# *Campanile giganteum* (Lamarck 1804) from the middle Lutetian (~45 Ma) Paris Basin: a potential seasonality archive?

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Fossil gastropod shells have often been used as paleoenvironmental and paleoclimatic archives (Andreasson & Schmitz 1996, Huyghe et al. 2015). Usually, stable carbon and oxygen isotopes, $\delta^{13}C$ and $\delta^{18}O$ respectively, and the incorporation of elements such as Sr and Mg, are used to reconstruct variations in paleotemperature and seasonality. However, most of the commonly used gastropod species only have lifespans of a few years. In this study, a *Campanile giganteum* (Lamarck 1804) specimen from the Lutetian of Fleury-la-Rivière (Paris Basin, France) was examined for its potential to reconstruct climate conditions during the middle Eocene. With an estimated lifespan of ~20 years, this extremely large species might provide an exceptionally long record of seasonal variations in temperature and salinity. A comparison to the nearest living relative, *Campanile symbolicum* (Iredale 1917), suggests that both taxa live at sublittoral depths in subtropical climates (Houbrick 1981).

Cathodoluminescence microscopy was performed on our specimen to evaluate the extent of diagenetic alteration. No significant alterations were found, illustrating the excellent preservation of carbonates at the Fleury-la-Rivière locality. Micro-X-Ray-Fluorescence line scanning was used to determine elemental concentrations in the columellar and parietal walls. Measuring along the columella of the gastropod yielded accurate results, indicating its potential as a future method of examination in long-living gastropods. Correlations between carbonate $\delta^{13}C$ and $\delta^{18}O$ values of the parietal wall segments and the corresponding elemental ratios of Sr/Ca (Fig.1) and Ba/Ca illustrate their potential as seasonality proxies. A possible paleoproductivity proxy using Sr/Ca and $\delta^{13}C$ was inferred. Our analyses also revealed a possible species-specific incorporation of Mg and Cl. A model for the growth of *C. giganteum* is proposed based on the growth of modern gastropod shells (Tojo & Ohno 1999).

This reveals the potential future use of carbon and oxygen isotopes incorporated into the secondary whorl infills as a paleotemperature archive after the main shell growth has stopped. Paleoclimatologically, it was found that the modern Red Sea represents a possible analogy to the Paris Basin in the middle Eocene. Using stable carbon and oxygen isotopes, mean annual seawater temperatures between 22°C and 23°C were reconstructed, with a range of ±5°C depending on the temperature calibration used. This is comparable to other ranges found for the middle Eocene of the Paris Basin (Andreasson & Schmitz 1996, Huyghe et al. 2015) and confirms the potential use of the geochemical composition of *C. giganteum* species as a paleotemperature and paleoseasonality proxy.

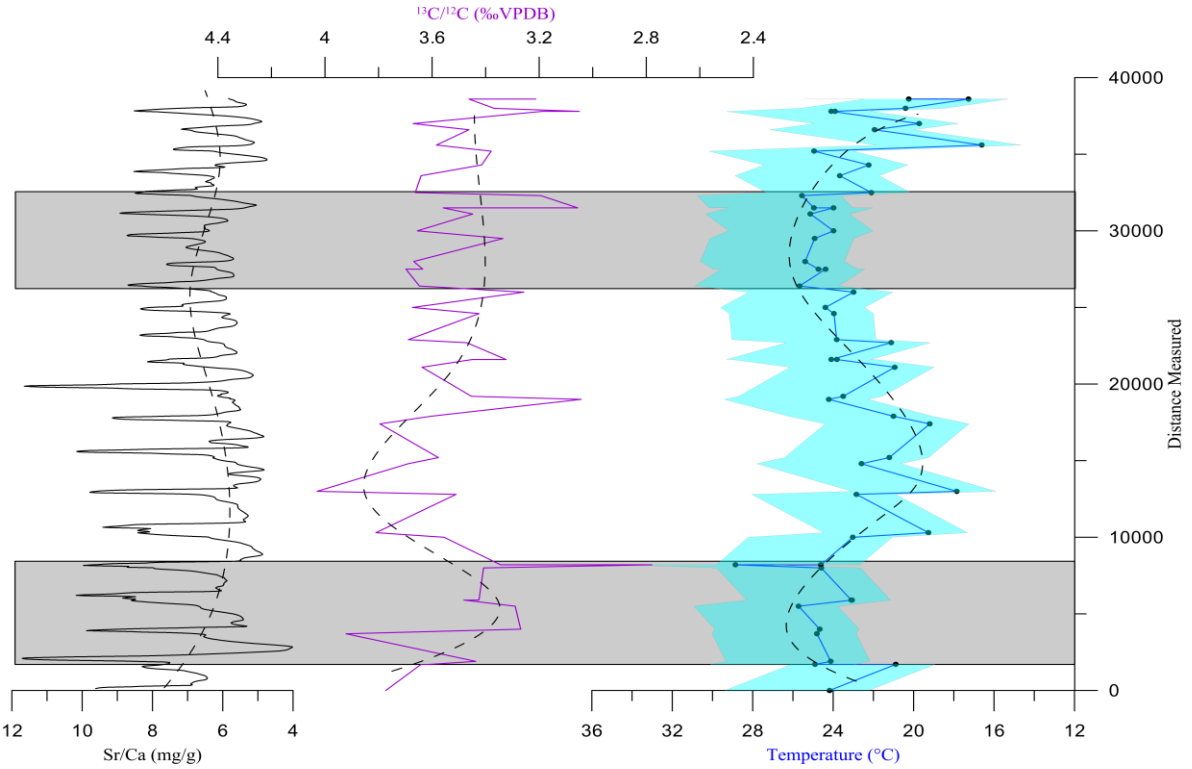


**Figure 1.** Temperature (based on $\delta^{18}O$), Sr/Ca and $\delta^{13}C$ ratios showing seasonality. The light grey areas represent summers while the white areas reflect other seasons. The dotted lines are manual fits of the data.

## References


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