

# Magnetic mineral inclusions in single zircon crystals from the Tanzawa tonalite and the river of Yangtze and Mississippi

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Although it is essential to understand the variations in geomagnetic field intensity through the Earth history, data are still scarce to resolve billion year-scale geomagnetic field variation. This is mainly due to the lack of well-preserved rocks for older eras, which often results in unsuccessful paleointensity experiments. To overcome this problem, recent investigations have focused on paleointensity experiments using single silicate crystals, which often accompany magnetic mineral inclusions, such as plagioclase (Tarduno et al., 2006), quartz phenocryst (Tarduno et al., 2010), pyroxene (Muxworthy and Evans, 2012), olivine (Tarduno et al., 2012), and zircon (Tarduno et al., 2015, Sato et al., 2015; Fu et al., 2017). Sato et al. (2015) and Sato (2018, JpGU) reported the rock-magnetic properties of the single zircon crystals sampled from the Tanzawa tonalite (4-5 Ma) and from the Yangtze and Mississippi river. They demonstrated that the various rock-magnetic properties such as natural remanent magnetization (NRM), isothermal remanent magnetization (IRM), hysteresis parameters, and transition temperature could be measured using the standard magnetometers (SQUID magnetometer, MPMS, and AGM). During their rock-magnetic measurements, many of single zircon crystals are below the limits of the sensitivity of the magnetometers employed, but a few % zircons had values of  $M_{NRM} > 4 \times 10^{-12} \text{ Am}^2$  and  $M_{IRM} > 4 \times 10^{-12} \text{ Am}^2$ , containing enough magnetic minerals to be measured in the DC SQUID magnetometer. The main remanence carriers seem to be nearly pure magnetite with pseudo-single-domain grain sizes. These samples are expected to be appropriate for the paleointensity study, but identification of mineral inclusions in those zircons are not yet investigated.

Here, we report mineral inclusions in zircons from 1) Tanzawa tonalite, 2) the Yangtze river, and 3) the Mississippi river, with an optical microscope, Laser-Raman microspectroscopy and SEM-EDS system. Results indicate that zircon crystals appropriate for the paleointensity study contain magnetic minerals, such as titanomagnetite and pyrrhotite. Significantly, titanomagnetite inclusions display fine exsolution lamellae indicating single- or pseudo-single-domain size. In this presentation, we will discuss the results of rock-magnetic measurements and magnetic mineral inclusions in zircons.

Keywords: paleointensity, zircon, inclusion