Paleomagnetism and rock magnetism of Miocene dikes in the Nakaoku area, Kii Peninsula, Japan

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A tuffite intrusion of the Middle Miocene arcuate volcanic dikes intruding pre-Tertiary rocks in the Nakaoku area, central Kii Peninsula has a northerly remanent magnetization direction of normal polarity. This direction, possessing relatively low unblocking temperatures (300-400 deg C), has previously been regarded as a primary thermoremanent magnetization acquired during a later stage of cooling of the tuffite dike. In this paper we present new results of rock-magnetic, paleomagnetic, and ore microscopic investigations, which we use for testing an alternative hypothesis that the direction is a secondary magnetization. Samples were collected from the tuffite dike and nearby quartz porphyry and basaltic andesite dikes. A detailed rock-magnetic study including the analysis of isothermal remanent magnetization (IRM) acquisition curves, thermal demagnetization of a composite IRM, and high- and low-temperature measurements, as well as ore microscopic observation, indicates that pyrrhotite carries the northerly magnetization in the tuffite dike. The pyrrhotite occurs not only as anhedral minerals enveloping other small grains, but also as those filling open fractures within lithic fragments. These observations suggest that the pyrrhotite is very likely a secondary mineral, so that the magnetization would be secondary as well. On the other hand, the quartz porphyry dike has a reverse-polarity magnetization with a southerly declination and a steep inclination. Magnetite is the main carrier. We interpret the magnetization as a primary one that represents the paleomagnetic direction at the time of intrusion of the arcuate dikes (c.15 Ma). The reversely-magnetized direction is statistically different from the reverse-polarity direction of the Middle Miocene Muro Pyroclastic Flow Deposit distributed some 30 km to the north. Thus we consider, from a paleomagnetic point of view, that the arcuate dikes are not the source for this large-scale pyroclastic flow deposit.