Geochemical evidence for environmental changes at the Permian–Triassic transition, Mt. Velebit, Croatia

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A detailed geochemical study, based on carbonate and associated organic carbon isotope composition, major and trace elements (including REE) distribution, the abundance and carbon isotope composition of hydrocarbon biomarkers, provides insights into the environmental changes at the Permian–Triassic (P/Tr) transition in the Velebit Mt., Croatia. The P/Tr transitional beds are regionally mainly represented by early to late diagenetic dolomites. The fossils in dolostones are represented mostly by calcareous algae, foraminifera, calcisponges, bryozoans, brachiopods and mollusks. The gradual impoverishment of Late Permian taxa moving towards the boundary is associated with a negative excursion at the transition of the $\delta^{13}C$ values of carbonates by up to 3‰ (P: –0.8 to +2‰, average +1.2±0.5‰; T: –1.3 to +0.9‰, 0.0±0.5‰), kerogen by up to 5‰ (P: –27.3 to –24.4‰, –25.8±0.9‰; T: –29.1 to –26.4‰, –27.5±0.4‰). The $\delta^{15}N_{ker}$ values vary between –2.4 to +8.2‰ (P: +3.7±2.8‰; T: +3.8±2.0‰), suggesting mixed contribution of ^{15}N-rich marine (~7‰) and ^{15}N-depleted terrestrial (~0‰) organic materials or cyanobacteria (–2 to +4‰). Throughout the section the possible presence of zygospores suggests a contribution of terrestrial biomass. The variations in the distribution of *n*-alkanes (C_{13} to C_{34}), acyclic isoprenoids (C_{21} to C_{28}), hopanes and steranes, indicate input of bacterial and algal biomass. The occurrence of odd long-chain *n*-alkanes (maximazing at C_{26}) and C_{39} steranes in all samples indicate a contribution of continental material. The relatively high contents of redox sensitive elements in the uppermost Permian dolomites (up to 28 µg/g V, 11 µg/g U, and 25 µg/g Cr) indicate a more reducing environment. In the uppermost Permian rocks an enrichment in most REE compared to the other Permian and Triassic samples is associated with a negative Ce anomaly (1.1 to 0.5). The decrease in the $\delta^{13}C$ values in the carbonates and kerogens are synchronized with a drop in $\Delta^{13}C_{carb\text{-}ker}$ by 2‰, indicating lower productivity at the P/Tr transition. The first results of compound specific C isotope analyses of alkanes indicate a ^{13}C depletion towards the boundary, supporting the lowering of primary productivity.