

Bivalve *Glycymeris pilosa* as Data Archive of the Global Atmospheric ^{14}C Change and the Suess Effect

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Introduction

Glycymeris pilosa

is a large (> 8 cm), long-lived bivalve (>60 years) locally abundant in the Adriatic Sea (Peharda et al. 2016).

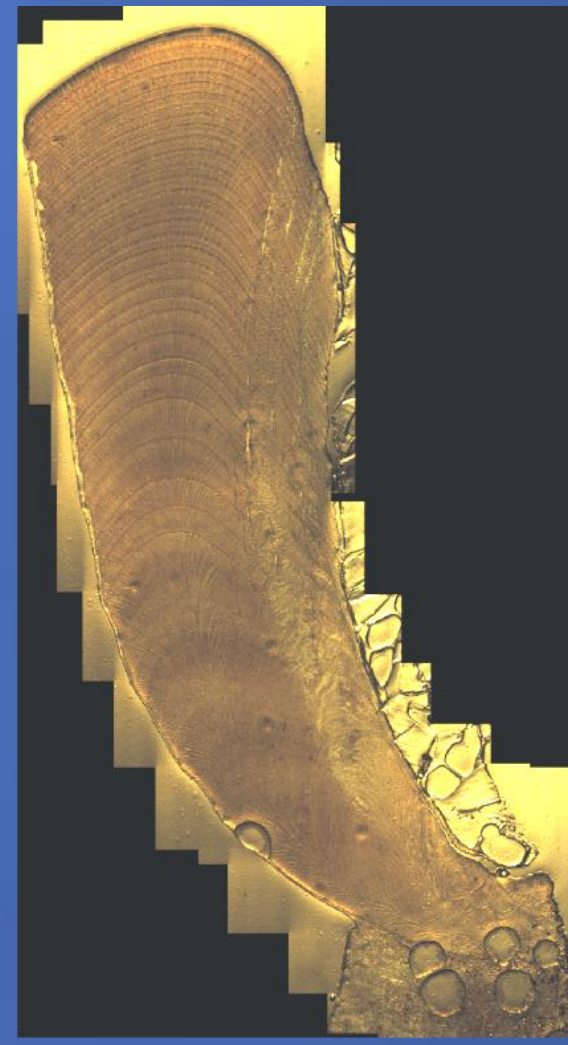
Species identity recently confirmed by Purroy et al. (2016) that demonstrated that it differs from *Glycymeris glycymeris*.

Due to their longevity and clear growth lines, species from *Glycymeris* genus are interesting source of geochemical data – including stable isotopes, trace elements and ^{14}C .



