# Numerical investigation of the role of slope and flow dynamic characteristics on the "fill-and-spill" process and deposit in linked submarine intraslope minibasins

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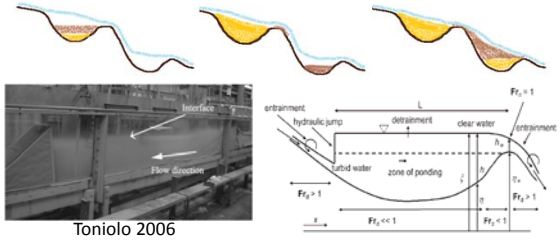
## 1. Introduction

Salt-withdrawal minibasins are a quasi-circular depression on the continental slope formed from plastic deformation of thick deeply buried salt accumulation overlying by sediment load. Minibasins can be linked by network of submarine channels; they are of economic importance because they are prime targets for oil exploration when filled with sand rich deposit

**'Fill-and-spill' process**

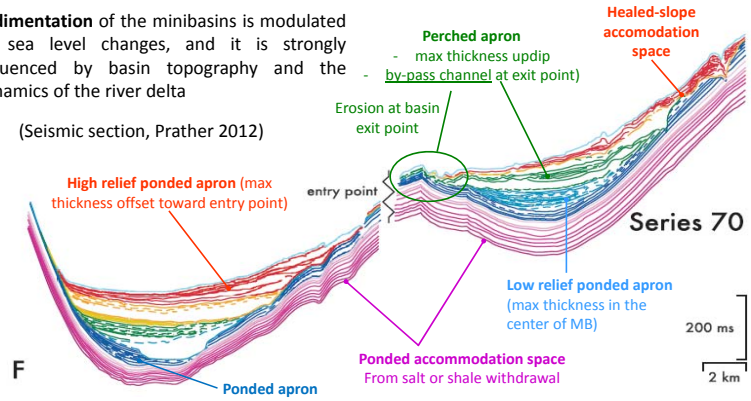
Minibasins often contain layered deposits of turbidity currents in which either mud or sand dominate i) turbidity current reach the minibasin and runs the relatively steep slope of the updip part, ii) ponds within it and deposits sediment, and eventually iii) overflows and fill the next one



Toniolo 2006

**Sedimentation** of the minibasins is modulated by sea level changes, and it is strongly influenced by basin topography and the dynamics of the river delta

(Seismic section, Prather 2012)




## 2. Motivation and Research Questions

- **What is the role of the system geometry and of the flow characteristics of the turbidity current on the depositional pattern?**
- **What is the spatial distribution of the grain sizes in minibasin deposits?**
- **How the deposit characteristics change for increasing the slope of the minibasin-canyon system?**

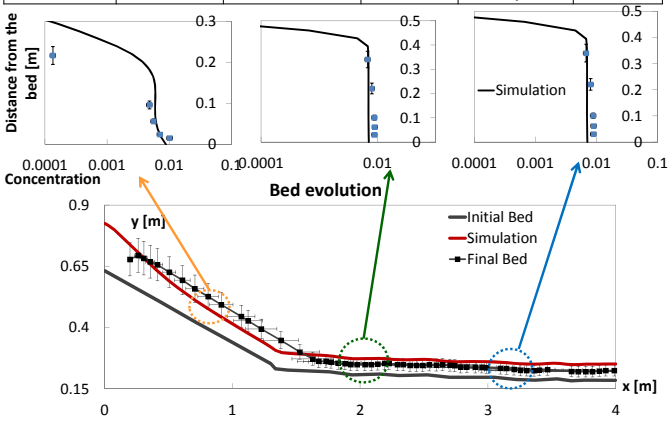
**OBJECTIVE:** *Conduct three-dimensional model simulations to investigate how the deposit characteristics change with an increase in slopes of the minibasin-canyon system*

The Reynolds-averaged Navier–Stokes equations for dilute suspensions over a deforming bottom boundary are solved in 3-D. Turbulence is modeled with a buoyancy-modified k–ε closure scheme.

