Staying Current in Your Discipline: Reaching out to the Community

Bill Hirt

Randy Richardson

Why Stay Current??

- Does your job depend on it?
- Does your personal/job satisfaction depend upon it?

If your answer is yes, then your local community can be an excellent way to stay current and be relevant!

Reality Check: make sure your institution values reaching out to the community as part of your career development.

Staying Current—Reaching Out

- A few of strategies to consider:
  - Become well-versed in some aspect of earth science on a local or regional level
  - Become active in a local political body that uses earth science in its decision making
  - Become knowledgeable about earth science standards for elementary and secondary education in your state

Staying Current—Reaching Out

- By becoming well-versed about some local or regional earth science issue you may have opportunities to…

… build bridges to local civic, academic, and governmental groups on behalf of your institution

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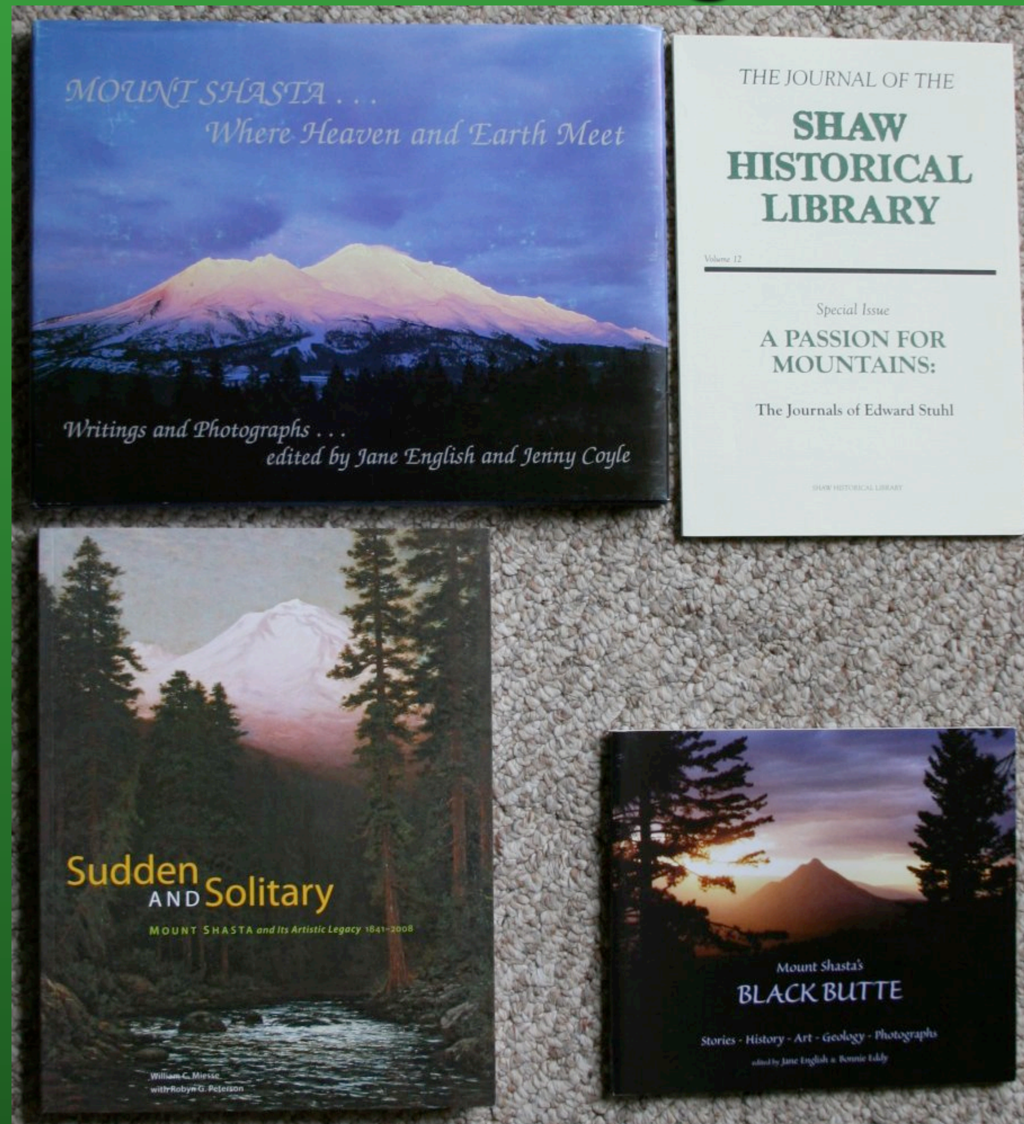
… contribute articles to newspapers, journals, or books of local or regional interest



