Going with the flow: Experimental simulation of sediment turbid transport from a foraminifera perspective

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Previously..

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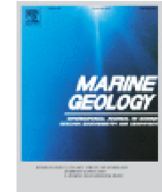
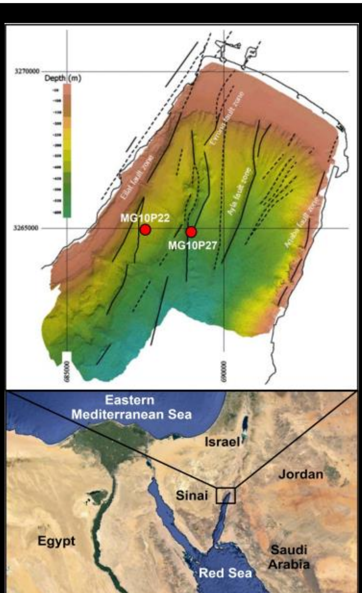
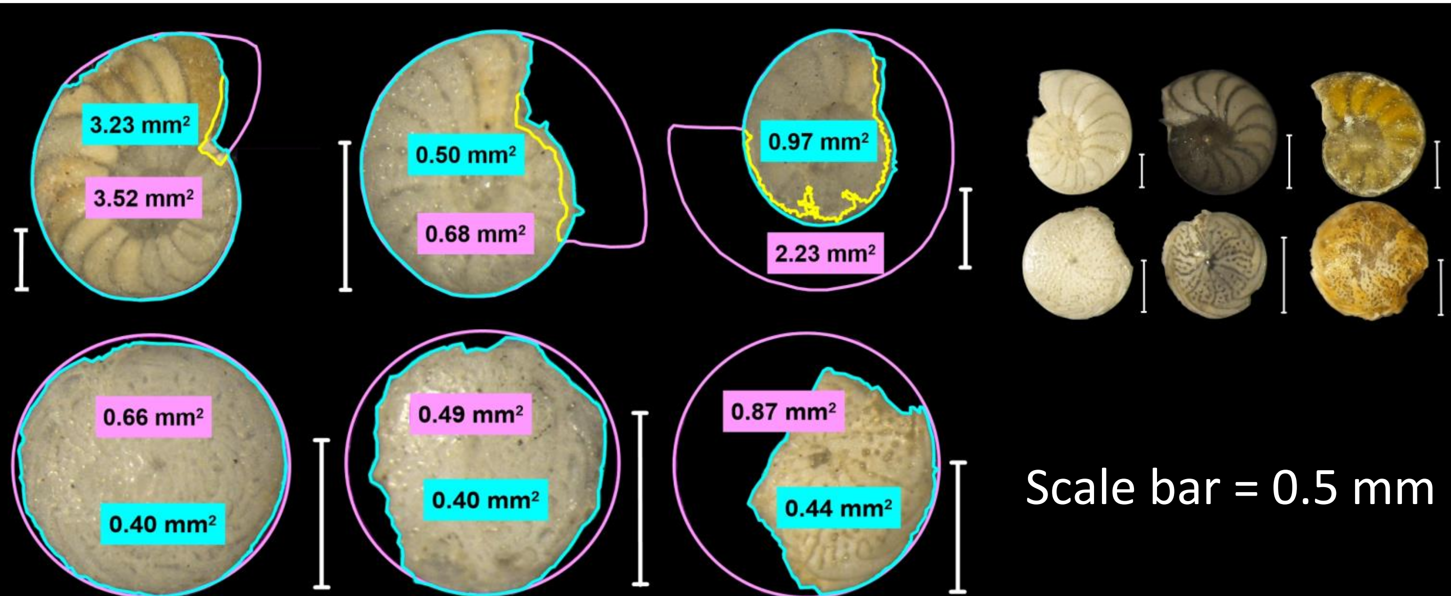


Micropaleontological and taphonomic characteristics of mass transport deposits in the northern Gulf of Eilat/Aqaba, Red Sea

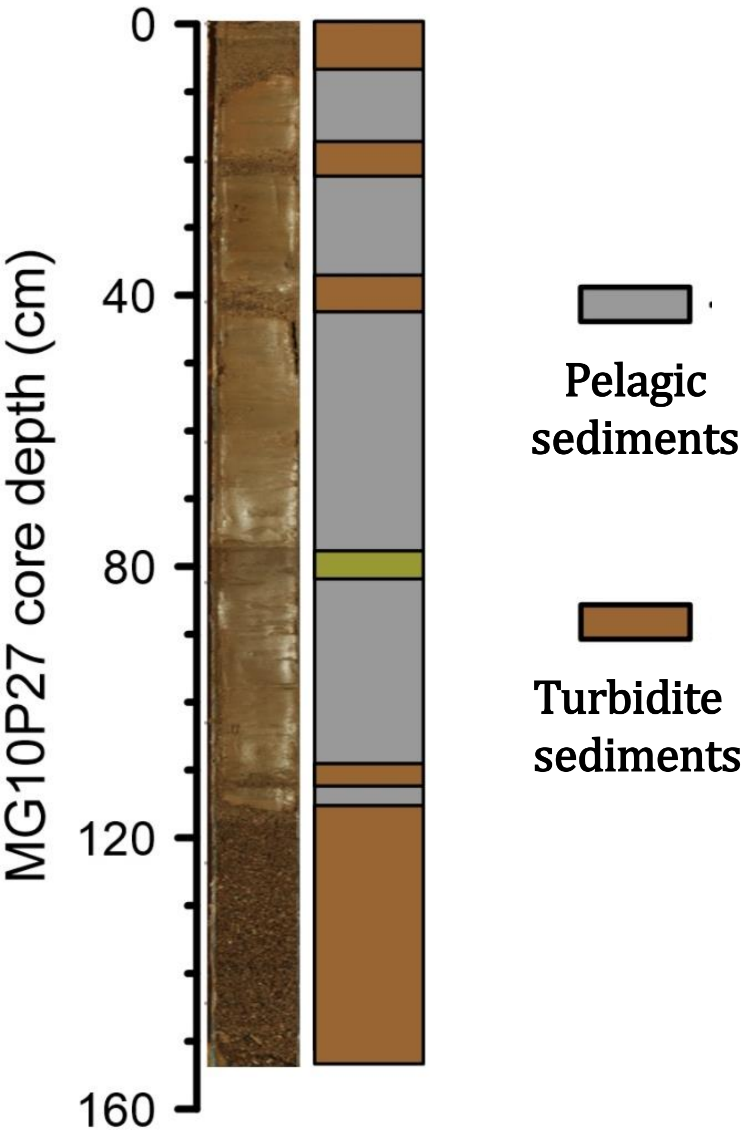
Anat Ash-Mor [a], Revital Bookman [a], Mor Kanari [b], Zvi Ben-Avraham [a, c], Ahuva Almogi-Labin [d]

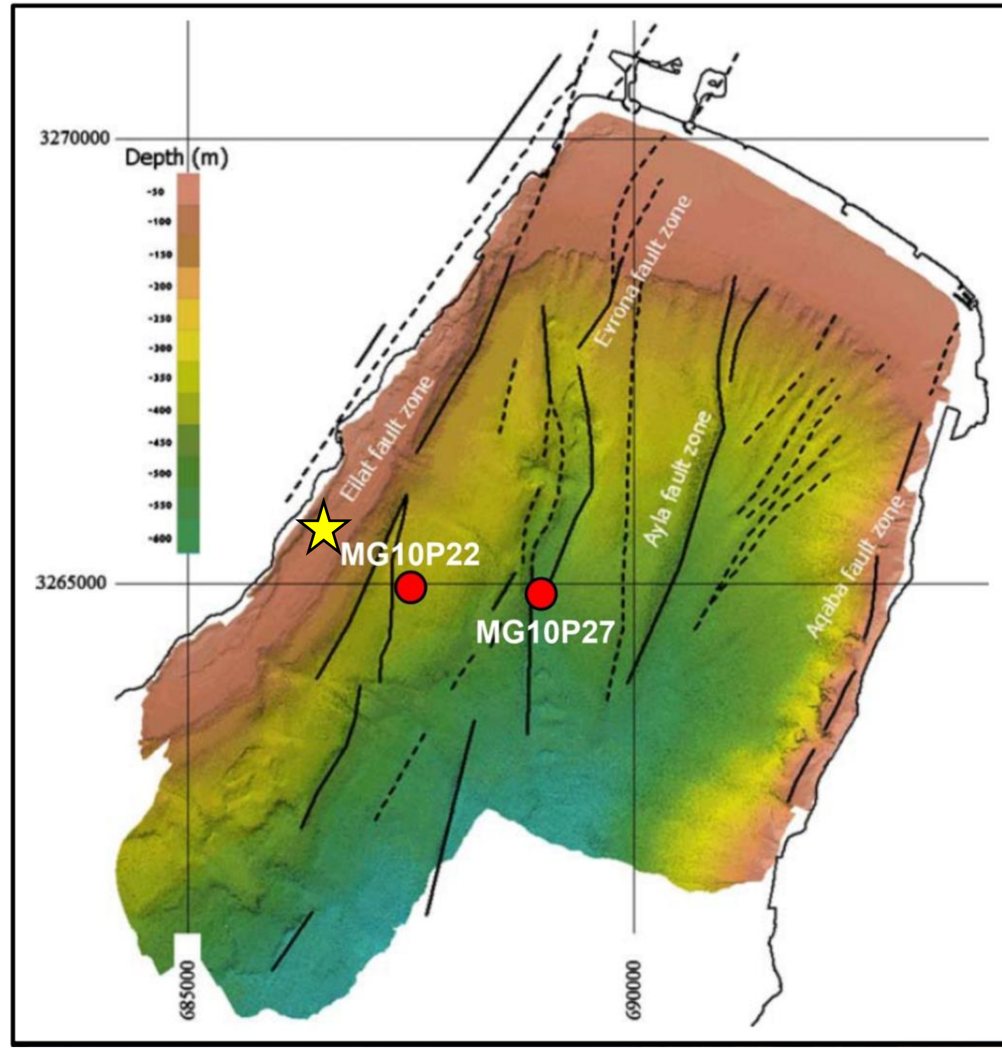




Present Goal: evaluating the energy and current velocities involved in turbidity transport processes.

