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Density flow tanks

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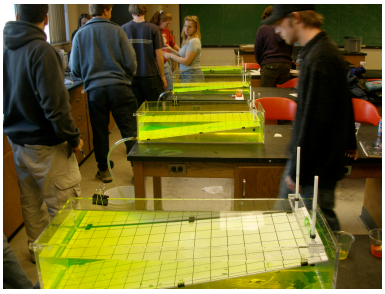
DENSITY FLOW IN THE LAB: Experimental tanks for Geology Labs, UNR; Instructional Enhancement Grant to Jim Trexler, 2005

GEOL 202, Earth Surface Processes and Deposits; instructor: Dr. Jim Trexler

This grant was used to fund the design and construction of acrylic tanks with adjustable sloping ramps that would enable students to examine the flow of dense fluids. The students can adjust the ramp angle and the fluid density, and determine how this affects the flow.

In this course and others in the Geological Sciences and Engineering curriculum, students study the processes that are active on the surface of the Earth. In this lab we ask the question: "What happens when a dense fluid flows down a slope, underneath less-dense fluid?" These fluids might be mud in water, or dust or snow in air.



River and wind processes can be readily studied in the field, and we have devised a series of lab exercises in western Nevada that take advantage of our rivers and deserts. But for density-contrast flows, there was no easy way to get the students beyond pictures and formulae. With the assistance of Tripp Plastics, we designed acrylic tanks that fit on a lab bench. They have a ramp with screw-adjustable slope up to 20°. Students mix a solution of Epsom salt ($MgSO_4$) to several experimental densities. They add a dye to make the dense fluid visible. The dyed fluid is released at the top of the slope. The grid allows the flow to be accurately timed and described. The students determine how density changes and how slope affect the flow velocity and structure.

Where in nature does this happen?

Avalanches occur on snow-covered mountainsides, during volcanic eruptions, and under water in lakes and the oceans. Snow or ash-charged air flows down mountain slopes. Muddy water, flushed from rivers by storms, flows along the bottom of lakes. Sub-ocean "sea-slides" fail due to earthquakes and transport mud and debris far out on the ocean bottom.

Although this is an important and sometimes catastrophic process, it is difficult to study. Conditions during flow can be difficult and dangerous, or in the case of sub-ocean flows, impossible to study directly.

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