This research

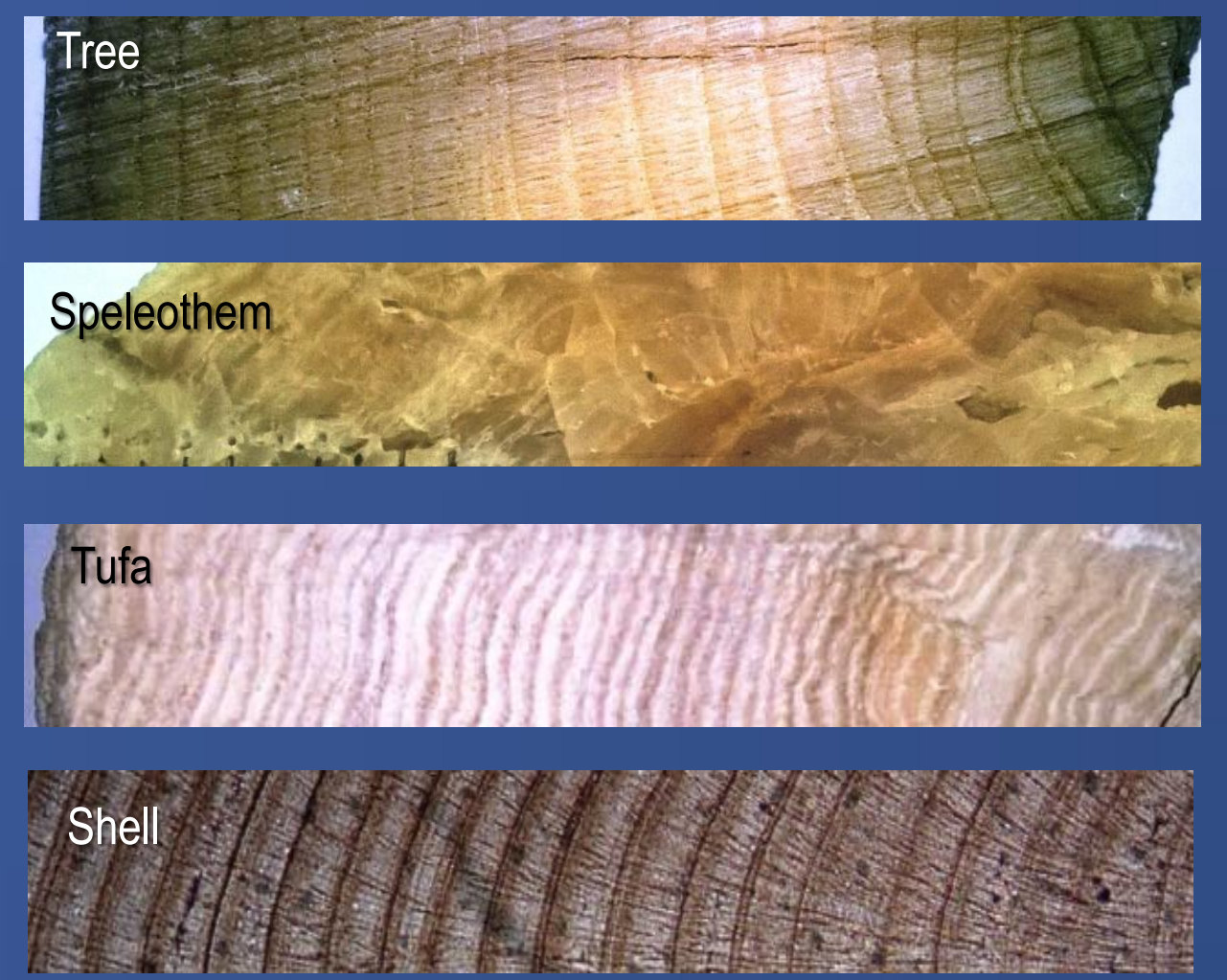
Glycymeris pilosa with clearly visible annual increments was studied for ^{14}C and ^{13}C composition. The study here involves 5 individuals that lived during 1948-2015 period in the north Adriatic Sea and one fossil which was dated both by ^{14}C (using the bomb peak curve) and sclerochronological methods.



Sclerochronology

is the study of physical and chemical variations in the accretionary hard tissues of organisms, and the temporal context in which they formed making it a natural data archive. The growth patterns reflect annual, monthly, fortnightly, tidal, daily, and sub-daily increments of time.