ET14 survey
Sample collection





Core ID ★	Water depth (m)	Method	Weight (kg)
ET14#7	89.4	Grab	2.826
ET14#8	68.8	Grab	7.41

Active tectonic morphology and submarine deformation of the northern Gulf of Eilat/Aqaba from analyses of multibeam data

Gideon Tibor • Tina M. Niemi • Zvi Ben-Avraham • Abdallah Al-Zoubi • Ronnie A. Sade • John K. Hall • Gal Hartman • Emad Akawi • Abdelrahmem Abueladas • Rami Al-Ruzouq

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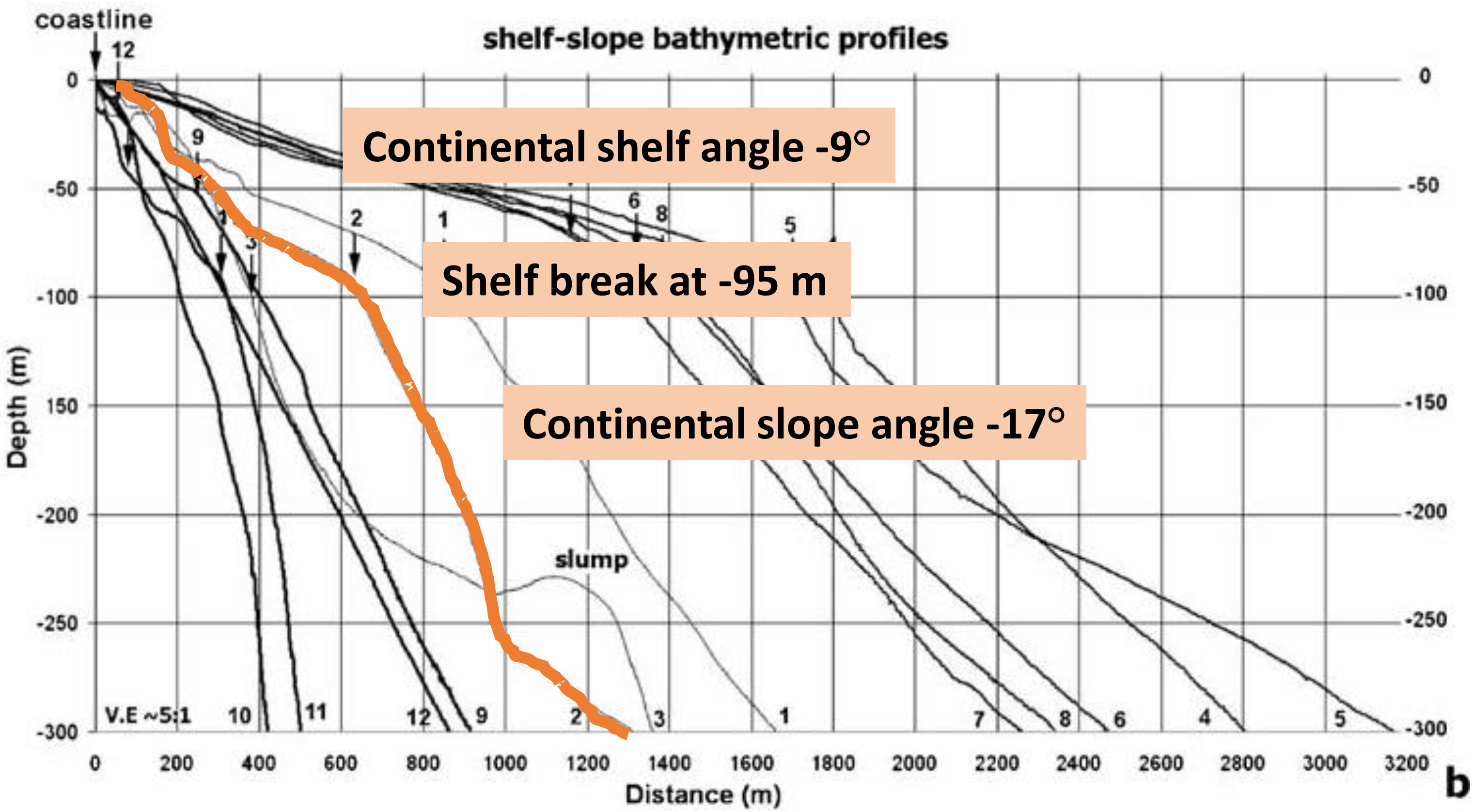
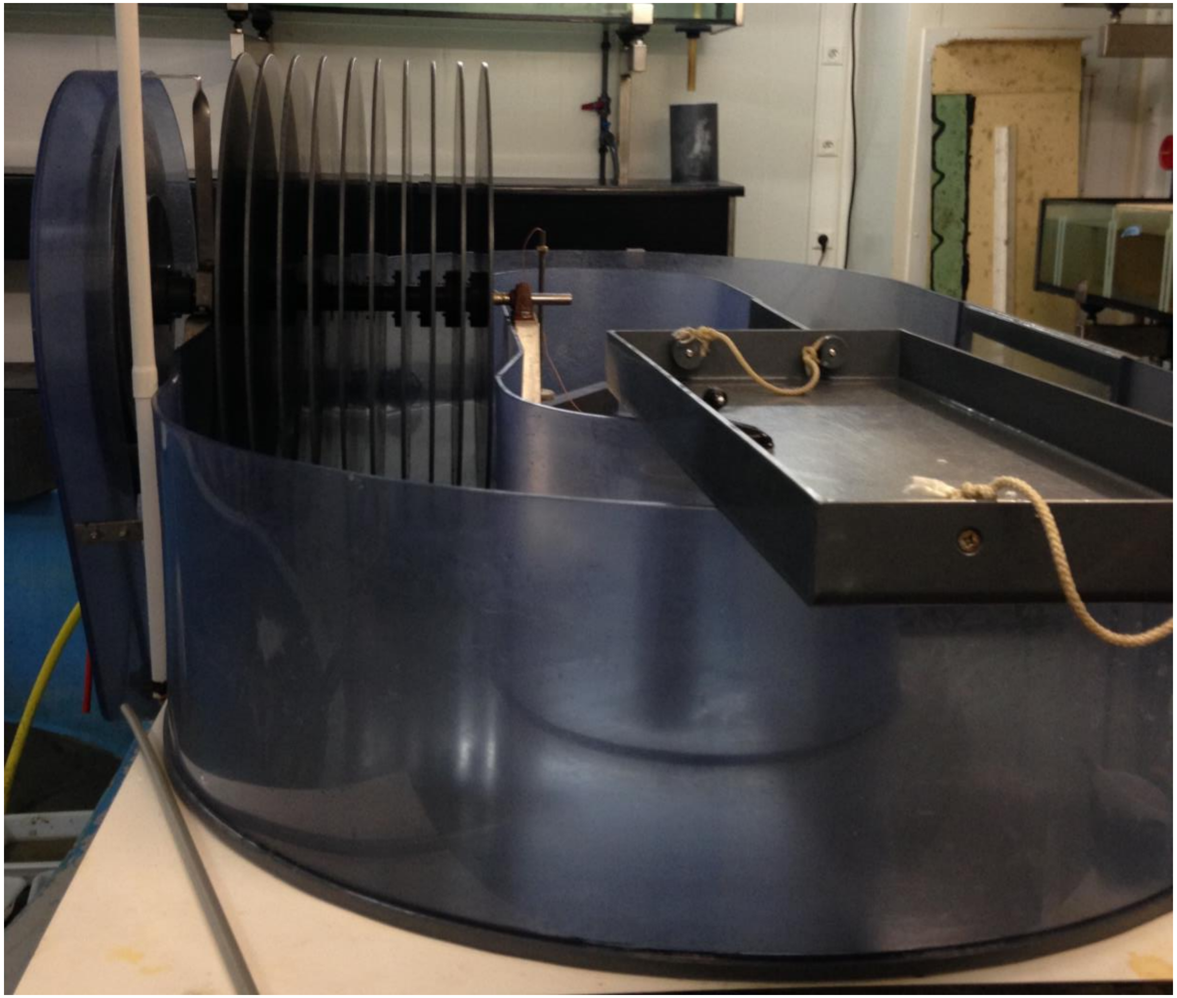


The flume system



- Water volume – 300 L
- Current velocities – 60 and 80 cm/sec

OPEN

SUBJECT AREAS:
PALAEOCEANOGRAPHY
BIODIVERSITY

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Unexpected biotic resilience on the Japanese seafloor caused by the 2011 Tōhoku-Oki tsunami

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events (2011 Tōhoku-Oki tsunami or Typhoon Songda) qualify as likely to cause the signatures observed. Simulated modelling of the regular Tsugaru Warm Current, the 2011 Tōhoku-Oki tsunami and Typhoon Songda velocities indicated that bottom-water speeds of investigated sediments reached up to 80 cm/s at depths lower than 100 m. This is beyond the estimated velocity of Typhoon Songda and

In-situ measurements of velocity structure within turbidity currents

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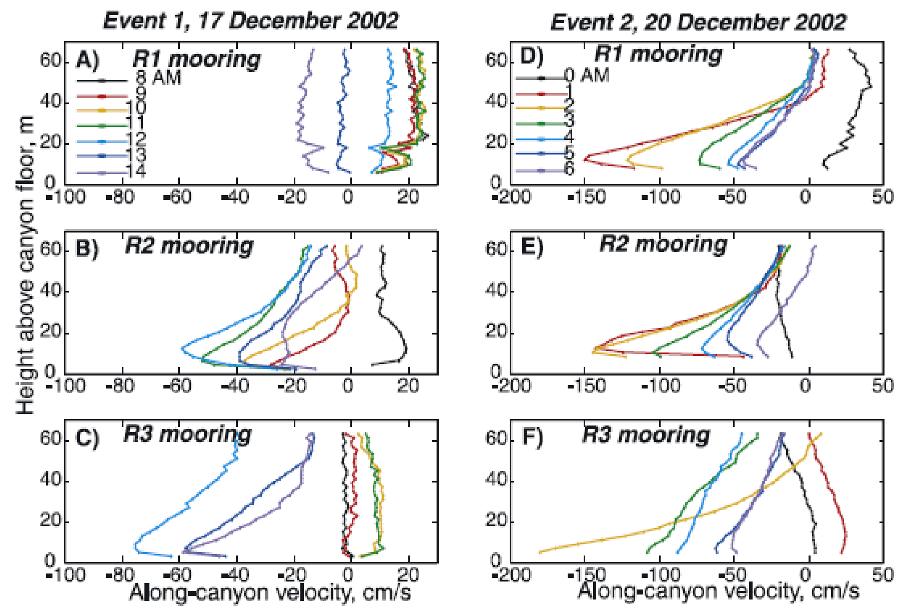
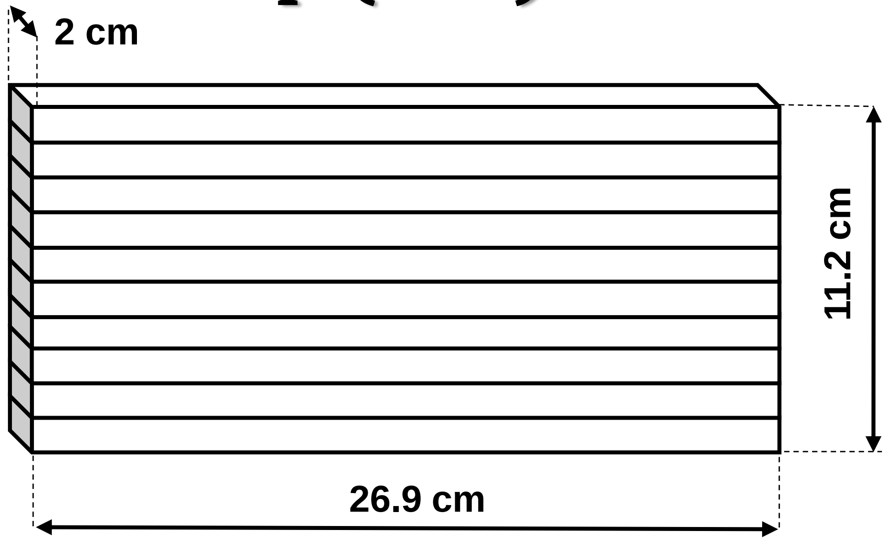


