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Press release

The little secrets of diamonds

Diamonds and their inclusions prove that crucial elements such as oxygen and carbon have, not only have a superficial cycle, but can also be transported from the surface to great depth in the Earth. Prof. Daniela Rubatto of the Institute of Geological Sciences of the University of Bern has published her results in the Journal „Chemical Geology“.

Only the skin of Earth, the first few kilometers, can be directly sampled and investigated. To understand processes acting at greater depth we rely on minerals and rocks that have been brought up to the surface by plate tectonic processes (volcanoes and mountain building).

Diamond is a scientist's best friend for sampling the deep Earth as it forms below a depth of 150 km and can be transported to the surface by fast - moving magmas. Diamond is physically robust and can preserve mineral inclusions that were encapsulated at great depth all the way to the surface. Diamonds and their inclusions thus serve as unique carrier of information from the deep Earth. Diamond consists of densely packed carbon whereas oxygen is one of the major elements in the inclusions. Are the carbon and oxygen coming from the deep mantle or have they been transported to great depth by tectonic processes?

These questions have been addressed in a study recently published in the international journal Chemical Geology by Prof Daniela Rubatto at the University of Bern in collaboration with Dr Zedgenizov and colleagues at the Sobolev Institute of Geology and Mineralogy, in Novosibirsk, Russia. The research team used diamonds found in sands in Siberia to investigate if carbon and oxygen, can be recycled from the Earth's surface to a depth of more than 150 km.

A powerful mass spectrometer (an ion microprobe, similar the instrument located in the SwissSIMS laboratory in Lausanne) was used to determine the abundance of the different isotopes of carbon and oxygen in the precious crystals and their tiny mineral inclusions.

The study is one of the first that successfully performed those isotope analyses directly on the crystals without destroying them. The isotope abundances that were measured prove that both the carbon that built the diamonds and the oxygen contained in the inclusions came from the Earth's surface, where ocean water and biological processes gave them their specific isotope compositions.

This study contributes to the ongoing research on element cycles in our planet, and particularly how elements that are typical of the surface like oxygen and carbon not only circulate in the oceans and atmosphere, but also have a deep cycle and can be stored at great depth within the Earth.

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Reference:

Zedgenizov, Dmitry; Rubatto, Daniela; Shatsky, V. S; Ragozin, Alexey; Kalinina, Victoria (2016). Eclogitic diamonds from variable crustal protoliths in the northeastern Siberian craton: trace elements and coupled $\delta^{13}\text{C}$ – $\delta^{18}\text{O}$ signatures in diamonds and garnet inclusions. *Chemical geology*, 422, S. 46-59. Elsevier 10.1016/j.chemgeo.2015.12.018

Image: The diamond samples of which the oxygen and carbon compositions were measured in a non-destructive way using a mass spectrometer (© Daniela Rubatto, Institute of Geological Sciences)

