MULTIPLE INTERVALS OF INSTABILITY DURING THE BIOTIC RECOVERY FROM THE END-PERMIAN EXTINCTION

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CO_2-forced warming is commonly accepted as the basis of environmental changes at the end-Permian mass extinction. As temperatures and CO_2 levels rose, a series of interrelated processes including seal level rise and fall and oceanic anoxia, reduced ocean circulation, elevated weathering rates and nutrient influx, have been suggested as triggering marine ecosystem collapse and controlling the pace and pattern of recovery.

The end-Permian mass extinction decimated biological diversity, ecosystem function and the stability of biogeochemical cycles. The eight-million year delay between the extinction and final Earth system recovery has been strongly debated. Here we use carbon, sulfur and hydrogen isotopic data combined with biomarkers from a distal offshore shelf setting in Svalbard to provide the first documentation of transitions in the major biogeochemical cycles spanning the mass extinction and the entire Early Triassic from a northern mid-paleolatitude locality. An extended stratigraphic profile of 250 meters spanning the Induan to the Anisian was sampled at high resolution.

Global modelling studies on $\delta^{13}C$ of carbonates at the end Permian extinction event and the recovery are mirrored here by the stable carbon, hydrogen isotopes of biomarkers from algal and land plant precursors supporting synchronous shifts in major carbon and hydrogeological cycles of the atmosphere and oceans in the recovery (Figure 1). We find that this interval is also punctuated by at least three additional pulses of extinction and/or multiple global sea level transgressions based on the unanimously high relative abundance of the C_{33} *n*-alkylcyclohexane biomarker. Shallow water photic zone euxinia were largely persistent on continental shelves until the Middle Triassic based on abundant Chlorobi derived biomarkers and $\delta^{34}S$ of pyrite.

This is the first extended biomarker and stable carbon, sulfur, hydrogen isotopic record (unpublished) for the recovery interval of the largest mass extinction event of the Phanerozoic that is also highly relevant to petroleum source-rock exploration in Canada, Australia and Europe (e.g. the Barents Sea).

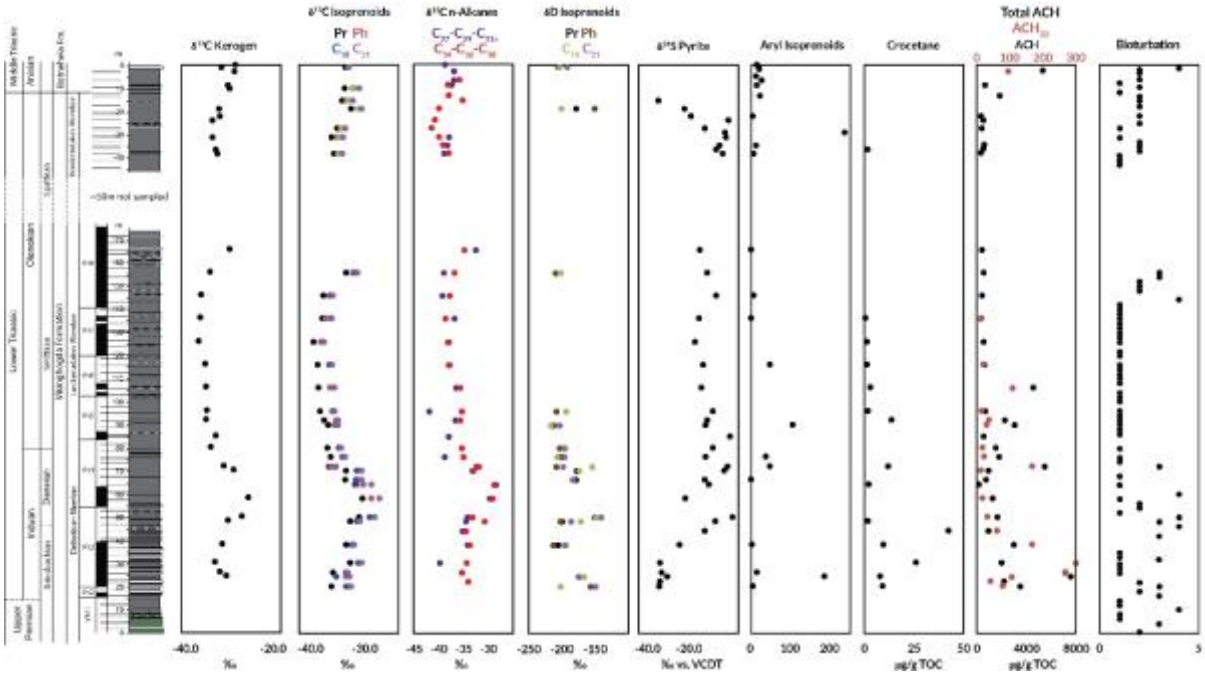

Fig 1. Multiple stable isotope measurements and biomarker abundances in a northern mid-paleolatitude Permian/Triassic section from Svalbard