Breaking up is hard to do: Africa may eventually split into two continents

By Doyle Rice, USA Today, adapted by Newsela staff on 05.03.18

Word Count **464**

Level **MAX**

Image 1. Vehicles drive next to a deep split on a repaired road that had been washed away during a heavy downpour at Maai-Mahiu, Kenya, on March 15, 2018. Photo by: Tony Karumba, AFP/Getty Images

Africa is breaking up. It isn't happening soon though. It will take tens of millions of years. But, the continent may eventually split into two parts.

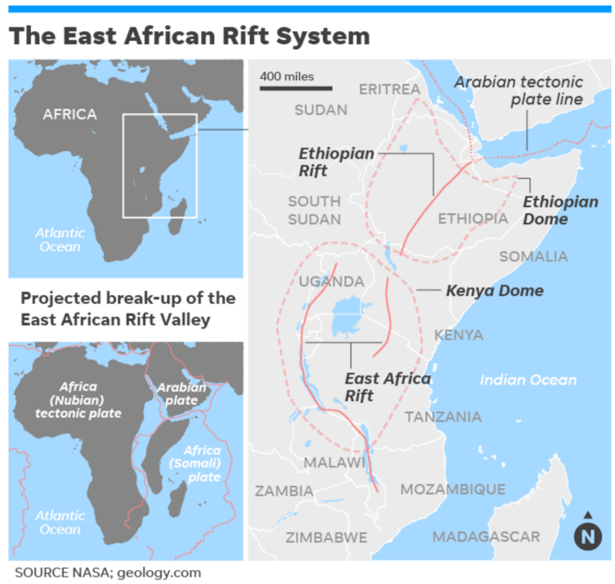
Geologists have known about this possibility for a while. It became news recently. A large crack stretching several miles in length made a sudden appearance in southwestern Kenya following heavy rain.

The tear continues to grow. It collapsed part of a highway. Lucia Perez Diaz is a postdoctoral researcher on tectonic plates. She works at the Royal Holloway, University of London. The crack "was accompanied by seismic activity in the area," said Lucia Perez Diaz.

The crack is located in a region known as the East African Rift Valley. It measures more than 50 feet in depth and 65 feet across, according to National Geographic. A rift valley refers to a lowland region. This is where tectonic plates rift, or move apart.

Stretching from the Gulf of Aden in northern Africa down to the country of Zimbabwe in the south, the East African Rift Valley is over 1,800 miles long. The rift splits the plate into two unequal parts. There is the smaller Somali plate and the much larger Nubian plate, Perez Diaz noted.

Eventually, the rift should expand and break Africa into two continents. The smaller continent will include the present-day eastern Africa countries of Somalia and parts of Kenya, Ethiopia and Tanzania. The bigger one will include the rest of Africa



"A rift like this once eventually separated the African and South American continents to form the Atlantic Ocean, and the rift in east Africa may be the very early stages of this," said Christy Till. She is a geologist at Arizona State University. "The process just occurs very slowly and takes millions of years."

In the United States, the southwest is sliced by the Rio Grande Rift Valley, which stretches from Chihuahua, Mexico, to Colorado, according to National Geographic. Its formation, roughly 30 million years ago, is responsible for the Rio Grande River bordering the southern United States.

Rifting can be dramatic at times, causing "sudden motorway-splitting faults or large catastrophic earthquakes that may give continental rifting a sense of urgency," says Perez Diaz. But most of the time, "it goes about splitting Africa without anybody even noticing."

Quiz

1 The sentence below helps prove the claim that the rifting process is usually a gradual process.

> *"The process just occurs very slowly and takes millions of years."*

Which sentence from the section provides further support for the claim?

(A) A large crack stretching several miles in length made a sudden appearance in southwestern Kenya following heavy rain.

(B) It measures more than 50 feet in depth and 65 feet across, according to National Geographic.

(C) Its formation, roughly 30 million years ago, is responsible for the Rio Grande River bordering the southern United States.

(D) But most of the time, "it goes about splitting Africa without anybody even noticing."

