In vitro bone fossilization – micro to nanoscale alteration processes

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Bones (and teeth) are the most common vertebrate fossil remains and are widely used as archives for reconstructing living and paleo-environmental conditions. However, there remains a crucial gap of knowledge regarding the fossilization process itself. For a better understanding of the processes occurring *post mortem* and the influence of the diagenetic alteration on organic and inorganic components, especially at early stages of taphonomy, we perfromed *in vitro* aqueous alteration experiments under controlled conditions on cylindric-shaped cortical bone samples (3.5 mm in diameter and height) from a modern ostrich. Bone samples were exposed to unbuffered artificial (1) seawater, (2) fresh water, and (3) sediment-bearing fresh water solutions, enriched with the REE's Lu and Nd, ^{18}O and ^{238}U. Here, we present the results of selected experimental run products that were treated for 30 days in steel bombs with Teflon® inlays at 30°C, 60°C and 90°C and analysed at the micro- down to the atomic scale. Micro-computed tomography (µCT) scans prior to and directly after the experiments revealed significant textural variations in the initial material as well as changes caused by the treatment with aqueous solutions at different temperatures. Raman spectroscopy, LA-ICP-MS, EMP and NanoSIMS analyses further showed significant chemical changes of the bone tissue and provided first insights into collagen degradation processes. Additionally, atom probe tomography (APT) measurements were performed at selected points within the bone samples, based on the aquired NanoSIMS data.

These preliminary results highlight the potential of a multi-method microanalytical approach to assess chemical changes of both the organic and mineral phases during early diagenesis at the micro- to nanoscale. *In situ*-Raman spectroscopy will be used to trace the degradation process of collagen in more detail and to better understand under which conditions re-crystallization of bioapatite predominantly occurs. This will enable us to come up with a better mechanistic understanding of fossilization processes of bones and teeth.