

Drill Cores Across Ridge R: Age, Distance and a Spreading Rate

Learning target: I can graph seafloor age against distance from a ridge, compute a spreading rate with correct units, and use the pattern as evidence that new seafloor forms at the ridge and moves outward.

Data and graphing

About 45 min

Individual

MS-ESS2-3 · assesses

MS-ESS2-2 · supports

data analysis

independent practice

Name

Date

Period

Directions

Part A uses a teaching dataset. The numbers were invented to look like real drill-core results, so they are labeled simulated; the pattern they show is the real one. Part B uses real, rounded reference rates. Graph with a ruler, write units on every number, and show every step of every calculation. Where a question asks you to explain, write in full sentences.

You will need: This worksheet, Pencil, Ruler, Calculator

Part A: Ten drill sites across one ridge

A research ship drilled ten holes in a straight line across a mid-ocean ridge we will call Ridge R. At each site the crew measured the site's distance from the ridge crest and the age of the oldest sediment lying directly on the volcanic rock, which tells how long ago that piece of seafloor formed. Five sites were west of the ridge and five were east. 'Ma' means millions of years ago.

Seafloor age at ten drill sites across Ridge R (teaching dataset)

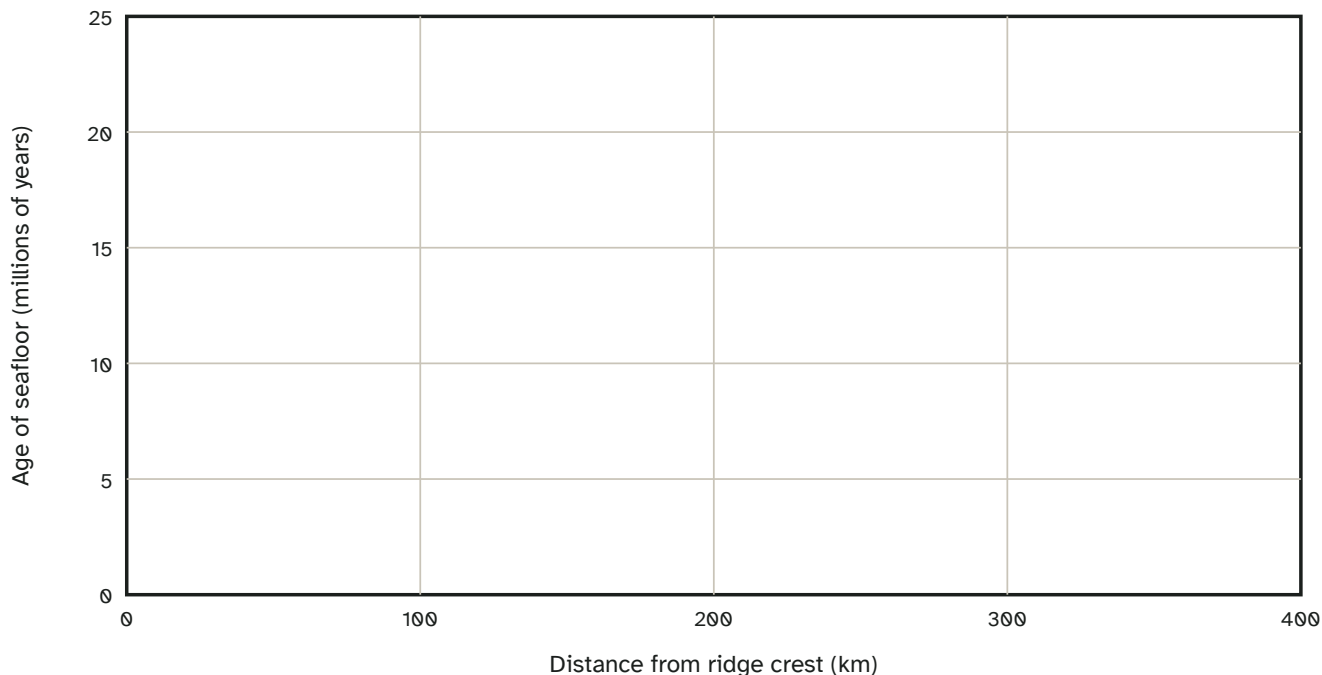
Simulated teaching dataset: the numbers are invented to be realistic, not measured.