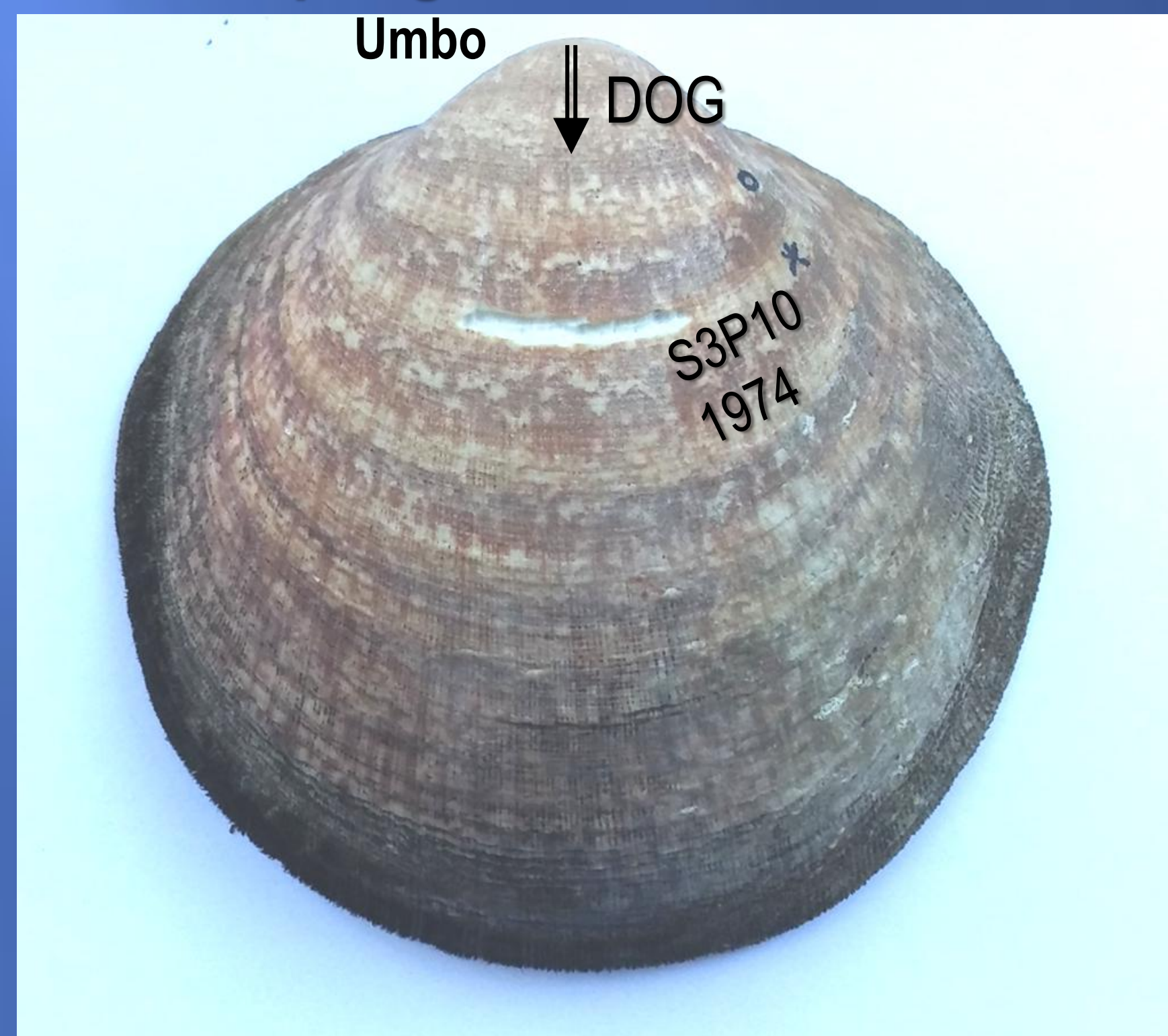
Natural archives
Trees, ice cores, speleothems, tufa, varved sediments, corals / sclerosponges / rodolites, fish otoliths, mollusk shells ...



