Settling properties of freshly eroded aggregates.

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Suspended sediments in head water catchment

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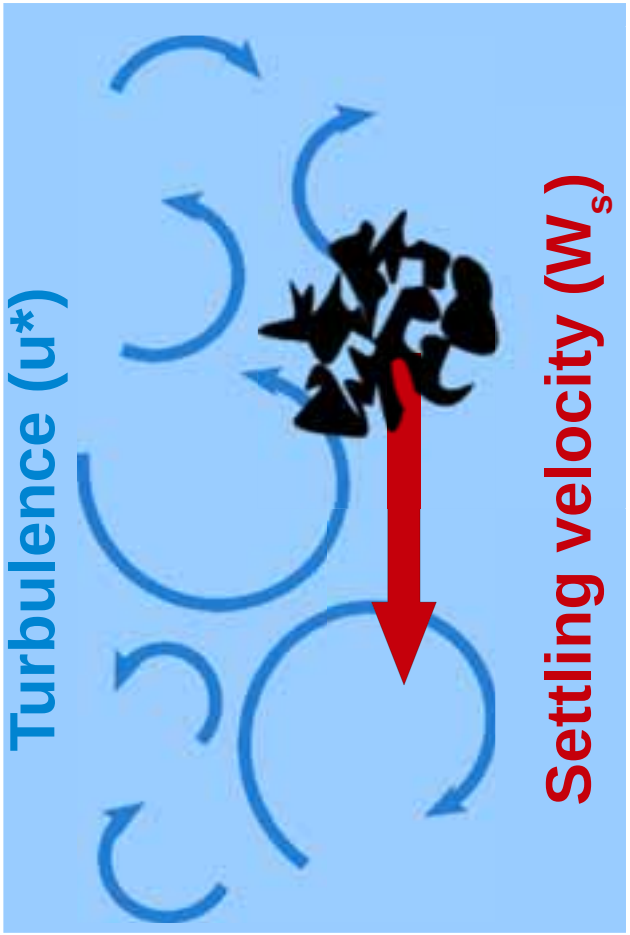
- large uncertainties still remain on modelling the suspended sediments fluxes in head water catchment (Jetten et al., 1999 ; Wainwright, 2011)

Physically-based models for suspended load

- Suspension is governed by the balance between turbulence and settling velocity.



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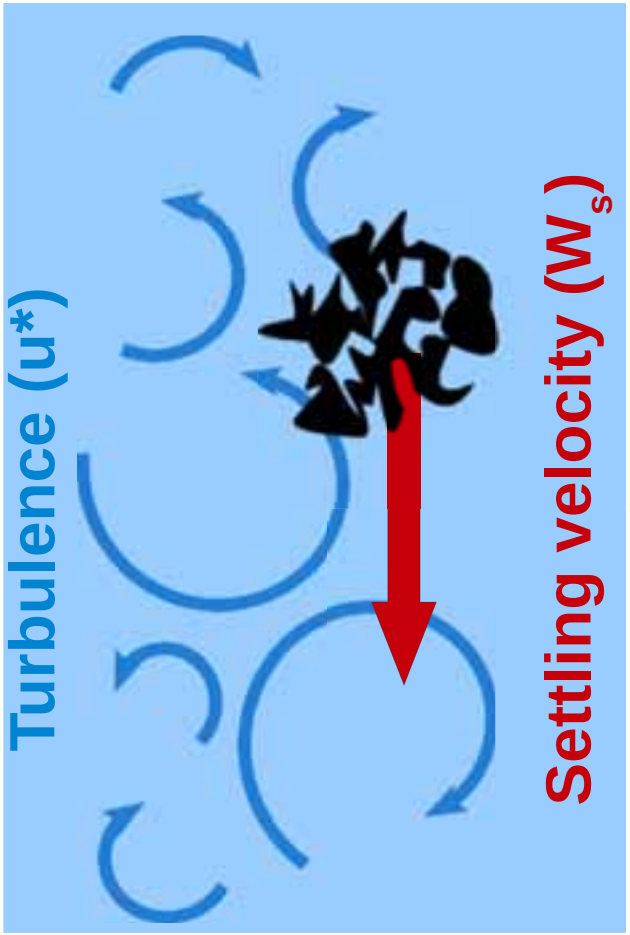
- Suspension is governed by the balance between turbulence and settling velocity.
- Settling velocity of spherical particles (Stokes Law) :

Settling velocity — Particle equivalent diameter

$$w_s = \frac{g}{18 \cdot \mu} \cdot (\rho_s - \rho_w) \cdot D_s^{\,2}$$

Gravity and water viscosity — Particle and water densities



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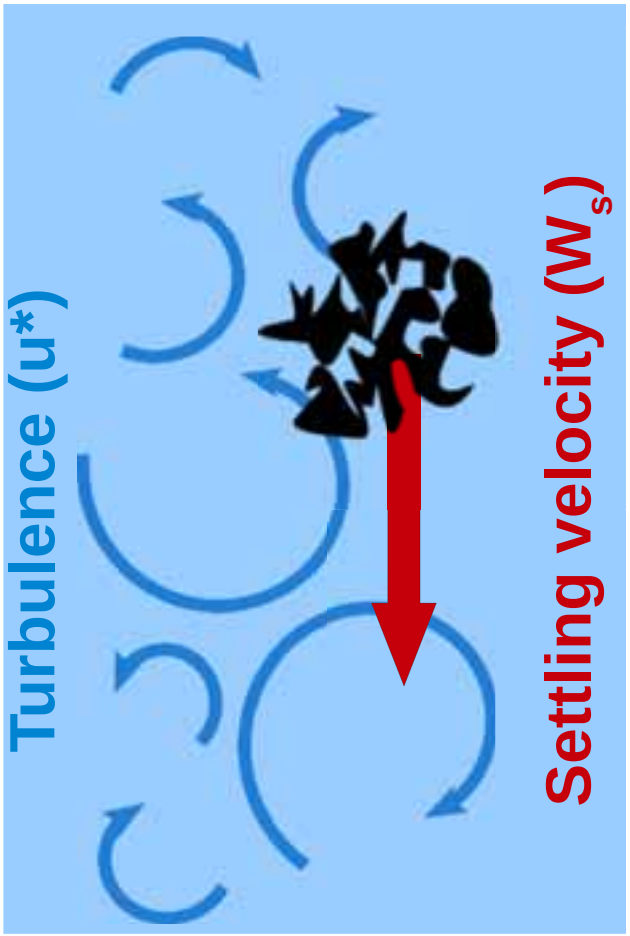

→ Do particle settling properties vary during their transport?

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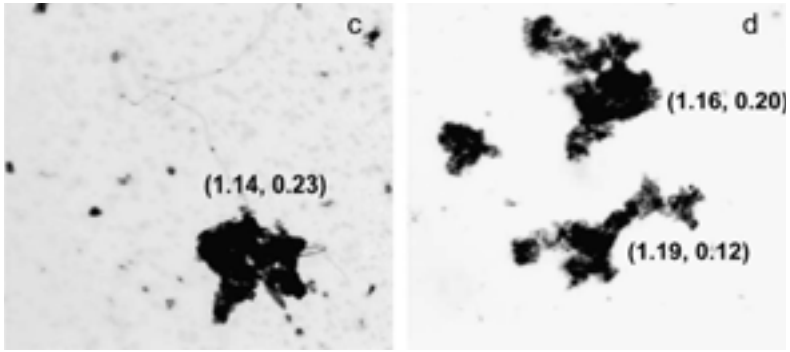
Estuarine and lowland flocs



