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Speleothem Shape and Natural Remanent Magnetization

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Speleothems might be of interest for high-resolution reconstruction of the Earth's magnetic field. However, little is known about the influence of speleothem morphologies on their Natural Remanent Magnetization (NRM). Here we report on a high-resolution and detailed paleomagnetic and anisotropy of magnetic susceptibility (AMS) study of a dome-shaped stalagmite of Middle Holocene age (6.52±0.19 to 5.08±0.24 ka; ± 2σ) from Southern Portugal. In order to assess the potential influence of calcite growth dip on the recorded remanent magnetization, magnetic and AMS directions from sub-horizontal to gradually sub-vertical calcite growth collected in a transversal cross-section of the stalagmite are compared. A striking linear correlation is observed between magnetic inclinations, calcite laminae dipping angles and k3 inclination, whereas magnetic declinations are independent of the stalagmite's morphology. Magnetic inclinations recorded in oblique and vertical calcite growth layers are underestimated when compared to a global paleosecular variation model, and better fit the model when considering extrapolated magnetic inclinations from hypothetical horizontal layers. Therefore, we suggest that stalagmite's morphology exerts a critical role on the recorded magnetic inclinations, probably resulting from particle rolling with dripwater flow along the sloping surfaces. Such a new evidences have critical implications for reconstructing high-resolution paleomagnetic records in speleothems, and open new perspectives to better understand their mechanisms of remanent magnetization acquisition.

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