The Serpentosphere

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The Serpentosphere consists of a near earth-wide layer/shell of rock dominated by serpentine group minerals, largely lizardite under ocean basins and antigorite formed beneath continents during numerous flat subduction events throughout earth history. The Serpentosphere coincides with the seismic and gravity transition from crustal to mantle material, known as the Moho. The Serpentosphere has been and is currently being formed by reaction of deeply penetrating marine waters with depleted mantle peridotites under greenschist facies conditions (somewhat similar to the oceanic layer 3 as originally envisioned by Harry Hess).

The Serpentosphere has enormous and novel implications for four major geologic problems that are of current interest to the geologic and social community: the origin of hydrocarbons, the origin of life, contributions to global climate, and driving mechanisms for plate tectonics. A close relationship between trace elements in crude oils and kerogen-like material in serpentinite has been found. Migration of Serpentosphere-sourced heat and hydrocarbons to seep sites on the ocean floor and in subaqueous continental environments is the energy drive for and has been polymerizating and catalyzing life-related organic chemical reactions since the beginning of geologic time. Heat, methane, hydrogen and carbon dioxide generated during the serpentinization reaction provide a major thermal and greenhouse contribution to the earth's hydrosphere-atmosphere system and a carbon dioxide sequestrian sink (in ophicalcite-enriched low-angle normal fault zones) that has been overlooked and underappreciated by the current global climate science initiatives. The ductility of the serpentine group minerals provides a plate scale tectonic 'grease' that allows crustal plates to be able to slide and glide around the outer earth at the Serpentosphere/Moho interface.

The Serpentosphere is ultimately the product of a first order earth process that points to the fundamental importance of water. Without it, oil, life, plate tectonics, and climate as we know it would be impossible.

Ralstonia species mediate Fe-oxidation in the deep biosphere of Henderson Mine

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At the Henderson Molybdenum Mine in Colorado, microbes live within waters circulating in fractures of granite host rock, 3000' below the surface. The 40C waters at pH 6 contain abundant energy sources in the form of reduced Fe, Mn and S. Organisms from the genus *Ralstonia* make up 45% of the bacterial community extracted from a core drilled into the granite host rock, and nearly 20% of that from fracture fluids [1]. Two recently isolated strains of *Ralstonia* grow by lithotrophic, microaerophilic Fe-oxidation in $FeCO_3$ gradient tubes. The biotic controls over the spatial distributions of aqueous Fe and O_2 are assessed with *in situ* voltammetry using microelectrodes. The Fe-oxides are interrogated using extended x-ray absorption fine structure (EXAFS) spectroscopy. Results indicate a potential biomarker in the mineralogical difference between biotic and abiotic Fe-oxides that is magnified with time. The finding of microaerophilic, neutrophilic and moderately thermophilic Fe-oxidizing organisms from the deep, terrestrial subsurface also represent a novel and vast environment for this metabolism. And, as *Ralstonia* is a dominant member of the subsurface community at Henderson, Fe-oxidation could be a crucial metabolic strategy sustaining life in this deep subsurface environment. This work expands our knowledge of the diversity and versatility of Fe-oxidizers, the environments in which they live, potential biomarkers, and how life survives within the spatial and energetic constraints imposed by the deep subsurface.

[1] Sahl *et al.* (2008) *Appl. Env. Microbiol.* **74**, 143–152.