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Single plagioclase paleointensity for the Cretaceous Superchron from granite

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Single-plagioclase Thellier's paleointensity experiments were carried out using the Cretaceous Goyozan granite of 111 +/- 9 Ma from Kitakami massif, NE Japan. Recent dynamo simulations suggest that when the geomagnetic reversal rate is small, fluctuation of field is small and the geomagnetic intensity is high. On the other hand, paleomagnetic estimation of the field strength (virtual dipole moment: VDM) during the Cretaceous normal superchron (CNS), when the field did not reverse for nearly 40 million years, reported a contradiction showing high and low VDM. The high VDM are mainly supported by experiments using single plagioclase crystals extracted from basalts. In this study, we report low VDM for CNS from experiments using plagioclase crystals from granite. Compared to the basalts, this may be a time-average value due to the presumably protracted sub-blocking temperature remanence acquisition. SEM observation of our granite sample reveals the presence of submiroscopic, needle-shaped exsolved magnetites within plagioclase crystals. Exsolved magnetites have been reported to be able to record reliable paleomagnetic information (Feinberg et al., 2005). We investigated magnetic stability and paleo-inclination of plagioclase crystals by alternating field and thermal demagnetization experiments on oriented single crystals cut from oriented rock slab. They showed high magnetic stability (mean destructive field of 25 mT) and a narrow range of unblocking temperatures between 565-585 ^{o}C, which suggest a narrow grain size distribution of nearly pure magnetite. They revealed stable single component remanence, which is consistent with the remanence vector from whole-rock experiments. On the other hand, those remanence inclinations are slightly steeper than previously proposed primary direction for Kitakami massif (Otofuji et al., 2000). Coe's version of Thellier's experiments was succeeded on 20% of the measured plagioclase crystals. As a result, the paleofield intensity are 29 - 39 micro-T. Using the inclination value from our experiment, its VDM is calculated to be 5.9 - 8.0 x 10^{22} Am^2. Even if we adopt the inclination value of Otofuji et al. (2000), the VDM would be 6.9 - 9.3 x 10^{22} Am^2. Considering possible overestimation due to the slow cooling rate of the granite, our result suggest that the VDM of CNS around 111 Ma is no higher than the present value of 8.0 x 10^{22} Am^2.

Feinberg, J. M. et al. (2005) Geology v.33 p.513-516.
Otofuji Y. et al. (2000) Earth Planet. Sci. Lett. v. 180 p. 271-285.