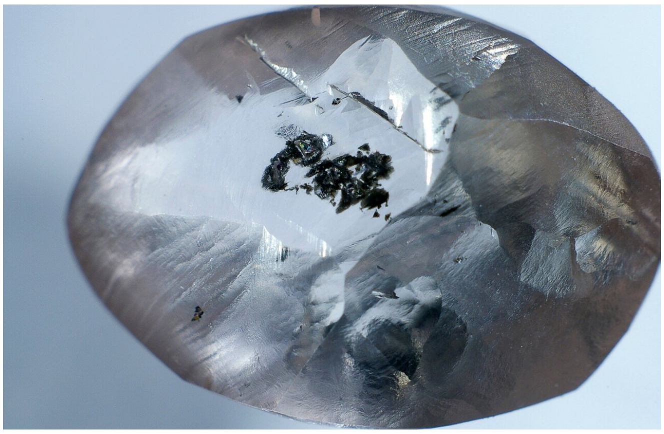
New insights into Earth's carbon cycle

10 September 2020, by Andrew Lyle



A rough diamond from Kankan, Guinea, that was analyzed in a new study led by a PhD student at the U of A. The imperfections inside the diamond are small inclusions of a mineral called ferropericlase, which is from the lower mantle. Credit: Anetta Banas

In a new study led by a University of Alberta Ph.D. student, researchers used diamonds as breadcrumbs to provide insight into some of Earth's deepest geologic mechanisms.

"Geologists have recently come to the realization that some of the largest, most valuable diamonds are from the deepest portions of our planet," said Margo Regier, a Ph.D. student in the Faculty of Science under the supervision of Graham Pearson and Thomas Stachel. "While we are not yet certain why diamonds can grow to larger sizes at these depths, we propose a model where these 'superdeep' diamonds crystallize from carbon-rich magmas, which may be critical for them to grow to their large sizes."

Beyond their beauty and industrial applications, diamonds provide unique windows into the deep Earth, allowing scientists to examine the transport of carbon through the mantle.

"The vast majority of Earth's carbon is actually stored in its silicate mantle, not in the atmosphere," Regier explained. "If we are to fully understand Earth's whole carbon cycle, we need to understand this vast reservoir of carbon deep underground."

The study revealed that the carbon-rich oceanic crust that sinks into the deep mantle releases most of its carbon before it gets to the deepest portion of the mantle. That means most carbon is recycled back to the surface, and only small amounts are stored in the deep mantle—which has significant implications for how scientists understand the Earth's carbon cycle.

The mechanism is important to understand for a number of reasons, Regier noted.

"The movement of carbon between the surface and mantle affects Earth's climate, the composition of its atmosphere and the production of magma from volcanoes," said Regier.

"We do not yet understand if this carbon cycle has changed over time, nor do we know how much carbon is stored in the deepest parts of our planet. If we want to understand why our planet has evolved into its habitable state today and how the surfaces and atmospheres of other planets may be shaped by their interior processes, we need to better understand these variables."

The study was made possible through a collaboration between researchers at the U of A and the University of Glasgow, including Jeff Harris, who collected the diamond samples. Support through federal funding from the Natural Sciences and Engineering Research Council of Canada, through the Diamond Exploration Research Training School at the U of A, was also integral in enabling the research.

The study, "The Lithospheric to Lower Mantle Carbon Cycle Recorded in Superdeep Diamonds," was published in *Nature*.

More information: The lithospheric-to-lower-mantle carbon cycle recorded in superdeep

diamonds. *Nature* (2020).
doi.org/10.1038/s41586-020-2676-z

Provided by University of Alberta