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Cosmogenic He-3 exposure ages of basalts from Ascension Island – implications for evolution of ocean islands

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Ascension Island is the emergent top of a volcano situated at 7º56'S and 14º22'W in the South Atlantic Ocean, approximately 90 km west of the Mid-Atlantic Ridge and 50 km south of the Ascension Fracture Zone [1, 2]. It rises about 860 m above sea level and the base of the volcano covers about 2000 km2 approximately 3200 m beneath sea level [3]. Volcanic activity is associated with the Mid-Atlantic Ridge, and commenced at 6-7 Ma [2, 4, 5]. The volcanic rocks of Ascension Island are transitional to mildly-alkaline basalt to rhyolite volcanic suite and are distinguished by trace element ratios (e.g. Zr/Nb) [3]. Whereas the age of the trachyte intrusions are well constrained (0.6 – 1.0 Ma) [e.g. 3] the younger basalt suites have not been dated reliably and the low K concentration make Ar/Ar dating difficult. In order to reconstruct the volcanic history of Ascension Island we have used cosmogenic He-3 in olivine and pyroxene phenocrysts from uneroded basalt flows to date the three basalt lava suites that appear to span the range of volcanism.
Ages of co-genetic pyroxene and olivine agree within analytical uncertainties. Implanted radiogenic He-4 tends to lower He-3 derived exposure ages therefore some olivine samples were etched with HF/HNO3 to remove about 30% of the sample mass. The so etched olivine is systematically older (by less than 10%) than the unetched samples. The three basalt suites have exposure ages of 300 to 190 ka. The high and intermediate Zr/Nb basalts seem to have been erupted contemporaneously or at least in overlapping events about 300 ka ago. These suites were previously thought to be separated in time on the basis of K-Ar chronology and stratigraphy [3]. The third suite which seams to be a more local vent is erupted between 260 and 190 ka. Our new data indicate the co-existence of different magma chambers with different geochemical signatures.

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