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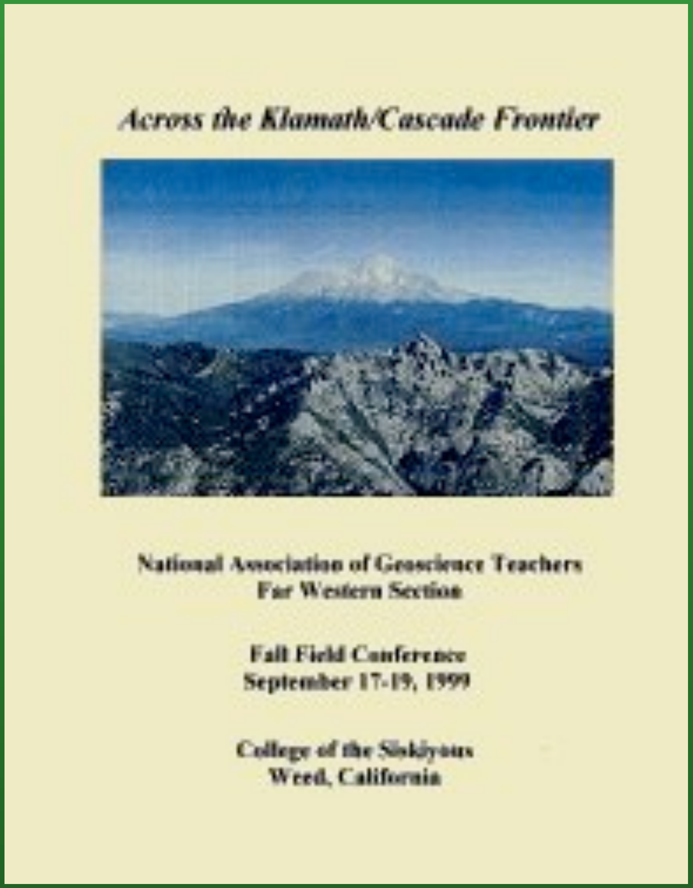
… host workshops or field trips for regional geologic associations (e.g., GSA, NAGT) or land management agencies

