

Title: Environmental and clinical implications of induced and controlled biomineralization processes

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Proposal

The name biomineralization gathers all those processes of mineralization induced or controlled by living organisms. The need to understand the causes and effects of biomineralization phenomena on the environment and human health is driving Earth scientists to undertake increasingly multidisciplinary research where chemistry, biology, medicine and geological sciences merge into a single research scope.

One of the most exhaustive examples is represented by urinary stones. Urolithiasis is a pathological and multifactorial biomineralization process that mainly involves adult populations all over the world with a constantly increasing incidence especially in the most developed countries. Calcium stones (oxalates and phosphates) together with uric acids, represent the most frequent biomineralogical products of human urolithiasis although specific components may also be present (e.g. struvite, cystine, ammonium urates, proteins, etc.). Recent studies show that through a mineralogical and morphological classification of uroliths it is possible to trace the potential causes of their formation and therefore support the medical community in the prevention, management and treatment of this pathology. Furthermore, urinary stones can incorporate, by ionic substitution in the crystal lattices, unwanted trace elements (Cu, Cd, Pb, Cr, Hg, As) present in the body due to metabolic processes, due to the intake of particular foods or drinks but also from environmental factors. These aspects suggest the potential correlation between biomineralizations and the surrounding geological context, favoring the use of uroliths for clinical and environmental biomonitoring purposes.

Research Program

The PhD student will be entrusted with highly interdisciplinary tasks, aimed at a complete characterization of the abiotic fraction constituting the biomineralogical matrices and in particular of the uroliths. The PhD student will therefore have to

highlight the correlation between pathological biomineralizations and the geological and environmental context in which the organism is inserted.

The PhD student will develop technical-scientific skills of chemical, mineralogical and petrographic analysis. Among the main analytical techniques, particular emphasis will be given to optical and electron microscopy, vibrational Raman and/or FTIR spectroscopy, X-ray diffractometry and fluorescence, UV-Vis spectrophotometry, simultaneous thermal analysis TG/DSC with gas analysis (EGA), spectrometry mass and gas chromatography. Collaborations with both Italian and foreign research institutions will be envisaged.