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Early evidence of magmatic rise through $^{3}He/^{4}He$ ratio measurements at Dos Aguas cold mineral spring, La Palma, Canary Islands

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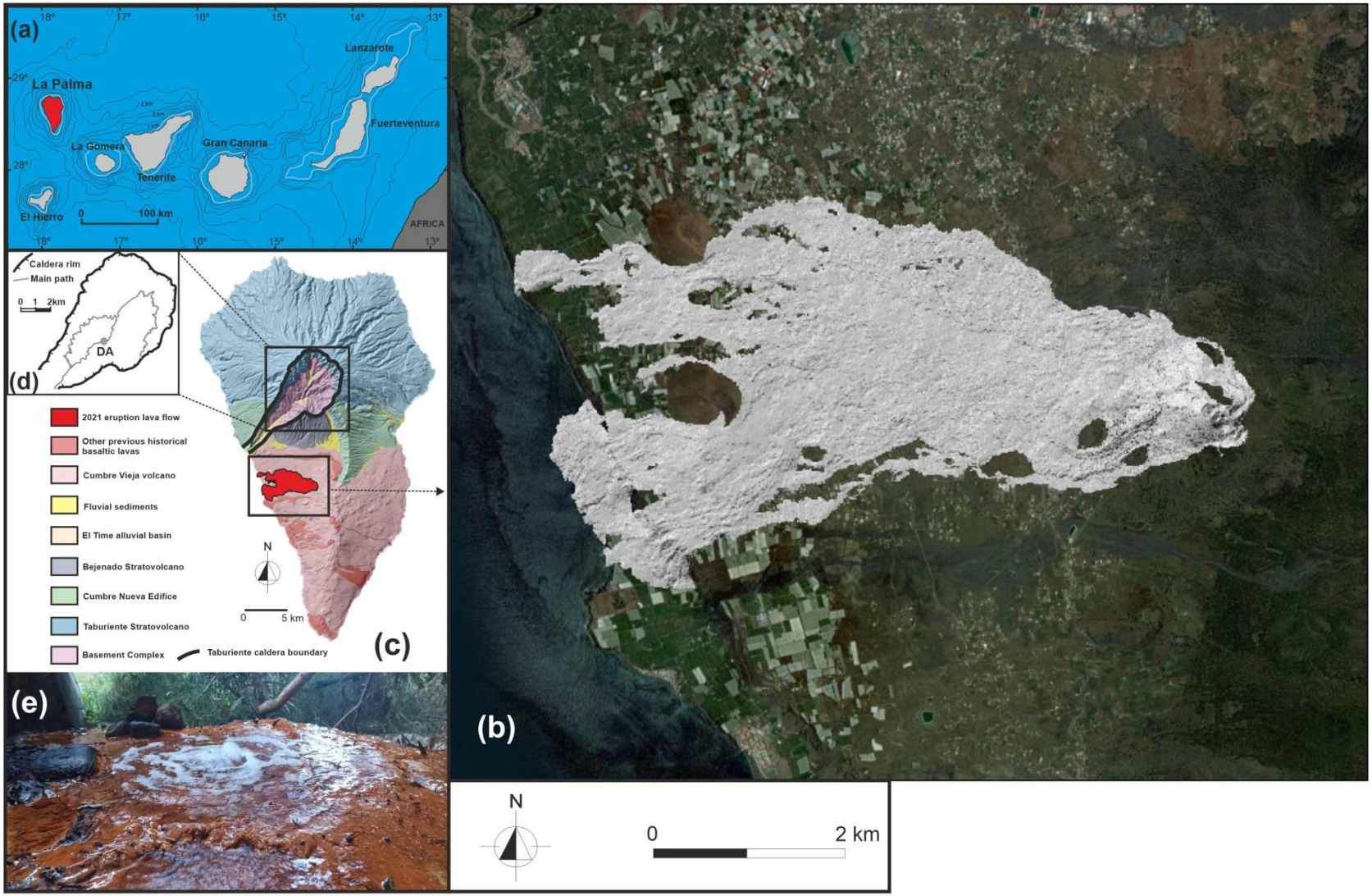
1) To monitor the $^{3}He/^{4}He$ ratio at Dos Aguas CO_2-rich cold mineral spring in La Palma Island.

