Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37757

Mantle-hosted granitoids as archives of sediment recycling and abiotic carbon cycling during Samail ophiolite evolution

TIAGO ANGELO[1], CHRIS SPENCER[2], HONGYAN LI[3], AARON J. CAVOSIE[4], ROBERT THOMAS[5], JACOB HANLEY[6], MITCHELL KERR[7], DEREK R KNAACK[8], EVELYN LEDUC[9], ZIYI ZHU[10], DR. MARINA SERAINE, PHD[11], NICK M. W. ROBERTS[12], SOPHIE DIVILEK[1], ANNA REN[1], GUIMEI LU[13] AND BRIAN JOY[1]

[1]Queen's University
[2]Queen's University
[3]State Key Laboratory of Deep Earth Processes and Resources, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences
[4]Space Science and Technology Centre (SSTC), School of Earth and Planetary Sciences, Curtin University
[5]Council for Geosciences
[6]Saint Mary´s University
[7]Saint Mary's University
[8]Natural Resources Canada
[9]Queens University
[10]The University of Hong Kong
[11]Timescales of Mineral Systems Group, Curtin University
[12]British Geological Survey
[13]China University of Geosciences

Subduction zones play a fundamental role in transferring sedimentary material and volatile elements into the mantle. Mantle-hosted granitoids (MHG) of the supra-subduction Samail ophiolite (Oman–United Arab Emirates) represent a rare and well-preserved archive spanning subduction to exhumation, providing an opportunity to investigate the coupled processes linking sediment recycling, mantle melting, and fluid evolution during ophiolite emplacement.

We integrate whole-rock and zircon trace element geochemistry with radiogenic (Sr–Nd–Hf–Pb) and stable (O–Li–C) isotope systematics, together with fluid inclusion petrography and Raman microspectroscopy, to evaluate the origin and post-magmatic evolution of these granitoids. Elevated zircon $\delta^{18}O$ values, seawater-like $\delta^{7}Li$ signatures, and radiogenic isotope compositions indicate partial melting of metabasaltic and metasedimentary sources, including biogenic and ferromanganese-rich sediments, within the mantle wedge. These results demonstrate direct recycling of ocean-floor sedimentary material into the MHG system.

Secondary fluid inclusions crosscutting quartz in the MHG record late-stage fluid circulation during ophiolite obduction. Raman spectroscopy reveals hydrocarbon-bearing assemblages associated with strongly negative carbon isotope compositions ($\delta^{13}C \approx -27‰$). These signatures are interpreted as products of CO_2 reduction via Fischer-Tropsch-type reactions during serpentinization of surrounding ultramafic rocks. In this catalytic abiotic process, sediment-derived CO_2 reacts with H_2 to form methane, where H_2 is generated through aqueous oxidation of ferrous iron in olivine. Kinetic isotope fractionation during CO_2 reduction preferentially incorporates ^{12}C into methane, producing strongly ^{13}C-depleted compositions that can overlap values commonly attributed to biological methanogenesis and higher hydrocarbon production. The peridotitic host therefore acts not as a primary carbon source but as a reductant and catalytic medium, linking sediment-derived carbon infiltration to abiotic hydrocarbon formation during exhumation.

Together, these observations reveal mantle-hosted granitoids as integrated records of lithospheric recycling, linking sediment subduction, mantle melting, and obduction-driven fluid circulation. The results demonstrate that serpentinization during ophiolite emplacement can generate strongly ^{13}C-depleted abiotic hydrocarbons overlapping compositions commonly attributed to biogenic carbon isotope signatures.