

## Helium Isotope and $C^3He$ Signatures in the Northern Lau Basin: Distinguishing Arc, Backarc, and Hotspot Affinities

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Helium isotope and  $C^3He$  ratios have proven useful for differentiating between various mantle reservoirs such as mid-ocean ridges, arcs, backarcs, and mantle hotspots. True back-arc systems are similar to mid-ocean ridge (MOR) systems with  $^3He/^4He$  of  $\sim 8 Ra$  ( $R = ^3He/^4He$  and  $Ra = R_{air}$ ) and  $C^3He$  of  $\sim 10^9$ . In contrast, arc volcanoes have lower  $^3He/^4He$  and higher  $C^3He$  ratios ( $\geq 10^{10}$ ), presumably due to carbon addition by the downgoing slab. Hotspots typically have elevated  $^3He/^4He$  (12 - 30 Ra) and  $C^3He$  similar to MORBs ( $\sim 10^9$ ). We have applied this approach to the northern Lau Basin, which is host to a complicated pattern of volcanic activity, with the NE Lau Spreading Center in the west, the volcanoes of the Tofua Arc in the east, and various other volcanic centers in between. Farther west along the NW Lau Spreading Center, elevated  $^3He/^4He$  ratios in the seafloor lavas suggest that an OIB or mantle plume component, possibly from Samoa, has influenced this extensional zone. This paper will discuss how these volcanic centers and spreading zones show varying degrees of influence from arc, MOR, and hotspot components based on their  $^3He/^4He$  and  $C^3He$  fingerprints.

## Characterization of transport parameters during limestone dissolution experiments

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$CO_2$  sequestration in deep geological formation is considered an option to reduce  $CO_2$  emissions in the atmosphere. After injection the  $CO_2$  will slowly dissolve into the pore water producing low pH fluids with a high capacity for dissolving carbonates. Limestone rock dissolution induces geometrical parameters changes such as porosity, pore size distribution, or tortuosity which may consequently modify transport properties (permeability, diffusion coefficient). Characterizing these changes is essential to model flow and  $CO_2$  transport during and after the  $CO_2$  injection.

Here we report experimental results from the injection of acidic fluid into limestone core samples of 25.4 mm diameter, 12.5 mm length. Experiments were realized at room temperature. Before and after each acidic rock attack, we measure the sample porosity, the diffusion coefficient and the pore size distribution. During percolation experiments, the permeability changes are recorded and chemical samples taken to evaluate calcite dissolution. Several dissolution-characterization cycles are performed on each sample in order to study the evolution and relation of the different parameters.

These experiments show that far from the well injection site (i.e. intermediate pH solution (4-5)), dissolution processes are characterized by slow mass transfers. We measure a permeability decrease during the different experiments. Nevertheless, we observed a porosity increase in the sample inlet with higher pore diameters. In the opposite, we measured smaller pore sizes near the core sample outlets. These results indicate that some fine particles move from the sample inlet towards the outlet. Due to the low fluid acidity, these fine particles are not dissolved inside the samples and are transported inside. Consequently, these particles can locally clog the porous space and decrease the permeability.