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Petrogenesis of western Saudi Arabia sub-continental lithospheric mantle: Insights from spinel lherzolite xenoliths of Harrat Uwayrid

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Numerous Upper Miocene to Quaternary harrats (alkali basalt volcanic fields) litter the western margin of Saudi Arabia along the Red Sea between Jordan and Yemen and are related to opening of the Red Sea system. Many of these harrats have alkaline scoria bombs and lavas that bear mantle xenoliths and one of these is Harrat Uwayrid, situated between Tabuk to the north and Al Ula to the south. This study presents preliminary whole-rock and spinel chemistry data to provide insights on the nature of and degrees of partial melting undergone by ultramafic xenoliths of Harrat Uwayrid. Xenoliths are predominantly spinel lherzolite with minor pyroxenites. Spinel lherzolite xenoliths range from cm-scale to fist-size and are found mostly in basanite scoria bombs that comprise cinder cones in the central Pliocene to Quaternary field; others however, were also recovered from Upper Miocene alkali basalt and hawaiite lavas in the southern plateau. Samples exhibit granular texture and are exceptionally fresh (<0.7 wt.% LOI). High CaO (1.46-4.76 wt.%) and Al_2O_3 (1.75-4.24 wt.%) and low Al_2O_3/SiO_2 (0.04-0.09) suggest relatively low degrees of melt extraction. Calculation of the degrees of partial melting using $F = 10\ln(Cr\#)+24$ however, yields heterogeneous results. For example, one cinder cone in the younger volcanic field has spinel lherzolite that records very low F (0.2-0.3%), whereas spinel lherzolite xenoliths from a nearby cinder cone (~4-5 km to the SW), cede high F of 12.0-12.2. Spinel lherzolite xenoliths from the older plateau lavas yield F (7.6-8.1) in between these extremes. Our preliminary results document broadly differing degrees of partial melting over very small areas.