Coercivity- and blocking temperature-dependent remanence properties of single plagioclase crystals with exsolved magnetite

*Yoichi Usui[1], Chie Kato[2]

1. Japan Agency for Marine-Earth Science and Technology, 2. Earth-Life Science Institute, Tokyo Institute of Technology

Single-domain particles are fundamental to paleomagnetism. Increasing number of reports verify that exsolved magnetite in plagioclase is close to the non-interacting single-domain state, and pioneering works have successfully used them for both paleodirection and paleointensity studies. On the other hand, anomalously strong magnetic anisotropy and high efficiency of remanence acquisition have been identified as obstacles to accurately interpret paleomagnetic record in exsolved magnetite. However, rock magnetic measurements concerning these properties are still scarce. Moreover, coercivity- and blocking temperature-dependence has been rarely assessed, while stepwise demagnetization is a standard protocol in most of the paleomagnetic applications. In this study, we report systematic measurements of anhysteretic remanence (ARM) and thermoremanence (TRM) at different field directions, field magnitude, and demagnetization steps, for plagioclase crystals separated from oceanic gabbros. Similar to the previous reports, plagioclase crystals showed high coercivity (median destructive field ~60 mT), and sharp unblocking above 560 °C. Both ARM and TRM suggested large anisotropy with deviation of remanence direction from applied field by 10 - 30°. Upon progressive AF and thermal demagnetization, ARM showed 2-3 apparent "components", indicating coercivity- and blocking temperature-dependent anisotropy. The directional patterns were different between AF and thermal demagnetization. There was a tendency that the direction of the low coercivity (<90 mT) "component" is similar to that of the high blocking temperature (>560 °C) "component". AF demagnetization of TRM was generally similar to that of ARM, except that the high coercivity "component" was larger in TRM. Remanence acquisition was efficient, and both ARM and TRM reached 10-30 % of saturation remanence with bias field of 40 uT. This fraction increased upon AF demagnetization, reflecting smaller AF stability of IRM. Nonetheless, the remanence acquisition curves versus the bias field magnitude seems to be insensitive to coercivity window. The complex pattern in AF demagnetization of ARM and TRM particularly warns the interpretation of data such as those in Shaw-type paleointensity experiments. Thermal demagnetization may be relatively easier to interpret, because the main unblocking above 560 °C seems to be of single "component". Nevertheless, we emphasize that anisotropy should be determined around the unblocking temperature rather than for total TRM, and precise temperature control would be a next challenge. Nonlinear remanence acquisition may be approximated using total ARM or TRM. We will discuss these observations in light of microscopic texture of exsolved magnetite.

