Name: _____ Date: _____

Lesson 3.2: "A Continental Puzzle"

It can be overwhelming to think about the massive changes that have happened on Earth over millions and billions of years. In this lesson, you will read an article about a curious scientist named Alfred Wegener, who thought he was just studying climate but ended up with a lot of evidence about plate motion. Once you have read this article, you will be able to apply this understanding to the *Mesosaurus* fossils and use evidence to better explain how the fossils got so far apart.

Unit Question

- Why are fossils of species that once lived together found in different locations on Earth now?

Chapter 3 Question

- How did the *Mesosaurus* fossils on the South American Plate and African Plate get so far apart?

Key Concepts

- Earth's plates travel at a rate too slow to be experienced by humans.

Vocabulary

- analyze
- claim
- convergent
- cross section
- divergent
- earthquake
- evidence
- mantle
- mid-ocean ridge
- outer layer
- pattern
- plate
- plate boundary
- rate
- trench
- volcanic activity

Digital Tools

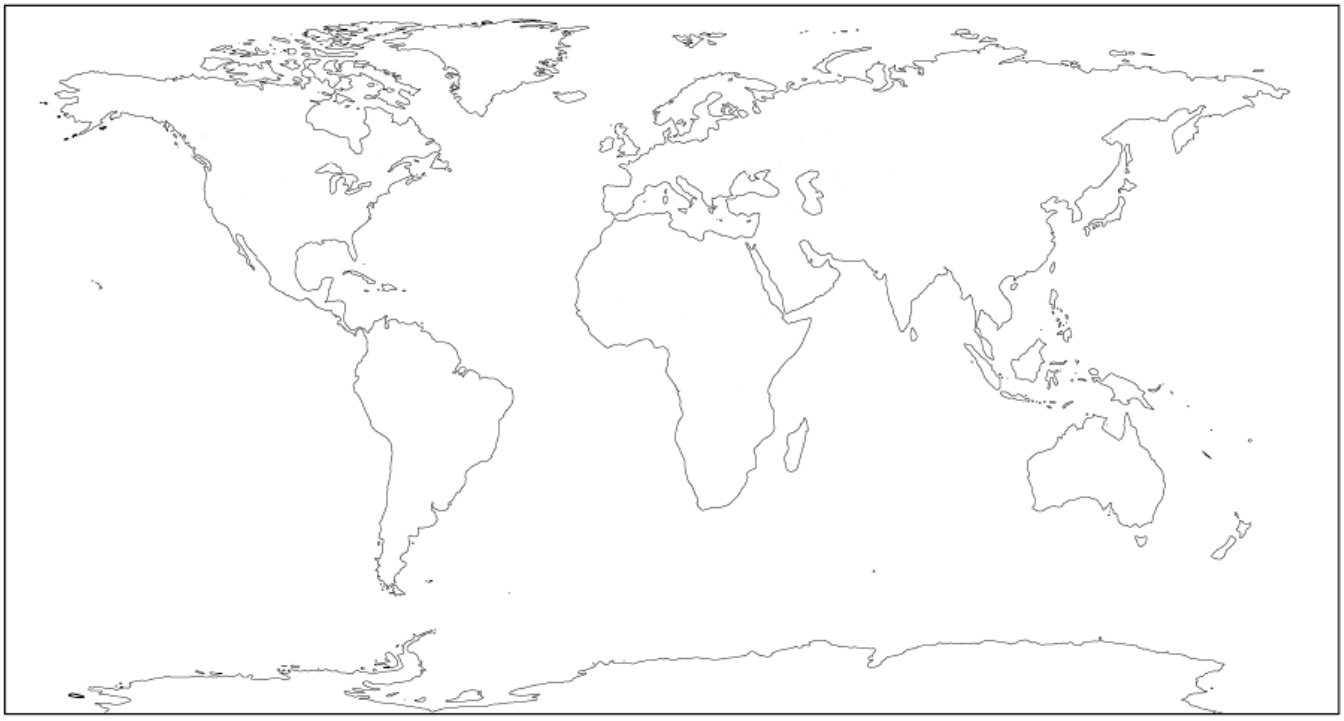
- *Plate Motion* Sorting Tool activity: Earth's History

Name: _____ Date: _____

Warm-Up

Earth's plates are constantly moving. What evidence do scientists use to support this claim?
Hint: You may choose more than one answer.

