

Hotspots

Modelling the movement of a plate across the globe

Model the movement of a tectonic plate above a hot spot in the mantle as follows:

- Take a sheet of A4 paper and fix a thick felt-tipped pen upright to the bench beneath it, using Blutak™ or similar. The paper represents a moving tectonic plate, and the pen represents a hot spot in the mantle beneath.
- Resting the paper on the tip of the pen, move it slowly away from you, allowing the ink to “bleed” through the paper, to leave a line.
- If you wish to introduce a change in direction or speed of movement of the card (“plate”), move the card accordingly.

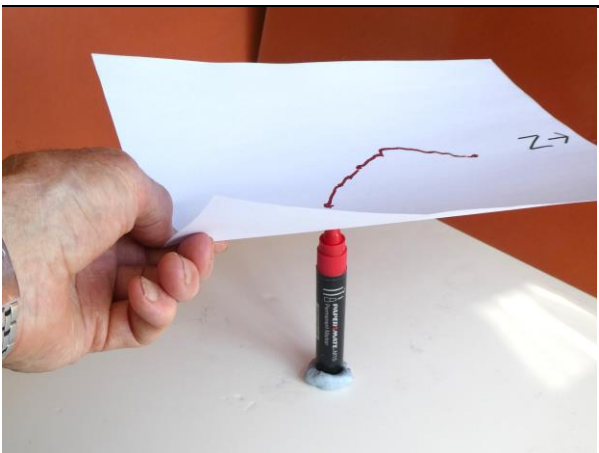


Fig 1. Moving the paper (“plate”) over a felt-tipped pen (Photo: Peter Kennett)

Discuss with the group how the line on the paper provides evidence of its movement over the pen. Link this to the way in which the movement of a tectonic plate over a hot spot in the mantle might be determined by the distribution of volcanic activity above the hot spot.

Show Figure 2 to the group and ask them to say how the paper was moved over the candle, given that the “youngest” end is shown. (An answer is shown in Figure 3).

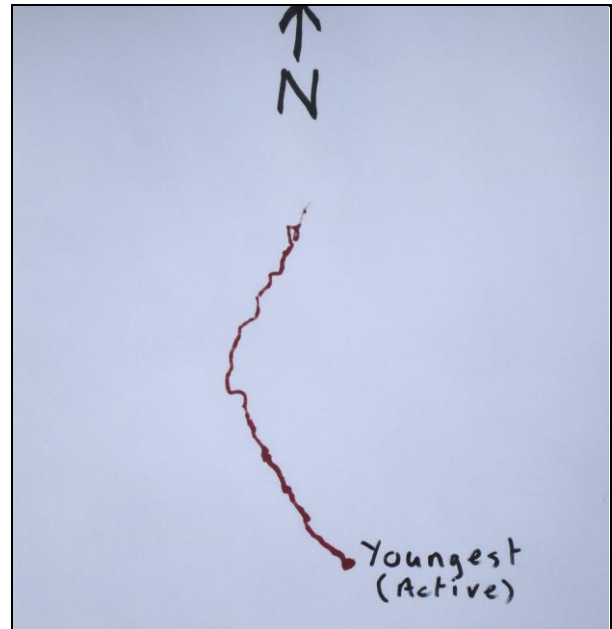


Fig 2. The result of moving a paper sheet over a felt-tipped pen as shown in Figure 1 (Photo: Peter Kennett)

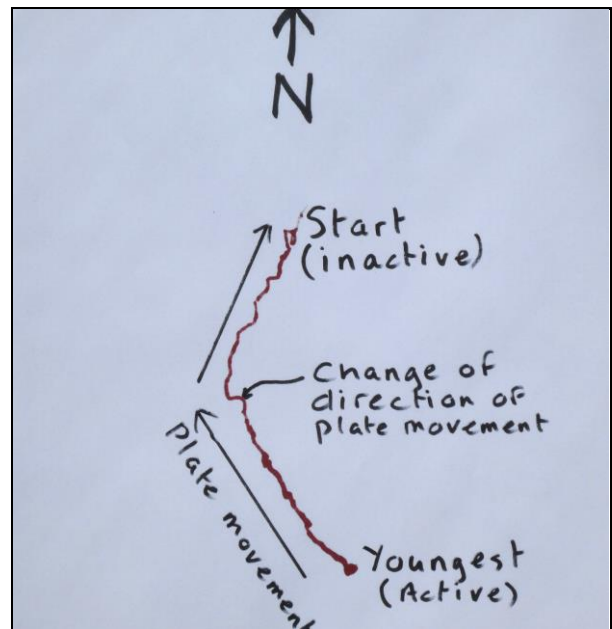


Fig 3. Answer to the pupil activity, showing the history of movement of the paper over the pen (Photo: Peter Kennett)

The back up

Title: Hotspots

Subtitle: Modelling the movement of a plate across the globe

Topic: Using a felt-tipped pen and a piece of paper to model the evidence of the movement of a tectonic plate over a fixed heat source in the Earth’s mantle.

Age range of pupils: 11 -18 years

Time needed to complete activity: 15 minutes

Pupil learning outcomes: Pupils can:

- understand the motion of one object (the paper) relative to another (a point source of “heat” – a felt-tipped pen);
- relate the paper and pen model to the movement of a plate relative to a fixed source of heat in the mantle below;
- use evidence of volcanic activity in the Pacific Ocean to deduce the ongoing motion of the Pacific plate.

