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Microbialites and geochemistry of the Early Triassic enigma?

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The Permian-Triassic mass extinction, 252 Myr ago, is the most devastating global-scale event ever recorded. Ecological and environmental changes during this interval are commonly assumed to be associated with numerous perturbations (i.e. productivity changes, acidification, redox changes, eustatism) that still remain elusive. The present study focus on the relationships between the redox conditions within the water column, the successive sedimentary deposits and marine community turnovers.

Our study is based on new Early Triassic sections from the western USA Basin that preserve diversified reefs and bioaccumulations that contain microbialites and various benthic and pelagic organisms (e.g. serpulids, bivalves, ostracods, gastropods, cephalopods). Such a sedimentary prisitine record provides interesting new prospects to decipher the relationships between lithology, microbial structures and the geochemistry of the water column.
Three outcrops were studied: the Mineral Mountains, the Confusion Range and the Pahvant Range, that record a general transgressive trend from proximal to distal deposits during the Smithian substage. Continental to open marine conditions are deduced from sedimentological studies and are related to variations of the microbialite meso- and micro-structures over a short time scale. Hydrodynamics and bathymetry are shown to be the major parameters that influence the morphology and distribution of these microbialites. Additionally to the study of the different microbialites structures and associated depositional environments, the chemiotratigraphic record of both carbon isotopes and major elements indicate a complex and a wide range of variations at short time scale. Carbon isotopes vary from -5 to 2 ‰and FeHR/FeT ratio, after iron speciation, indicate a broad range of variation between 0.1 and 1.5. On the one hand, these analyses suggest potential transient oxygen depletion within the water column. On the other hand, fluctuations of these geochemical proxies seem to be influenced by lithology. We thus suggest that biogeochemical cycles of carbon and iron in the studied sections were influenced by the paleo-bathymetry and the distal to proximal polarity between the three locations. A second order control on the water column geochemistry is also probably the consequence of the microbially-induced carbonate precipitation.
This study suggests that the Early Triassic paleoenvironments with the western USA basin were highly variable in terms of sedimentology and geochemistry, but also suggest a low oxygen concentration within the water column during the Smithian substage.