2) To investigate the magmatic component of helium at Dos Aguas CO_2-rich cold mineral spring in La Palma Island.

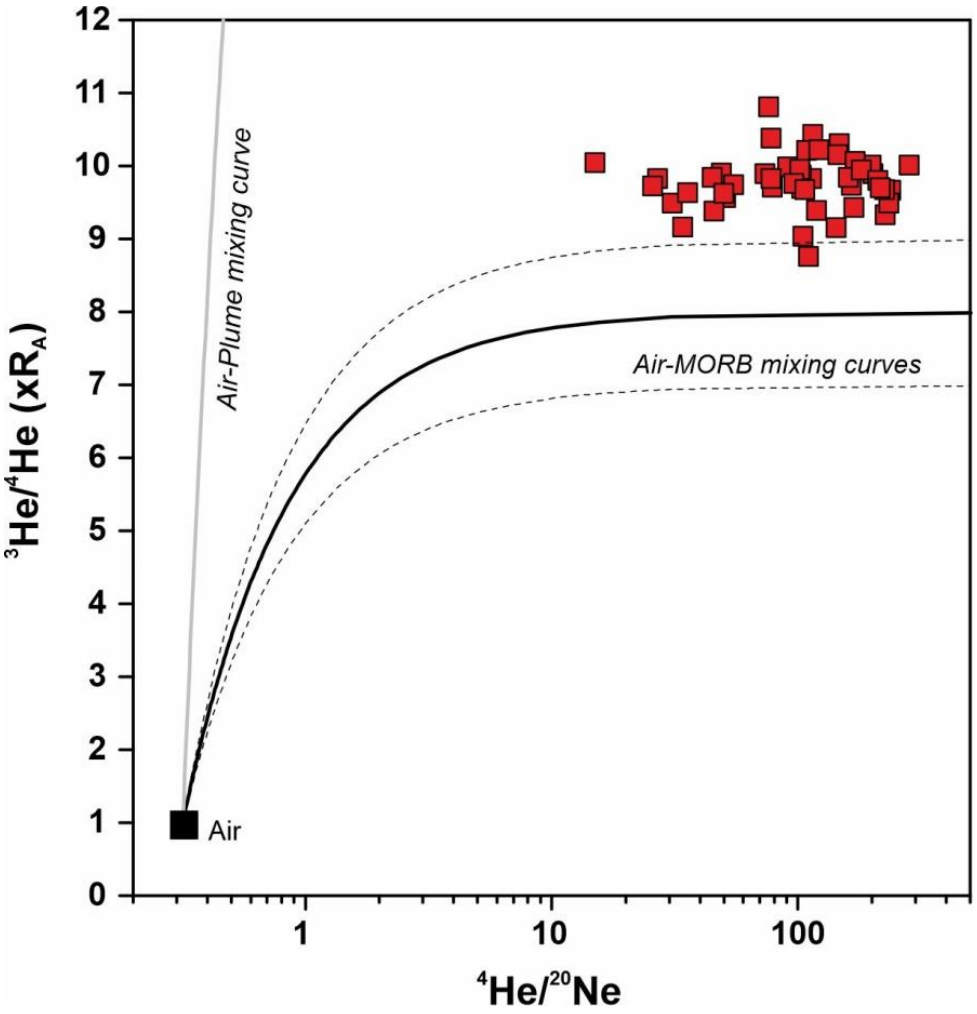
3) To provide early warning signals of future volcanic unrest episodes.

Why diffuse $^{3}He/^{4}He$ studies at Dos Aguas CO_2-rich cold mineral spring?

