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The (geochronological) tale of three minerals (cpx-grt-rt) in eclogites from Kaapvaal Craton

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In situ U-Pb geochronology is experiencing a small revolution nowadays. Besides U-Pb being the most used isotopic system for dating accessory minerals, its use has been expanded to rock-forming minerals like garnet. In this study, we have dated garnet, rutile and, for the first time, clinopyroxene from kimberlite–borne eclogite xenoliths from the Namaqua–Natal Fold Belt, at the southwestern Kaapvaal craton margin ([1] and references therein).

We found that each of the three minerals tells a different story with respect to U-Pb geochronology: I) Although we were only able to date one clinopyroxene (1062 ± 67 Ma, Fig.1), all samples have similar initial $^{207}Pb/^{206}Pb$ ratios, pointing to a coeval origin. The clinopyroxene may, therefore, reflect subduction associated with the Namaqua–Natal Belt orogeny. Ages obtained for garnet and rutile are distinctly younger (Fig. 1). II) Given the low closure temperature (ca. 600 °C) of the U-Pb system in rutile, we believe that rutile (ca. 95 Ma) indicates the maximum age of the host kimberlite eruption. III) Garnet shows resolvably slightly older ages (ca. 105-110 Ma). Inclusions in large garnet and clinopyroxene grains as well as “spongy” rims on clinopyroxene suggest that the eclogites have not recrystallised prior to entrainment. Therefore, we think that the garnet could have suffered Pb-loss associated with heating and relatively rapid cooling after melt metasomatism precursory to kimberlite eruption.

[1] Aulbach, Höfer, Gerdes, Tinguely, & le Roex (2024), *Journal of Geophysical Research: Solid Earth* 129, e2023JB027894. https://doi.org/10.1029/2023JB027894

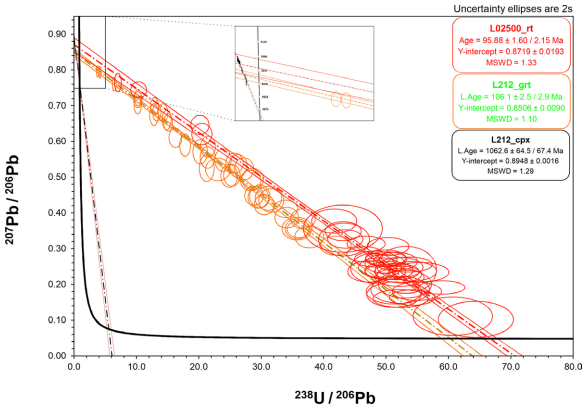

Fig. 1 – Tera-Wasserburg diagram for the three analysed minerals. Note that the rutile corresponds to a different sample.