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How dry was the Archean mantle lithosphere beneath Kaapvaal?

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Kimberlite eruptions allow exceptional insights deep into cratons by rapidly bringing to the surface well-preserved mantle fragments from a broad depth range. Water is a key parameter for craton long-term stability as it affects viscosity and melting properties. We report here a multi-disciplinary (FTIR, Mössbauer, XANES, EPMA, LA-ICPMS) study of 17 harzburgite xenoliths from the Jagersfontein mine (Kaapvaal, South Africa) that are typical residues of high-degree melting (Mg# 93-94) and displaying minimum metasomatic interaction with the kimberlite as evidenced using trace elements. Thermobarometry yields 742-887 °C and 30-37.5 kbar for the equilibrium conditions of garnet free peridotites and 674-1084 °C and 27-51 kbar for garnet bearing peridotites. Oxygen fugacity, D$\log f O_2$ relative to the FMQ buffer, varies between -1.32 and -0.29 ± 0.5 in the Cr-spinel bearing peridotites and between -2.87 and -0.57 ± 0.5 in garnet peridotites. OH content ([OH]) in the bulk rock varies between 29 and 99 ppm wt. H_2O and displays equilibrium inter-mineral distribution indicating that these samples remained unchanged for billions of years. Bulk [OH] and D$\log f O_2$ decrease with increasing depth, as observed previously. This observation may imply a change in C-H-O fluid speciation from oxidized (H_2O-CO_2) to reduced (H_2-CH_4) in line with thermodynamic modelling of fluid-saturated peridotite, often used in the literature. However, we show here that the OH content in olivine is well below saturation, with very low H_2O and H_2 calculated fugacities, and we did not observe any H_2 despite specific search for it.