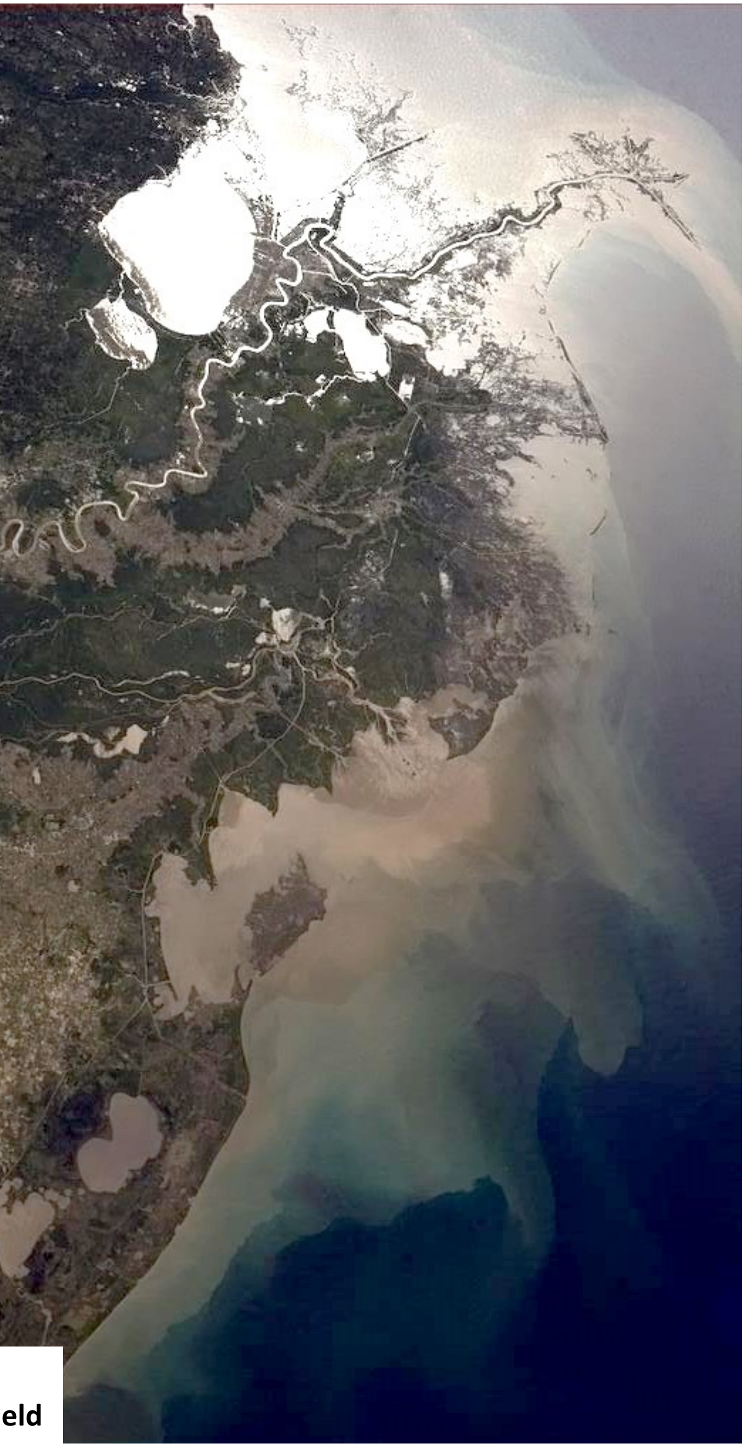


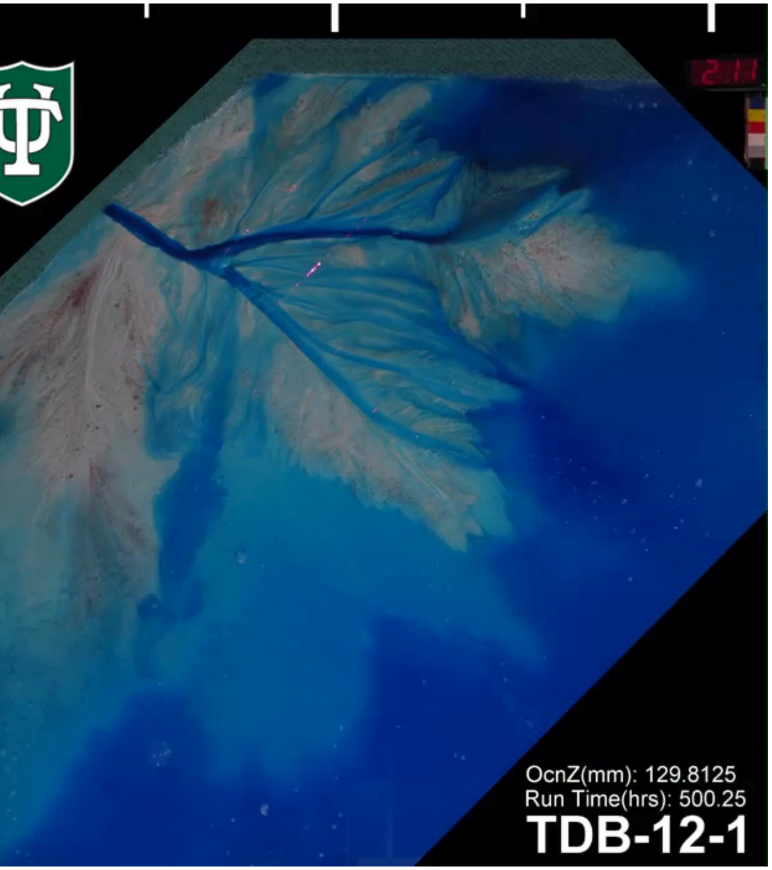
Signals of Relative Sea Level perturbations: Defining the divide between autogenic si shredding vs. preservation in the stratigraphic record

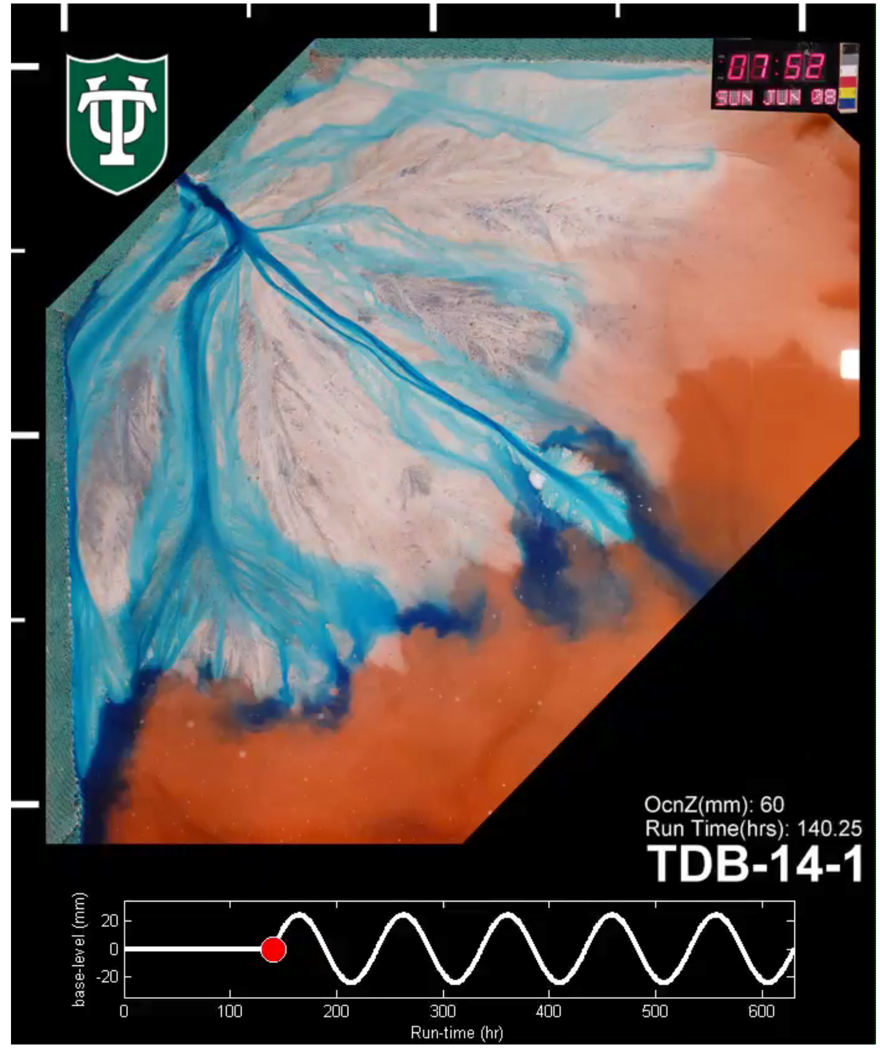
TULANE
SEDIMENT DYNAMICS
& STRATIGRAPHY

Kyle M. Strau
Qi Li, & Lizhu

Grants:
EAR-10244
EAR-14243
OCE-10493

enic Processes & Allogenic Forcings





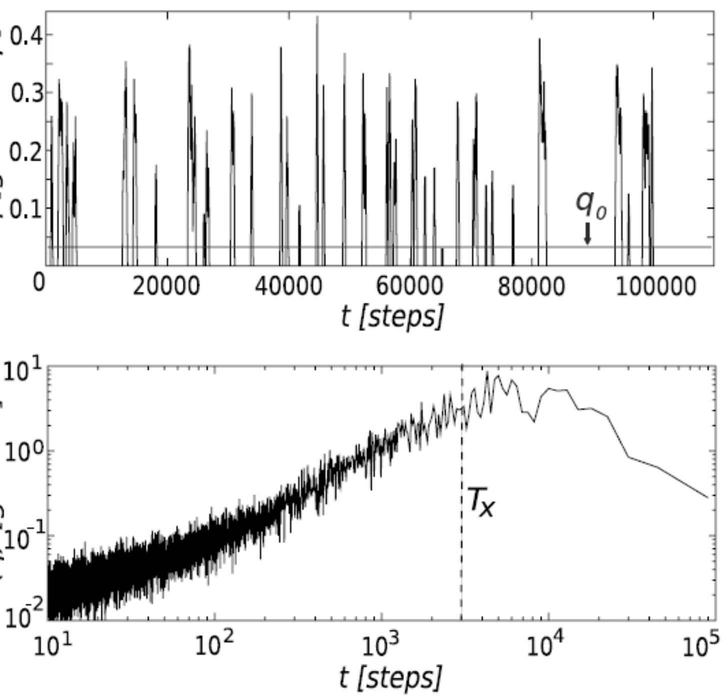
nic Processes:

