Age and Growth of Three Bamboo Coral Species from the Northeastern Pacific Ocean

Allen H. Andrews[1] Robert P. Stone[2] Craig C. Lundstrom[3] Andrew P. DeVogelaere[4]

[1]Age and Longevity Research Laboratory, Moss Landing Marine Laboratories
California State University, USA

[2]NOAA Fisheries, Alaska Fisheries Science Center, Auke Bay Laboratories, Alaska USA

[3]University of Illinois - Urbana Champaign, Department of Geology, Illinois USA

[4]Monterey Bay National Marine Sanctuary, Monterey, California USA

Figure 1. *Keratoisis* sp. Davidson Seamount

Figure 2. *Isidella tentaculum* Gulf of Alaska

Introduction

Bamboo corals are common deep-water inhabitants of continental slopes and seamounts of the northeastern Pacific Ocean. They are extremely fragile, relatively large, and have a patchy distribution; three attributes that make them vulnerable to disturbance. The goal was to determine the age, growth rate, and recovery time from disturbance of bamboo corals from Davidson Seamount off California (Fig. 1) and the Gulf of Alaska (Fig. 2) using a refined lead-210 dating technique.

Methods

Corals were collected from Davidson Seamount in 2002 and 2006 using the ROV *Tiburon* from the R/V *Western Flyer* (Fig. 3). Gulf of Alaska corals were collected along the slope of SE Alaska from long-line surveys (Fig. 4). ID and collection data are in Table 1. Radial sampling of skeletal cross sections using a New Wave® micromilling machine provided an opportunity to measure lead-210 with higher resolution (Fig. 5). Successive radial samples increased the sample size and lead-210 activity for the same formational period by sampling "cylinders" of growth (Fig. 5). Lead-210 dating relies on the decay of lead-210. Sample sections were from cylindrical portions away from the base; colony age was a calculated using the rate and base diameter.

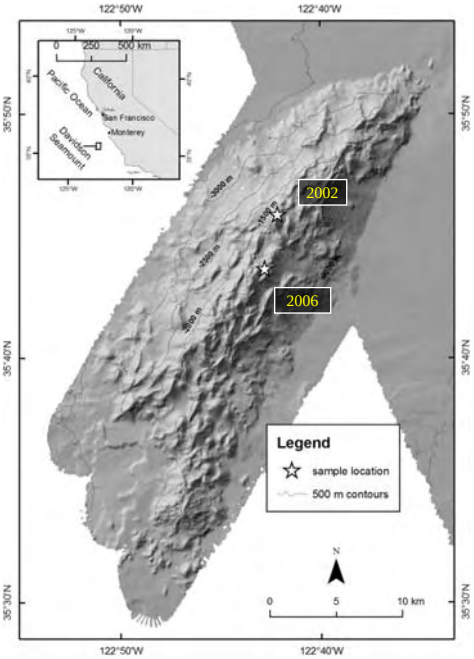

Figure 3. Davidson Seamount sampling locations in 2002 & 2006.

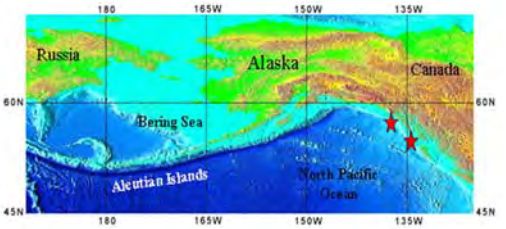

Figure 4. Gulf of Alaska sampling locations in 2006. *Isidella tentaculum* was from the southerly location of the two red stars.

Table 1. Data for specimens collected for this study. Specimen ID was made for 3 of the 4 colonies using genetic analyses; *Keratoisis* D grp? is unverified.

Species	Location	Depth (m)	Obs. height (cm)
Keratoisis sp. (D grp?)	Davidson Seamount	1425	irregular
Keratoisis sp. (D1a[1])	Davidson Seamount	1574	70
Keratoisis sp. (B1c[2])	Gulf of Alaska	746	120
Isidella tentaculum[3]	Gulf of Alaska	874	70

1. Genetic identification by Scott France, University of Louisiana at Lafayette (haplotype igr4-12 / msh1 D1a).
2. Genetic identification by Scott France, University of Louisiana at Lafayette (haplotype igr4-9 /msh1 B1c)
3. Recent taxonomic identification by Peter Etnoyer, Harte Research Institute, Texas A&M University.

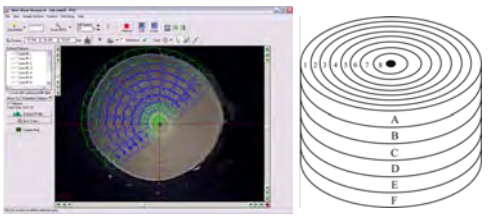

Figure 5. Micromilling screen shot with 3D serial sampling design.

Davidson Corals

Lead-210 dating for two *Keratoisis* sp. (D group) colonies converged on a radial growth rate of ~0.055 mm•yr^{-1} (Figs 6 & 7). For the smaller of the two colonies (~70 cm tall), the age was ~98 years with an average axial growth rate of ~0.7 cm•yr^{-1} (Table 2). A minimum age of 145 years (upper limit of 450 years) was determined for the largest colony; an irregular shape precluded determination of an axial growth rate, but based on one major branch length the axial growth rate ranged from 0.09 to 0.24 cm•yr^{-1}. Differences in the axial growth rates between the two colonies may indicate nonlinear growth with increasing colony height.