Context: This activity can be used in any lesson in a science or geography class dealing with plate tectonics.

Following up the activity:

Show pupils the picture of the Pacific Ocean floor and the associated cross section (Figures 4 and 5, below). Point out that the Hawaiian Islands are built up from volcanoes, the most southern of which is still active. According to plume theory, lavas come from a hotspot or mantle plume beneath Hawaii. The line to the northwest of the island chain comprises a series of seamounts, i.e. former volcanoes, which are no longer active. Ask pupils to use what they have learnt from the demonstration to state the direction of movement of the Pacific plate.

Follow the story in more detail by reference to the Wikipedia article and the animation given opposite.

Underlying principles:

- Some volcanic activity is caused by a localised source of heat rising from within the mantle, a mantle plume.
- Such heat sources are known as hotspots.
- Hotspots are mostly thought to remain in the same place for millions of years.
- Volcanoes formed at an earlier stage of the plate's movement over the hotspot become extinct as the plate moves them away.

- As the plate moves away from the hotspot, the lithosphere cools and becomes denser. It tends to sink as it moves, resulting in the former volcanoes disappearing beneath the ocean surface, to form underwater seamounts.

Thinking skill development:

Identifying the pattern of staining in the paper relative to the pen involves skills of construction. Relating the model to the real world is a bridging skill.

Resource list:

- A4 sheet of printer paper
- thick felt-tipped pen
- Blutak™ or another means of holding the pen upright

Useful links:

http://en.wikipedia.org/wiki/Hawaii_hotspot

Animation:

<https://www.youtube.com/watch?v=AhSaE0omw9o>

This activity:

https://www.earthlearningidea.com/Video/208_Hotspots.html

Source: This activity was demonstrated, using a candle flame and a sheet of dampened card, by Chris Bedford at the 2013 Conference of the Earth Science Teachers' Association and is outlined in *Teaching Earth Sciences* 39.1, 2014 p34. Our version is safer, but the candle activity could perhaps be attempted safely outdoors!

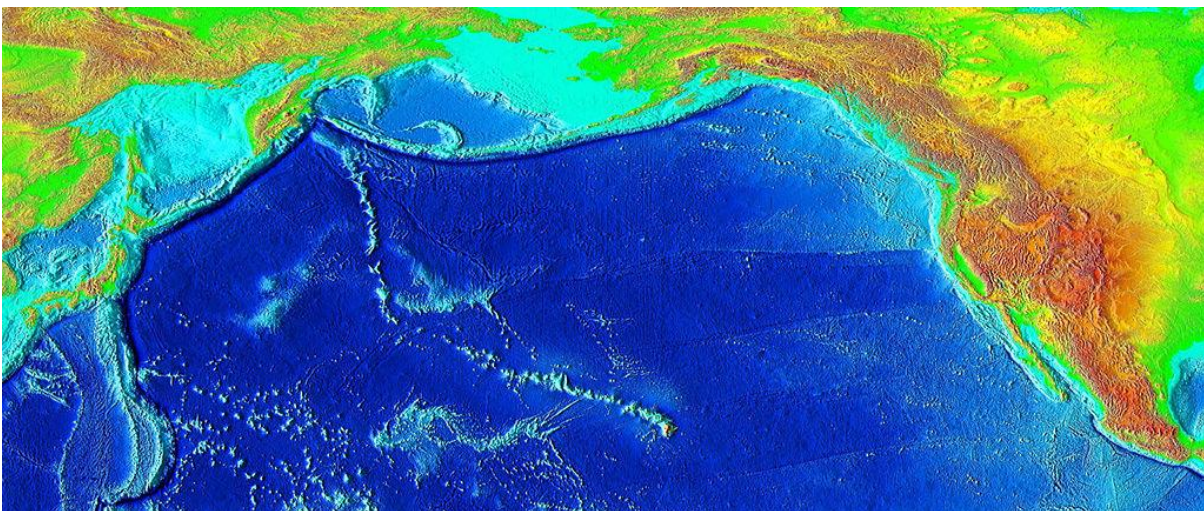


Fig 4: The floor of the Pacific Ocean (*Wikipedia*). The Hawaiian Islands are near the bottom centre of the image, with a line of seamounts extending to the northwest.

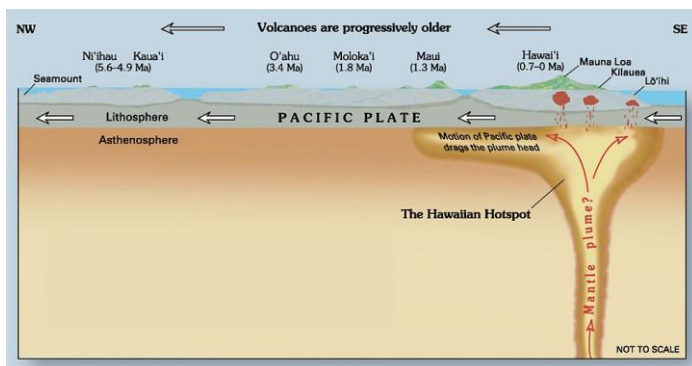


Fig 5. Cross section of the Hawaiian Islands and the seafloor ridge to the northwest (*Wikipedia*)

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