Paleomagnetic results from Pliocene basalts in Styria (Austria) indicate intermediate field directions recorded during the Matuyama chron

Robert Scholger (1), Elisabeth Schnepp (1), Ingomar Fritz (2)

(1) Montanuniversität Leoben, Chair of Applied Geophysics, Peter-Tunner Str. 25, 8700 Leoben, Austria
(2) Universalmuseum Joanneum, Studienzentrum Naturkunde, Weinzöttlstr. 16, 8045 Graz, Austria

The volcanic rocks from the Pliocene in southeastern Austria have been studied paleomagnetically for more than forty years, and the directional results from six locations have already been published by Pohl & Soffel (1982). In our study, samples were taken from 28 locations spread across 8 volcanoes (sites) to investigate the paleodirection and paleointensity of the Earth's magnetic field.

Rock magnetic investigations revealed that the magnetic carriers are titanium-rich or titanium-poor titanomagnetites with predominantly pseudo-single domain grain sizes. Characteristic remanence magnetization directions were obtained from both alternating-field and thermal demagnetization. Four locations show reverse directions, which correspond to the direction expected based on secular variation. Four other locations in the Klöch-Königsberg volcanic complex and the Neuhaus volcano show reverse directions with shallow negative inclinations and declinations of about 240°, while the Steinberg basalt has a positive inclination of about 30° and a declination of 200°.

These divergent directions cannot be explained by local or regional tectonic movements. All positions of the virtual geomagnetic poles (VGP) are in the southern hemisphere. Four VGPs are close to the geographic pole, while all others are concentrated in a narrow sector of longitude off the coast of South America (310° to 355°) with VGP latitudes between -15° and -70°. The hypothesis that a transitional configuration of the Earth's magnetic field was recorded during the short volcanic activity at these five locations is supported by 9 paleointensity results and ^{39}Ar-^{40}Ar dating (Schnepp et al., 2021). These new ^{39}Ar-^{40}Ar ages of 2.51 ± 0.27 Ma for Klöch and 2.39 ± 0.03 Ma for Steinberg enable the correlation of the Styrian transitional directions with the cryptochron C2r.2r-1 of the geomagnetic polarity time scale. A cryptochron is a short geomagnetic event in which the Earth's magnetic field reverses polarity for a period of less than 10 to 30 kyr. Accordingly, at least three of the four Styrian volcanoes studied could have formed in a short time interval corresponding to the duration of a geomagnetic cryptochron.

Pohl, J. & Soffel, H.C. (1982): Paleomagnetism of tertiary volcanics of Styria (Austria). Geol. Jahrb., 52: 137-147.

Schnepp, E., Arneitz, P., Ganerød, M., Scholger, R., Fritz, I., Egli, R., & Leonhardt, R. (2021): Intermediate field directions recorded in Pliocene basalts in Styria (Austria): evidence for cryptochron C2r.2r-1. Earth Planets Space, 73, 182 (2021). https://doi.org/10.1186/s40623-021-01518-w