## 3. Model Validation

*Two-dimensional horizontal minibasin – Toniolo 2006*

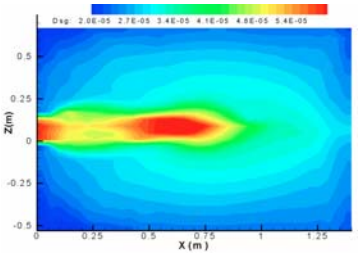
| Experiment | Upstream Discharge | Upstream Flow thickness | Upstream conc. | Sediment diameter | Duration |
|---|---|---|---|---|---|
| 1 | 0.33 l/s | 1 cm | 0.05 | 42 μm | 58 min |

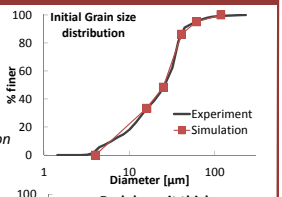


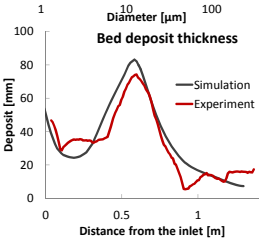

*Three dimensional –horizontal minibasin*

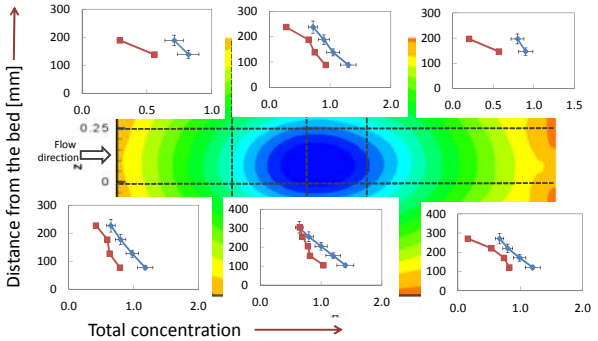
| Upstream Discharge | Upstream concentration | Dsg | Duration |
|---|---|---|---|
| 0.45 l/s | 3.09% | 19.6 μm | 15 min |

*Distribution of the mean size diameter at the end of the simulation*

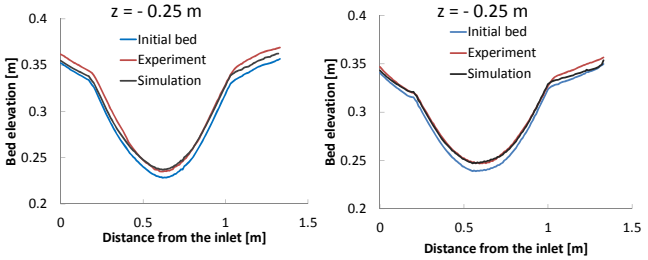



*Bed elevation profile*




## 5. Observations and future work

- The model validation against 2D experiment shows that the model captures the concentration profiles, while it over estimate the deposit in the entrance of the minibasin
- The deposit thickness for the case of the 3D minibasin matches the deposit observed in the experiment reasonably well and the total concentration profiles have the same trend.
- Deposit grain size distribution is symmetrical, coarsest in the proximal and central part of the basin
- *Future work:*

i. Compare the grain size distribution with the experiment results
ii. Store the information of the stratigraphy of the deposit
iii. Investigate the effect of the geometry on the deposit by increasing the slope of the minibasin system
iv. Apply to field scale

References
1. **Toniolo et al. (2006);** Depositional turbidity currents in diapiric minibasins on the continental slope: experiments—numerical simulation and upscaling; Journal of Sedimentary Research, 2006, v. 76, 798–818
2. **BradfPrather et al. (2012); Stratigraphy of linked intraslope basins: Brazos–Trinity system western Gulf of Mexico,** Society for Sedimentary Geology, Special Publication No. 99