K-Ar dating on Haleakala volcano in the island of Maui, Hawaii

Yoshitomo Nishimitsu[1], Dave Sherrod[2], Takahiro Tagami[3]

[1] Earth and Planetary Sci, Kyoto Univ, [2] H.V.O, [3] Earth and Planetary Sci., Kyoto Univ.

K-Ar age was determined on the rocks in Haleakala volcano, the island of Maui, Hawaii. Hawaiian volcanoes grow through four volcanic stage. Kula Volcanics of Haleakala volcano is in the third stage, post-shield stage, which has never studied in detail. Consequently we have done K-Ar dating to clarify the eruption history of Kula Volcanics. Radiogenic 40Ar concentrations have been determined with sensitivity method and mass fractionation correction procedure. Potassium concentrations have been determined by the flame emission photometry and lithium internal standard and peak integration methods are adopted.

In this study, K-Ar age was determined on the rocks in Haleakala volcano, the island of Maui, Hawaii, to clarify the volcano forming history.

Haleakala volcano forms the eastern part of the island of Maui and is the third largest of all Hawaiian shield volcanoes. It is about 54 km from east to west and 42 km from north to south and has a total volume of 29,300 km3. The volcano rises to a height of 3056 m. At its summit lies Haleakala Crater, a broad erosional valley. Haleakala last erupted about A.D. 1790.

Hawaiian volcanoes grow through four stages: pre-shield, shield, post-shield and rejuvenated stages. Quiescence between post-shield and rejuvenated stage ranges from a few hundred thousand to a few million years. Pre-shield stage lava, if present, is buried by later stage lava at all volcanoes except Loihi Seamount.

Lava of three volcanic stages is exposed at Haleakala. The oldest is the Honomanu Basalt (shield stage), next youngest is Kula Volcanics (post-shield stage) and the youngest is Hana Volcanics (rejuvenated stage). Haleakala is the youngest Hawaiian volcano to have rejuvenated stage lava.

Honomanu Basalt is almost completely buried by Kula Volcanics and is exposed only in seacliffs along the north coast. The youngest age from the unit is 0.97+- 0.04 Ma (K-Ar, whole rock, Chen et al., 1991).

Kula Volcanics forms the majority of exposed lava on East Maui. The ages range from 0.93+-0.33 Ma to 0.22+-0.05 Ma by K-Ar and Ar-Ar methods (McDougall 1964; Naughton et al., 1980; Chen et al., 1991; Baksi et al., 1992; Singer et al., 1999; and this study).

The oldest radiocarbon ages from Hana Volcanics are 45+-1.8 ka and 43.8+-1.4 ka (Bergmanis, 1998; Sherrod and McGeehin, 1999). Ar-Ar ages as old as 58+-1ka and 60+-8 ka have been reported (Bergmanis, 1998). Compositionally the Hana Volcanics are similar to the Kula (analyses from Chen et al., 1990; West and Leeman, 1994; Bergmanis, 1998).

Sampling, forming a part of Haleakala project, was done in January 2000. Twenty-nine samples (hawaiite, alkalic basalt, and basanite) were collected from Haleakala Crater to clarify the Kula Volcanics eruption history. The crater is 11 km long (east-west) and 3 km wide (north-south). The walls of the summit depression range in height from 170 to 610 m above the floor.

Sampling was concentrated along three traverses up the walls of Haleakala Crater. Representative lava flows in each traverse were chosen using following guidelines. (1) Lowest flow, which has reversed polarity magnetization for each traverse; (2) First lava flow upsection with normal polarity magnetization; (3) Any lava flow that overlay thick tephra, debris-flow deposits; (4) Lava flow showing distinct difference from underlying flows; (5) Remarkably thick flows because they are easily recognized from distance and therefore good markers; (6) Lava flows where slope changes its steepness; (7) Highest flow from each traverse.

It will be possible to clarify the eruption history from the ages of these samples. By now nobody has ever determined the eruption in the post-shield stage. Consequently this study is important to think of the volcano forming history by hot spot and the structure.

Dating ages was done in Geochronology laboratory in Kyoto University. In order to remove the influence of excess 40Ar, phenocrysts are removed from the sieved samples by isodynamic separator and/or handpicking. Radiogenic 40Ar concentrations have been determined with sensitivity method and mass fractionation correction procedure (Matsumoto et al., 1989b; Matsumoto and Kobayashi, 1995). Potassium concentrations have been determined by the flame emission photometry. Lithium internal standard and peak integration methods are adopted.

I wish to express my grateful thanks to Dr. Kozo Uto of Geological Survey of Japan for his constant guidance and invaluable advice in this work.