



Dating volcanic ash and pumice stones from volcano El Misti, Peru, by thermoluminescence



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ABSTRACT

El Misti is one of active volcanos in Peru, and known because it is located close to an important city of Arequipa, at about 17 km. There has been in the past several eruptions and the volcano is covered with lava, ash, etc. from such eruptions. The edifice is composed of a stratotocone called Misti 1, two stratocones designated Misti 2 and Misti 3 and a summit cone Misti 4. In this work samples from Misti 3 have been collected for TL dating. In the past charcol has been used for radiocarbon measurements and found age varying from 25000 to 35000 years. The TL dating produces ages between 28700 and 32300 years.

1. Introduction

Thermoluminescence (TL), optically stimulated luminescence (OSL) and electron paramagnetic resonance (EPR) are methods that can be used for dating minerals, specially containing SiO₂ (McKeever, 1985; Aitken, 1998).

In any one of the above methods it is important to know or evaluate following parameters: (1) natural minerals such as quartz, feldspar, cristobalite, etc., particularly underground, is subject to α -, β -, and/or γ -rays emitted by surrounding material. This means that any such material to be dated has TL (or OSL or EPR) induced in it. For any dating it must be eliminated. In the case of ancient ceramics the heating clay mould high temperature will eliminate previously induced TL property by natural radiation. This period of heating is called “time zero” of the age to be determined. (2) Since “time zero” up to the time the material is collected for dating, as mentioned above, is irradiated with local radioactive emission. The effect is measured in the unit of absorbed dose or accumulated dose, Dac. (3) The radiation emitted by surrounding material must be measured; it is called annual dose rate, Dan.

The age then is given by:

$$\text{Age} = \frac{\text{Dac}}{\text{Dan}}$$

The Dan is calculated in the following way. First ²³⁸U, ²³²Th and ⁴⁰K that emit radiation during radioactive decay must be measured as to their concentrations. By means of these the total Dan is calculated (Ikeya, 1993).

In the case of lava from a volcano the high temperature during lava flow eliminate any previously induced radiation effects (Berger, 1991; Berger and Davis, 1992).

The Pleistocene volcanic range parallels N120° - trending boundary of the Western Cordillera, oblique to the N80° convergence of the Nazca plate along the Peruvian Margin (Fig. 1). Straddling the south slope of the Cordillera Occidental and the north edge of the Arequipa depression. El Misti is the most recently active edifice of a cluster of Pleistocene volcanoes, which includes the dormant Chachani compound volcano, 15 km to the northwest, and the extinct Pichu Pichu compound volcano, 20 km to the southeast (De Silva and Francis, 1991; Pallares et al., 2015).

Fig. 1 shows northwest side of El Misti (Herrera, 2006).

According to Thouret et al. (2001) “the composite edifice of El Misti is composed of a stratovolcano called Misti 1 with about 833–112 ka of age, and partially overlapped by two stratocones designated Misti 2 and

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