Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37226

Less recycling and more mantle in cratonic MARID metasomes

KATIE SMART[1], PROF. SEBASTIAN TAPPE, PHD[2], RONNY SCHOENBERG[3], ILKA C. KLEINHANNS[3], TOMÁŠ MAGNA[4] AND ANDREAS STRACKE[5]

[1]TU Bergakademie Freiberg
[2]Technical University Bergakademie Freiberg
[3]University of Tuebingen
[4]Czech Geological Survey
[5]University of Münster

The presence of metasomatic domains within the lithospheric mantle are inferred from enriched geochemical and isotopic compositions of primitive alkaline melts and from seismically slow regions beneath continents. These indirect observations suggest that metasomatic lithologies, which are distinct from olivine-rich peridotites that are residues of melt-depletion, form discrete and heterogeneous domains within the lithospheric mantle. Tangible examples of mantle metasomatism are often limited to the presence of scarce amphiboles or micas within peridotite or eclogite xenoliths, where recovery of distinct metasomatic lithologies is often absent.

An exception to this, and central to understanding mantle metasomatism, are the occurrence of ultrapotassic and ultramafic mantle xenoliths that consist of amphiboles, micas, pyroxenes and oxide minerals. These metasomatic xenoliths, known broadly as ‘MARID’, are dominantly found in kimberlites and other volatile-rich ultramafic rocks in cratonic settings - particularly the Kaapvaal craton (southern Africa). The formation of MARID xenoliths is inextricably linked to kimberlitic magmatism, due to overlapping Cretaceous ages and similar enriched incompatible element contents and Sr-Nd-Hf-Pb isotopic compositions. Despite the assumption of clear links between kimberlite magmatism and the formation of metasomatic lithologies within the Kaapvaal craton root, the determination of Proterozoic ages for some metasomatic xenoliths, as well as their geochemically heterogenous nature, has ensured that the parental melts to these metasomatic lithologies remain debated. Particularly, it is unclear if the metasomatic lithologies contain contributions from deeply subducted recycled crust.

We invigorate the debate surrounding formation of lithospheric metasomatic domains by discussing our new geochemical and Nd-Hf isotopic data for an extensive collection of MARID-suite xenoliths from Kimberley in South Africa. This ‘standard’ geochemical toolkit is supplemented by first combined Li-Cl-Zn-Cr-Mo isotope data. The integration of classic radiogenic isotope systems and several non-traditional stable isotope datasets shows that overly simplistic links to regional kimberlite magmatism are questionable. Most importantly, however, the input of recycled crustal components to MARID metasomatism was limited, because mantle-like stable isotope compositions prevail. This suggests that typical cratonic metasomes, often invoked in interpretations of seismic mid-lithospheric discontinuities, result from the differentiation of mantle-derived melts and their complex interactions with lithospheric wall-rocks, without the need for exotic components.