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Unveiling the Covert Linkage Between Geomagnetic Dynamics and Climate in the Northern South China Sea Over the Last 30 ka

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The hidden link between the geomagnetic field and climate is gradually being noted for its unexpected consistency. However, the unclear linking mechanisms and questions regarding whether geomagnetic reconstructions entirely exclude climatic influences have sparked controversy surrounding this relationship. Here, we analyze a high-resolution geomagnetic paleosecular variation record since 30 ka in the northern South China Sea and find a good correlation between its climate-independent inclination record with the regional temperature and precipitation.

The studied core, SCS-5, was obtained from the northern South China Sea (21.21°N, 118.04°E) at a water depth of 1600 m, twenty AMS ^{14}C ages were used to establish the age framework since ~30 ka, with an overall sedimentation rate exceeding 30cm/kyr. Detailed rock magnetic and environmental magnetic analysis determined that the sedimentary environment of the core is stable and homogeneous. Reliable characteristic remanent magnetization directions are established, with all the maximum angular deviations less than 3. The inclination has fluctuated considerably over the last 30 ka period, but is more moderate during 20-10 ka. Reconstructed paleointensity shows an overall upward trend except for a slight decrease during 15-12 ka, with several significant shallowing of the inclination corresponding to the low values of the field intensity, which may be related to the role of geomagnetic reverse flux patches.

Comparing the local precipitation $\delta^{18}O_{sw\ local}$ record of the core and the paleotemperature record from South China, we observe that as the geomagnetic field strength decreases with shallower inclination, regional precipitation increases significantly, while the land temperature decreases. We hypothesize that the decline in geomagnetic strength may have regulated the regional hydroclimate through the mediation of cosmic rays, aerosols, and cloud cover. The weakening field could have induced increased cloudiness, leading to a parasol effect and greater precipitation. Additionally, the correlation between rainfall and the geomagnetic field is evident throughout the Late Pleistocene-Holocene, whereas the relationship between temperature and the geomagnetic field is more pronounced in the Holocene. It suggests that the forcing mechanism of the geomagnetic field on climate change is complex and nonlinear, which may differ in glacial and interglacial periods due to low-latitude processes or other forcing mechanisms.