Laser-based stable isotopic analyses of carbonates to obtain high resolution climatic signals and its application to understand Early Harappan climate

Torsa Sengupta[1*], Arati Deshpande-Mukherjee[2], Ravi Bhushan[3], and Anindya Sarkar[1]

[1]Department of Geology and Geophysics, Indian Institute of Technology Kharagpur, Kharagpur, 721302, India
[2]Department of A.I.H.C. and Archaeology, Deccan College Post Graduate and Research Institute, Pune, 411006, India
[3]Physical Research Laboratory, Navrangpura, Ahmedabad, 380009, India

***Contact: torsasengupta13@gmail.com**

This presentation participates in OSPP

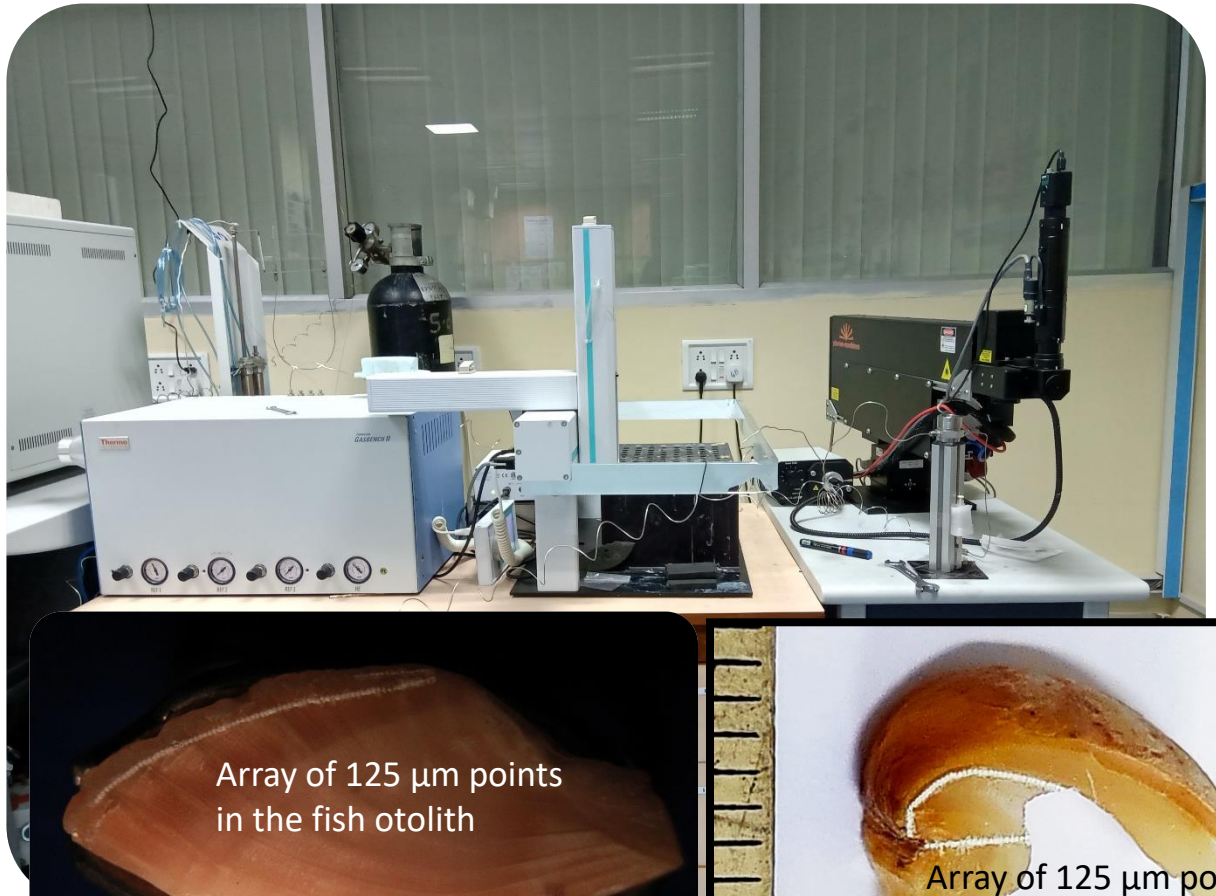
Outstanding Student & PhD candidate Presentation contest