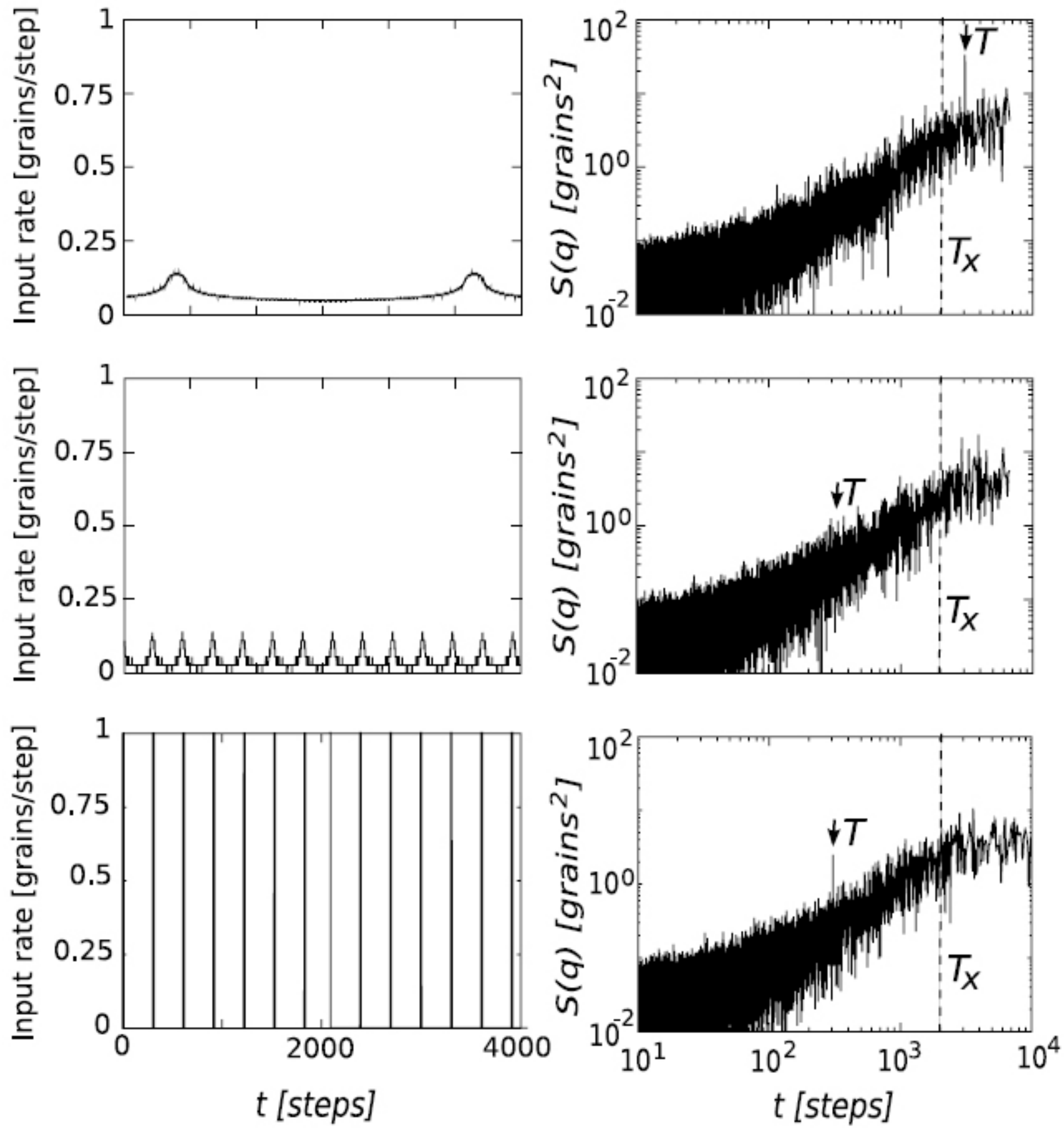
s internal to a sediment routing system. Can be c or cyclic in nature. Occur when boundary s are constant or dynamic

Allogenic Forcings:

Changes in boundary conditions (think sea-level, cli tectonic environment), which influence a sediment system