- ☐ earthquakes
- ☐ volcanic activity
- ☐ GPS measurements
- ☐ They watch the plates move with their eyes.



If Earth's plates are constantly moving, why don't we need to update the locations of continents on world maps (such as the one above) all the time?

_____

_____

_____

_____

Name: _____ Date: _____

The Value of Fossil Evidence

What evidence do we have of past plate motion?

Discuss the following questions with your partner.

1. How can understanding how plates move today help explain how plates moved in the past?
2. How could knowing about past plate motion help explain how the *Mesosaurus* fossils got separated?

Name: _____ Date: _____

Reading "A Continental Puzzle"

1. Read and annotate the article "A Continental Puzzle."
2. Choose and mark annotations to discuss with your partner. Once you have discussed these annotations, mark them as discussed.
3. Now, choose and mark a question or connection, either one you already discussed or a different one you still want to discuss with the class.
4. Answer the reflection question below.

Rate how successful you were at using Active Reading skills by responding to the following statement:

As I read, I paid attention to my own understanding and recorded my thoughts and questions.

- ☐ Never
- ☐ Almost never
- ☐ Sometimes
- ☐ Frequently/often
- ☐ All the time

Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. After you read, discuss what you have read with others to help you better understand the text.

Name: _____ Date: _____

Homework: Understanding Earth's History

Fossils found in rock layers have helped scientists understand the sequence of events in Earth's history, such as when different organisms evolved. The Earth's History Sorting Tool activity shows a few kinds of organisms and the approximate time they were first on Earth. Scientists use the kinds of fossils they find, as well as what kind of rock these fossils are found in, as evidence to help them determine both the relative age of the fossils and the relative age of the rocks around the fossils.

Part 1: Earth's History Sorting Tool

Open the Sorting Tool activity: Earth's History to become familiar with how long ago some of these major events occurred.

Goal: Move the images from the toolbar into the correct locations on the timeline.

After you complete the Sorting Tool, press HAND IN.

Part 2: Reading "Steno and the Shark"

Read the "Steno and the Shark" article to learn about how fossils in rock layers have helped scientists understand Earth's history. Annotate the article as you read and answer the questions below.

1. How can scientists use fossils in rock layers as evidence that one event happened earlier than another event?

_____

_____

_____

_____

_____

2. Look at the events in your Sorting Tool activity and at the Geologic Time Scale diagram from the article. In what period did the first fish appear?

_____

3. Use the Sorting Tool activity to find another event in Earth's history. Name the event and the period or eon in which the event occurred.

Event: _____ Period/Eon: _____

Name: _____ Date: _____

Lesson 3.3: Reconstructing Gondwanaland

In this lesson, you will interpret the evidence scientists use to understand past plate motion. To accomplish this, you will return to the article about Alfred Wegener. After closely rereading part of the article, you will complete an activity that challenges you to think about evidence of past plate motion the way Wegener did.

Unit Question

- Why are fossils of species that once lived together found in different locations on Earth now?

Chapter 3 Question

- How did the *Mesosaurus* fossils on the South American Plate and African Plate get so far apart?

Key Concepts

- Earth's plates travel at a rate too slow to be experienced by humans.

Vocabulary

- analyze
- claim
- convergent
- cross section
- divergent
- earthquake
- evidence
- mantle
- mid-ocean ridge
- outer layer
- pattern
- plate
- plate boundary
- rate
- scientific argument
- trench
- volcanic activity

Digital Tools

- *Plate Motion* Sorting Tool activity: Plate Motion Predictions

Name: _____ Date: _____

Warm-Up

Open the Sorting Tool activity: Plate Motion Predictions and follow the instructions below. You'll be revising this response for homework.

When your model is complete, press HAND IN. If you worked with a partner, write their name here:

_____

Goal: Show where you think South America and Africa will be located 50 years from now and 50 million years from now.

