∂13C data of picrite rock samples from St Helena Island (South Atlantic Ocean)

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1. Licence

2. Citation

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Table of contents

3. Data description

St Helena, a small volcanic island in the South Atlantic Ocean, represents one of the classic exam-ples of ocean island basalt (OIB) volcanism associated with intraplate mantle plumes. Although the island is geographically remote, it occupies a significant position in the geochemical classification of Atlantic OIBs due to its association with the so-called HIMU (high μ = high U/Pb) mantle reservoir. The isotopic and geochemical signatures of HIMU basalts are widely believed to reflect the long-term recycling of ancient oceanic crust, possibly subducted hundreds of millions of years ago and stored in the mantle before re-emergence as plume volcanism. One important aspect of understanding OIBs is the role of volatile components such as CO_2. Carbon is a critical tracer of mantle source re-gions because its concentration and isotopic composition ($\delta^{13}C$) can help distinguish between pris-tine mantle-derived volatiles and those derived from recycled sediments or altered oceanic litho-sphere. The present report examines six measurements of olivine separates from picritic samples collected on St Helena. These analyses, focusing on CO_2 contents, carbon isotopic ratios, and net pCO_2, provide a window into the volatile budget of the St Helena mantle source and allow compari-son to global mantle values. The carbon isotopic composition shows significant variability. $\delta^{13}C$ values span from –12.54‰ to –1.52‰. The canonical mantle $\delta^{13}C$ range is considered to be around –4‰ to –8‰. The spread in $\delta^{13}C$ values provides strong evidence for the involvement of recycled carbon in the mantle source. The most negative $\delta^{13}C$ values (<8‰, which coincide with the lowest CO2 con-tents) fall well below the range expected for unmodified mantle, pointing to isotopic fractionation. Conversely, the least negative value (–1.5‰) suggests the presence of isotopically heavy carbon, potentially linked to marine carbonates recycled into the mantle. Such isotopic heterogeneity aligns with St Helena's broader classification as a HIMU-type OIB, reflecting the long-term storage and reprocessing of subducted oceanic lithosphere. The HIMU reservoir sampled by St Helena is thought to be derived from ancient oceanic crust that has undergone extensive alteration and de-hydration. The relatively low CO_2 contents observed in the olivines may therefore reflect a mantle source that is volatile-depleted relative to fertile peridotite or enriched plume sources. The isotop-ic spread suggests that while the bulk source is depleted, heterogeneities persist at the scale of melt production, allowing carbonate-rich components to contribute to magmatism.

3.1. Sampling method

Samples were obtained from St Helena Island. Samples include 6 picrites. The picritic rocks were first reduced to smaller fractions by crushing and then passed through a series of sieves to isolate olivine grains larger than 0.5 mm. From this material, at least 2 g of olivine was manually selected for each aliquot. The chosen grains were then sent to the noble gas isotope laboratory at INGV–Palermo, where they underwent a sequence of ultrasonic cleaning steps in HNO_3, deionized water, and finally high- purity acetone. After the cleaning procedure, each aliquot of olivine was carefully dried and precisely weighed.

3.2. Analytical procedure

Laboratory: Noble gas isotopes Laboratory of the INGV-Palermo

Samples were properly prepared at the University of Palermo (approximately 2 weeks): all samples were crushed and sieved with the aim of hand-picking crystals of olivine with diameters > 0.5mm. A mimimum of 1gr was collected for each aliquot. After picking, samples were transferred to the noble gas isotopes Laboratory of the INGV-Palermo. The crystals were then cleaned in an ultrasonic bath in 10% HCl and then in deionized water, weighed and loaded in a crusher system consisting of a stainless- steel sample holder, a hydraulic press (which exerts a single-step pressure of approxi-mately 200 bar). Subsequently, during the mechanical crushing of crystals, a glass sampler was sub-merged in liquid nitrogen to freeze CO2. A pump ensured the vacuum conditions (10−3 - 10−4 mbar)

inside the system. The sampler was then connected to a glass line equipped with a 626B Baratron® Absolute Capacitance Manometer MKS (measuring range between 10-3 and 10 mbar), for the purification procedure and quantification of CO2 concentration (mol/g). The purified CO2 was condensed in the same glass sampler (adjusted to atmospheric pressure by adding pure helium) and transferred to the laboratory of stable isotopes for the following isotopic measurements. Results are reported as CO_2 concentrations (mol/g), $\delta^{13}C$ (per mil relative to VPDB). Further details in Sand-oval-Velasquez et al. (2021b).

4. File description

Data is reported in file *2025-105_Sandoval-Velasquez-et-al_data.csv*. δ13C is reported in parts per mille (‰ relative to VPDB). The measured CO_2 is expressed in mol/g.

4.1. Description of data table

4.1.1. 2025-105_Sandoval-Velasquez-et-al_data

Column header	Unit	Description
Sample	-	Sample identifier
Locality	-	St Helena
Rock	-	Picrites
Mineral	-	Olivines
Loaded (gr)	gr	Grams (mass unit)
CO2 (mol/g)	mol/g	CO_2 concentration in sample
d13C (‰)	‰	13C content relative to the reference standard Vienna-PeeDee belemnite (V-PDB)

Table 1. Column description of file 2025-105_Sandoval-Velasquez-et-al_data.csv

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6. References

Sandoval-Velasquez, A., Rizzo, A.L., Aiuppa, A., Remigi, S., Padrón, E., Pérez, N.M., Frezzotti, M.L., 2021b. Recycled crustal carbon in the depleted mantle source of El Hierro volcano, Canary Islands. Lithos 400–401, 106414. https://doi.org/10.1016/j.lithos.2021.106414