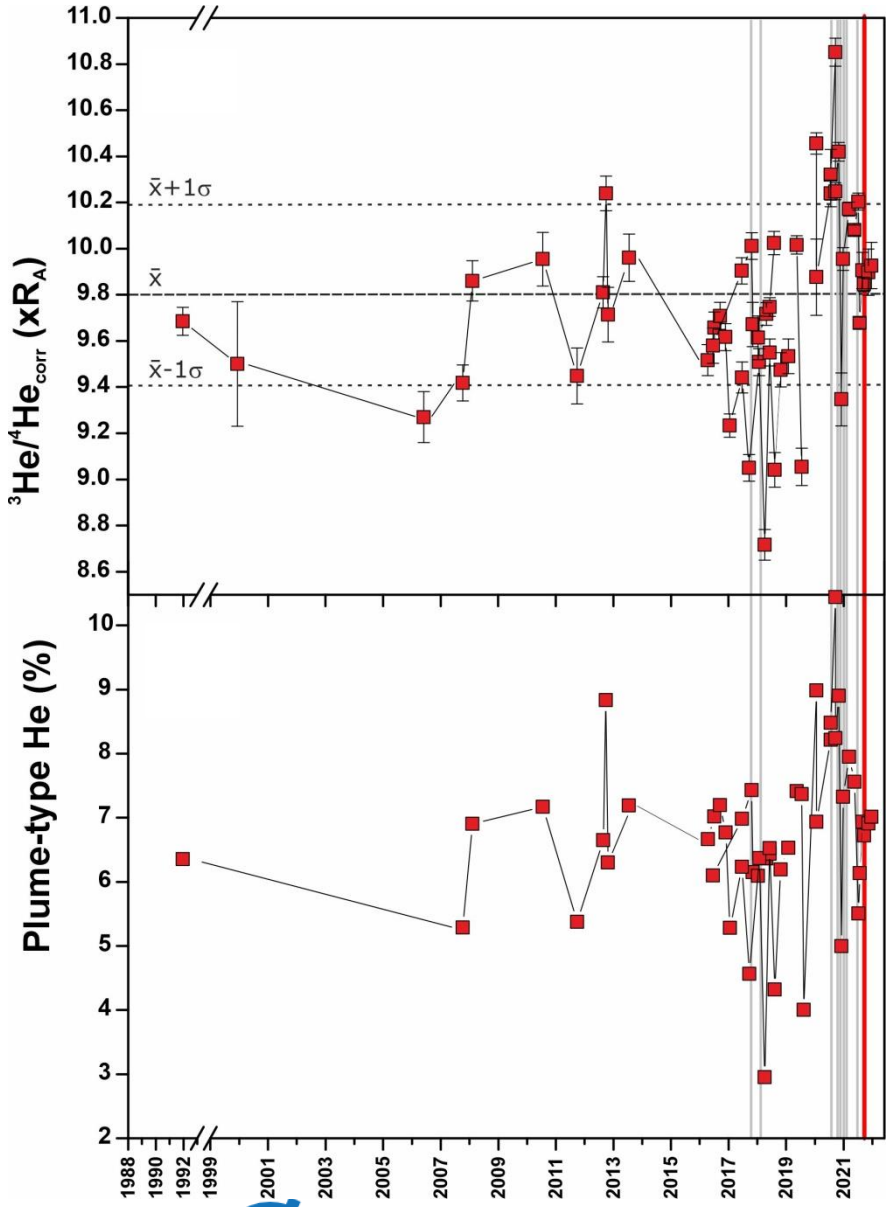
1) This type of studies have demonstrated to be sensitive and excellent precursors of magmatic processes occurring at depth.
2) Helium represents an important advantage in geochemical volcano monitoring because its geochemical characteristics help it not to be affected by secondary processes during its ascent toward the surface,
3) Dos Aguas CO_2-rich cold mineral spring is, in terms of noble gases, the only place of the Canarian archipelago where it is possible to identify a primordial component of the Canary mantle source,


(a)
La Palma
Lanzarote
Fuerteventura
La Gomera
Gran Canaria
Tenerife
El Hierro
100 km
AFRICA
(b)
(c)
(d)
(e)
Caldera rim
Main path
DA
2021 eruption lava flow
Other previous historical basaltic lavas
Cumbre Vieja volcano
Fluvial sediments
El Time alluvial basin
Bejenado Stratovolcano
Cumbre Nueva Edifice
Taburiente Stratovolcano
Basement Complex
Taburiente caldera boundary
N
0
5 km
2 km

Binary diagram of the $^{3}He/^{4}He$ vs. $^{4}He/^{20}Ne$ measured at Dos Aguas CO_2-rich cold mineral spring

