A molecular view of the reductive dehalogenase-homologous gene in subseafloor sediments

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Recent molecular analysis of microbial communities in subseafloor sediment indicates that phylogenetically diverse bacteria utilize organohalides as the electron acceptor: e.g., diverse 16S rRNA and reductive dehalogenase-homologous (*rdhA*) genes related to the member of *Dehalococcoides* have been detected by PCR from organic-rich deep subseafloor sediments (Futagami *et al*., 2009, 2013). Incubation experiments also demonstrated the biological degradation of organohalides (e.g., trichloroethene), indicating that organohalides support anaerobic microbial respiration in sedimentary habitats that are generally poor in bio-available electron acceptors.

To gain molecular insight into the largely unknown subseafloor reductive dehalogenation processes, we studied metagenomic pools obtained from five sediment core samples (i.e., 0.7, 5, 18, 48, 107 m in depth) at Site C9001 off the Shimokita Peninsula of Japan during the *Chikyu* Shakedown Cruise CK06-06 in 2006. From all samples examined, we detected phylogenetically remarkably diverse *rdhA*-homologous genes that affiliate to novel specific clusters, indicating that molecular characteristics of subseafloor *rdhA*-homologous genes are evolutionary and functionary more diverse than those previously expected from the modern surface biosphere (e.g., anthropogenic habitats). Consistently, the frequency of *rdhA*-homologous genes in the subseafloor metagenomic pools was found to be statistically high as compared to those in genomic sequences of over 1,800 isolated species. Interstingly, however, no or very little differences in phylogenetic distribution of *rdhA*-homologous genes were observed between five pools, suggesting that the genes are spatially evenly distributed in sediment regardless of the formation age ranging from modern to Pleistocene.

Contrasting behaviour of monazite and zircon during partial melting and fluid infiltration: An example from the Ryoke metamorphic belt, Japan

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Behaviour of monazite and zirocn in the pelitic and psammitic migmatites are investigated in the low P/T type Ryoke metamorphic belt at the Aoyama area, Japan where regional metamorphic terrane is thermally overprinted by later granite intrusions.

Monazite grains in migmatites yield a CHIME age of 96.5±1.9 Ma mainly in the core, and rims and patchy domains yeild 83.5±2.4 Ma. The age of ~97 Ma is interpretd to represent the timing of monazite growth during prograde regional metamorphism. Some monaizte includes PbO-rich phases at the core/rim boundary where sharp chemical and age zonings are observed, suggesting the contribution of interface-coupled dissolusion-precipitation mechamism. Patchy young domains could represent the result of fluid-related Pb loss through mircocracks. Therefore, ~80 Ma overprint on migmatites represents the wide and combined effect of thermal input and fluid activity on the monazite grains caused by the ~80 Ma granite intrusions [1].

On the other hand, zircon in the same area records 90.3±2.2 Ma alone except for inherited ages at the core. Between inherited core and the metamorphic rim, a thin, dark-CL annulus containing <2 μm melt (glass) and nano-granite inclusions is commonly developed, suggesting the presence of melt during the rim growth. In diatexites, the annulus is further truncated by the brighter-CL overgrowth, suggesting the resorption and regrowth of the zircon after peak metamorphism. This kind of zircon rim probably crystallized during the solidification of the melt in migmatites, and yeilds 90.3±2.2 Ma. Therefore, zircon records the timing of partial melting event but not the fluid infiltration event during the ~80 Ma contact metamorphism [2].

Using the difference of growth timing of monazite and zircon, the duration of metamorphism higher than the amphibolite facies grade is estimated to be ca. 6 Myr [2], similar to ~5 Ma estimated by [3]. This duration of high-temperature metamorphism is difficult to be attained by the intrusion of a single granite sill (3 km thick), and requires additional granite intrusions [4] or alternative heat source.

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