First insights into the noble gas signature of the 2021 Cumbre Vieja eruption, La Palma (Canary Islands)

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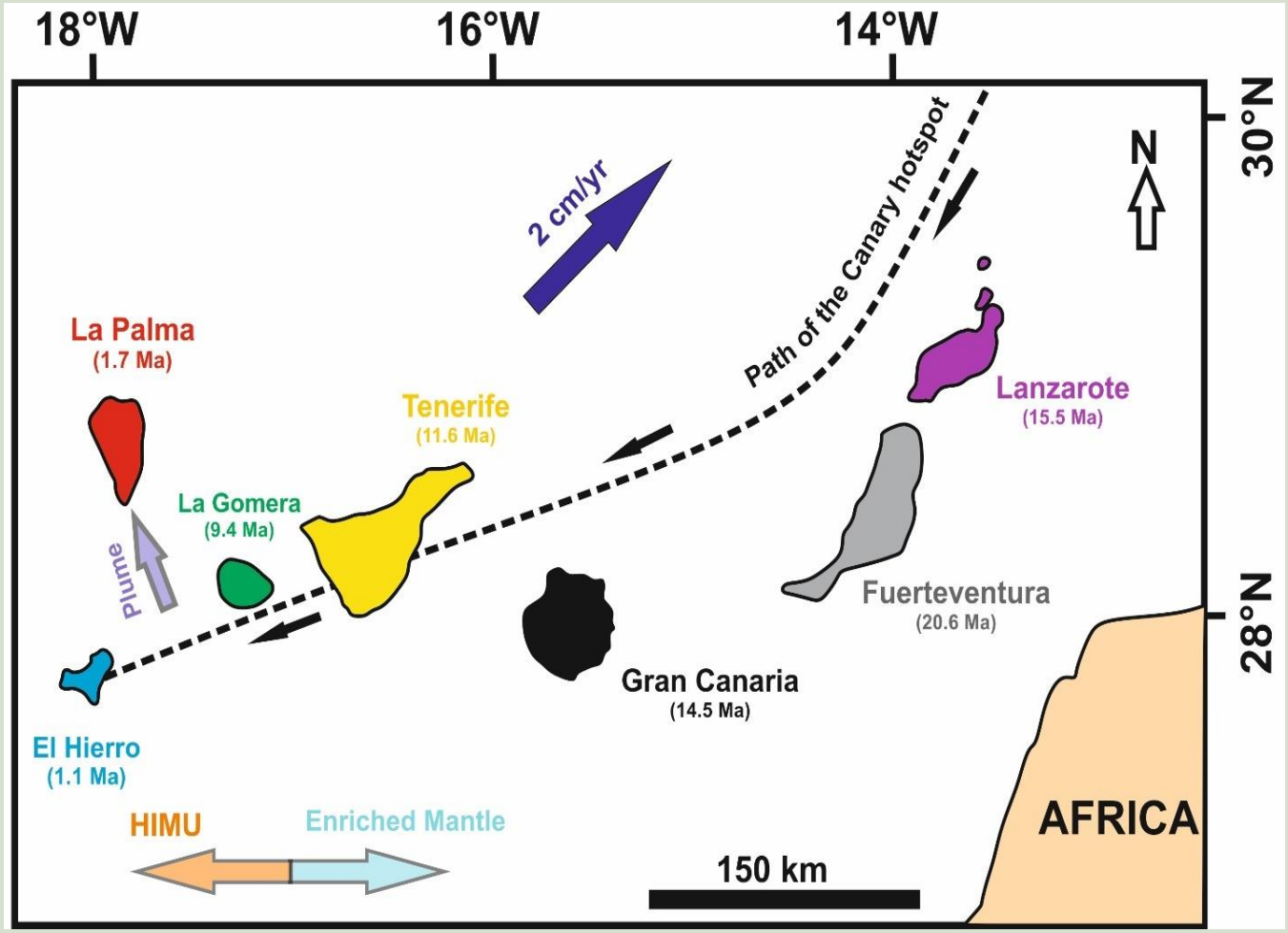
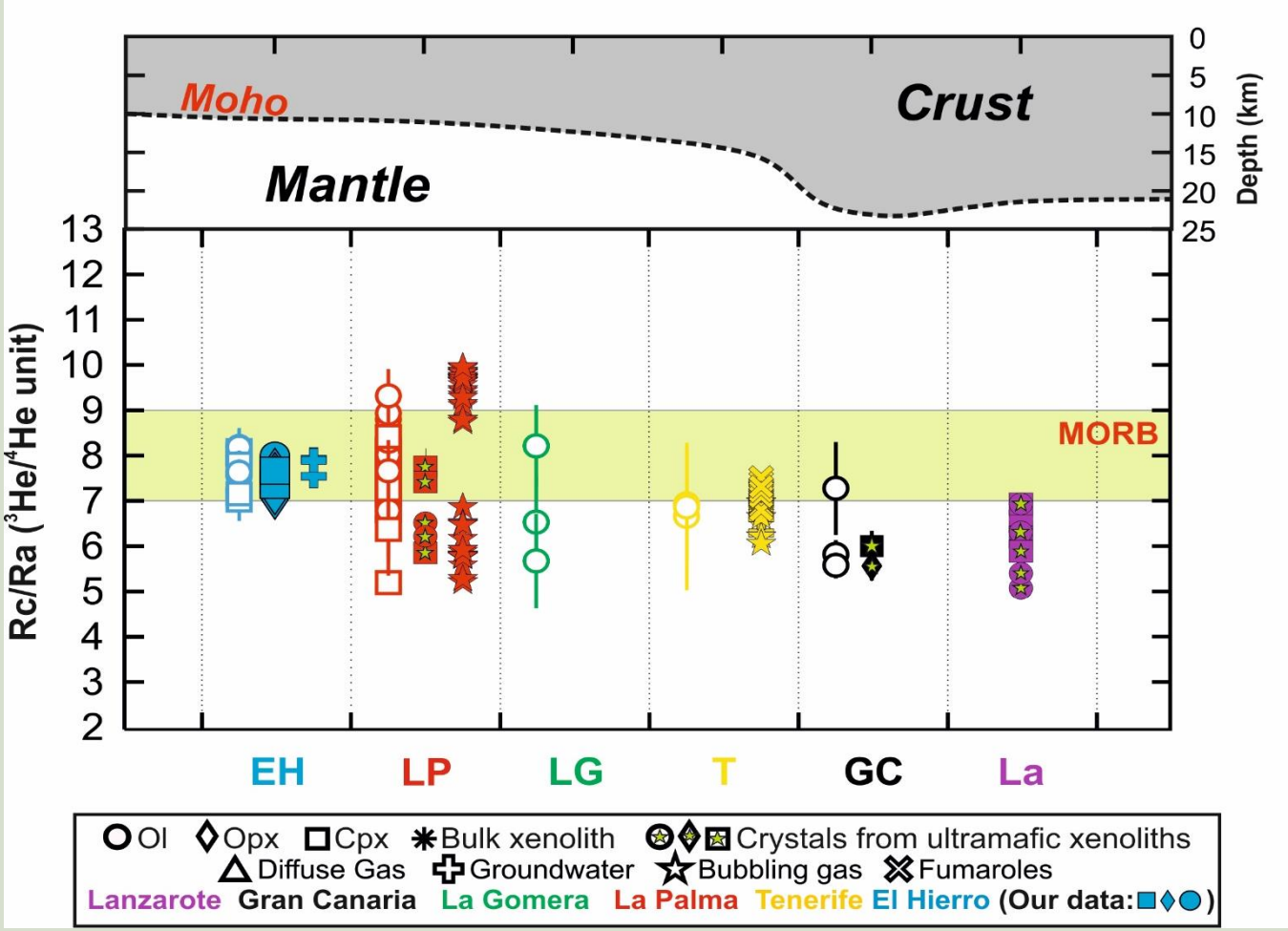
Research topic: the Canary Islands