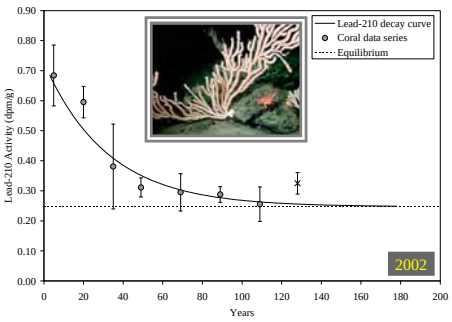

Figure 6. Lead-210 decay of Davidson *Keratoisis* sp. (D grp?).

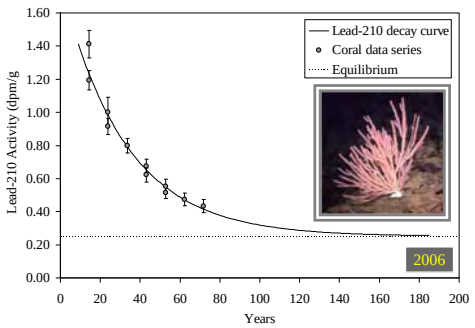

Figure 7. Lead-210 decay of Davidson *Keratoisis* sp. (D1a).

Alaska Corals

Lead-210 dating of the *Keratoisis* sp. (B group) colony provided a radial growth rate of ~0.056 mm•yr^{-1} (Figure 8), similar to the Davidson Seamount *Keratoisis* sp. (D group). The 120 cm tall colony was aged at ~116 years with an average axial growth rate of ~1.03 cm yr^{-1} (Table 2). Lead-210 dating of the *Isidella tentaculum* colony provided a radial growth rate of ~0.099 mm yr^{-1} (Figure 9). The 72 cm tall colony was aged at ~53 years an with an average axial growth rate of ~1.32 cm•yr^{-1} (Table 2).

Table 2. Growth rates and estimated ages calculated for full colonies based on lead-210 data, and constrained by lead-radium equilibrium at 100 yr (footnote 1). Colony age was estimated based on the basal diameter. Axial rate (growth in height) was calculated assuming constant growth. *Keratoisis* sp. (D grp?) is a tentative ID at this time.

Species	Radial rate (mm/yr)	Colony age (yr)	Axial rate (cm/yr)
Keratoisis sp. (D grp?)	0.12 - 0.025	-	-
Equilibrium limited[1]	0.055[1] - 0.025	145 - 450	0.093 - 0.24
Keratoisis sp. (D1a[2])	0.054 - 0.059	95 – 105	0.67 - 0.74
Keratoisis sp. (B1c[3])	0.050 - 0.069	103 - 129	0.93 – 1.16
Isidella tentaculum[4]	0.092 - 0.11	49 -57	1.23 – 1.46

1. Equilibrium limited at ~100 years eliminates more rapid growth rates.

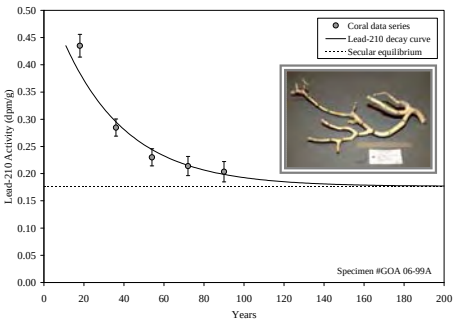

Figure 8. Lead-210 decay of Alaska *Keratoisis* sp. (B1c).

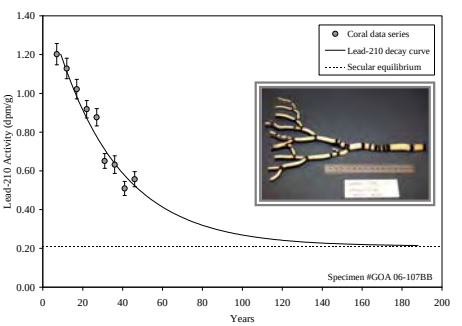

Figure 9. Lead-210 decay of Alaska *Isidella tentaculum*.

Conclusions

Refined lead-210 dating provided well constrained estimates of age and growth for bamboo corals. Growth rates determined in this study were similar to other bamboo coral studies. *Isidella tentaculum* has the greatest recovery potential growing to nearly 0.75 m in ~50 years. *Keratoisis* spp. seem to be slow growing and long lived every where they have been studied and recovery from disturbance may not happen in our life time. Our findings of low growth rates and high longevity compare positively to those determined for bamboo corals from other regions of the Pacific Ocean and highlight the need for immediate conservation measures to protect these important, habitat forming, members of deep-sea ecosystems.

The Age and Longevity Laboratory at Moss Landing Marine Laboratories is doing other radiometric studies and we are looking for collaborative efforts with other invertebrates and fishes. Please inquire if interested.

Acknowledgments

We thank Dr. Les Watling (University of Hawaii at Manoa) and Dr. Scott France (University of Louisiana at Lafayette) for specimen identifications to the the genetic level. We feel strongly that this kind of taxonomic work is extremely important and encourage funding of the bamboo coral monograph.