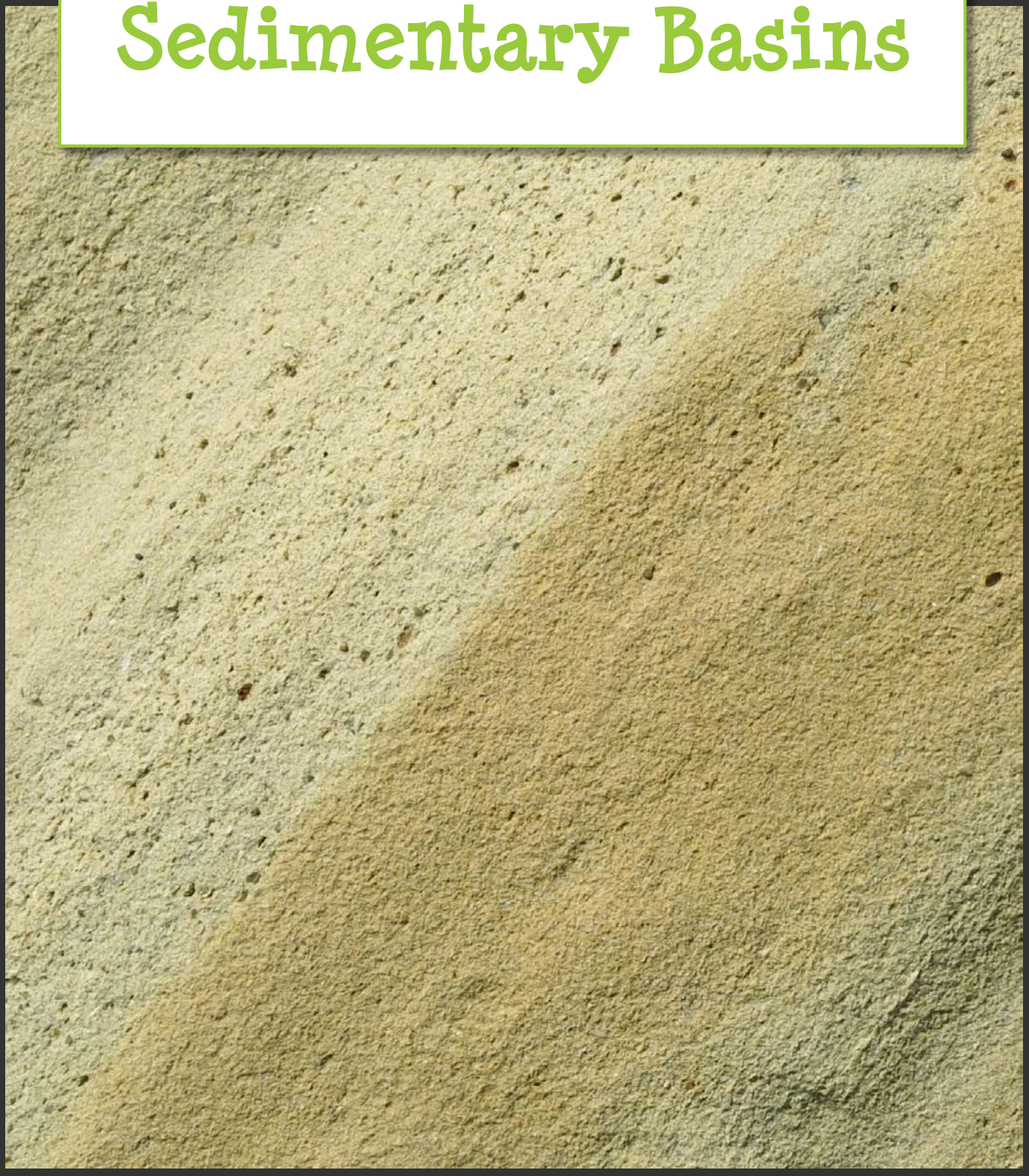
Sedimentary Basins



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AUSTRALIAN EARTH SCIENCE EDUCATION

Sedimentary Basins – Teacher Resource

Powering Careers in Energy Link:

Unit 2: Demonstrate an understanding of the importance of science in LNG operations.

Background Information:

Petroleum formation takes place in sedimentary basins. These basins form in special regions where the Earth's crust subsides / sinks, which in turn creates a depression in which thick sediments can accumulate. Sediment accumulations continue to fill the depression as it subsides, filling it layer upon layer with various sediments and organic matter.