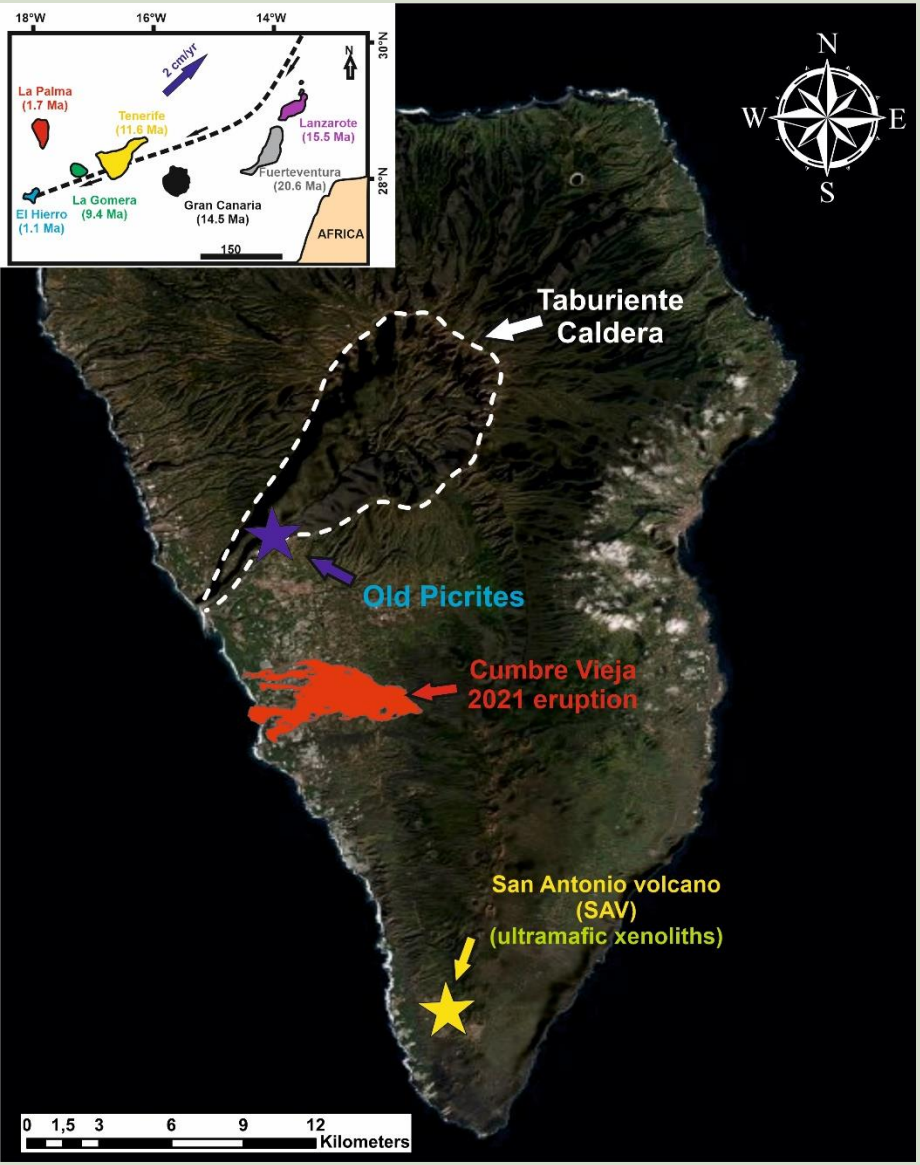
Geophysical and geochemical evidence suggests that volcanism in Canary Islands is driven by the presence of a mantle plume, although helium isotopes show this evidence only in La Palma.

