Session summary EGU2020 session SPP1.5 *"(Bio)mineral archives of past environmental conditions: from the Precambrian to the present."*

Block 1: Mineralization in the sedimentary record

So called nonclassical crystallization processes "*are fuelled by the attachment of multiatomic assemblies rather than by attachment of single ions drive crystal formation*" as envisaged in the classical nucleation and growth theory (Presentation by **Wolf**). Non classical crystallization processes, such as oriented attachment, are not only "*backed by experimental evidence and thus accepted by the science community*" (Wolf). There is evidence that oriented and even slightly misoriented particle attachment are growth pathways in continental calcium carbonates from caves to spring, as seen by Transmission Electron Microscopy (TEM) (**Frisia et al.'s** presentation). High resolution Electron Microscopy techniques help investigating crystallization pathways in minerals that are important archives of past Earth's climate and allow insight onto the effects of diagenesis (see **Mentler et al.'s** presentation). One of the issues that still remain unsolved is the role of organic matter to the crystallization pathways and diagenesis (see Frisia et al.'s) of climate and environmental sedimentary minerals archives. This needs a nano-scale approach that complements Electron Microscopy. **Ni et al.'s** present high resolution geochemical techniques that provide information about the sequence of authigenic minerals formation in foraminifera and their early diagenesis. Finally, **Molnár et al.'s** contribution explores the power of scanning and scanning transmission electron microscopy (SEM and STEM) to highlight nanostructural features in otholiths and shells, which *could provide important details about the growth of biogenic aragonite and the structural properties of distinct growth zone.*

Block 2: Experimental biomineralization and proxy development

Legacy steel slag disposal sites are comparable to extreme paleo environments; **van der Land et al.** investigate the carbonate deposits forming in these human-made systems to connect carbonate mineralisation rates and carbonate morphologies with prevailing physico-chemical and microbial processes under extreme environmental conditions. **Metha et al.**'s presentation will focus on a specific and highly relevant player in microbial communities. Cyanobacteria have not only fundamentally shaped Earth, they are also capable of intracellular calcification and trace element enrichment. Understanding cellular traits of coccospheres is critical to understanding past ecosystem dynamics. **Langley et al.** will present their recent work using high-throughput imaging flow cytometry for sorting coccospheres from marine sediment to "*investigating the interplay between a changing climate and coccolithophore response*". Then, **Schnabel et al.** will discuss the links between shell chemistry and bivalve microstructure, followed by the second solicitated presentation of this session by **Evans et al.** on the carbonate system conditions necessary to produce ACC from seawater and hence on the controls on ACC geochemistry. This presentation will highlight that the "*characteristics and geochemistry of ACC is important in the development of a process-based understanding of marine calcification*" and will exemplify this for Low-Mg foraminifera. Next, **Henehan et al.**'s presentation will investigate the species-dependent boron incorporation in late Cretaceous foraminifera in the context of proxy reconstructions, palaeo-CO_2 and palaeotemperature reconstructions. Lastly, a detailed investigation of boron isotope variability in calcite shells of planktonic foraminifera will be provided by **Buisson et al.**, also in the context of paleoclimatic reconstructions.

Block 3: Proxy validation and climate reconstruction

First, **Höche et al.** will present their recent work on the potential of bivalve shells, particularly of morphological variations of individual biomineral units (BMUs) in modern specimens, as an alternative high-resolution archive of paleo-water temperature oscillations. **Clark et al.** will then use Conid shells from the Hampshire and Paris Basins to explore the seasonality changes at the transition from greenhouse to icehouse conditions during the middle Eocene Lutetian period (~48 to 41 Ma). The formation of the microstructures of oyster shells is highly debated; today, **Dämmer et al.** discuss the chemical variability within oyster shells in context of this debate and propose that specific isotopic signatures indicate that "chalky" oyster shell microstructures were precipitated by symbiotic microbes. This is also relevant for sampling fossil oyster shells for paleoclimate and paleoenvironment reconstructions. This contribution will be presented by @Niels de Winter. Then, **de Winter et al.** will present a new technique for using microsampled clumped isotope measurements to reconstruct temperature seasonality in deep time from fast growing carbonates. Microbial metabolic processes and inorganic carbon from dissimilatory processes, specifically their effect on often large isotope variation in diagenetic carbonates will be discussed by **Meister and Reyes**. Both, "*reservoir sizes, diffusive mixing of different carbon sources, and episodic formation of carbonate*" influence the range of isotope values of carbonate phase. The dissolved inorganic carbon pool of parent solutions is also at the root of the "*isotopic disequilibrium commonly observed in speleothems and scleractinian coral skeletons*" according to **Bajnai et al.**, who will present their high-precision clumped isotope work using speleothem carbonates, modern coral skeletons, brachiopod and belemnite. Last, **Bonnin et al.** examine high precision and high time-resolution (Sr, Li, Mg)/Ca ratios on a diurnal cycle in planktic foraminiferal calcite of *O. universa*.