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Mantle xenoliths in young intraplate volcanism: The mantle beneath the Arabian plate

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Mantle-derived xenoliths occurrence in volcanic rocks provide an opportunity to study deep mantle structures in specific geological settings. As direct samples of the mantle, xenoliths are information carriers of the lithospheric mantle nature at the time they were transported to the surface by volcanism. The Arabian plate comprises one of the largest Cenozoic intraplate volcanic provinces, the so-called “Harrats”, spreading more than 120000 km^2 in North-South direction from Syria and Jordan to Saudi Arabia and Yemen. [1] The last eruption in 1256 AD in Harrat Rahat and dyke intrusion episode during 2009 in Harrat Lunayyir,[2] indicate that Harrat volcanism may still be active with possible future eruptive activations. Thus, an understanding of the mantle dynamics may be crucial for constraining hazards in Saudi Arabia. Nevertheless, the origin of the Harrats is still not well understood and the source of the Harrats mostly undetermined; moreover, mantle xenoliths potentially providing information on the source are poorly studied.

The Harrat volcanism can be divided into an older and a younger phase. Each phase contains mantle xenoliths. However, the younger phase is more xenolith abundant.[3] Here we present various types of mantle xenoliths collected during several field research trips from 2020 to 2022, from the North to the South of Saudi Arabia, from Harrat Uwayird, Lunayyir, Kishb, Al Birk, and Jizan Group. Sampled mantle xenoliths range from dunites, harzburgites, lherzolites to wehrlites and pyroxenites. This study presents a characterization of the mantle xenoliths lithological types as indicators of the mantle depth, structure, and heterogeneity, in order to study the source responsible for the initiation of the partial melting, resulting in the intraplate volcanism in Saudi Arabia.

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