Do:

- Place the continents labeled "50 Years Later" and "50 Million Years Later" to indicate where you think they will be located at those times.

Tip:

- The gray continents shown on the map indicate the current locations of South America and Africa.

Name: _____ Date: _____

Rereading "A Continental Puzzle"

By rereading a portion of the article "A Continental Puzzle," you will be able to answer the Investigation Question: *What evidence do we have of past plate motion?*

Read and annotate the first three paragraphs in the "Evidence of Change on Earth's Surface" section. Highlight or annotate any important information you find and then answer the questions below.

How did Wegener use the shapes of the continents as evidence that the continents had moved?

_____

_____

_____

How did Wegener use the similar mountain ranges and areas made of certain types of rock found in Africa and South America as evidence that these two continents were once connected?

_____

_____

_____

How did Wegener use fossils as evidence that continents had moved?

_____

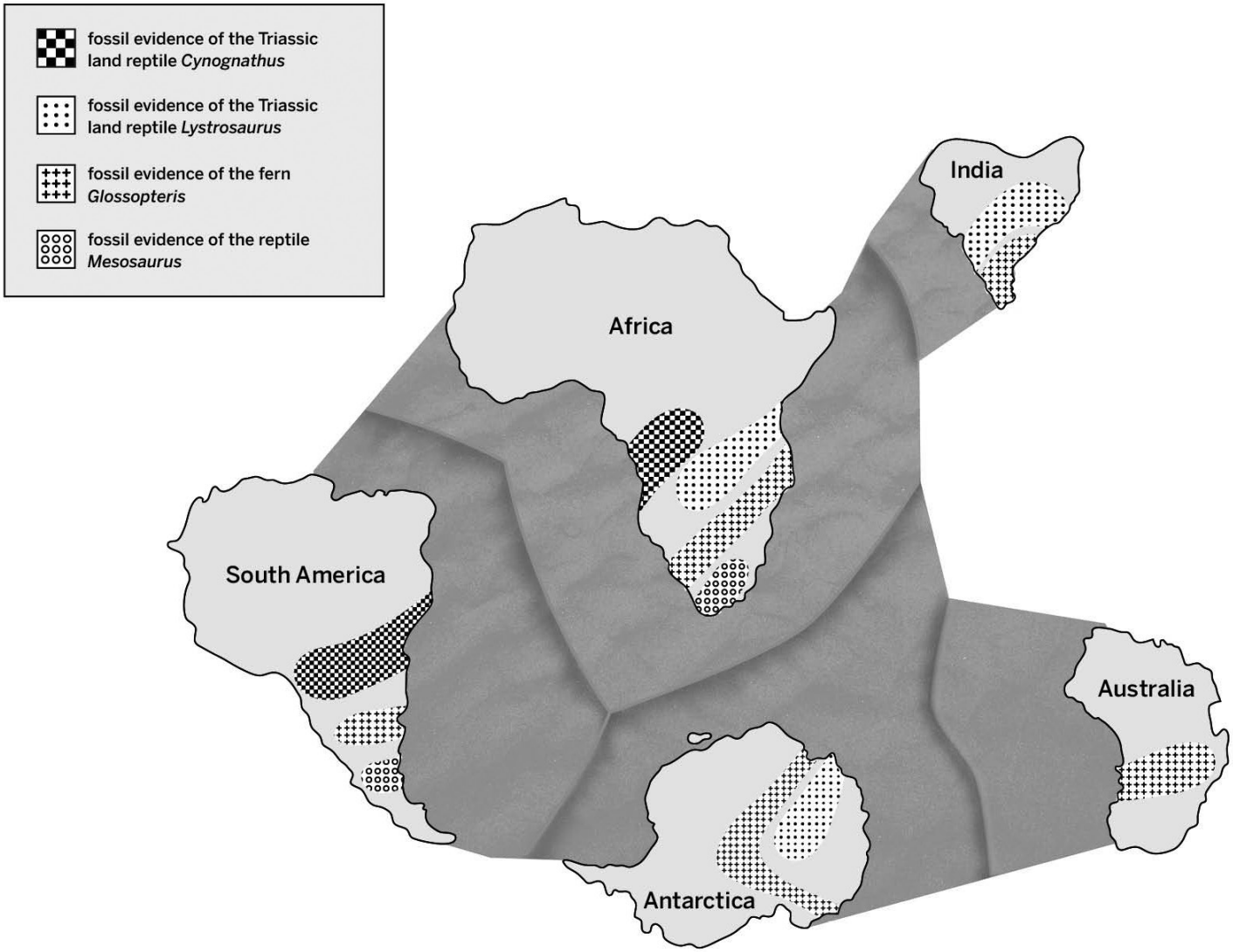
_____

_____

Name: _____ Date: _____

Reconstructing Gondwanaland

Part 1: Map of Gondwanaland Today



Discussion Questions

- If you were to go back in time, to 200 million years ago, what do you think the location of these landmasses would be?
- Would there be more ocean floor between the continents or less? Why?

Name: _____ Date: _____

Reconstructing Gondwanaland (continued)

Part 2: Reconstructing Gondwanaland

Instructions

1. Gather the map, a glue stick, and a blank sheet of paper.
2. Cut away and discard the white space on your map.
