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

In 2014, my research has largely focused on improving the methods by which paleointensity data are evaluated (Paterson et al., 2014). We also acquired new results from lavas (di Chiara et al., 2014) and archeological artifacts (Cai et al., 2014).

Cai et al., (2014), published the first new archaeointensity results from China since the the 80s. We discovered a new period of quite low virtual axial dipole moments (VADMs) of ~25% of the present day field at around 2250 BCE followed by a sharp six-fold increase to a high field intensity (160% of present day field) at around 1300 BCE. The rate of change of geomagnetic intensity during this period is ~6 µT/century or 47% per century which is faster than the rate of change anywhere on Earth today.
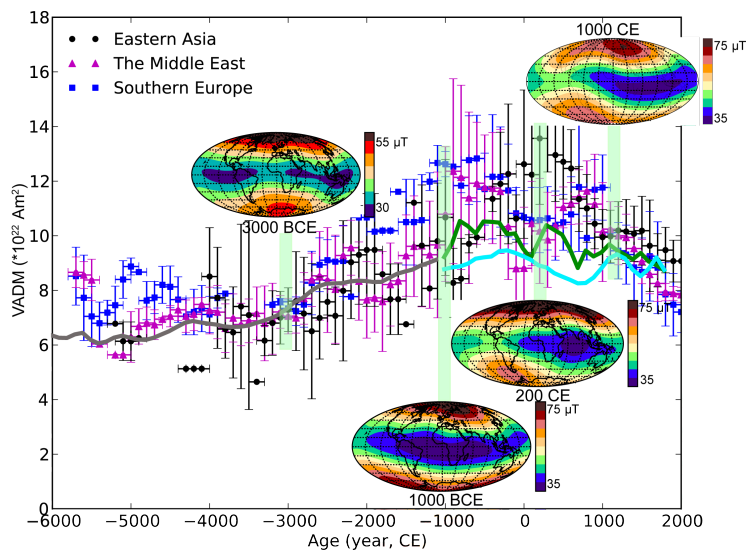

Figure 1: Variations of average VADMs in the areas of Eastern Asia (black solid circles), the Middle East (magenta triangles) and Southern Europe (blue squares) from data in the MagIC database and in Cai et al., 2014. The averages are calculated every 200 years with a 100-years sliding window. Balloons are predictions of the geomagnetic field intensities at the earth surface from CALS10k.1b (older than 1000 BCE) or ARCH3k.1 (younger than 1000 BCE) models (Korte et al., 2011 and Korte et al., 2009 respectively). Grey/ cyan/ green heavy line represents the VADMs predicted by the models. [Figure from Cai et al., 2014.]

Our new data allow a comparison with data along a latitudinal transect from Eastern Asia to Europe and with the geomagnetic field models published by Korte et al., 2009, 2011, Korte and Constable, 2011 and Korte et al., 2011) which are mutually incompatible in their predictions of field intensity in China. Our data are in better agreement with the ARCH3k.1 model of Korte et al., (2009). We also found that the high field values observed in the Middle East around ~1000 BCE is unlikely to be a global feature (see Figure 1). The three areas of Eastern Asia, the Middle East and Southern Europe appear to evolve quite indepently from one another with non-dipole field features growing and decaying in place as opposed to being caused by migrating flux patches.

In the study of di Chiara et al., (2014) we presented the first dataset of reliable paleointensity estimates for the central-northern Atlantic Ocean. The new data are internally consistent and radiocarbon dated, so they can be included in global geomagnetic datasets, and used to help improve the next generation of global geomagnetic field models.

The paleomagnetic literature on paleointensity is rife with competing methods of selecting "good" data and rejecting "bad" data, with many different statistics for estimating the degree of alteration and other common proplems with the method. Paterson et al., (2014) assembled a definitive list of published paleointensity selection criteria. These statistics have been incorporated into the program Thellier_gui.py of Shaar and Tauxe (2013) and allow great flexibility in choice of selection criteria. In an examination of data obtained from material produced in known fields, we concluded that certain sets of selection criteria in common use are quite inefficient at choosing accurate results while excluding inaccurate ones.

Selected publications:

Paterson, G.A., Tauxe, L., Biggin, A.J., Shaar, R., Jonestrask, L., On improving the selection of paleointensity data, Geochem., Geophys., 15, Geosyst., doi:10.1002/2013GC005135, 2014.

Cai, S., Tauxe, L., Deng, C., Pan, Y., Zheng, J., Xie, F., Qin, H., Zhu, R., Geomagnetic intensity variations for the past 8 kyr: New archaeointensity results from Eastern China, Earth Planet. Sci. Lett., 392, 217-229, doi: 10.1016/j.epsl.2014.02.030, 2014.

Di Chiara, A., Tauxe, L., Speranza, F., Paleointenstiy determination from S\~ao Miguel (Azores Archipelago) over the last 3 ka, Phys. Earth Planet. Int., 234, 1-13, doi:10.1016/j.pepi.2014.06.008, 2014.

References cited:

Korte, M. and C. Constable (2011). "Improving geomagnetic field reconstructions for 0-3 ka." Phys. Earth Planet. Int. 188: 247-259.

Korte, M., C. Constable, F. Donadini and R. Holme (2011). "Reconstructing the Holocene geomagnetic field." Earth and Planetary Science Letters 312: 497-505.

Korte, M., F. Donadini and C. Constable (2009). "Geomagnetic field for 0-3 ka: 2. a new series of time-varying global models." Geochem. Geophys. Geosys. 10: Q06008.

Shaar, R. and L. Tauxe (2013). "Thellier_GUI: An integrated tool for analyzing paleointensity data from Thellier-type experiments." Geochem. Geophys. Geosys. 14: 677–692.