Shona and Discovery seamount chains, South Atlantic: Superplume source constraints

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The effectively un-sampled major bathymetric anomalies of the Shona Ridge – Meteor Rise – Agulhas Ridge – Cape Rise and Discovery seamounts in the South Atlantic have been attributed to the activity of the Shona and Discovery mantle plumes based solely on geochemical signatures measured in Mid-Ocean Ridge basalts from the adjacent Mid-Atlantic Ridge and a single Discovery Seamount sample. Here we present new Sr-Nd-Pb-Hf isotope data on dredge samples from these seamount chains collected by the ANT XXIII/5 cruise of the FS Polarstern.

The new Discovery seamount data form endmembers to the so-called Discovery and LOMU geochemical anomalies on the southern Mid-Atlantic Ridge (MAR), suggesting that the latter are formed from the same plume source through plume-ridge interaction.

Some samples from the Shona Ridge – Agulhas Ridge and Cape Rise Seamounts have isotopic compositions forming an endmember to the geochemically enriched basalts of the southern MAR, previously attributed to the influence of the so-called Shona plume. The occurrence of this signature in dredges from each of these bathymetric anomalies suggests that it might represent a long-lived Shona plume component. Overall the samples from the purported Shona plume track are very heterogeneous and range from EMI- to HIMU-type. A Gough-like component is present in the Shona and Agulhas Ridge and combined with its presence in the Discovery Seamounts and Discovery geochemical anomaly on the MAR suggests that this component is an important and common source composition in the South Atlantic mantle. A shallow component from recent continental breakup seems to form an additional but minor component in the Shona plume track.

The new data demonstrate a strongly hetergenous source region for South Atlantic intraplate volcanism, including DUPAL, HIMU and possibly sub-continental lithospheric mantle components. Combined with the abundance of hotspot tracks lacking intial plume heads, the new data support similarly heterogenous source characteristics and dynamics to the hotspots developed from both the Pacific and African superplume regions.

Uranium-lead dating of speleothems: Prospects and limitations

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In recent year several studies have shown that U-Pb isotopic dating is a promising option for dating speleothems from the early Pleistocene and earlier which has otherwise presented a difficult challenge.

The integrity of the U-Pb system has been confirmed by comparison of U-Pb and U-Th data on a speleothem from the Spannagel Cave in the Austrian Alps. Disequilibrium-corrected U-Pb ages date growth from 340 ka to 267 ka. High resolution sampling of one short growth interval yielded U-Pb and U-Th ages in close agreement at 266 ka with ± 1 ka error on the U-Pb age. These results confirm closed system behaviour throughout the uranium decay chain even in such U-rich samples.

Speleothems from the Wilder Mann and Wildmahd caves in the Allgäu Alps, western Austria encapsulate a detailed history of environmental variations at the time of speleothem growth. High uranium concentrations have led to the development of highly radiogenic lead compositions by the present day, giving the potential for dating of samples that are well beyond the reach of U-Th disequilibrium dating. Ages are in the order of 2 Ma and for samples of this age 'normal' residual levels of excess ^{234}U are no longer detectable. To incorporate the uncertainty of the unknown initial ^{234}U excess a range of possible values was estimated from a log-normal distribution and incorporated into a Monte Carlo error propagation of the analytical data. One of the stalagmite samples shows significant age variation along its length with a well-resolved growth hiatus separating a younger growth period at 2.04+.02/-.07 Ma from an older period for which three groups of subsamples give ages of 2.11+.03/-.07, 2.14+.02/-.06 and 2.16+.04/-.07 Ma, in the correct stratigraphic order.

Future applications of this approach depend critically on how well we can correct for the effects of excess ^{234}U. Even with precisions <0.5‰ residual excess is undetectable in many samples of interest. It would assist greatly if other persistent geochemical parameters could be identified that correlate with initial excess ^{234}U; such parameters could then be used as a proxy for initial excess in older samples in which residual excess ^{234}U can no longer be detected.