

Abstract

Southern Utah is situated in the transition zone between the Basin and Range Province and the Colorado Plateau. The unique area has undergone both contractional deformation during the Sevier Orogeny and extensional deformation from the Hurricane Fault Zone. The rich geologic record exposed here highlights how plate tectonics influence structural geology, sedimentology, and environmental geology. To help Southern Utah University geology majors understand how tectonic processes control many subfields of geology, a deformation sandbox, described by Del Casto and Cook, was used. Students modeled both the Sevier Orogeny and Hurricane Fault Zone, allowing students to observe the creation and current condition of Southern Utah's geological setting both on the surface and in the subsurface of the model. The lessons complemented Southern Utah University students' ample field experiences as they connected classroom concepts to the outside world.

The sandbox model was utilized during three exercises throughout the semester, each focusing on a different branch of geology. Students sketched and recorded their observations in their field notebooks during each experiment, and they applied their observations to in-class projects and discussions. Student learning outcomes included inquiry and analysis, integrated learning, and problem solving. Pre- and post-assessments measured the effectiveness of the sandbox models and associated exercises

Purpose

The purpose of this project was to use a sandbox model to introduce students to different geological features. The sandbox allowed students to see both a cross section and a surface view of these features. The sandbox was capable of both contracting and extending the layers of sand.

The model was used in a Plate Tectonics class to help the students recognize geology structures. Students were encouraged to make sketches of their predictions of the structures the model will create. As the sand model exercise was preformed, students filled out a worksheet to help direct their attention to the features as they were created. After the exercise students made sketches of the observed structures. The pre-exercise and post-exercise sketches were compared. They show how the model helped the students improve their understanding of the various observed tectonic features and the processes that created them.

Different Views from the Model

Cross Section View



Surface View



Contraction



Extension



Methods: Examples of Worksheet Questions

Three different worksheets were created for each discipline of geology: Structural Geology, Sedimentology, and Environmental Geology. The purpose of these worksheets was to help guide students' attention to the various geological events as they were created. Below are examples of questions asked in each worksheet.

Structural Geology

Assuming that the crank on the box is pointing north, what was the orientation of maximum compression during contraction? During extension?

Describe how the layers' orientation (strike and dip) changed before contraction to after contraction to after extension.

What kinds of faults can be observed during both contraction and extension?

Sedimentology

Where would deposition most likely occur after contraction? After extension?

Where would erosion most likely occur after contraction? After extension?

Do any of your cross sections show layers that are pinching out? Do they exhibit boudins?

Environmental Geology

Where would be the safest location to build a house?

Identify the geological hazards that could occur in the geological settings represented in the sandbox.

Assuming that the green layer has high permeability and porosity and that the white layer has low permeability and porosity, identify potential locations of reservoirs in both of your cross sections.



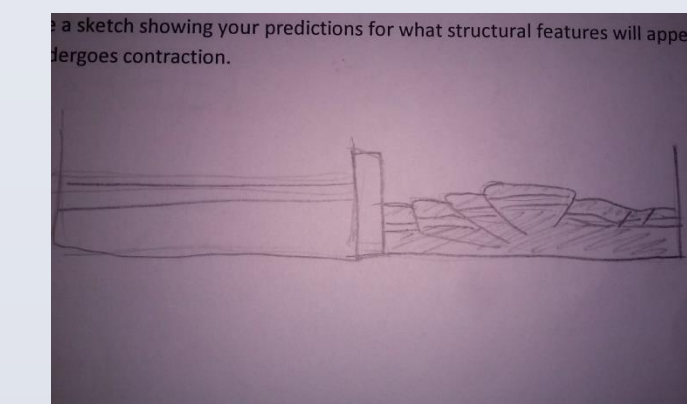
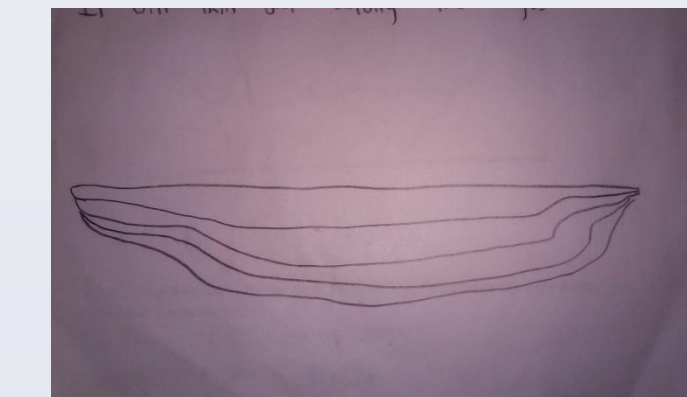
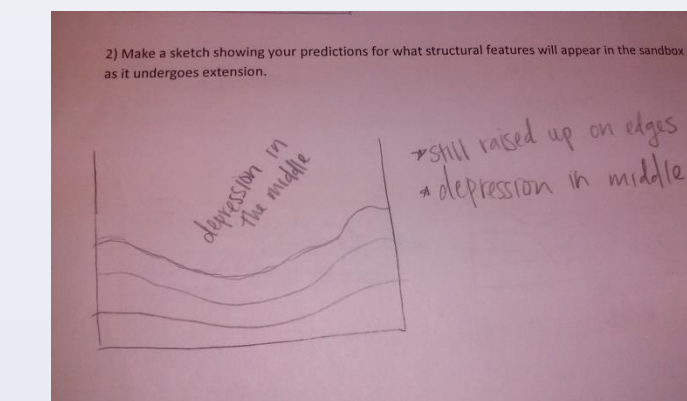
References