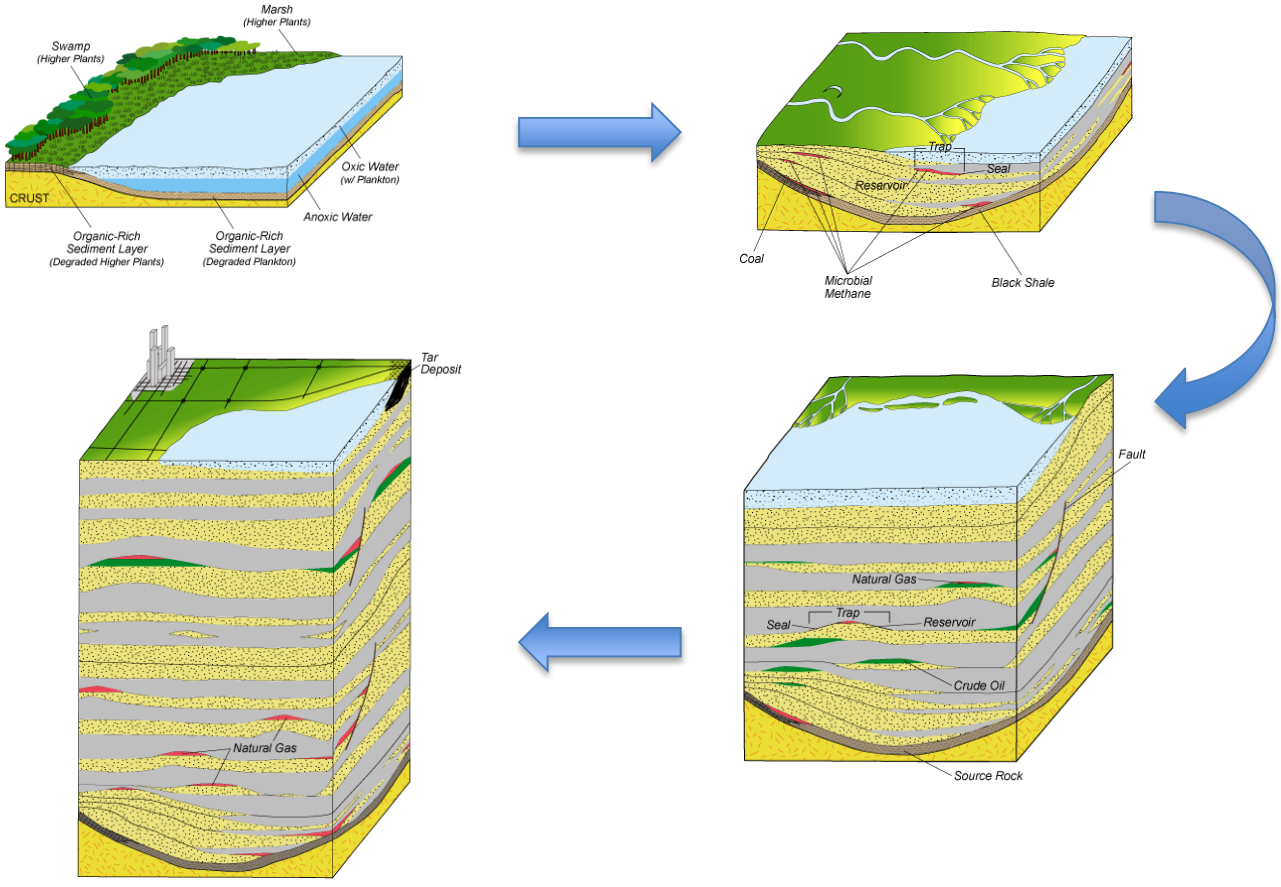
As more sediments are deposited, the lower layers solidify into sedimentary rocks due to compaction and cementation processes.

Different sediment layers accumulate that vary in character because the sources and depositional settings of the sediments change through geologic time.

For petroleum formation, it is critical that at some time during the accumulation of sediments at least one of the sediment layers contains the remains of deceased plants or microorganisms.

Over time, due to transgression (rising) and regression (falling) of oceans, development of stagnant water conditions cause the bottom waters to be depleted in oxygen (anoxic), which allows portions of decaying plankton (e.g., algae, copepods, bacteria, and archaea), which originally lived in the upper oxygen-bearing (oxic) waters, to be preserved as an organic-rich sediment layer.

