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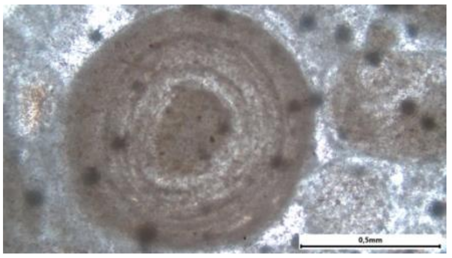
Microscopic carbonate grains as archives for past mass extinctions

Have you ever wondered how the sea looked like with respect to water temperature or oxygen-content millions of years ago? Microscopic carbonate grains called 'ooids' might give us some answers. Calcareous ooids are mm-sized carbonate grains with laminations, which form in warm, saline, shallow water environments. Their formation is not completely clear, but it is likely that they form around a nucleus which for example could be a mineral grain, accumulating elements of the surrounding seawater in their laminae. This property makes them useful for reconstructing million-year-old environments. Ooid formation has been found to be very common directly after major mass extinctions allowing us to use ooids as archives for studying the marine recovery from these devastating events.

One of the five "big" mass extinctions in Earth's younger history was the end-Triassic mass extinction event, which occurred ~201 million years ago. This catastrophic event was likely caused by the "supervolcanism" of the Central Atlantic Magmatic Province, located in today's America, Europe and Africa. These large eruptions emitted huge amounts of sulphur dioxide and greenhouse gases like carbon dioxide and methane, causing ocean acidification, oxygen-poor conditions in the ocean and global climatic changes. Marine organisms were severely hit by this event and researchers estimate that ~47 % of all marine genera went extinct in the end-Triassic mass extinction event. On land, many of the ancestors of the dinosaurs went extinct, making it possible for the famous dinosaurs you might see in *Jurassic Park* to flourish in the following geologic periods Jurassic and Cretaceous.

In this study, I investigated an ooid-bearing limestone formation called the Lorüns oolite, located in today's Austria and formed just after the end-Triassic mass extinction. After having analysed the ooids more closely in the microscope I investigated the content of chemical elements like Mg, Al or Mn in the ooids by using laser-driven mass spectrometry. The concentration of these elements can give us valuable information about the mineralogy of carbonates, oxygen content or climate patterns.



Ooid from Lorüns with nucleus and laminae.

My investigations show that the end-Triassic extinction in the Lorüns section is recorded as a siltstone interval lacking fossils. It likely developed because of carbonate dissolution, increasing weathering and sea-level drop around the world following the extinction event. Living conditions for marine organisms became horrible during this period and many calcifying organisms like mussels, snails, and corals became extinct. As organisms living in the sediment of the sea were dead, the mixing between sediments and the water column stopped, which led to oxygen-poor conditions in the sea sediment directly after the extinction event. Ooids began to form in the tropical, shallow and warm waters at Lorüns, as the ecosystems started to recover from the end-Triassic mass extinction. The climate also became less hot and humid than during the extinction. After a while the sea became deeper, allowing marine organisms to flourish in the sea again.

This study shows that ooids are valuable archives for past environments and indeed should be used more for studying both past extinctions and environmental changes.

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