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Organic δ^{13}C negative excursion at 2.7 Ga viewed along a 100 m depth drill-core profile (Tumbiana formation, Western Australia).

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Stable isotopes are sensitive tracers of metabolic processes, hence providing direct means of constraining microbial ecological niches. In this study, we performed a detailed carbon and oxygen stable isotope study of a well-preserved suite of drill-core carbonate samples recently collected in the Tumbiana Formation, Western Australia (Pilbara Drilling Project). This formation dated at 2.729 Ga represents one of the reference sections of the "Fortescue Excursion", namely, the oldest organic δ^{13}C negative excursion recorded on Earth, with values down to -60 permil reflecting microbial assimilation of methane.

The studied rocks consist of low-grade metamorphic (prehnite/pumpellyite facies) carbonated sediments, with a strong occurrence of stromatolitic horizons and volcanogenic tuffs interpreted as deposited in a shallow water oceanic or lacustrine environment. 20 samples collected over a 50 m depth interval were analyzed. Calcite content shows a wide range of concentrations between 0.8 and 86.3 weight %. Calcite $\delta^{13}C_{PDB}$and $\delta^{18}O_{PDB}$ values range from -2.46 to +1.24 permil (average value of -0.51 permil and from -29.38 to -13.77 permil (average value of -18.01 permil), respectively. The observed range of oxygen stable isotope composition combined with detailed mineralogical investigations suggests that the carbonates were reequilibrated during low-grade metamorphism. Slightly negative calcite carbon isotopic compositions are characteristic of the Archaean and Proterozoic eon, implying that they were not affected by metamorphism. However, recognition of a positive correlation between calcite δ^{13}C and calcite content points to an early diagenetic overprint of the δ^{13}C car-

bonates, at least in carbonate poor samples.

The isotopic compositions of organic carbon range from -55.86 to -33.34 permil (average value of -46.56 permil) with a Total Organic Carbon (TOC) ranging from 0.04 to 0.45 % (average value of 0.19 %). No systematic stratigraphic evolution of the TOC and δ^{13}C can be evidenced. Drastic organic δ^{13}C variations at the meter scale independently of calcite isotopic compositions is best interpreted in terms of concomitant variations of the contribution of the methanotrophic biomass to the pool of organic matter. This in turn could reflect concomitant evolution of microbial ecological niches with environmental conditions. Optical microscope and SEM observations indicate that the most negative organic δ^{13}C values arise from mudstone samples containing abundant pyrite in addition to chlorite and silica, which is strong support in favor of methanotrophy performed by anaerobic methane oxidation (AOM). Integrated C, N, S stable isotope systematics are currently underway to bring further insights into the methanotrophic pathway and the environmental conditions prevailing during sedimentation and/or diagenesis of this key stratigraphic section.