Exploration of the most alkaline extreme in a deep-sea serpentine seamount, the South Chamorro Seamount as an interface between abiotic and biotic in this planet. K. Takai[1], J. Miyazaki[1], Y. Morono[2], F. Inagaki[2], K. Kubota[3], C. Moyer[4], J. Seewald[5], G. Wheat[6], [1]SUGAR Project & Precambrian Ecosystem Laboratory, JAMSTEC, [2]Geomicrobiology Group, JAMSTEC-Kochi, [3]Dept. of Ciil and Environmental Engneering, Tohoku Univ., [4]Western Washington Univ., Bellingham, WA, USA, [5]WHOI, Woods Hole, MA, USA, [6]Univ. of Alaska, Fairbanks, USA.

Introduction: In 2001, Ocean Drilling Program (ODP) expedition Leg#195 was conducted in the South Chamorro Seamount located in the Mariana Forearc. The geochemistry characterization of the subseafloor serpentine mud pore-water demonstrated that the subseafloor environment is among the most alkaline-extreme environments in the Earth, of which pH reaches to pH12.5. Based on the culture-independent molecular analysis of the subseafloor microbial communities, there were detected hot spots of archaeal populations at several subsueafloor strata of the core down to 10 m below seafloor. The subseafloor environment under pH12.5 is almost marginal for the microbial habitability from consideration of the highest pH limit for microbial growth (pH12.4) and the availability of biologically fixable carbon sources. If the active microbial communities are truly present, what kinds of energy and carbon sources sustain the communities? Is is like 'the Lost City type'?

To clarify these questions, we conducted two ROV expeditions in the South Chamorro Seamount and explored the biogeochemical interactions in the highly alkaline crustal fluid entrained through the CORK that had been deployed during the ODP Leg#195. The CORK entrains the nearly endmember of the serpentinization-derived deep crustal fluid from ~150 m below seafloor. Using a ROV HyperDolphin (JAMSTEC) and a newly developed pressure-preserving subseafloor fluid samplers, the pristine subseafloor fluids have been collected and the detail geochemical characterization, SIP-NanoSIMS analysis, RI-tracer experiments, culture-dependent and –independent analyses are being conducted. In addition, in situ colonization devices for active microbial populations and mineral-microbe interaction were also deployed in the borehole for 5 months under 4 ˚C and pH12.3.

The geochemical characterization of serpentinization-derived deep crustal fluid demonstrated that the deep crustal fluid in the South Chamorro Seamount was characterized by a low concentration of H_2 and extremely high concentrations of CH_4 and H_2S. This compositional feature is consistent with relatively low temperatures of dissolution equilibrium of brucite. The $\delta^{13}C(CO_2)$ and $\delta^{13}C(CH_4)$ values were variable after the onset of the CORK fluid re-circulation; the $\delta^{13}C(CO_2)$ shifted from 1.4 ‰ to 1.7-2.3 ‰ and the $\delta^{13}C(CH_4)$ shifted from -25.8 ‰ to -36.1 ‰. The $(C_1/C_2 + C_3)$ ratio was also shifted from 74 to 184-247. These results strongly suggested the possible aerobic CH_4-and sufide-oxidation in the long resident crustal fluid. The microbiological characterization using in situ ^{14}C-CH_4 tracer experiment and 16S rRNA gene pyrosequencing highly supported the microbial aerobic CH_4 consumption. The microbial biomass and activity were highly less abundant in the re-circulated deep crustal fluids.

Based on these results, the nearly-pritine deep crustal fluid produced by serpentinization of the South Chamorro Seamount peridotite may be close to 'abiotic' or 'quite less biotic' probably due to its extraordinary high pH. However, once the less alkaline fluid sources (e.g., seawater and subseafloor aquifer) are mixed with the 'abiotic' serpentinized crustal fluid in the subseafloor or the seafloor, the mixing zones would be highly productive as observed in the chemosynthetic animal communities at the seafloor of the South Chamorro Seamount.

The serpentinization-depedent subseafloor microbial communities are the most plausible analogs of the most ancient living ecosystem in the Earth and even of the energetically possible extraterrestrial ecosystem. Several candidate communities are suggested in the serpentinization-driven fluid circulation systems; Lost City hydrothermal field, Kairei hydrothermal field and Soth Chamorro Seamount. Our investigation points that the occurrence of sizable and continueing ecosystems in the Earth and the other planets necessitate not only the serpentinization but also the heat as the driving force of fluid covection and chemical input.