Microbial life associated with low temperature alteration of ultramafic rocks in the Leka ophiolite complex

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The Leka Ophiolite Complex (Mid-Norway) is a unique location for sampling oceanic crust and mantle lithologies. To examine peridotite-hosted subsurface microbial communities we have drill-sampled a dunite unit that is located close to ancient crust-mantle boundary. Samples were taken of mineralised fractures as well as of ground water produced by a 50 m deep borehole. Microbial community analyses were done by 16S rRNA gene sequence amplification clone library constructions. The morphological diversity was examined by electron microscopy. Enumeration of *Archaea* and *Bacteria* were done with fluorescent microscopy and real time polymerase chain reaction.

Different microbial communities were observed in the groundwater, the fracture fillings and the surface water. The groundwater, having a pH of 9.1, was dominated by close relatives of putative hydrogen oxidizing beta Proteobacteria suggesting that microbial communities at Leka are largely driven by hydrogen possibly produced by low temperature water-rock reactions. The microbial communities in the mineralised fractures are dominated by close relatives of heterotrophic hydrocarbon-degraders, but close relatives of hydrogen-, manganese-, and iron-oxidizers were also present.

Metal-silicate mixing during impact-driven planet accretion – Implications for the age of the Moon

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The final accretion of planet Earth involved giant collisions between protoplanets (>1000km radius) with the Moon forming as a result of one of these impacts. At this stage both bodies had differentiated into a metallic core surrounded by a silicate mantle. During the Moon-forming impact nearly all metal sank into the Earth's core. We have investigated to which extent large self-gravitating iron cores can mix with surrounding silicate as they sink through the Earth's mantle. This allows us to evaluate how incomplete metal-silicate equilibration during core formation influences the short-lived chronometer, Hf-W, used to infer the age of the Moon.

We have established fluid dynamical models of turbulent mixing in fully liquid systems to constrain the degree of iron-silicate mixing. Erosion of sinking cores driven by Rayleigh-Taylor instability does lead to mixing, but only 1-20% of Earth's core would emulsify and equilibrate with the silicate mantle during Earth's entire accretion process. The initial speed and obliquity of impact is of little importance, but the size and shape of the sinking core matters. We evaluate the mixing potential for shear instabilities where silicate entrainment across vertical walls leads to mixing. The turbulent structure indicates that vortices remain at the largest scale and do not cascade down to centimeter length scales where diffusion operates and isotopes can equilibrate.

Because most of the impacting metal plunge directly through the silicate mantle, and the fraction of impacting metal that mix within diffusion distance from silicate is small, giant impacts have limited effect on siderophile depletion during core formation. On a global scale residual ^{182}W from early core formation processes is left behind in the mantle and this source of ^{182}W generates a higher ε_W excess compared to what is expected in early models for ^{182}W evolution in the silicate Earth. Hence, the Moon forming impact must have occurred >30 Myrs after CAI formation. Furthermore, we find that a single giant impact has limited ability to reset the Hf-W system and that ε_W is more sensitive to early core formation processes than to radiogenic ingrowth after the giant impact [1].

[1] Dahl T.W. & Stevenson D. J (2010) *EPSL* **295**, 177-186.