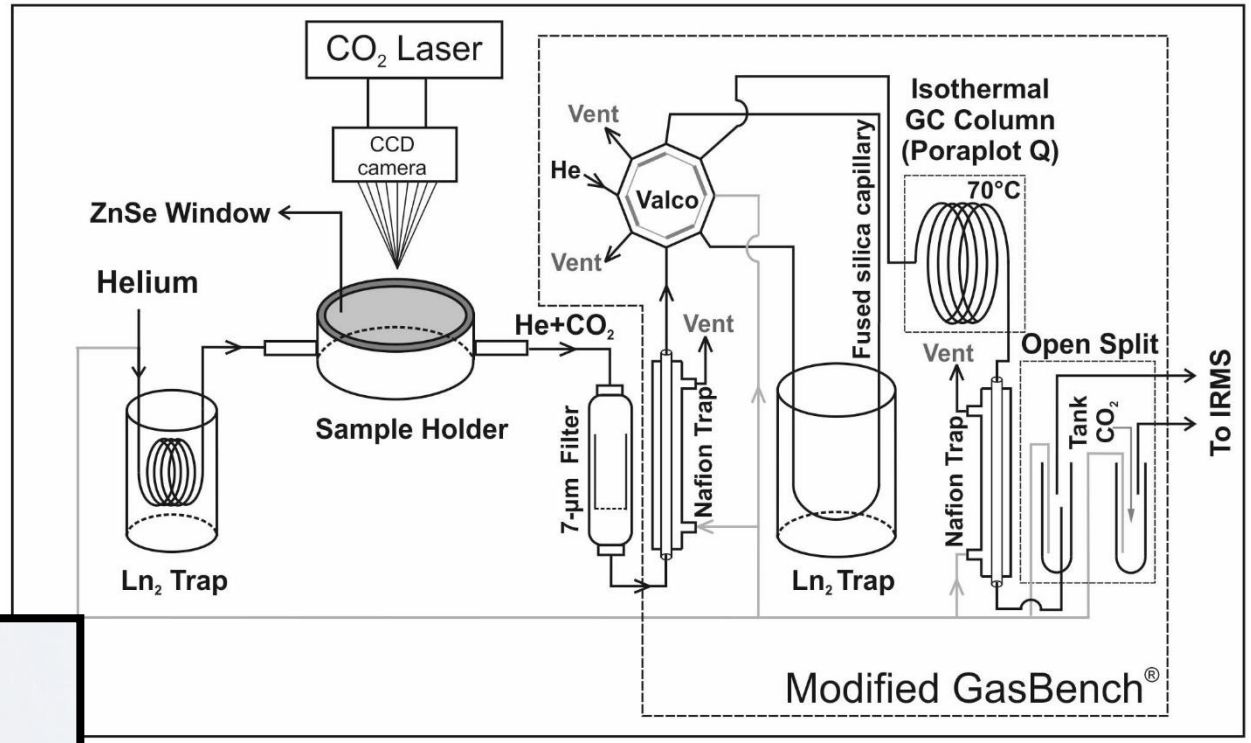
Abstract ID: EGU22-254

CL5.1.3 – Novel and quantitative methods for reconstructing continental palaeoenvironments, palaeohydrology and palaeofire

Laser-based stable isotopic Sclerochronology: the new rapid method for sclerochronological analyses

- New laser-based stable isotopic analyses is a faster method (1 point/3mins) for in situ stable isotopic analyses
- Aids in Sclerochronological analyses of accretionary biogenic carbonates
- Could reach up to 125 µm resolution



