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Molecular and isotopic records of the PermianTriassic transition at the Mt. Velebit, Croatia

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During the Middle/Late Permian and Early Triassic, a continuous shallow water deposition took place at the eastern shelf of the Pangaea. Part of these carbonate rocks outcrop today in the central part of the Mt. Velebit, Croatia. The prevailing rock type is dolomite (70 to 99 wt% of $CaMg(CO_3)_2$), represented by two lithological units: Transitional Dolomite and Sandy Dolomite, with a narrow intercalation of oolithic dolomite in between.

Detailed paleontological, isotopic, organic, and inorganic geochemical studies have been carried out for this section, in order to investigate the environmental changes. Fossil communities show the evidence of two biotic crises, one that coincides with a lithological change in the Upper Permian, and the other accompanied with the pronounced negative shift in $^{13}C_{carb}$ by up to 3‰ (VPDB), which is probably the consequence of global extinction at the Permian-Triassic transition. Upper Permian values for $^{13}C_{carb}$ vary between –0.8 to +2‰, with an average of +1.2±0.5‰, while Lower Triassic values range from –1.3 to +0.9‰, with an average of 0.0±0.5‰. At the transition level, $^{13}C_{carb}$ is +1.4 to 0.6‰, and on average 0.4±1.4‰. $^{18}O_{carb}$ values in the Upper Permian range from –3.2 to –1.3‰, with an average of –2.6±0.4‰, and in the Lower Triassic from –3.2 to –2.2‰, with an average of –2.7±0.3‰. This uniform slow decrease in $^{18}O_{carb}$ values is probably due to an enhanced terrigenous input towards the P/Tr transition and in the Lower Triassic. Upper Permian ^{13}C for kerogens vary from –27.3 to –24.4‰, average –25.8±0.9‰. The values at the transition level are –
27.0 to –27.1‰, and the Lower Triassic values range from –29.1 to –26.4‰, with an average of –27.5±0.4‰. The range of ~4.7‰ is probably a result of the variations in the primary composition of the organic matter. A constant decrease in the values of $^{13}C_{ker}$ is accompanied with the negative trend of ^{13}C for carbonates. The value of $^{13}C_{karb\text{-}ker}$ shows the same trend as the $^{13}C_{carb}$ and $^{13}C_{ker}$, indicating lower productivity at the Permian-Triassic transition, and a primary source for inorganic and organic signals, with no secondary change. ^{15}N values for the Upper Permian samples are –0.7 to +8.2‰, with an average value of +3.7±2.8‰, for the transition samples –0.7 to +0.8‰, average 0.0±1.0‰, and for the Lower Triassic samples +0.3 to +6.9‰, average +3.8±2.0‰. Altogether, values for the $^{15}N_{ker}$ vary between –2.4 and +8.2 ‰, pointing to a mixed contribution of ^{15}N-rich marine (~7‰), mostly in the Upper Permian, ^{15}N-depleted terrestrial (~0‰) organic materials towards the transition, and cyanobacteria (–2 to +4 ‰) at the transition level and in the Lower Triassic.

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, however there is no pronounced change between the Late Permian and Early Triassic samples. Odd long-chain n-alkanes (maximazing at C_{26}) and C_{39} steranes confirm the important contribution of continental debris. Results of compound-specific C isotope analyses of alkanes indicate an increase in ^{13}C values after the transition, showing gradual recovery of biota after the extinction event.

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