Endolithic cyanobacteria that actively bore into carbonate minerals, known as euendoliths, constitute a major erosive force contributing to the morphogenesis of coastal and terrestrial limestones, the destruction of coral reefs and other biological carbonates as e.g. shell hash and diverse skeletal fragments. They also represent a pest of commercial bivalve aquaculture. Despite their environmental relevance, endoliths diversity and the mechanism that enables them to dissolve and disrupt carbonates, has remained elusive. Therefore, the aim of the proposed project is the first to date, extensive, combined molecular and phenotypic diversity study on marine endoliths. Further, we will perform the first metagenomics study on endoliths aiming to give information not only on the diversity of the endolithic community but also on its function and ecological potential.

Parallel and subsequent to molecular work we will extensively apply microscopy to provide a “face to the molecular signature” which would otherwise remain anonymous or associated with the closest available name as recorded in the GeneBank.

Here, we will conduct for the first-time single cell genomics (SCG) applied to endolithic organisms. Single cell genomics (SCG) will provide detailed information on metabolic types and unique abilities enabling these microorganisms to bore carbonate, phosphate and other similarly soluble substrates. We will use only single cells taken directly from the site without prior culturing, directly matching phylogeny and metabolism at the same time in the uncultured to date cyanobacterial endoliths that dominate marine rocks and biochemical cycles. Our forte is the use of molecular tools for the first time to carbonate penetrating microorganisms, where they naturally occur, an approach that will provide a direct information link between cell´s phylogenetic and metabolic markers.

In order to understand and record the diversity and importance of boring cyanobacteria and their boring mechanisms a combined phylogenetic diversity studies of euendoliths from five different geographical sites with different nutrient availability will be performed.

We will address the question how the environment (climate and chemistry) influences endolithic ecological success, and their functional capacity. The phylogenetic identity of endoliths from geographically different sites will be related to their metabolic potential.

Better understanding of the metabolic and taxonomic relationship of endoliths in the geochemical contexts of coastal carbonates will enable constrain the microbial impact on global bioerosion and calcium cycling.

Moreover, it is important to better understand the metabolism as well as ecological characteristics and requirements of euendoliths’ in modern environments in order to improve our knowledge about past environmental conditions and to better predict the future.