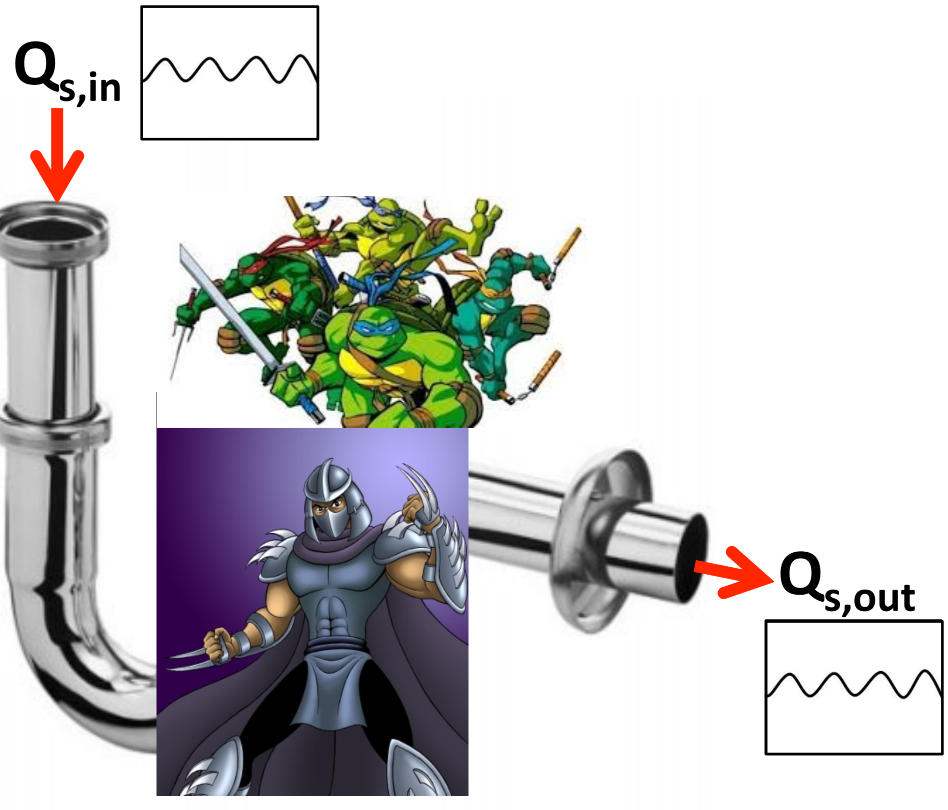
“Shredding”: Jerolmack & Paola, 2010

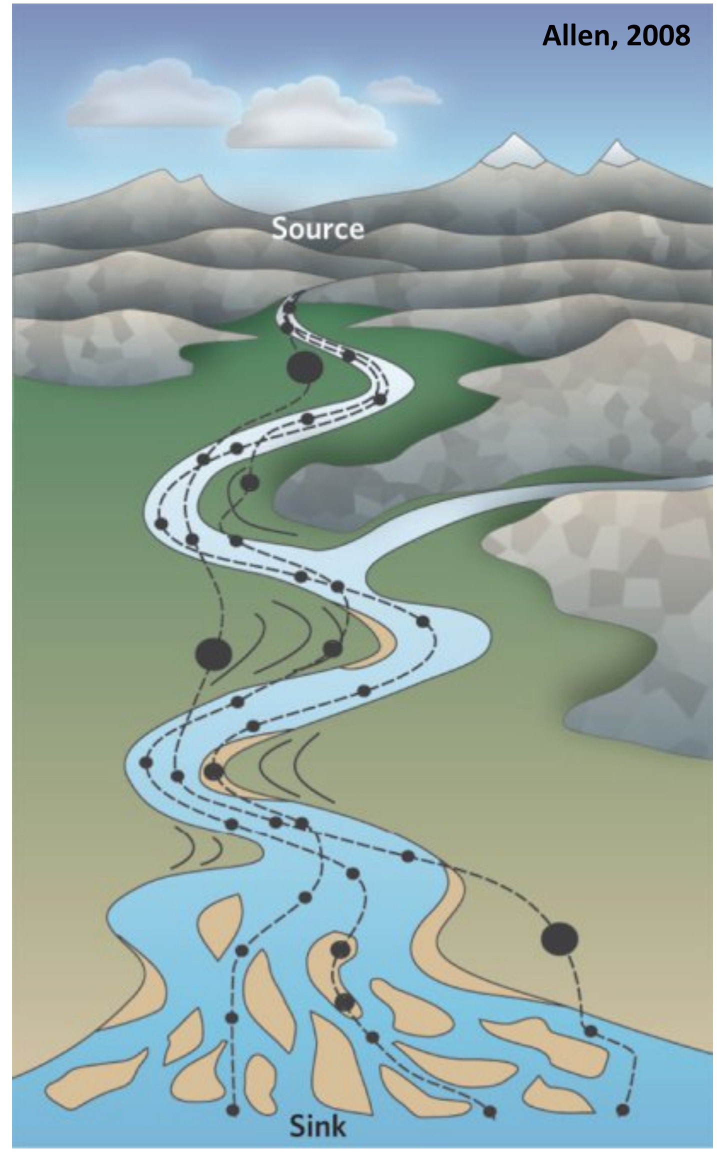




port Shredder vs. Depositional Shredder

Transport Shredder

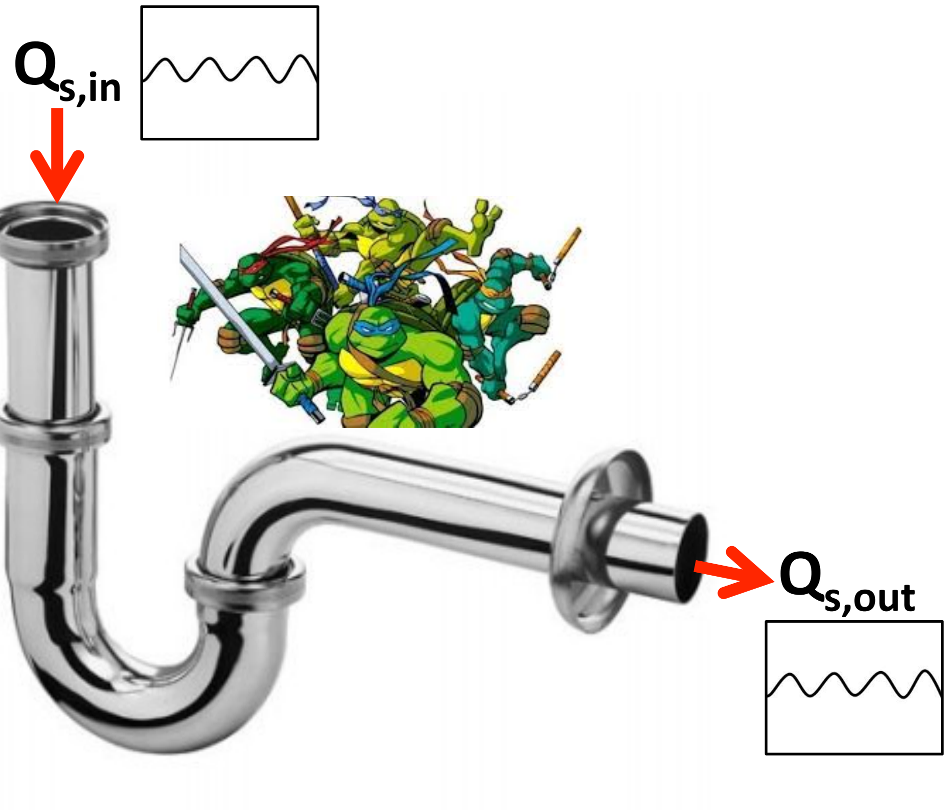




Sediment still in flux and available for deposition, not yet stored in the immobile substrate!

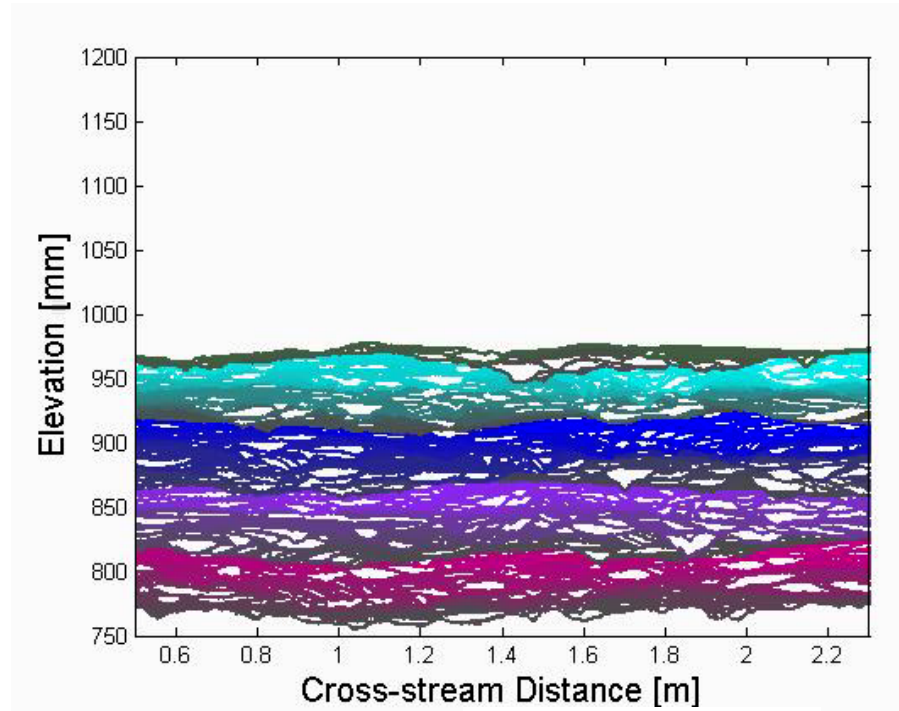
port Shredder vs. Depositional Shredder

Transport Shredder



Sediment still in flux and available for deposition, not yet stored in the immobile substrate!

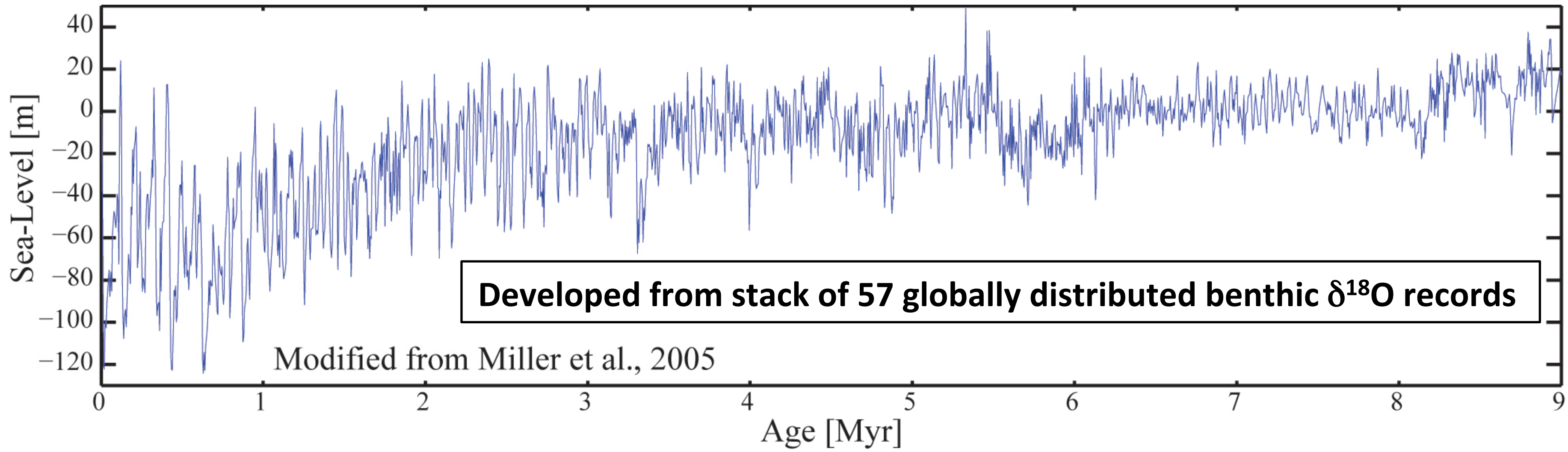
Depositional Shredder



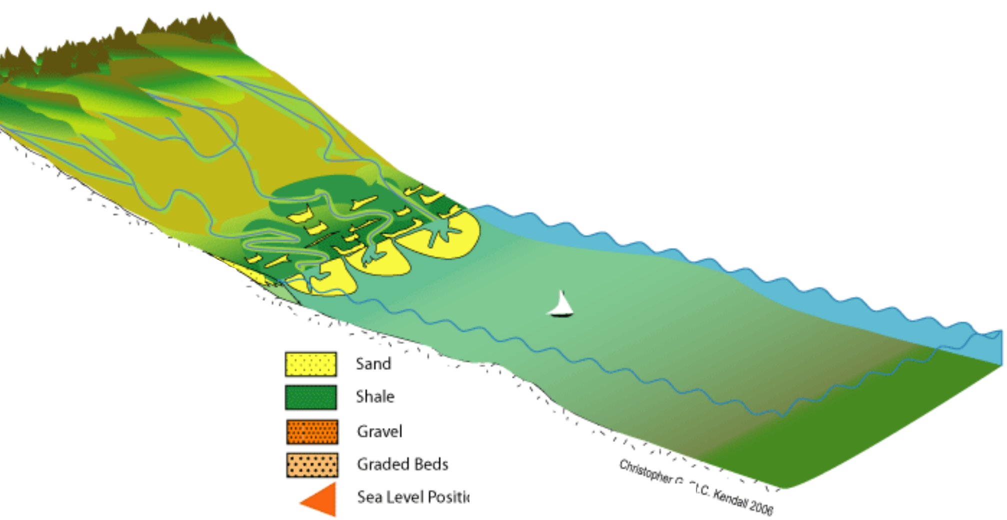
Straub & Esposito, 2013

Short term cut and fill until surface is transferred to depth that is no longer susceptible to surface processes, driven by long term accumulation associated with generation of accommodation space

l Sea-Level Change



Sequence Stratigraphy



- Influence of RSL on morphodynamics a resulting stratigraphy of deltaic systen well known.

