

Recovery of marine primary producers following the KPg mass extinction in Southern Tethys Upwelling system

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The Cretaceous-Paleogene mass extinction (KPg~66.02 Myr) had a devastating effect on marine ecosystem as well as primary and export productivity. A relatively few studies have been conducted on how primary producers, especially non-fossilizing algal and microbial communities, recovered through the mass extinction.

The Golan sequence was part of the Southern Tethys upwelling system, and present a complete stratigraphy across the KPg boundary, with high TOC and sulfur (8 ± 1.6 and $1.4\pm 0.5\%$ respectively). Here, we aim to understand how the primary producers recovered through the mass extinction. We use a high resolution, multiproxy approach, which include biomarkers, bulk and compound specific carbon and sulfur isotopes analysis (CSSIA). The biomarker results show similar abundance of algal steranes (C_{27} - C_{29}) in both pre and post extinction samples indicate a persistence of primary producers throughout the KPg extinction period. A relatively lower contribution of eukaryotes to prokaryotes in the immediate aftermath is indicative by a transient decrease in steranes/(steranes+hopane) ratio from 0.37 to 0.27. A high contribution from chlorophyll c containing phytoplankton such as, diatoms, dinoflagellates, coccolithophores (C_{28}) compared to green algae (C_{29}) throughout the KPg extinction is evident from C_{28}/C_{29} sterane ratio (>0.80). Further, a short term decrease in primary productivity is supported by the negative excursion of $\delta^{13}C$ in both carbonate ($-1.2\pm 0.8\%$) and organic matter ($-27.6\pm 0.5\%$) by the samples of immediate aftermath extinction. All these evidences point towards a rapid recovery (< 6 Kyr) of primary producers in the upwelling Golan section. Thus, this conclusion agrees with the heterogeneous ocean model, and is similar to the results obtained in two other marine ecosystems, neritic (Denmark) and bathyal (Spain).

Interestingly, the primary producers persisted and flourished pre and post the KPg event, while photic zone euxinia prevailed throughout the Golan section, as indicated by the distribution of carotenoid biomarkers such as isorenieratane and aryl isoprenoids, as well as a low pristane/phytane (<1) and high organic and pyrite sulfur content ($1.1\pm 0.1\%$ and $0.56\pm 0.2\%$ respectively). The results of compound specific C and S isotope data are in progress which may reveal specific sulfurization pathways of biomarkers, their origins and associated paleo-environmental conditions recorded in the Golan section.