Ultra-thin slices of diamonds reveal geological processes

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Diamonds are not only beautiful and valuable gems, they also contain information of the geological history. By using ultra-thin slices of diamonds, Dorrit E. Jacob and her colleagues from the Macquarie University in Australia and the University of Sydney found the first direct evidence for the formation of diamonds by a process known as redox freezing. In this process, carbonate melts crystallize to form diamond. The slices were prepared by Anja Schreiber of the GFZ German Research Centre for Geosciences in Potsdam, Germany. The work is published in *Nature Communications*. The study shows that the reduction of carbonate to diamond is balanced by the oxidation of iron sulphide to iron oxides.

The researchers used the new nano-scale technique of Transmission Kikuchi Diffraction to discover rims of the iron oxide mineral magnetite just a few ten thousandths of a millimetre thick around sulphide minerals inside the diamonds. The GFZ's Anja Schreiber prepared these slices using a focussed beam of charged atoms (ions) to ablate the surface. The already ultra-thin slices were re-thinned after being mounted on a carbon-coated copper grid. This process was carried out for the first time successfully on a grid and yielded the data set used for the study.

The results also solve a puzzle that has occupied diamond researchers for decades, namely the over-abundance of sulphide occurring as inclusions in diamond. Iron sulphides are the most common inclusions in diamond even though there is only about 0.02% of sulphur in the mantle: it now appears that the oxidation of the iron sulphides directly causes the

formation of the diamonds that include them.

More information: "Redox-freezing and nucleation of diamond via magnetite formation in the Earth's mantle" *Nature Communications*, DOI: 10.1038/NCOMMS11891

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