Research topic: the Canary Islands



Looking at Canary Islands, helium isotopes show an eastward decreasing trend of the signature that is coupled to an increasing age and crustal thickness as well as the presence of an EM component.

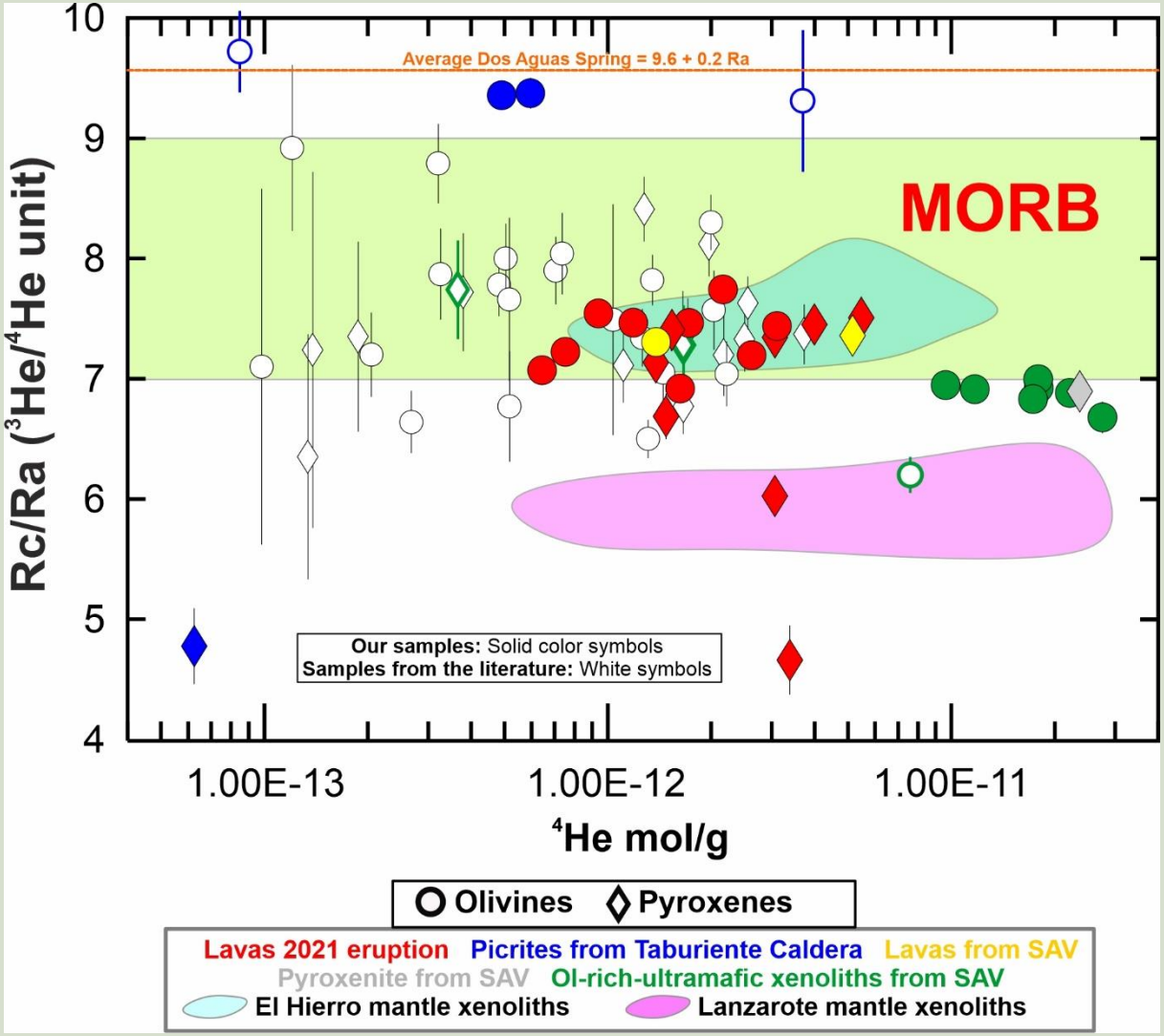
La Palma volcanic island and 2021 eruption



The 2021 lavas belonging to the October 27th and November 9th flows are basanite tephrites, with an average Mg# of 58.6, being more mafic than those from the September opening phase (Mg# = 50.3; Pankhurst et al., 2022).

