

## It's getting hot on Earth - The Middle Eocene Climatic Optimum in a terrestrial sedimentary record

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The Middle Eocene Climatic Optimum (MECO) is an enigmatic global warming event interrupting the protracted Cenozoic cooling. It is marked by a negative shift in marine oxygen isotope records that indicate an increase of water temperatures by up to 5 to 6 °C and thus, documents an increase in temperatures on top of the warm Eocene climate. This makes the MECO one of the hottest phases during Earth's climate history, but the questions, if and how the MECO affected continental sites are still unresolved.

Here, we present a stable isotope record ( $\delta^{18}\text{O}$ ) and clumped isotope ( $\Delta_{47}$ ) temperatures from an Eocene mammal fossil locality in southwestern Montana, USA. The sampled section (Upper Dell Beds, Sage Creek Basin) comprises about 60 m of stacked paleosols that were correlated to Chron C18r by paleomagnetic and biostratigraphy. The oxygen isotopic record of pedogenic carbonates range from -12 to -18 ‰ (SMOW) and reveals prominent shifts of oxygen isotope ratios of up to 6 ‰ within 3 m of section. The associated  $\Delta_{47}$ -temperatures indicate an increase in temperatures of about 5 °C, reaching peak temperatures of  $31 \pm 2$  °C, and a rapid drop in temperatures of about 9 °C. Thus, we think that this record has the potential to (1) document the MECO in a terrestrial record, (2) yield realistic temperature changes between the MECO event and the post-MECO cooling phase, and (3) help to track the isotopic evolution of precipitation during a short term climatic event in continental interiors.

## Stability behaviour of silver nanoparticles in different aqueous media

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Due to the wide application of engineered nanoparticles (ENP) in different industrial products, in the last years, the risk potential for their release in the environment is increased as never before. Mobility and toxicological behaviour of ENP in aquatic systems is strong depending on their stability and aggregation properties [1]. Furthermore, the changes in the chemical composition of the aqueous phase can influence the aggregation reversibility [2], which can lead to the remobilisation of previously aggregated and immobilised nanoparticles. Despite the increasing amount of studies on the environmental behaviour of ENP, there is a lack of information about reversibility of the aggregation.

In this study, aggregation of citrate stabilised silver nanoparticles (Ag NP) was investigated in synthetic aqueous media and natural river water (Rhine). The influence of pH value, sodium and calcium cations and humic acid (HA) on the stability of Ag NP was characterised. The reversibility of the aggregation was studied after reducing of ionic strength (by centrifugation and washing) and applying of ultra sound at different energy levels.

Ag NP showed high aggregation at high sodium and calcium concentrations ( $c(\text{Na}^+) > 40$  mmol/L,  $c(\text{Ca}^{2+}) > 0.5$  mmol/L), at low pH values (pH <3) and in river water. HA stabilised Ag NP and the stabilisation effect was much higher for pH induced aggregation than for sodium and calcium cation induced aggregation. After reducing of ionic strength, the aggregation of Ag NP was reversible especially after applying of shear forces, but the disaggregation was not fully complete. After treatment, small aggregates remained in the dispersions, which were more stable, than the big aggregates.

The results of this study show that the reduction of ionic strength and the presence of shear forces can lead to the partial disaggregation of previously aggregated nanoparticles. As a consequence, the probability of nanoparticle remobilisation can be increased.

[1] Morones *et al.* (2005) *Nanotechnology* **16**, 2346-2353. [2] Fabrega *et al.* (2009) *Environ. Sci. Technol.* **43**, 7285-7290.