Halogens in basalts of the Azores, Canaries and Tristan da Cunha

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The halogens (Cl, Br, I) are moderately volatile elements that exhibit incompatible behaviour during melting, and are hydrophyllic - in addition, iodine is strongly fractionated by biological processes. Although the halogens share similar geochemical properties to the noble gases, the heavy halogens in particular have been underutilized as tracers, because of the analytical difficulties related to determining their low abundances in geological materials.

Olivine and pyroxene mineral separates from basalts have been analysed from Tristan da Cunha, Canaries, and Azores ocean island groups. The halogens are assumed to be mainly sited in fluid (Canaries) and melt (Tristan, Azores) inclusions observed within the mineral phases; noble gases were liberated by a combination of crushing and stepped heating. Only bulk molar halogen ratios are quoted here.

The Tristan da Cunha basalts show Br/Cl and I/Cl ratios that extend from the range previously determined for MORB samples up to the high values characteristic of marine pore fluids, with maximum values of Br/Cl = 3.4×10^{-3} and I/Cl = 4.1×10^{-3}. This range is interpreted to represent a mixing trend between MORB and a subducted marine pore fluid or I-rich sediment signature, in the source of the Tristan da Cunha basalts.

Initial results show that the Azores basalts have a similar range in I/Cl (9.92-253×10^{-6}) to MORB, with the Br/Cl values offset to slightly higher values (0.62-4.22×10^{-3}). There appears to be some variation between islands, observed in the I/Cl values – with the samples from Graciosa having the highest I/Cl and Br/Cl ratios.

Crushing analyses show that the Canaries basalts have a similar range in Br/Cl (0.456-1.07×10^{-3}) to MORB, but extend to much higher I/Cl values (94.5-15500×10^{-6}). The data overlap with unpublished data from marine sediments. Analyses indicate the presence of a fluid component, which is not seen in the other OIBs.

Reducing uncertainty in the climatic interpretations of speleothem $\delta^{18}O$

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We explore two principal areas of uncertainty associated with paleoclimate reconstructions from speleothem $\delta^{18}O$ ($\delta^{18}O_{spel}$): i. potential non-stationarity in relationships between local climate and larger-scale atmospheric circulation; and ii. routing of water through the karst aquifer. Using a $\delta^{18}O_{spel}$ record from Turkey, the CSIRO Mk3L climate system model and the KarstFOR karst hydrology model, we confirm the stationarity of relationships between cool season precipitation and regional circulation dynamics associated with the North Sea – Caspian Pattern since 1ka. Stalagmite $\delta^{18}O$ is predicted for the last 500 years, using precipitation and temperature output from the CSIRO Mk3L model and synthetic $\delta^{18}O$ of precipitation as inputs for the KarstFOR model. Interannual variability in the $\delta^{18}O_{spel}$ record is captured by KarstFOR, but we cannot reproduce the isotopically lighter conditions of the 16th to 17th Centuries. We argue that forward models of paleoclimate proxies (such as KarstFOR) embedded within isotope-enabled general circulation models are now required.

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