3. Cut the plates apart along the plate boundaries. These boundaries are found in the middle of the oceans.
4. Cut away the ocean floor. This hard, solid rock formed between the landmasses over the last 200 million years.
5. Use the fossil evidence and the shapes of the landmasses to reconstruct Gondwanaland as it was 200 million years ago.
6. Glue your Gondwanaland to the blank sheet of paper.

Discussion Questions

- Why did you cut away the hard, solid rock on the ocean floor that formed between the landmasses over the last 200 million years?
- After cutting away the hard, solid rock that makes up the ocean floor, what was your strategy for putting the landmasses of Gondwanaland back together, as they were 200 million years ago?
- How did your knowledge of plate motion help you complete the Gondwanaland puzzle?

Name: _____ Date: _____

Homework: Revising Your Predictions

Open the Sorting Tool activity: Plate Motion Predictions and revise your response, if needed.

When your model is complete, press HAND IN. If you worked with a partner, write their name here:

_____

Goal: Show where you think South America and Africa will be located 50 years from now and 50 million years from now.

Do:

- Place the continents labeled "50 Years Later" and "50 Million Years Later" to indicate where you think they will be located at those times.

Tip:

- The gray continents shown on the map indicate the current locations of South America and Africa.

How is your revised response different from your Warm-Up response? Why did you make these changes?

_____

_____

_____

Alfred Wegener argued that the continents had changed their positions on Earth, but his claim wasn't accepted by other scientists until many years later.