Vertical sediment trap (VST)

Open side



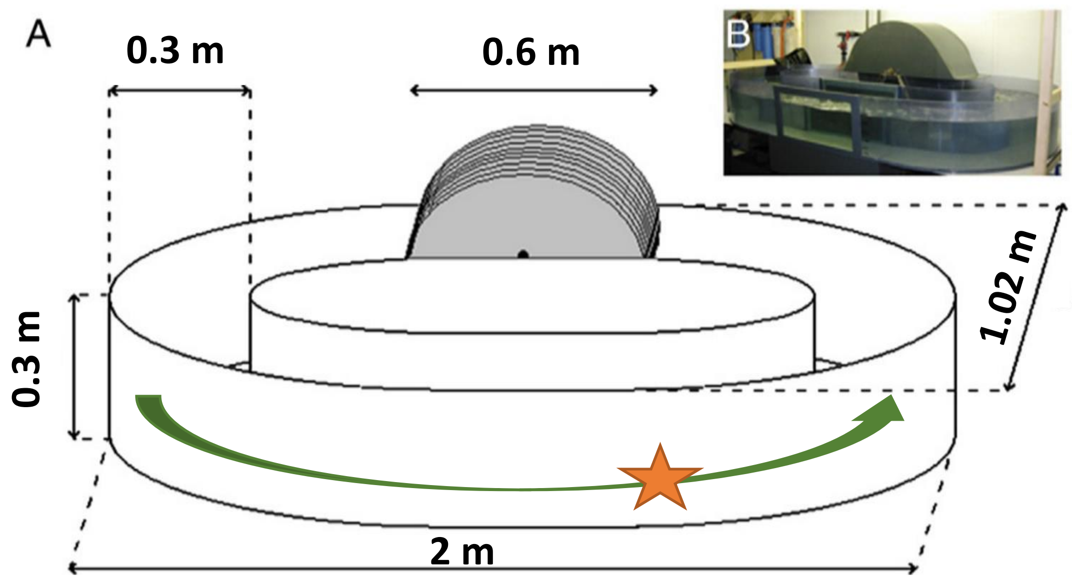
200 µm mesh

60 cm/sec samples = L1-10

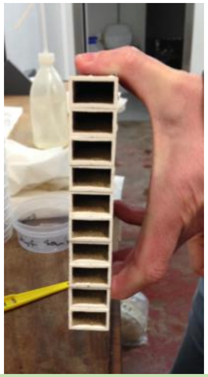
80 cm/sec samples = H1-10

Procedure

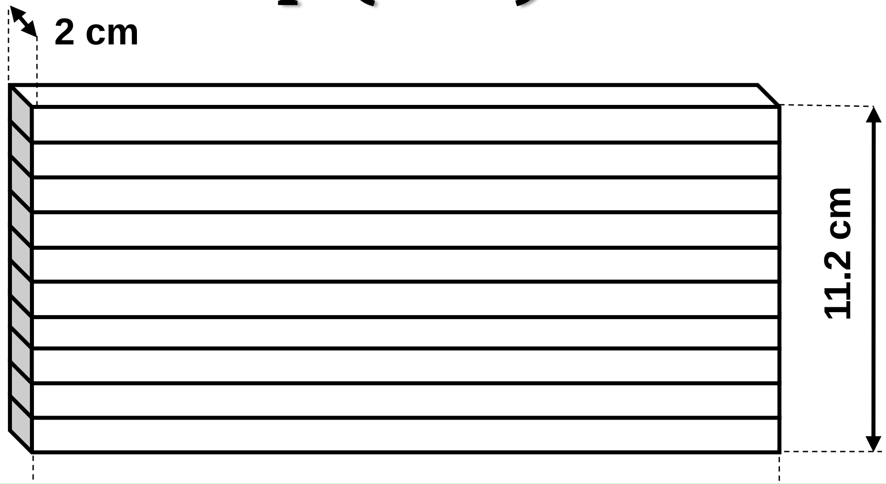
1. Motor ON
2. Acceleration – 5 min
3. Steady velocity – 5 min
4. Motor OFF
5. Accumulation – 10 min



Vertical sediment trap (VST)



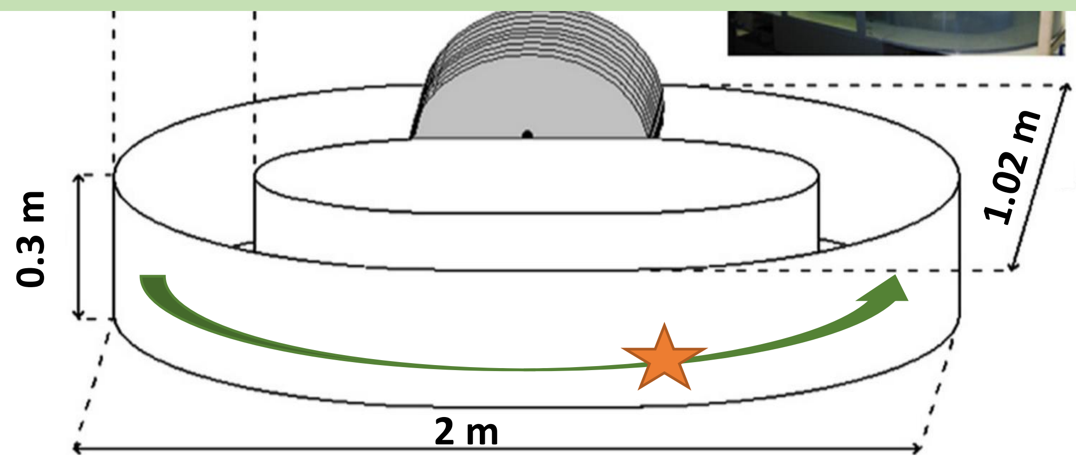
Open side



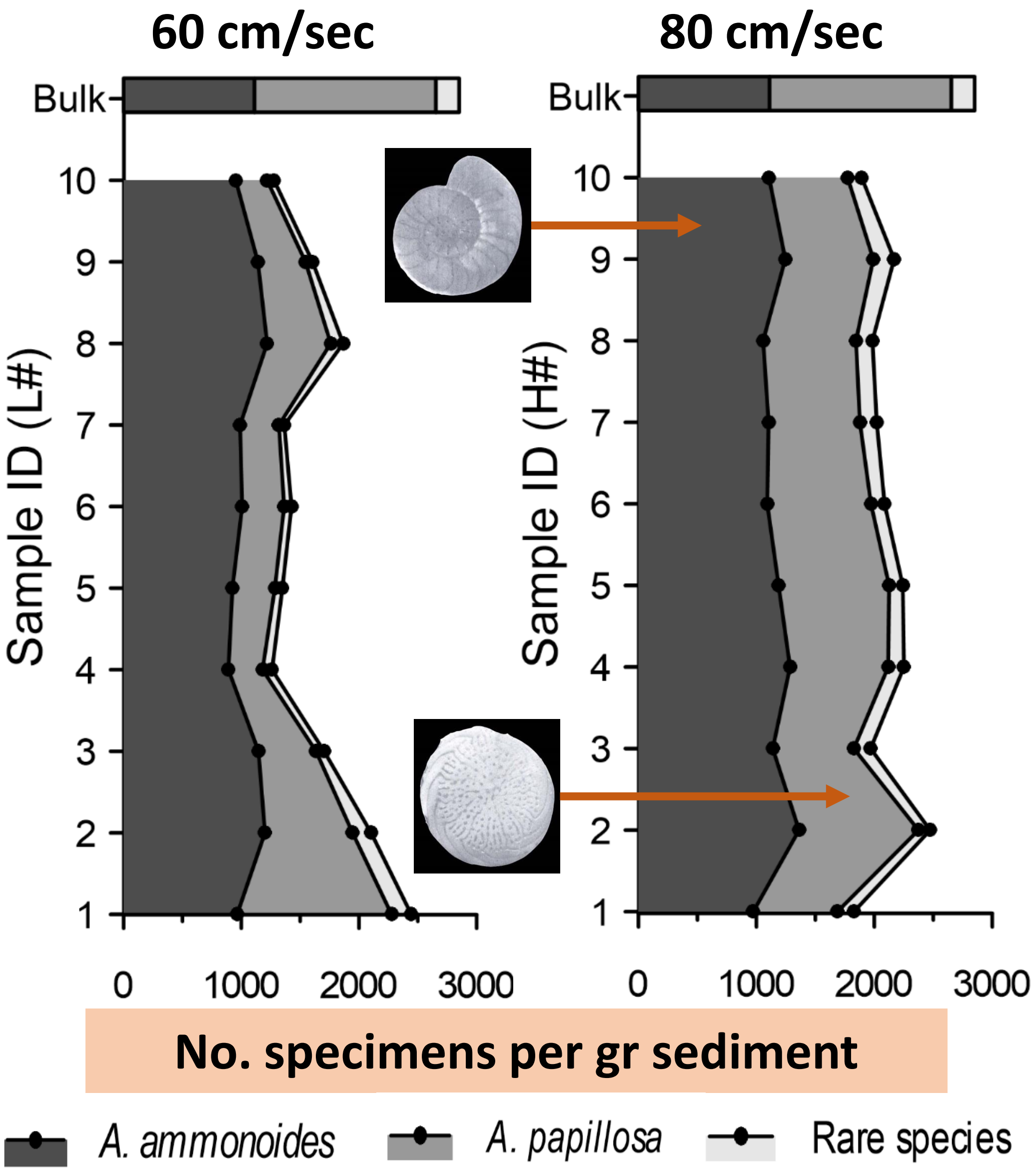
200 µm mesh

What is being suspended?
How high in the water column?
How far downslope?

