Plate Motions Past and Present

Middle School

NGSS: MS-ESS2-3

Background

Lesson Description

Students analyze maps of the present day Earth and utilize fossil data from around the world to recreate a map of the globe 240 million years ago. By analyzing and interpreting data about the structures of the Earth's crust and the fossil record, students gain an understanding of the data that indicate tectonic plate movement such as the break-up of the Pangea supercontinent or India colliding with Asia to form the Himalayan mountains. Students use the data as evidence to support a claim about the motions of Earth's tectonic plates in the past.

Driving Phenomenon

Up until the 20th century, exploring the Earth on a global-scale was time and cost prohibitive. Now, geologists are able to gather global-scale data from equipment like satellites and sonar, and paleontologists have also learned how to read the history of the Earth in the fossil record. By utilizing these newer capabilities, humans have started to recognize patterns in the Earth's structures and events that help us understand where and when Earth's landforms have been and predict where they might go in the future.

Events like earthquakes, volcanic eruptions, and emerging sinkholes can seem random and unrelated, but they are clues to a big puzzle about how the Earth works. **In our everyday lives we generally think of the ground under us as being solid and still, but it's actually in motion.** How can we say that we know this? How do we record and measure a global phenomenon like this happening?

Driving Questions

- How do we know the Earth under our feet is moving?
  - How is the crust of the Earth structured?
  - What was the Earth like long ago?
  - What was life on Earth like long ago

Learning Objectives

- Students will demonstrate an understanding of geological features such as sea floor ridges and continental shelves by analyzing and interpreting geographical data
- Students will demonstrate an understanding of prehistoric life on Earth when they organize, map, and analyze data related to key fossils.

Time Requirements

- Three-Four 40-minute class periods

Prerequisite Knowledge

- The geosphere of the Earth consists of the solid rock crust and the molten rock interior.
- Fossils represent plants and animals that lived long ago.

Teacher Resources

1.1 Silfra Fissure Information
2.1 What was a Lystrosaurus?

Student Resources

1.1 Studying the Earth through Exploration
1.2 Patterns on the Earth
1.3 Mapping Global Patterns
1.4 Patterns of the Earth's Crust Reference
1.5 Evaluating Evidence

2.1 Organisms of the Permian and Triassic
2.2 Where did Prehistoric Organisms Live?
2.3 Continental Plate Puzzle
2.4 Claim, Evidence, Reasoning Tool

How is the crust of the Earth structured?

See pg. 5-7 for full lesson procedure

Engage | 25 minutes	
Watch video clip about the Silfra Fissure in Iceland, and reflect upon the challenges of exploring, measuring, and making sense of a phenomena that is massive in scale.	Notes
Teacher Resource: 1.1	
Explore | 50 minutes	
Students look for patterns of features of the Earth's crust using Google Maps and record their findings in Student Resource 1.2.	Notes
Student Resource: 1.1 and 1.2	
Explain | 50 minutes	
Students share the patterns that they recorded. Students are grouped according to common patterns that were found by the class. Groups are assigned a pattern to map on a world map.	Notes
Student Resource: 1.3	
Elaborate | 30 minutes	
Students compare their observations with a data sheet that introduces names and information of common features of the Earth's crust, and have the opportunity to revise their observations.	Notes
Student Resources: 1.2, 1.3, and 1.4	
Evaluate | 25 minutes	
Post and review group maps of feature types. Engage in a discussion evaluating relevance and sufficience of evidence gathered thus far.	Notes
Student Resource: 1.5	

What was life on Earth like long ago?

See pg. 9-10 for full lesson procedure

Engage | 15 minutes	
After exploring images of Lystrosaurus fossils, students reflect on the questions that inspire scientists to seek fossils, on questions that arise while investigating them, and the questions that are answered in these processes.	Notes
Teacher Resource: 2.1	
Explore | 40 minutes	
Students analyze and interpret data about pre-historic organisms and utilize it to complete a map that shows geographic ranges of where organisms lived long ago.	Notes
Student Resources: 2.1 and 2.2	
Explain | 60 minutes	
Students construct a model of what the Earth's crust looked like 250 million years ago based upon the mapped fossil evidence.	Notes
Student Resources: 2.2	
Elaborate | 25 minutes	
Students make a claim about the movements of the Earth's plates over time using evidence and reasoning.	Notes
Student Resource: 2.3	
Evaluate | 25 minutes	
Students will evaluate the strength of the claim in light of the evidence that they have encountered thus far.	Notes
Any resources from both inquiries may be used.	

Preparation and Enrichment Ideas

Materials

- Tablets or computer lab time. One device per student or pair of students
- Colored pencils or pens for each group
- Copies of student resources for each student
- Extra copies of Student Resource 2.2 (approx.three per student)
- Scissors and glue sticks for each group

Lesson Enrichment Ideas

DO

Students can examine maps showing data of the age of the crust of the sea floor. Then, analyze this data for evidence of directional trends of crust formation and destruction to provide further evidence of past plate motions and positions. The National Oceanic and Atmospheric Administration offers interactive globes spheres that have been mapped with global datasets.

These can be used in lieu of Google Maps if need be.

https://sos.noaa.gov/datasets/etopo2-topography-and-bathymetry-color-enhanced/

https://sos.noaa.gov/datasets/age-of-the-seafloor-topography/

The maps can also be accessed in a geographic projection at:

https://www.ngdc.noaa.gov/mgg/image/crustalimages.html

READ

Solving the Puzzle Under the Sea, Marie Tharp Maps the Ocean Floor
by Robert Burleigh
A picture book examining the life of Marie Tharp and development of her love of maps and outlining the ocean floor. Reading level is elementary.
http://worldcat.org/oclc/890011300

Older Than Dirt: A Wild But True History of Earth
by Don Brown and Dr. Mike Perfit
Two dirt-loving animals explore the major events in the history of the Earth in a graphic novel format.
http://worldcat.org/oclc/949922830

A History of Life in 100 Fossils
by Paul Taylor and Aaron O'Dea
More advanced in level of detail and reading level. It could be a helpful resource to have in the classroom during the final project of this lesson. Each story is only about a page of text and accompanied by rich photographs.
http://worldcat.org/oclc/951146948

Inquiry 1: What is the structure of Earth's crust?

