Introducing basic elements of structural geology to 100-level students using sand-box experiments

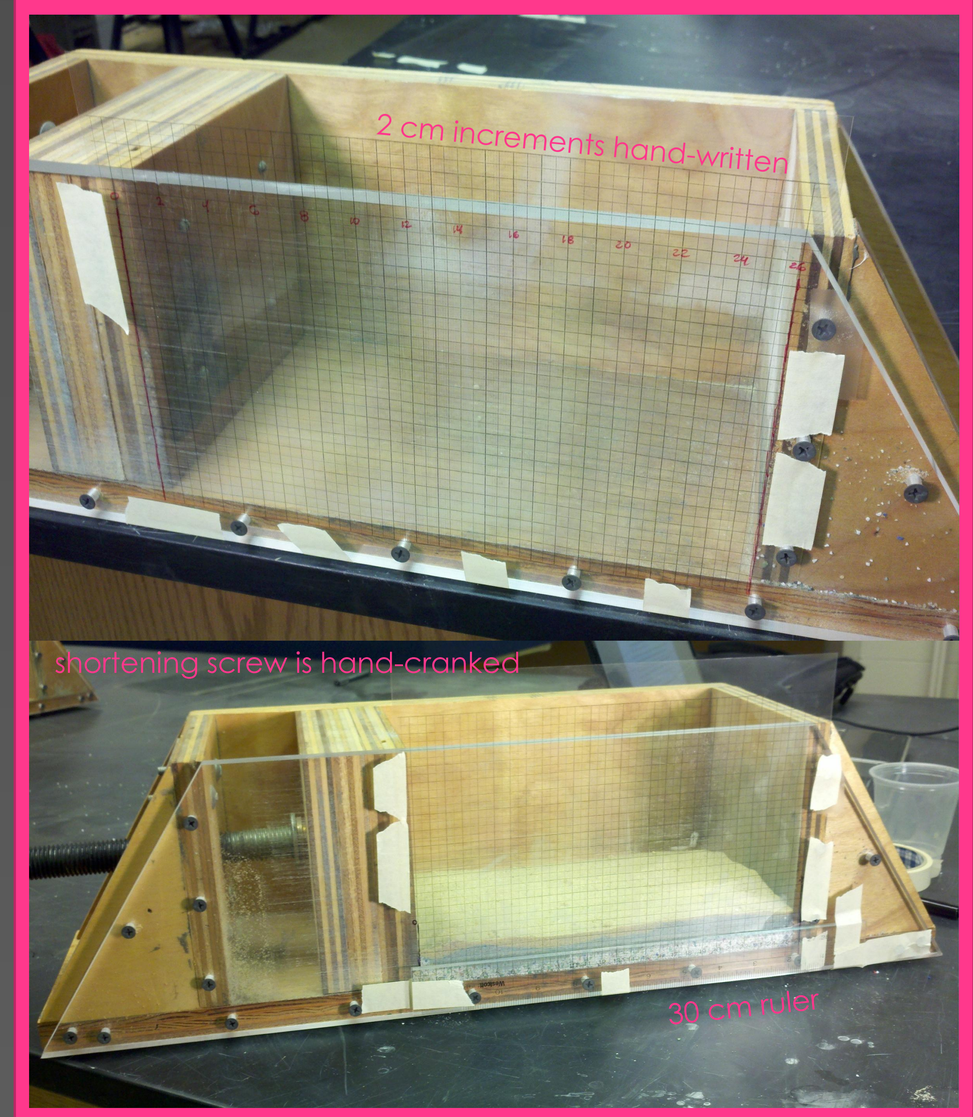
Graham DM Andrews –
CSU Bakersfield & UC Santa Barbara

Students gain first-hand experience of:

- measuring incremental and finite strain,
- measuring and describing fold geometry,
- careful data collection,
- graphical and numerical data analysis,
- conducting an analogue experiment,
- comparing experimental results with reality.