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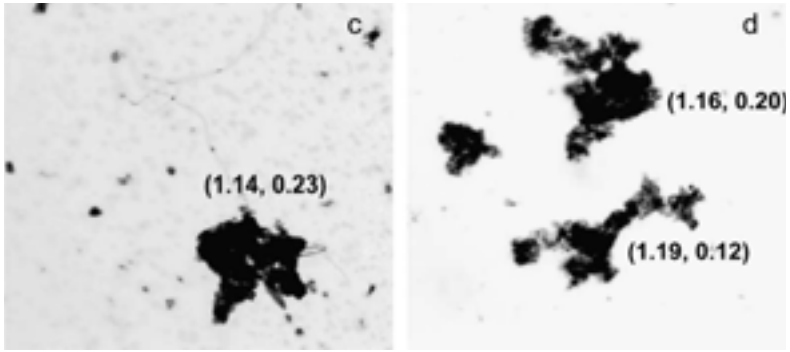

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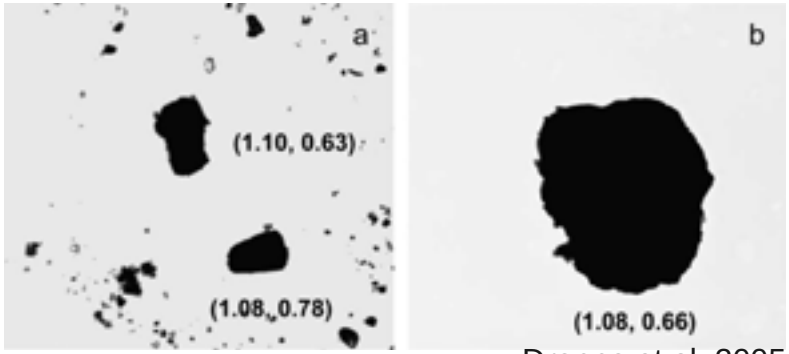

Droppo et al, 2005

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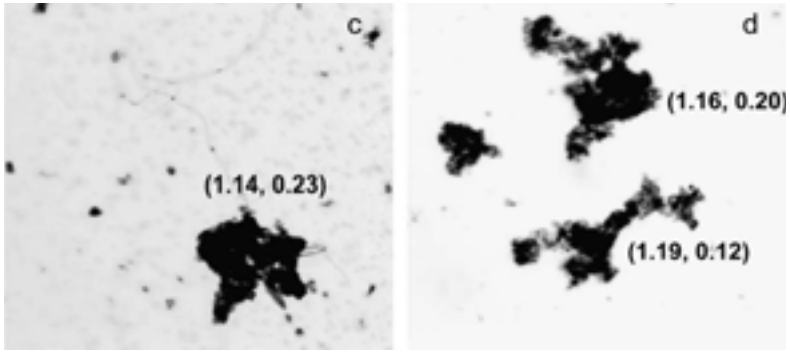

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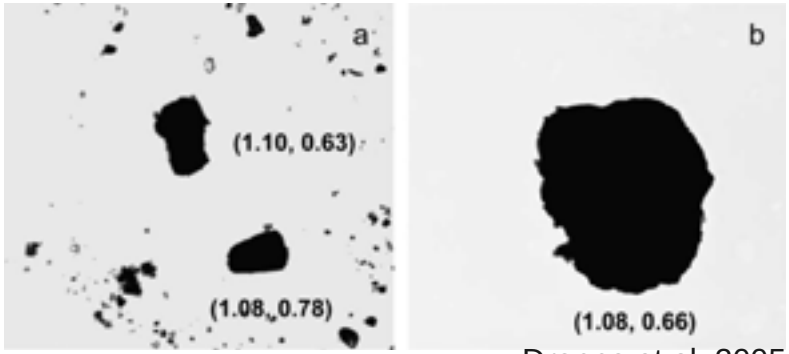

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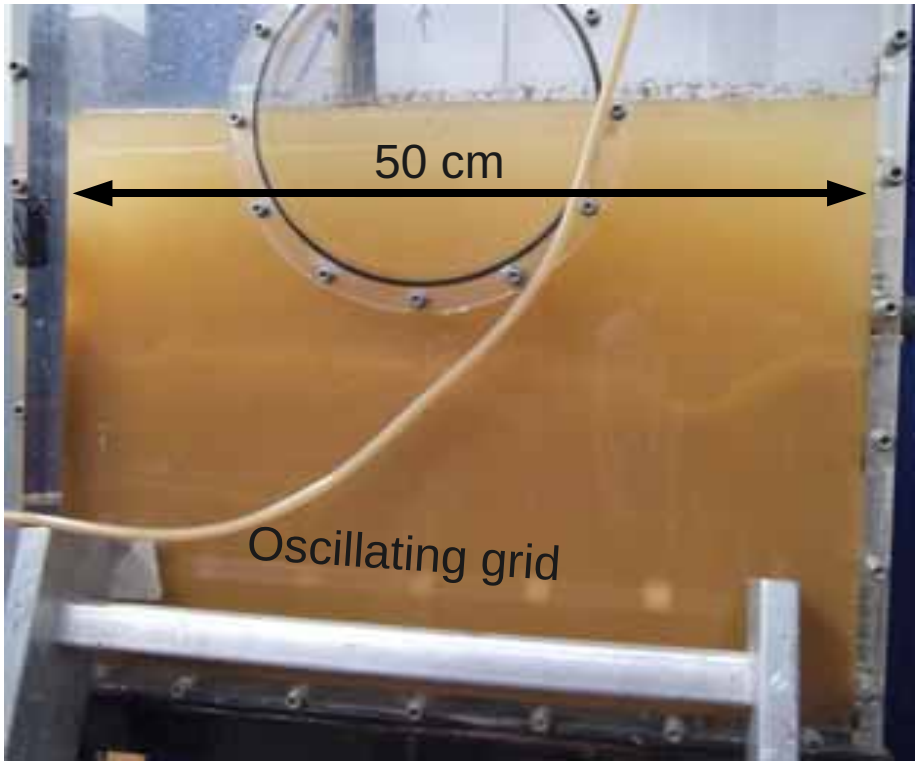
→ Study of soil particles evolution in controlled turbulent water

Method

- Diffusive turbulence water tank $G = \sqrt{\frac{\overline{u^3}}{\rho \cdot \nu}} \approx 7\, s^{-1}$

- Soils are dried and sieved at 1 mm



Monitored parameters:

- Suspended Sediment Concentration (OBS, dry mass sampling)
- Settling velocity (video)
- Aggregated particle sizes (video and laser sizer)
- Dispersed particle sizes (laser sizer after high stirring and sonication)

Tested soils

- Three Mediterranean materials were tested

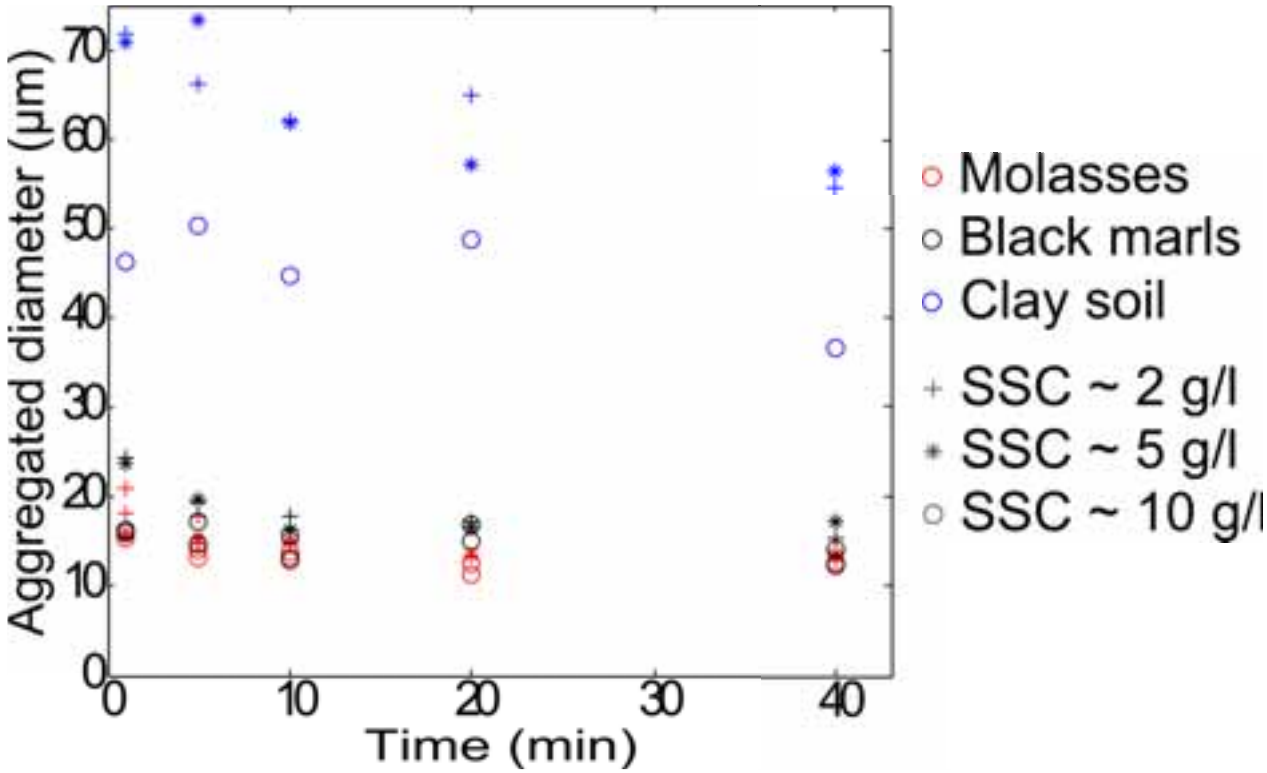
Clay soil
(Vineyard hillslope)

