Clues in Stone

Use rock evidence to explain a sequence of changes.

ESS.4.c "Construct an explanation using evidence from experiments, models, or data of the processes that create and transform igneous, sedimentary, and metamorphic rocks."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline observations about each rock, then circle the processes those observations support. Draw a line from each underlined clue to the process it helps explain.

A Roadcut Through Rock History

1. At a mountain roadcut, pale granite contains large, interlocking crystals of quartz, feldspar, and mica. These crystals are evidence that molten rock cooled slowly beneath Earth's surface: minerals had time to grow before the melt hardened. If the same melt cooled quickly at the surface, its crystals would usually be smaller. Granite exposed today was not always at the surface. Over millions of years, erosion removed rock that once covered it. The roadcut exposes a record of both its igneous origin and later change in location. A rock's present setting does not always show where it formed.

2. Downhill, a sandstone layer holds separate, sand-sized quartz grains. Some grains have rounded edges, and the layer contains thin bands deposited one above another. Quartz can survive when granite breaks apart during weathering. Flowing water can carry these loose grains, wear down their edges, and deposit them where the current slows. As more sediment piles up, its weight compacts the lower layers, while minerals carried by water cement the grains together. The rounded grains and bands support an explanation for transport and deposition; grains joined by cement support an explanation for sandstone becoming solid rock. Not every grain must come from the granite uphill.

3. Farther along the roadcut, quartzite contains tightly joined quartz crystals rather than loose grains held by cement. Geologists also find a boundary where sandstone grades into quartzite near rocks that were heated and squeezed during mountain building. Heat and pressure can cause the quartz grains in buried sandstone to recrystallize without the whole rock melting. This process produces a metamorphic rock. The change from separate grains to interlocking crystals, together with the boundary, supports that explanation. If quartzite later melted, the resulting magma could cool into a new igneous rock, but the observed quartzite does not show that melting happened here.

2 ANSWER WITH EVIDENCE

Use the passage

1. How do the granite's crystals support an explanation for how it formed?

2. Use two observations about the sandstone to explain how its grains were transported and deposited.

3. What evidence supports the explanation that sandstone changed into quartzite without melting?

4. Explain one possible path from the granite to the quartzite. What part of that path cannot be confirmed from the observations?

3 YOUR TURN

Your own words

At a different site, scientists find a dark rock with tiny crystals, a layered rock containing rounded pebbles of that dark rock, and a deeper rock containing stretched pebbles of the same material. Write three or four sentences explaining a possible sequence that formed and transformed these rocks. Use at least one observation as evidence for each stage.

ANSWER KEY

Clues in Stone

PART 1 · READ AND MARK

Underline observations about each rock, then circle the processes those observations support. Draw a line from each underlined clue to the process it helps explain. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How do the granite's crystals support an explanation for how it formed?	**Its large, interlocking crystals indicate that molten rock cooled slowly beneath Earth's surface, giving minerals time to grow.**
2	Use two observations about the sandstone to explain how its grains were transported and deposited.	**Rounded edges suggest that moving water carried and wore down the grains. Thin bands suggest that the grains settled in successive deposits.**
3	What evidence supports the explanation that sandstone changed into quartzite without melting?	**Sandstone grades into quartzite near rocks heated and squeezed during mountain building. Quartzite's tightly joined crystals are consistent with grains recrystallizing under heat and pressure.**
4	Explain one possible path from the granite to the quartzite. What part of that path cannot be confirmed from the observations?	**Granite could weather into quartz grains that water deposits as sand. Compaction and cementation could form sandstone, which could recrystallize into quartzite under heat and pressure. The observations do not confirm that the sandstone's grains came from the granite uphill.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The dark rock's tiny crystals suggest that lava cooled quickly to form an igneous rock. Pieces of it were carried and worn into rounded pebbles, then deposited in layers that became sedimentary rock. Deeper burial exposed that rock to heat and pressure, stretching its pebbles as it became metamorphic rock without melting.

Accept other plausible sequences that connect each observed feature to a process. Students should distinguish evidence for a possible history from proof that every rock at the site came from the same original material.