

Nondwenite: Messenger of the organic rich ocean world from the Archaean

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Rocks with high total organic content (TOC) greater than 10 wt.% have been noted in the Proterozoic of Russia (*aka Shungite*), but not from the early Archaean Eon until now. In the ~3.53 Ga old Nondweni Greenstone Belt (NGB) of South Africa, we document sedimentary rock with TOC up to 17.45 wt.% and $\delta^{13}\text{C}$ ranging from -28.6 to -39.6‰. The lightest values are most parsimoniously interpreted as evidence of methane cycling. Nitrogen isotopes ($\delta^{15}\text{N}$) range from 0.78 to -0.69‰, possibly indicative of an N_2 -fixation-dominated ecosystem.

The organic-rich horizons are sulfur abundant, which total reduced S levels up to 3.7 wt.% and $\delta^{34}\text{S}$ from -3.31 to 1.71‰, accompanied by $\Delta^{33}\text{S}$ up to 2.31‰, consistent with low atmospheric pO_2 and limited supply of sulfate during the early Archaean. Collectively field based observations and geochemical data suggest paleo-hydrocarbon seepage on the Archaean Ocean floor linked to the extensive emplacement of (ultra)mafic volcanic rocks. This finding supports the existence of a diverse microbial community capable of utilizing nutrient fluxes available in the ancient oceans resulting from dynamic early Earth processes. We propose classifying this rock type from the Nondweni Greenstone Belt, characterized by anomalously high TOC, as "Nondwenite."