2 Which sentence in the article supports the conclusion that rifts can occur quickly and without warning?

(A) Stretching from the Gulf of Aden in northern Africa down to the country of Zimbabwe in the south, the East African Rift Valley is over 1,800 miles long.

(B) "A rift like this once eventually separated the African and South American continents to form the Atlantic Ocean, and the rift in east Africa may be the very early stages of this," said Christy Till.

(C) In the United States, the southwest is sliced by the Rio Grande Rift Valley, which stretches from Chihuahua, Mexico, to Colorado, according to National Geographic.

(D) Rifting can be dramatic at times, causing "sudden motorway-splitting faults or large catastrophic earthquakes that may give continental rifting a sense of urgency," says Perez Diaz.

3 What is MOST likely the reason the author included the information about the rift between South America and Africa?

(A) to describe one of the worst earthquakes that Earth has ever seen

(B) to highlight the idea that rifts can have enormous long-term consequences

(C) to explain why so many people were confused about how quickly the rift formed

(D) to teach readers more about South America and why it is similar to Africa

4 Read the selection below.

> *Eventually, the rift should expand and break Africa into two continents. The smaller continent will include the present-day eastern Africa countries of Somalia and parts of Kenya, Ethiopia and Tanzania. The bigger one will include the rest of Africa.*

Why did the author include this selection?

(A) to demonstrate that the rift is breaking apart more swiftly than geologists predicted

(B) to describe how dangerous the rift in Africa is for the people who live near it

(C) to elaborate on what will eventually happen to Africa as a result of the growing rift

(D) to explain that the rift in Africa will create two different continents in the near future

Scientists closing in on the dawn of plate tectonics

By Shannon Hall, Scientific American on 09.28.17
Word Count **739**
Level **MAX**

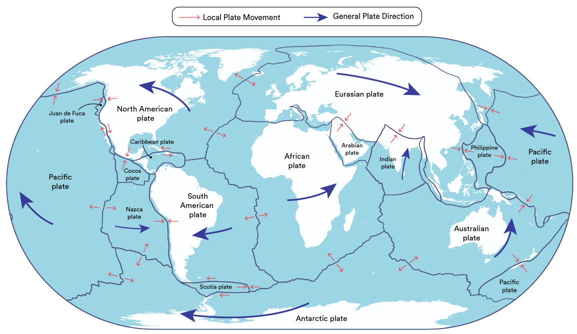
Scientists now think early Earth contained light-colored rocks, like the granite within Yosemite's Half Dome. Such rocks likely formed via plate tectonics. Photo from Wikimedia.

Geologists think early Earth may have looked much like Iceland—where jet-black lava fields extend as far as the eye can see, inky mountainsides rise steeply above the clouds and stark black-sand beaches outline the land.

But over time the world gradually became less bleak. Today, Earth also harbors light-colored rocks, like the granite that composes Half Dome in Yosemite National Park. But scientists remain uncertain as to when the world started to transition from the one that looked like Iceland to that which we know today.

A new study published Thursday in Science suggests the shift transpired more than 3.5 billion years ago. Not only does the finding tell scientists the color of the world's early beaches, it might help them understand when tectonic plates—the interlocking slabs of crust that fit together like puzzle pieces far beneath our feet—started to wake up and shuffle around. That is because the lighter-colored rocks, known as felsic rocks, are actually dark, or mafic, rocks "reincarnated." In short, felsic rocks form when mafic ones are pushed deep inside Earth—possibly when one tectonic plate slips under another in a process called subduction. Given that light-colored felsic rocks were abundant billions of years ago, plate tectonics had likely already kicked into action.

In order to reach that conclusion, Nicolas Greber, a geologist at the University of Chicago, and his colleagues analyzed 78 different layers of sediment to pin down the ratio of felsic to mafic rocks. This was not as simple as counting light versus dark stones (both had long ago eroded into tiny particles). Instead, Greber's team looked at titanium. Although the metallic element is present in both types of rock, the proportion of its isotopes (chemically identical atoms with the same number of protons but a different number of neutrons) shifts as the rock changes from mafic to felsic. Suppose you mix something that turns out both salty and sweet, Greber says. An analysis like this gives you "an idea of how much salt you added and how much sugar you added." He had expected the earliest sediments in his sample, which date back 3.5 billion years, would be composed mostly of mafic particles. But to his surprise, roughly half of the particles locked within were felsic.



