# Mineralogy and geochemistry of an Archaean chert: In quest of N-sites

J.P. GALLIEN[1], B. ORBERGER[2], D.L. PINTI[2], C. WAGNER[3], M. FIALIN[3], L. DAUDIN[1], K. HASHIZUME[4]

[1]Laboratoire Pierre Süe, CEA-CNRS, UMR 9956, 91191 Gif-Sur Yvette Cedex, France. (jgallien@drecam.cea.fr)
[2]FRE 2566 ORSAYTERRE, Université Paris Sud, Bât. 504, 91405 Orsay Cedex, France.
[3]Laboratoire PMMP – Centre CAMPARIS, Université Paris 6, 4 Place Jussieu, 75252 Paris Cedex 05, France.
[4]Dept. Earth & Space Sciences, Osaka University, Toyonaka, Osaka 560-0043, Japan.

The nitrogen breakdown product of organic matter (OM) is preserved in ancient metasediments and can be used as biomarker. Archaean cherts show multiple N components. In order to provide a correct interpretation of their N isotopic signature, N-bearing phases should be identified. Therefore, SEM-EDX, EPMA (WDS) and nuclear reaction analyses were carried out on the hydrothermal chert PB 458 (Marble Bar, Pilbara, Australia). The $\delta^{15}N$ in this chert vary from –5 to 9‰ (Pinti et al. 2001). We identified two redox-environments: (1) Low $fO_2$ and high $fS_2$ are indicated by the presence of silicified euhedral dark ghost phenocrystals in a cryptocrystalline quartz matrix. They are rich in Fe, Al, K, Ca, Mg, Cu, Ti, Zn and host euhedral Fe-sulfides. (2) The redox-front (2 mm wide), changing to high $fO_2$ and low $fS_2$ conditions, is marked by the precipitation of Fe-and Fe-Mn oxide (BI) and coarse-grained quartz bands of stromatolite-like structure. The Fe–Mn-oxides of worm-like textures are probably pseudomorph after euhedral quartz. Arsenic is incorporated in Fe-oxides, whereas Fe-Mn oxides contain traces of Ca, Al, K. Au-Pd, Cu-Ni-Zn; Cr-Ni alloys (1-2µm); Y-REE phosphates (2µm) and Mg-Fe-spinel occur in interstitial quartz. Precipitation of cryptocrystalline quartz continued under high $fO_2$, but lower metal activity. The matrix rarely hosts orthoclase (< 10µm), Ti-V oxides, Ba-mica, Ca-Mg carbonates and barite (< 1µm). Secondary mm-wide quartz veins with Fe-Mn oxides, biotite and clay minerals crosscut the chert. Nitrogen and C occur in Fe-Mn oxides (C: 214-2380 ppm, N: 107-150ppm, N/C: 0.06-0.5), and in K-Al-silicates related to the quartz veins (C: 1790–4190ppm, N: 710-2130ppm, N/C: 0.4-0.5). The N/C ratio is 10 to 100 times higher than the N/C-ratio of the whole rock, suggesting that additional C might be adsorbed on mineral surfaces or included in quartz as OM. The occurrence of N and C in Mn-Fe-oxides of the BI of PB458 might indicate microbial activity during Fe-Mn oxide precipitation, while secondary K-Al silicates incorporated remobilized $NH^{4+}$ by replacing $K^+$.

**Reference:**

Pinti D.L. Hashizume, K., Matsuda J. (2001) *Geochim. Cosmochim. Acta*, **65**, 2301-2315.

# "Microbial plumes" as inferred from the increase of stable carbon isotope composition of methane originated from submarine hydrothermal activity

T. GAMO, U. TSUNOGAI, S. ICHIBAYASHI, A. HIROTA, AND SHIPBOARD SCIENTIFIC PARTIES OF THE KH-00-5 AND KH-02-1 CRUISES

Division of Earth and Planetary Sciences, Hokkaido University, Sapporo, Japan (gamo@ep.sci.hokudai.ac.jp)

Spatial distributions of neutrally buoyant hydrothermal plumes were traced using dissolved methane ($CH_4$) and its stable carbon isotope ratio ($\delta^{13}C_{PDB}$) at the following hydrothermal active areas: i) No.4 Yonaguni Knoll of southern Okinawa Trough, northwestern Pacific (24°50-54'N, 122°41-44'E), and ii) Gulf of Aden, south of the Arabian Peninsula (12-13°N, 45.5-49°E). At the former area, CTD hydrocasts were performed at five stations, one is nearly close (~0.4 mile) to a known black smoker chimney site and the others locate within 3 miles from the chimney site. Seawater samples were kept in sealed glass vials with $HgCl_2$ for the measurement of $CH_4$ and its $\delta^{13}C$ with a CF-IRMS system at Hokkaido University. We detected triple layered $CH_4$ plumes, the centers of which were at depths of ~800 m, ~1,050 m and ~1,200 m. The $CH_4$ concentrations and the $\delta^{13}C$ values for the 1,200 m plume ranged between 1,026 nM and 10 nM, and between -22.4‰ and +40.4‰ (the heaviest values yet reported for oceanic $CH_4$), respectively, indicating active microbial $CH_4$ oxidation to cause the $\delta^{13}C$ increase (fractionation factor of ~1.010) of residual $CH_4$ as the plume ages. As for the 800 m plume, it was found that the $CH_4$ oxidation or the $\delta^{13}C$ increase still occurs after the $CH_4$ concentration reached at the background level (~1 nM) or less. In this case, we can recognize the hydrothermal plume from the $\delta^{13}C$ anomaly, accompanied by little (or negative) $CH_4$ anomaly. Such a "microbial plume" or $\delta^{13}C$ plume was also observed in the Gulf of Aden.