# Geologic Expertise and Field Mapping: Lessons from a 3rd year undergraduate field school


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## Introduction and Objectives

We seek to develop new pedagogical methods for teaching field geology to undergraduate students. Studies on the way expert geologists map in the field may assist in that process. One of the field courses at the University of British Columbia, EOSC 328, provided us with an opportunity to study both experts and novices in a novel field setting. The course, a two-week field school offered to 3rd year students in our Earth and Ocean Science program near Oliver, BC, contains two, 5-day bedrock mapping exercises and a number of 1-day Quaternary geology exercises. Six experts (2 Instructors, 4 Teaching Assistants) and 18 student pairs (36 students) participated in the study.

**Study Objectives**

1) Identify expert mapping behaviors and characteristics through direct observation in the field. Can this behavior be summarized and used to model "ideal" behavior or mapping skills for students?

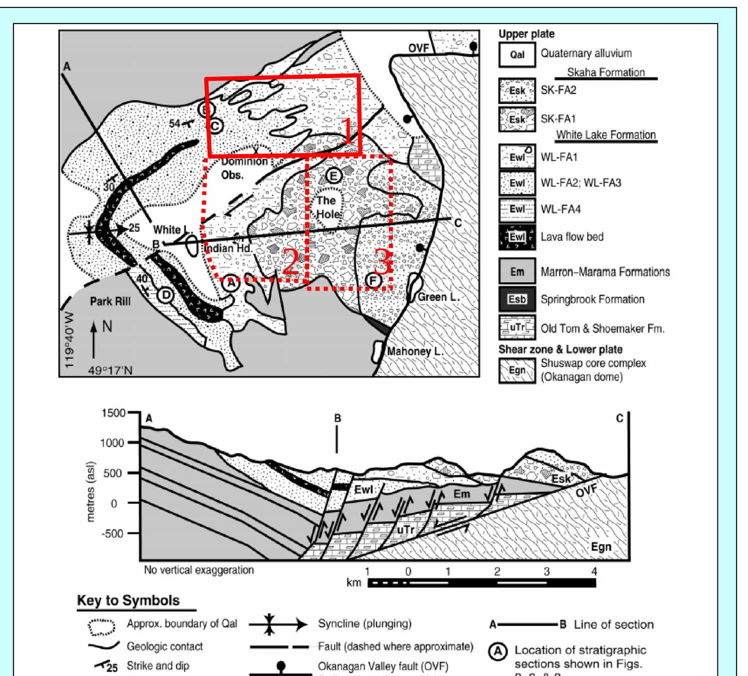
2) Observe students in the field to determine degree of expert-like behavior. Are there ways of identifying student behaviors that may indicate early on which students may require additional assistance or specialized mentoring?

Left: Students examining an outcrop.

Right: An "expert" mapper in the field.

## Unique Field Setting

Students map parts of the middle Eocene White Lake and Skaha Formations, which are sedimentalogically interfingered volcanics and breccias.



Regional Geology Map of the White Lake Mapping Area (solid red area is Map Area 1; dotted areas are Mapping Areas 2 and 3).

**Expert Study**

**Experts were completely unfamiliar with the terrain prior to the mapping exercise**. Mappers were paired and each pair given two days to map one of the three areas. In this way, the experts were performing a "true" cognitive task, one that they were not able to plan in advance of the actual mapping exercise.

## Methodology

Video interviews of participants and GPS units used to record participant location while mapping were used. Interviews were of two types: (1) focused interviews with a series of questions and (2) relatively informal interviews conducted with actively mapping pairs.

**Interviews:** During interviews of type (1) , which were conducted both in the field and back at camp, students and experts were asked to show on their map and then explain what their mapping plan or path had been prior to the initiation of mapping that day. They were then asked to explain what they had seen and to state how their plans had changed, if at all. Type (2) interviews were conducted ad hoc, usually of experts or students mapping naturally in the field. Over 15 hours of video footage were collected and transcribed.

**GPS Tracking:** Garmin eTrex units were obtained and placed with each mapping pair. The unit recorded a location every 10 seconds; participants were asked not to manipulate or attempt to read the devices. The data produced tracks of movement through the field area while mapping although some units did not collect complete data sets each day due to reception and power issues.

## Results: Interviews

From video footage of expert and student interviews, a number of general observations can be made.

Expert mapping pair.

**Expert Interviews and Observations**

In general, the expert mappers were found to have:

- A deep understanding of geologic principles and models
- Superior technical abilities (sketching, compass use, etc.)

In addition, **experts tended to be**:

- More **strategic and flexible in their use of time**
- More **efficient at locating themselves** and **making field observations**
- More likely to **make sketches and draw cross-sections** to enhance understanding
- More likely to **describe geologic models seen elsewhere** as a way to understand the current geologic problem

Despite these qualities, experts were often as challenged by the geology as students were.

