Diagenetic origin of inclination shallowing

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We found anomalously low inclinations which are caused by chemical dissolution due to reductive diagenesis in a sediment core. In this core, most of the interval show normal inclination values (67.2 degrees) expected from a geocentric axial dipole field. However, extremely low inclinations as low as 10 degrees were observed in two depth intervals which are about 40 cm thick. These intervals correspond to low magnetic susceptibility intervals and to low a* (a color index showing a hue between green and red) intervals suggestive of reductive condition. Hysteresis parameters of samples with normal inclinations are plotted on a trend of pseudo-single-domain maghemite on a Day plot. Meanwhile, samples with low inclinations fall on a coarse-grained end of the same trend or on a different trend. No Verwey transition was found from normal inclination samples, whereas unambiguous Verwey transitions were observed on low inclination samples. It is hard to believe that such low inclinations represent past geomagnetic field directions. Rather we suppose that such low inclinations were originated from diagenetic alteration in a sediment column. Reductive diagenesis induces dissolution of maghemite and this dissolution effectively occurs especially in small grains. Therefore, diagenesis results in a significant decrease of fine-grained maghemite which should faithfully record a past geomagnetic field, and a relative enhancement of coarse-grained magnetite and/or high-coercivity minerals exhibiting low inclinations.