Noble gas systematic of Shona Seamount, 52°S Atlantic

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Introduction

The South Atlantic–Indian Ocean province called DUPAL is isotopically distinct from the Pacific–North Atlantic province (Dupré and Allègre, 1983; Hart, 1984). For He, basalts from the South West Indian Ridge and the South Atlantic Ridge are more radiogenic than Pacific and North Atlantic basalts (ex: Staudacher *et al.*, 1994, this volume; Graham *et al.*, 1992). Here we report a complet rare gas study of the so-called Shona seamont (Hartnady and Le Roex, 1985). Shona is localised on the South Atlantic Ridge between 50.5 and 52.5°S. The only $^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$ and trace elements results for this area by Le Roex *et al.* (1987) proposed that the source of this seamount should be similar to hotspots like Gough and Tristan da Cunha, in particular it should be derived from a different source region than the ^{3}He rich Bouvet hotspot. Our results however show that Shona is a ^{3}He enriched hotspot with a primitive rare gas isotopic signature.

Samples location

The present samples came from the South Atlantic Ridge between 50.5° and 52.5°S (Figure 1). They have been collected during the EW9309 cruise of the R/V Maurice Ewing (nov-dec 1993). Nine dredge stations were occupied in order to delineate more fully the Shona geochemical anomaly.

Results and discussion

We used fresh centimeter sized glasses for isotopic studies. All the rare gas were analysed on the same sample with the noble gas mass spectrometers ARESIBO I & II. Analytical procedure was given elsewhere (Sarda *et al.*, 1986; 1988).

The most important results are the low $^{4}He/^{3}He$ isotopic ratios down to 58,000 of 20D-1g (R/Ra = 12.5), which indicates that Shona is a primitive high ^{3}He hotspot like Bouvet (Kurz, 1982). Figure 2 shows that the R/Ra is almost perfectly correlated with the topography of the Shona seamount (for clearness we use here R/Ra, were Ra is the $^{3}He/^{4}He$ of air of 1.384×10^{-6}).

A similar picture is given by the Ne isotopic

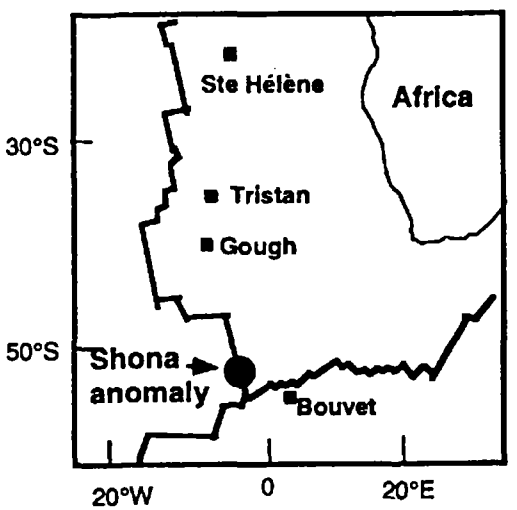

FIG. 1. Location of Shona Ridge anomaly.

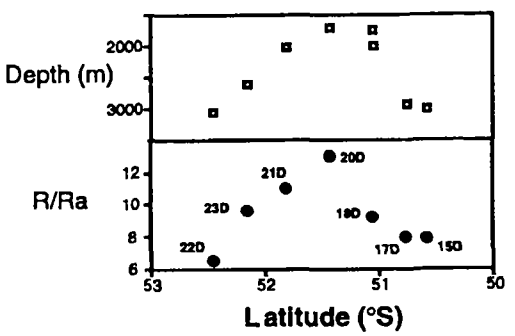

FIG. 2. Variation of depth and R/Ra with latitude.

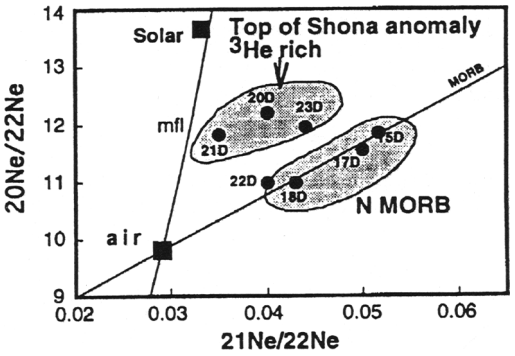

FIG. 3. Ne–Ne diagram.

ratios. Samples from the top of Shona (20D-1g, 21D-1g, 23D-1g) which have low $^4He/^3He$ isotopic ratios plot in Figure 3 between the mfl and MORB line (Sarda *et al.*, 1988), while all other samples plot exactly on the MORB line. These results could be consistent with a solar lower mantle model (Honda *et al.*, 1991). They could be explained by a mixing between three end-members: MORB, lower mantle like Loihi (Honda *et al.*, 1991) and atmosphere by contamination during the eruption.

The $^{40}Ar/^{36}Ar$ isotopic ratios, corresponding to the high temperature step (1750°C) show large variations between 900–20,000. The top of the seamount has a $^{40}Ar/^{36}Ar$ of ~900. It is the smallest ratio of all samples. All the other ratios are near 1500 except sample 23D-1g (20,000) and 15D-1g (5200).

Conclusion

The He and Ne isotopic ratios are consistent with a primitive origin for the Shona Seamount. The Helium ratio is similar that of Reunion- ($^4He/^3He$ = 55,000) and Bouvet islands (50,000). The Ne ratios could be explained by a solar lower mantle model.

References

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