Using the Visible Geology Program in the Classroom: Inquiry and Exploration

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The use of targeted instruction and digital block models to improve three dimensional visualization and spatial skills has been documented in previous studies (Piburn and others, 2002). Visible Geology is an interactive, web based program that encourages students to explore and visualize geologic structures through the creation and manipulation of 3D block models. It is currently available as a free Beta version and includes many features and opportunities to enhance learning in introductory and upper level geoscience courses. There is a growing library of models available on the website, including nice examples of various topographies, fault offsets, the Rule of V's, and fold interference patterns. I'd like to acknowledge the creativity and generosity of the program's creator, Rowan Cockett.

At Guilford College, we plan to integrate exercises using Visible Geology into several courses, including:

- Strengthening student understanding of geologic history and relative dating of events through a think/share/pair model construction and interpretive exercises in Historical Geology
- Creating models and interactive exercises to help introductory students visualize dipping beds, faults , and folds in 3D
- Students in Structural Geology will develop their own models and further develop their 3D visualization skills with more complex geologic systems
- Introducing students to stereonets for structural analysis in Structural Geology

I have developed two exercises for use in my undergraduate Structural Geology course in as an experimental project in Fall 2011

(1) An inquiry based assignment to help students develop their own version of the Rule of V's to describe the outcrop patterns of dipping beds

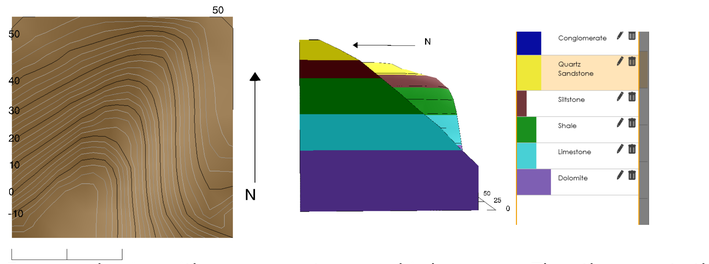
(2) Exploratory exercises to visualize how multiple events (such as polyphase folding) are expressed in 3D

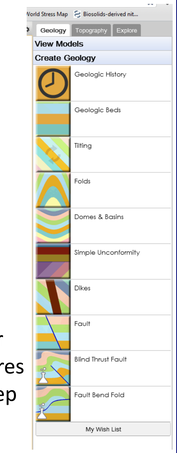
"The program is very intuitive and makes it easy to see how the particular geologic structures occur and appear."

Using Visible Geology to Independently Describe Outcrop Patterns for Dipping Beds (Rule of V's)

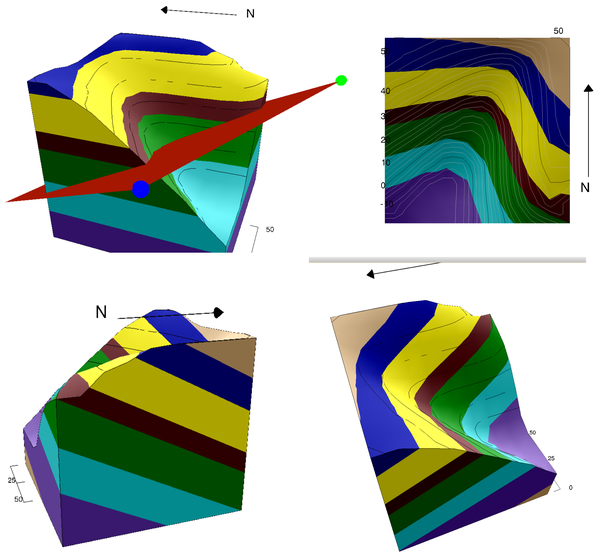
Learning Objectives:

- Students will be able to use the Visible Geology program to create, manipulate, and save 3 dimensional geologic models
- Students will be able to analyze characteristic outcrop patterns for dipping beds exposed in valleys and describe these patterns in their own words
- Students should have the ability to analyze an unfamiliar geologic area and determine the direction of dip based upon outcrop geometry.



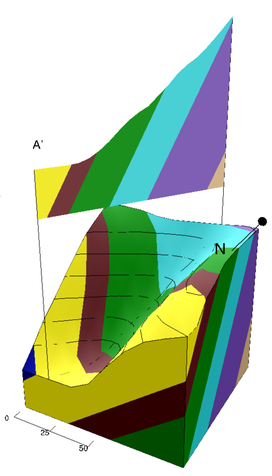


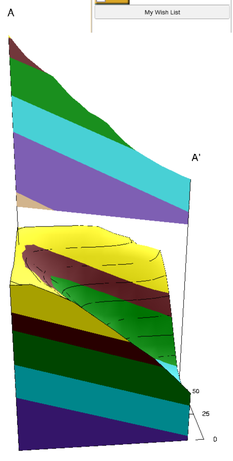
Everyone begins with a common topographic basemap . They then create their own geologic layers, with some guidance on the number and thickness. Features and controls are highly intuitive for most, but some students may still need step by step instructions.



