Poster

A crystallographic approach to the study of dinosaur eggshells of 70 Ma from Mexico

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One of the most mysterious and fascinating animal species to have ever lived on Earth were dinosaurs. The proof of their existence can be found in the fossils that have been discovered all across the world. A thorough structural and morphological investigation of several dinosaur eggshells from 70 million years ago is presented in this work. These ancient dinosaur eggshells from the Late Cretaceous were gathered at El Rosario, Baja California, Mexico's coastal region. Several dinosaur eggshell types were analysed, including Spheroolithus, Lambeosuaridae, Prismatoolithus, and one unidentified Ootaxon. All samples were provided by the Institute of Geology of the National Autonomous University of Mexico (UNAM). *These fossils, part of the Cultural Heritage not only of Mexico but of the whole world, are cultural treasures that connect us to the deep roots of life on Earth*.

General objective of this work is the study the mineral phase of eggshells, constituted of calcium carbonate related to biomineralization processes [1-3]. In nature, these processes are associated with structural control, carried out by biological macromolecules in combination with mineral phases. In the literature there is a lack of information on the role played by the latter and on the chemical and biological mechanisms of these processes [4].

Centimeter-sized fragments of eggshells of dinosaur species mentioned above were analysed by several techniques. Optical, DIC and fluorescence microscopies, μ-Raman and FTIR spectroscopies, SEM-EDS and EBSD were used to characterise the eggshell surfaces and their cross-sectional morphologies, as well as internal and external surface compositions.

The morphology of the herbivorous species' ornithopod eggshells reveals that the mammillary cones are shaped like columns with uneven holes and microaggregates. On the other hand, the mammillary cones are seen in diverse forms with bigger pores in the eggshells of theropods.

Among the several important outcomes of this research, cross-section analyses revealed the presence of a Mn-rich calcite layer in all dinosaur eggshells, located at ca 50-100 μm from the external surface, which is hypothesized to be an antibacterial barrier. In one of the dinosaur samples, the Prismatoolithus, some nanometric S-bearing organic fibres were found by SEM in a breathing channel, and more investigations will be done to understand if these are proteins (or fragments), which survived for 70 million years.

The isolation and purification of intramineral proteins from eggshells of the Spheroolithus is successfully carried out, and preliminary analyses indicate this could be peptides or fractions of intramineral proteins. Mass spectroscopy and synchrotron SAXS analyses are planned to confirm such a hypothesis. This result will shed light on the presence of these ancestral biological samples, should those amino acids and proteins be still present in the samples after 70 million years.

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