Black marls
(Badlands)

Molasses
(Badlands)

- For each soil, three Suspended Sediment Concentrations were tested (~2, 5 and 10 $g.l^{-1}$)

Does particle sizes vary within turbulent water?



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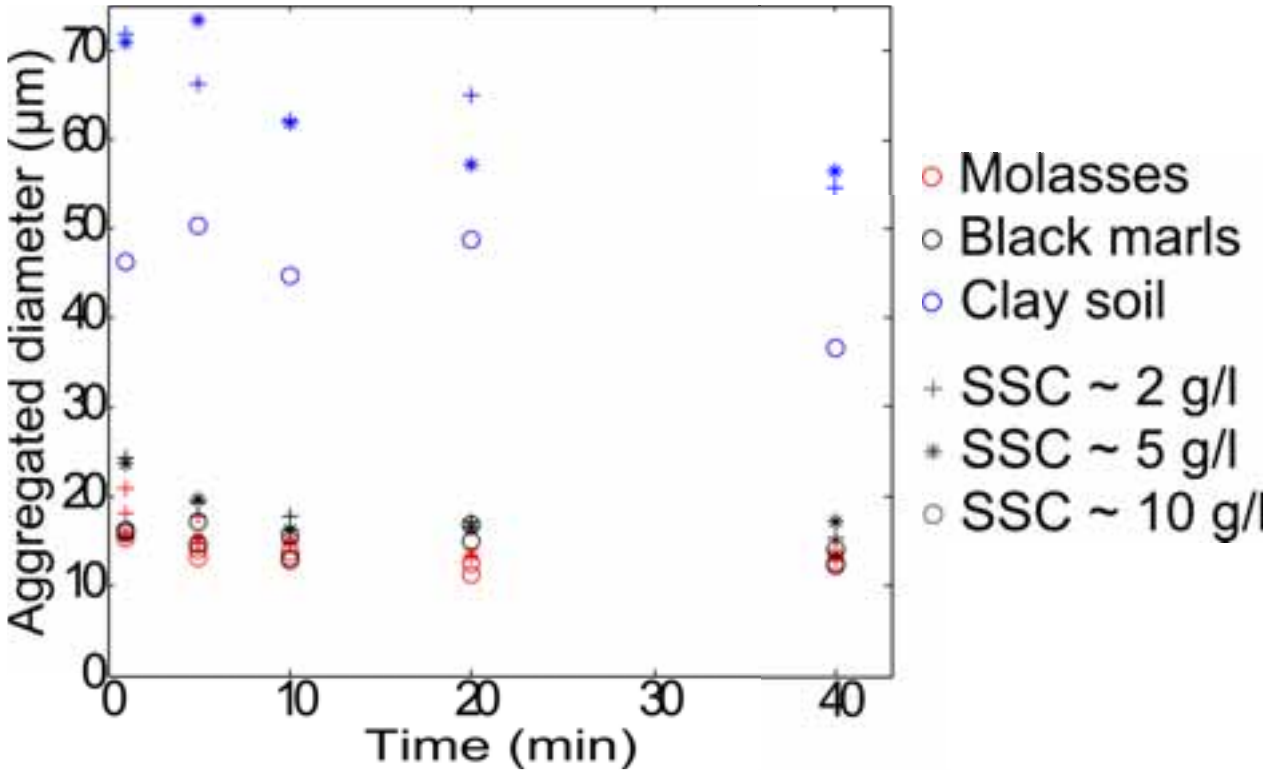

