# Anaerobic Oxydation of Methane at 2.73 Ga ? the record of the Tumbiana pristine drill core

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The 2.73 Ga Tumbiana formation of the Fortescue Group (Pilbara Craton, Australia) shows one of the best record of the first "great negative excursion", with organic $\delta^{13}C$ values as low as -60 ‰. These values were interpreted as reflecting microbial assimilation of methane either by aerobic pathway or by Anaerobic Oxydation of Methane (AOM) using sulphate as electron acceptor.

In order to bring further insights into the environmental conditions prevailing during methanotrophy, a detailed carbon and sulphur isotopic systematics has been undertaken in a pristine diamond drill core from Meetheena (Pilbara Drilling Project). The studied rocks consist of low-grade metamorphic interlayered carbonate, carbonated sandstone and tuffaceous material with local horizons of cm- to m-scale stromatolites that were deposited in a shallow water (lacustrine or oceanic) environment.

Calcite content and $\delta^{13}C_{PDB}$ values are comprised between 2 to 100 wt %, and -9.2 to 1.9 ‰, respectively. Mean $\delta^{13}C$ value of -0.4 ‰ indicates that the rocks were not modified by the low grade greenschist facies metamorphic event. A positive correlation between calcite content and $\delta^{13}C$ values points to the preservation of an early diagenetic overprint.

Total Organic Carbon (TOC) and organic carbon $\delta^{13}C_{PDB}$ values range from 0.03 to 0.4 (average 0.2 %) and -24.7 to -55.9 ‰ (average -41.2 ‰), respectively. No systematic correlation between TOC and $\delta^{13}C$ values has be evidenced. Recognition that organic $\delta^{13}C$ values vary markedly on a meter scale and display a bimodal distribution with two maxima at – 43 and – 28 ‰ indicate the occurrence of two distinct biomass. This organic carbon $\delta^{13}C$ distribution with depth is best interpreted in terms of local change of metabolic pathways and environmental conditions on a small time scale.

Pyrite content and $\delta^{34}S_{CDT}$ compositions range from 0 to 2.6 wt % (average 0.2 %) and from -5.8 to 2.7 ‰ (average -0.5 ‰), respectively. This relatively small range of $\delta^{34}S$ values can reflect bacterial sulphate reduction under specific environmental conditions involving high reduction rate and/or low sulphate concentration, which are higly compatible with the operation of AOM metabolism.