Investigation of obsidian hydration and implications for 40Ar/39Ar dating method

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Preliminary results from a systematic investigation of obsidian by electron microprobe and the Ar/Ar method show that hydration can adversely affect Ar/Ar ages, but this effect can be mitigated by specialized sample preparation. Volcanic glass can be a problematic material for Ar/Ar geochronological studies, in part due to hydration and the resultant element mobility of Ar and other elements. The No Agua Peaks volcanic complex was chosen for this study due multiple obsidian flows displaying varying degrees of hydration. The twofold purpose of this study is to understand the effects of hydration on Ar/Ar ages of glass as well as to determine which sample preparations yield the most accurate and precise age for obsidian.

Multiple sample preparation methods including five and twenty-four hour ultrasonic baths in distilled water, as well as air abrasion and five and twenty-four hour ultrasonic washes in hydrofluoric acid were performed on sample splits. Samples were characterized using an electron microprobe to assess hydration and chemistry. To determine the effects that the extraction method has on the apparent age of a sample, furnace and CO₂ laser incremental heating were performed on splits, as well as a two-step laser extraction and laser fusion.

Microprobe results show that the hydration process does not cause significant element mobility, and most water is concentrated within the hydration rinds. Results also indicate that preparation by air abrasion, any HF treatment or a 24-hour ultrasonic rinse in distilled water can remove hydration rinds from an obsidian core, thereby increasing the quality of the data. Different argon extraction methods yield the same age for different splits of the same sample within uncertainty. Two eruptive periods at 4.08±0.07 Ma and 3.72±0.11 Ma represent chemically different magmas, which are separated by a paleosol at the No Agua Peaks complex. Preparation methods that include HF decrease the yield of 40Ar*, decreasing the accuracy and precision of the apparent age for a given sample. So far, furnace step-heating has produced encouraging results for displaying the effects for argon loss and the true eruption age. The preparation and extraction methods presented begin to permit the dating of young and poorly constrained volcanic events, which can be used to predict future volcanic hazards.

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Argon dating, geochronology, Ar, obsidian, volcanology, electron microprobe,