Mineralogy and boron geochemistry of mud volcanoes from Northern Apennines (Italy)

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Mud volcanoes and associated waters of the Emilia-Romagna Apennines were sampled at Rivalta, Montegibbio, Regnano, Nirano, San Clemente and Bergullo localities and analysed for mineralogy and geochemistry. Mud consists of sandy and clayey silt, composed by quartz, calcite, dolomite, feldspar and phylosilicates. The separated clay fraction (< 2 μm, about 20%) is represented by illite - smectite (I-S, 29 to 53%) and illite (I, 30 to 49%), with subordinate chlorite, smectite and kaolinite. Boron concentration varies in the range 100 - 400 μg/g in mud samples, and 5 – 80 μg/ml in waters. The mineralogical assemblage of the clay fraction is investigated together with the δ^{11}B signature of mud (5.3 to 13.2‰) and waters (17.8 to 43.1‰). These preliminary results allow to investigate: a) the variation of the δ^{11}B signature in mud samples as compared to the inverse correlation observed between I-S *vs* I; b) the relationship between the boron content and the mud – water isotopic fractionation.

Coupling mineralogical and geochemical data, this research was aimed to investigate the roots of the studied mud volcanoes within the Apennine sedimentary pile.

Energy Metabolism in Sulfate Reducing Bacteria

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The metabolic pathway involved in dissimilatory sulfate reduction has long been known to involve the activation of sulfate by reaction with ATP to form adenosine-5´-phosphosulfate (APS) performed by the ATP sulfurylase, the reduction of APS to sulfite by the APS reductase (AprBA), and the reduction of sulfite to sulfide by the dissimilatory sulfite reductase (DsrAB). However, how this pathway is associated to energy conservation in sulfate reducing organisms (SRO) has not been clearly established. Our team has characterized several new membrane respiratory complexes from SRO, including the QmoABC and DsrMKJOP complexes involved in the electron transfer pathways to AprBA and DsrAB, respectively [1]. These two complexes are specific to sulfur-metabolizing organisms (sulfate/sulfite/organosulfonate reducers and sulfur oxidizers), and both have subunits that are closely related to subunits of the heterodisulfide reductases from methanogens. I will present recent results on the role of the QmoABC and DsrMKJOP complexes in sulfate reduction, and discuss possible mechanisms of energy conservation associated with both APS and sulfite reduction by the AprBA/QmoABC and DsrAB/DsrC/DsrMKJOP proteins, including an electron confurcation hypothesis involving menaquinone [2].

[1] Grein, Ramos, Venceslau & Pereira (2013) *Biochim Biophys Acta -Bioenergetics* 1827, 145-160. [2] Ramos, Keller, Wall & Pereira (2012) *Front. Microbiol.* 3:137 (open access)

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