1. Motor ON
2. Acceleration – 5 min
3. Steady velocity – 5 min
4. Motor OFF
5. Accumulation – 10 min



Total species assemblage



Ash-Mor et al., under review

1. <u>Dominance:</u>

Bulk sediments – *A. papillosa.*
Experiment – *O. ammonoides*.

Rare species – negligible.

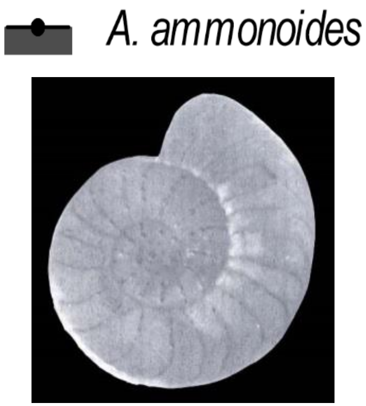
2. <u>60 cm/sec:</u>

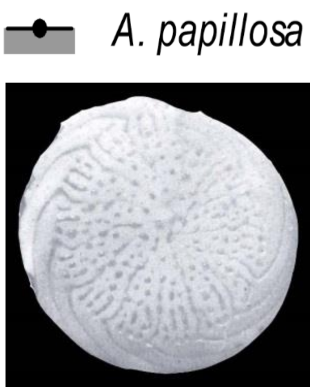
A. papillosa abundance decreases upwards.

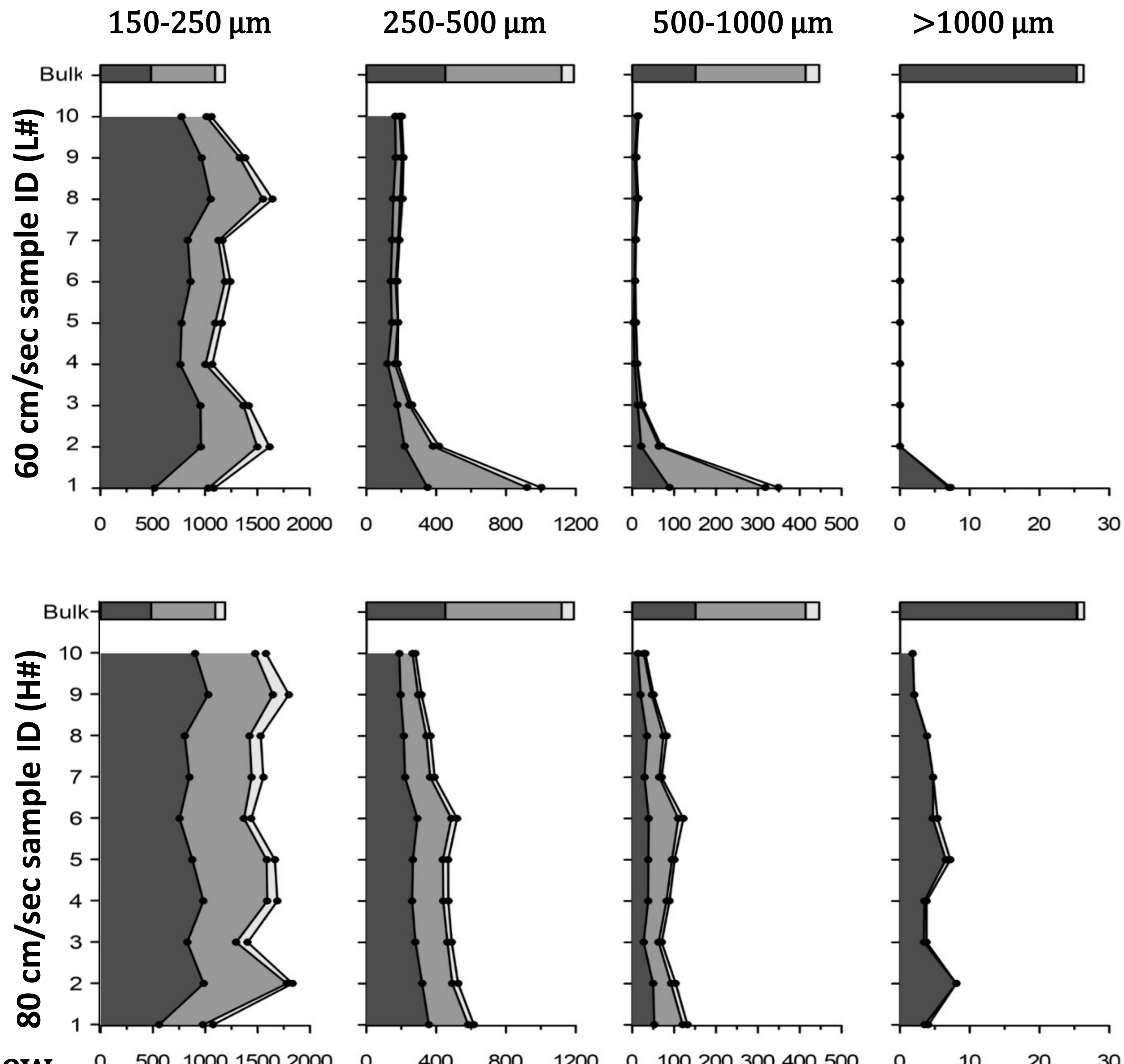
3. <u>80 cm/sec:</u>

Homogeneous distribution of both species.

