Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19622

Composition and thermal state of the Arabian lithospheric mantle: Evidence from mantle xenoliths

IVANA ZIVADINOVIC[1], FROUKJE M. VAN DER ZWAN[2], JANNE M. KOORNNEEF[3], ERIC HELLEBRAND[4] AND GARETH R. DAVIES[3]

[1]King Abdullah University of Science and Technology
[2]KAUST - King Abdullah University of Science and Technology
[3]Vrije Universiteit Amsterdam
[4]Utrecht University

Presenting Author: ivana.zivadinovic@kaust.edu.sa

Large Cenozoic lava fields named "Harrats" spread from Syria through Saudi Arabia to Yemen and represent extensive intraplate volcanism in the western part of the Arabian plate, following the Tertiary rifting and the Red Sea opening 30 Ma ago.[1]These lavas, with sub-alkaline to alkaline affinity, frequently contain mantle xenoliths, offering the chance to study the composition and thermal conditions of the lithospheric mantle beneath the Arabian plate at the time of the eruption (active from 9Ma to present).

Mantle xenolith pressure-temperature estimates in previous studies from several volcanic fields indicated multiple complex cooling and heating events, and some elevated temperatures, attributed to either westward mantle upwelling from the Red Sea or heating by the Afar plume. [2] The latter is in agreement with a low-velocity zone extending from 70 to 190 km beneath western Arabia, suggesting northward lateral mantle flow of the Afar plume.[3] Interestingly, the xenolith suite from Northernmost Harrat Uwayrid recorded the highest calculated $T_{En\text{-}Di}$ temperatures between 1000 and 1120 °C.[4]

A comprehensive P-T analysis of xenoliths of the Harrats is required to increase our knowledge of the Arabian lithospheric mantle's thermal state and structure. To address this, we calculated P–T arrays using the major elements of diverse mantle xenoliths from Harrat Uwayrid, Lunayyir, Al Birk, Kishb, and the Jizan volcanic group. A particular focus is on samples with (hydrous) minerals associated with late-stage Red Sea rifting processes.[5] These estimates will allow us to evaluate the state of the mantle and learn more about heating episodes that could be related to the partial melting of the mantle forming the Harrats.

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