Catalysis of Methane Production in Serpentinization Systems

L. Jones\textsuperscript{1,4}; C. Oze\textsuperscript{2}; J. Goldsmith\textsuperscript{3}; R. J. Rosenbauer\textsuperscript{4}

1. University of Delaware, Newark, DE, United States.
3. Bryn Mawr College, Bryn Mawr, PA, United States.

Serpentinization is a geochemical process resulting in the inorganic synthesis of molecular hydrogen (H\textsubscript{2}) where H\textsubscript{2} is capable of reducing carbon (i.e., CO\textsubscript{2}) to form methane (CH\textsubscript{4}). Although CH\textsubscript{4} formation is thermodynamically favorable over a wide range of pressure and temperature, the rate of CH\textsubscript{4} production via Fischer-Tropsch type (FTT) synthesis is slow without the aid of mineral catalyst(s). Chromium- and Fe-bearing minerals (e.g., chromite) have been shown to be effective aids in enhancing FTT synthesis. Here, we report serpentinization experiments at 200 °C and 300 bar demonstrating no difference in the rate of CH\textsubscript{4} production (~0.1 µmol kg\textsuperscript{-1} h\textsuperscript{-1}) with the addition of chromite comprising ~1 Wt. % of the total solids. The mass and low surface area of chromite utilized in our experiment, representative of mineral-fluid interactions in a peridotite-hosted hydrothermal system, was potentially below a threshold to cause any appreciable change in the CH\textsubscript{4} production rate.

Residual end-member solids contain an abundance of fine-grained magnetite comprising ~3 Wt. % of the solids over ~850 h of reaction time where magnetite is also a mineral catalyst for advancing FTT synthesis. Based on our observations, high surface area magnetite may overshadow the effects of the Cr-bearing catalyst chromite, therefore, making serpentinization and the production of CH\textsubscript{4} autocatalytic.

Contact Information
Laura Camille Jones, Newark, Delaware, USA, 19716, click here to send an email