OH and CO_2 diffusion profiles in garnets from eclogitic xenoliths from the Rovic diamond mine, South Africa (UNESCO IGCP 557)

JESSIKA POTGIETER[1]*, HOLGER SOMMER[1], KLAUS REGENAUER-LIEB[3], BILIANA GASHAROVA[4] AND MEGAN PURCHASE[1]

[1]Department od Geology, University of the Free State, PO Box 339, Bloemfontein 9301, South Africa (*correspondence: jessikapotgieter@yahoo.com)
[2]School of Earth & Geographical Sciences, The University of Western Australia 6009, Australia
[3]CSIRO Exploration & Mining, PO Box 1130, Bentley, WA 6102, Australia
[4]ANKA/Inst. Synchrotron Radiation, Forschungszentrum Karlsruhe Gmbh, Hermann-von-Helmholtz-Platz 1, Eggenstein-Leopoldshafen, D-77344 Germany

The mechanism of kimberlite eruptions plays a significant role in diamond exploration. The composition of the kimberlitic melt is a major physical aspect in understanding the eruption dynamics of kimberlites. In the studied eclogites, water and CO_2 is commonly dissolved in nominally water free minerals (NAMS) as OH and CO_2, which is caused by mantle metasomatism. The eruption of the kimberlite causes water to partition prefentially into the kimberlitic melt due to the higher solubility of water in the melt compared to NAMS. The concentration of OH in garnets can thus be used, to quantify the composition of the kimberlitic melt. For the first time high resolution FT-IR based synchrotron measurements of OH and CO_2 concentrations in eclogitic garnets from the Rovic Diamond Mine in South Africa is presented. Hydrogen and CO_2 profiles, has been measured towards totally embedded microcracks in the garnet crystals. These measurements show a strong variation in OH and CO_2 concentrations, which demonstrate that the amount of water and carbondioxide stored in diamond bearing layers has been underestimated for a long time due to the loss of water and carbondioxide during the uplift of the kimberlite.

Oxygen isotopic exchange at a contact between the Bushveld Complex and meta-sedimentary rocks of the Phepane Dome

R.H. POTTER[1]*, S.C. PENNISTON-DORLAND[1] AND J.W. VALLEY[2]

[1]Department of Geology, University of Maryland, College Park, MD 20742 (*correspondence: rhpotter@umd.edu)
[2]Department of Geology and Geophysics, University of Wisconsin-Madison, Madison, WI 53706

Within the Eastern Lobe of the Bushveld Complex, the Phepane Dome is a circular structure of meta-sedimentary rock hypothesized to have formed as a wallrock diapir. The duration of diapir rise and eventual freezing into the Bushveld Complex has implications for the timescale of melt and fluid processes in the Bushveld and its contact aureole.

Oxygen isotopic compositions of samples collected along two traverses (EP and WP) across the contact between the Bushveld Complex and Phepane Dome place constraints on the timescale of formation of the Phepane structure. The average $\delta^{18}O$(quartz) of Lakenvalei quartzite collected at distances of 1 to 48 m from the contact in both traverses in the Phepane Dome is 11.01±0.58‰ (2 s.d.), within error of Lakenvalei samples from the outer aureole of the Bushveld. In the EP traverse, quartz from samples of felsic Bushveld rock extending 1.5 to 114 m from the contact has an average $\delta^{18}O$ of 7.33±0.81‰. In the WP traverse, the average $\delta^{18}O$ of plagioclase in the mafic Bushveld rock is 7.95±0.13‰, correlating well with measurements from previous studies that determined these to be magmatic values. Each rock type is distinct and internally homogenous, showing no systematic variation with distance from the contact. Thus, all measured oxygen isotopic values are interpreted as preserved initial compositions, indicating that there was limited oxygen isotopic exchange across the contact and that hydrothermal alteration did not affect the oxygen isotopic compositions.

However, evidence for partial melt and later aqueous fluid in these rocks is unambiguous. Partial melt of the sedimentary rock is necessary for diapirism and unmistakable in thin section. Abundant fluid inclusions are also evident in thin section. The duration of connected partial melt and/or aqueous fluid must have been short lived because the oxygen isotopic compositions close to the contact are undisturbed. Models of grain boundary diffusive oxygen isotopic exchange across the contact with low fluid flux suggest timescales of ~100 kyrs. Measurements of Li isotopic compositions and concentrations are consistent with this interpretation.