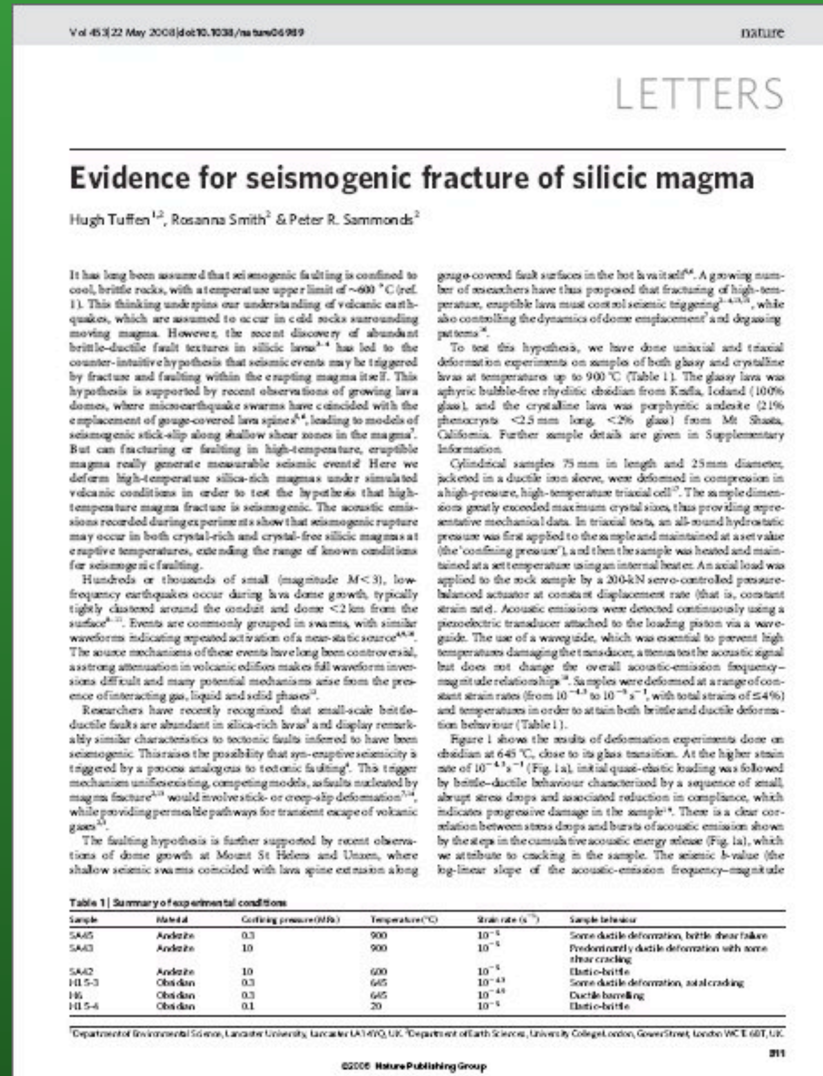


Staying Current—Reaching Out

… that may grow into short courses offered as part of your regular curriculum.

Staying Current—Reaching Out

… collaborate with visiting researchers and explore opportunities for your students to work with them as well; if you are in a CC, this is a very good way to prepare students for success at the local 4-yr college/university. Also opens up access to equipment and labs.



Vol 453 | 22 May 2008 | doi:10.1038/nature06989 nature

LETTERS

Evidence for seismogenic fracture of silicic magma

Hugh Tuffen[1,2], Rosanna Smith[2] & Peter R. Sammonds[2]

It has long been assumed that seismogenic faulting is confined to cool, brittle rocks, with a temperature upper limit of ~600 °C (ref. 1). This thinking underpins our understanding of volcanic earthquakes, which are assumed to occur in cold rocks surrounding moving magma. However, the recent discovery of abundant brittle–ductile fault textures in silicic lavas[2–4] has led to the counter-intuitive hypothesis that seismic events may be triggered by fracture and faulting within the erupting magma itself. This hypothesis is supported by recent observations of growing lava domes, where microearthquake swarms have coincided with the emplacement of gouge-covered lava spines[5,6], leading to models of seismogenic stick-slip along shallow shear zones in the magma[7]. But can fracturing or faulting in high-temperature, eruptible magma really generate measurable seismic events? Here we deform high-temperature silica-rich magmas under simulated volcanic conditions in order to test the hypothesis that high-temperature magma fracture is seismogenic. The acoustic emissions recorded during experiments show that seismogenic rupture may occur in both crystal-rich and crystal-free silicic magmas at eruptive temperatures, extending the range of known conditions for seismogenic faulting.

Hundreds or thousands of small (magnitude $M < 3$), low-frequency earthquakes occur during lava dome growth, typically tightly clustered around the conduit and dome <2 km from the surface. Events are commonly grouped in swarms, with similar waveforms indicating repeated activation of a near-static source. The source mechanisms of these events have long been controversial, as strong attenuation in volcanic edifices makes full waveform inversions difficult and many potential mechanisms arise from the presence of interacting gas, liquid and solid phases.

Researchers have recently recognized that small-scale brittle–ductile faults are abundant in silica-rich lavas[3] and display remarkably similar characteristics to tectonic faults inferred to have been seismogenic. This raises the possibility that syn-eruptive seismicity is triggered by a process analogous to tectonic faulting[4]. This trigger mechanism unifies existing, competing models, as faults nucleated by magma fracture would involve stick- or creep-slip deformation, while providing permeable pathways for transient escape of volcanic gases.

The faulting hypothesis is further supported by recent observations of dome growth at Mount St Helens and Unzen, where shallow seismic swarms coincided with lava spine extrusion along gouge-covered fault surfaces in the hot lava itself. A growing number of researchers have thus proposed that fracturing of high-temperature, eruptible lava must control seismic triggering, while also controlling the dynamics of dome emplacement[7] and degassing patterns.