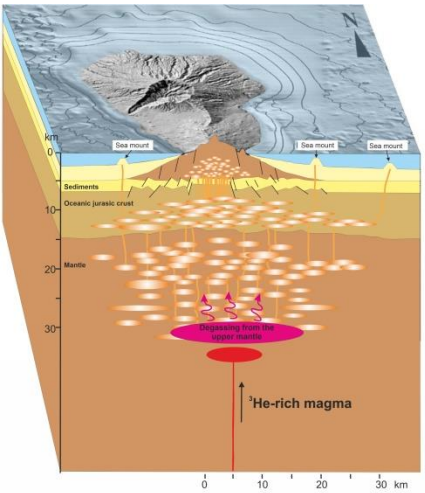


Data from this work (28 new unpublished data), Pérez et al., 1994, Hilton et al., 2000, Padrón et al., 2015, Day and Hilton, 2020 and Torres-González et al., 2020)

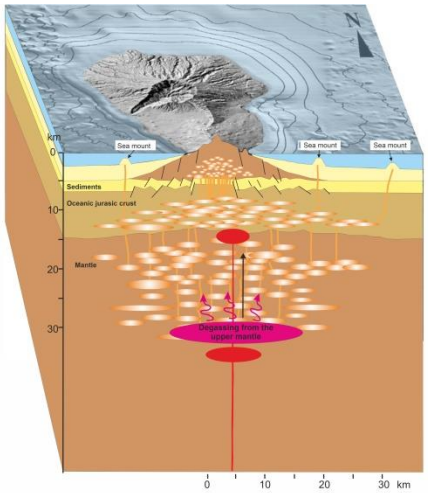


Temporal evolution of the observed changes in the air-corrected $^3He/^4He$ ratio and the plume-type He estimated once removed the atmospheric contribution measured in Dos Aguas CO_2-rich cold mineral spring

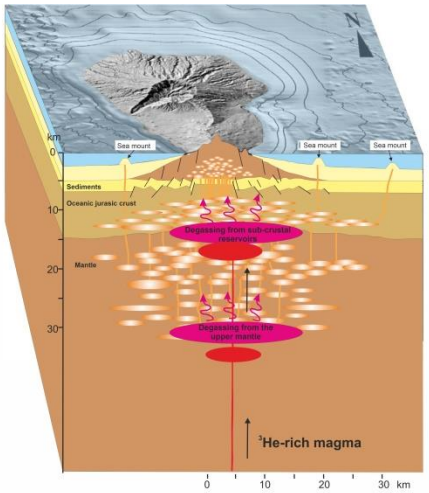
Conceptual model for the magma evolution beneath La Palma in the period 2008-2021



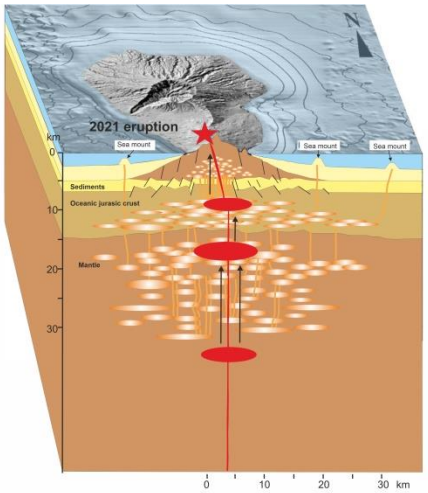
2008-2013



2017



2020



2021

- The average value of the air-corrected $^{3}He/^{4}He$ ratio measured at Dos Aguas CO_2-rich cold mineral spring in the study period exceeded the canonical mid-ocean ridge basalt (MORB) value and has shown variable portions of the primordial component of the Canary mantle source.
- The temporal evolution of the air-corrected $^{3}He/^{4}He$ ratio measured at Dos Aguas CO_2-rich cold mineral spring has been tremendously useful to monitor the magma evolution beneath La Palma in the period 2008-2021.
- Dos Aguas CO_2-rich cold mineral has demonstrated to be an excellent location to monitor the deep magmatic plumbing system of La Palma Island, able to provided the earliest precursory signal of the upcoming eruptive phase of Cumbre Vieja.

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THANK YOU VERY MUCH
FOR YOUR ATTENTION