ng Deltas on a Delta

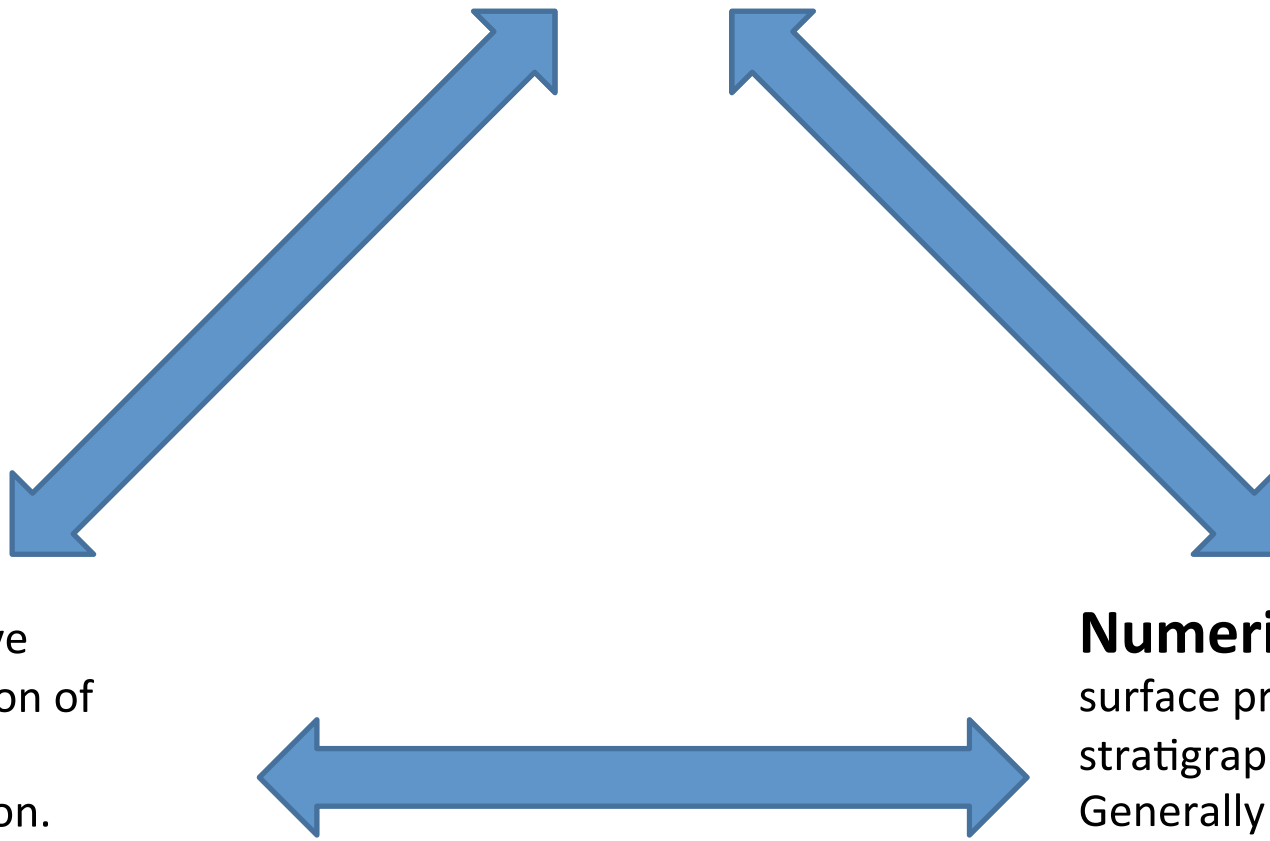
servations: guide development of
pe evolution models and provide benchmarks
3D numerical models of surface processes
ir relationship to stratigraphy

o these because:

y evolve fast
y are small enough to compressively monitor
nplete transport system
can independently control individual
ables

Also: In the last 10-15 yrs experiments have highlighted stochasticity in sediment routi systems and the need to treat problems in surface processes stratigraphy with a statistical/ probabilistic approach.

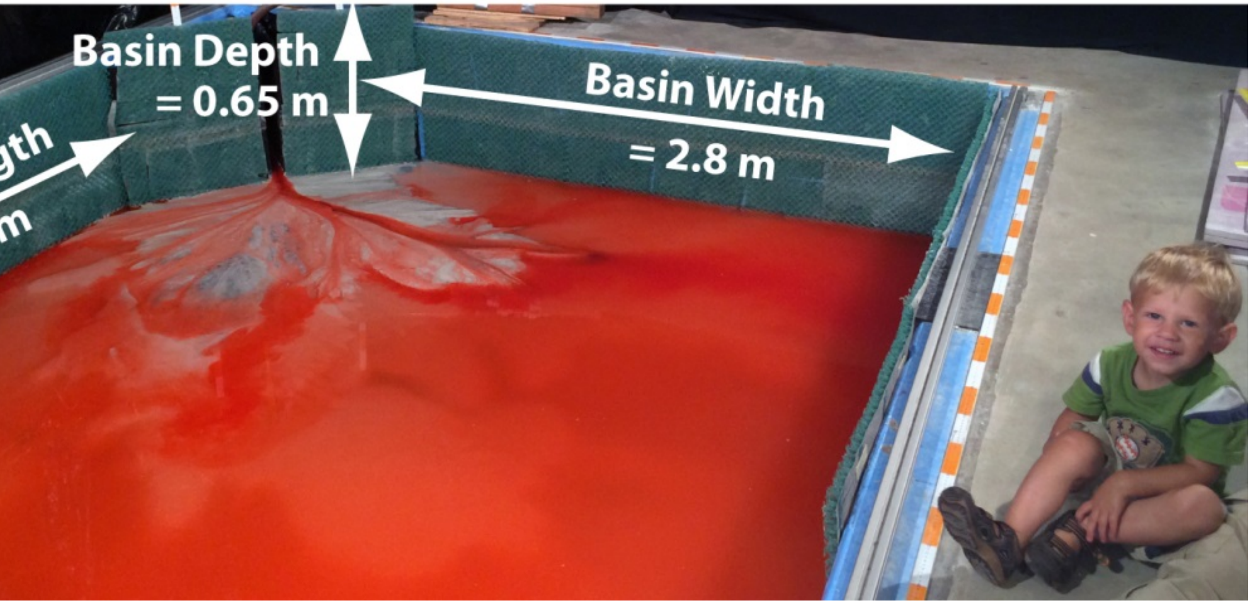
Field Systems: The real thing at field scale: Hard to observe surface processes & generation of stratigraphy over these time scales.

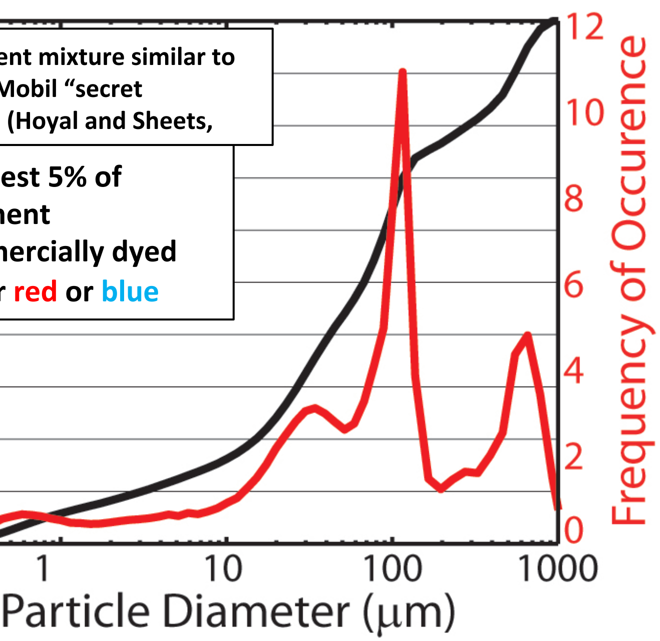


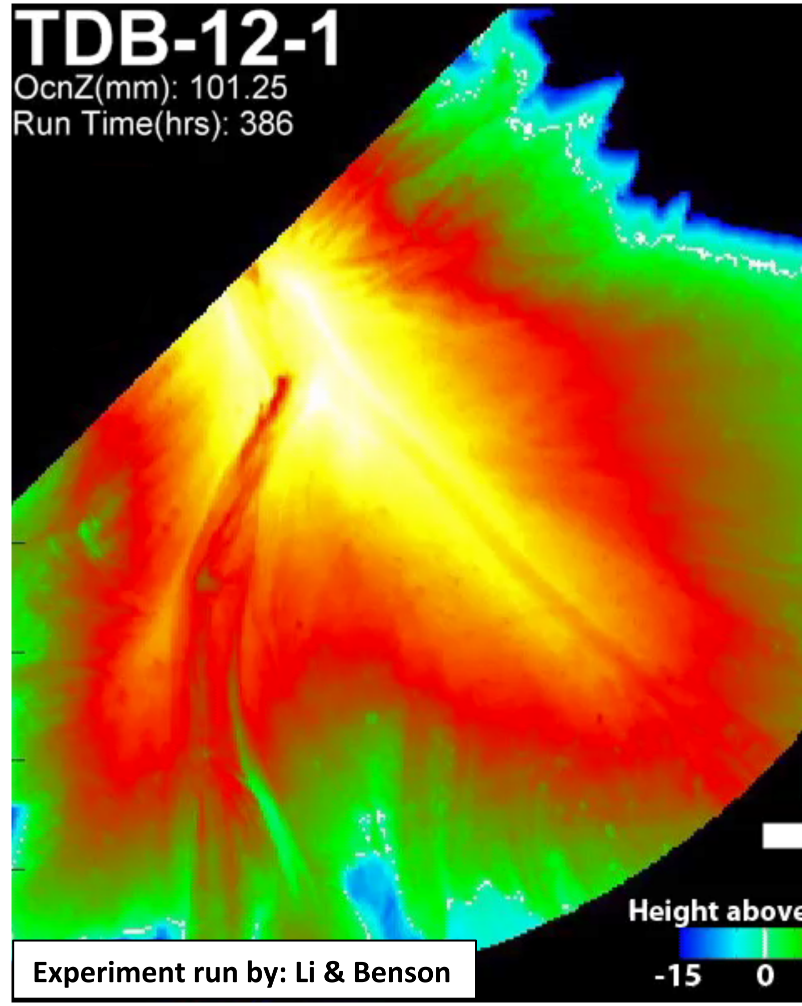
ystems: Can observe processes & generation of phy over "long" time Full Physics in operation. de: scaling problems.

