# Oxygen Isotope Constraints on the Environment and Growth History of *Conus adversarius* from the Pliocene Pinecrest Sands of Florida

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*Conus adversarius* is an extinct species of predatory cone snails that produced a relatively large shell and is one of the few *Conus* species to coil counterclockwise (sinistral). Previous systematic work has focused on describing morphological variations within the species and reconstructing evolutionary relationships with other species. *C. adversarius* is abundant within the Pliocene Pinecrest Sands of Florida, an extremely fossiliferous deposit with over of 1,000 species of which ~70% are extinct. The well-preserved unit within which *C. adversarius* was collected, Unit 7, was a relatively open-marine environment. Various mechanisms have been proposed to explain the nature of this unusual deposit of shells, ranging from enhanced productivity from upwelling and/or freshwater runoff to extensive winnowing of sediment that produced dense concentration of mollusks and other fossils.

To improve our understanding of both the growth dynamics of the species as well as the paleoenvironment of the Pinecrest Sands, we: (1) serially micro-sampled three specimens at a minimum of every quarter-whorl from aperture to apex; (2) determined oxygen stable isotopic variations via mass-spectrometry; and (3) converted these isotopic data into ambient water temperatures using a standard paleotemperature equation and a local Pliocene $\delta^{18}O$ seawater estimate from global ice-volume and regional evaporation-precipitation balance. This approach allowed us to address two basic questions:

*What was the mean annual temperature (MAT) and mean annual range in temperature (MART) during the lifetime of these specimens?* Pronounced sinusoidal oscillations in d18O were attributed to annual-scale temperatures variations. Based on this assumption, the three shells recorded relatively similar MAT (i.e., 24.9, 22.67 and 23.3°C) as well as MART (i.e., 8.47, 9.30, and 8.03 C°). These estimates are consistent with recent MAT and MART reconstructions by Tao and Grossman (2010), which employed a similar approach and attributed the Pinecrest's high productivity to enhanced nutrient supply from freshwater runoff and groundwater discharge based on trace- and minor-element concentrations.

*How long did each snail live and how did this growth history influence each specimen's final morphology?* The hypothesis that shell size and animal lifespan are highly correlated is not supported by the isotopic data. The largest and smallest specimens (90.9 and 73.8 mm in length, respectively) both lived approximately two years, but grew at slightly different growth rates (123.5 and 104.25 mm/year, respectively). The majority of the length difference reflects a greater apertural expansion rate, which is consistent with faster increase in body size over ontogeny. While such data cannot explain the cause of these growth differences, they provide important insights into the life-history of the organisms that should be included in traditional paleontological analyses.