Castello, M. D., & Cooke, M. (2008). Watch Faults Grow Before Your Very Eyes in a Deformational Sandbox. *Journal of Geoscience Education*, 324-333.
Castello, M. D. (2007). Instructions For Analog Model Set-Up. 1-11.

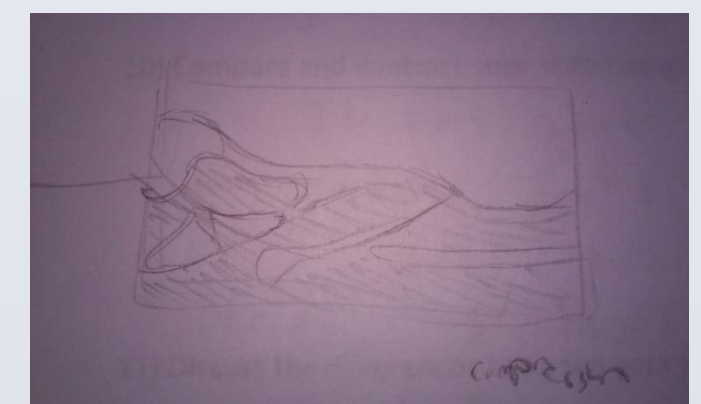
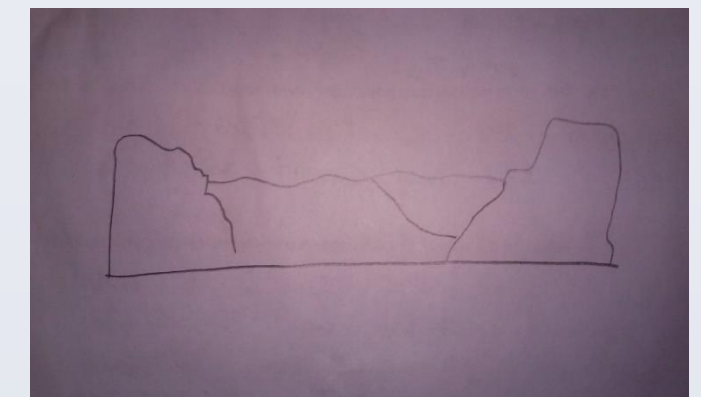
Results

The purpose of this project was to test whether the sandbox model can help students of the Plate Tectonics class improve their understanding of structural geology, sedimentary basins, and environmental geology. This is best represented by the sketches that the students made both before and after the exercise; the "before" sketches are on the left and the "after" sketches are on the right. These sketches were compared to attempt to show how much the students improved.

Before Exercise



After Exercise



Conclusions

The improvement between the "before" and "after" sketches suggest remarkable improvement. The "before" sketches show that the students were expecting ductile deformation while the "after" sketches show that they realized most of the deformation that occurred is brittle. The most useful thing that the students were able to do was compare the sandbox model to the local geology of Cedar City. Cedar City is located on the boundary of the Sevier Orogeny and the Basin and Range. The contraction in the model was compared to the Sevier Orogeny. The extension in the model was compared to the Basin and Range. The model essentially creates the valley that Cedar City resides in. In conclusion this exercise is beneficial in helping the students of the Plate Tectonics class understand geological features. The improvements in the students sketches validate this claim. This project also shows that the sandbox can be used in a variety of geology classes, including Plate Tectonics, Sedimentology, and Environmental Geology. This model is helpful in the southern Utah area because it accurately describes the geological setting that is present in southern Utah. It is believed that this sandbox model would benefit geology students of all levels and could be adjusted to teach the geology of any area.

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