**Student Interviews and Observations**

Students who performed better on mapping exercises were:

- More likely to **make predictions** (not necessarily correct ones, but actively making and testing predictions).
- More likely to **produce flexible field strategies** (e.g. were more likely to change plans to follow interesting or suggestive data or to stop work that appeared fruitless).
- More likely to **make sketches** to improve understanding.

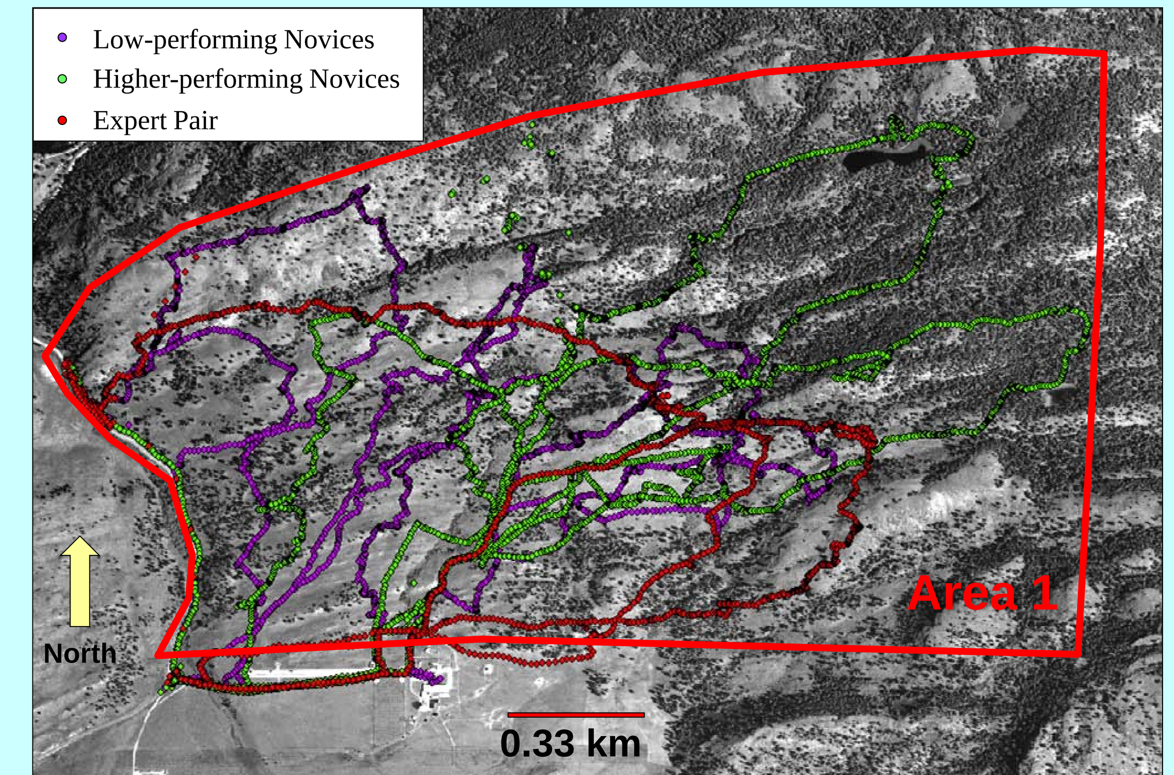
Students mapping in the field.

## Initial Interview Implications

Based on these observations, **students would likely benefit from instruction that requires students to increase the amount of sketching and cross-section creation they do in the field** (e.g. exercising 3D spatial skills). **Experts and high-performing students also tend to make, and test, predictions while in the field, something that could be included explicitly as part of a mapping exercise or field-based curriculum.**

## Results: GPS Tracks

Examination of the GPS track data is on-going and has proven to be a challenging endeavor. Despite this challenge, we qualitatively examined all tracks collected during the White Lake exercise and have made a few preliminary observations:




Aerial Photograph of White Lake Area 1 with three examples of GPS tracks: Purple – Low-performing students, Green – Higher-performing students, Red – Expert mapping pair.

- A number of **lower-performing student pairs showed only partial coverage of the field area** (purple data in above figure). **This seems to indicate on-going challenges with the most basic skills of field mapping: orienteering, location, physical fitness, mineral and rock identification.**
- Experts were able to encapsulate and map much of the area in two days that lower performing students covered in five days (red data in above figure).
- Higher-performing students covered most of the field area in the time allotted (green data in above figure).

## Future Work

In the course of this work we amassed a very large data set and we are only beginning to approach objectives 1 and 2. We intend to continue this work at the May 2011 Oliver field school. Changes to be made will incorporate some of our findings; we will include a 3-day "boot camp" before the field camp to assist students in honing the most basic mapping skills (e.g. orienting, location, pacing, sketching, rock/mineral ID, etc). We also plan to extend the camp to three weeks.

Issues that we hope to address in the future include:

- The effect of student pairing on student mapping
- The appropriate balance in field instruction between mentoring students and providing them opportunities to learn on their own.

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If you are interested in further discussion, please contact me directly at: **caulkins@eos.ubc.ca**