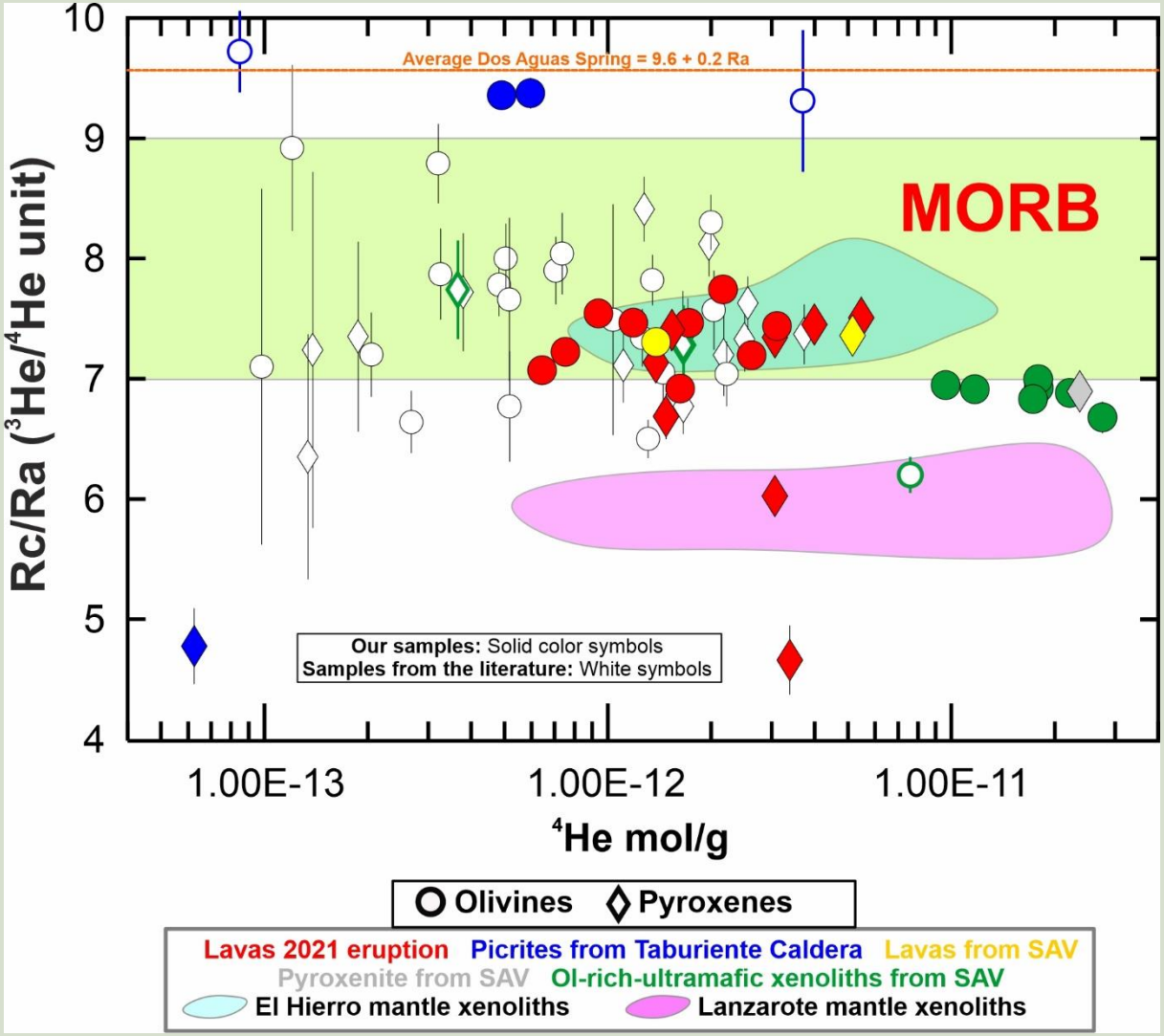
For comparison, we analyzed the poorly evolved lavas from 1677 San Antonio eruption bearing mantle xenoliths (South of Cumbre Vieja) and a 3 Ma old picrite cropping out in the Taburiente caldera (Day et al., 2010), close to the Dos Aguas spring.

