MODELING GEOLOGICAL STRUCTURES WITH VISIBLE GEOLOGY

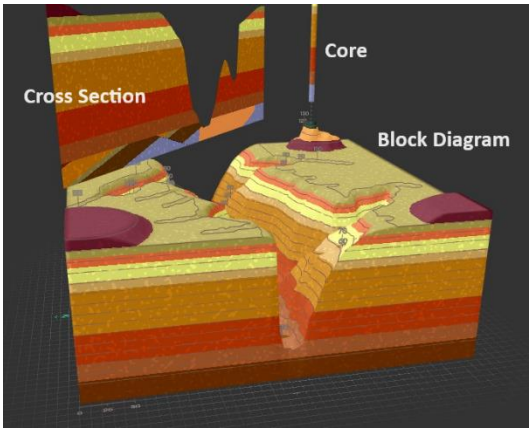
Understanding the complexities of geological structures and processes is fundamental to the study of earth sciences. Visible Geology, offered by Seequent, provides an innovative and interactive way to explore these concepts through 3D models. Much can be learned about the geological history and processes that shape the land by examining 3D geologic models, cross-sections, and core samples.

Exploring the Grand Canyon Model

1. Examine the block model, cross-section, and core models of the Grand Canyon (available at https://bit.ly/ESW-VisibleGeology). Make observations of each model as you rotate and zoom in and out using your mouse:

    a. Block model (3D visualization that shows the different layers and features inside the Earth)
    b. Cross-section (a slice or cut-through view of the model that displays internal geological layers that occur along a slice)
    c. Core (vertical column that shows geological layers at a specific point)

    To hide or show the cross-section and core models at any point, select "xSection" or "Core" from the left side menu. Then, select "View" at the bottom of the right menu.



2. Make inferences from the model:

    a. What color layer is the youngest? Explain your reasoning.
    b. What color layer is the oldest? Explain your reasoning.
    c. Choose 2 features shown on the model and describe what geological events or processes might have occurred to form these features of the Grand Canyon.
        - Feature 1: Draw and/or describe the feature and then explain how it might have formed.
        - Feature 2: Draw and/or describe the feature and then explain how it might have formed.

3. Explore the geological history of the Grand Canyon:

    a. Select the "History" button from the left side menu.
    b. Select 1. Beds.
    c. Travel through time by selecting 2, then 3, and so on to see a portrayal of how the Grand Canyon formed.

4. Consider the following questions as you are exploring the model:

    a. How do the different layers inform us about the geological history and processes that formed the Grand Canyon?
    b. What do the variations in the layers (color, thickness) indicate about past environments and events, such as erosion, deposition, and tectonic activities?
    c. What are the benefits of creating a cross-section and a core of the model? What do you think mappers consider when deciding where they will add these elements?

Exploring Pre-Built Block Models

1. Select a block model to explore from Visible Geology's prebuilt library:
    a. Log in to Visible Geology. To log in you will need a Seequent ID. If you do not already have a Seequent ID, creating one is quick and free, select 'Create Seequent ID' in the top right-hand corner.
    b. Select "Groups" at the bottom of the screen under "Manage your account"
    c. Select "Join with code" and enter **Group-R24hJMtkrUkPAeqjtqzEb8**
    d. Once you are in the "Public Group," select one of the model groups and a specific model.
2. Make observations of the block model, including the layers and topography.
3. Examine the block model and determine which events listed below you think would have occurred to create the land on which this model is based:

    - ☐ Deposition (horizontal layers form)
    - ☐ Dike
    - ☐ Dome and Basin
    - ☐ Fault
    - ☐ Fold
    - ☐ Pluton
    - ☐ Tilt
    - ☐ Unconformity

4. In what sequence do you think the events you selected above occurred? Write a flow chart starting with the event you think came first.
5. Select the "History" button at the top of the left menu. Compare the flow chart you created with the history of the model.
6. Choose 1-3 of the events to reorder or change to create a NEW block diagram.
    a. Write out the new flow chart with your proposed changes.
    b. Consider how the block model would look different. Explain your thoughts with words and a new model.
    c. Test it out! Use the "Geology Explorer" to create your newly revised model.

Building Block Models

1. Visit https://www.visiblegeology.com/

2. If you wish to save your model and share it, please start by logging in with a Seequent ID. Select the “Log in” button at the top. If you do not already have a Seequent ID, creating one is quick and free, select ‘Create Seequent ID.’

3. Select “Geology Explorer” once you have logged in.

4. Build a block model with at least three layers and at least three geologic events.
   a. Select “Layers” from the left menu bar to change the thickness and/or color(s) of existing layers, and to add or remove layers. Select “Apply” when you are done altering the layers.
   b. Select “Events” from the left menu bar to add a “Form” (including a tilt, fold, or add an unconformity, a dike, a pluton, a dome and basin) or a “Fault” (including a normal fault, reverse fault, a bend fault, a blind thrust fault, or a horst and graben) to the model.
   c. After selecting an event, you can adjust the event by moving the colorful arrows or the numbers in the menu on the bottom right. When you are done making adjustments, select “Apply” to go on to the next event.
   d. To adjust or remove the events, select “History” from the left menu bar.

5. Adjust the topography of your model.
   a. Select “Topography” from the left menu.
   b. Choose a prebuilt topography (e.g., flat, cliff, hill) or,
   c. Create your own by selecting “+New.” The “Terrain Dimensions” tool becomes visible, which will allow you to adjust the size of the block. Once you are done adjusting the dimensions, click “Apply.” The “Terrain Editor” will allow you to raise, lower, flatten, or smooth the surface. Play around with the “Radius” and “Strength” settings while you are creating your terrain. Select “Save & Return” to finish.

6. Take a cross-section of your model.
   a. Select “xSection” from the left menu.
   b. Select “+New” from the right menu.
   c. Move the block model around so you are looking at it from the top.
   d. Use your mouse to move the arrows around to the location where you want to take a cross-section.
   e. Move the block model to view it and the cross-section from different angles.
   f. Once the cross-section selection is placed where you want it, select “Apply.”
   g. Turn the cross-section off and on by selecting “View Cross-Sections" at the bottom of the right menu.

7. Take a core sample of your model.
    a. Select “Core” from the left menu.
    b. Select “+New” from the right menu.
    c. Move the core selection around until you are satisfied with its location and angle, then select “Apply.”
    d. Turn the core off and on by selecting “View Core Samples" at the bottom of the right menu.

8. To save your model, select “Menu” from the bottom of the left menu.

9. To share your model, select “Publish.” (Once you publish your model, you will not be able to make any more changes, but you can create a copy and continue editing a new version.)