

# Oxidation state of the mantle transition zone through majoritic inclusions in diamonds

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The oxidation state and oxygen fugacity ( $fO_2$ ) of the Earth's mantle exert a crucial influence over the speciation and mobility of volatile elements in the interior. Even the small changes in the mantle oxygen fugacity can trigger the change in the element's oxidation state and affect the stability of mineral phases (i.e., carbonate or diamond/graphite, sulphide or sulfate) or influx melting [1].

The oxidation state of the mantle is generally decreasing from close to QFM in the top part of the upper mantle to close to IW at about 250 km [2]. According to experimental studies, at the pressures of mantle transition zone, divalent iron ( $Fe^{2+}$ ) tends to disproportionate into iron metal ( $Fe^0$ ) and trivalent iron ( $Fe^{3+}$ ) that partitions into the majoritic garnet [3].

In order to test these experimental results and to unravel the oxidation state of the deep mantle, we used Synchrotron Mössbauer Spectroscopy (SMS) at id18, ESRF, Grenoble and measured  $Fe^{3+}/Fe_{tot}$  ratios in 13 majoritic garnet inclusions in diamonds from Jagersfontein kimberlite, South Africa [4]. These majorites span over the interval of pressure between 8 and 18 GPa and showed a systematic trend of increasing  $Fe^{3+}/Fe_{tot}$  with depth [4].

In this study we further expand on the types, compositions and locations of majoritic garnets and present new data for 11 majoritic garnets from Juina, Brazil and Cullinan, South Africa. Contrary to the results of our previous study, the  $Fe^{3+}/Fe_{tot}$  ratios obtained for majorites from Juina and Cullinan do not show a clear trend of increasing  $Fe^{3+}/Fe_{tot}$  ratios with pressure, however, if converted to  $fO_2$ , they are on the whole similarly oxidised. To date, most majoritic garnets analysed for  $Fe^{3+}/Fe_{tot}$  ratios by SMS show oxygen fugacities higher than expected for the mantle transition zone and outside of the stability field of metallic iron.

## References

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4. Kiseeva, E.S., et al., Nature Geoscience, 2018. **11**(2): p. 144-150.