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A stable remanent magnetization carried by greigite

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Recently the Miocene marine section at Monte dei Corvi in northern Italy has been ratified as Tortonian Global Stratotype Section and Point (GSSP) and a reliable magnetostratigraphy in combination with astronomical tuning now guarantees its global correlation potential. The section consists of an alternation of basic cycle made up of marls, limestone with intercalated organic rich layers, called sapropels. Paleomagnetic experiments showed that the primary magnetic remanence is carried by an unusually low temperature component which is thermally demagnetized at 260 to 280 ºC. In intervals with higher natural remanent magnetization (NRM) intensities, thermal demagnetization is feasible up to 360 ºC.

To test the fidelity of the magnetostratigraphy, several rock magnetic experiments and scanning electron microscopy analysis have been carried out. All rock magnetic results point towards a low coercive, fine-grained magnetic mineral. Thermal demagnetization of three orthogonal isothermal remanent magnetizations (IRM) indicates the presence of iron sulphides. Low temperature thermal runs indicate no phase transition for pyrrhotite. In addition, a substantial amount of the iron sulphide pyrite has been recorded in the sediment. Scanning electron microscopy analysis supports the pervasive occurrences of pyrite but mostly in combination with other iron sulphides. The latter ones have chemical compositions mainly close to greigite but also to pyrrhotite. In addition, partially dissolved large detrital magnetite grains have been observed, which most probably have been affected by a late diagenetic substitution of oxygen by sulphur in the crystallographic structure. Accordingly, greigite is the most likely magnetic remanence carrier is greigite However, most studies considered greigite as unreliable recorder of paleomagnetic field because its acquisition timing is ill-considered. Authigenic sulphide formation under prevailing anoxic conditions in the sediments may take up to several tens of thousands of years.

However, the magnetostratigraphy is entirely consistent with biostratigraphy, astronomical tuning and radiometric dating of ash layers and can be correlated unambiguously to the Geomagnatic Polarity Time Scale (GPTS).

Therefore, (most of) the greigite must have been formed during early diagenesis (within 5-10 kyrs after deposition). We will discuss the pros and cons of various formation scenarios.