Engage

The size difference between humans and the Earth can make it challenging to evaluate phenomena that are literally the size of the planet. After viewing a video of SCUBA divers at the Silfra Fissure in Thingvellir National Park, Iceland, students will reflect on issues of measurement and observation at this large scale.

1 Show the students the YouTube video of snorkeling and SCUBA diving in the Silfra Fissure. Teacher Resource 1.1 provides a link beginning at the one minute and 30 second (1:30) time mark. Try to pause the video right when it gets to the two minute and 48 second time mark (2:48). Help the students orient themselves to the elements of this image, based what they can see, and other clues from the video. You may want to show the clip more than once.

- What are the people doing?
- What are some features of the place where they are swimming? (you can use the captions as clues)

2 Once the students have identified several clues in the the video for themselves, read or paraphrase the following description of the Silfra Fissure.

> The Silfra Fissure is located in a valley by the same name in Iceland. The water comes from a glacier so it is extremely cold, just above freezing. Divers must wear special equipment in order to even survive the experience. As the glacier melts the water filters through volcanic rock slowly for years before reaching the fissure. Because of this filtration process, the water here is the clearest in the world. In the video captions labeled the walls of the fissure indicating that this space is right between two tectonic plates of the Earth's crust. This presents potential danger to divers because earthquakes are more frequent in this area. Sometimes when an earthquake occurs giant boulders crash down from the walls of the fissure.

3 Ask the students to reflect and share what the video and description make them think about how humans study and understand phenomena that are as big as the entire Earth.

4 Ask students to reflect on the questions in Student Resource 1.1 and discuss their responses before they explore the features on the crust of the Earth.

In the Student Resource

Engage | Step 4

- What types of data do you need to gather to show that something is or is not in motion?
- How can scientists gather data that is sufficient, relevant, and quantitative to investigate a phenomenon as big as the Earth?

Explore

Arrange for students to use Google Maps to explore the globe. They should look for patterns in features of the crust. Patterns could be geological features such as continental shelves, ocean ridges, and ocean trenches. While students may not be able to name these features, they should look for irregularities that stand out to them in the images. They may also notice that similar shapes appear across different features such as how ocean ridges are often shaped similarly and run parallel to the nearest coastline.

1 Tips for using Google Maps are provided in Student Resource 1.2. Direct students who are less familiar with using Google Maps to the warm-up question on Student Resource 1.2 to help them become comfortable with the interface before they start to look for patterns.

2 As students begin to recognize patterns of features on the globe, have them record the following types of data in Student Resource 1.2.
- Describe the patterns via sketches and text. Think about how you would explain the patterns to someone who is not familiar with the Earth.
- Note the longitude and latitude of each instance of this feature so you can refer back to the globe later and point them out to others
- Locate at least three different patterns or types of features to record.

3 Provide students with individual work time to explore the globe on Google maps while monitoring their progress.

In the Student Resource

Explore | Step 1

- What do you notice in the ocean areas on this map of Earth that you don't always see on many other maps and globes?

Explain

1. Once students have made sufficient progress recording their observations, pass out Student Resource 1.3 and have them share the patterns that they identified.

2. As students share, create a list on the board of "recognized patterns" based on the observations of this class. As patterns are presented multiple times, mark the students' initials next to each on the list.

3. Form small groups around the common patterns that showed up on the list the most. If there was a single pattern that most students identified, you may need to split the large group into smaller ones and assign a different pattern to one of them.

4. Each small group will map each observation of the pattern onto a geographic projection map provided in Student Resource 1.3: Global Crust so that they can see the global presence of their patterns all in a single view.

5. As they develop their maps remind them of some good visualization/ communication practices such as:
   - Create a descriptive name for your map.
   - Design a key that describes elements and the symbols chosen to represent the features and patterns identified.

Elaborate

1. As they are working to finish their maps, pass out Student Resource 1.4: Features of the Earth's Crust. Allow students time to discuss and answer the questions comparing observations made on Google Maps to the resource document.
2. As the maps are revised, students should hang them somewhere in the classroom so that they and their classmates can refer back to them during future inquiries.

In the Student Resource

Elaborate | Step 1

- Did any of your previous observations align with the features described in the Earth's Crust document? Take some time to revise or add to your group's descriptions and map.
- Did any of your individual observations align with the features described in the Earth's Crust document?
- Even though Google Maps is based upon satellite photography, it's still a simplified model.
  - What aspects of the model helped your understanding of Earth's features?
  - What feature was most challenging to understand on this model? If you were a map or globe designer, how would you represent this feature differently?

Evaluate

1 Provide space on the wall or board for students to hang the revised version of their group's map, so that the class can view all of the patterns that were mapped.

2 Invite students to share any relationships they notice between the types of features.
- Are certain features always near one another?
- Are certain features never near one another?

3 Does the dataset we've just explored provide ***relevant*** evidence for whether or not the crust of the earth is moving? Explain why or why not.
- Relevant evidence is appropriate and closely connected to the question or phenomena at hand.
- Students may have trouble recognizing this evidence as relevant at this point in the lesson.
- However, this is a great opportunity to begin to record any relevant evidence in a visible location that can be referred back to like chart paper or the board.

4 Again reviewing the dataset we've just explored, does the relevant evidence that we've identified provide ***sufficient*** support for whether or not the crust of the earth is moving? Explain why or why not.
- Sufficient evidence means that there is enough evidence to address all of the facets of a claim.
  The original claim is that the ground under our feet is in motion.
- One reason that evidence from this exploration is insufficient as to whether or not movement is occuring is that it is a single snapshot of time. By its nature, movement is a time-based phenomenon, so we need data that compares the earth at a different point in time.

