# **Plate Tectonics: Evidence of Plate Movement**

A Carolina Essentials<sup>™</sup> Activity

#### Student Worksheet

#### **Overview**

Early in the twentieth century, German meteorologist Alfred Wegener proposed the theory of continental drift based on the coastal geography of continents, geologic patterns in folded rock bands, and the occurrence of the same fossils on continents that are on opposite sides of an ocean. Wegener's theory faced harsh criticism because he couldn't explain the mechanism by which continents move.

It wasn't until the mid-twentieth century that evidence was presented for the mechanism. Computer analysis of continental shapes 1,000 meters below the surface of the ocean showed close matches between the coastlines of Africa and South America. Measurements of ocean depth led to the discoveries of ocean ridges, trenches, and transform faults, which now determine types of tectonic plate boundaries.

Additionally, a magnetic field survey of the Pacific Ocean floor identified regular patterns of greater-than-average field strength, then less-than-average field strength in line with and parallel to the ocean ridge, giving rise to the theory of seafloor spreading. Geologists are still investigating the specific details of the crust-mantle boundary to understand more fully how tectonic plates move. In this activity, north-central Pacific Ocean floor maps are examined for evidence of Pacific plate movement.

#### Phenomenon

Watch the virtual fly-through. What looks familiar? Where do you think this is?



#### SAFETY REQUIREMENTS

No PPE is required for the activity.

#### MATERIALS -

4 Pacific Ocean maps (see pages S4 and S5) Colored pens, pencils, or overhead markers



#### Virtual fly-through of the Mariana Arc

#### **Essential Question**

How do surface features provide evidence of tectonic plate movement?

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#### **Activity Objectives**

- 1. Use information from ocean floor maps to determine past tectonic plate movement.
- 2. Use information from ocean floor maps to determine the type of tectonic plate boundary.

#### **Activity Procedures**

- 1. Look at map 1, covering the north-central portion of the Pacific Ocean.
  - a. At the bottom right edge, locate the Hawaiian Islands.
  - b. Using a colored pen or pencil, trace the island and sea mount features that begin with Hawaii and end at the Aleutian Trench. Seamounts appear light blue.
  - c. Label the compass direction for each line segment drawn.
- 2. Look at map 2, the Hawaiian Ridge topography.
  - a. Place a mark on what appear to be or have been volcanoes.
  - b. Draw a boundary around the location of the volcanoes.
- 3. Look at maps 3 and 4, the North American and Pacific Plates Boundary. The color coding indicates the darker the shade of blue, the greater the depth of water. Browns and greens indicate features above sea level.
  - a. Label the deepest areas and shallowest areas on map 3.
  - b. Circle the features above sea level that are adjacent to the trenches.

#### **Analysis and Discussion**

#### Map 1

1. The north-central Pacific hot spot has not changed location. In what direction(s) has the Pacific plate moved through history? State the evidence to support your claim.

2. In what direction is the Pacific plate moving now? State the evidence to support your claim.

3. Given that darker blue is deeper and lighter blue is shallower, what happens to the depth of seamounts as you travel north from the Hawaiian Islands?

4. Where along the seamount feature are the mounts the oldest? Where are they the youngest? State the evidence to support your claim.

#### Map 2

- 1. What evidence did you use to locate past and current volcanoes?
- 2. How does the boundary you drew compare to the Hawaiian Ridge?
- 3. Based on the evidence, where is the location of the hot spot?

#### Maps 3 and 4

- 1. What is the spatial relationship between the location of deep areas and surface features?
- 2. What type of plate boundary does this topography suggest? State the evidence for your claim.
- 3. Does the topography on maps 3 and 4 support or refute your claim for the direction of plate movement from map 1? Explain your reasoning.

Use the surface feature evidence you gathered in this activity to propose an explanation for tectonic plate movement. Explain the constructive and destructive forces occurring at hot spots and tectonic plate boundaries.

# Northwest Pacific Basin Mid. Pacific Mountains 107.501', 28.333

### Map 1: North-Central Pacific Ocean Floor

Source: NOAA National Centers for Environmental Information (NCEI)



# Map 2: Topography of the Hawaiian Islands and Hawaiian Ridge

Source: NOAA National Centers for Environmental Information (NCEI)



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Map 3: North American and Pacific Plates Boundary

Source: NOAA National Centers for Environmental Information (NCEI)



## Map 4: Close-up of Plate Boundary

Source: NOAA National Centers for Environmental Information (NCEI)