Evidences from helium isotopes



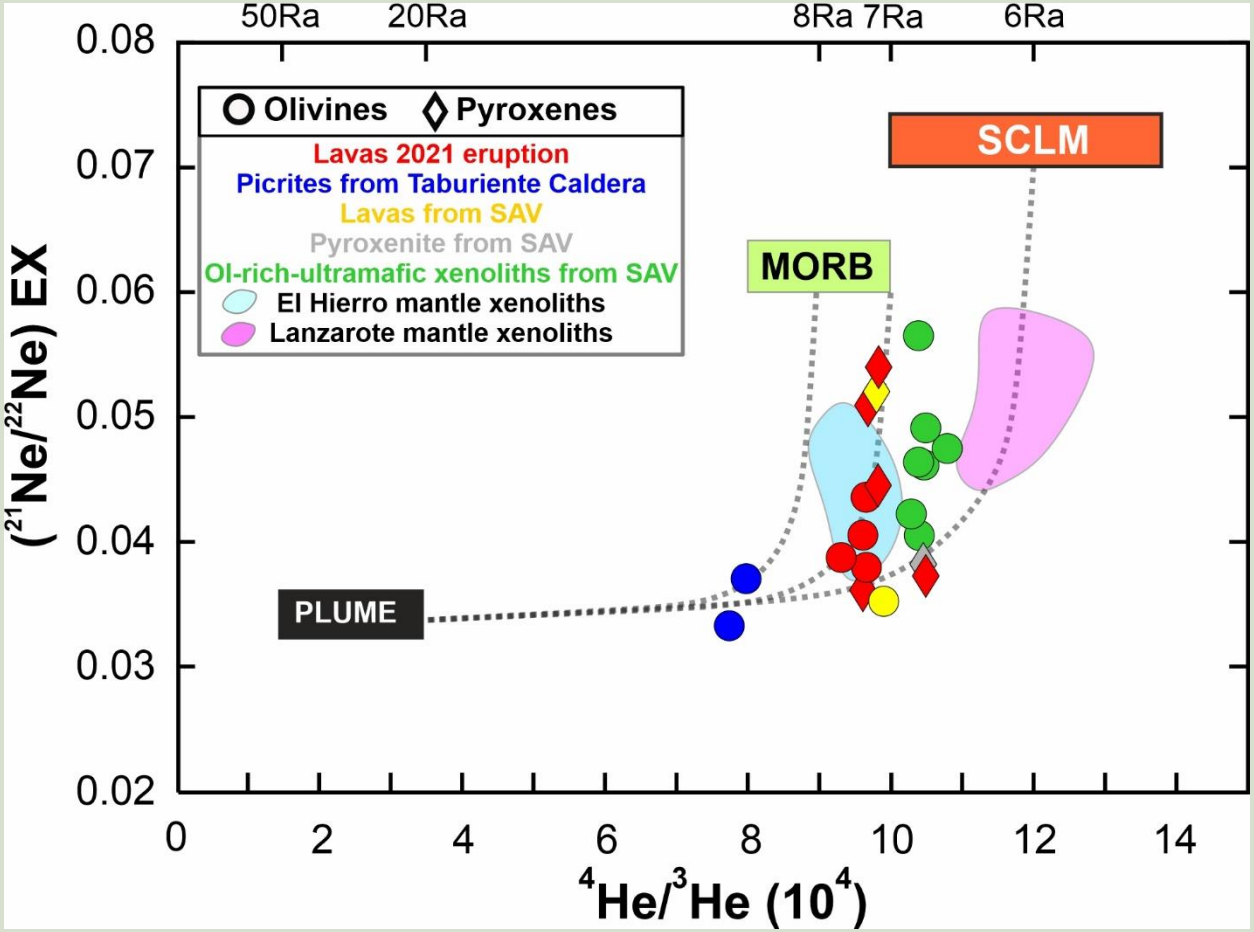
The ^{3}He/^{4}He ratio in phenocryst-hosted fluid inclusions from the 2021 products is 7-7.5 Ra, confirming the MORB-like signature of the volcanic products and gases dissolved in water of the Cumbra Vieja system (Day and Hilton, 2020; Torres-Gonzalez et al., 2020).

Evidences from helium isotopes



Instead, the olivines in the Taburiente picrite yield 9.4±0.1 Ra, comparable to values in the Dos Aguas spring, confirming the existence of a lower mantle component below this sector of the island.

Helium-Neon isotopic systematics



Similar indications come from the He vs Ne isotopic systematics, whereas the 2021 products are dominated by a MORB-like signature while those from the Taburiente caldera show a lower mantle contribution.

Concluding remarks

The distinct $^{3}He/^{4}He$ signature observed at Taburiente and Cumbre Vieja products is preliminary interpreted as due to either

(i) small-scale heterogeneities in the local mantle, and/or

(ii) a plumbing system effect below Cumbre Vieja, which lowers the $^{3}He/^{4}He$ of the recently erupted magmas. In the latter case, magma differentiation and degassing at the crust-mantle boundary or even deeper in the mantle, coupled to the production and accumulation of radiogenic ^{4}He, would play a central role.

If gases from Dos Aguas reveal temporal variations related to the magmatic activity up to one year before the eruption onset, than the hypothesis of a mantle heterogeneity should be discarded. As a consequence, the primary melts would have a $^{3}He/^{4}He$ signature comparable or higher than the maximum values measured in Dos Aguas gases.