Assuming those rocks formed within subduction zones, that means tectonic plates were already on the go by that time—a conclusion that just might help solve an age-old mystery: the birth date of plate tectonics. Scientists have long argued over the precise date these crustal plates started to rouse from their slumber, with estimates ranging from 1 billion to 4.2 billion years ago. That range is far too large if scientists want to understand the evolution of early Earth. Shifting plates have the ability to dramatically reshape the planet by sculpting ocean basins and thrusting up mountain ranges. They also alter the composition of the atmosphere and oceans. This would have affected the supply of nutrients available to the fledgling life on our young planet.

With such a vast time range involved, it is easy to see why scientists cannot agree on a firm date. Paul Tackley, a geophysicist at the Swiss Federal Institute of Technology, disagrees with the latest interpretation. He contends felsic rocks can form anytime mafic rocks sink deep within Earth—and not only along subduction zones. In fact, he argues this process can occur on a motionless plate. Should a volcano erupt, for example, the newly released lava will push down on mafic rocks until they become so deeply buried that they melt under the high subterranean pressures and temperatures, transforming into felsic rocks.

Although Greber agrees felsic rocks can certainly form like this, he argues such a high felsic ratio cannot be explained by Tackley's rock-sinking explanation alone. Take Iceland, for example—because the island is far from any subduction zones high numbers of light-colored rocks simply do not form—hence the island's endless black lava fields and black-sand beaches. So Greber argues the high ratios of light-colored rocks discovered in his old sediments can only mean plate tectonics began early in our planet's history. But 3.5 billion years is just a lower limit. In the future he hopes to find even older rocks, allowing him to pinpoint an exact birth date.

Quiz

1 The author uses a neutral tone in the article.

How does this tone help the author to achieve her purpose in writing?

(A) by allowing the facts of Greber's conclusions to be evident to the reader

(B) by presenting the findings as a possibility but not a definitive conclusion

(C) by suggesting doubts about the reliability of using rocks to date plate tectonics

(D) by giving equal space for both sides of the argument to defend their work

2 Read the sentence from the third paragraph of the article.

> *That is because the lighter-colored rocks, known as felsic rocks, are actually dark, or mafic, rocks "reincarnated."*

What is the meaning of the word "reincarnated" as it is used above?

(A) reborn after being destroyed

(B) altered by movements in the Earth

(C) changed only in outward appearance

(D) made again by adding new particles

3 What are the reasons why Greber believes he is close to dating the birth of plate tectonics?

1. *The color of Earth's early beaches was characterized by felsic particles.*
2. *Titanium isotopes in sediment show a large proportion of felsic particles.*
3. *Felsic rocks are more likely to be formed along subduction zones.*
4. *Felsic rocks can form any time mafic rocks sink deep within the Earth.*

(A) 1 and 3

(B) 1 and 4

(C) 2 and 3

(D) 2 and 4

4 Which of the following ideas did the author develop LEAST in this article about the dawn of plate tectonics?

(A) the reasons why scientists disagree on interpretations of the date

(B) the relationship between mafic and felsic rock sediments

(C) the role of subduction zones in forming mafic and felsic rocks

(D) the alterations to Earth caused by the birth of plate tectonics

Runaway sprinkles from Museum of Ice Cream create "environmental hazard"

By Brigit Katz, Smithsonian.com on 02.05.18
Word Count **495**
Level **MAX**

Visitors play in a large pool filled with faux confetti-colored sprinkles at the Museum of Ice Cream on July 29, 2016, in New York City. The temporary museum dedicated to all things ice cream is now open in Miami, Florida, where officials are worried that the museum's fake sprinkles will get washed into oceans and eaten by marine creatures. Photo by: Kena Betancur/Getty Images

One of the main attractions of the Museum of Ice Cream, a pop-up that has been touring the country and taking over your Instagram feed, is a giant pool filled with fake sprinkles, where visitors can frolic and temporarily forget that they are adults with responsibilities. But in Miami Beach, where the Museum of Ice Cream is currently stationed, runaway sprinkles have prompted city officials to slap the museum with a $1,000 fine for creating an “environmental hazard,” according to Brittany Shammas of the Miami New Times.

