Paleomagnetic directions of the Sakashita body of the Ueno basaltic rocks and volcanic interpretations

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There are many ancient (late Pliocene to early Pleistocene) basaltic monogenic volcanoes in central Japan, collectively called the Ueno basaltic rocks. The Sakashita volcano (or Sakashita body) of this basaltic suite is dated at about 1.5 Ma, and consists of a few basaltic flows. In this study we collected oriented basalt samples from the Sakashita body for paleomagnetic study. Detailed analysis of demagnetization results revealed site-mean remanent magnetization directions of reversed polarity at 15 sites. They displayed an unexpectedly large dispersion, and it is significantly larger than the range of ordinary geomagnetic fluctuations. Approximately half of the site-mean directions, however, cluster around a south and up direction, and provide a mean direction (D = 181.2, I = -64.1, alpha95 = 5.6) characterized by a somewhat deeper inclination than expected in the studied area. It seems reasonable to suppose that this mean direction represents the paleomagnetic direction at the time of eruption. Interestingly, such consistent site-mean directions are determined at sites located in the central part of the Sakashita body, and unexpected site-mean directions are from the margins. To explain these observations, we propose a model that interprets the large directional dispersion as resulting from deformation during cooling. Our model is as follows: Lavas begin to solidify at surfaces, and the resultant outer shells are magnetized at first. At this point, however, the interior of the lavas are still hot, mobile, and not magnetized. Mobility in a still fluid core in the interior of the lava would break the outer magnetized shell, which would cause rotation of pieces of the shell; hence dispersed site-mean directions. The interior then solidifies and records a consistent magnetization direction.