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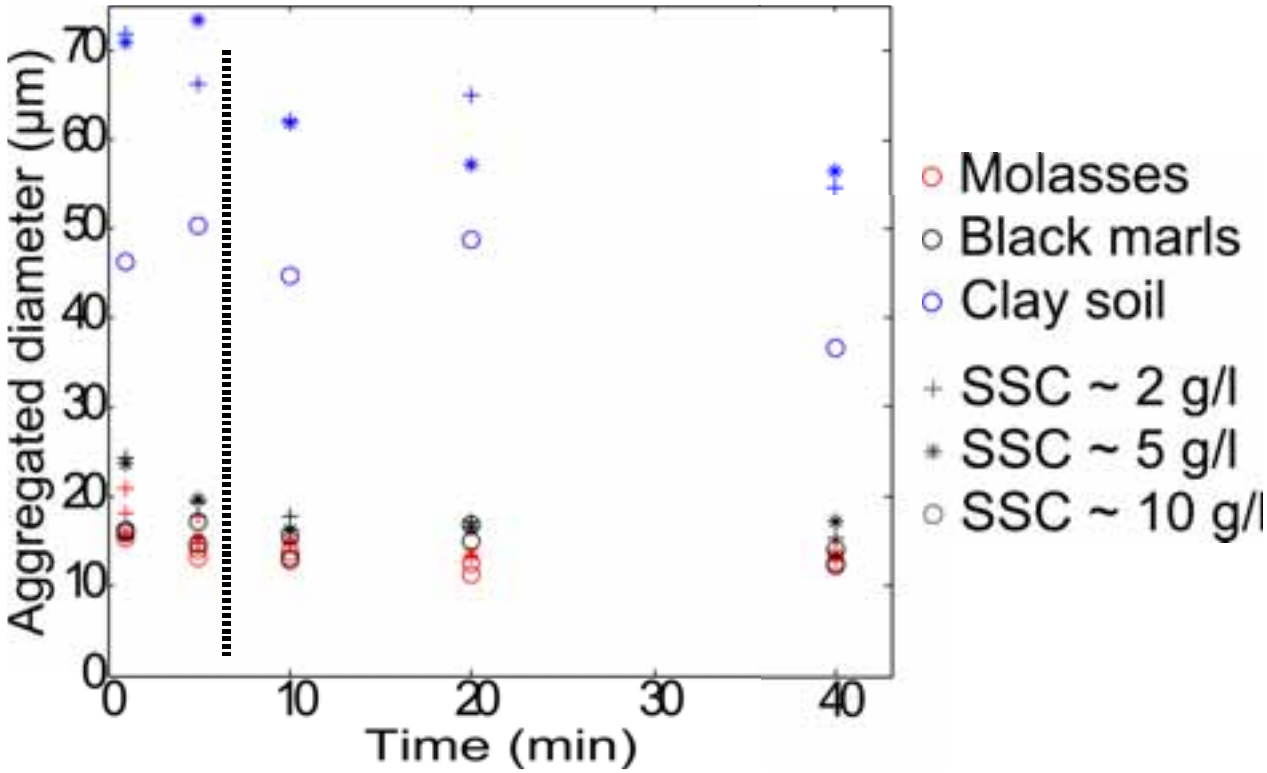
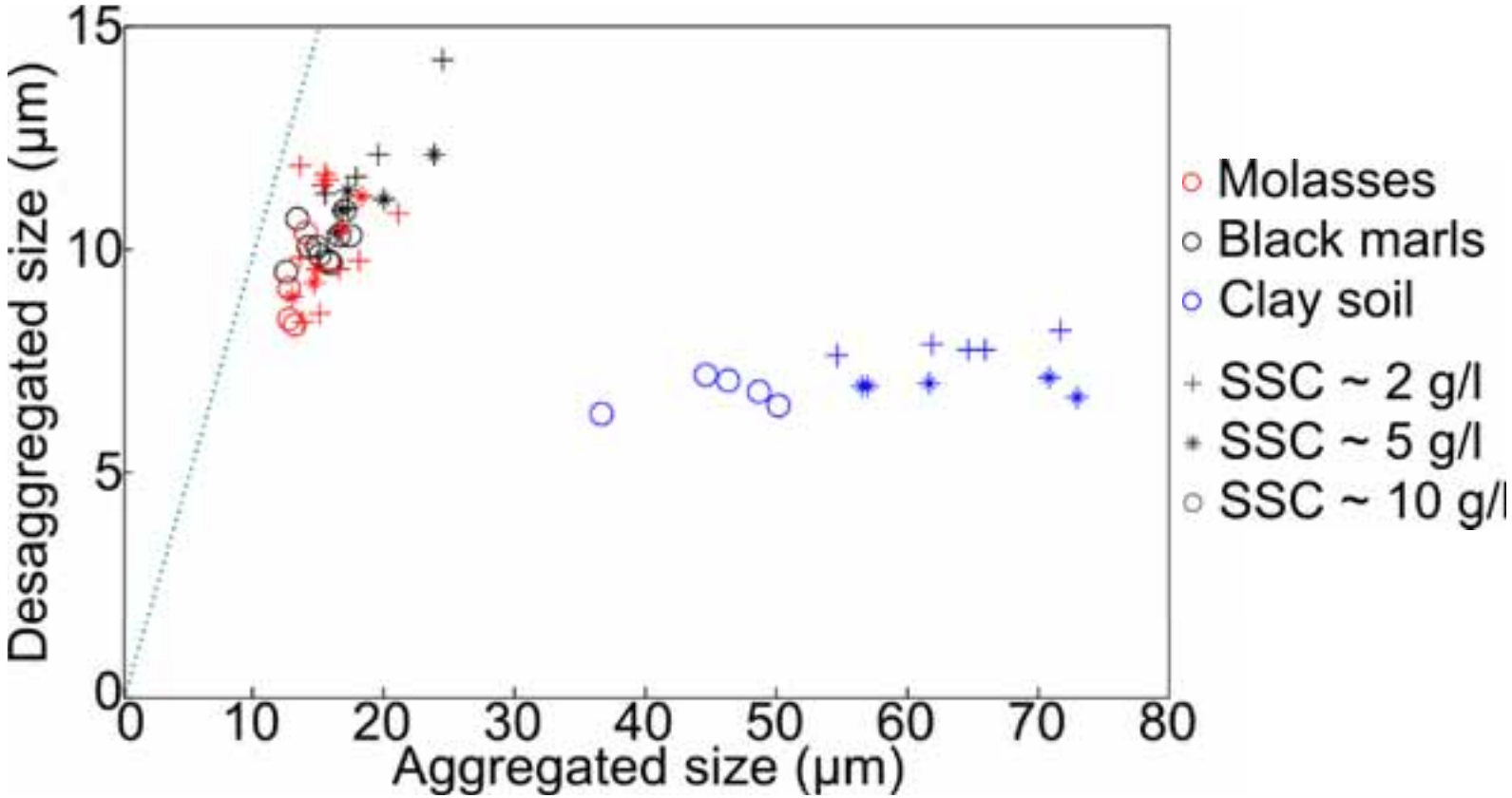


- Disaggregation of all soils
- Little evolution after 5 minutes

Are particles aggregated ?



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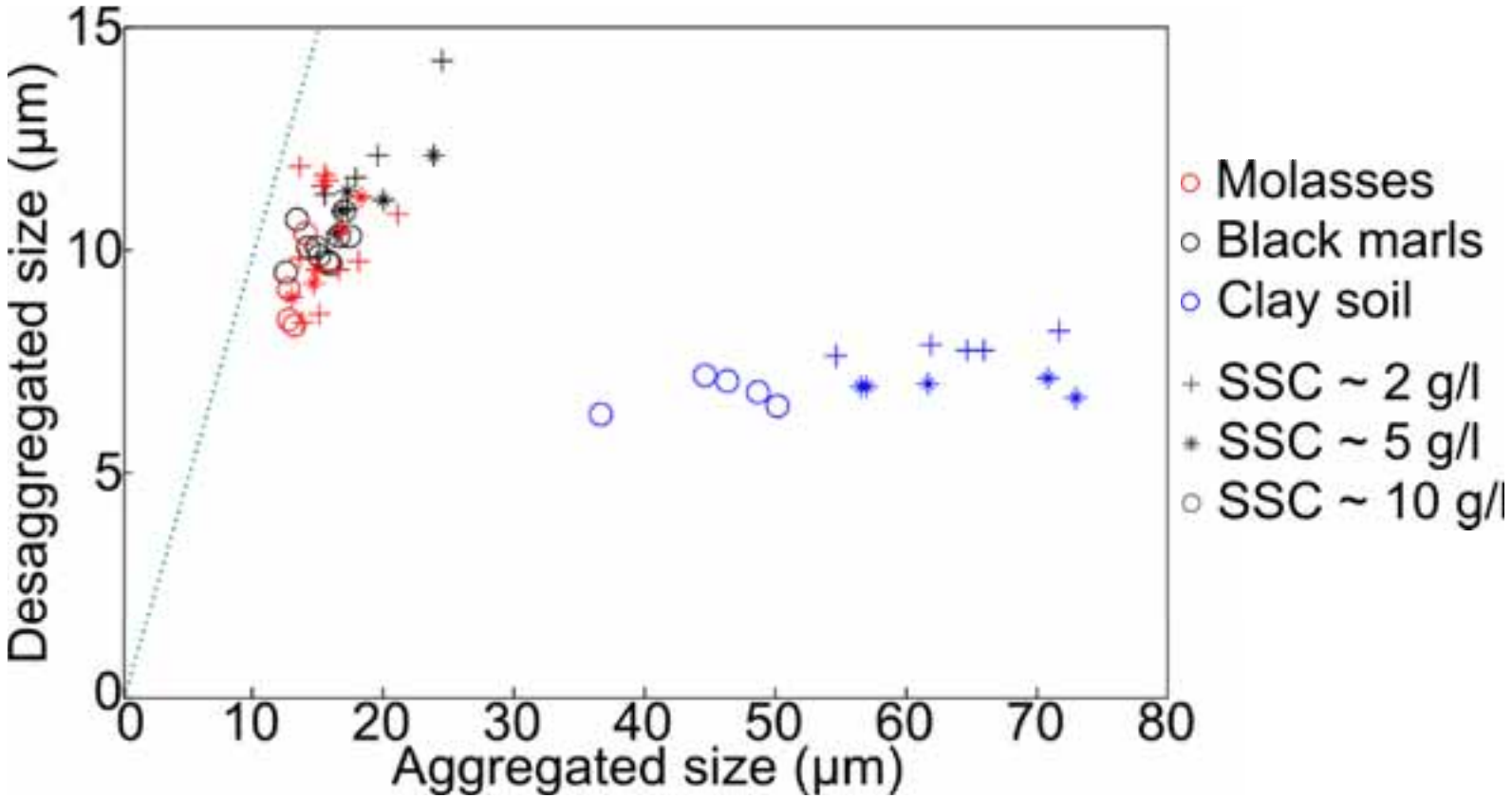

- The suspended particles are all aggregated.

