Newly revealed NNW shift of granitic magmatism during Mid-Miocene period, Kyushu, Japan

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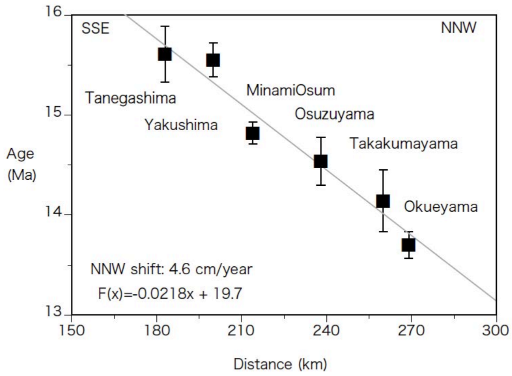
Mid-Miocene granitic plutons, related to subduction of young Shikoku Basin of the Philippne Sea (PS) plate after immediate clockwise rotation of SW Janpa, are spoladically but widely distributed along the Nankai Trough in the outer zone of SW Japan (e.g., [1]). Kyushu Island is located on western part of the outer zone. This study newly determined precise U-Pb ages for felsic dikes and granitic bodies of six locations; Tanegashima, Yakushima, MinamiOsumi, Osuzuyama, Takakumayama and Okueyama, by using LA-ICPMS technique [2]. The obtained U-Pb ages ranged from 15.6 Ma to 13.7 Ma and showed negative correlation to their distances from the Nankai Trough (see below figure). Shift rate of the granitic magmatism is 4.6 cm/year with NNW direction, which is almost same to that of recent plate movement of the PS plate (4.8 km/year). Considering that the shift rate is reflected to the subduction of the PS plate, the subdction angle in Mid-Miocene is estimeted as ca. 17 degree, which is almost same to that of recent PS plate on Shikoku Island. In Kyushu Island, however, the recent angle becomes max. 60 degree and Plio-Quaternary arc volcanism makes apparent volcanic front. This suggests that the PS plate during Mid-Miocene period has been shallowly subducted and subsequently slab rollback has been occurred due to slab-pushing caused by latteral flow of ashenospheric upwelling of the Ryukyu Trough [3] and/or other unknown tectonic events.



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Authigenic carbonates as dynamic microbial ecosystems: expanding views of methane cycling in the deep sea

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Sulphate-dependent anaerobic oxidation of methane (AOM) is the dominant sink for methane along continental margins, oxidizing significant fraction of methane in anoxic sediments prior to its release to the hydrosphere. The alkalinity generated during this process frequently results in the precipitation of $\delta^{13}C$-depleted authigenic carbonates, which vary in morphology, size, and mineralogy, ranging from micritic cements and cm-sized concretions to massive 'chemoherm' structures, mounds, and pavements that can cover hundreds of square meters. These methane-derived structures often persist long after the flux of methane subsides, with remnant methanotrophic biomarkers recovered from paleo-seep carbonates dating back to the Paleozoic. While these authigenic carbonates have long served as important indicators of methane seepage, they are frequently discussed as passive recorders of prior seep activity, rather as than an active microbial habitat. Using a combination of molecular and geochemical analyses, rate measurements, stable isotope labelling experiments and nanoscale secondary ion mass spectrometry (nanoSIMS), we examined the potential for these systems to sustain active methanotrophic microorganisms and documented changes in the microbial community associated with areas of active methane venting and sites of low methane flux. Here we demonstrate that authigenic deep-sea carbonates 1) host abundant methanotrophic archaea and sulphate-reducing bacterial consortia, 2) are actively oxidizing methane 3) are capable of growth and incorporation of methane into biomass 4) provide a unique habitat and food source for seep-associated meio- and macrofauna. Seafloor calcite and dolomite incubations, transplant experiments and *in situ* collections of carbonates show differences in the dominant methanotrophic archaea (ANME-1 vs. ANME-2) and methane-oxidation rates related to levels of methane seepage and possibly mineralogy, with viable endolithic methanotrophic archaea and above background levels of methane-oxidation documented in authigenic carbonates well outside areas of visible methane seepage. Together, this data indicate that authigenic carbonates are living and actively evolving ecosystems and represent a previously underappreciated sink for methane.

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