Numerical Systems: Can surface processes & generation stratigraphy over long time scal Generally no scaling problems. D side: user has to specify their ch important physics.

enic Experimental Setup

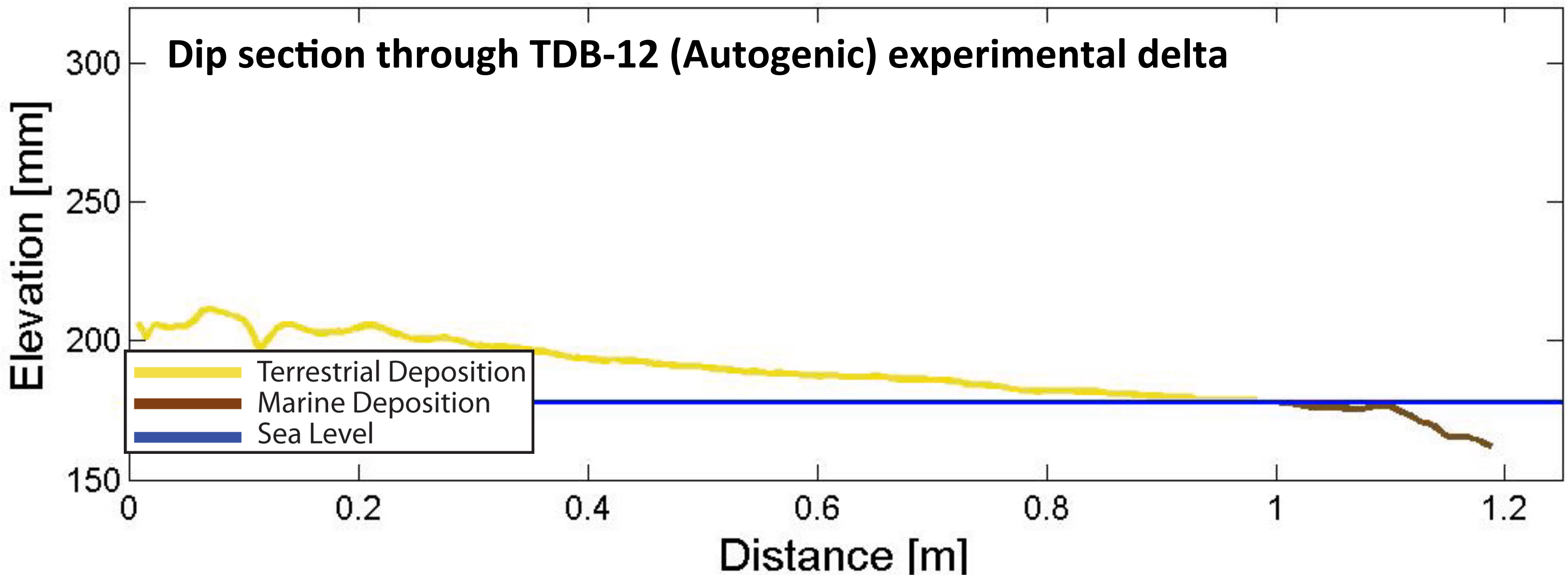




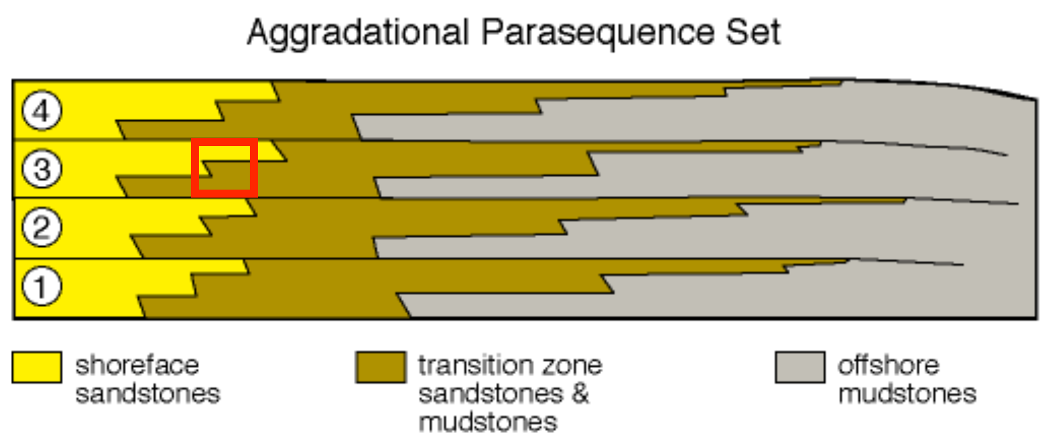


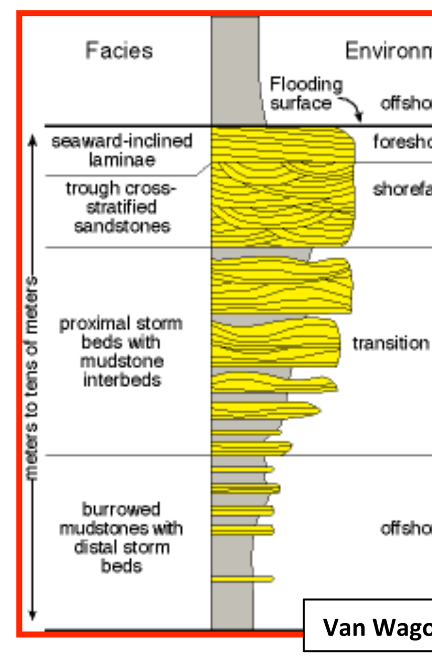
- Constant input water & sediment flux rates and constant base leve
- Q_w:Q_s = 1000:1
- Overhead photographs of active delta-top once every 15 minutes
- Lidar used to map deltaic topography once an hour
- Aggraded ~15 channel depths of stratigraphy