5 How would we learn about the what the Earth was like 200 million years ago?

Inquiry 2: What was life on Earth like 200 million years ago?

Engage

1 Show the photograph of the Lystrosaurus fossil in Teacher Resource 2.1, and introduce the background on the organism.
   - What can we infer about the time and place where this organism lived by the clues we get from the fossil?
   - What kinds of questions would you be able to answer after finding and studying this fossil?

2 Have students think-pair-share on these questions.

3 Explain that we will be analyzing data about fossils found around the globe, and determining what the Earth was like prior to when the dinosaurs lived to gather more evidence to support the idea that the Earth's crust moves.

Explore

Students will be analyzing data about fossils found around the globe, and determining what the Earth was like prior to when the dinosaurs lived to gather more evidence to support the idea that the Earth's crust moves.

1 Have students analyze the map on Student Resource 2.2: Where Did Pre-historic Organisms Live? with their small group to determine what they would add to complete the map. Then have each group share one item from their map and create a list on the board for everyone to refer to. Students should come to the conclusion that the essential items that the map still needs are a title, labels, and a key.

2 Working in small groups, they will analyze the paleo-organism datasets to find the information needed to complete the maps. By analyzing and roughly plotting the locations where the fossils were found, students will be able to decide which region represents each organism's range. This will help them create labels or a key. They should also craft a title for their map.

Explain

1 Have students discuss the questions in small groups and record their answers in Student Resource 2.3: Puzzling Continents in order to help them further analyze the map and data.

2 Provide materials such as markers, extra paper, tape, glue, and scissors.

3 Allow time for students to alter their maps.

Elaborate

1 Have students make a claim related to movement of the Earth's crust via the Claim-Evidence-Reasoning method in Student Resource 2.4.
   - Example Claim: The crust of the Earth is made up of masses of solidified rock called plates that are slowly moving in different directions.

2 Students should use evidence that they have observed throughout the two inquiries to support the claim that the crust of the Earth is moving.

Evaluate

1 Students again evaluate the strength of the evidence that they have gathered over the course of the two inquiries.

2 Remind students that science is never done. Additional data can strengthen or refute a previous claim. Have students reflect about what additional evidence they might need to further support their claim.

In the Student Resource

Explain | Step 1

- Why is it that we have found these organisms on all of these different continents?
- What evidence in the datasets or map supports your answer from the previous question?
- Use your map to make a claim about what the Earth was like when these organisms were living. You can alter the map in a way that communicates the claim that you want to make about the Earth 250 million years ago. Your teacher will provide you with supplies to help you accomplish your vision.

Evaluate | Step 1

- Does the dataset we've just explored provide relevant evidence for whether or not the crust of the earth is moving? Explain why or why not.
- Does the dataset we've just explored provide sufficient evidence for whether or not the crust of the earth is moving? Explain why or why not.

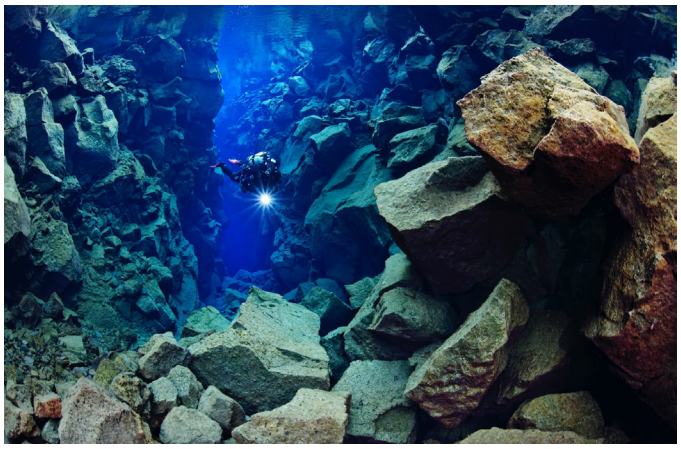
Silfra Fissure Information

Teacher Resource 1.1

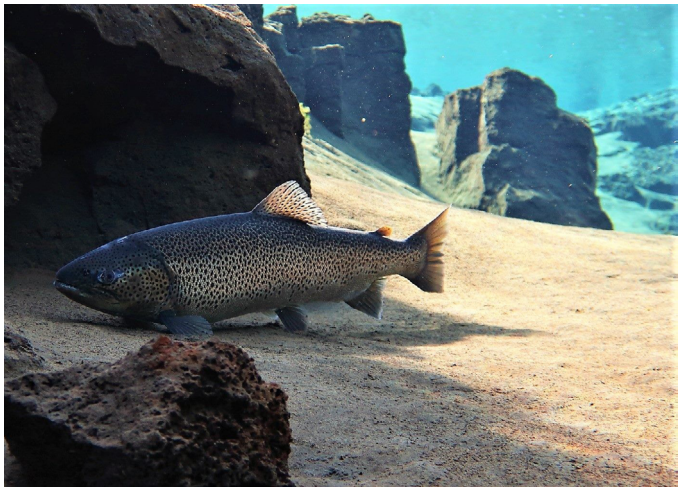
https://www.dive.is/diving-snorkeling-tours/diving-day-tours/silfra-diving-day-tour

This website is actually designed to sell tourists snorkeling or SCUBA diving expeditions at the Silfra Fissure, but it can also be used to provide you, as an educator, some information about the natural history of the site. Show the YouTube video to students beginning at the 1:30 mark (link to time-stamp provided) because earlier in the video it introduces some of the concepts of the lesson prematurely. Photographs from the slide show about halfway down the web page have been shared with us for use in the classroom activity.