Swamps and marshes may also develop in the coastal areas adjacent to oceans overlying subsiding basins. In these depositional settings, sediment layers can be enriched with decaying land plants (e.g., trees, shrubs, and grasses).



Aim

To model the formation of a sedimentary basin containing oil and gas.

Materials

Per group

- Different types of breads, cake, etc
- Clear glass or plastic rectangle container
- Plate
- Different diameter plastic straws
- BBQ sauce (to represent oil)
- Weight or jar of water

Safety Notes:

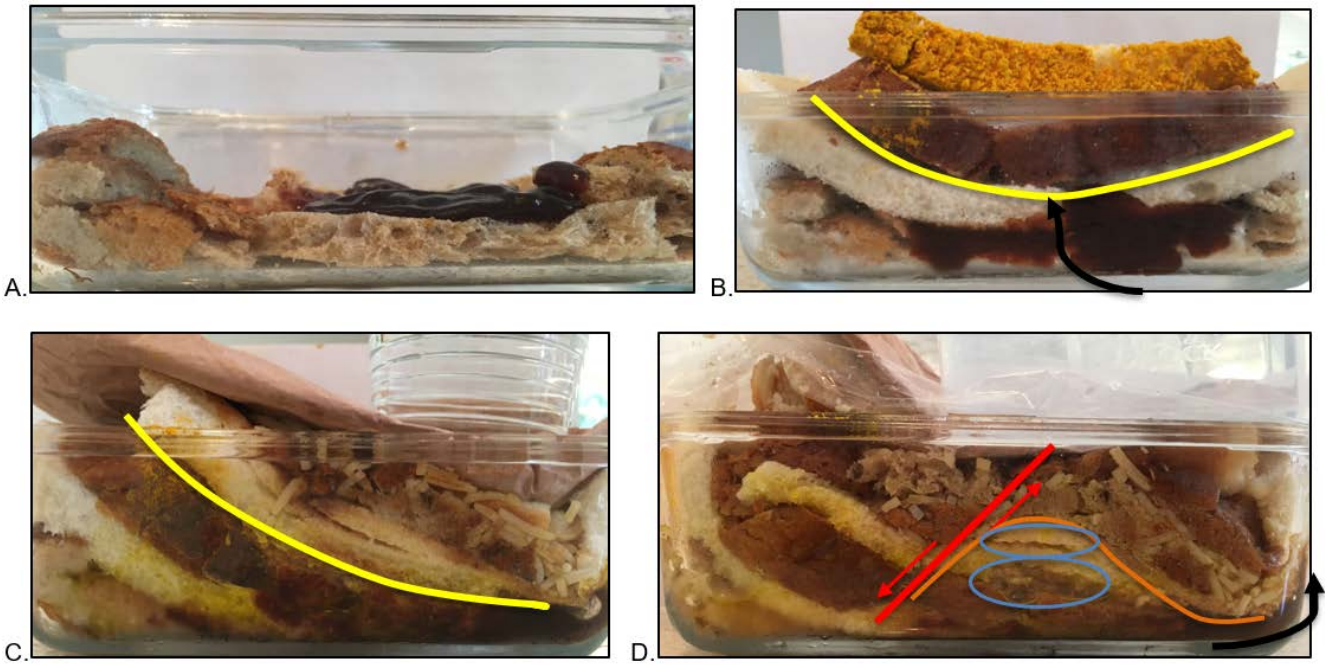
Students may have food allergies. Please alert them to the foods they will be working with and ask them to not consume anything that may trigger an allergy for them.

Method:

Students should be given an overview of the formation of a sedimentary basin using the **Background Information** provided above.

Students should collect all equipment and consider how to use this equipment to model the formation of a sedimentary basin. Two example models are pictured below.