Total species shell size assemblages



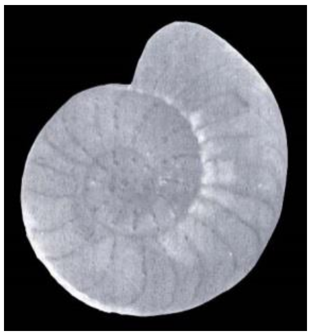


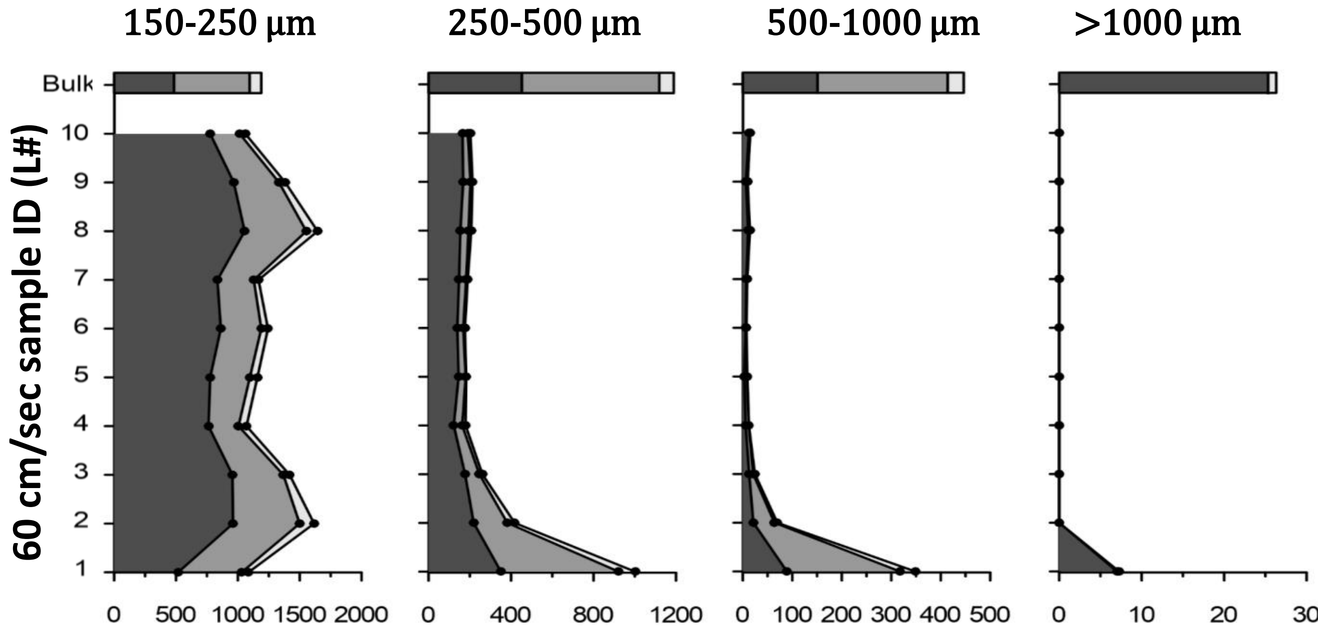


Ash-Mor et al., under review

Total species shell size assemblages

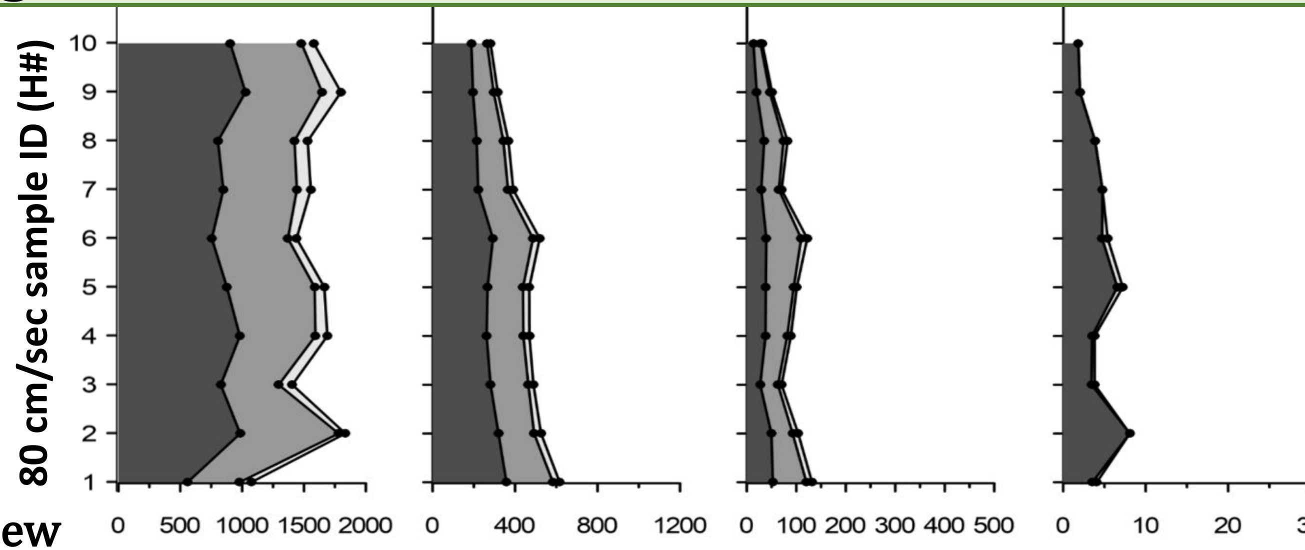
A. ammonoides





Decreasing occurrence of LBF with the increase of shell size

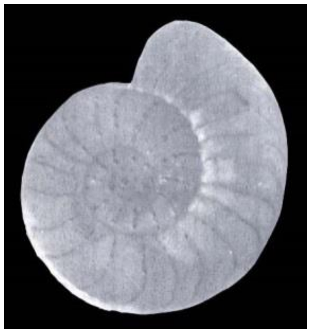
A. papillosa

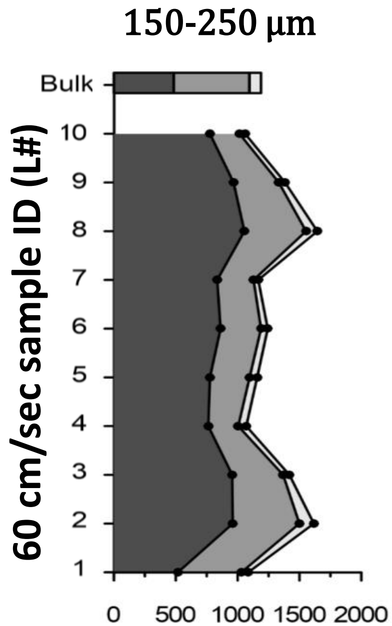


Ash-Mor et al., under review

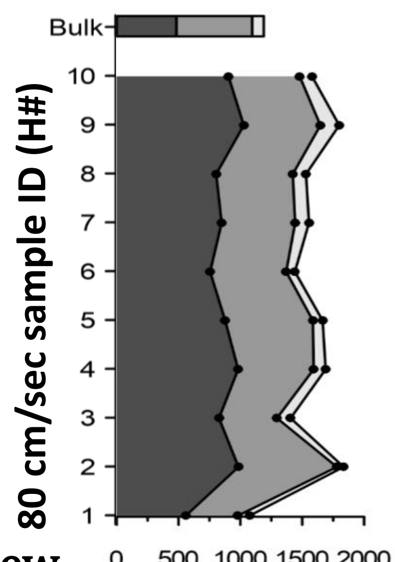
Total species shell size assemblages

A. ammonoides





A. papillosa



Juveniles of both species are completely resuspended throughout the water column by both current velocities

Ash-Mor et al., under review

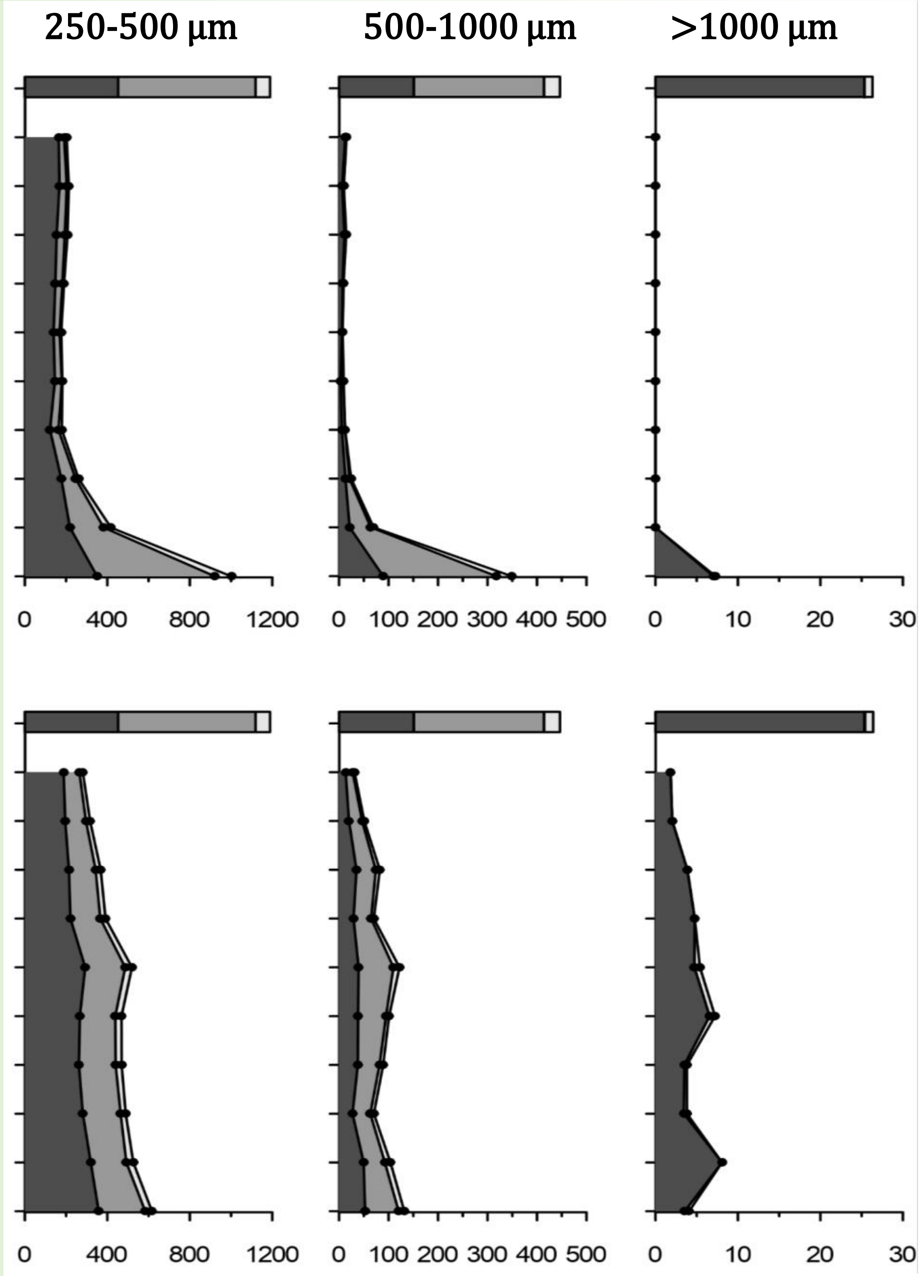
Total species shell size assemblages

<u>60 cm/sec:</u>

- *A. papillosa* <u>sharply</u> decreases upwards.
- *O. ammonoides* <u>slightly</u> decreases upwards.

<u>80 cm/sec:</u>

- Equal distribution of both species



What did we have so far?

1. Bulk sample – *A. papillosa* dominance
   Experiment samples – *O. ammonoides dominance.*

2. Decreasing LBF occurrence with increasing shell size.

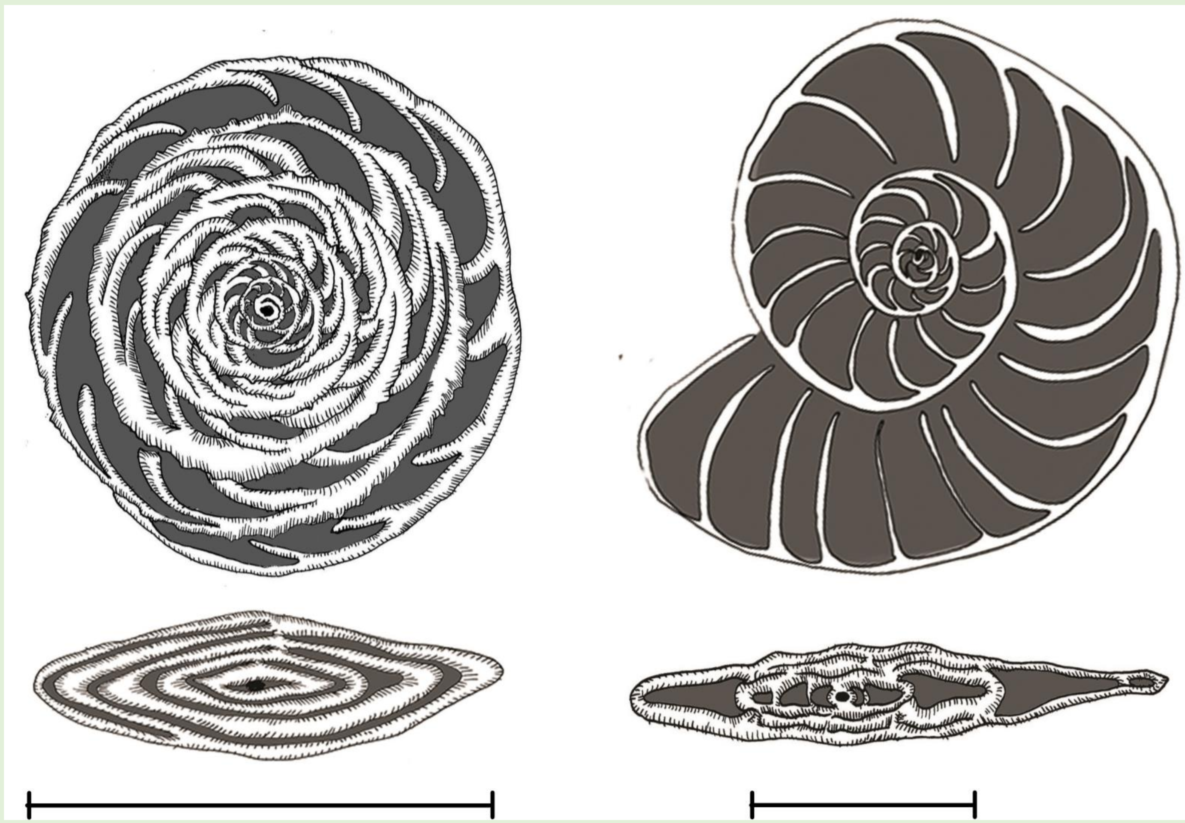
3. Similar occurrence of juveniles in both velocities.

