Diffusion-modified volatile contents in melt inclusions: Evidence for open system behaviour

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Melt inclusions are assumed to be isolated post-entrapment, and therefore are considered ideal for determining the primitive concentration of volatile elements in magmas. Ratios of volatile to similarly incompatible non-volatile elements (H_2O/Ce, F/Nd, etc.) are used to identify processes (e.g. degassing) that decouple volatile concentrations from other refractory incompatible trace elements (ITEs).

We recently performed major, trace and volatile analyses on melt inclusions and their olivine hosts in basalts from the island of Fernandina in the Galápagos Archipelago. These data show that ratios of volatile/non-volatile elements vary significantly for ITE-depleted and ITE-enriched melt inclusions from the same host basalt. Strongly ITE-depleted lavas have very high H_2O /Ce and F/Nd ratios, with H_2O and F concentrations similar to the ITE-enriched host glass. These data suggest that the melt inclusions were modified post-entrapment by diffusion of H_2O and F from the surrounding ITE-enriched melt, through the host olivine, and into the melt inclusion. However, none of the host olivines have Mg#'s that are in equilibrium with the composition of the host basalt.

The different timing required for diffusive re-equilibration of H_2O, F and Fe-Mg between the melt inclusion, olivine and host glass provides a unique opportunity to investigate the time-scales of magma ascent post-entrapment of the melt inclusions. Our data suggest that water, which is a fast diffusing element, has equilibrated with the external melt while comparatively slower diffusing elements (like Fe-Mg) have not. The difference in the extent of equilibration will be used to place constraints on the time between melt inclusion entrapment and eruption for the Fernandina lavas.

Constraining hinterland tectonics and basin evolution from the detrital record: A multi-technique approach applied to sediments in the Bengal Basin, Bangladesh

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The application of isotopic analyses to detrital material, in particular techniques applied to single grains, has revolutionised the utility of the detrital record to determination of hinterland tectonics and basin palaeogeography and evolution. Using the sediment record to constrain hinterland tectonism is of particular value where the bedrock record is overprinted by later metamorphism, or removed by tectonism or erosion. Now a plethora of techniques are available and a multi-proxy approach is preferable if provenance is to be constrained robustly.

We applied 11 techniques to the Tertiary sediments of the Bengal Basin, in order to understand the tectonic and erosion history of the Himalaya, and to constrain the evolution of this petroliferous basin. The principle objective of the study was to search for the earliest record of Himalayan erosion, as the Paleogene archive of orogenic erosion is scant. We used seismic data to determine sediment input direction, biostratigraphic and isotopic methods to constrain formation ages, and petrographic, heavy mineral, and a number of geochemical and isotopic techniques (including Ar-Ar, U-Pb, fission track, Sm-Nd and Re-Os) to determine that by 38 Ma, sediments are Himalayan rather than Indian craton or Burman derived. Comparison between detrital mineral ages and sediment depositional age determined by biostratigraphy indicates rapid exhumation of the orogen at this time

Our data reduce the time gap between collision and known onset of erosion from the southern flanks of the east-central Himalaya from >20 Myrs to 12 Myrs. This has implications for models of crustal deformation and tectonic-erosion coupling, as well as the proposed influence of Himalayan erosion on Cenozoic global cooling and the marine Sr record