Paleointensity experiments on single crystals separated from the middle Cretaceous Iritono granite

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Understanding the long-term evolution of the geomagnetic field is a key for constraining the thermal evolution of the deep Earth, mantle convection, and the preservation of a surface environment conducive to life. Previous studies have suggested possible correlations between the behavior of geomagnetic field and some important geologic events such as the beginning of core convection, nucleation of the solid inner core (e.g. Aubert et al., 2010; Biggin et al., 2015), and cycle of the mantle convection (e.g. Courtillot and Olson, 2007; Biggin et al., 2012).
Because of their slow cooling rate, plutonic rocks are potentially good recorders for averaging out relatively short-term fluctuations of the geomagnetic field for paleointensity studies. However, paleomagnetic measurements of these rocks often encounter the disturbance by alterations like weathering and lightning, and the viscous-remanence problem caused by effects of multi-domain magnetite. One of the approaches to avoid the weathering disturbances (but not lightning) is to separate single silicate crystals from the rocks and conduct paleomagnetic and rock magnetic measurements on them. Recently, several research groups have investigated paleointensities from single crystals of primary minerals such as plagioclase, pyroxene, zircon and quartz for their potential to avoid difficulties that frequently plague whole-rock measurements (e.g. Tarduno et al., 2007, 2010, 2015; Tarduno and Cottrell, 2005; Usui and Tian, 2017; Sato et al., 2015; Fu et al., 2017). To provide solid ground for single silicate crystal paleomagnetism, paleointensity and rock-magnetic properties of single crystals should be systematically studied and compared to those of the host granitic rock, but few such studies exist.
We performed paleointensity experiments by the Tsunakawa-Shaw method (e.g. Tsunakawa and Shaw, 1994; Yamamoto et al., 2003) on single plagioclase crystals separated from the middle Cretaceous Iritono granite, from which Tsunakawa et al. (2009) recovered reliable paleointensity data on whole rock samples. Measurements were carried out using the superconducting quantum interference device magnetometer at Center for Advanced Marine Core Research, Kochi University. Nine out of 17 samples passed the standard selection criteria for reliable paleointensity determinations. The mean and the standard deviation of the nine results was 57.4±11.8 μT. This is consistent with the mean whole-rock paleointensity with the standard deviation, 58.4±7.3 μT, reported by Tsunakawa et al. (2009). We conclude that paleointensity measurements were applicable to plagioclase, though further studies are needed to make the results comparable to those obtained by the conventional whole-rock method.