4. <u>60 cm/sec:</u>
   General decrease in the vertical distribution of LBF > 250 µm upwards (*A. papillosa* – sharp; *O. ammonoides* – slight)

5. <u>80 cm/sec:</u>
   LBF shells are well distributed in the water column.

Strong influence of shell structure on re-suspension and transportation

A. papillosa *O. ammonoides*

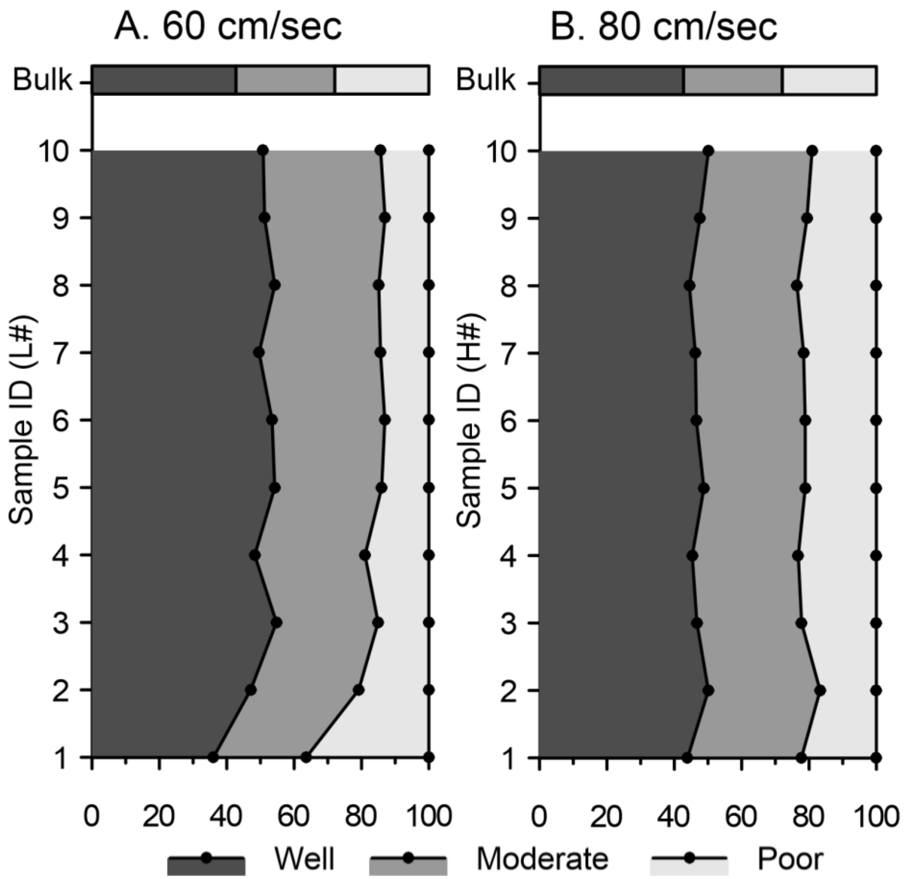


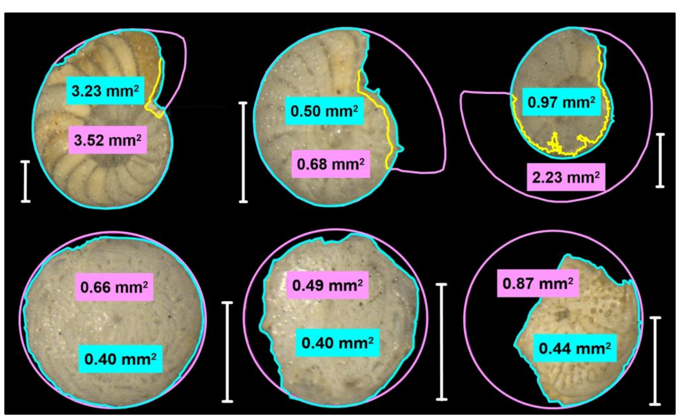
Scale bar value = 1 mm

Ash-Mor et al., under review

Lets’ take it to the next level…

Poorly preserved shells assemblages (%)





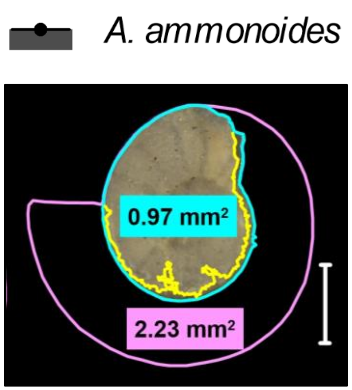
1. Well preserved shells transport better than poorly preserved.
2. <u>60 cm/sec:</u>

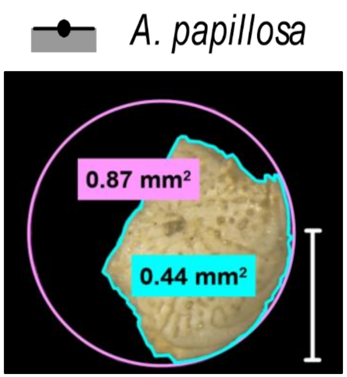
   High concentration of poorly preserved shell at the bottom.
3. <u>80 cm/sec:</u>

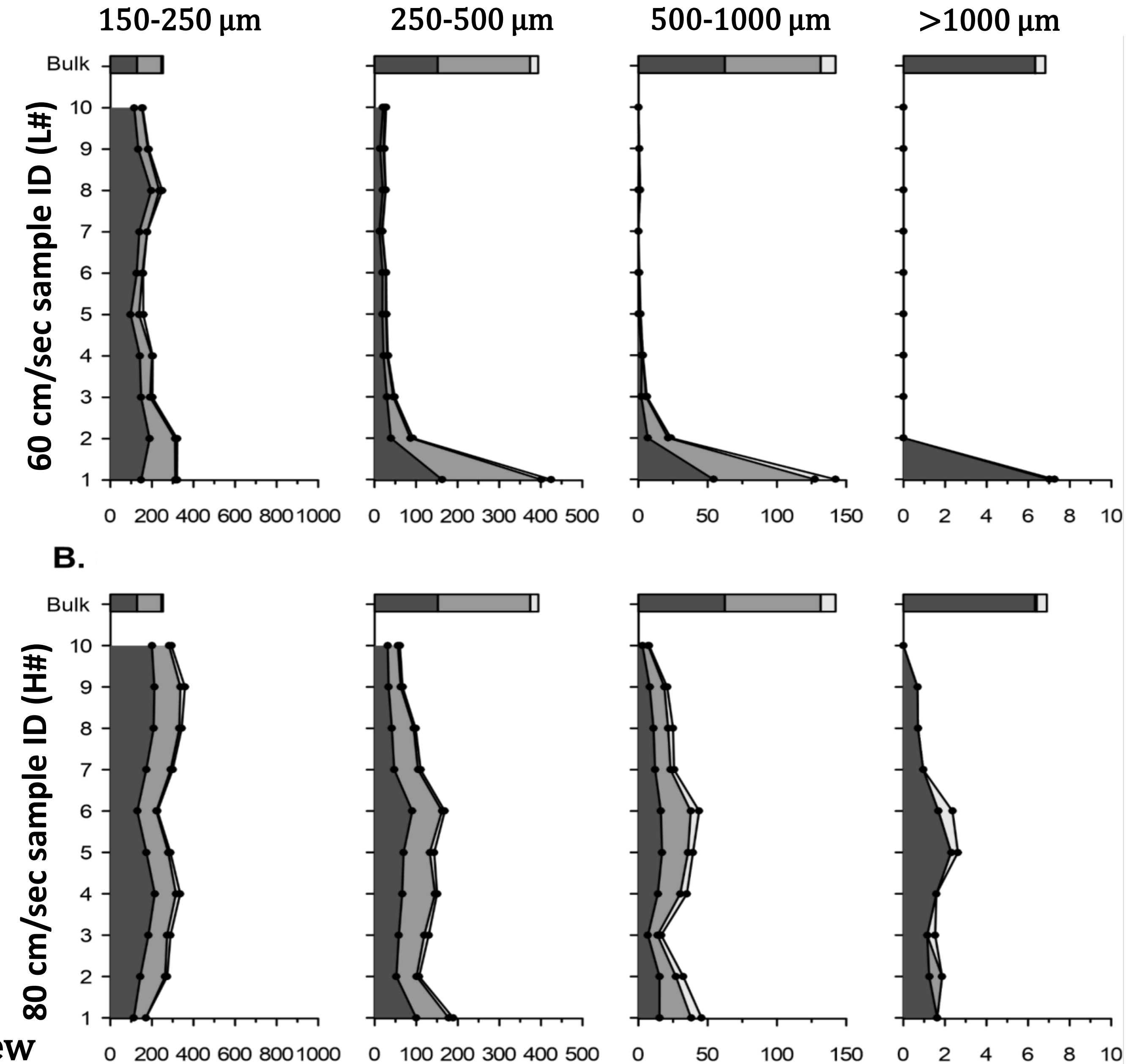
   Constant ratio throughout the water column.

