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Paleosecular variation from 14.5 ka back to 68.9 ka as reconstructed from Black Sea sediments

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Full vector paleomagnetic records were derived from 16 sediment cores recovered from the southeastern Black Sea. The obtained data were used to create a stack covering the time window between 68.9 and 14.5 ka.

Age models are based on radiocarbon dating and correlations of warming/cooling cycles monitored by high-resolution X-ray fluorescence (XRF) elementary ratios as well as ice-rafted debris (IRD) in Black Sea sediments to the sequence of 'Dansgaard-Oeschger' (DO) events defined from Greenland ice core oxygen isotope stratigraphy.

Reconstructed prominent lows of paleointensity at about 64.5 ka, 41.6 ka and 34.5 ka are coeval with the Norwegian–Greenland Sea excursion, the Laschamp excursion, and the Mono Lake excursion, respectively. The excursions are further evidenced by an abnormal PSV index, though only the Laschamp and the Mono Lake excursions exhibit excursional virtual geomagnetic pole (VGP) positions. The stacked Black Sea paleomagnetic record was converted into one component parallel to the direction expected from a geocentric axial dipole (GAD) and two components perpendicular to it, representing only non-GAD components of the geomagnetic field.

The Laschamp and the Norwegian–Greenland Sea excursions are characterized by extremely low GAD components, while the Mono Lake excursion is marked by large non-GAD contributions. Notably, negative values of the GAD component, indicating a fully reversed geomagnetic field, are observed only during the Laschamp excursion. The data from Black Sea sediments strongly suggest that the geomagnetic field behaved differently during these three excursions.