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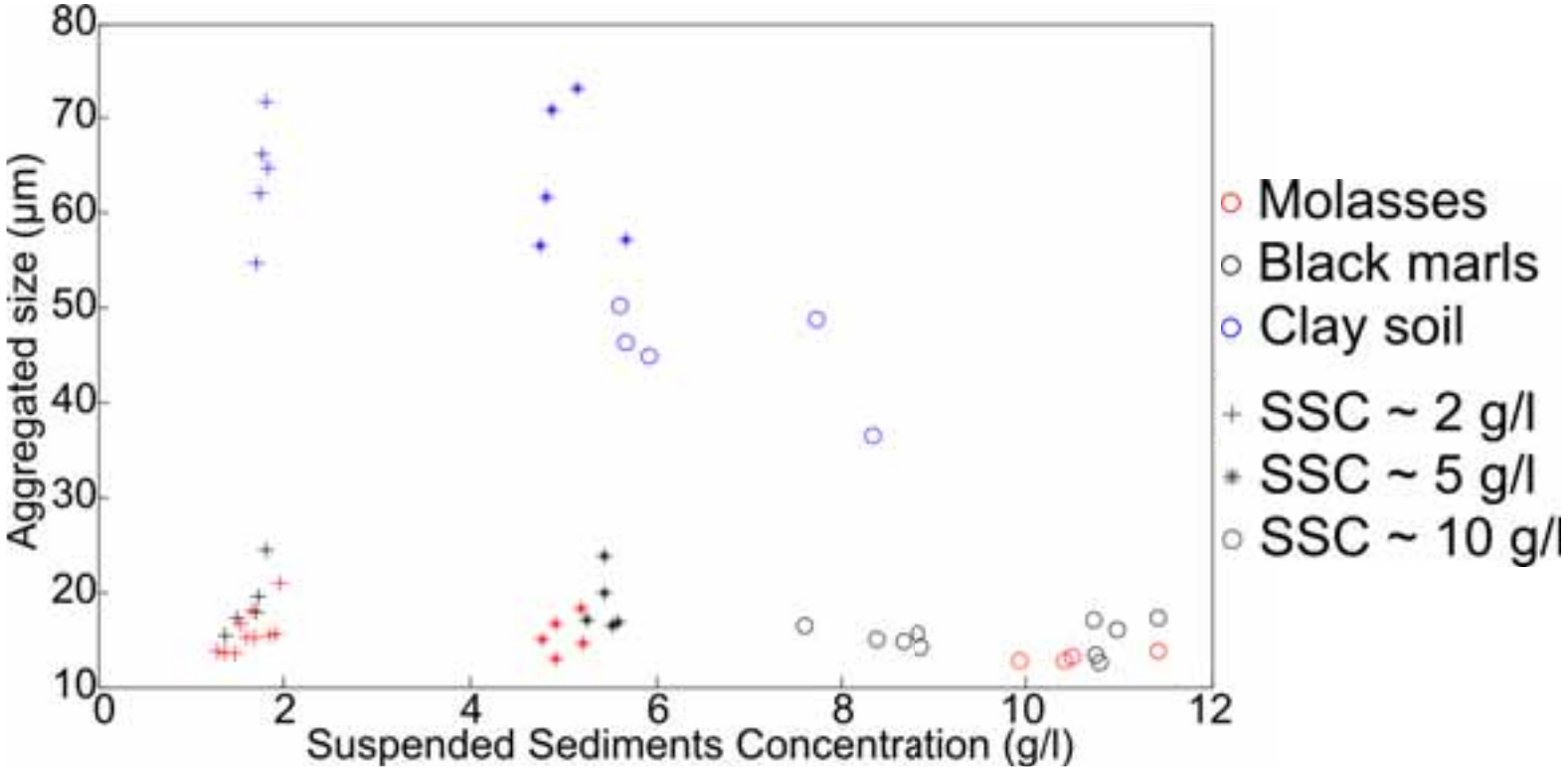

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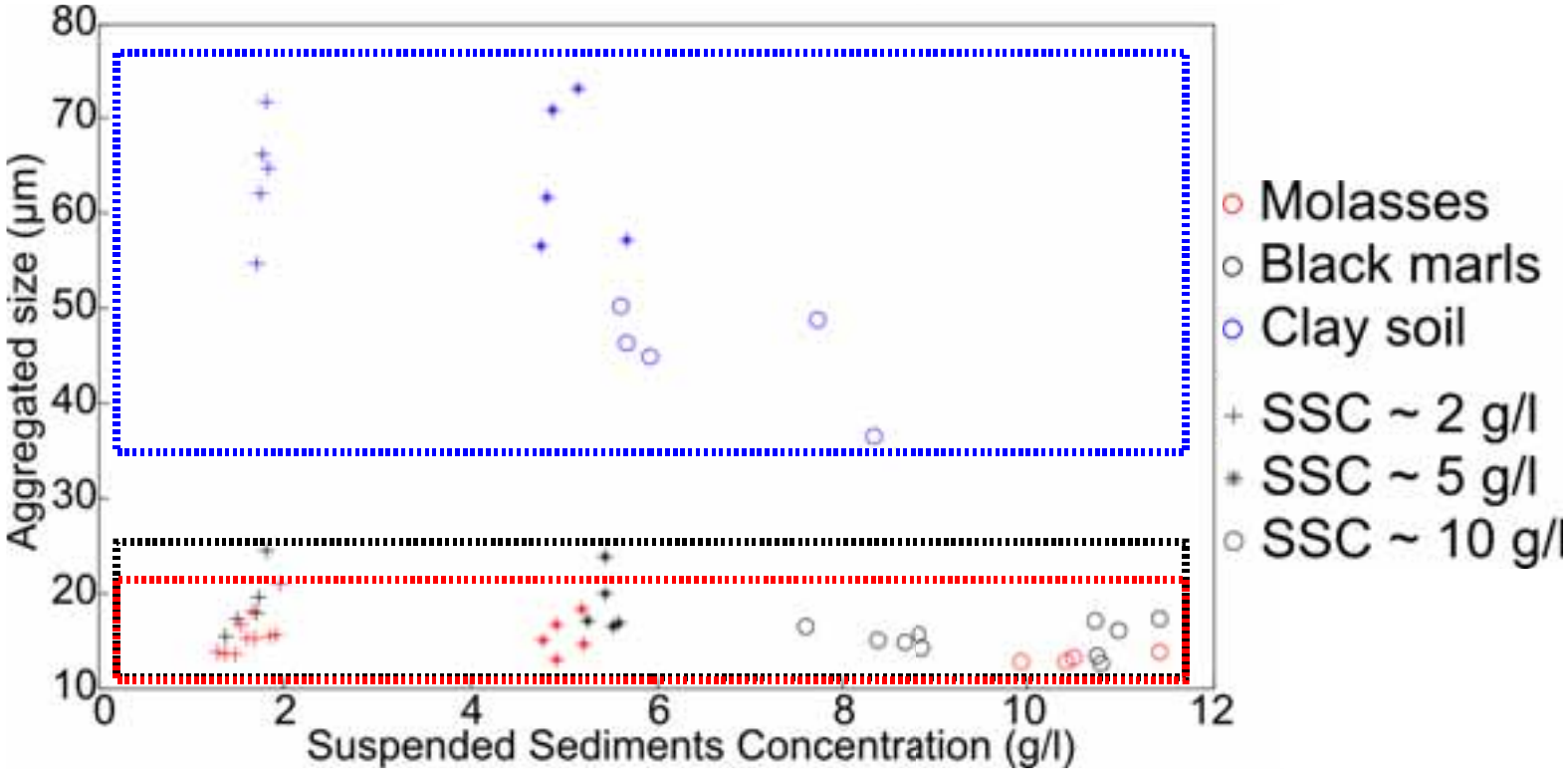