Ash-Mor et al., under review

Poorly preserved shells assemblages







Ash-Mor et al., under review

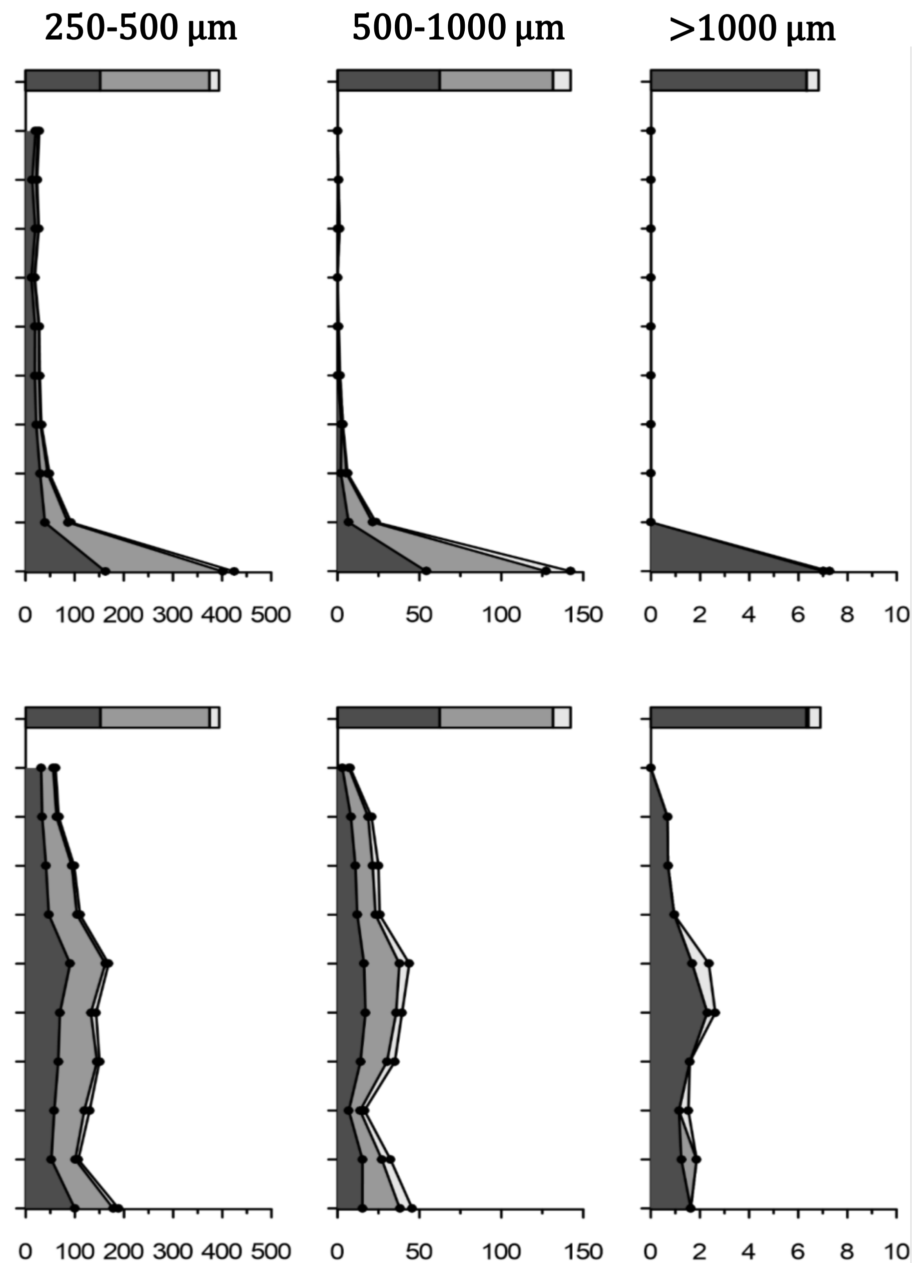
Poorly preserved shells assemblages

<u>60 cm/sec:</u>

- Poorly preserved shells highly abundant at the bottom sample.
- Both species <u>sharply</u> decreases upwards.

<u>80 cm/sec:</u>

- Equal distribution of both species regardless their size / preservation.



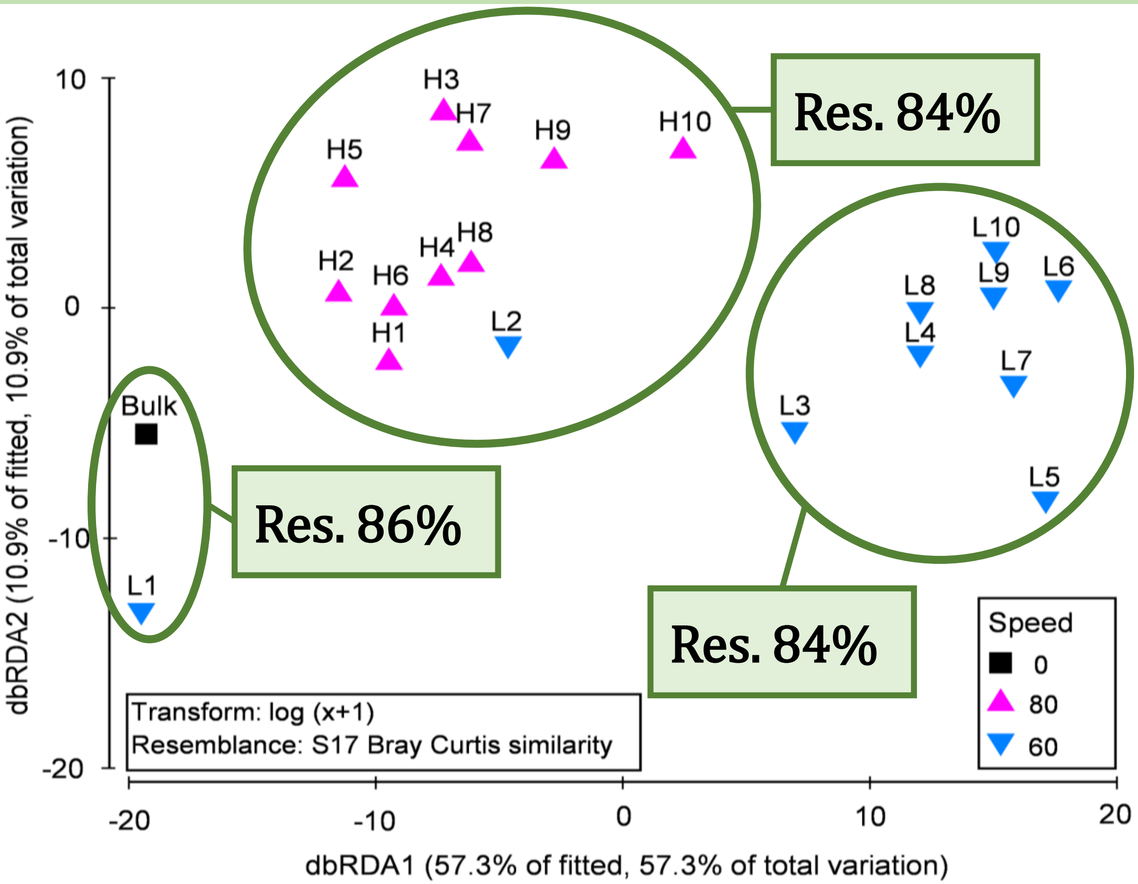
Some statistics to back it up..

PERMANOVA:

Source	p-value
Velocity	**0.003**
Height	0.128

pair-wise tests

velocity groups	p-value
bulk & 80 cm/sec	0.098
bulk & 60 cm/sec	0.169
60 & 80 cm/sec	**0.002**



Ash-Mor et al., under review

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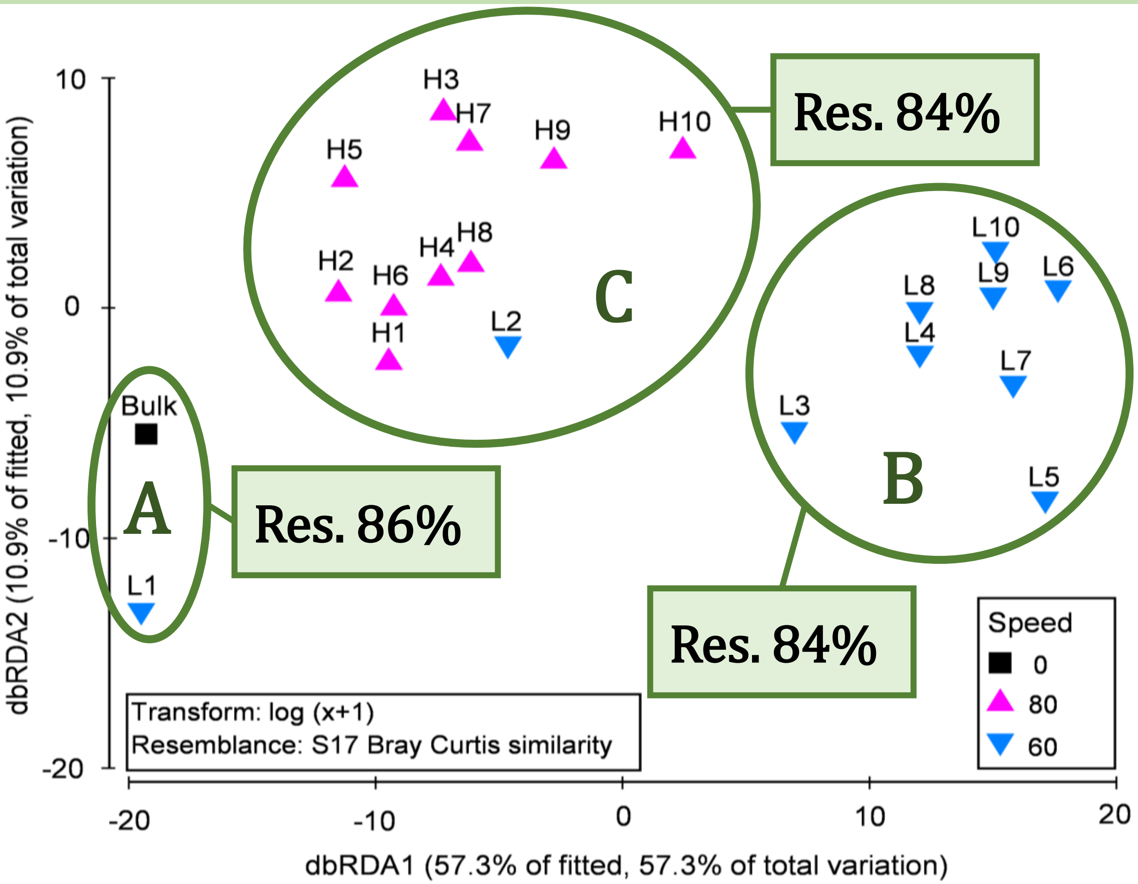
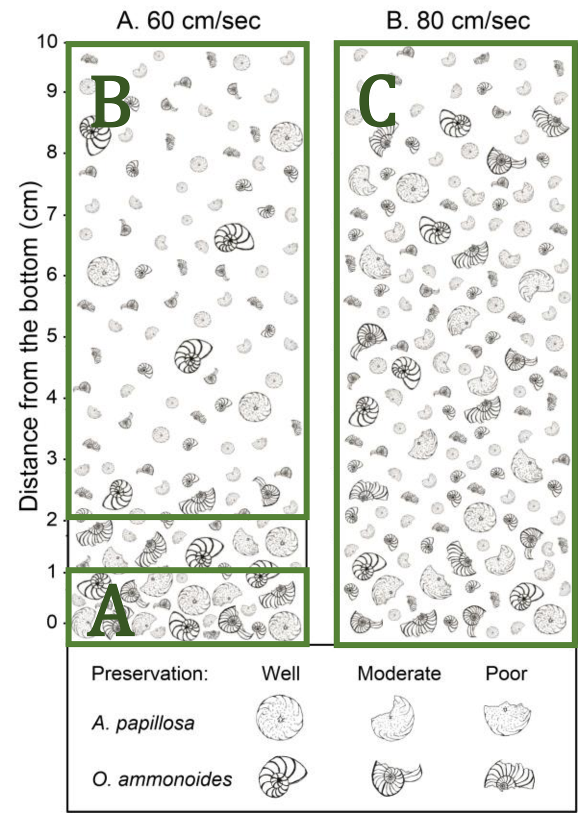




