$^{40}Ar/^{39}Ar$ thermochronology of low-temperature alteration in a flood basalt pile during burial metamorphism

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Celadonite is a low-temperature (<∼50 °C) alteration mineral that fills voids and fractures within buried and metasomatized volcanic rocks. The common occurrence, mineral chemistry and structural properties of celadonite (K_2O-rich and Ar retentive) make it attractive as a monitor of spatial and temporal variability of low-temperature hydrothermal fluid circulation and alteration.

The Neogene lava pile in E Iceland underwent burial metamorphism, tectonic tilting and subsequent glacial exhumation, and is today exposed with superimposed sub-horizontal regional zeolite facies mineral zones. From a single sample of the Skessa Tuff, a prominent welded pyroclastic flow, we present new $^{40}Ar/^{39}Ar$ incremental heating age determinations using the ARGUS-VI multi-collector mass spectrometer at OSU: plagioclase (10.26 0.12 Ma), groundmass (10.15 0.10 Ma), early-forming light green celadonite (9.73 0.03 Ma) and later-forming dark blue-green celadonite (9.67 0.03 Ma). The sample was collected at ∼550 m above sea level (masl) near the Thingmuli volcano.

Cooling ages of plagioclase and groundmass separates are in close agreement and represent the eruption age of this pyroclastic flow. The geochronologic data and petrographic observations suggest homogeneous and relatively rapid crystallization of celadonite. The inferred original top of the lava pile is ∼650 m (1400 masl) above the top of the analcime zone (∼750 masl). Celadonite is predominantly found as early-stage lining of primary pore space, but overgrown by chlorite/smectite clays and zeolites at higher grades. Above ∼750 masl vesicles are void of celadonite, and hence, celadonite precipitates in a narrow zone at ∼650 m depth. Timing of eruption and burial to ∼650 m depth are separated by ∼600 ky, which suggests a burial rate of ∼1100 m/m.y. This burial rate is 2x that of estimates from contemporaneous sections located away from central volcanoes. Considering proximity to Thingmuli it seems reasonable to expect a greater burial rate. Celadonite $^{40}Ar/^{39}Ar$ dating can unravel tectono-magmatic processes active during flood basalt burial.