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Investigating the impact of growth kinetics on geochemical records of oyster shells

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Sclerochronology provides valuable proxy data for investigating high-resolution paleoclimate dynamics at seasonal/(sub-)annual scale. Nevertheless, the interpretation of these proxy data is often hampered by the interplay between three main factors: (i) paleoenvironmental patterns; (ii) vital (physiological and kinetic) effects related to biomineralization pathways; and (iii) potential alteration during diagenetic modification of skeletal materials.

Because the interaction between environmental and metabolic factors is, at present, one of the most difficult to quantify, an ideal opportunity is brought forward to better understand the complexity of environment-metabolism interaction in marine biogenic carbonate archives. A project was tailored to investigate the impact of growth kinetics on geochemical proxy data (carbon and oxygen stable isotopes and main and trace elemental data) from oyster shells responding to changes in metabolism due to environmental fluctuations. Motivated by the exceptionally favourable circumstance that oyster farms are located near our Institution in Aveiro (Portugal), these will be used as a natural laboratory. Most interestingly, in Aveiro, oyster growth rates are significantly higher compared to those cultivated in France (Arcachon Bay). This is the case despite the fact, that the oysters grown in Aveiro are imported from France, and this will form the main study site of this project. In order to have a wider range of observational sites, a third oyster station in Southern Portugal (Olhão), influenced by warmer coastal waters will also be sampled. Finally, modern oyster specimen will be compared and contrasted with well-preserved ancient *Crassostrea* and *Ostrea* material in an attempt to bridge the gap between the Present and the Mesozoic.

State-of-the-art petrographic and geochemical research involving both modern and ancient oysters of the same genus will be performed. With reference to recent specimens, this must be performed in combination with a strict biological assessment of oyster metabolic performance, but with focus on carbonate archive research. An international Research Team (Portugal, Germany, France, Spain) was assembled, bringing together experts from a wide range of research fields, including Carbonate Geochemistry, Biomineralization, Sedimentology, Mineralogy, (Micro

Palaeontology, Sclerochronology, Biology, Ecology, Artificial Intelligence, and Data Modelling.

The goals of this project include: (i) establishing the link between modern environmental seasonal fluctuations, oyster growth rates and impact on the geochemical record of the shell, while additionally understanding non-linear responses (e.g., ontogenetic evolution, effects of storms or other extreme events); (ii) compile information from a variety of proxies (bio-geochemical, petrographic, mineralogical, ecological), locations and times, aiming to test the best approaches for integration with a coherent framework; (iii) explore the link to ancient shell-archives, distinguishing between the various forcers of their geochemical signals, more specifically the interplay between paleoenvironmental conditions and vital effects.