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High flux of hydrogen, abiogenic methane and heavier hydrocarbons from the slow-spreading Mid-Atlantic Ridge

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An important flux of matter, energy and gases is known to be issued from the hard rock on mid-oceanic ridges or from mud volcanoes and pockmarks on continental margins. The methane vented from sedimented ridges, hydrocarbon seeps, mud volcanoes, is mainly biogenic in origin. Along the slow spreading Mid-Atlantic Ridge, between 12˚N and the Azores Triple Junction, the strong CH_4 anomalies found in seawater above serpentinized diapirs demonstrate that the degassing [Charlou et al., 1996, 1998], is related to seawater-ultramafic interaction. New hydrothermal fields were recently explored and sampled between 12˚ and 17˚N (MAR) on the Mid-Atlantic Ridge as a part of the French-Russian cooperative Serpentine diving cruise. In addition to the Logachev I site (14˚45N) previously discovered, new smoking areas, called Ashaze I and 2 (12˚58N) and Logachev 2 (14˚43N) were also discovered in ultramafic environments. Very strong anomalies in temperature, nephelometry, CH_4 (from 1 to 120 μl/l), helium, were found in the seawater column above Ashaze and Logachev high-temperature fields. The fluid endmembers at these sites exhibit different temperature (310 to 370˚C), pH (3.5 to 4.0), chloride (150 to 620 mM), signifying that phase separation is occurring and controlling the fluid chemistry. All fluids are issued from ultramafics and controlled by seawater-peridotite interaction They show low sil-

ica (5 to 10 mM), low H_2S ($<$0.5 mM) and are extraordinary enriched in hydrogen gas. Gas bubbles are observed coming out from Ashaze 1 vents and pulses of clear fluid were observed venting from Logachev 2. Very high concentrations in H_2 (70 per cent of total gas), CO_2, CH_4 were measured. Preliminary calculations show that one vent at Ashaze 1 field produces 1 million of cubic meters of natural H_2 per year. CH_4 is clearly abiogenic with δ^{13}C varying from –6 to –14 per mil (PDB). In addition, the progressive isotopic trends for the series of C_1 to C_4 alkanes indicate that hydrocarbon formation occurs by way of polymerization of CH_4 precursors. The serpentinization process is observed here up to 4080m at Ashaze 1, the deepest venting area so far known in ocean, and generates high hydrogen and abiogenic hydrocarbons during the hydration of olivine and pyroxen minerals through catalytic reactions (Fischer-Tropsch type reactions) as previously observed at all ultramafic sites on the slow-spreading mid Atlantic Ridge between 12˚N and the Azores Triple Junction. More information is available at http://www.ifremer.fr/serpentine.