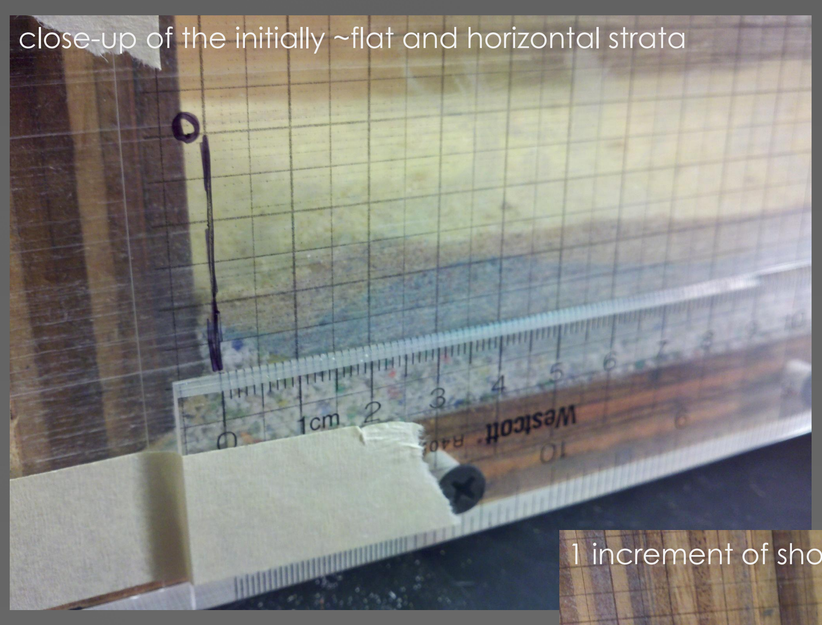
I was fortunate enough to teach ***GEO110 'Physical Geology'*** at F&M in 2010-11, where they had several identical sand-boxes available. I developed this lab from first-principles to introduce my to structural geology, in support of 2 weeks of lectures and textbook reading. I intend to develop this further for 100 and 300-level structure labs at CSUB.

Students were encouraged to follow the instructions for the experiment, but then to **record, analyze, and present data of their choosing**. They "discover" strain and strain measurement, and relate it to geometry.



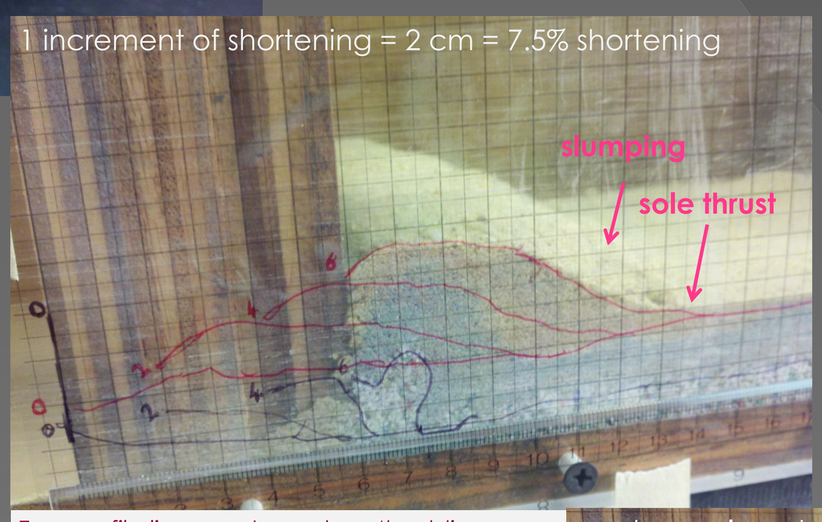
Apparatus:

- wood and Perspex sand-box with one shortening screw-adjusted end – 1 per group of **4-5 students**,
- >3 different colors of sand (ideally different grain sizes, sorting, etc., too),
- 1 mm^2 graph paper photocopied onto acetate,
- digital camera (cell phone) and calculator
- 30 cm ruler and 'overhead' pens (2 colors).