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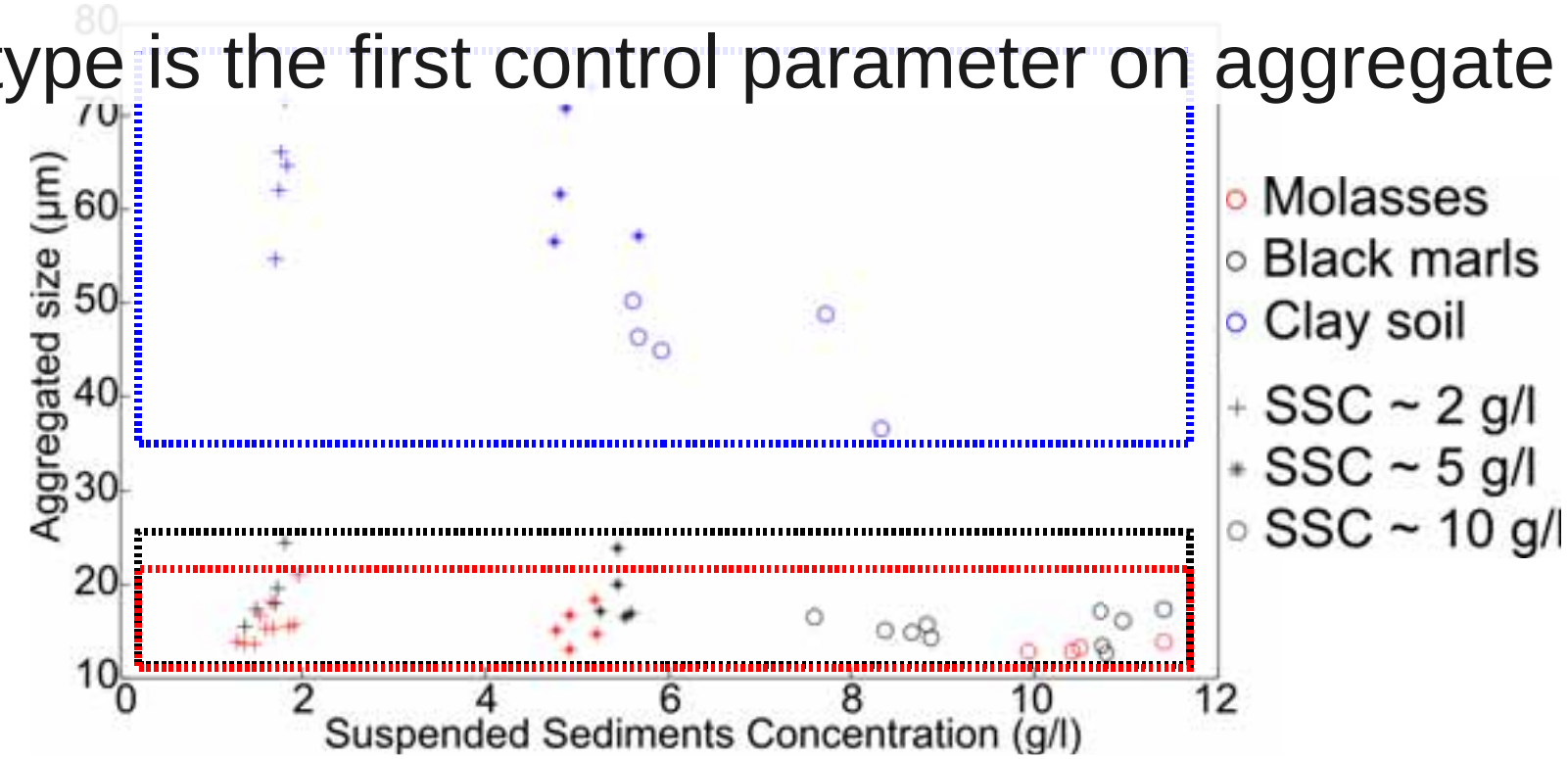

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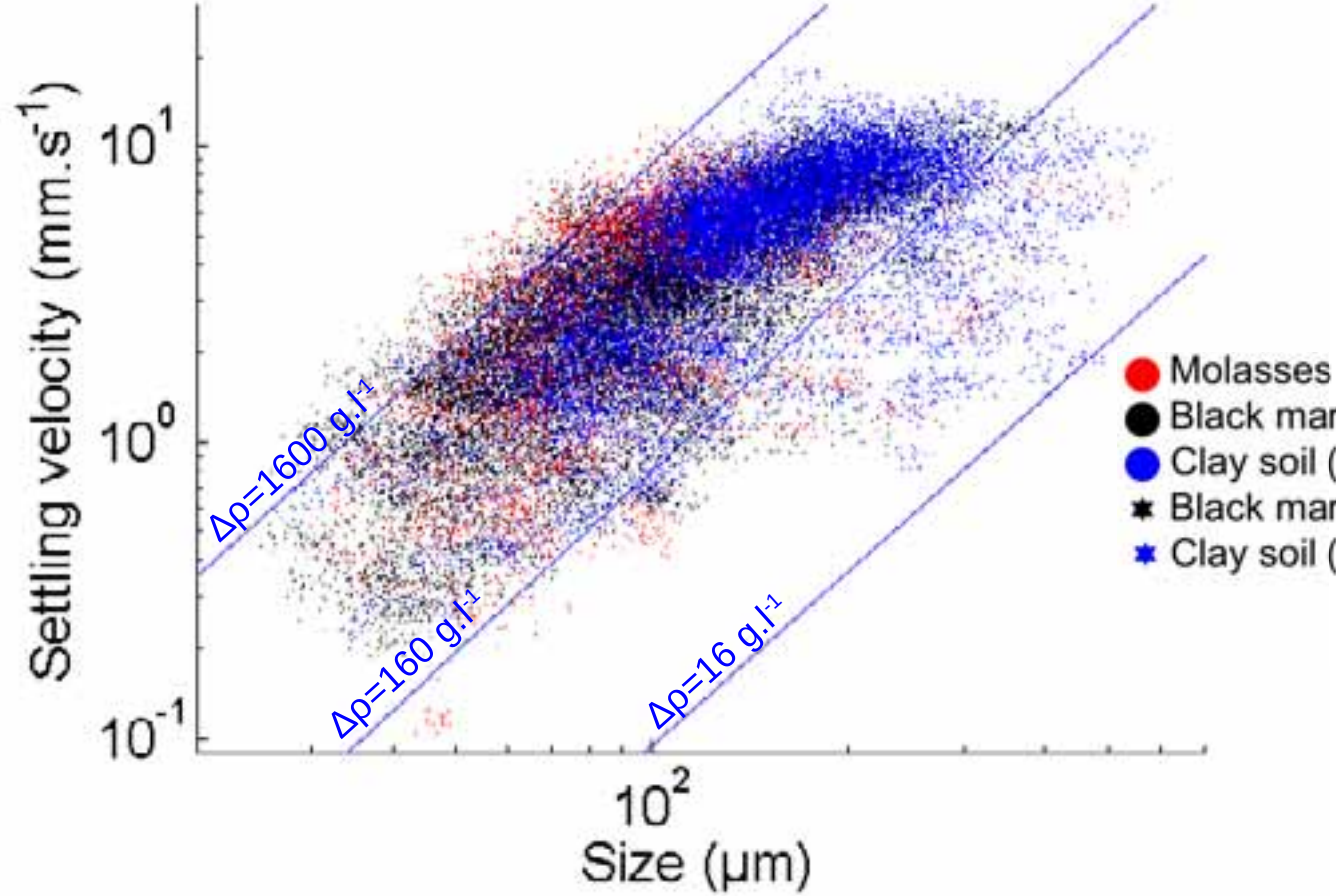