enic transgressions and regressions

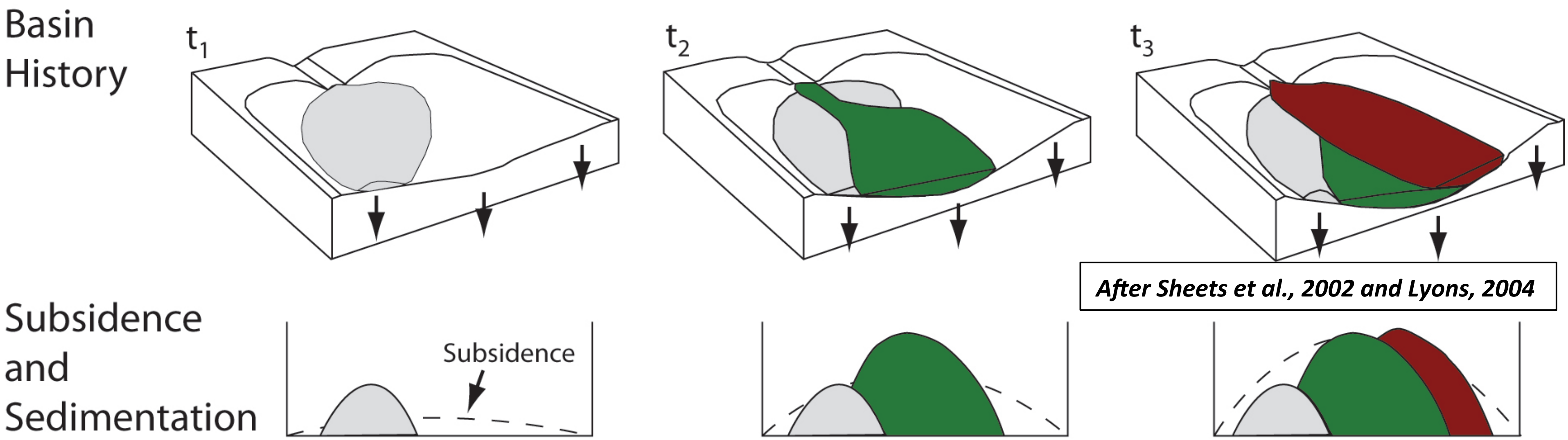


: to separate
s of autogenic
es and allogenic
s in parasequence
chitecture





ng time scales and strength of autogenics in alluvial basins



σ_{ss} → High

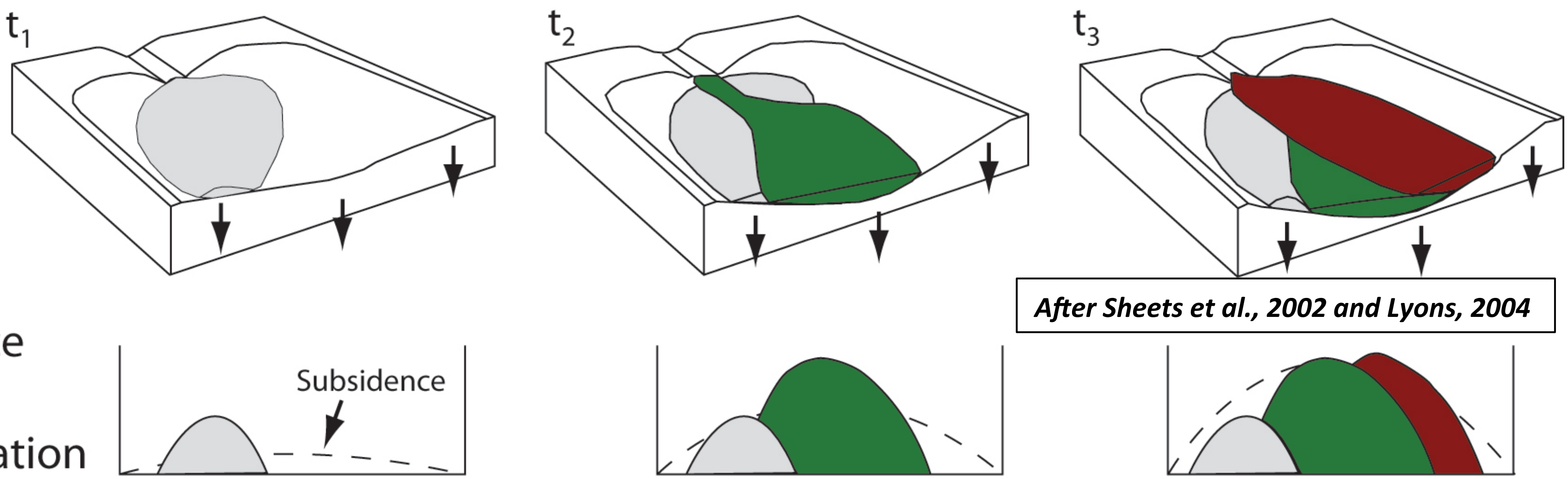
σ_{ss} → Medium

σ_{ss} → Low

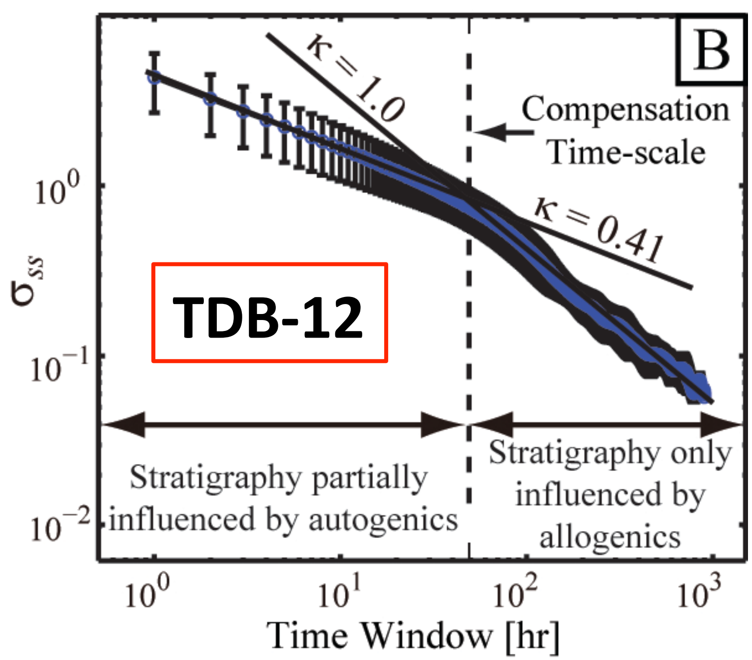
ng time scales and strength of autogenics in alluvial basins

Basin History

Subsidence and Sedimentation



σ_{ss} → High σ_{ss} → Medium σ_{ss} → Low



Compensation Index

$$\sigma_{ss} = \gamma T^{-\kappa}$$

Straub et al., 2009

Compensation Time scale

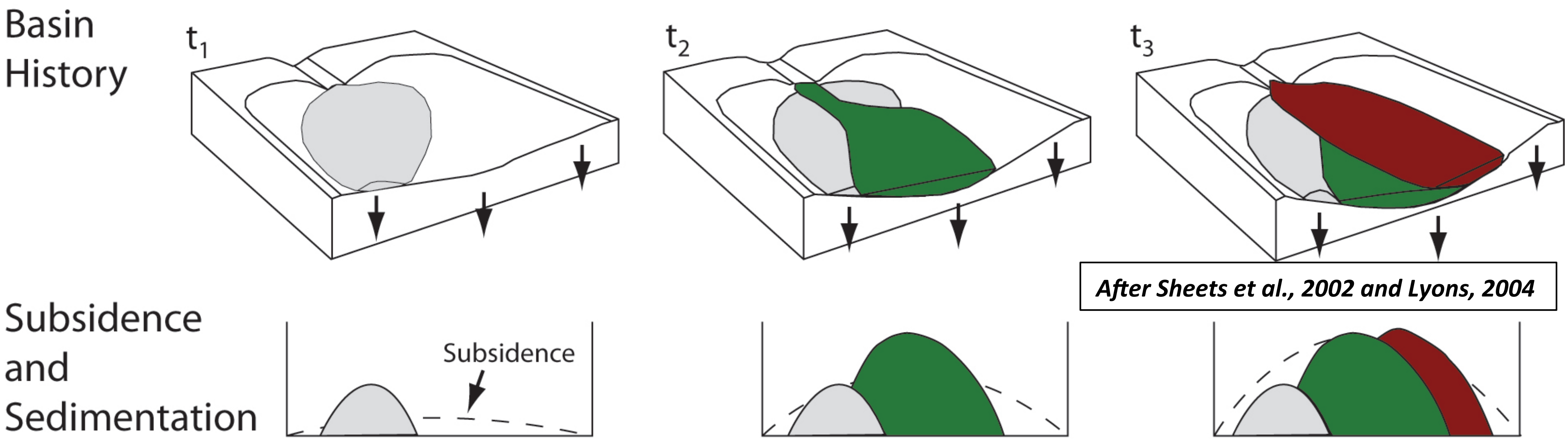
$$T_C = \frac{l}{\bar{r}}$$

Roughness Length Scale (l)

Long-term Aggradation Rate ($\bar{r}$)

Wang et al., 2011

ng time scales and strength of autogenics in alluvial basins



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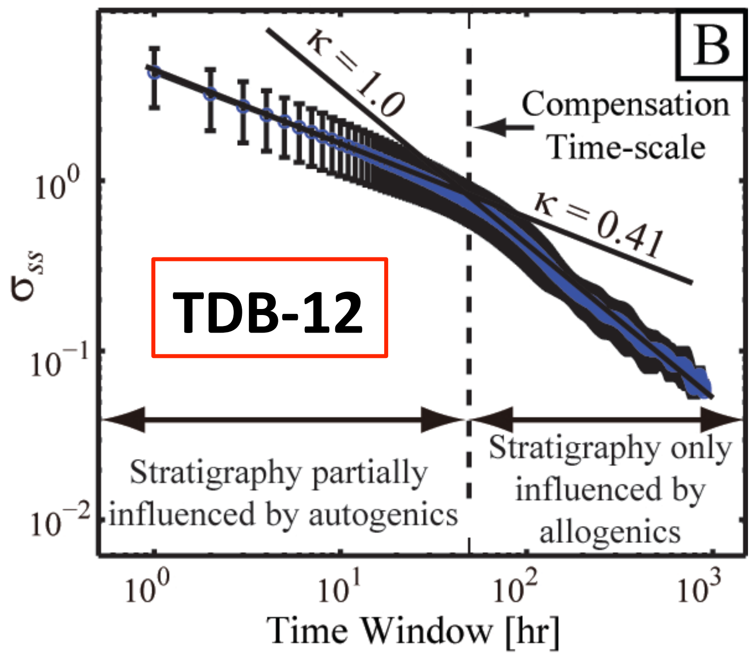


Compensation Time scale

$$T_C = \frac{l}{\bar{r}}$$

Roughness Length Scale (l)

Long-term Aggradation Rate ($\bar{r}$)