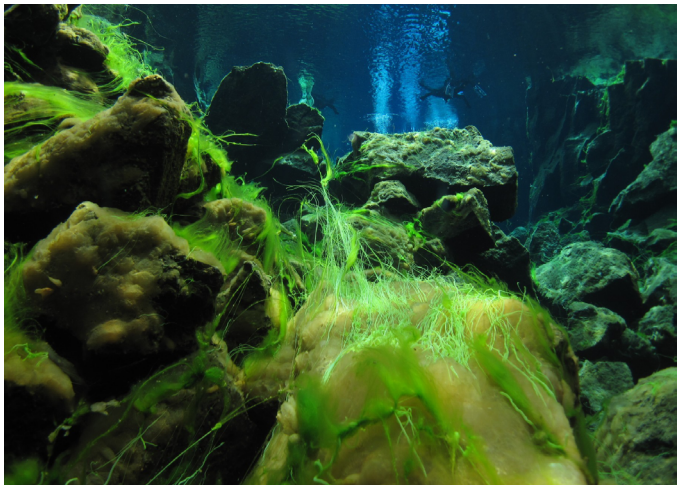
Snorkelers swimming between the continents



A diver with a torch light makes their way through the walls of basalt rock.



One of the only animal inhabitants of the fissure, an Arctic Char.

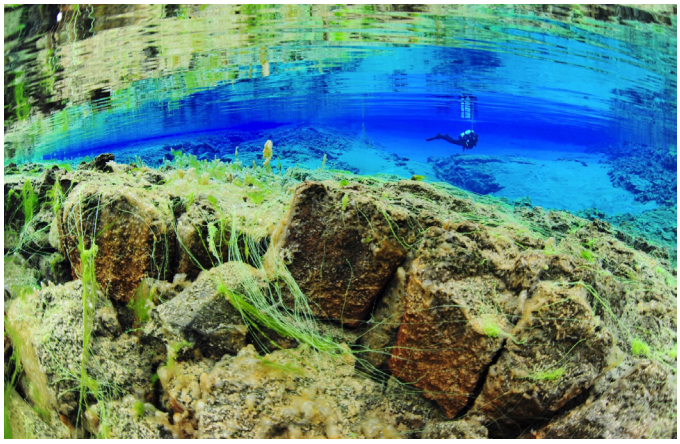


Troll hair algae grows throughout the lagoon.

Teacher Resource

Teacher Resource 1.1: Silfra Fissure Information

A free diver floats in front of a wall of basalt rock.



The clear water of the lagoon reflects the troll hair algae and basalt bottom.

Arial view of the fissure and diver entry point.

Arial view of Silfra fissure, lagoon, and diver exit platform.

Teacher Resource 1.1: Silfra Fissure Information

Divers enter the water at this platform for safety reasons and to minimize the impact on the surrounding environment.

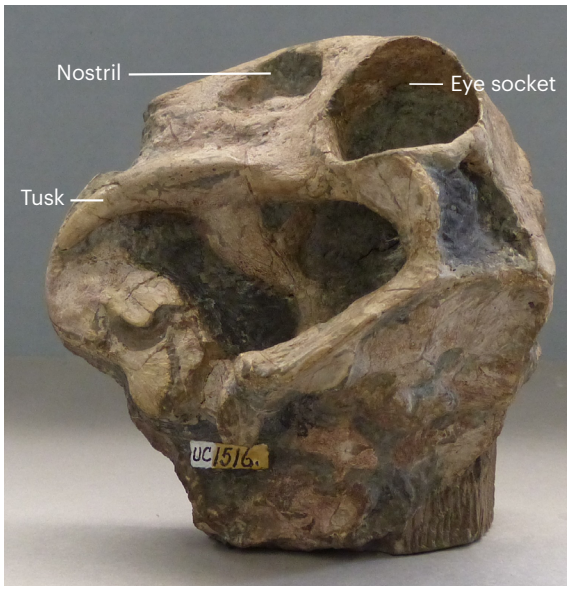
Snorkelers exiting the water.

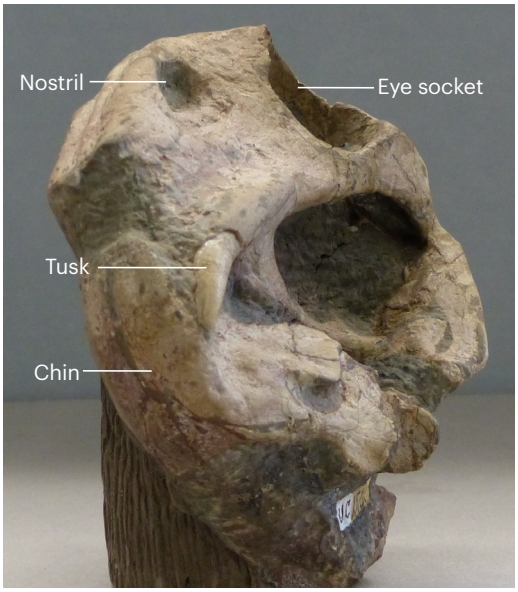
Divers wear special gear and dry suits when in the water. Survival time with out a dry suit is less than one hour.

Snorkelers in the water with snow in the background.

What was a Lystrosaurus?

Teacher Resource 2.1





Teacher Resource

Lystrosaurus fossils have been found all over the world, from North America to Antarctica and everywhere in between. It is the most prevalent fossil of a land animal from its time period of the late Permian through the early Triassic periods (290-206 million years ago). Paleontologists estimate that 95% of land animals during this time were Lystrosauri! Lystrosaurus also survived the largest extinction event in the history of the world when 70% of land animals and 95% of sea animals went extinct.

Studying the Earth Through Exploration

Student Resource 1.1

What types of data do you need to gather to prove that something is or is not in motion?

How can scientists gather data that is sufficient, relevant, and quantitative to investigate how the Earth changes and moves? What tools do humans use to explore the Earth on a global-scale?

How do we translate data into evidence?

Sufficient

Refers to whether there is enough evidence to address all of the facets of a claim.