As it turns out, fake sprinkles are like glitter: They get everywhere. After the Museum of Ice Cream opened in Miami Beach last month, local environmentalist Dave Doebler filmed little bits of candy-colored plastic — which most likely hitched a ride on visitors — scattered on the sidewalks and streets around the museum. Activists are concerned that rain will wash the sprinkles into storm drains and then into Biscayne Baye, where they could entice marine animals to take a bite.

The Museum of Ice Cream, in other words, could be contributing to a much bigger problem. As Mindy Wiesberger of Live Science notes, the world's oceans are believed to contain 5.25 trillion pieces of plastic, which pose a threat to sea creatures that mistake the plastic for food.

This isn't the first time that environmentalists have raised alarm bells about the sprinkle pool. The Museum of Ice Cream launched in New York in 2016, and then traveled to Los Angeles and San Francisco before reaching Miami Beach. In October of last year, Alix Martichoux of SF Gate reported that the faux confections were making their way out of the museum and onto city streets.

"Most plastic has a purpose, like bottle caps and food wrappers," Eva Holman, an environmentalist affiliated with the Surfrider Foundation, told Martichoux at the time. "What is the purpose of this tiny piece of plastic other than a selfie moment?"

In Miami Beach, city officials acted quickly to curb the sprinkle fallout, issuing a courtesy notice and sanitation violation, which carries a $1,000 penalty. City spokesperson Melissa Berthier tells Shammas of the Miami New Times that the museum has instituted a number of measures to ensure that its sprinkles stay confined to their pool, "including but not limited to the hiring of a cleaning crew, instituting checkpoints to remove sprinkles indoors, vacuums to remove sprinkles that escape, and relocating the pool to the beginning instead of the end of the museum." Drains near the museum have reportedly been layered with felt to catch any rogue sprinkles.

Museum spokeswoman Devan Pucci says in a statement to the New Times that the attraction is also "planning to install blowers that hit visitors on three different door entrances when they leave from the sprinkle pool." At some point in the "near future," Pucci notes, the museum hopes to introduce biodegradable versions of the colorful toppings, so humans can have their sprinkles and animals won't eat them too.

Quiz

1 The following sentences from the article support the idea that keeping the fake sprinkles from making their way into the environment is very difficult.

1. *As it turns out, fake sprinkles are like glitter: They get everywhere.*
2. *After the Museum of Ice Cream opened in Miami Beach last month, local environmentalist Dave Doebler filmed little bits of candy-colored plastic — which most likely hitched a ride on visitors — scattered on the sidewalks and streets around the museum.*
3. *Drains near the museum have reportedly been layered with felt to catch any rogue sprinkles.*

Which additional piece of evidence from the article helps to create the MOST complete argument that keeping the fake sprinkles from making their way into the environment is very difficult?

(A) Activists are concerned that rain will wash the sprinkles into storm drains and then into Biscayne Bay, where they could entice marine animals to take a bite.

(B) This isn't the first time that environmentalists have raised alarm bells about the sprinkle pool. The Museum of Ice Cream launched in New York in 2016, and then traveled to Los Angeles and San Francisco before reaching Miami Beach.

(C) In Miami Beach, city officials acted quickly to curb the sprinkle fallout, issuing a courtesy notice and sanitation violation, which carries a $1,000 penalty.

(D) Museum spokeswoman Devan Pucci says in a statement to the New Times that the attraction is also "planning to install blowers that hit visitors on three different door entrances when they leave from the sprinkle pool."

2 Read the following paragraph from the article.

The Museum of Ice Cream, in other words, could be contributing to a much bigger problem. As Mindy Wiesberger of Live Science notes, the world's oceans are believed to contain 5.25 trillion pieces of plastic, which pose a threat to sea creatures that mistake the plastic for food.

What conclusion can be drawn from this paragraph?