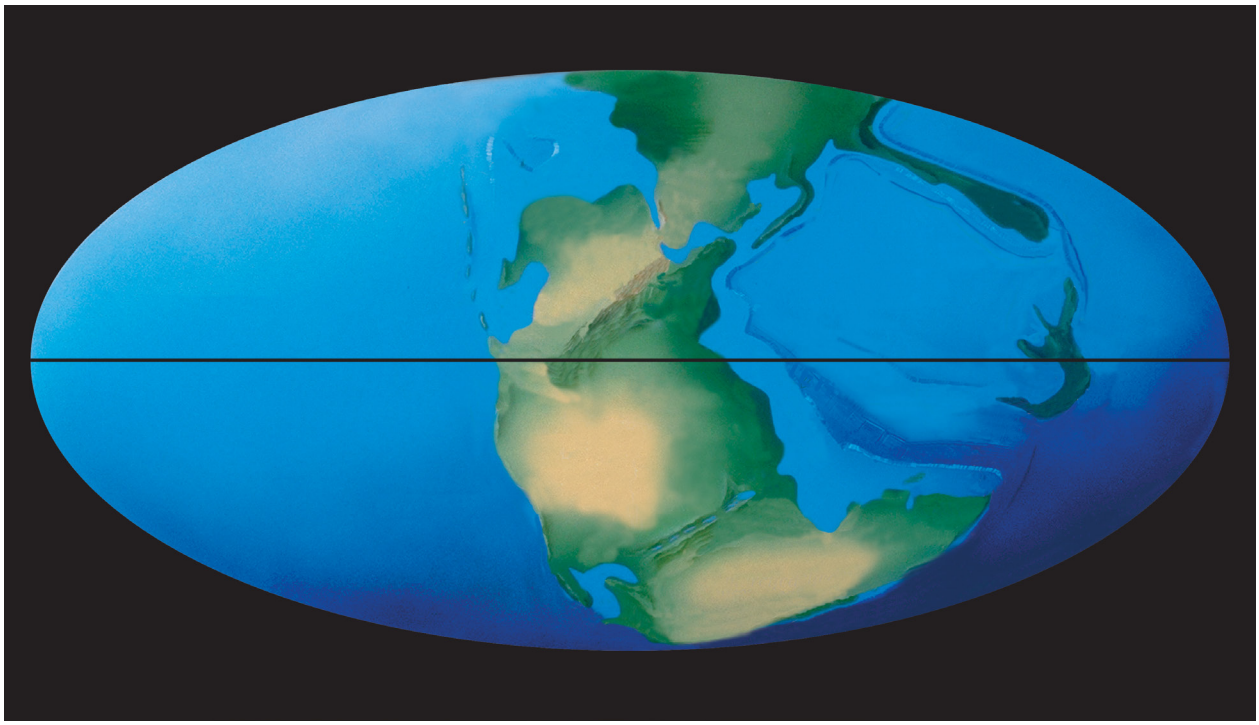
A Continental Puzzle

For scientists, making big discoveries and sharing them with the public can be a big deal. Often, their discoveries come after years of hard work, and they finally get to see the results of what they've done. In some cases, their work is welcomed by other scientists, and can even make them celebrities! However, this is not what happened to Alfred Wegener (1880–1930). Wegener (VAY-geh-ner) was the German scientist who first argued that continents on the Earth's surface had moved over long periods of time. During Wegener's lifetime, other scientists thought his claim was too strange to be true. They also said that Wegener did not have convincing evidence to support his ideas. At the time, many scientists mocked Wegener's claims. It wasn't until many years after his death that other scientists came to accept his argument.

In 1915, Wegener shocked other scientists when he made the claim that the continents haven't always been where they are today. He argued that the continents had all been together in one large supercontinent, which he named Pangea. Wegener said the continents have since traveled thousands of miles to their current locations, and will continue to travel thousands more. He concluded that these movements happen very slowly—but they add up over hundreds of millions of years. Scientists later accepted Wegener's claim as accurate and gathered additional evidence to support and build on his ideas. However, at the time, his argument was not well received at all!

Evidence of Change on Earth's Surface

How did Wegener come up with the claim that the continents were once together, but have moved over time? Since humans didn't exist hundreds of millions of years ago, there's no written record of what conditions

