

# **Age, geochemistry, and isotope ratios of Harrat Uwayrid alkali basalts, NW Saudi Arabia: Implications for the tectonic evolution of the Red Sea system**

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The western margin of the Arabian Shield along the Red Sea between Jordan and Yemen is littered with numerous mostly middle Miocene to Quaternary Harrats alkali basalts that are related to opening of the Red Sea system at ~25 Ma. One of these is Harrat Uwayrid which comprises a NW-SE oriented elongate volcanic field of ~7150 km<sup>2</sup> and which extends for about ~230 km in NW Saudi Arabia. Field investigations, petrography, whole-rock chemistry, isotope ratios, and <sup>40</sup>Ar/<sup>39</sup>Ar dating places constraints on the petrogenesis of scoria and lavas of Harrat Uwayrid. We investigated two main stages for the magmatic activities in this area with some differences in the sources. The underlying older, southern plateau lavas range from transitional basalt, alkali basalt, hawaiite, and basanite and yield plateau ages of 10.07 ± 0.03 to 9.00 ± 0.05 Ma (*n* = 3). In contrast, the younger scoriaceous basanites in the central region which cut the older lavas, yield plateaus (*n* = 5) of 0.97 ± 0.00 to 0.16 ± 0.03 Ma. The older lavas require slightly higher degrees of partial melting of a shallower, more depleted source than the younger scoriaceous lavas. Clarification of isotopic data is still undergoing, but initial interpretation suggests that the Miocene and Quaternary scoria and lavas tapped a Neoproterozoic subduction-contaminated source. The origin of the lava fields in northern Arabia and how they relate to the initial rifting of the Red Sea system is controversial. Our preferred model entails lithospheric thinning associated with collision of Arabia with Iran at ~ 25 Ma, which overlaps the ages of the oldest Arabian harrats at Harrat As Sirat (31–22 Ma) and the timing of Red Sea dike formation at 23 Ma. Pre-existing Neoproterozoic faults may have been reactivated due to compression between the Arabian Plate and the Eurasian Plate (Iran) and provided conduits for the harrats.