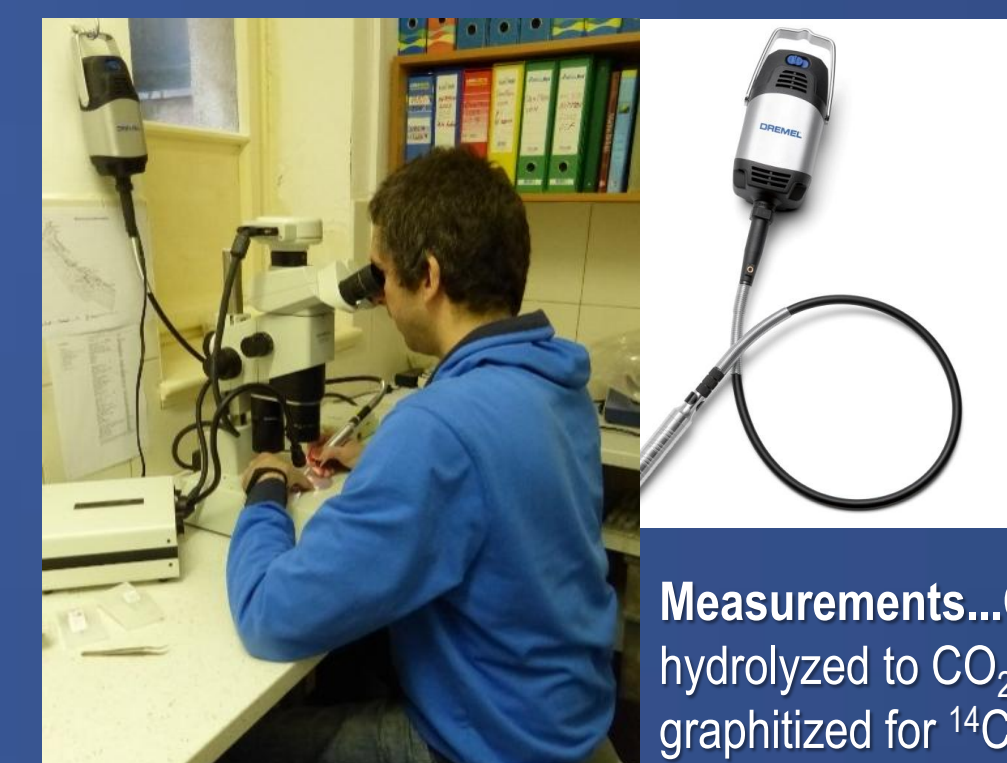
SITE



Sampling and measurements



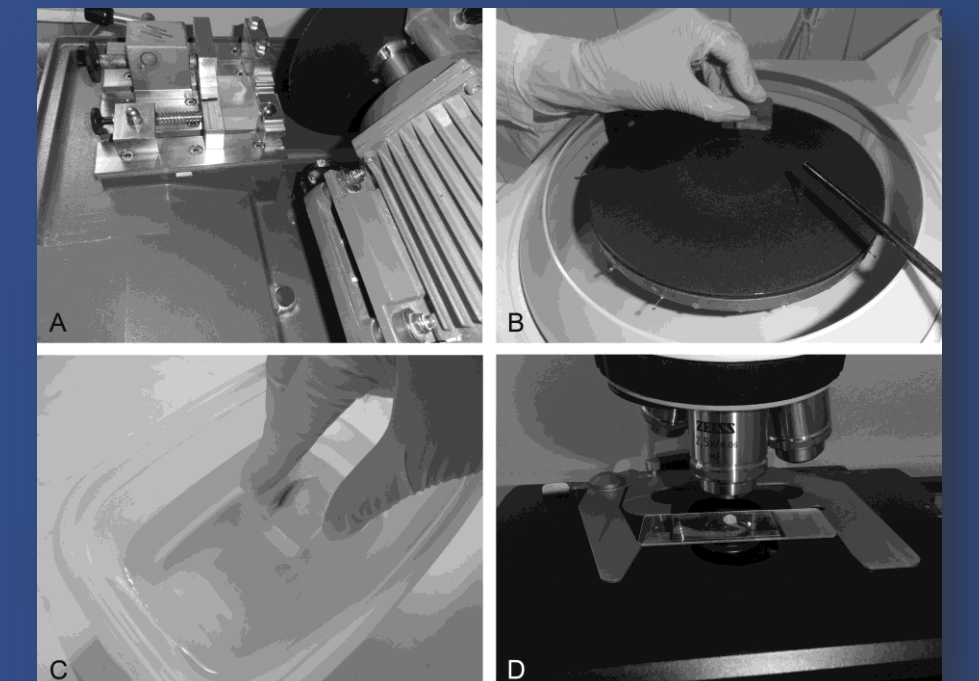
Glycymeris pilosa with marked direction of growth (DOG) of the shell and a notch after sampling for ^{14}C and ^{13}C analysis