(A) that most of the plastic in the world's oceans has come from the Museum of Ice Cream

(B) that the most common cause of death for sea creatures is ingestion of plastics

(C) that worrying about the small amount of plastic from the sprinkles is pointless

(D) that greater measures need to be taken to keep all kinds of plastic out of the oceans

3 Read the following quote from Eva Holman.

"Most plastic has a purpose, like bottle caps and food wrappers."

Why does the author include this quote in the article?

(A) to elaborate on the modern conveniences provided by plastics

(B) to emphasize that the sprinkles are a needless source of pollution

(C) to illustrate the plastics most commonly found in the ocean

(D) to introduce the idea that the museum should recycle sprinkles

4 Read the following sentence below from the article.

> *In October of last year, Alix Martichoux of SF Gate reported that the faux confections were making their way out of the museum and onto city streets.*

How does this sentence contribute to the effectiveness of the author's argument overall?

(A) It demonstrates that the problem with the plastic sprinkles in Miami is not an isolated incident.

(B) It illustrates the nationwide popularity of the Museum of Ice Cream's sprinkle pool.

(C) It highlights the difficulty of convincing people they should stay out of the Museum of Ice Cream's sprinkle pool.

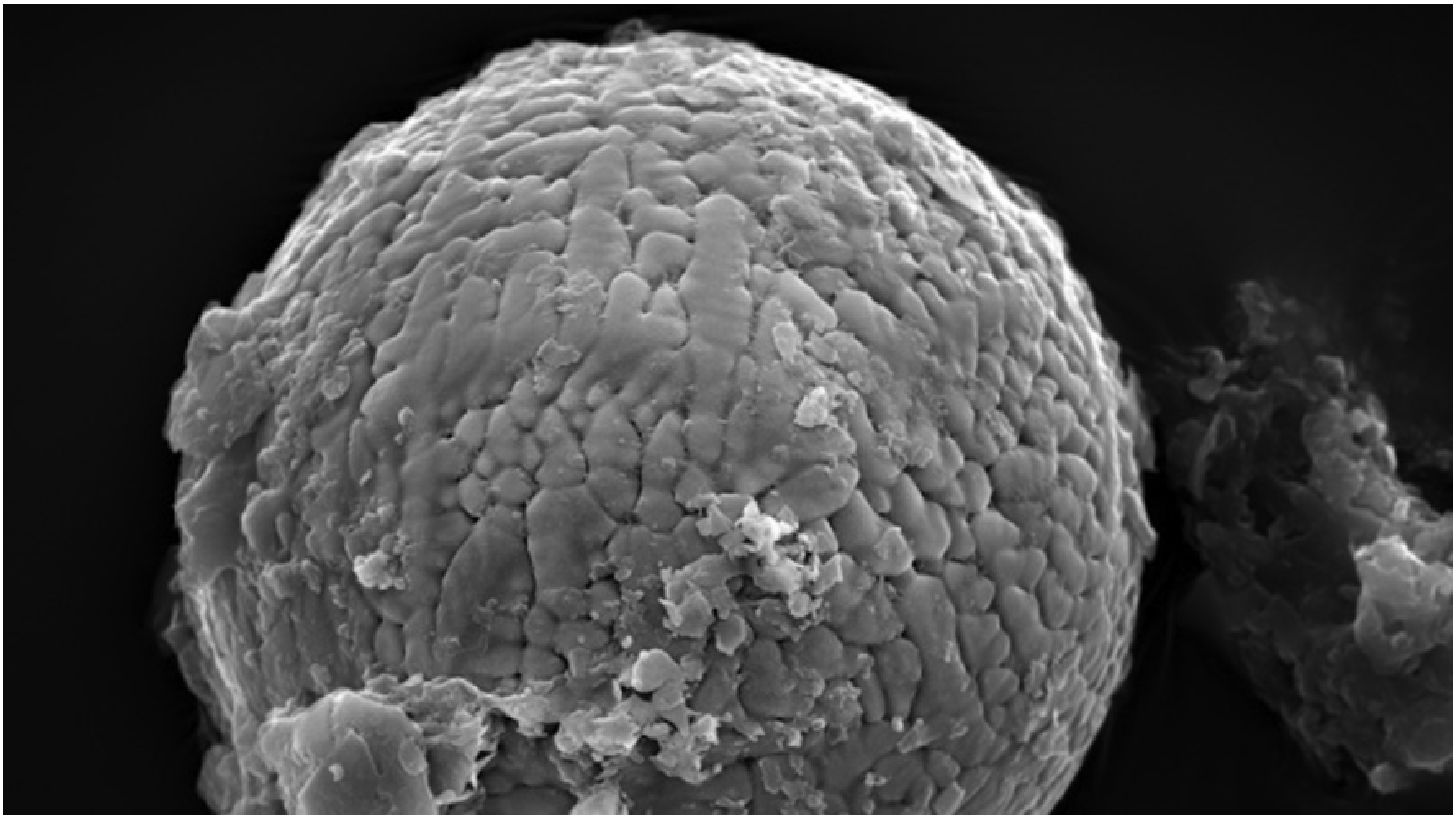
(D) It explores the premise that the sprinkles have not caused environmental problems in other cities.

