

Global carbon cycle turnover at the Triassic-Jurassic boundary

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The late Triassic is recognized as one of the five major mass extinction events of the Phanerozoic. Similar to the other extinction events, this interval is associated with a distinct perturbation in marine C-isotope records, likely related to turnovers in the global carbon cycle. The nature and causes of such isotopic events however, are not always similar and often poorly understood. The Triassic-Jurassic (T-J) boundary interval is marked by two negative excursions in bulk C_{org} and C_{carb} isotope records, of 7 and 3‰ respectively. The rapid and short-lived *initial* Carbon Isotope Excursion (CIE) concurs with the onset of Central Atlantic Magmatic Province (CAMP) volcanism. Deposition of this largest igneous province on earth is thought to be related to the break-up of Pangaea. The onset of the prolonged *main* CIE concurs with the base of the Jurassic and postdates the extinction event by ~100kyr. Volcanic CO₂ outgassing and the possible release of methane clathrates are likely causes for a whole set of environmental changes (e.g. global warming, biocalcification crises, ocean anoxic events) that ultimately led to the final end-Triassic extinction event. To constrain changes in the global exchangeable carbon reservoirs at the T-J boundary, it is necessary to understand the nature and size of the negative CIEs. Several high resolution C-isotope records were established for the western Tethys realm. We show that large changes in kerogen type with increased hydrogen index values of over 600mg HC/ g TOC, demonstrated by Rock-Eval VI measurements on sediments from the proposed T-J boundary GSSP, concur with the *initial* CIE and increased TOC values of 9%. Palynological study show that increased terrestrial organic matter supply to the basin is followed by the mass occurrence of green algae in this interval. Changes in origin of the sedimentary organic matter is potentially responsible for the observed extreme amplitude of the *initial* CIE in the western Tethys realm. However, high resolution records of compound specific carbon isotopes, measured on long chain *n*-alkanes originating from higher plant leaf waxes, provide an independent tool for estimating the actual amplitude of the carbon isotope excursion at the T-J boundary.

X-ray absorption fine structure investigation of uranyl-phosphate biomineralization

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The storage and disposal of radioactive waste has resulted in extensive uranium contamination of groundwater resources. The application of dissolved polyphosphate offers an inexpensive and efficient method to precipitate soluble U(VI) from contaminated aquifers as uranyl-phosphate phases. Bacteria can affect the extent of precipitation that occurs and the morphology of the resulting precipitate. In the first part of this study, we documented the effect of non-metabolizing bacteria in the precipitation process. The presence of bacteria in systems at higher saturation states leads to the nucleation of nanoparticulate uranyl-phosphates within the bacterial cell walls. The objective was to use XAFS spectroscopy to characterize the uranyl-phosphate precipitate that forms in both biotic systems and abiotic controls.

X-ray Absorption Near Edge Structure (XANES) and Extended X-Ray Absorption Fine Structure (EXAFS) at U L₃-edge were collected at Beamline 10-ID, Advanced Photon Source, Argonne National Laboratory. Samples had initial U concentrations ranging from 2 to 31 ppm, and initial P concentrations from 0 to 10 ppm. Two sets of experiments were conducted, all at pH 4.5: 1) those containing non-metabolizing *Bacillus subtilis* cells, and 2) parallel experiments without bacteria. For each sample, 10 XANES measurements were taken at first, each less than a minute, in order to monitor the radiation damage. EXAFS were collected afterwards at 10 spots, with 2 measurements at each spot. No radiation damage was observed. The valence state for all the samples is U(VI), so no reduction to U(IV) occurred. The EXAFS spectra suggest the presence of two possible uranyl-phosphate phases in the abiotic samples, but only one dominant phase in the biotic ones. Further analysis of EXAFS spectra for the biotic samples also indicates that the structure of the precipitate is close to that of the autunite group of minerals. This study provides molecular level details of how bacteria influence the uranyl-phosphate formation, and hence the effectiveness of the remediation approach.