Comparative thermoluminescence dating of Quaternary North American obsidians and mafic lavas

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Thermoluminescence (TL) dating is one of a very small number of techniques that can be applied to a variety of geological material to accurately determine ages of Quaternary deposits. TL dating of solid Quaternary North American volcanic rocks such as obsidian, basalt and dacite, may be extremely useful for thoroughly understanding regional volcanism by allowing correct spatial and temporal correlation of young, solid volcanic deposits. TL dating applied to glass separates from North American Quaternary solid volcanic rocks has not previously been attempted. The focus of this research project is to determine TL age estimates of known-age obsidians and basaltic glass extracts from mafic lavas collected from various localities in western North America. This study will attempt to date 5 obsidians and 11 mafic lavas. All samples have been independently dated with other Quaternary dating methods. Once the TL ages of the samples are obtained, they will be compared with the known ages of the obsidians and basalts. This contribution is presented as a work in progress.

Preliminary analyses of the samples have been completed, including major element analysis, microprobe analysis, and thick source alpha-counting, to determine the dose rates of samples. Alpha counting data of the samples show that the U activity is equivalent to 0.70 to 12.51 ppm, and Th activity is equivalent to 0.39 to 24.05 ppm.

A dose response test was designed to determine the intensity, reproducibility and short term stability of the TL signal of the samples. Samples which showed low reproducibility and extensive short term fading were discarded as unsuitable for TL dating. Unsuitable TL characteristics were noted in 4 samples. The obsidians which showed low disk to disk reproducibility are either extremely old (>3 my), contain extremely high levels of U and Th, as well as radioactive mineral inclusions such as zircon (Mt. Edziza, B.C., obsidian) or possess a saturated level of TL (Crater Lake, Oregon, obsidian). The basaltic glass sample which showed extreme short term fading (Tree Molds Flow, California, basalt) contains low Ca concentrations compared to the glass compositions of other basalt samples. Further detailed microprobe analysis of the glasses is needed to elaborate on the connection between chemistry and TL output. Excellent TL properties were displayed by Ice Springs basalt, Utah, and Callaghan Flow basalt, California, and are expected to yield favourable results.