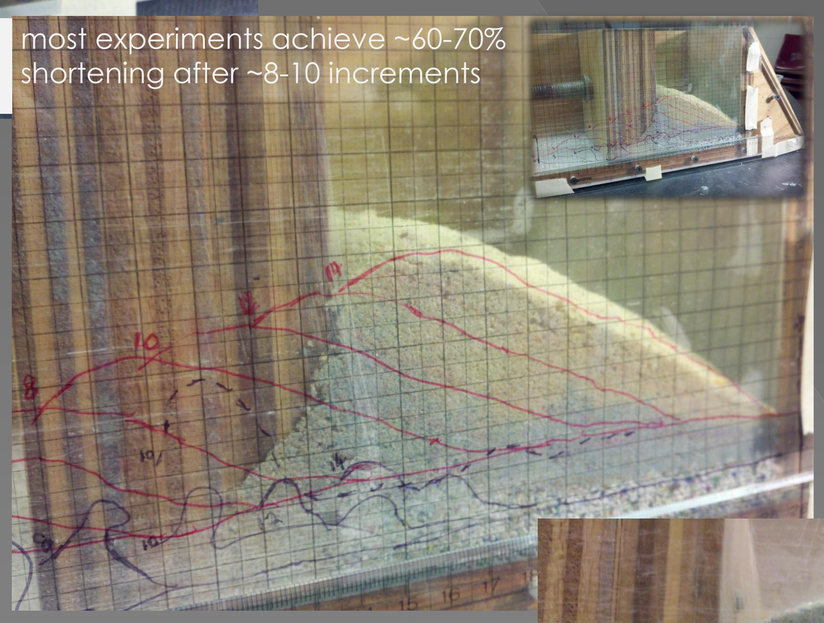


Students (mainly arts and social-science majors) conducted their own deformation experiment within the bounds I set → but this set-up and approach could be developed for a geology major class (yes?)

This has only been run once! Any suggestions for improvement are appreciated!



Two profile lines are traced – a 'bedding plane' (black) and the 'surface' (red) at each increment

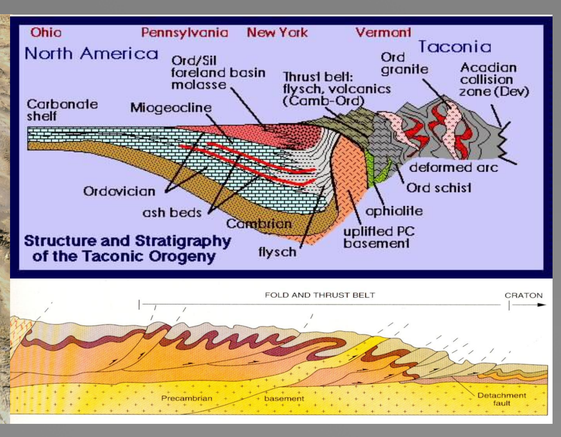


GOALS:

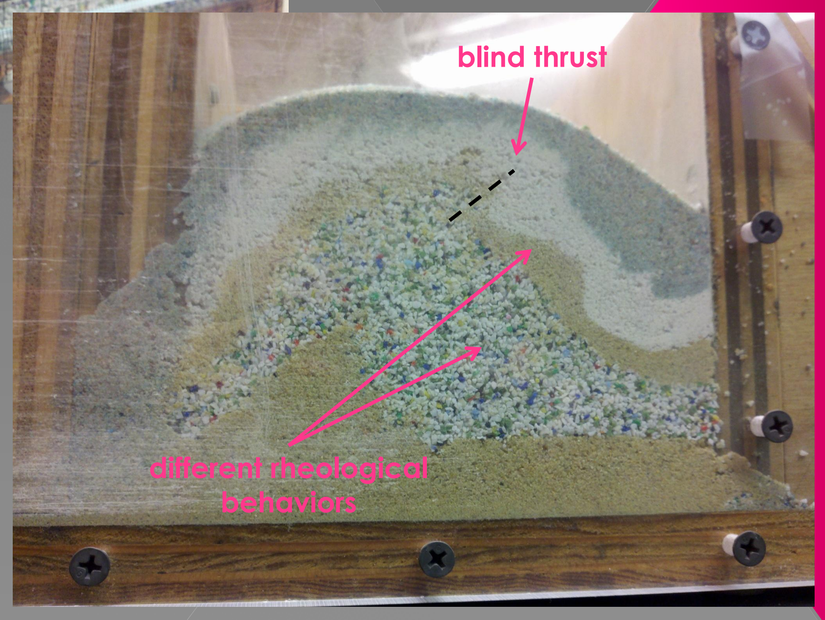
1. Develop an experiment to relate tectonic forces to deformation.
2. Conduct experiment and record different parameters – numerical and visual.
3. Write a narrative of the experiment – development, practice, outcomes, and improvements.
4. Analyze data, and relate it to broader geological knowledge.

Students are encouraged to record the evolution of the structures by tracing and photographing. Syn-tectonic slumping, or fault-tip propagation can be videoed – this requires careful team-work!

Students typically hone-in on the relationship between increasing fold amplitude and/or thrust offset and total shortening – they are encouraged to graph this data and to (semi-)quantify the relationship(s).



Finally, students are asked to relate what they have learned from the experiment to what they know about orogenesis (plate tectonics) – for example, surface expressions of folds, fold-thrust belts, and the geology of SE Pennsylvania (relates to local fieldtrips).



Thanks to NSF and SGT for their financial support.