To test this hypothesis, we have done uniaxial and triaxial deformation experiments on samples of both glassy and crystalline lavas at temperatures up to 900 °C (Table 1). The glassy lava was aphyric bubble-free rhyolitic obsidian from Krafla, Iceland (100% glass), and the crystalline lava was porphyritic andesite (21% phenocrysts <2.5 mm long, <2% glass) from Mt Shasta, California. Further sample details are given in Supplementary Information.

Cylindrical samples 75 mm in length and 25 mm diameter, jacketed in a ductile iron sleeve, were deformed in compression in a high-pressure, high-temperature triaxial cell. The sample dimensions greatly exceeded maximum crystal sizes, thus providing representative mechanical data. In triaxial tests, an all-round hydrostatic pressure was first applied to the sample and maintained at a set value (the 'confining pressure'), and then the sample was heated and maintained at a set temperature using an internal heater. An axial load was applied to the rock sample by a 200-kN servo-controlled pressure-balanced actuator at constant displacement rate (that is, constant strain rate). Acoustic emissions were detected continuously using a piezoelectric transducer attached to the loading piston via a waveguide. The use of a waveguide, which was essential to prevent high temperatures damaging the transducer, attenuates the acoustic signal but does not change the overall acoustic-emission frequency–magnitude relationships. Samples were deformed at a range of constant strain rates (from $10^{-4.3}$ to 10^{-5} s^{-1}, with total strains of ≤4%) and temperatures in order to attain both brittle and ductile deformation behaviour (Table 1).

Figure 1 shows the results of deformation experiments done on obsidian at 645 °C, close to its glass transition. At the higher strain rate of $10^{-4.3}$ s^{-1} (Fig. 1a), initial quasi-elastic loading was followed by brittle–ductile behaviour characterized by a sequence of small, abrupt stress drops and associated reduction in compliance, which indicates progressive damage in the sample. There is a clear correlation between stress drops and bursts of acoustic emission shown by the steps in the cumulative acoustic energy release (Fig. 1a), which we attribute to cracking in the sample. The seismic *b*-value (the log-linear slope of the acoustic-emission frequency–magnitude

Table 1 | Summary of experimental conditions

Sample	Material	Confining pressure (MPa)	Temperature (°C)	Strain rate (s^{-1})	Sample behaviour
SA45	Andesite	0.3	900	10^{-5}	Some ductile deformation, brittle shear failure
SA43	Andesite	10	900	10^{-5}	Predominantly ductile deformation with some shear cracking
SA42	Andesite	10	600	10^{-5}	Elastic-brittle
H15-3	Obsidian	0.3	645	$10^{-4.3}$	Some ductile deformation, axial cracking
H6	Obsidian	0.3	645	$10^{-4.9}$	Ductile barrelling
H15-4	Obsidian	0.1	20	10^{-5}	Elastic-brittle

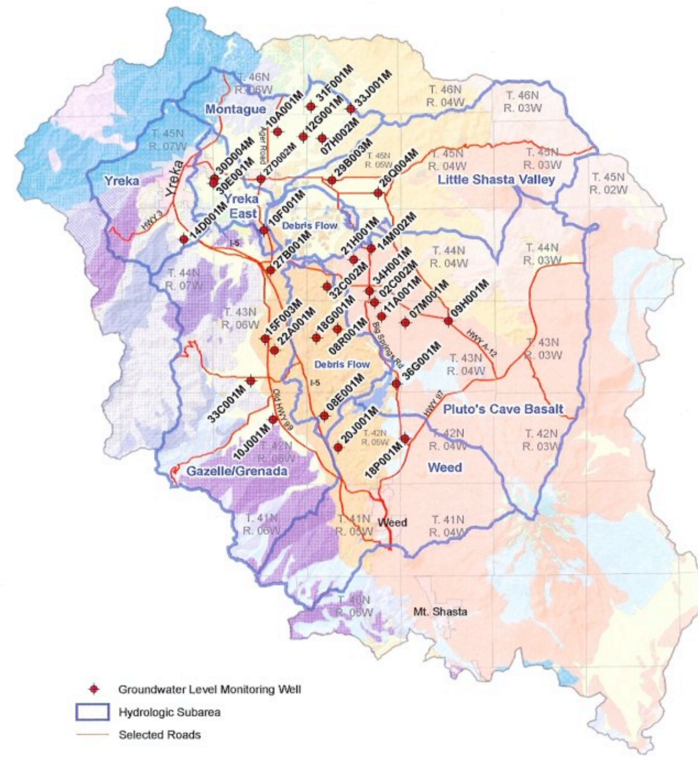
[1]Department of Environmental Science, Lancaster University, Lancaster LA1 4YQ, UK. [2]Department of Earth Sciences, University College London, Gower Street, London WC1E 6BT, UK.

