Evolution of the African continental crust from Pb-Hf-O isotope systematics of detrital zircons

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To better understand the evolutionaly history of the African continental crust, we have determined U-Pb ages, Lu-Hf and O isotopic compositions of ca. 450 detrital zircons from the Congo, Nile, Orange, Zambezi and Niger Rivers. The U-Pb isotopic data reveal the lack of >3.2 Ga zircons in the river sands, and distinct peaks at 2.7-2.5, 2.1-1.9, 1.2-1.0 and 0.9-0.6 Ga. The εHf(t) population shows that many zircons, even those having Archean U-Pb ages, crystallized from magmas involving an older crustal component (Figure 1). The O isotopic analyses reveal that ca. 70% of the zircons have $\delta^{18}O$ values higher than 6.5 (Figure 1), indicating that reworking of supracrustal material is important in the granitoid crust formation. However, no >2.0 Ga detrital zircons have $\delta^{18}O$ values higher than 8.0, suggesting restricted contribution of mature sediment to granitoid magma genesis in the Archean and early Proterozoic. We calculated Hf isotopic model ages for the zircons to estimate the mean mantle-extraction ages of their source materials. The oldest zircon Hf model ages of ca. 3.4 Ga suggest that some crust generation had taken place by that time, and that it was subsequently reworked into <3.2 Ga granitoid crust. The Hf model age distribution of the zircons having $\delta^{18}O$ values lower than 6.5 shows a prominent peak at 1.1-0.8 Ga, implying rapid generation of the continental crust at that time.

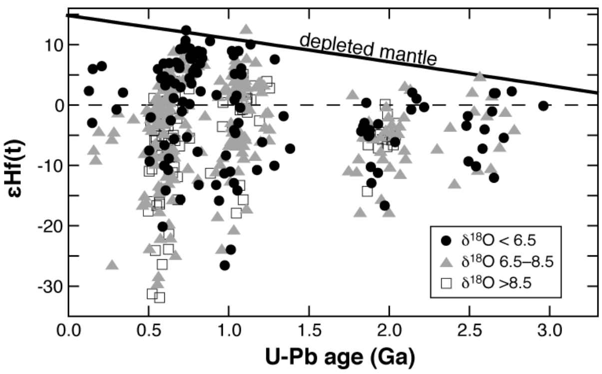

Figure 1: Plot of age vs. εHf(t) for African detrital zircons.

Biogeochemical processes in mud-volcano sediments from the Kumano forearc basin, Japan

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Remarkable populations of microbial life have been observed in global subseafloor environments. However, it remains largely unknown if the deep-derived diapiric structure provides potential habitats for subseafloor life or not. Here, we investigated microbial communities and biogeochemical processes in mud-volcano subsurface sediments down to 20 meters from the summit, obtained from the Kumano forearc basin in the Nankai Trough during the CK09-01 D/V *Chikyu* training cruise in 2009.

Pore water extracted from the cored sediments showed significantly low chlorinity to seawater (averaged in 23% of that in seawater), indicating that dehydrate reaction of clay minerals had previously occurred in the deeply buried sedimentary layer. The cored sediments contained relatively low population of microbial cells ($<10^4$ cells/cm^3). The $\delta^{13}C$ value of dissolved inorganic carbon ($\delta^{13}C_{DIC}$) increased with the coring depth, reaching +40‰ at 3 meters below the seafloor (mbsf). The highly ^{13}C-enriched values are possibly due to strong microbial reduction of DIC to ^{12}C-enriched products. The hydrogen isotopic composition of methane (-181±2‰) and magnitude of the carbon isotopic fractionation between DIC and methane (75.6±2.8‰) bellow 3 mbsf suggest the significant contribution of hydrogenotrophic methanogenesis as the source of methane. The $\delta^{13}C$ value of acetate was appeared to increase with the sediment depth (from -41 to -22‰), synchronous to the increase of $\delta^{13}C_{DIC}$. The significant isotopic fractionation between DIC and acetate (54.0±6.9‰) indicates that the principal process producing acetate is homo-acetogenesis via the reductive acetyl-CoA pathway. Radioactive tracer experiments exhibited relatively high activities of homo-acetogenesis (14–34,900 pmol/cm^3/day) and hydrogenotrophic methanogenesis (0.6–128 pmol/cm^3/day), consistently suggesting that autotrophy plays significant biogeochemical roles in the mud-volcano subseafloor microbial ecosystem.