

Deciphering microbial carbon sources and metabolic signatures in the deep terrestrial subsurface

SLATER, G.F.,¹ SIMKUS, D.¹, MAGNABOSCO, C.²,
LAU, M.², MAILLOUX, B.³, WILKIE, K.⁴, KIEFT, T.⁵,
BORGONIE, G.⁶, KULOYO, O.⁶, VAN HEERDEN, E.⁶,
SHERWOOD LOLLAR, B.⁴ AND ONSTOTT, T.C.²

¹McMaster University, Hamilton, CA, gslater@mcmaster.ca

²Princeton University, Princeton, NJ, tullis@princeton.edu

³Barnard College, NY, NY 10027 bmaillou@barnard.edu

⁴University of Toronto, Toronto, bsllollar@chem.utoronto.ca

⁵New Mexico Tech, NM, tkeift@nmt.edu

⁶University of the Free State, South Africa, vheerde@ufs.ac.za

The carbon sources and metabolic activities supporting microbial communities in the deep terrestrial subsurface are not well understood. Methanogenesis and acetogenesis have been proposed to provide the foundation of subsurface food webs. However, heterotrophic consumption of dissolved organic carbon (DOC) can also support these communities. We characterized the microbial communities and the isotopic compositions of their phospholipid fatty acids (PLFA) and DNA as well as potential carbon sources in boreholes located in gold mines in the Witwatersrand Basin, South Africa, at depths ranging from 0.9 to greater than 3 km.

PLFA with highly ¹³C depleted signatures (up to 73 ‰) and $\Delta^{14}\text{C}$ values comparable to CH_4 and dissolved inorganic carbon (DIC) indicated active methane cycling in the shallower boreholes (0.9, 1.3 km). This was supported by genetic analysis indicated the presence of methanogens including methanosarcinales and thermopasmata, though these represented a relatively minor component of the overall community. In contrast, at the deepest sites (>3 km), PLFA were isotopically enriched in ¹³C relative to methane, which contained no ¹⁴C, though DIC contained significant levels. This demonstrated that methane production/utilization was very limited. Molecular genetic characterization indicated sulphate reducing autotrophy was the predominant support for the microbial community in these samples.

In order to add in the paleometeoric versus saline waters comments need to confirm the salinities and GMWL position of these samples