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How fast was the last geomagnetic reversal? Experimental constraints from the Sulmona lacustrine sequence (central Apennines, Italy)

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Palaeomagnetic data from sedimentary and lava rocks provide a unique opportunity to investigate the details of geomagnetic field behaviour during field reversals, as well as experimental evidence to constrain predictions of geomagnetic field evolution during periods of field instability.
The sedimentary infill in the intermountain Sulmona basin, central Italy, includes a continuous succession of lacustrine sediments that spans the last full geomagnetic field reversal, the Matuyama-Brunhes boundary (MBB). The succession consists of biogenic carbonates and contains several distal tephra layers from volcanic eruptions that occurred along the Tyrrhenian margin of the Italian peninsula, which provide the means for high-resolution 40Ar/39Ar dating.

The stratigraphic interval spanning the MBB shows good paleomagnetic properties, with easily interpretable demagnetization behavior allowing for straightforward identification of a characteristic remanent magnetization that is carried by magnetite (likely biogenic). It is therefore particularly suitable for investigating the MMB and for precisely assessing the tempo of the magnetic directional change.

With an initial high-resolution paleomagnetic study of the Sulmona section (Sagnotti et al., 2014, Geophys. J. Int., 199, 1110–1124) we showed that the field reversal at the terminus of the MBB was extremely sharp and occurred in less than a century about 786 ka ago. In this section, such a sharp transition is recorded 2–3 cm below a faint cryptotephra (named SUL2-18). We also recognized that thin (4–6 cm) intervals above major tephra layers (SUL2-19 and SUL2-20) located $\sim$25 and $\sim$35 cm below the polarity flip were most likely remagnetized during the Brunhes Chron.
With the aim of improving the temporal resolution of the first reported Sulmona MBB record and understanding the possible influence of SUL2-18 cryptotephra on the paleomagnetic record, we did a second study (Sagnotti et al., 2016, Geophys. J. Int., 204, 798–812) with a more detailed sampling procedure that resulted in analyses of overlapping standard cubic and smaller samples from a single block that spans 50 cm of section across the terminus of the MBB.

In agreement with the previous study, the new data confirm that the polarity reversal is recorded $\sim$2.5 cm below tephra SUL2-18 and indicate that the transition is even sharper than originally reported. We also recognized that the MBB coincides with the rise of an intensity peak of the natural remanent magnetization (NRM), which extends across SUL2-18 and spans $\sim$260 $\pm$ 110 yr, according to the estimated local sedimentation rate. We conclude that either SUL2-18 resulted in the remagnetization of an interval of about 6 cm, and thus the detailed MBB record is lost because it is overprinted, or the polarity transition is well recorded in the sediments below cryptotephra SUL2-18 and lasted less than 13 $\pm$ 6 yr.

A duration at a decadal scale of the polarity transition at the terminus of the MBB is consistent with other sedimentary records and with the compilation of the best paleomagnetic transition records available from lava flows.