Staying Current—Reaching Out

- By becoming active in a local political body that uses earth science in its decision making …

  … you may find yourself learning about whole new areas of the discipline in an effort to address local problems;

Figure 9. Groundwater Level Monitoring Well Locations and Surface Geology



Shasta Valley Data Needs Assessment (DRAFT)
28

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… What are some of the local issues in your area?

- Natural Hazards (e.g., EQs, volcanoes, floods, etc.)
- Resources
- Pollution or Environmental issues
- Others?

Debris flows in the Catalina Mountains near Tucson, AZ 7/31/2006

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… you may also find there is a lot of community support for those who can bring a scientific background and perspective to land use and resource issues

RCD
SHASTA VALLEY
RESOURCE CONSERVATION DISTRICT

215 Executive Ct., Suite A
Yreka, CA 96097
(530) 842-6121x106

SHASTA RIVER DAM REMOVAL BENEFITS ALL

May 28, 2008

Article written by Charlie Unkefer

December weather in the Shasta Valley of Siskiyou County California can vary greatly. One day might bring azure blue skies, t-shirt temperatures, and clear views of snow clad Mt. Shasta, a short 25 miles to the south – the kind of day California is famous for. The next, however, could resemble what most think of when they think of winter: steel gray skies, snow flurries, and an unrelenting wind that keeps you from lingering. This afternoon, as Amy Hansen of the Shasta Valley Resource Conservation District (RCD) and I head east from Yreka, it is raining steadily and a cold gray mist hangs over everything.

Removal of the Araujo Dam (Oct 2007)

The Araujo Dam on the Shasta River.

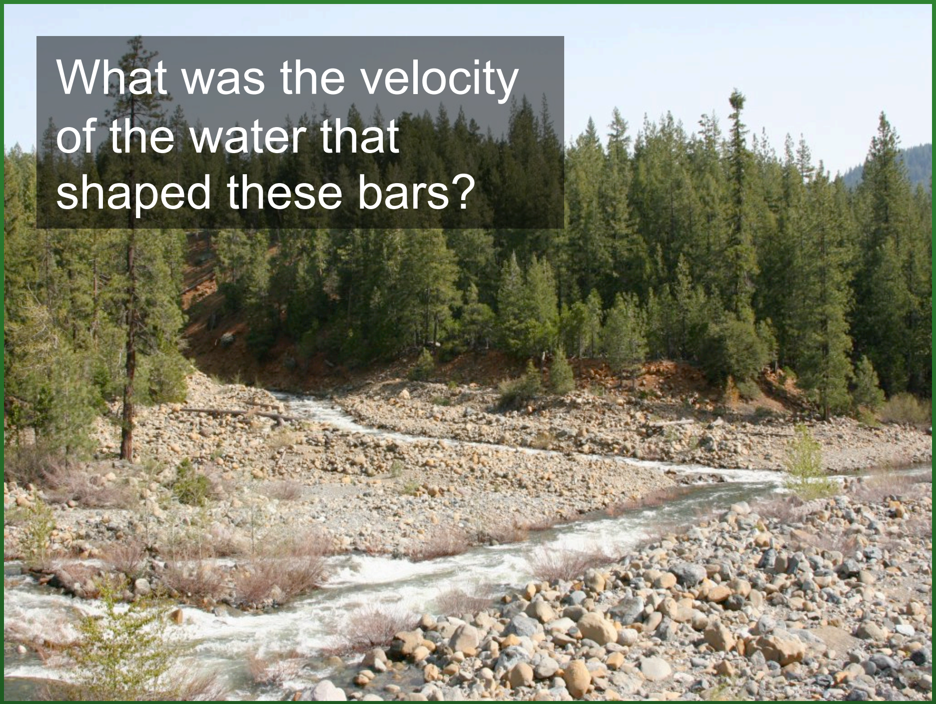
As we drive down the final grade on route 3 and the valley opens up before us, I am glad that I tucked my rubber boots in the back of the rig.

