High production of H2 and CH4 and abiotic hydrocarbons in ultramafic-hosted hydrothermal systems on the Mid-Atlantic Ridge

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The emplacement of serpentinized mantle at all ultramafic-hosted hydrothermal systems discovered along the slow-spreading Mid-Atlantic Ridge (MAR) where tectonic extension dominates over magmatic construction is a common feature leading to the production of high amounts of H2 and abiotically-produced CH4 and heavier hydrocarbons. The gas composition of ultramafic fluids sampled on the MAR at Rainbow (36°14’N), Lost City (30°N), Logatchev I and II (14°45’N), Ashadze I and II (12°58’N) is compared here. At each ultramafic-hosted field, all vented fluids are issued from a nearly identical source, are controlled by phase separation and show low H2S content (<1 mmol/kg, extraordinary high H2 (10 to 26 mmol/kg) endmember concentrations compared to basalt-hosted fluids. H2 production represents between 40 to 80% of the total extracted gas volume. The total hydrogen discharge &H2 is found to be between 2.5 to 7.5 millions standard cubic meters per year for the Rainbow single site. Based on Rainbow H2/3He and 3He/heat ratios, a global H2 flux for slow-spreading ridges of 2’109 m3 STP/yr is estimated. As a consequence of the high reducing power of these systems, isotopic measurements of light hydrocarbons (C1 to C4) show that abiogenic hydrocarbons are generated by catalytic Fischer-Tropsch type reaction, considering their isotopic pattern. These results show that in ultramafic environments, the existence of high concentrations of H2 may be of interest for the future as a potential clean energy but many questions have still to be clarified.