Ash-Mor et al., under review

To summarize…

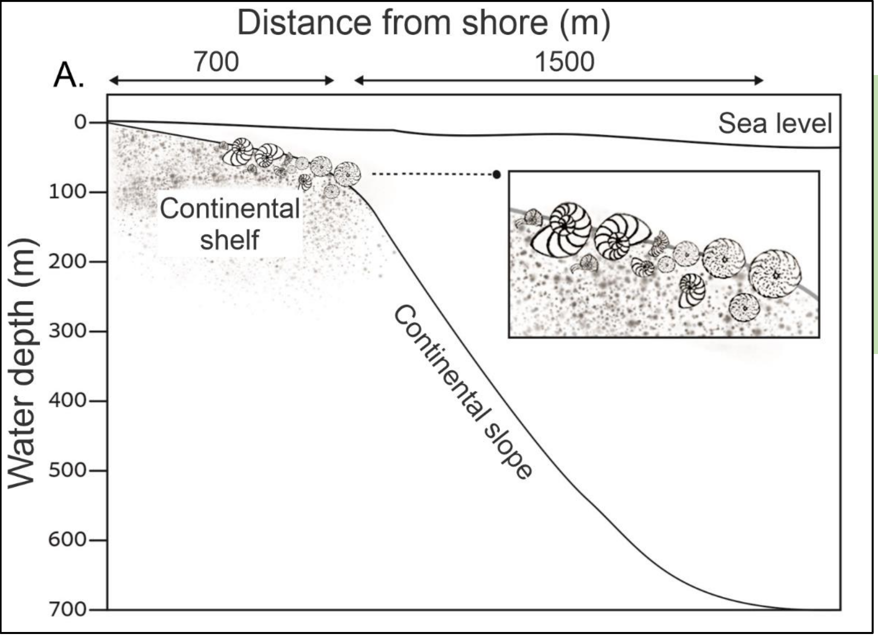
1. Current velocity of 60 cm/sec transports mostly small and well-preserved shells at the sediment-water interface.

2. Current velocity of 80 cm/sec transports shells of all sizes and preservation throughout the water column.

3. Turbidity currents that transport large size and poorly preserved shells of *O. ammonoides* and *A. papillosa* require minimum velocities 80 cm/sec.

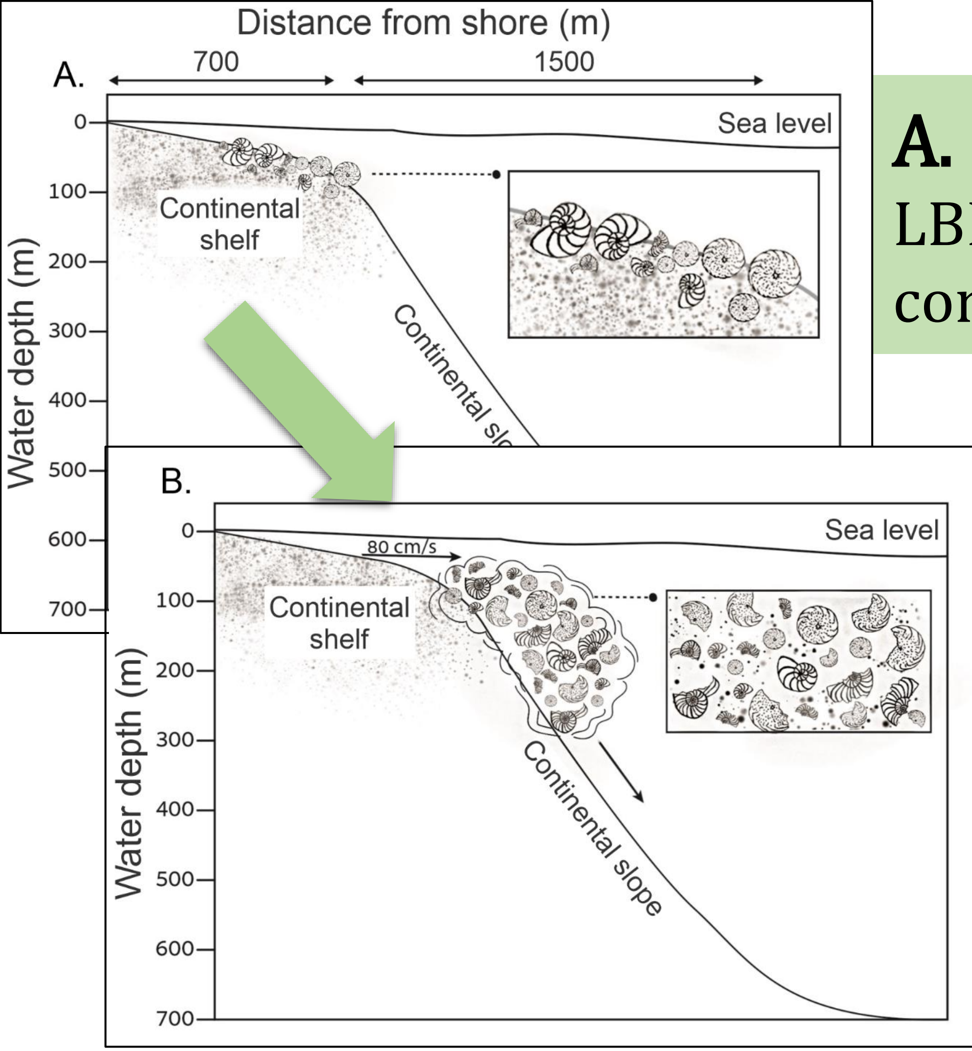
4. Foraminifera shell size, inner structure and state of preservation highly influence their portability.

5. Shells are deposited according to their hydrodynamic properties along the transport pathway.



A. Pre-event deposition

LBF inhabit and deposited on the continental shelf edge

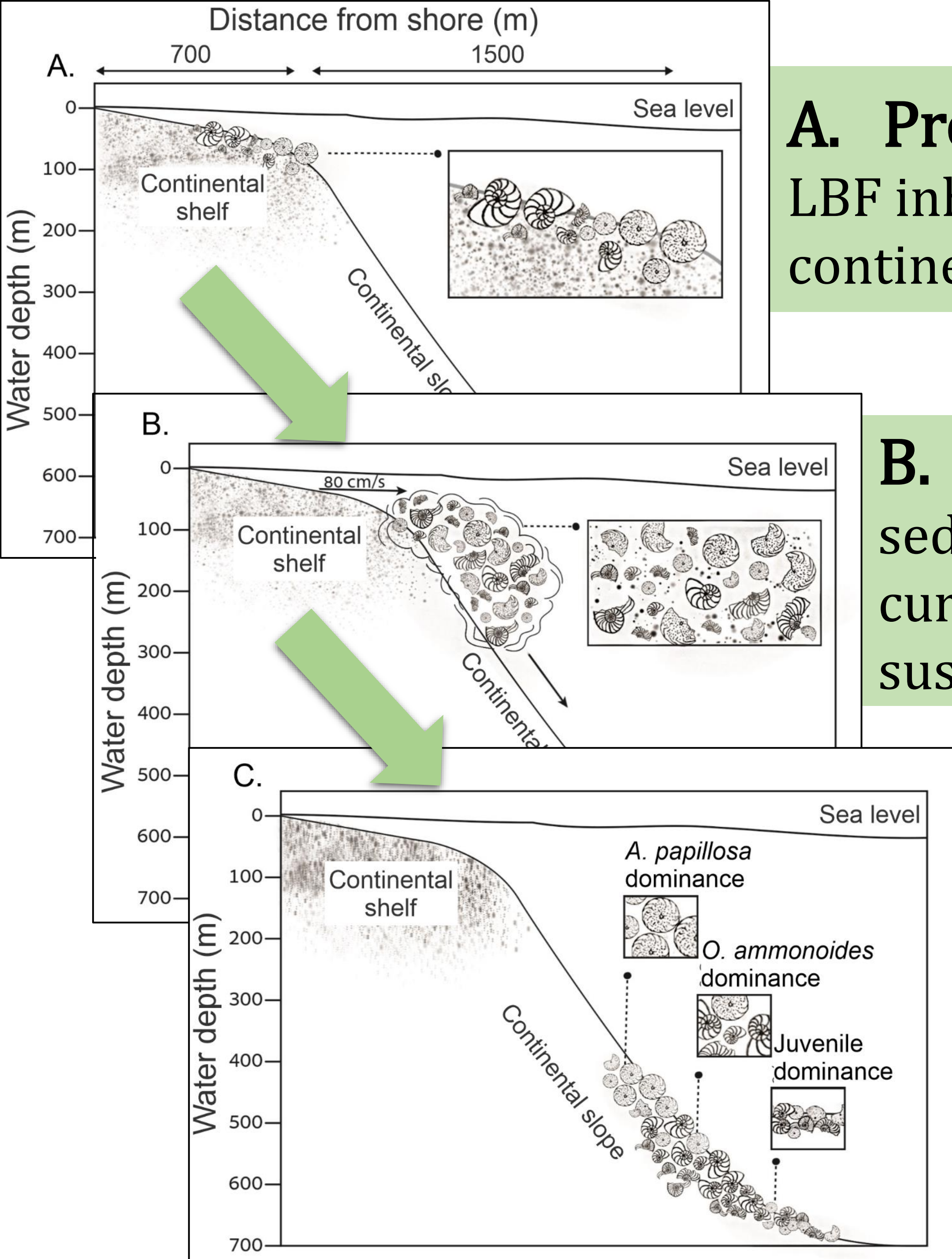


A. Pre-event deposition

LBF inhabit and deposited on the continental shelf edge

B. Trigger - turbidity event

sediments flow downslope at current velocity >80 cm/sec as suspended load



A. Pre-event deposition
LBF inhabit and deposited on the continental shelf edge

B. Trigger - turbidity event
sediments flow downslope at current velocity >80 cm/sec as suspended load

C. Post-event deposition
LBF assemblage changes along the transport pathway as shells deposit according to their hydrodynamic properties


THANK YOU