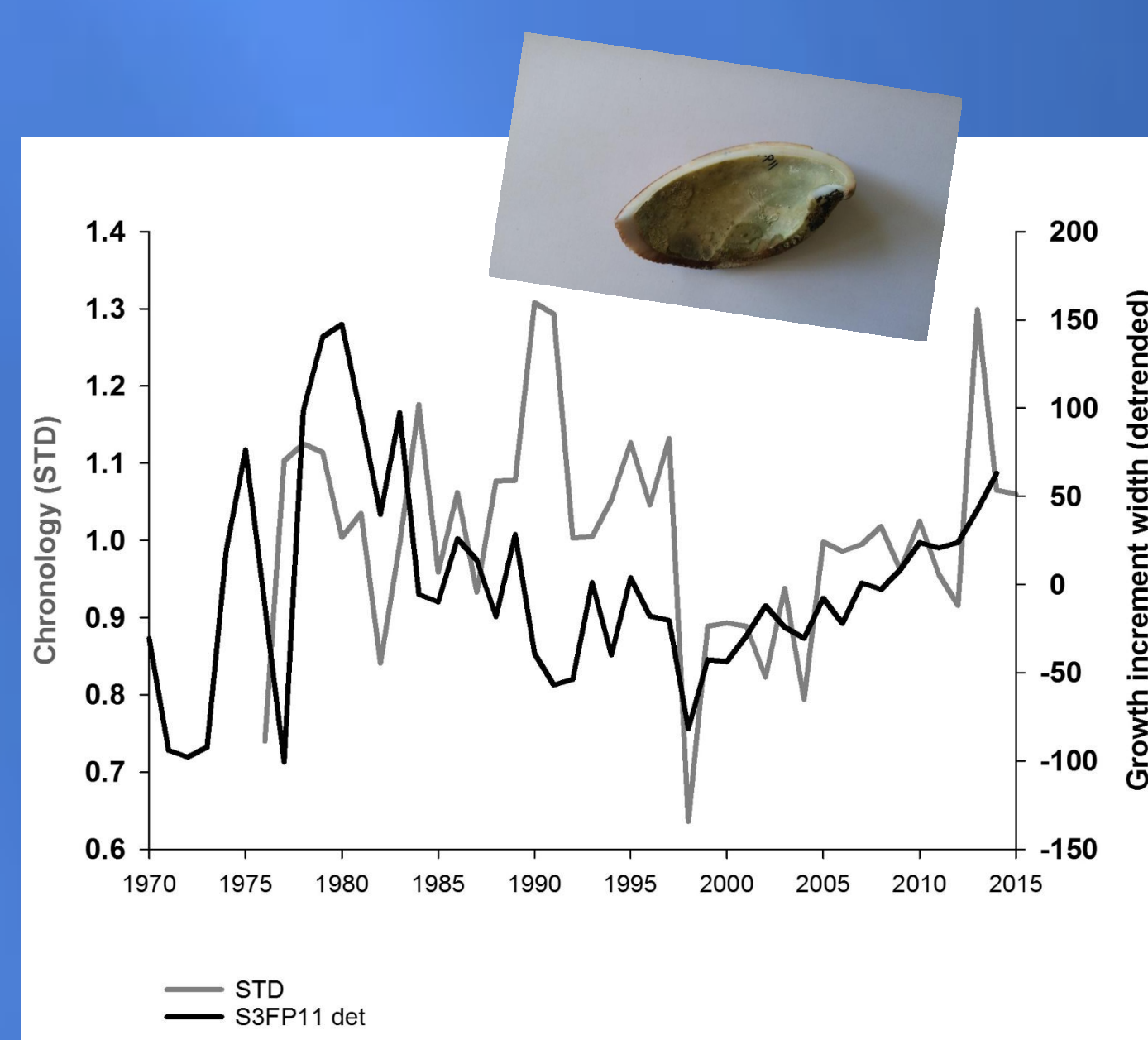
Layer sampling..Samples were collected by drilling shell powder from the shells by hand under stereo microscope using a DREMEL Fortiflex drill.

Measurements...Carbonate powder was hydrolyzed to CO_2 for ^{13}C analysis on IRMS and graphitized for ^{14}C AMS analyses. The ^{14}C values are corrected to the sampling date and ^{13}C fractionation.

Area around umbo of one valve of S3FP11 shell was cut, embedded in epoxy resin, cut along axis of maximal growth, ground, polished and acetate peel was prepared. Composite image and measurements were made in Image-Pro Premier software. Cross validation with chronology of live collected shells from Istria (Peharda et al. in preparation) was done in software package COFECHA.

