

What do Students Know? ... What do Students Learn? ... Examples from Mineralogy and Petrology

This 2-page outline summarizes a project to develop and use concept tests for tracking the progression of student abilities of one student cohort through introductory geology courses (EOSC 220: Mineralogy and EOSC 221: Petrology), and into upper level petrology courses. This is important because:

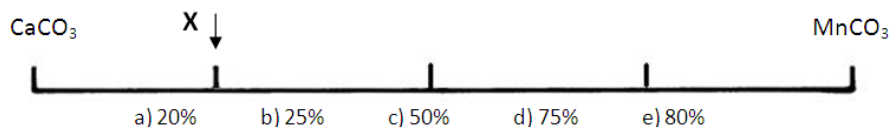
- Instructors of upper level courses have noted pre-requisite skills that are lacking
- Upper level students have noted that core concepts and skills are not always clear to them

Steps involved

- We developed two inventories or assessments that address core concepts and skills in mineralogy and petrology to be given as pre- and post-tests
- The iterative process of development consists of several crucial steps:
 1. Identify learning goals that instructors rated both crucial and consistently difficult for students.
 2. Create test questions to assess these particular goals.
 3. Improve questions based on faculty comments.
 4. Validate the tests through one-on-one interviews to ensure students understand and interpret questions as intended.
 5. Administer the tests (still in progress as of mid March 2011) – given as a pre-/post-test in 220 fall term, and a pre-test in 221 spring term. Post-tests are planned for the final week of term in 221.

Six examples of results so far

1. Students showed a **small learning gain** over the first term in 220 (average score increased from 53% to 67%)
2. Retention over the Winter Break was good (similar scores on all questions that were asked on both the 220 post and 221 pre)
3. **Students get BETTER at binary plots** (but 20% of students still have trouble). For example:
 - “Calcite (CaCO_3) and rhodochrosite (MnCO_3) form a complete solid solution series, which means that Mn can substitute for Ca in the chemical structure of the mineral in any proportion and vice versa. What is the % Ca of mineral ‘X’ on this line?”



Results:

- 45% correct on 220 pre-test (nearly an even split between 25% and 75%)
- 80% correct on 220 post-test
- 79% correct on 221 pre-test

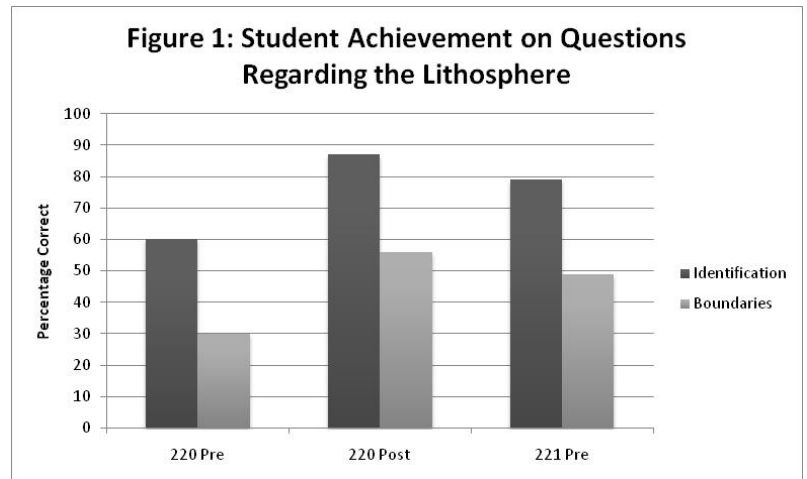
4. **Students get BETTER at identifying mineral groups from a formula** (but 40% of students still have trouble)
 - “To which group does the mineral with the formula $\text{CaFeSi}_2\text{O}_6$ belong?”
 - a) amphiboles
 - b) pyroxenes
 - c) feldspars
 - d) zeolites
 - e) oxides

Results:

- 12% correct on 220 pre-test (most selected oxides)
- 60% correct on 220 post-test

5. **Students get BETTER at identifying the lithosphere and recognizing chemical/physical boundaries within the Earth**, but consistently have more trouble with the latter (Fig. 1)

- “Which part of the Earth is referred to as the lithosphere?” and “Which two adjacent layers on/in Earth are physically different in their material properties but chemically are **THE SAME?**”



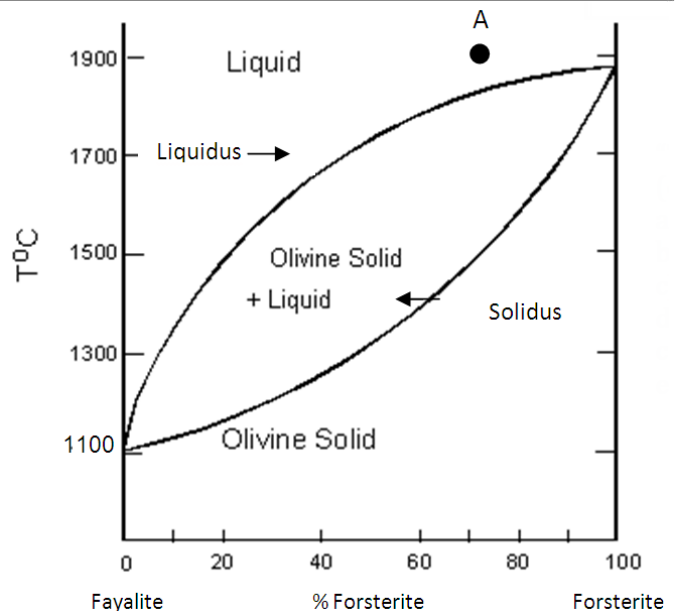
6. **Students are not yet proficient with solid solution diagrams at the start of 221**

- “Answer **ALL** of the questions a) through e) relating to the diagram below. They ALL refer to a cooling system (decreasing temperature) beginning at point A.”

- What is the % **Forsterite** of the liquid at point A?
- At what **temperature** do the first crystals form?
- What % **Forsterite** are the first crystals?
- At what **temperature** has the liquid completely crystallized?
- What % **Forsterite** is the last drop of liquid?”

Results:

- 2.28/5 average score on 220 post-test (not asked on pre-test)
- 2.76/5 average score on 221 pre-test
- Increase is small, and may be due to studying for the final that occurred after the 220 post-test?
- This skill may not be solidified until the end of 2nd year (or later)



In the works ...

- Administration and analysis of 221 post-test.
- Revision of both tests for 2011-2012.
- Organization of questions into subject-focused banks (to be available as diagnostic tools for the beginning of upper year igneous and metamorphic petrology).
- Plan for implementation during 2011-2012 and beyond.

Conclusion

The results from these tests provide useful information about student progress in Mineralogy and Petrology through our sequence of majors' courses. Instructors can use these results to guide future changes to learning opportunities in these courses, and can gain more accurate insight into student abilities at the start of each course.

To see the full tests for Mineralogy and Petrology, please contact Alison Jolley (ajolley@eos.ubc.ca) or Sara Harris (sharris@eos.ubc.ca). **OR - contact any STLF to discuss concept tests in your own discipline.**

Contact EOS-SEI: To talk about your course(s) or teaching and learning in general, visit EOS-South 361, or contact Francis Jones (fjones@eos.ubc.ca), Erin Lane (elane@eos.ubc.ca), Josh Caulkins (jcaulkins@eos.ubc.ca) or Sara Harris (sharris@eos.ubc.ca). See also <http://www.eos.ubc.ca/research/cwsei/>.