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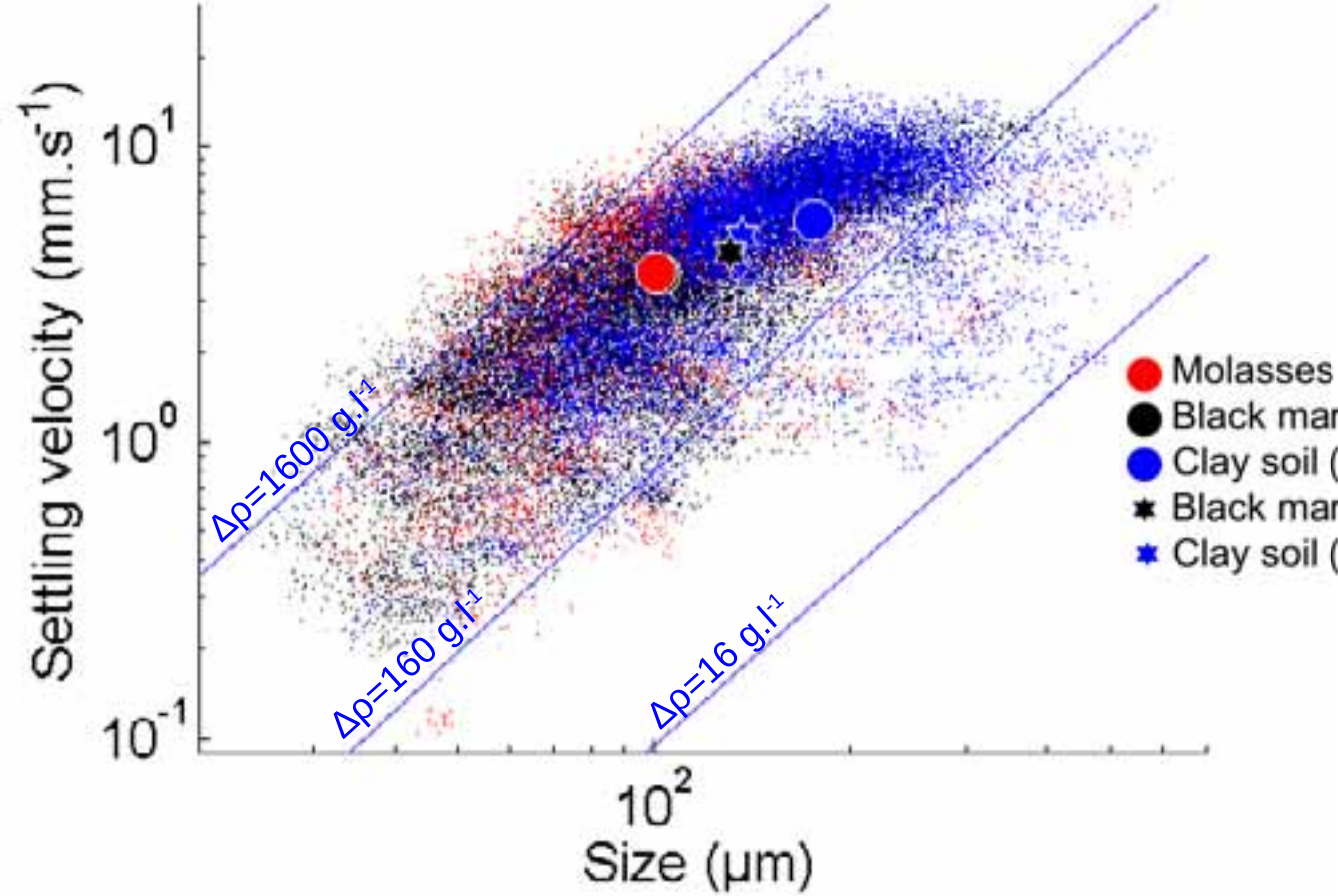

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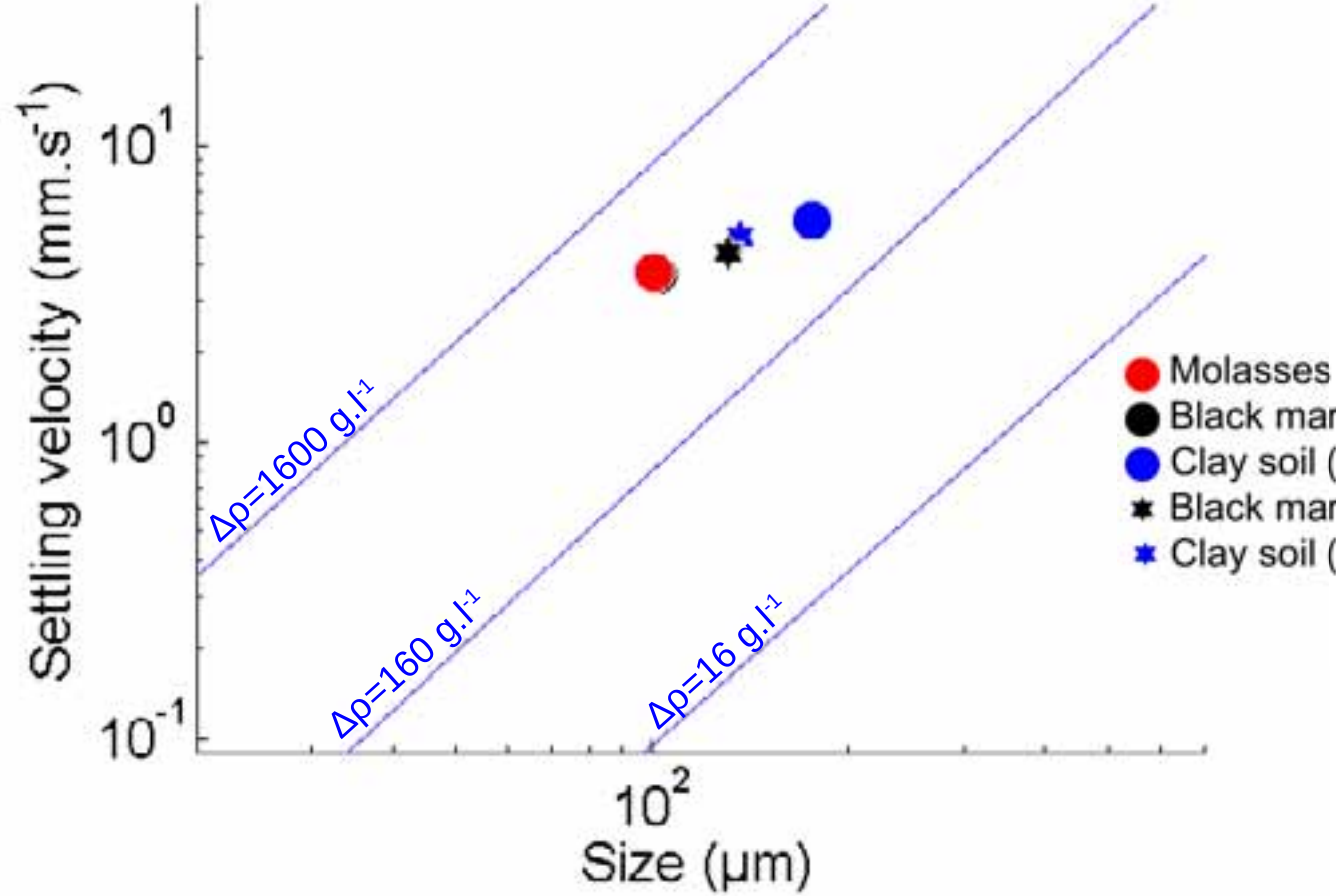

