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The calibration of a magnetic geothermometer from 50°C to 70°C in argillaceous rocks

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In sub-surface anoxic conditions, the microbe activity leads to a 'magnetic reset' of argillaceous rocks with the alteration of inherited iron oxides (Roberts et al., Review of Geophysics 2011). During the diagenesis, it is known that magnetic minerals (greigite, magnetite and pyrrhotite) are continuously forming. Hence, there is the possibility to use these neoformed magnetic minerals as a burial tracker (Aubourg et al., GSL; 2012). Aubourg & Pozzi (EPSL, 2010) fist proposed to use a parameter (PM) derived from rock magnetism analysis as a proxy of burial in a range 50°C to 250°C. They based their calibration curve from natural samples and laboratory heating. The evolution of PM marks two branches, up and down, with a maximum value near 90°C. Here we propose to precise the upward branch of PM evolution by studying ∼600 m of argillaceous Jurassic rocks from the EST433 borehole from the Basin of Paris. We have conducted low-temperature magnetic analysis (from -263°C to 27°C) on 32 samples and derived PM parameter. The PM depth profile displays a consistent convex curve which can be explained satisfactorily by a model of nucleation-and-growth of nanoparticles of magnetite. This is in agreement with laboratory heating results obtained from Kars et al. (Gcubed, 2012). The PM evolution is compared to vitrinite reflectance data. A 1D thermal modeling suggests that burial temperature evolves from ∼50°C to ∼70°C (Blaise et al., 2011). Our calibration curve indicates that the production of nanoparticles of magnetite is dramatically reducing near the onset of the oil window.