

# Supporting Students' Development of Expert-Like Map and Cross-Section Visualization Skills

Rowan Cockett<sup>(1)</sup> and Leslie Reid<sup>(2)</sup>, 2010, Department of Geoscience, University of Calgary

<sup>(1)</sup>arbcocke@ucalgary.ca, <sup>(2)</sup>lfreid@ucalgary.ca



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## Motivation

Students in introductory geology courses often have trouble visualizing three-dimensional features such as geologic beds and how these features interact with topography. Over the past 5 years in end of course evaluations, students in an introductory physical geosciences course consistently requested more resources to help them develop map visualization skills. In Fall 2008 in-depth pre-and post-course interviews with 12 students also revealed that their map interpretation skills did not meet the expected outcomes and did not improve over time despite receiving direct instruction and completing exercises on these skills.

There are few robust interactive tools that allow for students to explore map visualization problems in an interactive way, in the convenience of their home or personal computers. Over the summer of 2010, we developed an interactive program to allow students to create their own geologic scenarios and visualize them in three dimensions. This program is currently being piloted with students in a Fall 2010 introductory geoscience class.

## Approach

Create an interactive visualization program that allows students to create and view geologic features.

### Interactivity

Let the student be in control of all aspects of the program: from the topography to all of the geologic features and then viewing the results dynamically.

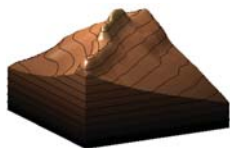
### Simplicity

Keep the focus on learning geology and away from learning the technology.

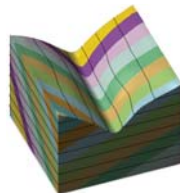
### Integration

Allow for teaching opportunities and learning assessments in the form of tutorials and tests.

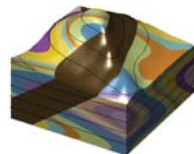
## Features



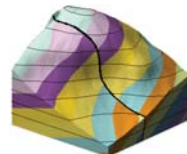
Topography



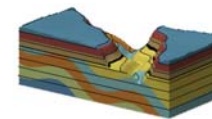
Geologic Beds & Folds



Igneous Intrusions



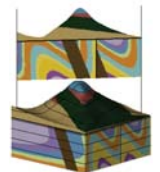
Faults



Unconformities



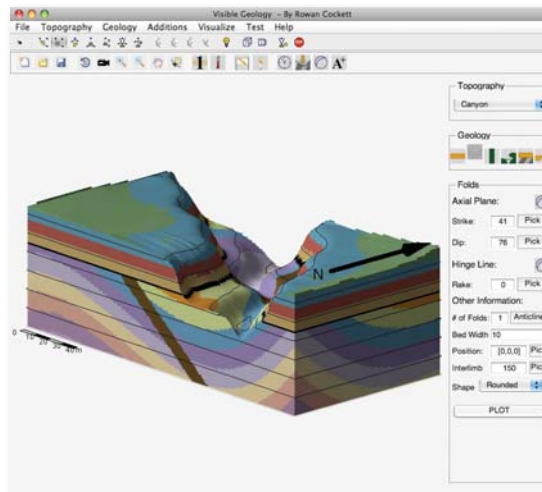
Geologic Histories



Cross Sections

## Results

A computer software package, Visible Geology, was created that incorporates highly interactive visualization features into introductory geology and structural geology classes. Visible Geology allows for users to create geologic models by making their own topography and then adding geologic features: from beds and folds to igneous intrusions, unconformities, and faults. Once a creation is complete students can explore, rotate, and visually manipulate the results. Additionally, students can take tests on geologic history, bed orientation, and fold orientation as well as complete professor assigned tutorials. Visible Geology provides a fun and creative environment that promotes a self-taught learning process.



## Student Use

Introductory geology students have been using Visible Geology throughout the Fall 2010 semester. The students will complete pre- and post-questionnaires asking them to rate their confidence in completing certain geologic mapping and visualization problems; this information will be compared to how much they used Visible Geology.

Data is not yet available, as students have not yet finished the semester.

## Future Work

Installing Visible Geology on personal computers provides a barrier to entry for students and professors. The solution may be to provide a web based learning environment that includes:

- 1) Interactive homework & labs;
- 2) Comprehensive course material; &
- 3) Graded learning assessments.



The current objective is to have these features available for Fall 2010. More rigorous pre- and post-testing will also be completed when this is available.

## Conclusions

An interactive visualization program has been produced that aids in conveying complicated geologic concepts in a simple visual environment. Although complete statistics are not yet available, the initial response from the students and professors has been positive. Future work on the program includes providing Visible Geology on the web and completing more rigorous pre- and post-testing of students ability to interpret and complete map visualization problems to determine if Visible Geology affects student learning outcomes in this domain.