Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12077

RECYCLING OF SUBDUCTION-RELATED NOBLE GASES AND CRUSTAL CARBON IN THE MEXICAN LITHOSPHERIC MANTLE

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Here, we aim at filling the gap of knowledge on the volatile composition of the Mexican lithospheric mantle. In this work, we report the chemical and isotopic composition (He, Ne, Ar and CO_2) of fluid inclusions entrapped in mantle xenoliths found in pyroclastic deposits of the Ventura Espiritu Santo Volcanic Field (VESVF), the Durango Volcanic Field (DVF) and the San Quintin Volcanic Field (SQVF) (three Quaternary monogenetic fields formed in the Basin and Range extensional province). We also analyze the olivine crystals found in lavas from the Sierra Chichinautzin (SCN), a Quaternary monogenetic field located in the Transmexican Volcanic Belt (TMVB; Fig 1). The averages Rc/Ra values measured in Mexican localities are within the MORB-like range: VESVF = 7.39 ± 0.14 Ra, DVF= 8.39 ± 0.24 Ra, SQVF = 7.43 ± 0.19 Ra and SCN lavas = 7.24 ± 0.33 Ra. The variable Rc/Ra values observed in xenoliths suggest that (i) the $^3He/^4He$ signature of the wedge was scarcely modified by the ancient Farallon plate subduction, and/or (ii) any crustal contribution was overprinted by a later metasomatism/refertilization episode, likely driven by the upwelling asthenosphere during the subsequent Basin and Range extension. This is the case especially of DVF, whereas the higher $^3He/^4He$ values than in the neighboring VESVF would reflect different ages of mantle refertilization and He residence times. The Ar and Ne systematics reflect a mixing between MORB-like upper mantle and atmosphere-derived fluids recycled by the Farallon plate. Finally, DVF and VESVF nodules show $\delta^{13}C$ values as high as -1.0‰, supporting the involvement of a recycled crustal carbonate component. Conversely, the SCN samples exhibit $\delta^{13}C$ values within the MORB range and comparable to what measured in Popocatépetl/Colima volcanoes, likely resulting from i) the modification of DVF-VESVF signature by magmatic degassing or ii) a deep mantle domain marked by carbon compositions not affected by subduction-related carbonate recycling.

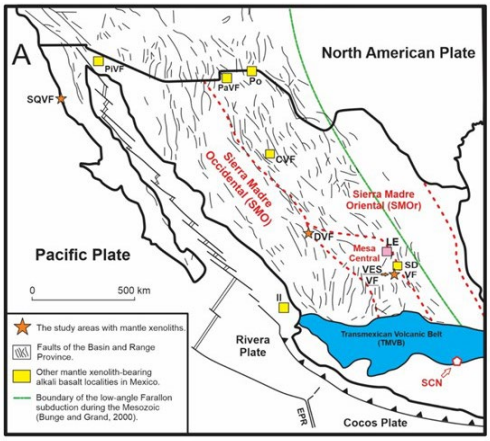

Figure 1. A) The map shows the Mexican part of the Basin and Range Province. Adapted from Aranda-Gómez et al. (2000). VESVF: Ventura Espiritu Santo Volcanic Field, SDVF: Santo Domingo Volcanic Field, PiVF: Pinacate Volcanic Field, PaVF: Las Palomas Volcanic Field, Po: Potrillo maar, CVF: the Camargo Volcanic Field, DVF: Durango Volcanic Field, SQVF: San Quintin Volcanic Field, II: Isla Isabel, SCN: Sierra Chichinautzin, Contours of Sierra Madre Occidental, Sierra Madre Oriental, the Transmexican Volcanic Belt and Mesa Central provinces were build based on Gómez-Tuena et al. (2007). Pink square represents Los Encinos Volcanic Field (LE) a monogenetic volcanic field without mantle xenoliths.