Wang et al., 2011

TDB-12

l **= 12 mm**

$\bar{r}$ **= 0.25 mm/hr**

T_C **= 49 hr**

tant non-dimensional #'s for RSL cycle shredding

Cycle Magnitude

$$H^* = \frac{R_{RSL}}{H_C}$$

R_{RSL} ← Range of relative sea level cycle

H_C ← Maximum depth of system channels

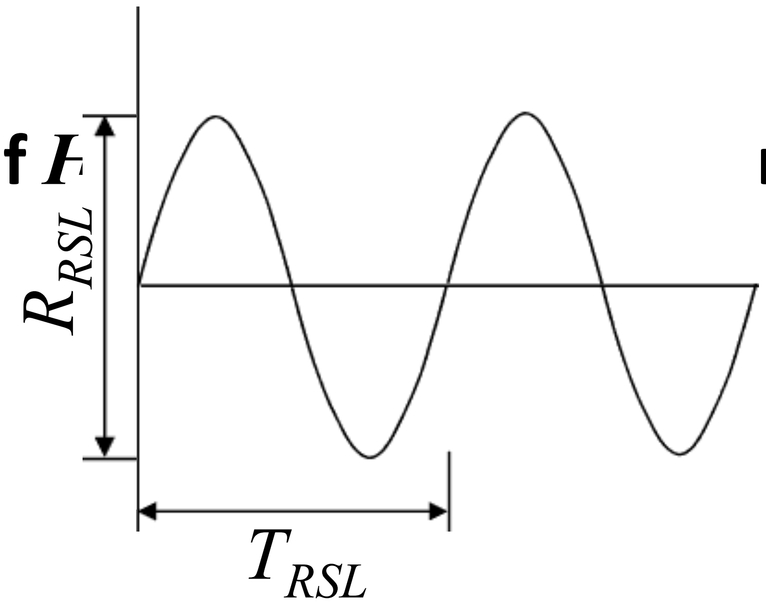
Cycle Period

$$T^* = \frac{T_{RSL}}{T_C}$$

T_{RSL} ← Period of relative sea level cycle

T_C ← Time scale of compensation

If H n



If T^* >> 1, signal retention

If H^* << 1 & T^* << 1, signal prone to shredding

riments share same background
evel rise rate, water and
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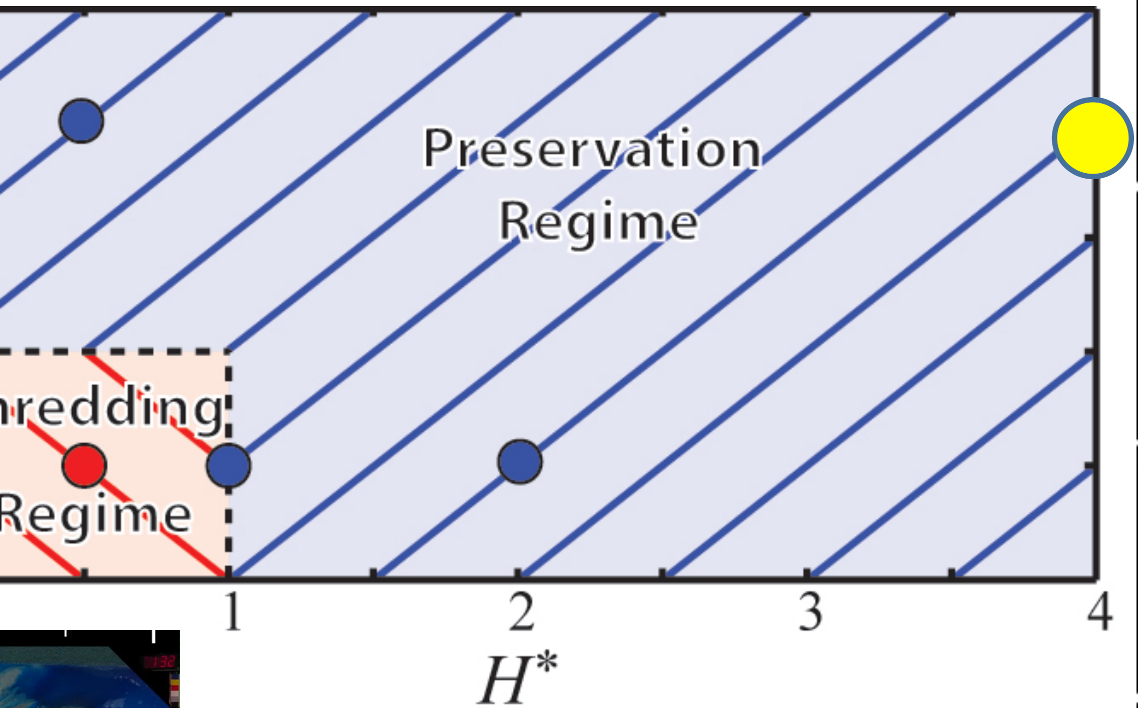

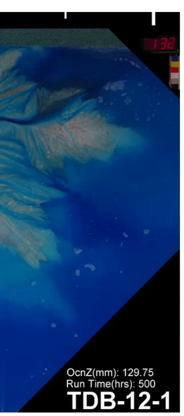

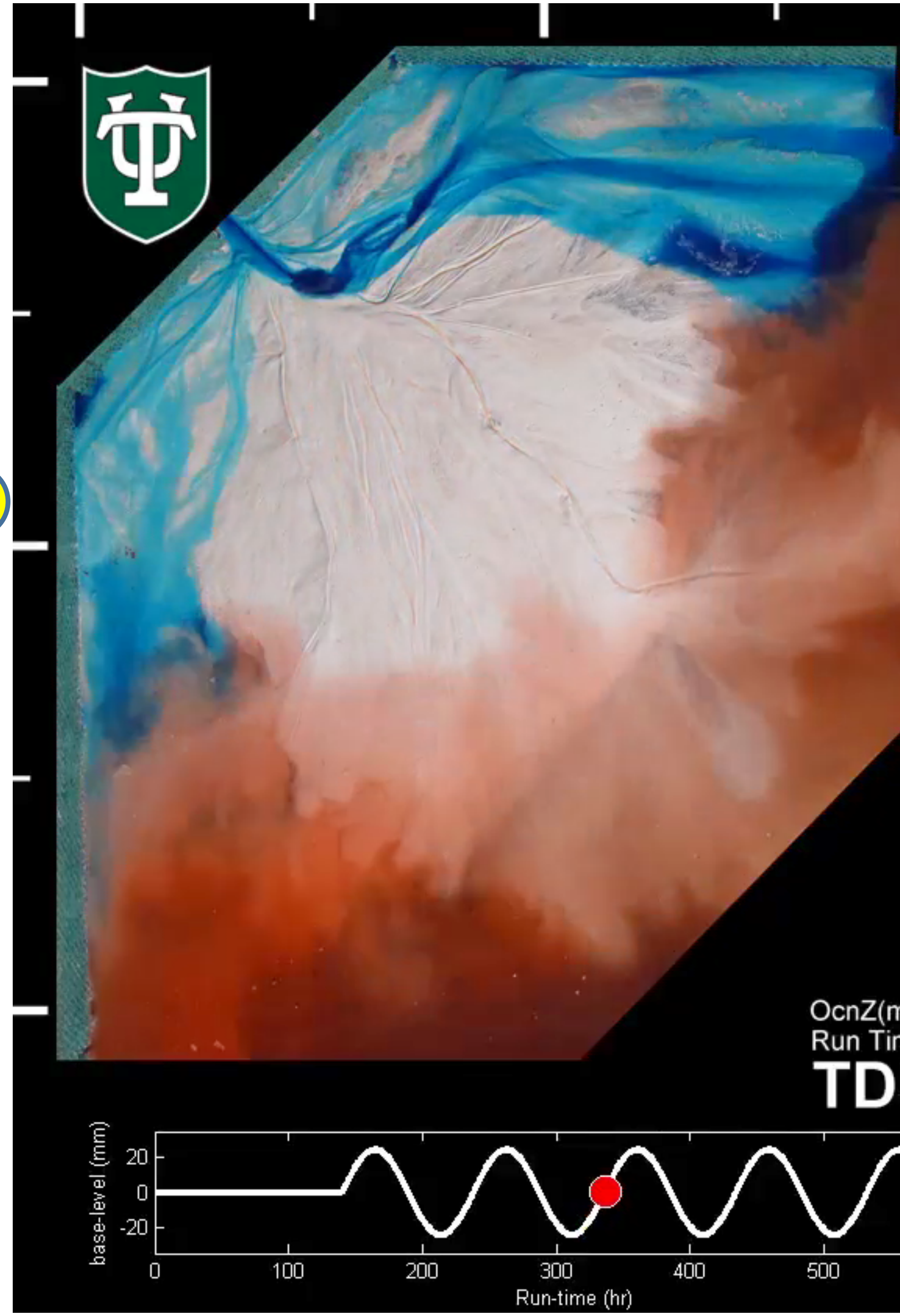

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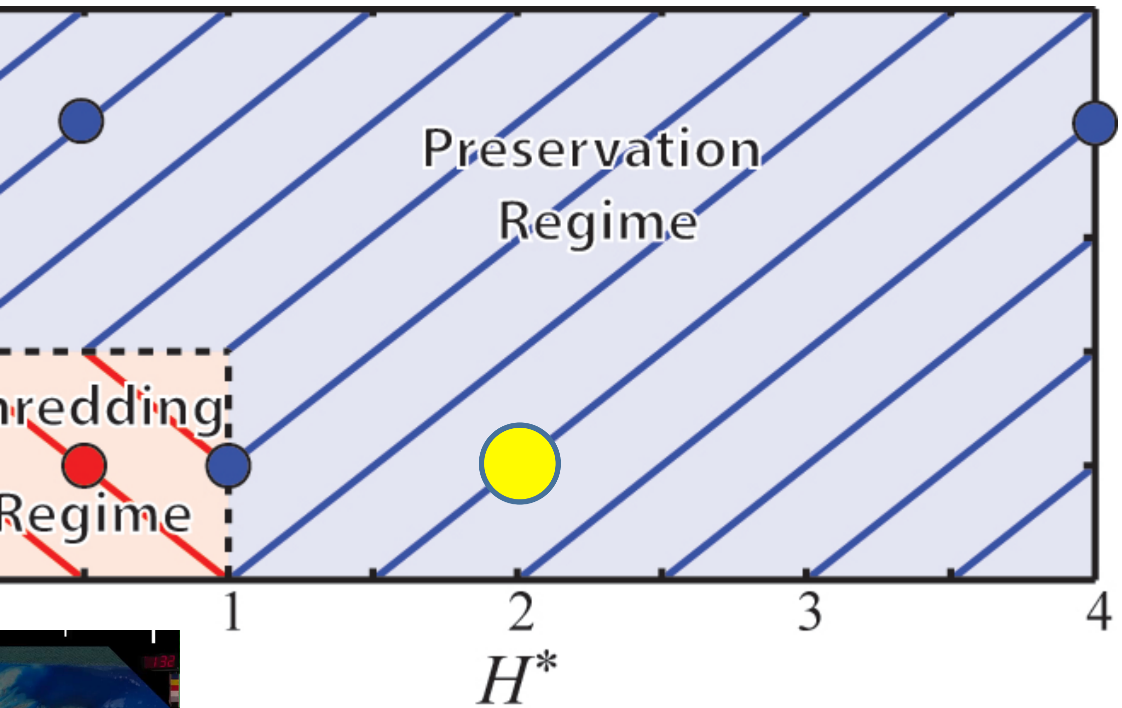

