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Reconstruction of the sedimentary environment using sea sediments in the northwest Australia

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The reconstruction of sea-level changes is the key not only to understand the Earth climate changes but also to predict the mantle viscosity. The Bonaparte Gulf in the northwestern Australia is located in a broad and well-developed shallow continental shelf. During times of sea-level lowstand, much of the shelf was exposed (Yokoyama et al., 2000; 2001). The Bonaparte Gulf has the Bonaparte Depression, which is the deepest part of the Gulf and has Ven Diemen Rise, Londonderry Rise and Sahul Rise. Sahul Rise is the shallowest Rise in them. The region is tectonically stable and far from the former ice-covered regions. The glacio-isostatic adjustment of the coast is therefore relatively small. So this region is suitable for the reconstruction of the sea level and evaluating the solid earth property using differential heights of the rsl at given times in the past using the restoration of the relative sea levels.

Yokoyama et al. (2000; 2001), which got sea-level information from the Bonaparte Gulf using radiocarbon dating and sediment core facies, reached the conclusion as

1) the LGM (Last Glacial Maximum) sea levels were locally at 125+-4 m;

2) the LGM terminated abruptly at 19 000 cal yr BP with a rapid rise in sea levels of about 15 m over the next 500 years

3) the onset of the minimum sea levels occurred before 22 000 cal yr BP.

In the cruise of KH11-1, a total of 1 piston core, 22 gravity cores and 6 multiple cores are collected. The number of cores is enough to reconstruct the tilting in this region. This study analyzed three cores, PC1, GC6 and GC9. We used the proxies of TOC, CN ratio and radiocarbon dating to reconstruct sea-level change and the tilting.

In this study, paleoenvironmental information is obtained using the habitat of shell samples found in the cores. We used AMS radiocarbon dating to determine the age of samples in MALT. Calendar ages were obtained using 14C curve marine09 (Reminer et al., 2009). We constructed age-model in PC1, GC6 and GC9.

The dried sediments of PC1, GC6 and GC9 were used for total organic carbon (TOC) and total nitrogen (TN) analyses. We obtained these data using EA-IRMS in Kochi Core Center.

Using dry bulk density (DBD: g/cm3) of the sediments and the liner sedimentation rate (LSR: cm/yr), we calculated the mass accumulation rate (MAR: g/cm2 yr) .

We constructed age-model for each core using the well-preserved shell samples. In PC1, GC6 and GC9, we plotted calendar age vs. TOC and CN ratio. PC1 does not have the hiatus and the water depth of PC1 (St. 1) site is 140 m below the present, so the lowest sea level was above -140m.

From 28 cal kyr BP, in PC1, TOC, CN ratio is gradually increased. This indicated that the catchment was spread in the Bonaparte Gulf by the cause of Sahul Rise exposed. MAR is reduced at the same timing, because the rise of the velocity of the current in the Gulf due to the post glacial transgression that the channel to the open (Timor Sea) became narrower as Sahul Rise being exposed. The depth of the water at Sahul Rise is about 60 m, so sea level at 28 cal kyr BP was about 60 m below.

In this study, we proved that at about 28 cal kyr BP Sahul Rise was exposed and the sea level is about -60 m.

We will reconstruct sea-level change and tilting at the broader area in the Bonaparte Gulf and predict the mantle viscosity from the estimation of the crustal tilting in future work.