Site	Side of ridge	Distance from ridge crest (km)	Age of seafloor (Ma)
W5	west	400	19.9
W4	west	300	15.2
W3	west	200	9.8
W2	west	100	5.1
W1	west	40	2.0
E1	east	40	1.9
E2	east	100	4.9
E3	east	200	10.1

Site	Side of ridge	Distance from ridge crest (km)	Age of seafloor (Ma)
E4	east	300	14.9
E5	east	400	20.2

Simulated data for teaching. The pattern matches what real drilling across the South Atlantic ridge found in 1968-69; the numbers themselves are invented.

Seafloor age versus distance from Ridge R



1. Describe the pattern in the table and on your graph in two sentences: one about how age changes with distance, and one comparing the west side with the east side.

2. Use site E5 to calculate how fast the seafloor on the east side has moved away from the ridge, in kilometers per million years. Show the division. Then check your answer with site W4 and say whether the two sides agree.

3. Convert your rate from q2 (round it to the nearest whole number of km per million years) into **centimeters per year**. Show every step. (1 km = 100,000 cm; 1 million years = 1,000,000 years.)

4. The ship could not reach a site 600 km east of the ridge. Use your rate to predict the age of the seafloor there. Show the calculation.

5. The rate you found is for **one** side of the ridge. The whole ocean widens by the motion of both sides together. Calculate the full spreading rate in cm per year, then use it to find how much wider this ocean becomes in 50 million years. Give that answer in kilometers and show the conversion.

6. Suppose seafloor spreading were **not** happening and the whole ocean floor had formed at one time long ago. Describe what the table and graph would look like in that case. Then explain why the actual data rule that idea out.

7. Explain why the **matching** ages on the two sides (for example W3 and E3) are important evidence that new seafloor forms at the ridge crest and moves outward in both directions. What would it mean if the east side were consistently twice as old as the west side at the same distance?

Part B: Comparing with real ridges

Real ridges spread at different speeds. The table gives rounded, approximate full spreading rates (both sides together) for four real ridges. Use it with your results from Part A.

Approximate full spreading rates of real mid-ocean ridges (rounded reference values)

Ridge	Ocean	Full spreading rate, both sides together (cm per year)
Gakkel Ridge	Arctic	about 1
Mid-Atlantic Ridge	Atlantic	about 2.5 to 4
Juan de Fuca Ridge	Pacific, off Oregon and Washington	about 6
East Pacific Rise	Pacific	about 6 to 15, fastest in the south

8. Which real ridge in the table spreads at a rate closest to Ridge R's full rate from q5? Explain how you decided.
- _____
- _____
- _____
9. The fastest part of the East Pacific Rise spreads at about 15 cm per year (full rate). If a drilling ship surveyed that ridge the way it surveyed Ridge R, what age would it find at a site 400 km from the crest? Show your work, and compare the answer with site E5. (Hint: first find the one-side rate.)
- _____
- _____
- _____
- _____
10. The oldest seafloor anywhere in the open oceans is less than about 200 million years old, while some continental rocks are about 4,000 million years old. Using what the Ridge R data show about how seafloor forms and moves, explain why the ocean floor is so much younger than the continents, and name the process and the structure that make seafloor disappear.
- _____
- _____
- _____
- _____
- _____
- _____

Rate in three lines

A rate is a distance divided by a time. Line 1: write the distance with its unit (for example, 400 km). Line 2: write the time with its unit (for example, 20.2 million years). Line 3: divide and write the unit as 'km per million years.' To change km per million years into cm per year, change the top and the bottom separately: multiply the kilometers by 100,000 to get centimeters, then divide by 1,000,000 years. Write each step on its own line so you can find a slip.

When did Ridge R's ocean open?

Suppose the ocean that contains Ridge R is 3,000 km wide from one continental shelf to the other, with the ridge in the middle. Use the one-side rate from Part A to estimate how long ago the ocean began to open, and show your reasoning. Then explain two reasons your estimate could be wrong: one about the assumption that the rate never changed, and one about where the oldest seafloor in an Atlantic-type ocean actually lies. Finally, look up the age when the South Atlantic began to open and compare it with your estimate.