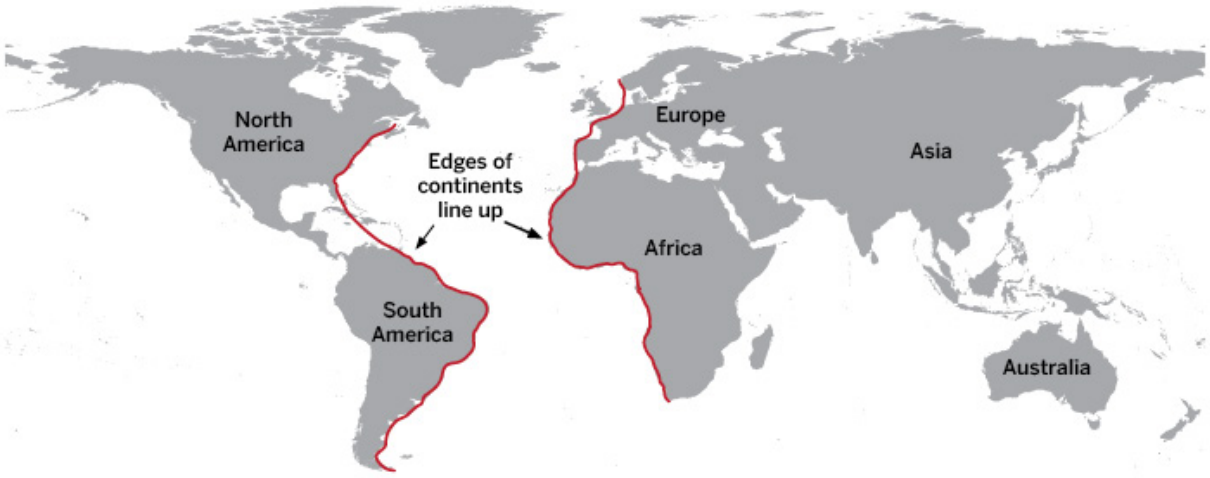


Alfred Wegener argued that the continents had once been joined together in a supercontinent called Pangea. This map shows how Pangea may have looked hundreds of millions of years ago.

on Earth might have been like. To support his claim, Wegener turned to evidence from Earth itself, just as scientists do today. Wegener was interested in what Earth's climate was like before humans existed. His study of ancient climate led him to think about how the continents might have been arranged millions of years in the past.

One type of evidence Wegener considered as he developed his ideas was the shapes of the continents and the landforms that appeared on them. He noticed that the edges of the continents matched, as if they had once fit together like puzzle pieces. Wegener wasn't the first to notice how similar the edges of the continents were, but he was the first to publicly argue that the way they appeared to fit together was evidence that they had once been connected. At the same time, he found that some identical landforms could be found on more than one continent. For instance, mountain ranges and areas made of certain types of rock that were found on the continent of South America could also be found on the continent of Africa. When scientists compared these similar mountain ranges and rocks on the two separate continents, they matched. Not only that: when people placed the matching rocks and mountains together, they appeared to fit perfectly, like two puzzle pieces.

Another source of evidence Wegener used to support his claim—and a type of evidence still used by scientists today—was the study of similar fossils found on different continents. Fossils are the remains and impressions of living things preserved in rock. They can tell us about life on Earth millions or even billions of years ago. By studying fossils and where they're found, scientists can tell when the organisms that formed the fossils lived and what conditions were like at the time. The oldest fossils on Earth are found in the hard, solid rock on land, because the plate material that makes up land is older than plate material that makes up the



Wegener noticed that the edges of some continents seem to match up like puzzle pieces.

ocean floor. The plate material that makes up the ocean floor is much younger because the plates of the ocean floor are always being destroyed at convergent boundaries, while new plate material is being created at divergent boundaries. In fact, the oldest plate material on the ocean floor is only 180 million years old! That may sound like it's been around for a long time, but plate material on land can be much older: up to four billion years old! Fossils are an important source of evidence as scientists support ideas about where the continents were located hundreds of millions of years ago.

In Wegener's case, he noticed that the same types of fossils were sometimes found in very different parts of the world. The fossils were sometimes thousands of miles apart or in places where the organism that formed the fossil wouldn't be able to survive. For example, Wegener studied fossils of tropical plants that had been found in Antarctica, where the cold climate would have killed the warm-weather plants. This evidence led Wegener to the claim that the entire continent where the fossils were found had once been located somewhere warmer. He concluded it had traveled to its current position over millions of years.

Fossils, like these trilobites, are one source of evidence that is still used today as scientists support ideas about Earth's history.

Wegener's Legacy

Wegener found evidence that the Earth's continents had moved apart over time, but he didn't explain how that motion happened—that's one important reason why the scientific community didn't accept his claims. Over the years other scientists collected additional evidence and made hypotheses, or claims, about how the continents moved apart. The evidence didn't support all of the claims,

but those claims that were supported by the evidence became part of the accepted explanation. The work of many scientists, including Wegener, and a lot of evidence led to what we now call the "theory of plate tectonics." Scientific theories are explanations for an observable phenomenon that have a lot of evidence gathered over time. Although he didn't get credit for his research during his lifetime, Wegener is now famous for his contribution to the theory of plate tectonics.