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:

a) Check that a smoke detector is not active in the room and that some water is at hand in case of fire!
b) Lightly spray with water a piece of thin card, to reduce any fire risk. The card represents a tectonic plate.
c) Hold the damp card over a burning candle, or similar flame. The flame represent a hot spot rising through the Earth's mantle. As soon as the card begins to char, move it slowly across the flame, to create a continuous line of charred card.
d) If you wish to introduce a change in direction of movement of the card ("plate"), move the card accordingly.

Fig 1. Moving the card ("plate") over a candle flame (Photo: *Peter Kennett*)

Discuss with the group how the charred card provides evidence of its movement over the candle.
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 card 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 card over a candle flame as shown in Figure 1 (Photo: *Peter Kennett*)

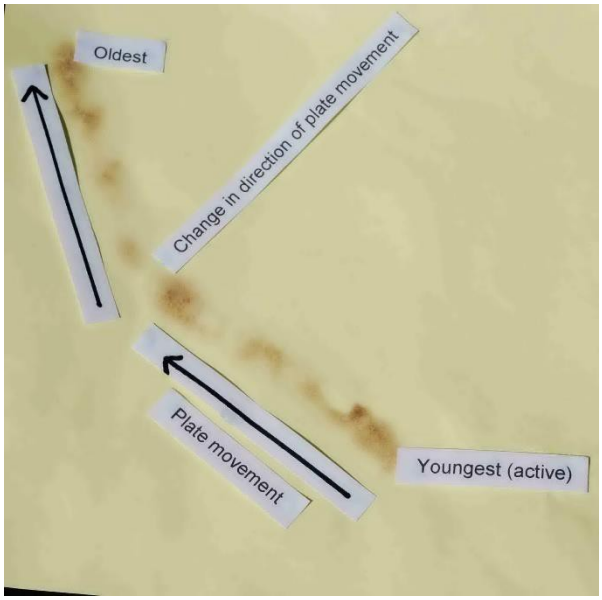

Fig 3. Answer to the pupil activity, showing the history of movement of the card over the flame (Photo: *Peter Kennett*)

The back up

Title: Hotspots

Subtitle: Modelling the movement of a plate across the globe

Topic: Using a candle and a piece of card 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 card) relative to another (a point source of heat – a candle);
- relate the card and candle 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 comprises a series of seamounts, i.e. former volcanoes, which are no longer active. Ask them 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 charring in the card relative to the candle involves skills of construction. Relating the model to the real world is a bridging skill.

Resource list:

- a piece of thin card
- water in a spray bottle, or a damp rag
- candle in safety holder, or a similar flame
- matches
- container of water for safety purposes

Useful links:
http://en.wikipedia.org/wiki/Hawaii_hotspot
Animation:
https://www.youtube.com/watch?v=AhSaE0omw9o

Source: This activity was demonstrated by Chris Bedford at the 2013 Conference of the Earth Science Teachers' Association and is outlined in *Teaching Earth Sciences* 39.1, 2014 p34.

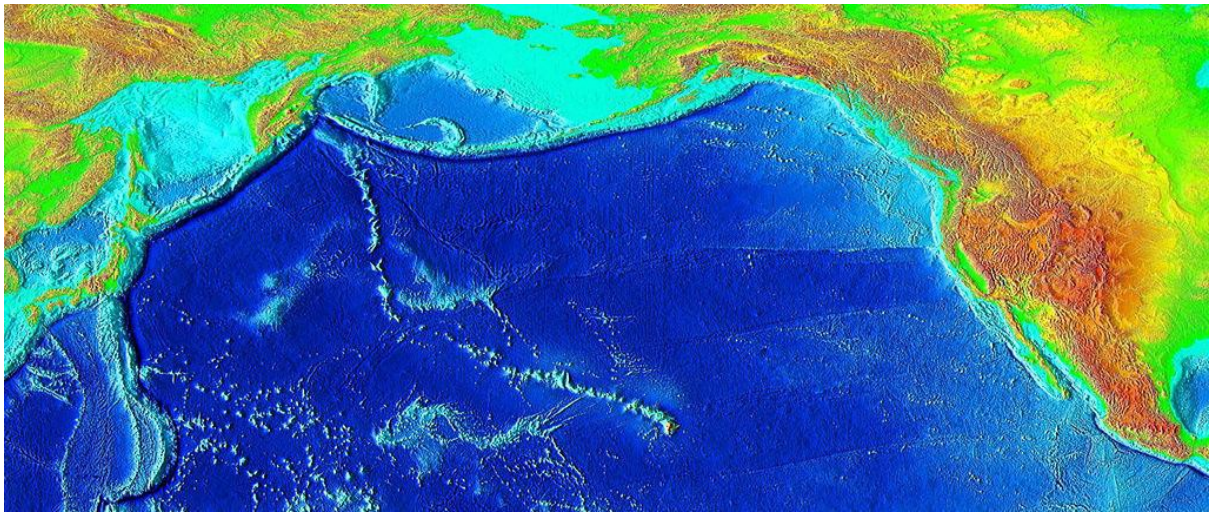

Fig 4: The floor of the Pacific Ocean *(Wikipedia).* The Hawaiian Islands are near the bottom centre of the image, with a line of seamounts extending to the northwest.

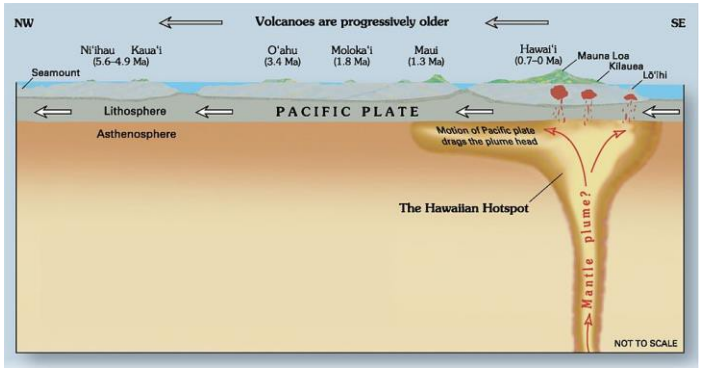

Fig 5. Cross section of the Hawaiian Islands and the seafloor ridge to the northwest (*Wikipedia*)