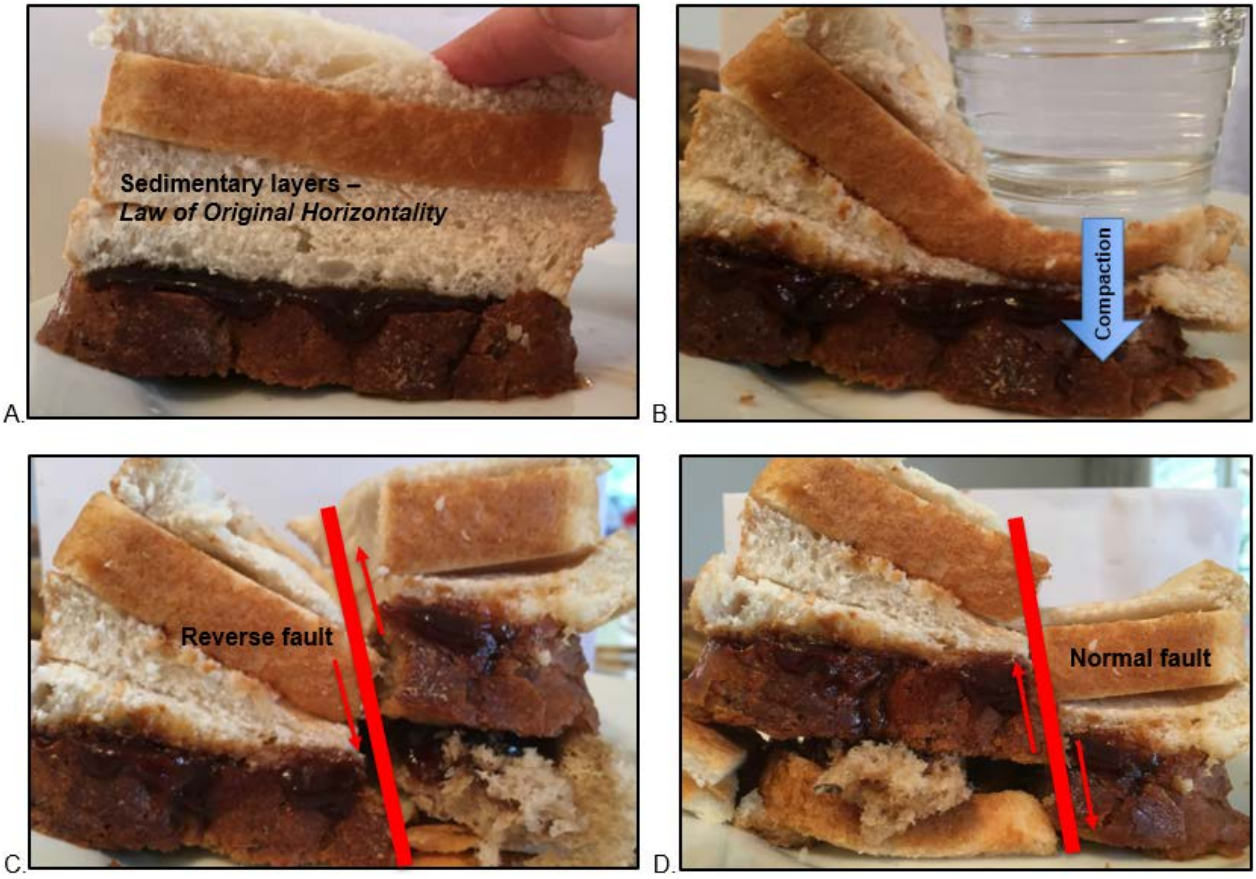
Students can record their method and observations, including visually if possible (photograph on computer / electronic pad or drawing on paper), on what they have modelled / demonstrated.



Example 1:

1. Place a piece of bread with BBQ sauce on it, to represent oil; then continue to add different types of bread to represent different sedimentary layers (A & B). Note that the sides of the first layer were built up to represent the edges of the basin

2. Push down on one end to show compaction of layers and formation of basin shape (A & B). Oil migration may start due to pressure from compaction (C)
3. Continue to add different layers of bread (or other materials) remembering that not all layers are uniform in thickness.
4. Use your imagination to observe different structures that may form (D – normal fault; oil migration; concave-down layers with potential traps containing oil and gas).



Example 2:

1. Place a piece of bread with BBQ sauce on it to represent oil; then continue to add different types of bread to represent different sedimentary layers (A)
2. Push down on one end to show compaction of layers and formation of basin shape (A & B)
3. Cut through the layers and place more bread under one side to represent faulting (C = reverse fault & D = normal fault)

Students should be able to explain how their model has demonstrated the formation of a sedimentary basin with oil present. If they unable to demonstrate due to their method, they should discuss what they could have done differently.

A **'Best Model / Demonstration' competition** could be undertaken to encourage greater thought and involvement in this activity. Students need to be able to explain the parts of their model / demonstration.

