Induced Thermoluminescence Dating of Volcanism on Hawaii

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Abstract Text:

Last year we demonstrated that a suite of tholeiitic basalts that had erupted about 2.2 ka to nearly 500 ka ago in the east Snake River Plain (Idaho) showed a correlation between induced TL and age, although there was considerable scatter. This correlation is consistent with petrographic changes in the feldspar, the major TL-producing mineral in these rocks, such as crystallization of glassy or amorphous phases to produce feldspar or the diffusional loss of incompatible elements, such as Fe, that quench TL in feldspars. We have now measured 19 basalts from Hawaii. The Kohala alkali basalts (130-470 ka) have higher induced TL than the Kilauea tholeiitic basalts (<10ka) by a factor of 10-100. Benoit et al. (2001) showed that there is a strong relationship between induced TL and composition of feldspars. Applying the results of Benoit et al. (2001) to correct for compositional differences between the alkali and tholeiitic basalts, by normalizing them all to a tholeiitic feldspar composition, the correlation between induced TL and age for the Hawaii basalts is identical to the correlation observed for the Idaho basalts within our experimental uncertainties. These results suggest that there is an induced TL vs. age trend for basalts that is not specific to one location, and that there is the potential for a non-isotopic method of dating volcanism. The main challenge now is to identify and correct for causes of scatter in the data, other than composition, such as the amount of crystallization before, during, and immediately after emplacement of the lava (e.g., devitrification of the residual glasses within the basalts). If this can be done, the TL method, which is low-weight, low-power, low data-rate, would be suitable to spacecraft use.

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