

Annual highlights

During the course of this year we have established the palaeoproteomics research group, <http://evogenomics.snm.ku.dk/palaeoproteomics/> and began to initiate new projects. One of the most enjoyable elements of the PROTEIOS award was the ability to fund small workshops, bringing together like-minded researchers to explore topics that we feel are important to the growth of ancient protein research in Denmark.

WP1 Biomolecular Survival

Just as PROTEIOS began in September of 2016 MJC and EC published a paper reporting on what we believe to be the oldest authenticated peptide sequence to date ([Demarchi et al. 2016](#)), a peptide from ostrich egg shells in East Africa. In February, Director of the museum Peter Kjergaard, EC and MJC visited researchers and sites in South Africa to discuss the opportunities for recovering ancient protein sequences from remains that could potentially reveal something of our human story. Enrico's position was strengthened when he was awarded a **Villum Experiment** Grant to pursue his work on proteins entrapped in enamel, and brought Frido Welker from MPI-EVA (Leipzig) to his group and Frido has subsequently successfully applied for a **Marie Skłodowska-Curie Postdoctoral Fellowship** to remain in EC's group in Copenhagen (2018-2020).

In February with the Max Planck Institute in Jena (MPI-Jena) and supported by the Wellcome Trust and the British Museum, we held a workshop bringing together researchers (including John Hawkes from the Universities of Witwatersrand/Wisconsin) to discuss methods for optimise the analysis of small samples taken from valuable fossil materials. This meeting, held at the Wellcome Building in London, resulted in the small [website](#) with a large (combined) presentation, most notable of which was the work from the National Gallery who emphasized the efforts that go in to maximising analysis from the core samples taken from works of art, which contrast strongly with a somewhat cavalier attitude to some of our rarest fossils taken by the archaeological and palaeontological communities. A follow-on the meeting at the University of Kent, MJC, EC, met with Anthropologist Matthew Skinner to discuss the selection of and future destructive sampling of teeth of *Homo naledi* from the Rising Star cave complex. Another further consequence of this meeting was the MJC was able to use my contacts to help some of my colleagues to get an article published in *Science* raising concerns regarding the lack of integration of archaeology into much of archaeological science ([Johannsen et al. 2017](#)).

Alberto Taurozzi (AT) began to develop novel extraction protocols to gain greater depth of coverage of non-collagen peptides in bone.

WP2. Fossil Sequences

Fossil sequences in deep time: All attempts to recover fossil sequences in deep time have so far failed. We have attempted a number of alternative approaches, but whilst in some cases (Eocene Penguin bones, Pleistocene horse bones) amino acid profiles are persuasive, we have so far been unable to extract authentic peptides.

Tar pit samples: We were able to detect well preserved collagen sequences from two tar seep deposits, in the USA and Azerbaijan. However other deposits failed to yield any significant proteins. The absence of a complex bone proteome is troubling, and tar seep do not appear to be giving us the level of preservation we would anticipate.

WP3. Complex Ancient Proteomes

Following analysis of dental calculus as part of KU16, the decision was made to scale back on this material, due to relatively consistent patterns of recovery and the challenges in adequately analysing complex datasets with unknown constituents using current proteomics tools. This is because proteomics search algorithms pattern match unknown peptides to databases. The larger the number of unknowns, challenging when a complex oral proteome has been buried for centuries. Instead the focus of this work package has shifted to the enamel proteome. Although this is less complex than the calculus proteome, it is intracrystalline, and therefore much easier to isolate. The persistence of this proteome into deep time in preliminary investigation resulted in this shift in focus, as it offers scope to support WP2 Fossil Sequences, and also aligns more closely with the mission statements of the Museum.

MJC attended the Danish Archaeological Society meeting in Ribe where he was able to meet new Danish colleagues and discuss research ideas. In particular meeting for the first time with the staff at SDU (Odense) to discuss the possibility of a joint project exploring the proteins in pathogens. Alberto Taurozzi (AT) was appointed to the laboratory manager roles in August 2017 and hosted a visit by Dr Amy Scott (University of New Brunswick) and helped her to refine her detection and analysis of osteocalcin, which she is using as a marker of physical stress.

WP4. Material Culture

MJC and HS see scope for building further links within Denmark between the different archaeological organisations. The size of the country means that there is very little replication of skills and in a small discipline such as archaeology we need to think about better ways in which we can encourage collaboration between institutions. For example it would be helpful to offer joint archaeology PhD studentships between universities within Denmark, bringing research questions and combined analytical tools together.. MJC has already had useful meetings in with Odense (SDU) and Aarhus and Copenhagen realised that there was a real potential for each of these to develop joint PhD projects leaning on the different expertise of each of these groups.

MJC with colleagues from the University of Pennsylvania and the University of Oxford a workshop to explore the materiality of parchment. The workshop brought together experts in craft, history, codicology and attempted to identify good interdisciplinary projects.

In December, HS and MJC with colleagues in other parts of the University prepared a paper to highlight the challenges to interdisciplinarity, feeding into the Universities new Research Strategy.