Continents in collision

Modelling processes at a destructive (convergent) plate margin

Some of the Earth's most dramatic (and damaging) events take place at destructive plate margins where two continents collide. These occur when one plate is pulled down (subducted) where it meets another, usually producing earthquakes and volcanic eruptions. These destructive plate margins can be modelled in cardboard.

Ensure that students are familiar with the theory of plate tectonics. Then, either gather them round a single large version of the model, or give several smaller models to the class. Ask them what they think each part of the model represents, i.e. two wooden blocks (*continents, e.g. the Indian sub-continent and Asia*); cardboard flap (*descending plate, composed of oceanic lithosphere*); paper serviettes (*sediments on the ocean floor*); slot in cardboard base (*subduction zone*).

Ask them to predict what will happen when they pull gently on the cardboard flap (*The cardboard flap descends below the main cardboard base of the model. The wooden blocks move towards each other. The paper serviettes crumple up in between the approaching wooden blocks*).

Ask the students what evidence they would expect to see at a real plate margin, if this sort of activity were to be happening beneath the surface. (*There would be a deep oceanic trench above the descending plate. Earthquakes would be triggered where the descending plate met the other one, with their foci at ever-increasing depths. Volcanoes, of an explosive type, would erupt above the plate junction. Fold mountains of highly crumpled sea floor sediment would be produced, probably accompanied by metamorphism. These rocks are of too low density to be carried down by the descending plate*).

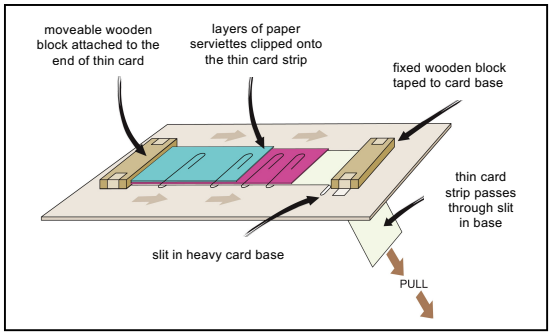
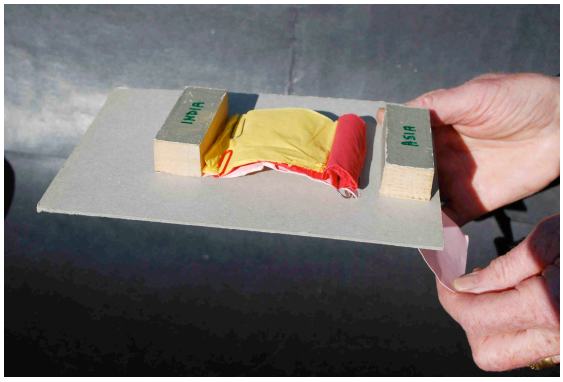
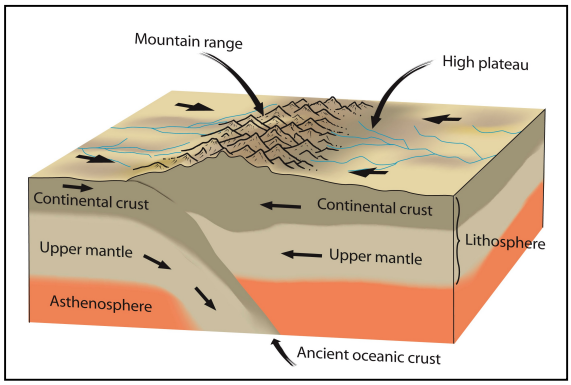


Diagram showing the construction of the cardboard model



The cardboard model in use (*Photo: Peter Kennett*)



Details of a continent to continent destructive plate boundary

The back up

Title: Continents in collision

Subtitle: Modelling processes at a destructive (convergent) plate margin

Topic: Demonstrating the features of a destructive continent v continent plate margin, using a cardboard model

Age range of pupils: 14 -1 8 years

Time needed to complete activity: 10 minutes, plus 30 minutes or so to make each model beforehand

Pupil learning outcomes: Pupils can:

- explain that compressive forces can result in the crumpling of flat layers and the bringing together of formerly separated masses;
- understand that materials of low density cannot sink in a higher density environment;
- describe how the model relates to reality.

Context: The activity can be used during the course of both science and geography lessons to illustrate the principles of destructive plate margin activity.

Following up the activity:

- Study maps showing the distribution of earthquake foci at depth and relate these to the angle at which the cardboard flap was pulled down.
- Examine pictures of fold structures in fold mountain belts such as the Himalayas or Alps. Relate the folds to the directions in which the compressive forces acted when the plates collided.
- Carry out the activities in the related titles in the Earthlearningidea series, e.g. *Geobattleships – do earthquakes and volcanoes coincide?; Magnetic stripes – modelling the symmetrical magnetic patterns of the rocks of the sea floor; Partial melting – simple process, huge global impact; The Himalayas in 30 seconds –making a miniature fold mountain range in an empty box.*

Underlying principles:

- Where two plates meet at a destructive margin, the denser (usually colder) plate descends beneath the slightly less dense one.
- The sediments of the sea bed are of too low density to sink.
- Compressional forces, caused in the model by two continents (wooden blocks) colliding result in the shortening of rocks near the surface, producing folding and thrust faulting as mountain ranges are formed.
  Magma is produced at most destructive plate margins. This happens because the release of water, which lowers the melting point, results in partial melting of the rocks above.

Thinking skill development:

Relating the model to the real world is a bridging activity.

Resource list:

Model of destructive plate margin made from:

- stiff cardboard
- thin cardboard
- paper serviettes or leaves of toilet paper
- two small wooden blocks;
- paper clips
- scissors
- sticky tape or staples

Either make up one large model, or encourage students to make their own smaller versions.

Useful links:

The US Geological Survey has published a useful downloadable book about the plate tectonics on its website, called '*This dynamic Earth: the story of plate tectonics'* available at: http://pubs.usgs.gov/gip/dynamic/dynamic.html

Source: Based on the workshop titled "The Earth and plate tectonics", Earth Science Education Unit (ESEU), © The Earth Science Education Unit: http://www.earthscienceeducation.com/ licensed under an Attribution-Noncommercial-Share Alike 3.0 Unported Creative Commons licence http://creativecommons.org/licenses/by-nc-sa/3.0/. The activity is based on a 'Crustal Evolution Project' activity originally published by the Missouri State University, USA. The diagrams were redrawn by ESEU and are used with permission.