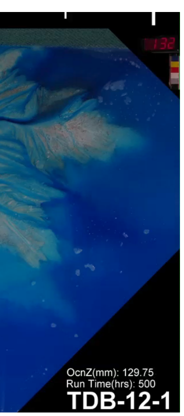

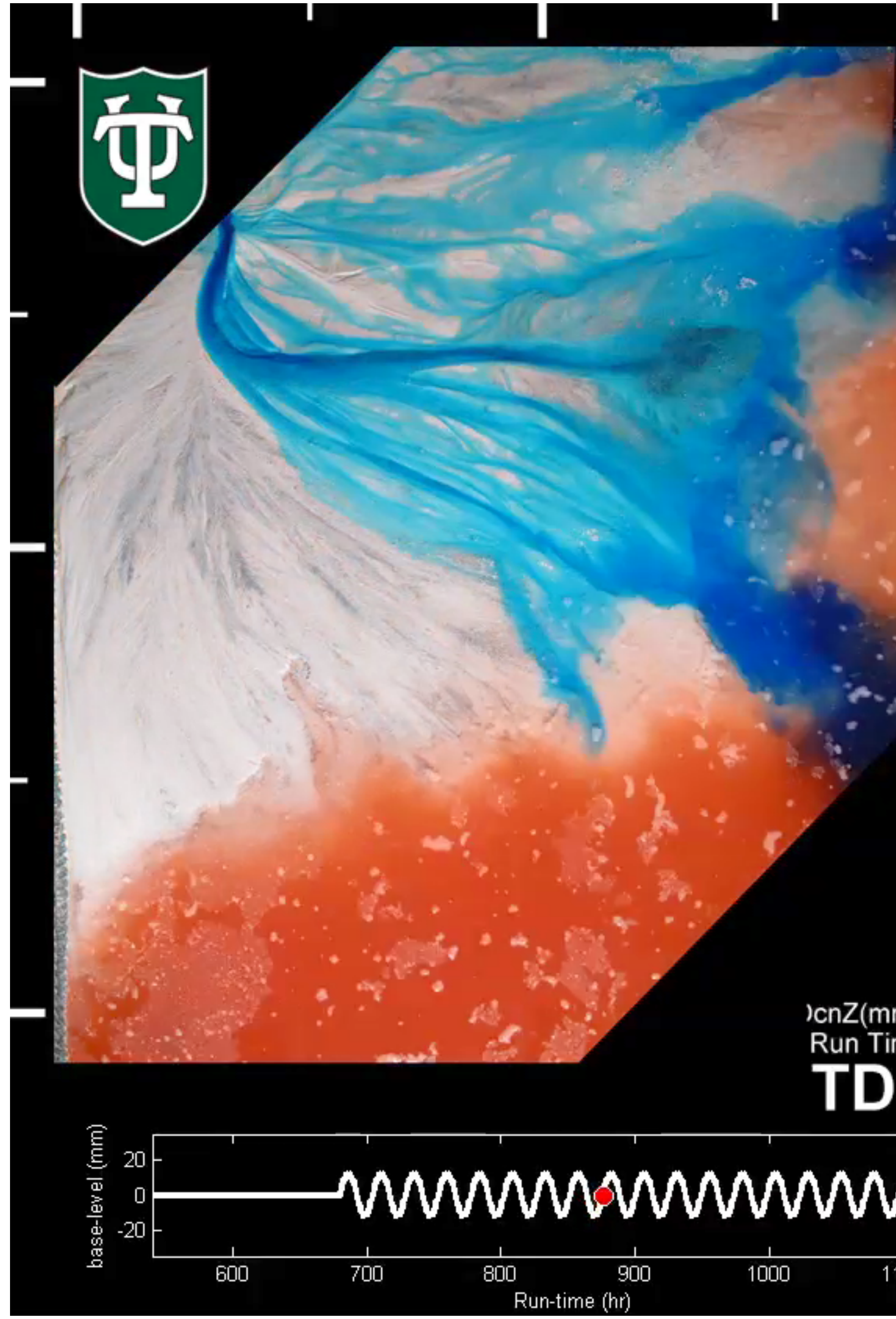

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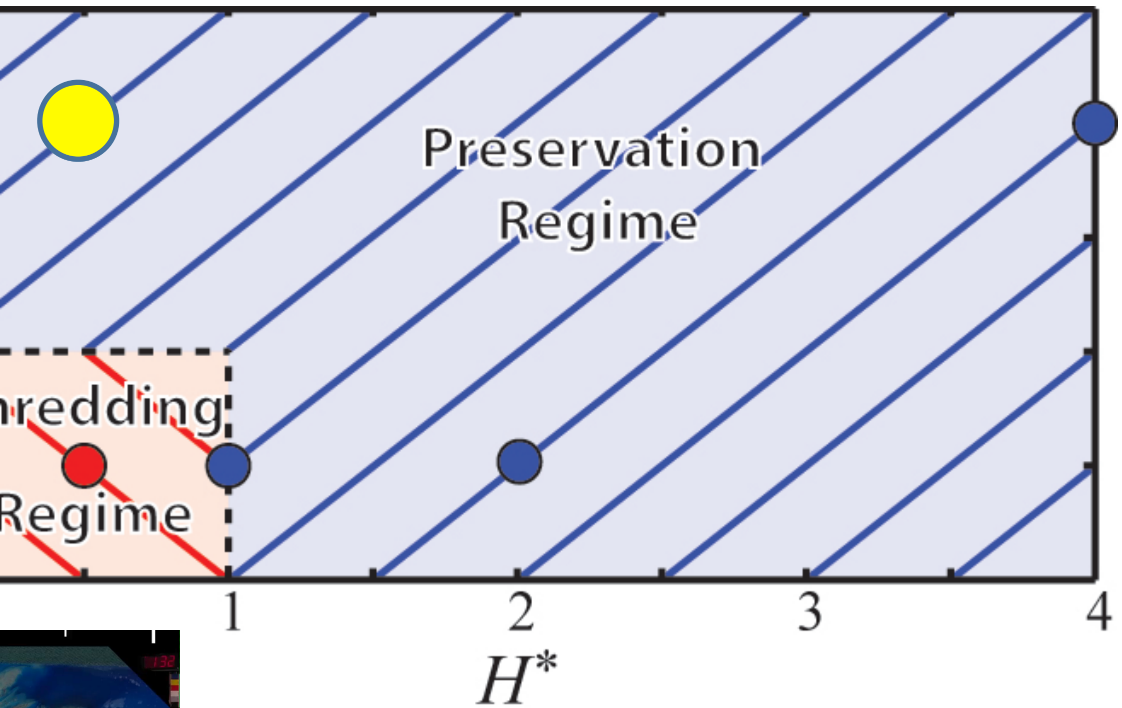

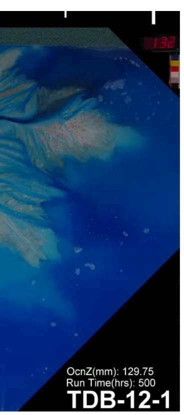

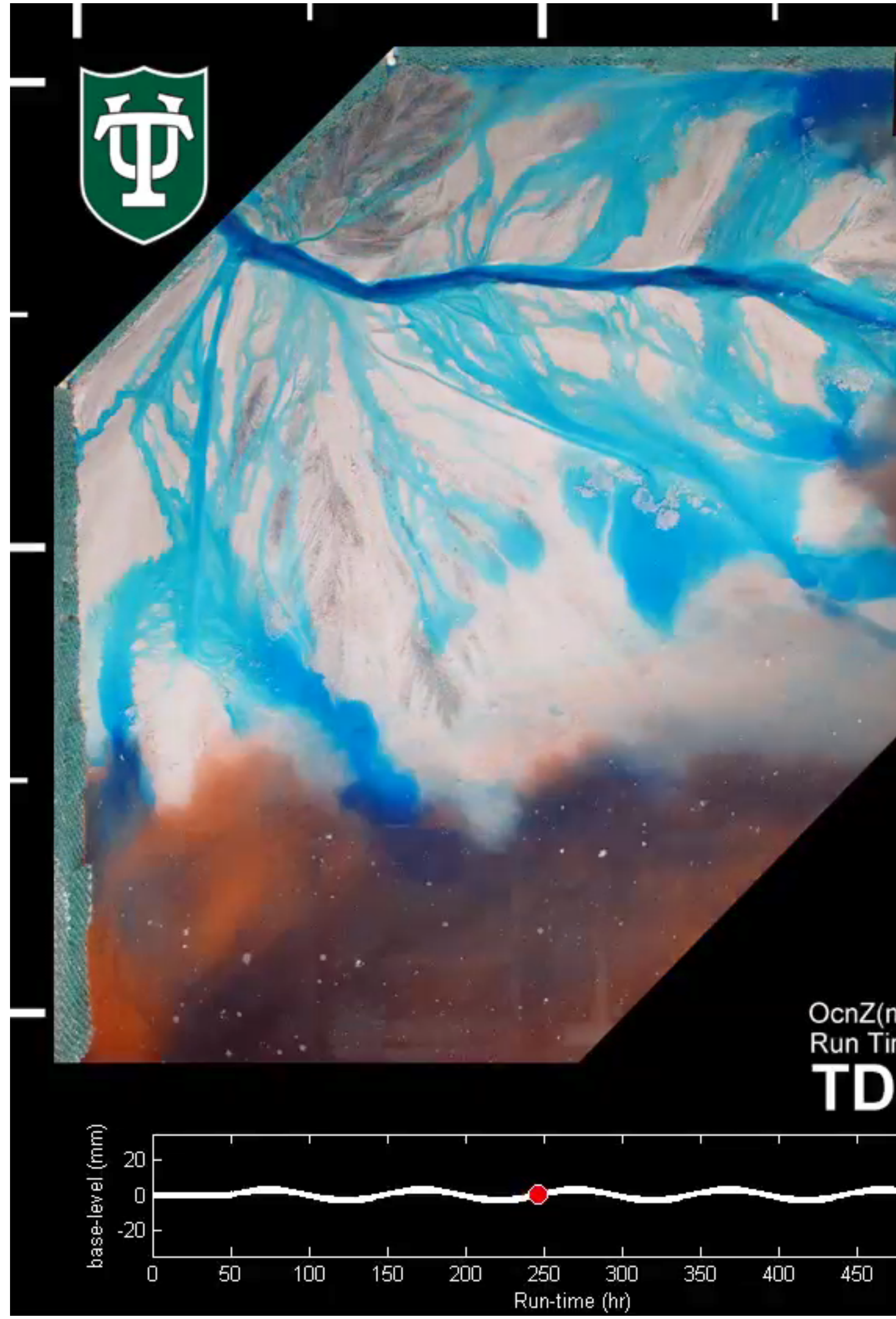

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