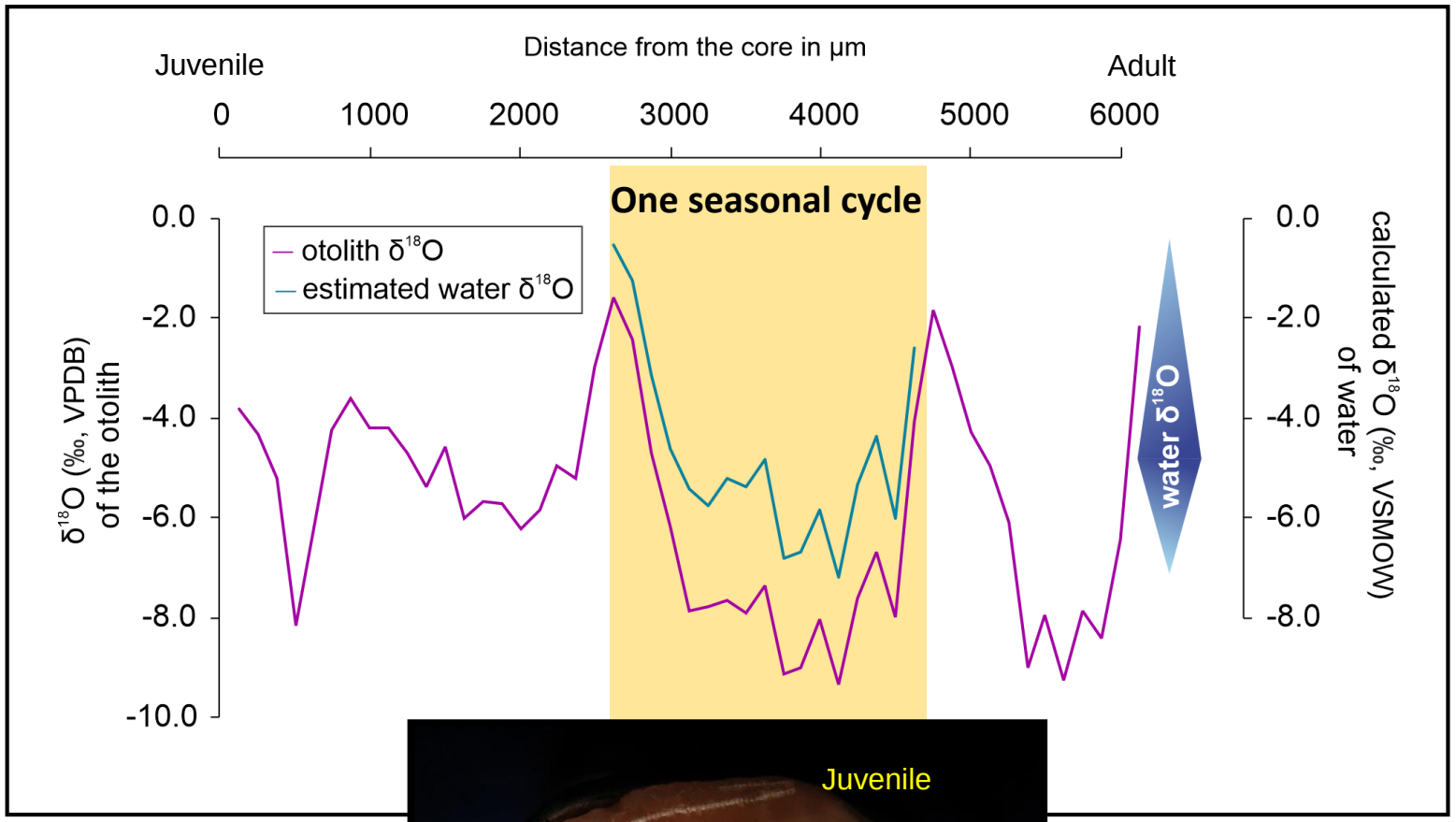


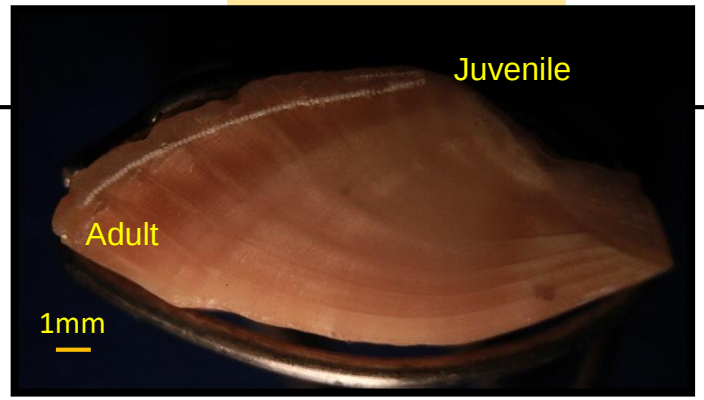
- Laser dissociation of carbonate:

$$CaCO_3 \rightarrow CaO + CO_2 \uparrow$$

- A dwell time of only 0.2s reduces possible fractionation

Sclerochronological analyses of the Early Harappan otolith





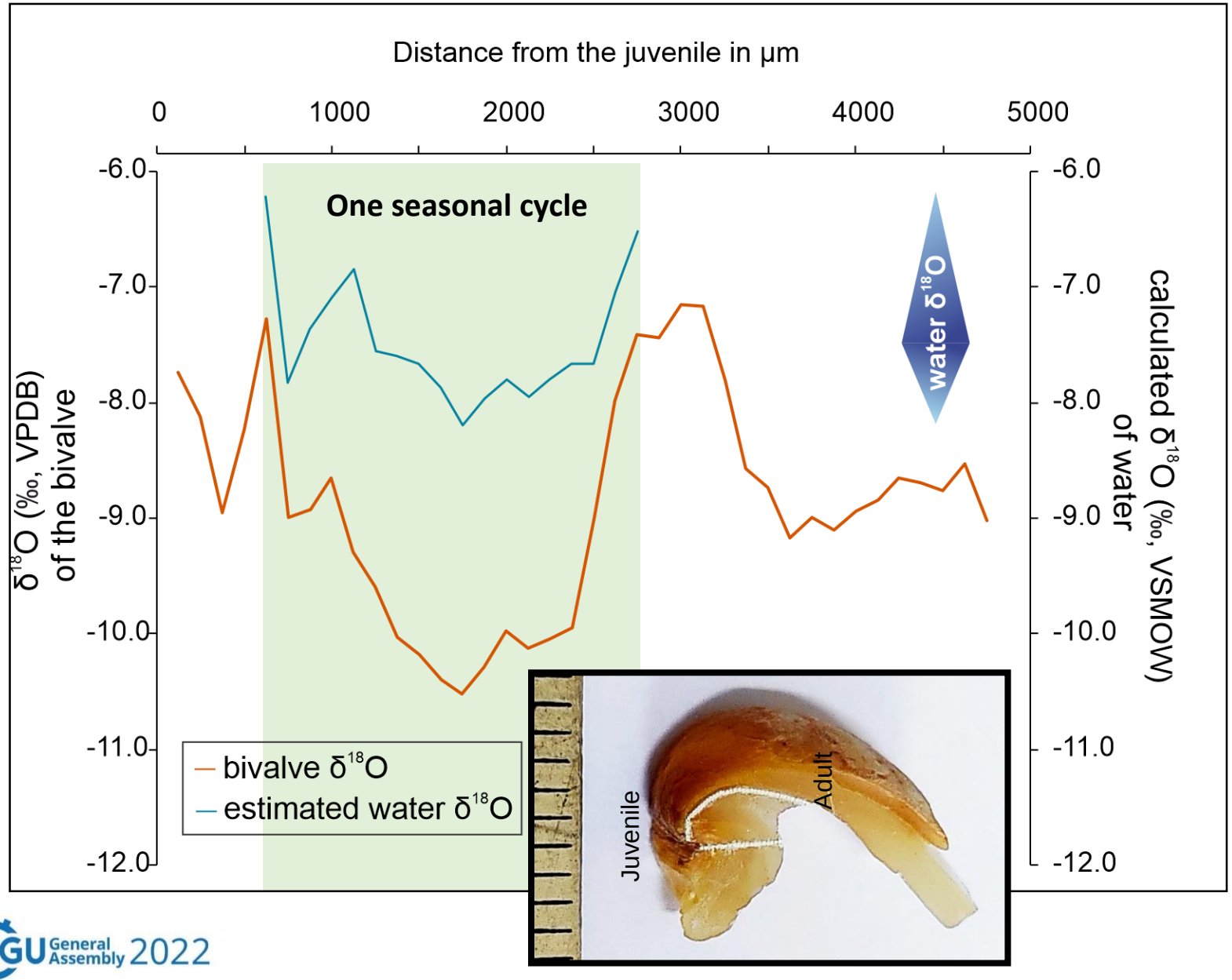
- AMS ^{14}C date: 4647 year BP
- $\delta^{18}O_{water}$: -0.5 ‰ to -7.2 ‰

$\delta^{18}O$ of brackish water (~15 ‰ salinity)	$\delta^{18}O$ of freshwater endmember
-0.5 ‰ (winter)	-1.5 ‰
-4.8 ‰	-8.7 ‰
-7.2 ‰ (summer)	-12.9 ‰

Presence of glacial fed river that helped the growth of agronomic society

Evaporative during winter explain the enrichment

Sclerochronological analyses of the Early Harappan freshwater bivalve



- AMS ^{14}C date: 5248 year BP
- $\delta^{18}O_{water}$: -6.2 ‰ to -8.5 ‰

$\delta^{18}O$ of lake/ pond water	High rainfall (~ +200mm more) than today ($\delta^{18}O$ of modern rainfall = -5 ‰ OR Presence of small streams with such negative water value
-6.2 ‰ (winter)	
-7.5 ‰	
-8.2 ‰ (summer)	

Higher rainfall; presence of streams; glacial fed river

Newly developed high-resolution Sclerochronology of biogenic carbonates suggested:

Conducive environment with higher rainfall and perennial river that supported agronomic development and helped Early Harappan culture to emerge in the present day dry landscape

Thank You

QR code for Abstract EGU22-254

Contact: torsasengupta13@gmail.com

Selected References:

1.Bisht, R. S. (2015). Excavations at Dholavira. *Excavation report to Archaeological Survey of India*.

2.Deshpande, R.D., Maurya, A.S., Kumar, B., Sarkar, A. and Gupta, S.K., 2010. Rain-vapor interaction and vapor source identification using stable isotopes from semiarid western India. Journal of Geophysical Research: Atmospheres, 115(D23).

3.Sengupta, T., Deshpande Mukherjee, A., Bhushan, R., Ram, F., Bera, M. K., Raj, H., ... & Juyal, N. (2020). Did the Harappan settlement of Dholavira (India) collapse during the onset of Meghalayan stage drought?. *Journal of Quaternary Science*, *35*(3), 382-395.