We are on our way to visit the site of the Araujo Dam, one of a handful of small "flashboard" diversion dams installed every summer on the Shasta River. In October of 2007 the dam was replaced with a boulder weir/pumping system, which serves as a way to remove water from the river while maintaining fish passage and improving water quality. The project is part of an ongoing effort by the Shasta Valley RCD to work with landowners and government agencies to help improve overall water quality while ensuring ranchers stay in business. It is a

Staying Current—Reaching Out

- By becoming knowledgeable about earth science standards for elementary and secondary education in your state you may…

… be afforded opportunities to work with local teachers to create and implement earth science exercises



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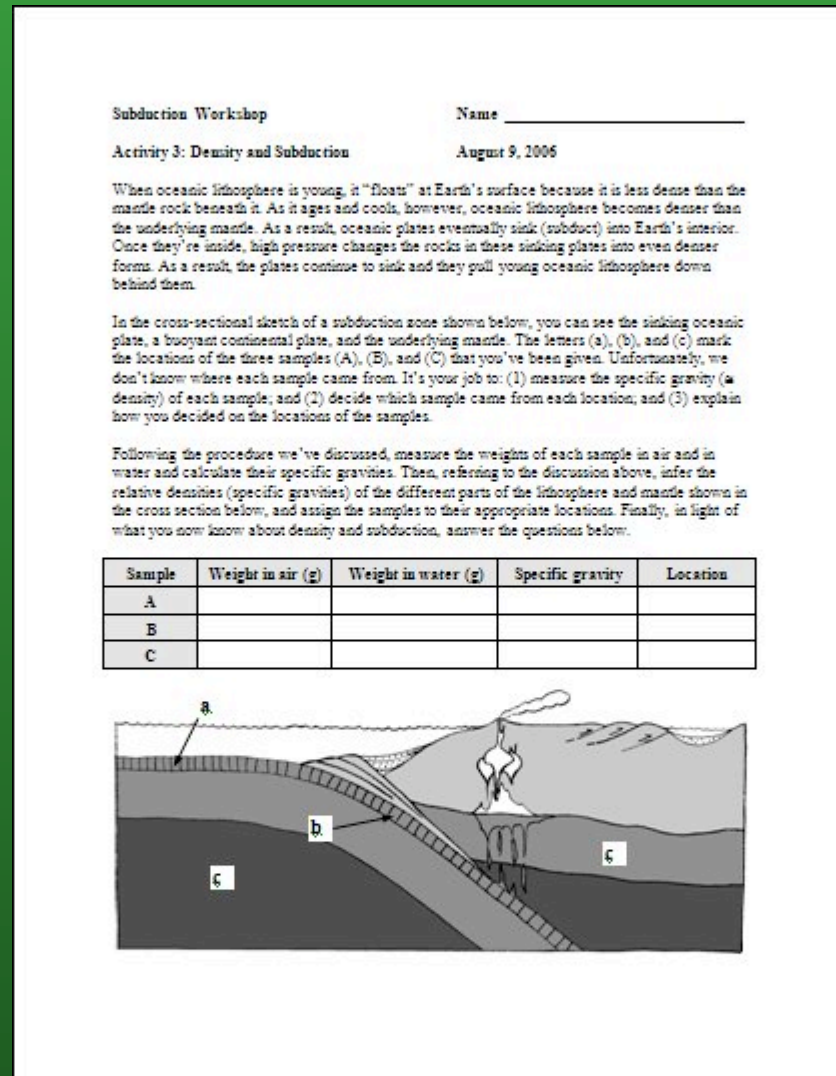
… be able to offer workshops to help teachers learn more about the earth science topics they'll be sharing with their students



Subduction Workshop **Name** ______________________

Activity 3: Density and Subduction **August 9, 2006**

When oceanic lithosphere is young, it "floats" at Earth's surface because it is less dense than the mantle rock beneath it. As it ages and cools, however, oceanic lithosphere becomes denser than the underlying mantle. As a result, oceanic plates eventually sink (subduct) into Earth's interior. Once they're inside, high pressure changes the rocks in these sinking plates into even denser forms. As a result, the plates continue to sink and they pull young oceanic lithosphere down behind them.

