

The submarine-cave sediments: implications for environmental variability over the last 2,000 years on coral reef at Okinawa

Akihisa Kitamura[1]

[1] Insti, Geo, Shizuoka Univ

We obtained a 43 cm-thick sediment layer from a submarine limestone cave on the fore-reef slope of Ie Island, off Okinawa mainland, Japan. The sediment was examined by binocular, mineralogical and geochemical means. Water temperatures measured within the cave for nearly one year show that patterns of daily temperature change are synchronous with the tidal cycle. The submarine-cave sediment consists of massive carbonate mud with sporadic molluscs and coralline sponge remains. Sediment grains consist mostly of carbonate debris, siliceous sponge spicules, coccoliths and benthic foraminifers. XRD analysis shows that the carbonate sediment consists of 50-58 percent high-Mg calcite, 30-37 percent aragonite and 9-19 percent calcite. There are no stratigraphic changes in both $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ for the carbonate mud, the former being about ± 1.2 permil and the latter about 1.3 permil PDB. Radiocarbon ages of excellently preserved epifaunal or semi-infaunal mollusc shells indicate that the average sedimentation rate increased from 16-17 cm per ka to 32-35 cm per ka after 610-320 cal BP. Based on a comparison of radiocarbon ages between mollusc shells and the bulk sediments yielding them, a proportion of the older carbonate detritus rapidly increased after 610-320 cal BP.

These data imply the following conclusions: (1) The exchange of water between the inside of the cave and the open sea occurs rapidly; (2) this hydrographic condition has persisted for the past 2,000 years; (3) carbonate mud is a major constituent of the submarine-cave deposit, and may mainly derive from suspended carbonate mud eroded from an emerged Holocene reef; (4) changes in both the sedimentation rate and supply rate for the older carbonate detritus within the cave imply that an increased discharge of groundwater has promoted recent degradation of the reef as a result of deforestation for agriculture.