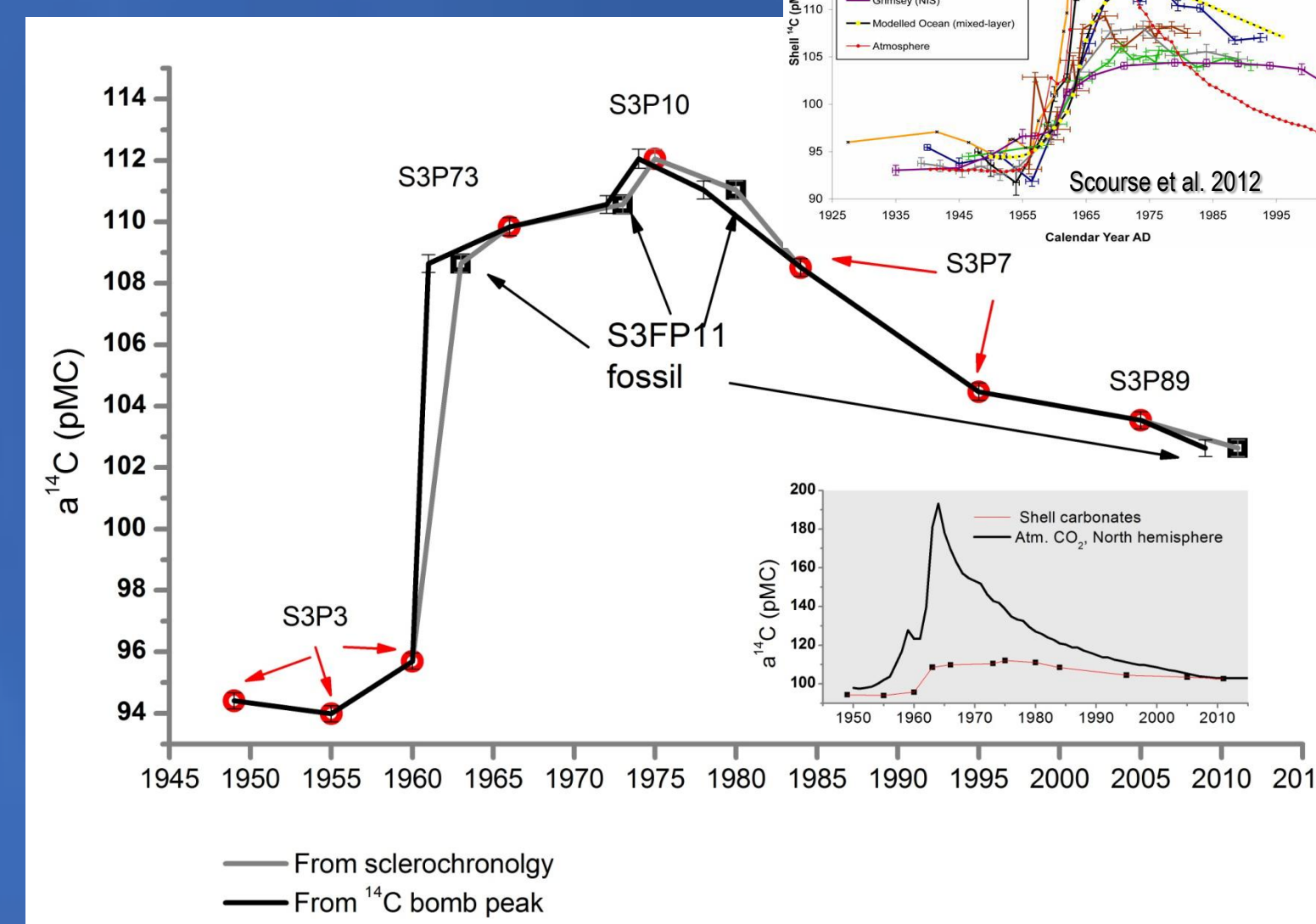


Results & Discussion

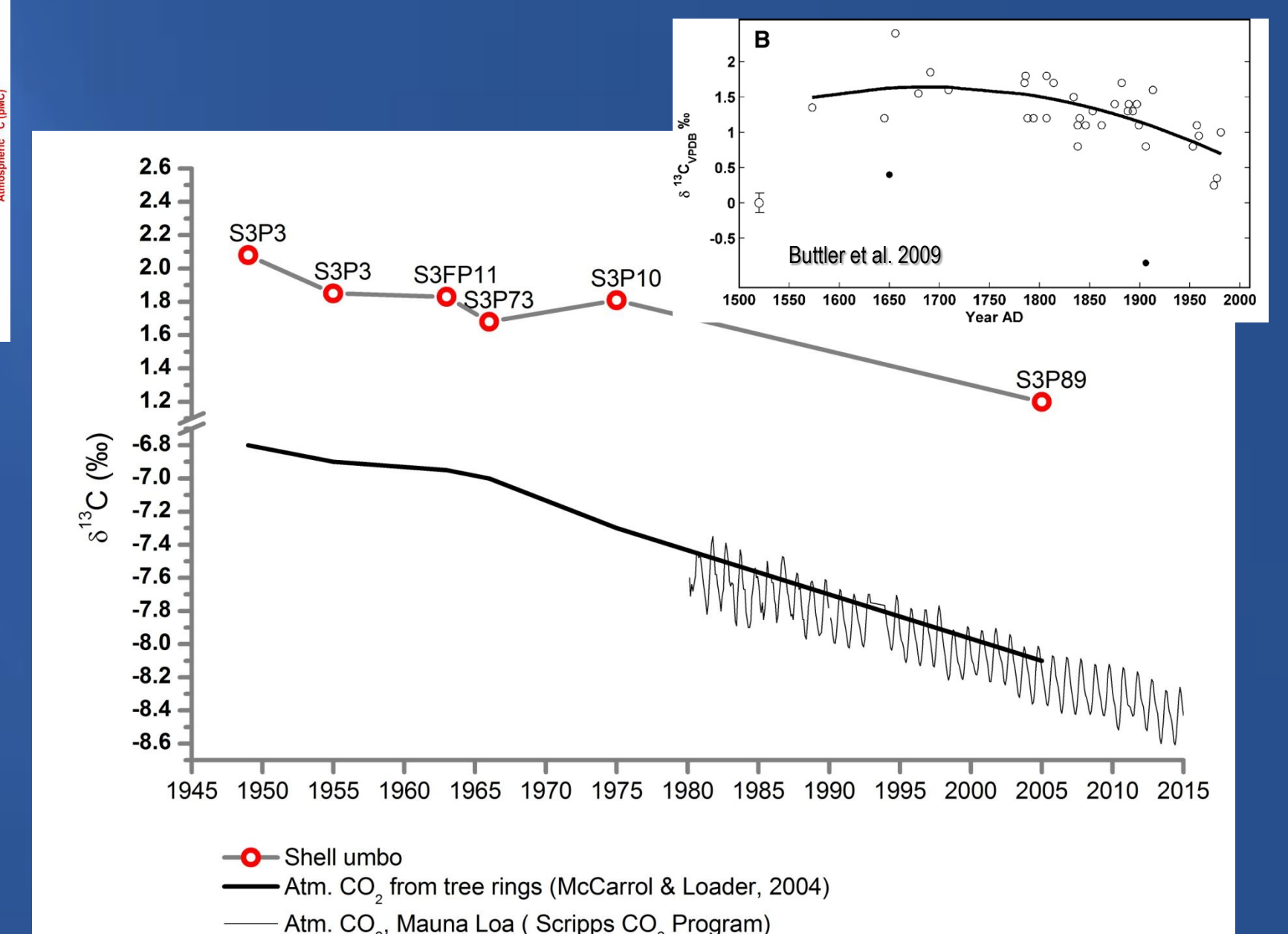


Chronology (STD-standard) for live collected *Glycymeris pilosa* from Barbariga (Peharda, in preparation) and detrended growth series for sample S3FP11 (fossil). Correlation in COFECHA was 0.511.

The marine reservoir age was determined from AD1945 layer of S3P3 live shell and calculated to be 265 years



Comparison of dates for layer in the fossil shell S3FP11 obtained by sclerochronology and by the least square method fit of the ^{14}C bomb peak curve reconstructed from live samples. The ^{14}C peak in shells carbonates is damped compared to the atmospheric CO_2 ^{14}C bomb peak curve (inner Figure). Also compared to the data for Atlantic ocean (upper Figure).



Values for $\delta^{13}\text{C}$ of carbonates from the shells umbo (3-10 first layers/years) are dropping in time probably reflecting the Suess effect. This is compared to the trend of $\delta^{13}\text{C}$ in atmospheric CO_2 reconstructed from tree rings and measured at Mauna Loa (Hawaii), both of which have steeper negative trend than the shells umbo. The similar was also observed in the Irish Sea (upper Figure).

Conclusion

- The calculated reservoir age in northern Adriatic is 265 years
- ^{14}C bomb peak reflection in *G. pilosa* is damped and can be used for precise dating of objects influenced by the marine reservoir effect
- ^{13}C temporal decrease in the umbo of the shells reflects the Suess effect
- Combining ^{14}C analyses with growth increments of fossil *G. pilosa* shells enables extending sclerochronologies to the early 20th century and before and reconstructing environmental changes (e.g. seawater temperature) during those periods

References

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