

## Oxidation state of the mantle through inclusions in diamonds

EKATERINA S. KISEEVA<sup>1,\*</sup>, BERNARD J. WOOD<sup>1</sup>

<sup>1</sup> Department of Earth Sciences, University of Oxford,  
Oxford OX1 3AN, UK, [kate.kiseeva@earth.ox.ac.uk](mailto:kate.kiseeva@earth.ox.ac.uk),  
[berniew@earth.ox.ac.uk](mailto:berniew@earth.ox.ac.uk)

The oxidation state and oxygen fugacity ( $fO_2$ ) of Earth's mantle exert important influences on the compositions of primary melts the speciation and mobility of carbon and sulphur, diamond formation, and the modification of subducted lithosphere [1, 2]

It is generally observed that the oxygen fugacity of both cratonic and asthenospheric mantle is close to FMQ in the spinel field and that  $fO_2$  in the cratons generally decreases with depth. According to experimental studies combined with thermodynamic modelling, at depths below 180-200 km the decreasing oxygen fugacity should destabilise carbonate with all carbon at greater depths being stored as diamond [1, 3]. These pressure effects also tend to stabilise metal in the transition zone following the disproportionation of divalent iron (FeO) into Fe (metal) and Fe<sup>3+</sup> (accommodated in garnet) [4].

To date, inclusions in diamond are the only available samples from the mantle transition zone and the lower mantle and these provide the opportunity for study of redox relationships in the deep mantle. In this study we used synchrotron Mössbauer Spectroscopy to measure Fe<sup>3+</sup>/(Fe<sup>2+</sup>+ Fe<sup>3+</sup>) ratios of majoritic inclusions in diamonds from the lowermost upper mantle and the mantle transition zone for comparison with garnets from the shallow mantle.

We find that there is a systematic increase with depth of the oxidation state of iron in garnets included in diamonds, with the deepest samples (~550 km depth) having Fe<sup>3+</sup>/(Fe<sup>2+</sup>+ Fe<sup>3+</sup>) of up to 0.30, which is more than twice as great as in non-majoritic upper mantle garnets (< 200 km depth) [5]. When converted to oxygen fugacity these measurements imply conditions just above the stability field of metallic iron (above IW).

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