Relevant

Appropriate and closely connected to the question or phenomena at hand. Data that is inapplicable or unrelated should not be used as evidence.

Quantitative

Evidence that uses measurement tools and numbers to signify amounts.

Student Resource

Patterns on the Earth

Student Resource 1.2

Find patterns on the Earth's crust by looking for similar features that appear in multiple places throughout the globe. A feature may be on land, near coastal areas, or on the seafloor. When you find a feature that starts to appear again and again, you've noticed a pattern! Record it on the following pages using the following guidelines.

- Describe the patterns via sketches and text. Think about how you would explain the patterns to someone who is not familiar with the Earth.
- Note the longitude and latitude of each instance of this feature so you can refer back to the globe later and point them out to others.
- Locate at least three different patterns or types of features to record.

What do you notice about the ocean areas on this map of Earth that you don't always see on many other maps and globes?

Using Google Maps:

1. Turn on the Satellite Imagery by toggling the icon in the lower left corner of the window.
2. Zoom out by scrolling up with a mouse wheel, two-finger swiping up on a touchpad, or clicking the "-" icon button in the lower right of the window.
3. Zoom should be out far enough that you can see a wide view of land and ocean but not have the atmospheric clouds obscuring your view. Zoom out until the clouds start to appear, and then zoom back in one step.
4. Record Location by clicking any point on the map will produce the longitude and latitude of that location. It appears in a small pop-up at the bottom-center of the window; latitude is listed first and longitude is listed second.

Student Resource

Student Resource 1.2 Patterns on the Earth

Feature Type 1

Found (Circle one)

On Land Near Coast In Oceans

Observation Locations

Longitude	Latitude

Student Resource

Feature Type 2

Found (Circle one)

On Land Near Coast In Oceans

Observation Locations

Longitude	Latitude

Feature Type 3

Found (Circle one)

On Land Near Coast In Oceans

Observation Locations

Longitude	Latitude

Mapping Global Patterns

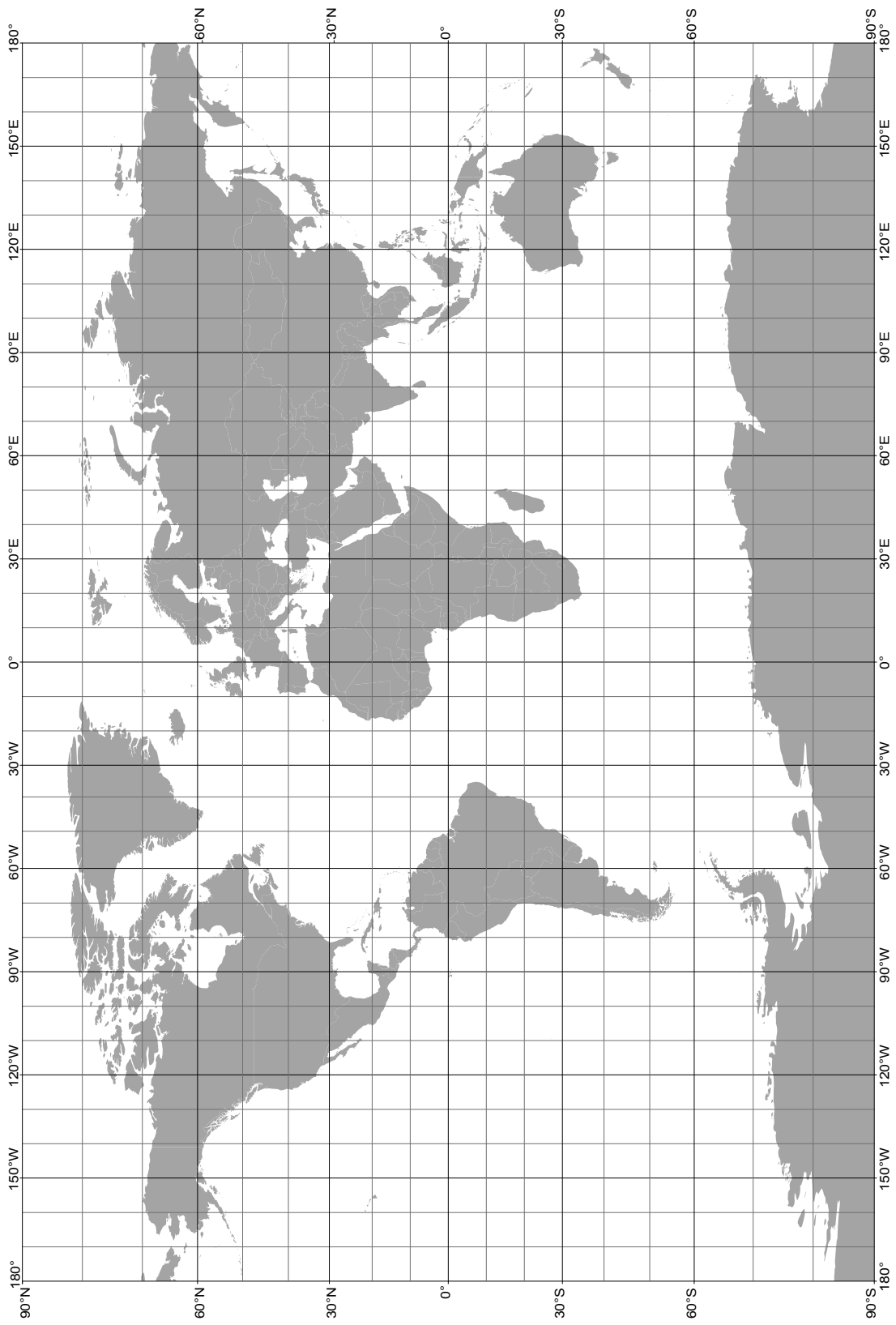
Student Resource 1.3

Did many people notice the same patterns or was there a wide variety of patterns?

What was the most surprising pattern noticed by a classmate that you did not notice?