Fossilized space dust holds surprise about Earth's ancient atmosphere

By Deborah Netburn, Los Angeles Times on 05.23.16

Word Count **718**

Level **MAX**



One of 60 micrometeorites extracted from 2.7-billion-year-old limestone, from the Pilbara region of Western Australia. Andrew Tomkins / Monash University

Each year, more than 3,000 tons of space dust fails to burn up in our planet's atmosphere and falls instead to Earth's surface.

These micrometeorites are just a few microns in diameter, but scientists say that embedded in the fossilized specks of this extraterrestrial debris are chemical clues that suggest Earth's upper atmosphere had almost as much oxygen in it 2.7 billion years ago as it does today.

"We've found a way to sample a part of the ancient Earth that we've never been able to investigate before," said Andrew Tomkins, a geologist at Monash University in Melbourne. "And we can show that the upper atmosphere 2.7 billion years ago was oxygen-rich compared to the lower atmosphere."

The finding, published recently in Nature, is surprising because other lines of evidence strongly suggest that there was essentially no oxygen in the lower atmosphere at that time.

“It is a truth almost universally acknowledged that Earth’s atmosphere before about 2.5 billion years ago had little or no free oxygen, “ wrote Kevin Zahnle of NASA Ames Research Center and Roger Buick of the astrobiology program at the University of Washington, in an independent analysis of the study.

Tomkins, who led the research, said he and his team were surprised by the findings as well.

“Geologists are generally familiar with the evidence that the early Earth’s atmosphere contained no oxygen,” he said. “But all of the previous observations relate to lower levels of the atmosphere. Nobody had found a way to sample the upper atmosphere before.”

The group did not initially set out to learn about the upper atmosphere of ancient Earth. Instead, the plan was to search for the oldest micrometeorites ever found, and then use them to look at how much space dust rained down on Earth billions of years ago compared with today.

“Scientists think that the flux was much higher early in Earth’s history, but haven’t got much to go on other than counting craters on the moon and other planets, and a bit of mathematical modelling,” Tomkins said.

But once the team actually got its hands on micrometeorites embedded in 2.7-billion-year-old rock deposits in Western Australia, the trajectory of their research changed.

“Once we saw that they had been metal particles that had become oxidized during atmospheric entry, I realized that they represented a sample of the Earth’s upper atmosphere and we refocused the project onto that topic from there,” Tomkins said.

The authors explain that while fast-moving bits of space dust burn up in Earth’s atmosphere and become shooting stars, those that are moving more slowly often don’t evaporate. Instead, the sand-sized particles of debris that hit the Earth at speeds of 7 to 44 miles per second get heated to melting temperature at the top of Earth’s atmosphere and then cool down very quickly — all in a matter of a few seconds.

But they are still able to accumulate oxygen from the upper atmosphere during their molten phase because chemical reactions go much faster at high temperatures.

“That’s why they sample a specific range of altitude — they stop being oxidized once they cool down,” Tomkins said.

