A Miocene polarity transition recorded on St. Helena, South Atlantic

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Paleomagnetic sampling was undertaken in locations with successions of lava flows on St. Helena in April 2019. Two parallel profiles recorded transitional field directions of a reversal from reversed to normal polarity. The lavas flows are part of the SW Upper Shield and have an age of ~9.0 Ma. Determinations of paleointensity and $^{39}Ar/^{40}Ar$ dating are currently under work. The detailed characterization of the polarity transition will allow for Earth's magnetic field modelling and provides a better understanding of the South Atlantic Magnetic Anomaly.

St. Helena is a small remote island in the South Atlantic at 16° S and 5.7° W. Although located in the so-called South Atlantic Anomaly of the Earth's magnetic field, the first paleomagnetic study of secular variation was performed only recently. Engbers et al. (2020) discovered a profile of six lava flows ranging from Prosperous Bay Plain to Fisher's Valley, which recorded a reversed-to-normal polarity transition with three intermediate directions. According to Baker (1967) these lavas were following a massive landslip and filled the associated cuvette rapidly with approximately horizontal lava flows.

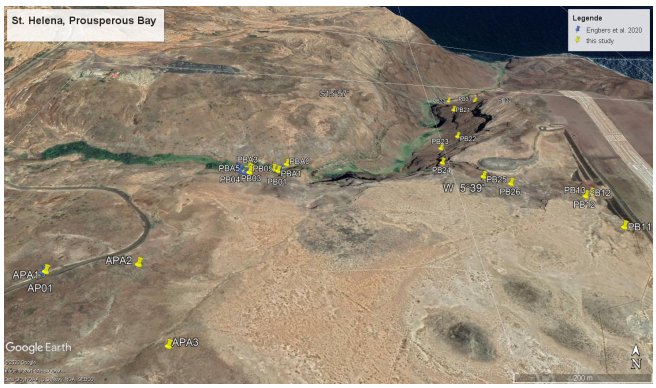

Figure 1: View of the sampling sites in Prosperous Bay and Fisher's valley.

The profile was resampled and extended by three lava flows in our study and another parallel profile following Fisher's Valley to the sea was sampled with 12 lava flows. Five to ten oriented paleomagnetic cores were taken per flow.

The mean characteristic remanent magnetization directions obtained from alternating field or thermal demagnetizations are mostly well defined and reproduce the ChRM directions from Engbers et al. (2020).

Profile 1 (9 flows) starts with three flows with reversed polarity, followed by three transitional directions with virtual geomagnetic poles (VGP) positions close to Brazil and ends with three normally magnetized lavas. The second profile also starts with reverse polarity lava, followed by a normal polarity flow. Above these, six reverse polarity lavas are found, of which one flow shows a low VGP latitude of -48°. Then, two flows with low VGP latitude have again VGP positions close to Brazil and the uppermost flow has normal polarity. The upper eight flows of Profile 1 show very similar directions compared to the five uppermost flows of Profile 2. Accordingly, the transitional nature of the lavas is well supported by two independent sampling campaigns and two parallel profiles.

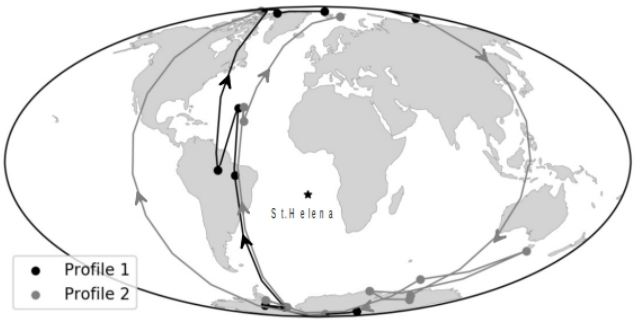

Figure 2: Virtual geomagnetic poles from St. Helena.

Age dating will allow for correlation with the geomagnetic polarity time scale. Along with determinations of paleointensities, the modelling of the polarity transition will contribute to our knowledge on geomagnetic field reversals.

References:

Baker, I., 1967. The Geology of Saint Helena Island, South Atlantic, University of London.

Engbers, Y. A., Biggin, A., and Bono, R. K., 2020. Elevated paleomagnetic dispersion at Saint Helena suggests long-lived anomalous behavior in the South Atlantic Proc. Natl. Acad. Sci. 117, 18258-18263.

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