Early microbial impact on carbonate diagenesis in lagoon sediments on Aldabra, Western Indian Ocean

An expedition to the Aldabra Atoll, conducted in November 2017, at the end of dry season, revealed new insights regarding the sedimentation, pore water chemistry and the microbial impact on early diagenesis of fine-grained carbonate sediments. Aldabra, located in the western Indian Ocean, northwest of Madagascar, is an elevated atoll consisting of karstified, Pleistocene reef limestones surrounding an approximately 30 kilometres long and 10 kilometres wide, flat lagoon. Sedimentation strongly varies within the inshore waters, due to tidal currents, organic input and the relief of the submerged limestones. 40 to 70 cm long, soft sediment cores were taken at four different sites:
(i) One at the northern lagoon margin, which was strongly affected by tidal currents and organic input of seabirds. (ii) One site at the southern lagoon margin, surrounded by mangrove shrubs and (iii) a site in the southwest, where vast flats of carbonate silt and sand were observable. (iv) Furthermore, sediment cores were gathered in the south eastern part of Aldabra, a region called Cinq Cases, which comprises a lacustrine, landlocked setting.
The northern cores show a thin layer of brownish carbonate mud above gastropod shell accumulations and exhibit anoxic conditions throughout the section. Additionally, microborings in the shell material indicate the activity of endolithic organisms. Similar redox values are found in cores from the southern site, which contain a homogeneous section of white grey carbonate mud. In contrast, the sediments in the southwestern lagoon consist of oxic, white-grey carbonate silt to sand, depicting signs of early diagenesis in form of recrystallized grain rims and incrustations, whereas Cinq Cases pool deposits show oxic to anoxic, grey carbonate mud.
With respect to pore water chemistry, all cores except the one from the southwestern site, show elevated nutrient and lower pH values. Furthermore, nutrient peaks at the top of anoxic zones are rather distinct in lower permeability levels, which can be provided by microbial mats.
Metagenomic and metatranscriptomic analysis, in combination with pore water analysis, stable isotope measurements, and SEM investigations will be used to test potential alteration effects by the microbial communities on the carbonate components.