Using cutting-edge microscopes, the team examined 11 of the 60 ancient micrometeorites it had uncovered and found that most of them had once been particles of iron that had turned into the iron oxide minerals magnetite and wustite.

In order for that chemical reaction to happen, computer models suggest that there had to be almost as much oxygen in the upper atmosphere as there is now.

The authors say their results do not challenge previous findings that the lower atmosphere had almost no oxygen 2.7 billion years ago, long before plants began pumping it into the air. It only affects the chemical makeup of the upper atmosphere, where oxygen can be created by photolysis — when carbon dioxide is split by sunlight into carbon monoxide and oxygen.

“It turns out that atmospheric chemists actually predicted that the atmosphere would be relatively oxygen-rich at high altitudes,” Tompkins said.

He added that the group’s next step is to collect micrometeorites from a broad range of geological time periods to look at how the chemistry of the upper atmosphere varied over millions to billions of years.

There is still more to learn from these tiny bits of space dust.

Quiz

1 Which statement BEST explains how the oxygen in micrometeorites has affected our understanding of the Earth's atmosphere?

(A) It confirms previous findings that the Earth's atmosphere was very rich in oxygen and iron billions of years ago.

(B) It confirms previous findings that the Earth's atmosphere was almost completely without oxygen billions of years ago.

(C) It contradicts previous findings and shows us that the atmospheric content of the Earth has remained completely consistent over billions of years.

(D) It contradicts previous findings and gives us a new way to understand how the Earth's atmospheric content has shifted over billions of years.

2 The author suggests that there is still more to learn from space dust because:

(A) The scientists' findings have created controversy regarding the Earth's upper atmosphere; there is now little consensus as to its true makeup.

(B) The scientists' findings tell us about the Earth's upper atmosphere at one point in time; we know little about what it was like between then and now.

(C) It remains a mystery how any micrometeorites are able to survive their journey to the Earth's surface; more tests must be conducted.

(D) It remains a mystery how the Earth's upper atmosphere could have contained oxygen; further research is needed.

3 Read the sentence below.

The finding, published recently in Nature, is surprising because other lines of evidence strongly suggest that there was essentially no oxygen in the lower atmosphere at that time.

Replacing the word "surprising" with which of the words below would create a NEGATIVE TONE in the sentence?

(A) The finding, published recently in Nature, is AMAZING because other lines of evidence strongly suggest that there was essentially no oxygen in the lower atmosphere at that time.

(B) The finding, published recently in Nature, is REMARKABLE because other lines of evidence strongly suggest that there was essentially no oxygen in the lower atmosphere at that time.

(C) The finding, published recently in Nature, is SHOCKING because other lines of evidence strongly suggest that there was essentially no oxygen in the lower atmosphere at that time.

(D) The finding, published recently in Nature, is UNEXPECTED because other lines of evidence strongly suggest that there was essentially no oxygen in the lower atmosphere at that time.

4 Read the selection from the article.

Instead, the plan was to search for the oldest micrometeorites ever found, and then use them to look at how much space dust rained down on Earth billions of years ago compared with today.

What does the verb "rained" MOST strongly convey?

(A) the dust traveled in water particles

(B) the particles' need for the oxygen

(C) the importance attached to the particles

(D) the large number of particles that fell

Yellowstone's supervolcano gets a lid

By Shannon Hall, Scientific American on 03.21.16
Word Count **719**
Level **MAX**

The Grand Prismatic Spring in Yellowstone National Park is the largest hot spring in the United States, and the third largest in the world. Below the hot springs at Yellowstone lies a sleeping supervolcano. Wikipedia

Simmering deep below the geysers and hot springs of the Yellowstone caldera is a dormant supervolcano—a powerful behemoth with the ability to blanket the western U.S. with many centimeters of ash in a matter of hours. What could spark such a powerful eruption? Scientists have long debated the origins of Yellowstone's supervolcano, with the most widely accepted idea suggesting that it was formed by a mantle plume—a column of hot rocks emerging from deep within our planet, in the mantle layer. But a new simulation shows that the conventional wisdom was wrong. The plume could not have reached the surface because it was blocked by a slab from an ancient tectonic plate.

