Palaeointensity study of the Brunhes-Matuyama polarity reversal recorded in the lava sequence in Punaruu valley, Tahiti Island

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It is thought that the geomagnetic field intensity during the reversal generally shows a large reduction prior to the directional full reversal. Since this reduction indicates a large drop of the geocentric axial dipole moment, the precise palaeointensity study on the beginning of a reversal could give key information about the dynamic processes of the geodynamo reversal. In order to investigate the relatively earlier stage of the Brunhes-Matuyama (B-M) polarity reversal, we have done a palaeointensity study of 21 lavas of the lava succession in the northern side of Punaruu valley, Tahiti Island, from the southern side of which Chauvin et al. (1990) reported a few palaeointensities for the B-M reversal.

We first carried out rock magnetic experiments. Curie temperatures were observed to be 500-600 and/or 100-200 deg., suggesting a single phase of titanium-poor or titanium-rich titanomagnetite, or a mixture of them. Hysteresis parameters of the samples are plotted mostly in PSD or SD regions of the Day plot. The samples were subjected to thermal demagnetisation, or alternating field (AF) demagnetisation following the low temperature demagnetisation (LTD). Secondary components were generally removed at low temperatures (below 300-400 deg.) or low AFs (below 10 mT). Although several lavas show significant amount of secondary components, a high coercivity or a high blocking-temperature component can carefully be extracted as a primary one. For palaeointensity determination, the double heating technique of the Shaw method combined with LTD (LTD-DHT Shaw method) was applied to 107 samples from those lavas. This is because AF demagnetisation was more effective for removing secondary components than thermal demagnetisation and also because the validity of the LTD-DHT Shaw method was supported from the rock magnetic characteristics of most samples (e.g. Oishi et al., 2005).

Mean palaeodirections (N=3 or more) were obtained for 18 lavas and mean palaeointensities (N=2-6) for 13 lavas. The results show two stages of palaeodirection: (1) the directionally stable period with reversed polarity (virtual geomagnetic pole, VGP: 60-90 deg. in latitudes) and (2) the directionally unstable period with intermediate-normal-reversed (I-N-R) polarity change. The reversed polarity recorded in the uppermost lava is regarded as the rebound followed by the Brunhes normal polarity (e.g. Okada and Niitsuma, 1989; Tsunakawa et al., 1999) or the precursor of B-M reversal (e.g. Hartl and Tauxe, 1996), suggesting the studied lava sequence recorded the earlier stage of B-M reversal. For the directionally unstable period (I-N-R stage), the palaeomagnetic field intensity was probably weak (4.7 micro T) though only one lava gave a meaningful palaeointensity. For the directionally stable stage with reversed polarity, the palaeintensity results suggest that the field intensity varied in oscillation-like manner between 5.9 and 42.9 micro T. It should be noticed that the virtual dipole moments (VDMs) in the oscillation-like change (1.5-9.0 E+22 Amˆ2) show a strong correlation with the VGP latitudes (60-90 deg. S) change, suggesting one of the important dynamic processes in the geodynamo reversal.