Student Resource

Title: _____


90°N
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180°

Student Resource

Student Resource 1.4

Continental Shelf - Europe

Continental Shelf - Africa South

Continental Shelf - North America

Continental Shelf - South America

Continental Shelves

At the periphery of the continents there are gently sloping plains that are flooded by ocean water. These are the continental shelves. During some geological periods in the Earth's past these areas were dry land.

Mountain Range - Rockie

Mountain Range - Himalayas

Mountain Ranges - Alps

Mountain Ranges

Mountains are often arranged in lines connected via high altitude ground. Some mountain ranges can be seen from space or in satellite photography.

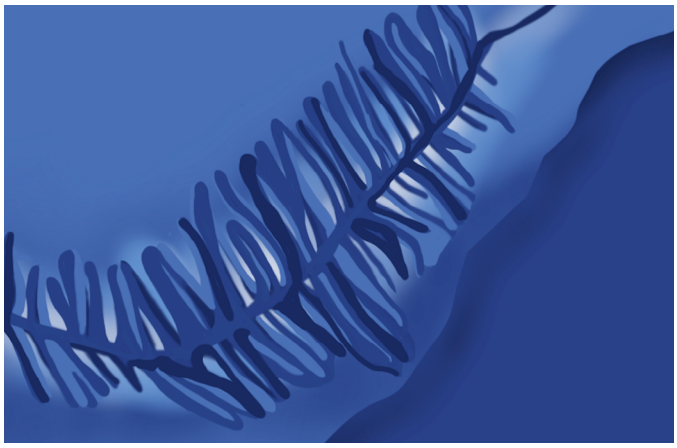
Student Resource 1.4 Patterns of the Earth's Crust

Ocean Trench - Marianas

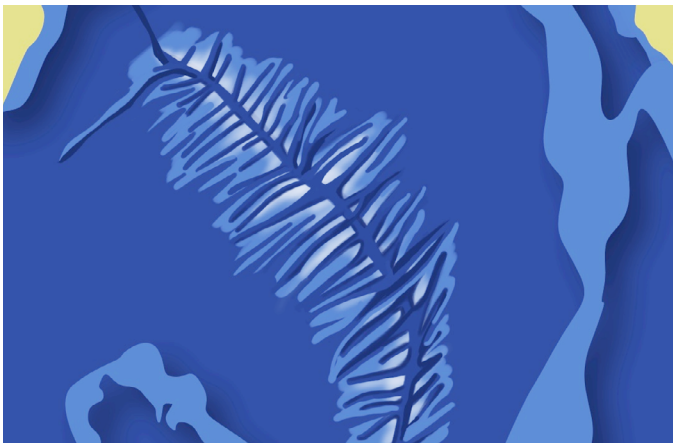
Ocean Trench - Chilean coast

Ocean Trenches

A long, thin deep part of the ocean floor. Many trenches, though not all, run parallel and near to a coastline. The environment at these extreme, deep areas affects the life that inhabits that space, and it also affects humans' ability to explore it. Trenches are also places of consistent seismic activity.



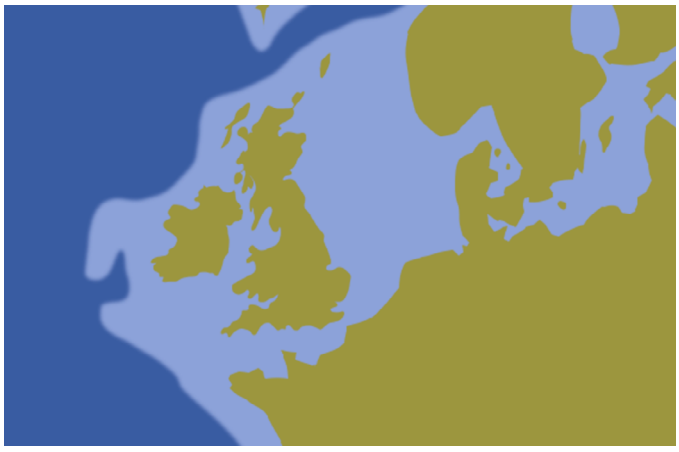
Ocean Ridge



Ocean Ridge

Mid-ocean Ridges

A network of underwater mountain ranges zig-zags across the global system of oceans. The longest of these ranges is in the Atlantic Ocean and is referred to as the Mid-Atlantic Ridge. A major characteristic seen at the ridges is a steep valley right down the center. Scientists have consistently found volcanic and seismic activity occurring in the central valley of the mid-ocean ridges.



Coastlines

Coastlines

Coastlines are a place where the land and a major ocean meet.

Student Resource 1.4 Patterns of the Earth's Crust

Did any of your previous observations align with the features described in the Earth's Crust document? Take a few minutes to revise or add to your descriptions.

Even though Google's Maps of the Earth are based on photographic imagery, it's still a model or a simplification. What aspects of the model helped your understanding of Earth's features?

What feature was most challenging to understand on this model? If you were a map or globe designer, how would you represent this feature differently?

Evaluating Evidence

Student Resource 1.5

Does the dataset we've just explored provide sufficient* evidence for whether or not the crust of the earth is moving? Explain why or why not.

Does the dataset we've just explored provide relevant* evidence for whether or not the crust of the earth is moving? Explain why or why not.

*Refer back to the sidebar titled "How do we translate data into evidence?" to review these terms if needed.

Student Resource

Organisms of the Permian and Triassic Periods

Student Resource 2.1

Glossopteris (glos-SOP-ter-is)

- A plant that was plentiful in the Permian period 298 million to 250 million years before present.
- First part of the name "Gloss" comes from the Greek word for tongue because the of the shape of the leaves.
- Seemed to belong to a general group of ferns that has seeds. Many modern ferns do not have seeds.

