

On the Recurrence of the South Atlantic Geomagnetic Anomaly: Paleomagnetic Evidence from Late Pleistocene and Holocene Chilean Volcanic Rocks

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Abstract

The growth of the South Atlantic Magnetic Anomaly (SAMA) during the last 2 centuries has generated very large geomagnetic secular variation in Chile (Roperch *et al.* 2015). Most global geomagnetic models suggest very low secular variation in southern South America during most of the Holocene but this result may simply be due to the lack of data to constrain the models. In order to better describe the poorly known secular variation during the late Pleistocene-Holocene, we sampled 21 dated lava flows or pyroclastic flows from several Chilean volcanoes (Lonquimay, Llaima, Solipulli, Villarrica, Mocho-Choshuenco, Osorno, Calbuco) located in the southern volcanic zone (~39°S–41°S). We also sampled 56 sites in Holocene lava flows with only relative ages with respect of the dated units. The paleomagnetic results obtained in the present study indicate little geomagnetic secular variation in direction during the Holocene except near 750–1000 AD. The steepest inclination of the geomagnetic field (-71.6°) and the highest intensity (70 μT±5) are recorded in a pyroclastic flow from the Osorno volcano (calibrated age range of 782–966 AD) (Roperch *et al.* 2014). A dated lava flow (720–980 AD) to the north of the Llaima volcano records also a steep inclination. The corresponding VGPs are not much different from the VGP recorded at European sites suggesting a significant dipole wobble at that time.

High paleointensities in the range 50–70 μT are observed in the time interval 2000 BC–1500 AD in agreement with global models showing geomagnetic moments above 10 10⁻²² Am². In contrast, paleointensity results from juvenile clasts of the late Pleistocene Lican ignimbrite at Villarrica (24.7±1.3 mT) and of the Curacautin ignimbrite at Llaima volcano (33±1.9 μT) show that the magnetic field strength was low during (14,000 BC–15,000 BC). A geomagnetic configuration (low inclination, low intensity) similar to the present-day field is also observed at the Pleistocene-Holocene boundary in silicate glasses from a site in northern Chile (Roperch *et al.* 2017).

Thus the large and rapid secular variation during the last three centuries also occurred at the end of the Pleistocene. Thus, the SAMA is probably not the speculated precursor of a geomagnetic reversal.

Keywords: geomagnetism, paleointensity, South Atlantic Magnetic Anomaly.

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