

Implications of new Paleocene paleomagnetic data from SW Japan for the mode of early opening of the Japan Sea

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Geological and paleomagnetic data suggest that the Japan Sea backarc basin has a two-phase opening history. The first phase may have been relatively slow opening that began in the Eocene or early Oligocene, and the second phase was relatively fast opening occurring in the early Miocene. Paleomagnetic data reported from the Japan arc over the past 40 years show that the second phase was accompanied by differential arc rotation, namely, clockwise rotation of the southwestern lithospheric sliver of the arc (SW Japan) and counterclockwise rotation of the northeastern sliver (NE Japan). However, it is uncertain whether the first phase was also accompanied by differential arc rotation. Here, new paleomagnetic data are presented to address this issue. In this study, Paleocene (~60 Ma) andesite dikes were sampled at 17 sites in the Toki-Mizunami area in SW Japan. These dikes vertically or subvertically intrude a late Cretaceous (~70 Ma) granite batholith and comprise an ENE-striking dike swarm. Stepwise demagnetization experiments were performed on all samples for obtaining characteristic remanent magnetization (ChRM) components. As a result, site-mean directions of ChRM components were determined for 14 sites. Thermal demagnetization of natural remanent magnetization (NRM) and isothermal remanent magnetization (IRM) shows that magnetite is the main magnetic carrier. Comparison of the site-mean directions with the anisotropy of magnetic susceptibility (AMS) suggests that the influence of the preferred orientation of magnetic particles upon the site-mean directions is absent or negligible. Although the site-mean directions display a small dispersion, the presence of dual polarities suggests that the dike emplacement extended over a set of normal and reverse polarity chrons. The overall mean direction of the 14 site-means is therefore interpreted to be a time-averaged paleomagnetic direction at ~60 Ma. It is deflected ~57° clockwise of an expected paleomagnetic direction calculated from a late Cretaceous paleomagnetic pole for the North China Block in the Asian continent, and the amount of clockwise deflection is larger than that (~44°) reported for early Miocene sediments in the Toki-Mizunami area. Therefore, small (~10–15°) clockwise rotation occurred in the study area between the Paleocene and the early Miocene. It is likely that this small rotation is associated with the early opening of the Japan Sea.

Keywords: Japan Sea, paleomagnetism, rock magnetism, SW Japan, tectonic rotation