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Isotopic and trace elemental distributions in daily growth lines of giant clam

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Coral reef dwellers, such as giant clams, are potentially useful for reconstructing paleoclimates with high temporal resolution because they precipitate hard and dense aragonite shells with daily growth lines and have life spans of several decades to a few centuries. In contrast to corals, which have been widely used for reconstructing paleoclimates, the shell of giant clam is calcified essentially in isotopic equilibrium with surrounding seawater (Aharon et al., 1983). Recent microanalytical investigations on corals skeletons have revealed large chemical heterogeneities for isotopic and trace elemental ratios, which cannot be explained by changes of surrounding conditions such as sea surface temperature or salinity (e.g. Meibom et al., 2003 and Rollion-Bard et al., 2003). In analogy with corals, giant clams contain symbiotic algae. Furthermore, the observed daily growth lines in the inner shell layer of giant clams enable direct, temporally well-resolved comparison with in situ environmental data, which might further our understanding of the calcification process. Profiles of Sr/Ca and Mg/Ca ratios were determined at 40-micrometer spots size and 100-micrometer intervals using SHRIMP (Sensitive High Resolution Ion MicroProbe) in the specimen of giant clam collected from Okinawa, Japan. This transect represents approximately 1.5 years of growth. Previously, O isotopic data had been obtained on the same transect with approximately 50-micrometer spatial resolution (Watanabe and Oba, 1999). Variations in Sr/Ca and Mg/Ca are not well correlated and do not correlate strongly with O isotopic data. Micro-scale imaging of Sr and Mg was conducted by EPMA (Electron Probe Micro Analyzer). The EPMA imaging shows that the spatial distribution of Sr and Mg corresponds to the daily growth lines. These results imply that

trace elemental distributions primarily correspond with the microstructure of the shell and are primarily controlled by biological processes. An improved understanding of these biological processes is essential in order to be able to use carbonates precipitated by marine organisms as paleocliamte proxies. In this meeting, we also would like to present preliminary results of sub micro-scale analysis by using NanoSIMS (Nano scale Secondary Ion Mass Spectrometry) on this specimen.