Paleoproterozoic organic carbon burial events and $\delta^{13}C_{org}$ excursions: Global or regional controls?

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Commonly occurring 2.1-1.9 Ga organic-rich rocks are considered to track global environmental changes in the aftermath of the GOE at 2.3 Ga. The presence of strongly ^{13}C-depleted organic matter in two of the best-studied successions, the Francevillian in Gabon and the Zaonega in NW Russia, have been explained by two contrasting hypotheses: (i) a global change in $\delta^{13}C$ of atmospheric CO_2 due to weathering of organic-rich rocks deposited during the preceding Lomagundi-Jatuli C_{carb} isotopic excursion; or (ii) by basinal methanotrophy triggered by local hydrocarbon generation and CH_4 seepage.

New data on the carbon and hydrogen isotopic characteristics of trapped hydrocarbon gases (C1-C4), particularly the relationships between heavier species (C2-C4) in the Zaonega succession, are compatible with the accumulation of ^{13}C-depleted organics ($\delta^{13}C$ c. -40‰) with seepage of thermogenic CH_4. These results, combined with published data, support the inference that regional/basinal processes best explain the Zaonega anomaly (Shunga Event).

New geochronologic results on the Zaonega rocks and comparison with age constraints on other broadly contemporaneous (2.1 to 1.9 Ga) organic-rich stratigraphic intervals demonstrate that Paleoproterozoic organic carbon accumulation define temporally discrete depositional episodes with conditions in individual basins being strongly influenced by magmatic activity.