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Research Interests:

Behavior of the ancient geomagnetic field. Statistical analysis of paleomagnetic data. Applications of paleomagnetic data to geological problems.

The research during 2015 of myself and my students and post-docs continued several recent threads and began several new ones. We continued to work on improving the methods by which we determine the ancient field strength (e.g, Cromwell et al., 2015a) and it seems we may have finally hit on an accurate and precise way of doing it. The key is first finding the appropriate materials (those that contain only the finest grained magnetic particles) and applying strict selection criteria. The need for using only so-called single-domain material was underscored by the work of Shaar and Tauxe (2015) who showed for the first time the danger of using samples with larger grain sizes as the remanences are not stable over time and the answers retrieved from such material is likely to be incorrect. Happily this non-ideal behavior is easily recognized by using the selection criteria proposed by Cromwell et al. (2015a), if all the measurements are available for analysis.

Using our newly revised approach, Cromwell et al. (2015b) sampled and analyzed sub-glacially erupted lava flows on Iceland in an attempt to constrain better the behavior of the Earth's magnetic field over the last few million years as witnessed at high latitudes (Figure 1). We found that the field strength is approximately equal to that implied by published data from lower latitudes - an impossible result if the field is largely that of a magnetic dipole, as presumed since the 1600s! Because of the work of Cromwell et al. (2015a) and Shaar and Tauxe (2015), we strongly suspect that it is the data from lower latitudes (based on what can now be viewed as fatally flawed samples) which is the problem. Naturally, we will be returning to lovely Hawaii in the near future to try to sort this out.

In addition to constraining field behavior over the last five million years, we had several other projects come to fruition. We continue to produce high quality data for the more recent past (e.g., Cai et al., 2015). Another project concluded work on the IODP Expedition 318 (Tauxe et al., 2015). This latter study applied rock and paleomagnetic techniques to the understanding of the melting history during the Pliocene of the East Antarctic Ice Sheet, which underwent startling melting during the Pliocene, a period of time with CO_2 levels thought to be as high as today's.

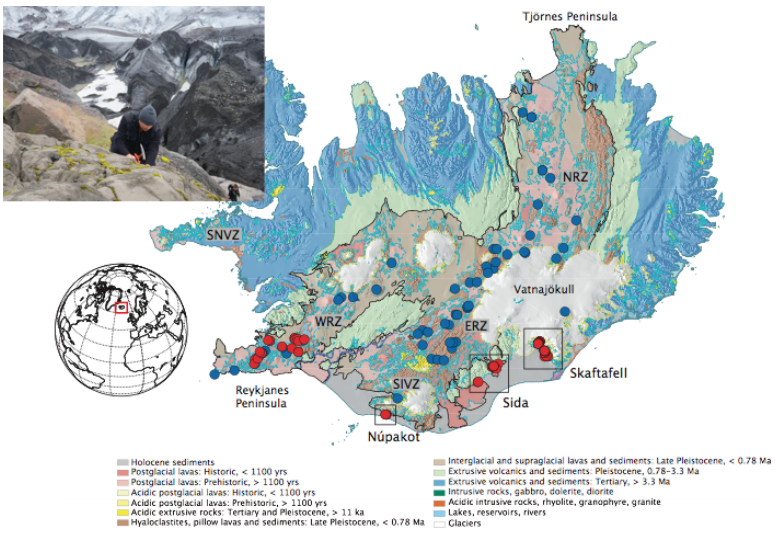

Figure 1: Sampling sites from study of Cromwell et al., 2015b. Inset shows Geoff Cromwell at work sampling sub-glacially erupted pillow lavas.

Selected Publications from 2015

Cromwell, G., Tauxe, L., Staudigel, H., Ron, H., Paleointensity estimates from historic and modern Hawaiian lava flows using volcanic glass as a primary source material, Phys. Earth Planet. Int., 241, 44-56, http://dx.doi.org/10.1016/j.pepi.2014.12.007, 2015a.

Tauxe, L., S. Sugisaki, F. Jimenez-Espejo, C. Escutia, C. P. Cook, T. van de Flierdt, M. Iwai, Geology of the Wilkes Land Sub-basin and Stability of the East Antarctic Ice Sheet: Insights from rock magnetism at IODP Site U1361, Earth Planet. Sci. Lett., 4123, 61-69, http://dx.doi.org/10.1016/j.epsl.2014.12.034, 2015.

Shaar, R., Tauxe, L., Ben-Yosef, E., Kassianidou, V., Lorentzen, B., Feinberg, J., Levy, T.E., Decadal-scale variations in geomagnetic field intensity from ancient Cypriot slag mounds, Geochem. Geophys., Geosyst., 15, http://dx.doi.org/10.1002/2014GC005455, 2015a.

Cai, S., Chen, W., Tauxe, L., Deng, C., Qin, H., Pan, Y., Zhu, R., New constraints on variation of the geomagnetic field during the late Neolithic period: Archaeointensity results from Sichuan, southwestern China, J. Geophysical Res., 120, 20562069, http://dx.doi.org/10.1002/2014JB011618, 2015.

Cromwell, G., Tauxe, L., Halldorsson, S.A., New paleointensity results from rapidly cooled Icelandic lavas: Implications for Arctic geomagnetic field strength, J. Geophys. Res., 120, 29132934, http://dx.doi.org/10.1002/2014JB011828, 2015b.

Shaar, R., Tauxe, L., Instability of thermoremanence and the problem of estimating the ancient geomagnetic field strength from non-single-domain recorders, Proc. Nat. Acad. Sciences, 112, 11187-11192, http://dx.doi.org/0.1073/pnas.1507986112, 2015b.