論文の内容の要旨

Northwestern Australian sea level records during Marine Isotope Stage 2 from marine sediment cores and glacial isostatic adjustment model

（海洋堆積物コアと GIA モデルによる北西オーストラリアにおける
海洋酸素同位体ステージ 2 の相対的海水準の復元）

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Global sea level change in the glacial-interglacial cycles has been fluctuated with global ice volume change and also closely related to global and regional climate variabilities. A further understanding of climate variabilities requires the information of the timing and amplitude of sea-level change. Marine Isotope Stage 2 (MIS 2) is the latest glacial period (30,000–15,000 years ago), including the Last Glacial Maximum (LGM) characterized by the maximum of global ice volume. There are a plenty of paleoclimatic records during MIS 2 because this period is useful for radiocarbon dating, which is the widely accepted measurement. The comparison of various paleoclimatic records with sea-level change derives an understanding of the earth climate system. However, global sea-level change during MIS 2, especially the LGM, is less understood due to its paucity of data and its uncertainty. The Bonaparte Gulf, northwestern

Australia, is a suitable region to reconstruct the global sea level change since the Gulf is far from the former ice sheet and tectonically stable. Marine sediment cores in the Bonaparte Gulf therefore could provide the accurate sea-level records during MIS 2.

The main objective of this thesis is to reconstruct sea-level change during MIS 2 and revise the global ice volume history during the LGM. To achieve this objective, I constructed this thesis structure as follows. First, the sedimentary environment in the Bonaparte Gulf is discussed to evaluate the response to sea-level change during MIS 2 (*Chapter 2*). Second, exceeding 250 radiocarbon dates of sediment cores with various and continuous depths provide relative sea-level change in the Bonaparte Gulf (*Chapter 3*). Third, the new ice volume equivalent sea level (ESL) is proposed based on relative sea-level change discussed in *Chapter 3* using the glacial isostatic adjustment (GIA) model (*Chapter 4*). Finally, the comparison of the new ESL curve with other global sea level records and the implication for the relation with climate change are discussed (*Chapter 5*).

Sedimentary environmental change in the Bonaparte Gulf during Marine Isotope Stage 2 (Chapter 2): The Bonaparte Gulf, located in the northwestern Australian continental shelf, is the widest in the world with shallow carbonate terraces and platforms that were exposed during lower sea level. The dominant sediments type switches between carbonate and siliciclastic over a sea-level cycle. However, the mechanism of sedimentary environmental change in the Bonaparte Gulf is not well understood. The Bonaparte Gulf is known as one of the gulf influenced by large tide, up to 6.0 m, corresponding to the volume of Greenland Ice Sheet. Researches on past tidal range are required to reconstruct an accurate sea-level change. I present a record of sedimentary environmental change from ca. 35 to 24 cal kyr BP (calendar age kilo years before present), which is related to a sea-level variability and exposure of carbonate terraces and platforms. Multi-proxy data from a marine sediment core shows a sea-level change induced change in sedimentary environment from siliciclastic to carbonate-dominated sedimentation during the last glacial. Radiocarbon ages show the

timing of this switch occurred at ca. 26 cal kyr BP, associated with a local sea-level fall from -60 to -90 m. Tidal range during the lower sea level was negligible for sedimentary environmental change due to the protection of carbonate terraces and platforms from wave activity of the Timor Sea.

Marine Isotope Stage 2 relative sea-level records from sediment cores in the Bonaparte Gulf (Chapter 3): Yokoyama et al. [2000] reported that the LGM was terminated abruptly at ca. 19 cal kyr BP with a rapid sea-level rise (19 ka event) using marine sediment cores from the Bonaparte Gulf. Their sea-level reconstruction defined the age of the LGM termination, but the timing of its initiation was less constrained, partly because the number of radiocarbon analyses was limited to clarify the LGM duration. Here I document the MIS 2 sea level records using marine sediment cores with various depths from the Bonaparte Gulf, which would provide high-resolution information of paleo-water depth at the time of deposition. Sedimentary environments were determined using benthic foraminifera and geochemical analysis. More than 250 radiocarbon dates on carbonates and bulk organic matters provide precise age-depth models. The results reveal that relative sea level shows the short LGM duration of ca. 1,000 years at ca. 19 cal kyr BP. The pre-LGM sea level located a ca. 5 m shallower position than previous works suggested.

Ice volume equivalent sea level based on relative sea-level records from the Bonaparte Gulf using glacial isostatic adjustment model (Chapter 4): Global ice volume change is obtained using the glacial isostatic adjustment (GIA) model. However, ice volume history in GIA model (ESL: ice volume equivalent sea level) during the LGM is less constrained due to the paucity of observations. I propose a new ESL model based on results from GIA model and new relative sea-level records for the Bonaparte Gulf. This model could explain well with other MIS 2 sea-level records.