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Decadal-scale variations in geomagnetic field intensity from ancient slag mounds in Israel, Jordan, and Cyprus

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After decades of paleointensity research, it is still not fully understood how fast can field intensity change. Direct measurements of field intensity that go back to the 1830s show relatively small changes with rather smooth behavior over decadal timescales. In contrast, recent archaeomagnetic studies have revealed periods with significant intensity variations termed “archaeomagnetic jerks” (Gallet et al., 2003) and “spikes” (Ben-Yosef et al., 2009). This apparent inconsistency suggests that temporal variations of the geomagnetic field intensity over the past two centuries have been relatively small compared to earlier periods. To address this question we have investigated several ancient slag mounds in Jordan, Israel, and Cyprus. The mounds are multi-layered sequences of slag and charcoal that rapidly accumulated near ancient copper smelting sites as long as copper was produced in the nearby sites. The chronologies of the slag mounds were modeled using radiocarbon dates of short-lived material. Paleointensities were obtained using Thellier-type IZZI experiments with additional anisotropy, cooling rate, and non-linear TRM assessments. The overall data indicate that some periods are characterized with extremely high variation rate, while other periods seem quieter.

In this presentation we review different aspects of our working methodology: field sampling, wood identification and radiocarbon analysis, age modeling, magnetic petrology, magnetic microscopy, and finally, paleointensity and data analysis. We present new recently published data from two Cypriot slag mounds, and discuss the overall archaeomagnetic findings in the context of high precision geomagnetic models of the past 170 years.