

## Low-temperature nanocatalysis of abiogenic methane during peridotite alteration

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Mantle peridotite alteration can catalyse abio-genic hydrocarbon formation, particularly CH<sub>4</sub>. This gas sustains the deep biosphere, promotes gas hydrate formation, and may form gas reservoirs. Although CH<sub>4</sub> synthesis is known to occur in the presence of metal alloys or chromite during serpentinization at T>200 °C, little is known about the potential for massive CH<sub>4</sub> catalysis at low-temperatures. Here, we present first results of our investigations into the natural catalyst within the massive, low-temperature (~50 °C [1]) CH<sub>4</sub> seep at the Chimaera site, Turkey. CH<sub>4</sub> has been used at this site for >2000 years and the original reservoir is estimated to be thousands to millions of cubic meters making it the Earth's largest onshore abiogenic CH<sub>4</sub> seep. Our investigations show that the serpentinites are massively enriched in chromite. Using micro-analytics we show that chromite alters to a mesoporous network of nanocrystalline spinel phases. We argue that the crystallographic preferred pore wall orientation, high surface area, and trace metal content of these spinel phases facilitates low-T CH<sub>4</sub> synthesis with significant production capacities over timescales of several hundred to thousands of years. Using paleo-tectonic reconstructions we estimate the amount of CH<sub>4</sub> production since ophiolite emplacement.

[1] Etiope et al. 2011, *EPSL*, **310(1-2)**, 96-104.