# Geomagnetic paleointensity experiments on diverse contemporaneous materials from a monogenetic volcano

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Reconstructing full vectors of the Earth's magnetic field over time and space is vital for deepening our understanding of the Earth's deep interior and its evolution. However, in particular, obtaining reliable paleointensity (PI) estimates is often difficult due to frequent occurrence of unwanted experimental results, which are generally caused by non-ideal materials for PI experiments as magnetic remanence carriers, surely common in nature. So, investigating relations between unwanted PI results and inherent non-ideal magnetic signatures of material and thus attempting to connect them can be a good way to immensely improve the reliability of PI determination and the acquisition rates. To this end, volcanic and archeological materials of the recent past and historical period and experimentally simulated ones, having known initial magnetic fields that we want to seek, have been frequently utilized. In this work, we have utilized diverse contemporaneous products from an old monogenetic volcanism, i.e. the 3.7 ka Songaksan eruption in Jeju Island, to investigate behaviors of PI results with two different methods. It is expected to have a good opportunity to explore effects of magnetic signatures on PI results and finally make the best faithful PI determination.

The 3.7 ka Songaksan eruption is known to be a sequence of basaltic phreatomagmatic and magmatic eruptions, providing a variety of products including basaltic juvenile and non-juvenile pyroclasts within tuff ring deposits, ponded trachybasaltic lava and scoria deposits with spatters/agglutinates. Of which, currently two kinds of volcanic materials, i.e. juvenile pyroclasts and lava, have been applied to PI experiments with the Tsunakawa-Shaw method and the IZZI-Thellier method in conjunction with rock-magnetic characterizations based on thermomagnetic curve, hysteresis parameter and first-order reversal curve analyses. These samples could be characterized by different magnetic mineral phases, domain states and magnetostatic interactions as follows. [1] Type I: juvenile pyroclast, dominance of magnetic mineral phase having a low curie temperature (Tc) of about 150-280 $^o$C with occasional co-existence of a Tc~540-600 $^o$C phase, single-domain (SD)-like particles with suppressed magnetostatic interactions or mixtures of SD and superparamagnetic-domain particles, thermal stability in temperatures between room temperature (Tr) and ~300 $^o$C; [2] Type IIa: trachybasalt lava, a single Tc~580 $^o$C phase, magnetostatically interacting SD-like particles, thermal stability between Tr and 610 $^o$C; [3] Type IIb: trachybasalt lava, a single Tc~580 $^o$C phase, magnetostatically interacting pseudo-SD particles, thermal stability between Tr and 610 $^o$C. IZZI-Thellier PI experiments for type I specimens show near-ideal results for the temperature ranges up to the temperature at which the pyroclasts were emplaced (less than ~300 $^o$C), giving PI estimates of ~50-65 micro T. For type IIa specimens, IZZI-Thellier PI results all show sagging non-ideal Arai plots allowing variable slopes corresponding to ~10-85 micro T, but the corresponding Tsunakawa-Shaw experiments all show ideal results giving PI estimates of ~20 micro T. For type IIb specimens, both IZZI-Thellier and Tsunakawa-Shaw results show apparently a consistent PI estimate of ~60 micro T, although the IZZI-Thellier results show somewhat zigzagged Arai plots. Most of the acceptable PI estimates from different specimens with different magnetic remanence carriers are concentrated at around 60 micro T (~20% higher than the present-day), which may indicate an actual surface magnetic field value at that time. This can suggest that juvenile pyroclastic rocks can be good materials to have promise for PI determinations. On the other hand, the highly biased PI estimates of ~20 micro T for apparently ideal Tsunakawa-Shaw results of type IIa lava specimens should be investigated further to seek the cause.

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