In the cross-sectional sketch of a subduction zone shown below, you can see the sinking oceanic plate, a buoyant continental plate, and the underlying mantle. The letters (a), (b), and (c) mark the locations of the three samples (A), (B), and (C) that you've been given. Unfortunately, we don't know where each sample came from. It's your job to: (1) measure the specific gravity (≈ density) of each sample; and (2) decide which sample came from each location; and (3) explain how you decided on the locations of the samples.

Following the procedure we've discussed, measure the weights of each sample in air and in water and calculate their specific gravities. Then, referring to the discussion above, infer the relative densities (specific gravities) of the different parts of the lithosphere and mantle shown in the cross section below, and assign the samples to their appropriate locations. Finally, in light of what you now know about density and subduction, answer the questions below.

Sample	Weight in air (g)	Weight in water (g)	Specific gravity	Location
A				
B				
C				

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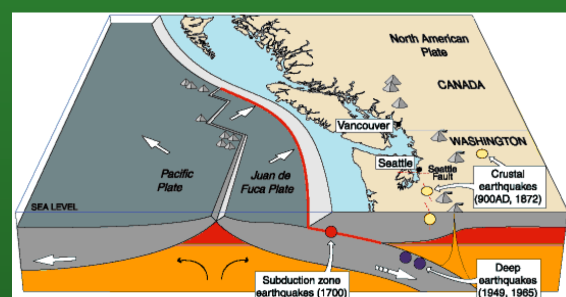
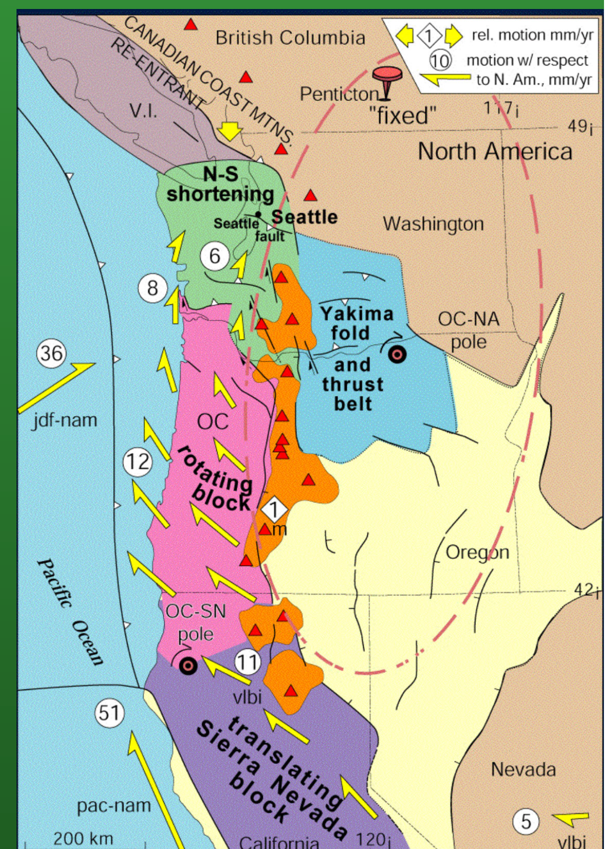
… there are many opportunities to partner with other institutions in funded work on teacher preparation (e.g., Bob Butler at University of Portland and his TOLE project at: http://orgs.up.edu/tole/about.html





Staying Current—Reaching Out

- So, take a few minutes to think and write down about one way in which you could act on one of the following:
  - Become well-versed in some aspect of earth science on a local or regional level
  - Become active in a local political body that uses earth science in its decision making
  - Become knowledgeable about earth science standards for elementary and secondary education in your state

- Finally, take a few minutes and share what you’ve written with one person near you.