Ultra-high-resolution evidence for transitional field behaviour during a geomagnetic polarity reversal

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We have obtained two nearby ultra-high-resolution, continuously sampled, records of the Upper Olduvai polarity transition from eastern Taiwan. The transition is recorded over the thickest sedimentary interval ever documented for a geomagnetic reversal (~16 m). The paleomagnetic record is carried by detrital magnetite and is not complicated by late diagenetic growth of greigite, which compromised previous attempts to obtain high-resolution sedimentary polarity transition records from Taiwan. The two transitional records can be correlated serially with each other, which lends confidence in the reliability of paleomagnetic recording. In contrast to most published sedimentary polarity transition records, our record resolves stop-and-go features so that they appear as gradual field changes. This demonstrates the exceptional resolution required to fully observe transitional field behaviour. The field underwent a rapid major shift near the beginning of the transition after collapsing to weak intensities, followed by several large and well-resolved directional swings with virtual geomagnetic poles (VGPs) lingering along "preferred" bands, notably in North America and the North Atlantic at the beginning and the South Atlantic at the end of the transition, respectively. However, the main transition then swings through the Pacific, with a minor VGP cluster south of Hawaii, followed by a cluster near New Zealand. Compilation of existing Upper Olduvai transition records indicates that field behaviour was different from that during the better studied Matuyama-Brunhes transition. This could support inferences from numerical geodynamo simulations that each reversal has a unique character, although the number of paleomagnetically well studied transitions remains small and the resolution of most records is not high. Despite the complex nature of the Upper Olduvai transition, VGP clustering in specific locations provides ongoing evidence for the influence of lateral lower mantle temperature variations on the reversing geodynamo.

Keywords: Geomagnetic field, Polarity reversal, Upper Olduvai