Occurrence Record	Latitude	Longitude	Country
1 Fossil Specimen	25.6°S	127.8°E	Australia
2 Fossil Specimen	20.9°S	84.7°E	India
3 Fossil Specimen	10.9°S	44.9°W	Brazil
4 Fossil Specimen	3.6°N	44.6°E	Somalia
5 Fossil Specimen	74.8°S	37.4°E	Antarctica
6 Fossil Specimen	3.5°N	19.3°E	D.R. Congo
7 Fossil Specimen	8.0°S	35.1°W	Brazil
8 Fossil Specimen	6.0°N	43.4°E	Ethiopia
9 Fossil Specimen	6.1°N	32.5°E	Uganda
10 Fossil Specimen	7.3°N	27.3°E	South Sudan
11 Fossil Specimen	21.3°S	76.9°E	India
12 Fossil Specimen	32.4°S	126.2°E	Australia
13 Fossil Specimen	69.5°S	60.5°E	Antarctica

Student Resource

Student Resource 2.1 Organisms of the Permian and Triassic Periods

Procolophon (pro-KOH-loh-fawn)

- A small, plant-eating reptile that was only about one foot long
- Had short, strong limbs probably used either for burrowing or digging for food
- Has a synapsid skull meaning that it has only one opening behind its eye socket, like mammals, rather than two like the archosaurs and dinosaurs
- Name means before the end because they lived prior to the End-Permian extinction (the largest extinction event in Earth's history)

Illustrator: Velizar Simeonovski © 2018 Field Museum

Occurrence Record	Latitude	Longitude	Country
1 Fossil Specimen	85.2°S	0.3°E	Antarctica
2 Fossil Specimen	82.2°S	0.5°W	Antarctica
3 Fossil Specimen	14.8°S	31.6°E	Mozambique
4 Fossil Specimen	12.3°S	22.1°E	Angola
5 Fossil Specimen	75.1°S	7.8°W	Antarctica
6 Fossil Specimen	13.9°S	27.9°E	Zambia
7 Fossil Specimen	9.9°S	15.4°E	Angola
8 Fossil Specimen	13.8°S	54.2°W	Brazil
9 Fossil Specimen	16.6°S	45.1°W	Brazil
10 Fossil Specimen	17.8°S	43.4°W	Brazil
11 Fossil Specimen	78.5°S	0.5°W	Antarctica
12 Fossil Specimen	12.6°S	20.6°E	Angola
13 Fossil Specimen	14.9°S	39.9°W	Brazil

Student Resource 2.1 Organisms of the Permian and Triassic Periods

Prolacerta (pro-la-SER-tah)

- A reptile which shares features of its dinosaur and bird descendants
- One distinction was that its teeth were deeply rooted in its skull rather than easily lost

Illustrator: Velizar Simeonovski © 2018 Field Museum

Occurrence Record	Latitude	Longitude	Country
1 Fossil Specimen	28.3°S	29.1°E	South Africa
2 Fossil Specimen	29.6°S	26.7°E	South Africa
3 Fossil Specimen	81.1°S	102.5°W	Antarctica
4 Fossil Specimen	28.3°S	29.1°E	South Africa
5 Fossil Specimen	30.5°S	26.0°E	South Africa
6 Fossil Specimen	29.0°S	26.3°E	South Africa
7 Fossil Specimen	82.2°S	95.5°W	Antarctica
8 Fossil Specimen	28.3°S	29.1°E	South Africa
9 Fossil Specimen	80.2°S	97.0°W	Antarctica

Student Resource 2.1 Organisms of the Permian and Triassic Periods

Lystrosaurus (lis-stroh-SAWR-us)

- A plant-eating synapsid that lived 270-230 million years ago
- Lystrosaurus was stocky and sturdy like a modern day pig
- Had a large set of lungs which are thought to have helped it survive the End Permian extinction event
- Thought to be good at digging and burrowing

Illustrator: Velizar Simeonovski © 2018 Field Museum

Occurrence Record	Latitude	Longitude	Country
1 Fossil Specimen	7.8°S	38.9°E	Tanzania
2 Fossil Specimen	80.1°S	114.8°E	Antarctica
3 Fossil Specimen	12.3°S	32.0°E	Zambia
4 Fossil Specimen	6.7°S	25.3°E	D.R. Congo
5 Fossil Specimen	8.8°S	35.8°E	Tanzania
6 Fossil Specimen	13.7°N	77.0°E	India
7 Fossil Specimen	75.1°S	14.8°E	Antarctica
8 Fossil Specimen	73.4°S	47.2°E	Antarctica
9 Fossil Specimen	75.6°S	90.2°E	Antarctica

Student Resource 2.1 Organisms of the Permian and Triassic Periods

Thrinaxodon (thrin-AX-uh-don)

- Meat-eating synapsid.
- Lived 250-235 million years ago.
- Grew only to about 18 inches long, making them leaner and smaller than their contemporary, Cynognathus.
- Thought to burrow for shelter and nesting.

Illustrator: Velizar Simeonovski © 2018 Field Museum

Occurrence Record	Latitude	Longitude	Country
1 Fossil Specimen	31.7°S	27.2°E	South Africa
2 Fossil Specimen	31.6°S	26.4°E	South Africa
3 Fossil Specimen	21.1°S	16.5°E	Namibia
4 Fossil Specimen	31.7°S	27.2°E	South Africa
5 Fossil Specimen	31.0°S	26.3°E	South Africa
6 Fossil Specimen	84.3°S	164.1°E	Antarctica
7 Fossil Specimen	34.9°S	68.6°W	Argentina
8 Fossil Specimen	30.9°S	26.1°E	South Africa

Student Resource 2.1 Organisms of the Permian and Triassic Periods

Cynognathus (SIE-nog-NAY-thus)

- A wolf-sized, meat-eating synapsid that lived 250-245 million years ago
- Legs positioned underneath its body, as in mammals, allowed it to moved more quickly than lizards with limbs turning out from the body
- Advanced teeth specialized for tearing and chewing in different parts of its mouth