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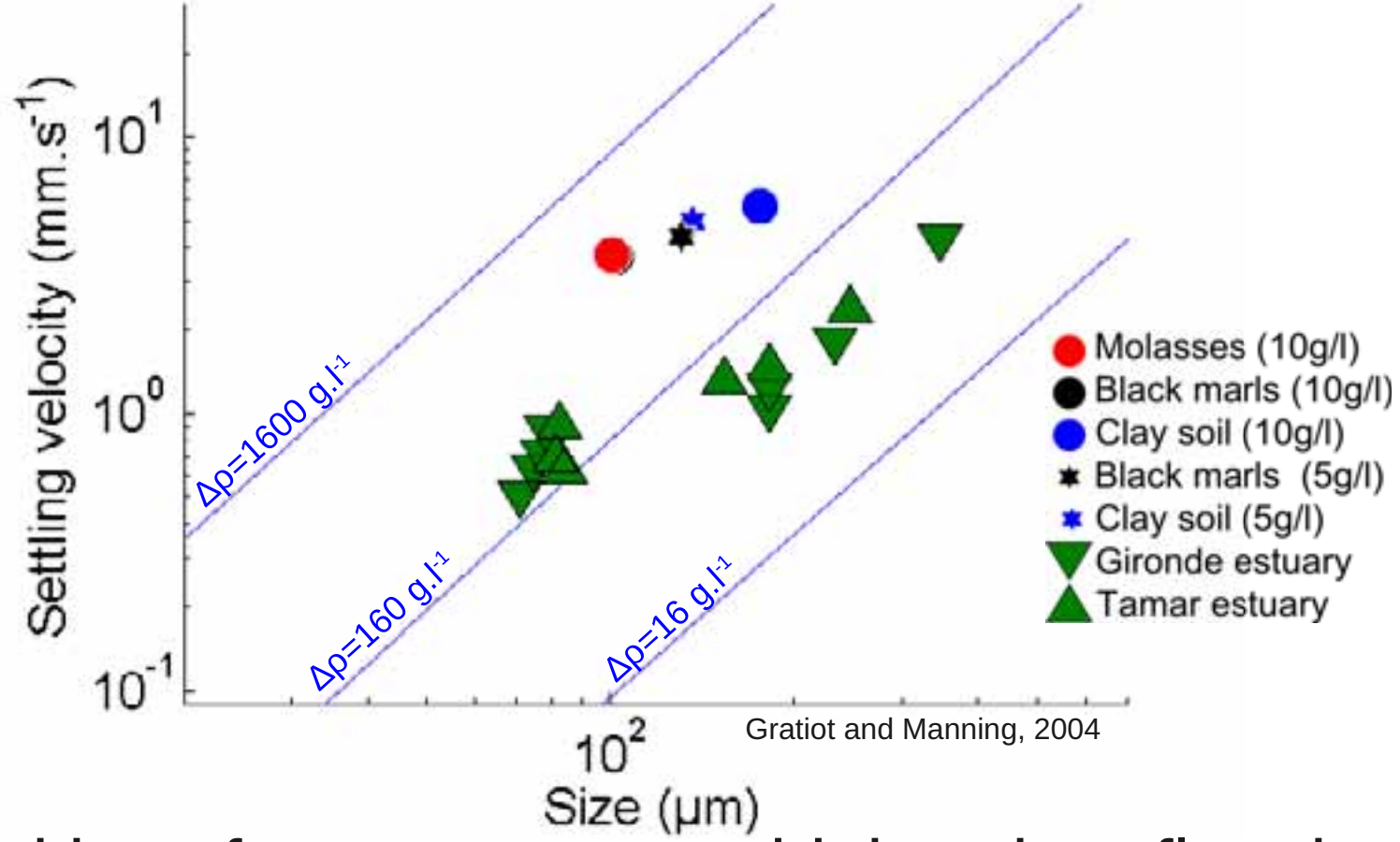

Gratiot and Manning, 2004

- The densities of aggregates are higher than floc densities

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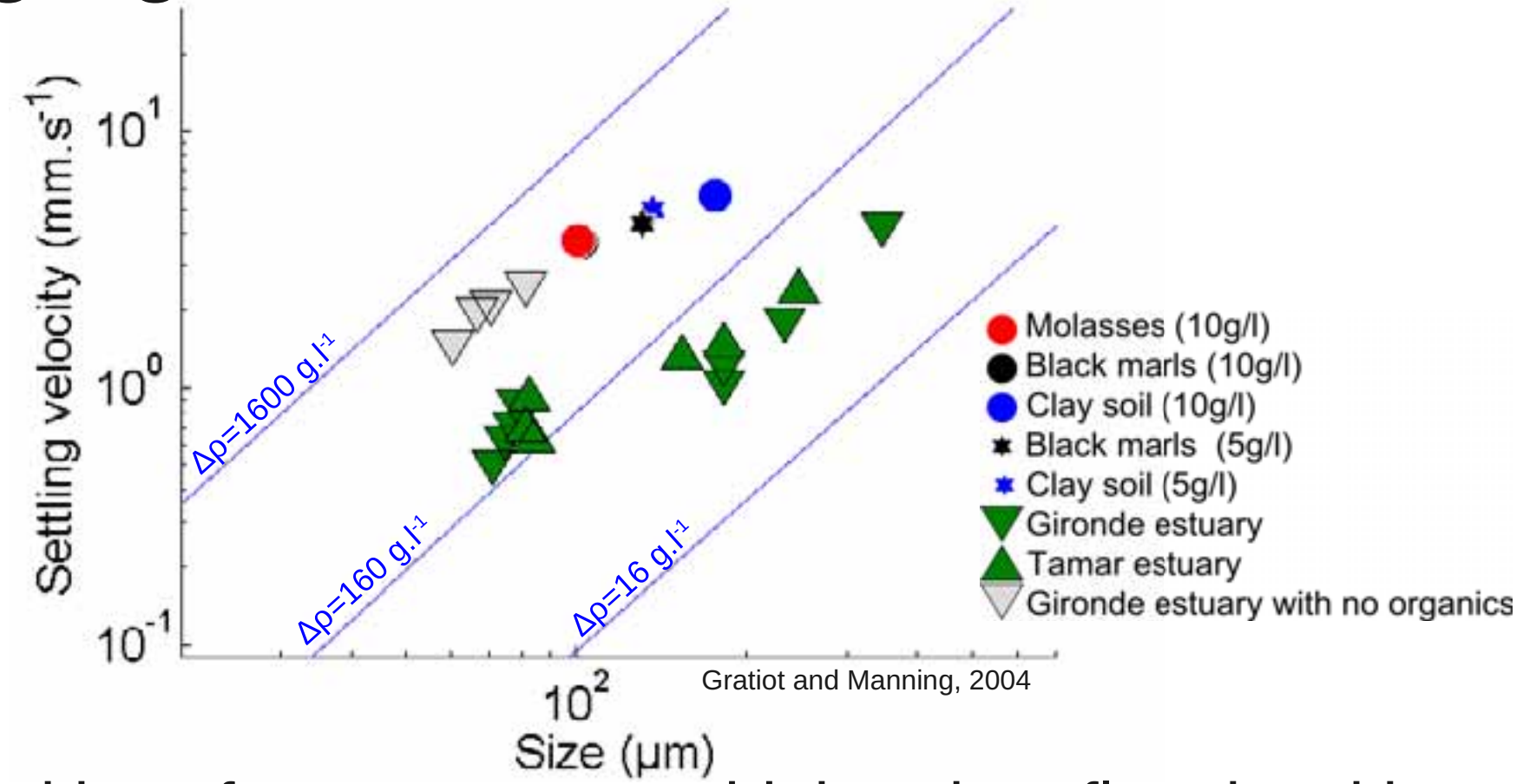

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- The densities of aggregates are higher than floc densities
- Estuarine muds with no organics form small flocs with similar density as aggregates.

Conclusions

- Freshly eroded aggregates properties exhibited little variations in turbulent water at hour scale

→ Aggregates can not be considered as inert

- Particle size do not vary with SSC and the type of source soil is the first order control parameter on settling properties

→ Aggregate sizes is not fully controlled by hydrodynamics

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future Investigation should be conducted to asses the time/space scales at which aggregates turn into flocs