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Specialized Field: Earth and Planetary Magnetism

Research Subject: Paleomagnetism of fault rocks and meteorites

Research purpose and overviews:
I am developing a new technique for selective micro-spot paleomagnetism to pursue ancient terrestrial and extraterrestrial magnetic field from old rocks and meteorites. Because the old rocks and meteorites suffered a severe alteration, we should select an armored magnetic mineral and/or unaltered portions like shock melt veins for the paleomagnetic research. Therefore, I have conducted researches described below.

a) **Development of stepwise selective laser demagnetization system:** My students and I have been developing a stepwise laser heating system of 532nm YAG green laser with two-color spot infrared thermometer. The collaboration of this system with our scanning MI magnetic microscope leads us to do a selective micro-spot paleomagnetism for terrestrial and extraterrestrial materials.

b) **Origin of abnormal remanences in Vredefort shocked granite:** The Vredefort crater, world’s largest meteorite crater, showed an extraordinary strong but random remanence in target granitoids. To determine the source minerals for the remanence, my students, overseas collaborators and I conducted a Raman spectroscopy over the strongly magnetized minerals using our MI microscope. Then we found fine-grained magnetites within biotite as a remanence carrier, disagreeing with previously determined carrier of needle-shape magnetites in planar deformation features.

c) **Earthquake-lightning hypothesis:** My students, domestic collaborators and I discovered anomalously magnetized fractured clays along the fault zone in 1200m depth of Taiwan Chi-Chi fault, resulting from an intense underground current.

d) **Extraterrestrial paleomagnetism of shock melt veins:** Although most chondrites are poor magnetic recorders due to the shock alteration and thermal metamorphism, my student and I revealed that a shock melt vein in chondrites is a pristine magnetic recorder at ancient asteroidal collision.

e) **Fractal time-temperature relation of nanophase iron particles:** My student and I constructed theoretical time-temperature relationship for nanophase iron particles to interpret a previously unexplained slow relaxation behavior of magnetic particles.

f) **Single plagioclase crystal paleointensity and exsolved magnetites:** Exsolved magnetites in plagioclase appear to be a good recorder of ancient geomagnetic field, but its needle shape attributes to the increase
of volume in single domain range, resulting in a saturation of thermal remanence even in a very weak field. To resolve this invaluable situation, my student and I conducted simulation experiments for paleointensity prediction using single plagioclase crystal from Cretaceous granitoids. We found an absolute intensity for geomagnetic field during the Cretaceous era, suggesting the active dynamo.

Publications:
Journals:

Symposium Participations:
7. Tachibana, S., Nakamura N. and TCDP team, Abnormal remanence of fault gouge and its
relation to pulse-like geomagnetic perturbations prior to Chi-Chi earthquake, Taiwan. Abstract for JPGU 2008, poster