Results:

Students should be able to model at least layering in a sedimentary basin.

Discussion:

1. What did you do to create your model?

   Layering of breads; BBQ sauce; added water; weighted down one side; cut through layers, etc…..

Evaluation:

What were you able to model / demonstrate with the materials provided?

This could include: layers of different sediments in a sedimentary basin; compaction; faulting; oil migration; etc.

References:

Information and diagrams sourced from:
https://energy.usgs.gov/GeochemistryGeophysics/GeochemistryResearch/OrganicOriginsofPetroleum.aspx
Offshore petroleum diagram: *The APPEA Journal* 57(2) 304-344 (http://www.publish.csiro.au/AJ/AJ16029)

Worksheet: Sedimentary Basins

Aim

To model the formation of a sedimentary basin containing oil and gas.

Materials

Per group

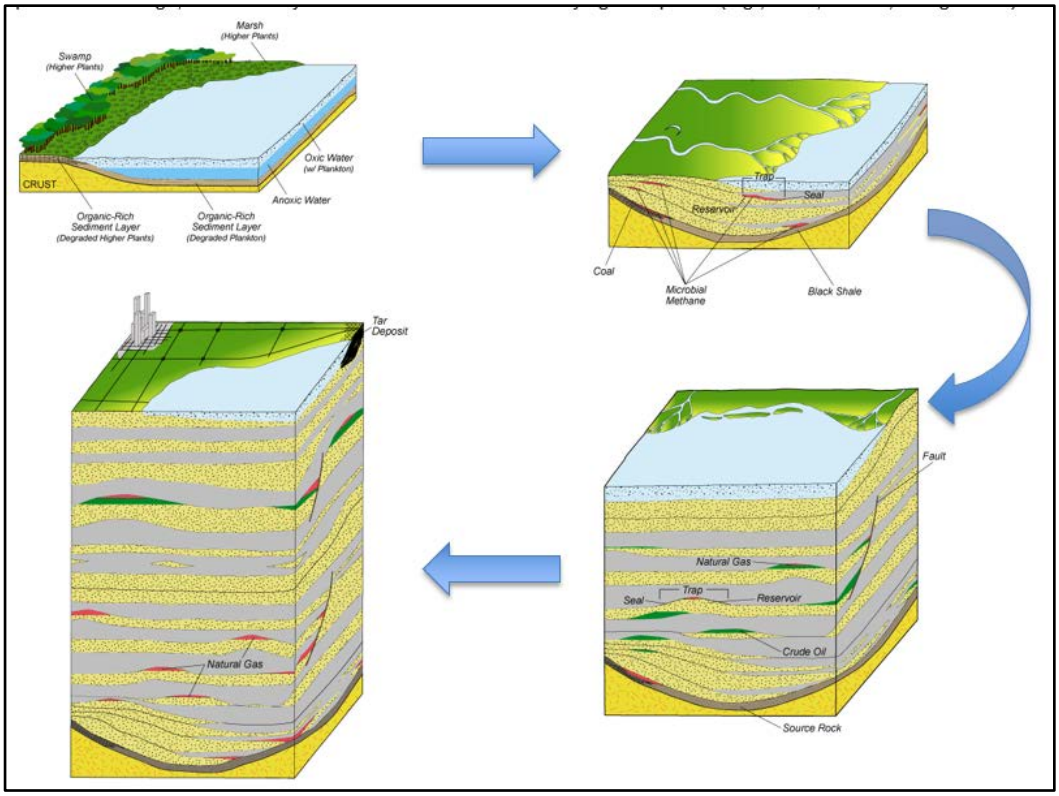
- Different types of breads, cake, etc.
- Clear glass or plastic rectangle container
- Plate
- Different diameter plastic straws
- BBQ sauce (to represent oil)
- Weight or jar of water

Safety Notes:

If you have any food allergies, please take the time to learn the ingredients of the foods being used today. Don't work with anything that may trigger a reaction or that you have any doubts about.

Method:

1. Collect the listed materials.
2. Using the diagram below, discuss in your group how you would use these materials to model and demonstrate the formation of a sedimentary basin, including an oil layer towards the base.
3. Note down your observations as you create your model in the results table.



Results:

Sketch or photograph some of the elements you've found and label them.

Discussion:

1. What did you do to create your model?

Evaluation:

What where you able to model / demonstrate with the materials provided?