

The microbial community structure of methane hydrate bearing deep subseafloor sediments in Cascadia Margin (ODP Leg204)

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Recent microbiological studies reports that one of the largest compartments of biomass on the earth is in the deep subseafloor environments. Subseafloor methane hydrates are now of great interest in terms of its formation mechanism as well as future energy resource. Carbon isotopic and chemical analysis determine the origins of methane in gas hydrate, and some of the gas hydrates are recognized as consisting of biogenic methane. However, microbiologists have not obtained direct evidence of active methanogenesis in methane hydrate bearing sediments.

We investigated the vertical distribution of subseafloor microorganisms on the Cascadia Margin (ODP sites 1244, 1245 and 1251) using 16S rDNA clone analysis. Samples from sites 1244, 1245 and 1251 contain microbial communities from above the bottom simulating reflector (BSR), just below the BSR and successively from seafloor to 200 m below the BSR, respectively. Clone analysis of these 3 sites indicates that the microbial community structure in the subseafloor at Hydrate Ridge on the Cascadia Margin is invariant from seafloor to deep subseafloor strata. The dominant archaeal components are members of the Deep Sea Archaeal Group (DSAG) and Miscellaneous Crenarchaeal Group (MCG), while most of the bacterial entities belong to candidate division OP9. The stable microbial community structure without methanogens at all the depths sampled and with decreasing microbial number provided an important implication for the formation mechanism of subseafloor methane hydrate on the Cascadia Margin.

Searching for the crustal component in martian meteorites

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Martian shergottites like Los Angeles (LA) that are minimally depleted in LREE are hypothesized to have assimilated an incompatible element-rich "crustal" component [1,2] that remains to be fully identified. Assuming binary mixing with a basaltic magma represented by shergottite QUE94201, contribution of 20% by mass of the parent magma by a hypothetical crustal component with Sr and Nd abundances of 203 and 53 ppm, resp., could explain the Sr and Nd systematics of LA if the ⁸⁷Sr/⁸⁶Sr and ϵ_{Nd} values of the crustal component were 0.74 and -12, resp., for Sr and Nd abundances in LA of 77 and 11.8 ppm, resp. [3]. The estimated crustal Nd abundance drops to 31 ppm for this model for lower Nd = 7.4 ppm in LA [4], and estimated crustal $\epsilon_{Nd} = -17$. Surface K abundances up to ~0.5 wt% in Martian "andesitic" surfaces as observed by the Mars Odyssey Gamma Ray Spectrometer (GRS) [5] and for soil at the Pathfinder site [4] plus estimated K/Nd = 308 and K/Sr = 27, resp., suggest locally averaged crustal Nd and Sr abundances up to ~16 and ~185 ppm [4]. The ~2X higher K abundance of the Mars Pathfinder Soil Free Rock (MPF-SR) gives estimated Nd and Sr abundances of ~36 and ~405 ppm [4], resp., in excess of values estimated for the crustal component isotopically. A mix of 20% MPF-SR and 80% basaltic shergottite parent magma E_g [1] gives major element abundances and mg' (~50) similar to Shergotty/Zagami.

Alternatively, analogy to the Wanapum Basalts of the Columbia River Basalt Group suggests that some of the Martian "andesites" may contain granitic glass with high incompatible element concentrations. Assimilation of 5% granitic glass with Sr = 670 ppm and ⁸⁷Sr/⁸⁶Sr = 0.7482 by a basaltic magma with QUE94201-type values of Sr = 46 ppm and ⁸⁷Sr/⁸⁶Sr = 0.7014 would be required to match the Sr-isotopic systematics of LA. Nd = 120 ppm with $\epsilon_{Nd} = -19$ in the glass would be required to match the Nd isotopic systematics of LA. The estimated Sr and Nd values are ~2X higher than measured for the Wanapum glasses [6], but would decrease if Sr and Nd enrichment from near surface-fractionation of both Los Angeles and QUE94201 were corrected. Assimilation of a smaller proportion of low melting temperature glass would be energetically favored compared to assimilation of bulk Martian materials.

References

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