Students use the software as one part of a laboratory exercise. They work in pairs to create their own models of dipping sedimentary layers. For each scenario they examine the 2D, 3D, and cross section views and develop their own description of the outcrop patterns. Students turn in hand drawn maps and uploaded images of their models for grading.

As a follow up in-class exercise, students interpret the direction of dip and relative degree of dip based upon geologic maps.





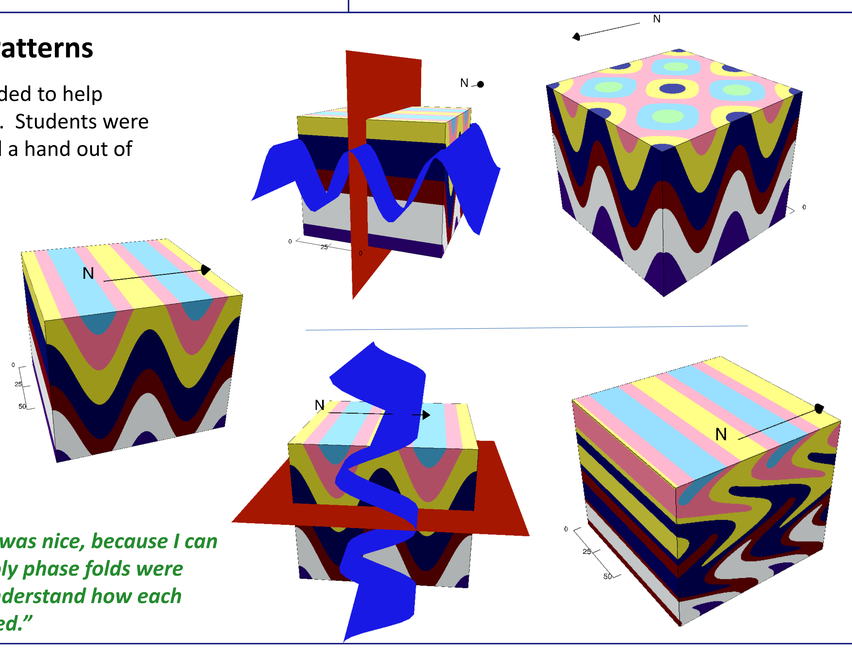
"At first, I was very frustrated with the program, but as soon as I started to get the hang of it , it really helped to visualize and actually understand different aspects of geology. This helped with the rule of v's so much for me. Strike and dip are also always very hard for me to visualize, but this program helped me really see it."

Exploration of Fold Interference Patterns

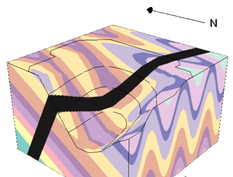
An investigation of complex fold patterns was included to help students grasp patterns of multiphase deformation. Students were already familiar with the software at this point, and a hand out of Ramsay's interference patterns was provided.

Students required significant assistance to orient the fold axes, but had fun exploring how changes in the geometric relationship between the F1 and F2 events affected patterns.

Students uploaded links to their models or images to the course Moodle page for review and grading.

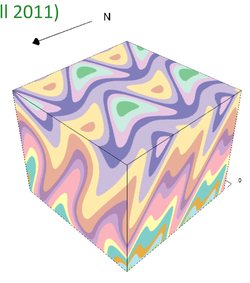


"The program didn't glitch at all on my Mac which was nice, because I can take it home and mess around with it there. The poly phase folds were pretty easy to understand, it just took a while to understand how each control changed how the fold axis dipped and turned."



Block model of multiple geologic events (deposition, folding, intrusion, erosion) created by M. MacNamara (Fall 2011)

Polyphase folding, created by Becca Dozier (Fall 2011)



Initial Perceptions

- Generally user friendly, but not all students will pick up the software quickly
- Creating topography is cool, but is a bit challenging and time consuming to have students develop their own
- Students universally liked the program with only minor complaints about controls (slider bars) and lack of unconformities (since added)
- No comparison data, but noticeably less student confusion with Rule of V's and fold interference patterns
- Fantastic potential as a teaching and learning tool

References

Cockett, Rowan. Visible Geology (Beta Version). http://app.visiblegeology.com/

Piburn, Michael D., Stephen J. Reynolds, Debra E. Leedy, Carla M. McAuliffe,James P. Birk, and Julia K. Johnson. The Hidden Earth: Visualization of Geologic Features and their Subsurface Geometry. National Association for Research in Science Teaching, New Orleans, LA, April 7-10, 2002. http://reynolds.asu.edu/pubs/NARST_final.pdf