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Authigenic nanoscale magnetite within methanic marine sediments

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Magnetic studies of methanic sediments focus mainly on magnetic iron sulfide (greigite, 3C pyrrhotite) formation and magnetic iron oxide (magnetite, titanomagnetite) dissolution, which mainly result from the release of hydrogen sulfide during sulfate-driven anaerobic oxidation of methane. In some instances, authigenic fine-grained magnetite within methanic environments is recognized from magnetic parameters, but the mechanisms for explaining its occurrence remain unclear. We report a novel authigenic nanoscale magnetite source in methanic marine sediments. The magnetite occurs in large concentrations in multiple horizons in a 230-m long sediment core with gas hydrate-bearing intervals. In contrast to typical biogenic magnetite produced by magnetotactic bacteria and dissimilatory iron-reducing bacteria, most particles have sizes of 200-800 nm and many are aligned in distinctive structures that resemble microbial precipitates. This new type of magnetite is interpreted to be a by-product of microbial iron reduction within methanic sediments. It will record younger paleomagnetic signals than surrounding sediments, which is important for paleomagnetic interpretations in methanic sediments.