Paleoproteomics of fossil fish otoliths

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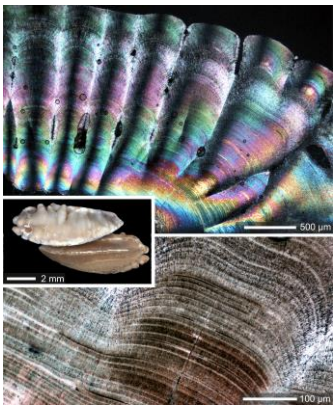

INTRODUCTION: Otoliths are mineral structures that are part of the gravity receptors of fish. Although morphologically they resemble inorganic aggregates of calcium carbonate crystals, they are formed in a strictly genetically regulated process that involves activity of several proteins (Sollner et al., 2003). Biomineralization proteins include insoluble collagen proteins that form framework organic matrix in which mineralization takes place, and soluble non-collagen proteins directly affecting the nucleation, orientation and growth of biocrystals (Poznar et al., 2020). Biomineralizing proteins, as well as other organic components, are successively incorporated into the structure of otoliths during growth (Thomas et al., 2020). In the fossil state, otoliths most often undergo diagenesis that results in transformation and/or decomposition of the mineral phase and organic components. Only in exceptional cases (e.g. impregnation in water impermeable rocks) these fossil structures can be preserved in an almost original form, with the finest microstructural details, and even with the original organic components preserved (Figure above: diurnal incremental lines of fossil otoliths). In the preliminary paleoproteomic studies of perfectly preserved otoliths from 14 million years ago, the presence of a dozen or so proteins (out of over 100 present in today's forms) were found including otolin-1 and otogelin. The discovery opens up new perspectives for the study of previously unknown proteins found in several groups of fossil fish.

WORK TOPIC: The proposed doctoral dissertation combines aspects of several scientific disciplines, but the main emphasis is on paleoproteomic research of fossil otoliths. The research will also cover selected aspects of the structure of the otolith mineral phase, which are essential in assessing the state of preservation of modern and fossil forms. The basic research method will be SDS-PAGE electrophoresis, therefore the candidate's ability to use this method is expected. Other methods (in cooperation) will include liquid chromatography with tandem mass spectrometry (LC-MS/MS) and bioinformatics, as well as microscopic techniques (including FE-SEM, TEM) and related techniques.

OTHER DETAILS: 4-year doctoral scholarship paid by the NCN OPUS grant (ca. 1100€/month). More details stolacy@twarda.pan.pl

Poznar, M., J. Stolarski, A. Sikora, M. Mazur, J. Olesiak-Bańska, K. Brach, A. Ożyhar, and P. Dobryszycki, 2020, Fish Otolith Matrix Macromolecule-64 (OMM-64) and Its Role in Calcium Carbonate Biomineralization: Crystal Growth & Design, v. 20, p. 5808- 5819.

Sollner, C., M. Burghammer, E. Busch-Nentwich, J. Berger, H. Schwarz, C. Riekel, and T. Nicolson, 2003, Control of crystal size and lattice formation by starmaker in otolith biomineralization: Science, v. 302, p. 282-6.

Thomas, O. R. B., K. L. Richards, S. Petrou, B. R. Roberts, and S. E. Swearer, 2020, In situ 3D visualization of biomineralization matrix proteins: J Struct Biol, v. 209, p. 107448.