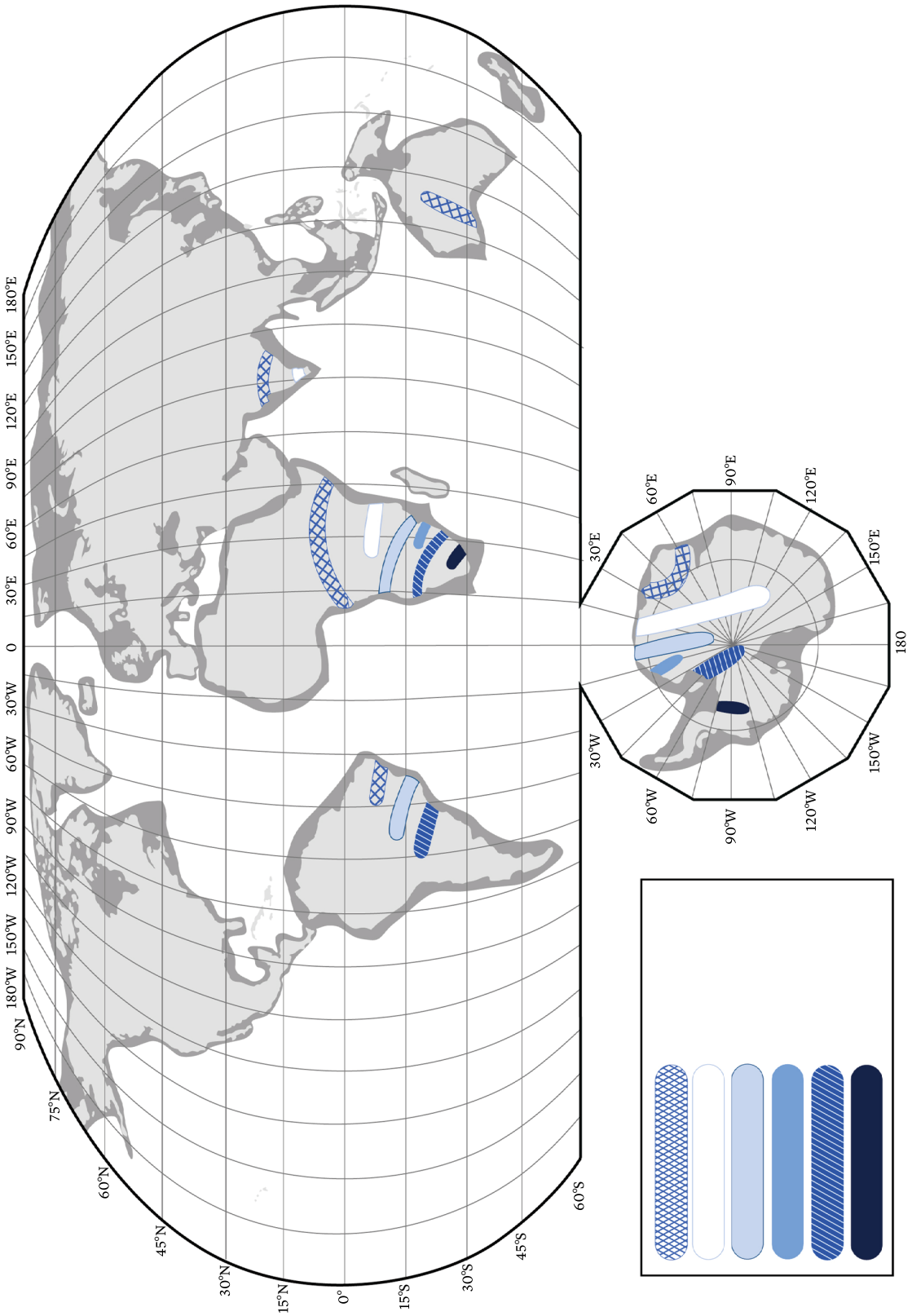
Illustrator: Velizar Simeonovski © 2018 Field Museum

Occurrence Record	Latitude	Longitude	Country
1 Fossil Specimen	84.3°S	71.7°W	Antarctica
2 Fossil Specimen	31.6°S	26.4°E	South Africa
3 Fossil Specimen	21.1°S	16.5°E	Namibia
4 Fossil Specimen	31.7°S	27.2°E	South Africa
5 Fossil Specimen	31.0°S	26.3°E	South Africa
6 Fossil Specimen	84.3°S	164.1°W	Antarctica
7 Fossil Specimen	20.9°S	58.6°W	Paraguay
8 Fossil Specimen	30.9°S	26.1°E	South Africa
9 Fossil Specimen	30.9°S	48.3°W	Brazil
10 Fossil Specimen	21.7°S	52.8°W	Brazil
11 Fossil Specimen	84.3°S	46.5°W	Antarctica

Where Did Pre-historic Organisms Live

Student Resource 2.2

Title: _____



Student Resource

Continental Plate Puzzle

Student Resource 2.3

Why is it that we have found these organisms on across different continents?

What evidence in the datasets or map supports your answer from the previous question?

Use a copy of your organism map to make a claim about what the Earth was like when these organisms were living? You can alter the map in a way that communicates the claim that you want to make about the Earth 250 million years ago. Your teacher will provide you with supplies to help you accomplish your vision.

Student Resource

Claim, Evidence, Reasoning

Student Resource 2.4

Claim: Make a claim about the Earth's crust and its movement.

Evidence: What data did you observe during the previous inquiries that supports this claim?

Reasoning: Using logic to show how the evidence that you have found is related to and supports the claim that you made.

Student Resource

Student Resource 2.4

Do we now have enough data provide sufficient evidence for whether or not the crust of the earth is moving? Explain why or why not.

Has the data that we've explored throughout these inquiries been relevant to whether or not the crust of the earth is moving? Explain why or why not.

What evidence in the datasets or map supports your answer from the previous question?

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