The simulation results of the model, which is the first to replicate the complex interaction between a mantle plume and a sinking slab, was detailed last month in Geophysical Research Letters. Lijun Liu, a geologist at the University of Illinois at Urbana–Champaign, and his graduate student Tiffany Leonard built the model to replicate both the plate tectonic history of the surface and the geophysical image of Earth's interior. "No one had modeled it this vigorously," says Brandon Schmandt, a geologist at the University of New Mexico who was not involved in the study. Not only did Liu and Leonard create a three-dimensional view of Yellowstone's underbelly, they did so over the past 40 million years in an attempt to re-create the eruptions that have dotted the U.S. from Oregon to Wyoming.

No matter how they tweaked the parameters, Liu and Leonard could not re-create most of the recent eruptions. The reason is simple: "Slabs are the bully," says Eugene Humphreys, a geophysicist at the University of Oregon who was also not involved in the study. "Plumes are just pretty wimpy in comparison."

The slab in question was driven deep into Earth's mantle about 100 million years ago when the Pacific and North American plates began converging. Like a canoe paddle pushing through water, the mantle flows around the sinking slab, causing pressure to build toward the front. But 15 million years ago the model shows that the pressure difference became too much to bear and the slab began to tear. The plume below pulsed through the slab, leading to massive outpourings of magma, the pattern and timing of which appear consistent with the Steens-Columbia River flood basalts, which spewed out 1 million times more molten rock than the 1980 Mount St. Helens eruption.

But that's where the similarities between the model and geologic surface features end. Despite the gaping hole in the center of the sunken slab, the plume did not continue to rise through it. That is because the mantle is more like honey than water — it's highly viscous. So as the slab continued to sink, it pulled the surrounding mantle down with it, ultimately sealing the hole and blocking the plume from reaching the surface for the next 15 million years. The favored hypothesis cannot explain the string of volcanic eruptions since those first flood basalts, including the formation of Yellowstone's caldera, which happened only 2.1 million years ago. "Ultimately, we need a new explanation for Yellowstone's formation," Liu says.

In other words, the team needs to find an additional heat source. Leonard thinks this could come from the Juan de Fuca ridge — a jagged volcanic seam where magma oozes up between spreading plates to create a new seafloor — in the Pacific Ocean. Although that's almost 1,600 kilometers away from Yellowstone's hotspot today, the ridge can easily affect the middle of the North American plate. Because it lies just slightly west of the Cascadia subduction zone, the young seafloor is easily shoveled east beneath the North American plate. So it is likely that some event, millions of years ago, spurred a lot of heat within the Juan de Fuca plate, which was then shoveled underneath the North American Plate and swept along with that string of volcanic eruptions until it eventually helped form Yellowstone's gaping caldera in the Rocky Mountains.

Although scientists will continue to argue over Yellowstone's murky origin, the model makes it clear that slabs are much more important than previously thought. "It's like smoke from a chimney that's getting swept up in some sort of windstorm," Humphreys says. "But it's not this vigorous plume that just blasts through everything."

Quiz

1 Which of the following excerpts from the article BEST describes an issue that the mantle plume theory does not address?

(A) No matter how they tweaked the parameters, Liu and Leonard could not re-create most of the recent eruptions. The reason is simple: “Slabs are the bully,” says Eugene Humphreys, a geophysicist at the University of Oregon who was also not involved in the study. “Plumes are just pretty wimpy in comparison.”

(B) But that’s where the similarities between the model and geologic surface features end. Despite the gaping hole in the center of the sunken slab, the plume did not continue to rise through it. That is because the mantle is more like honey than water — it’s highly viscous.

(C) The favored hypothesis cannot explain the string of volcanic eruptions since those first flood basalts, including the formation of Yellowstone’s caldera, which happened only 2.1 million years ago. “Ultimately, we need a new explanation for Yellowstone’s formation,” Liu says.

(D) Although scientists will continue to argue over Yellowstone’s murky origin, the model makes it clear that slabs are much more important than previously thought. “It's like smoke from a chimney that's getting swept up in some sort of windstorm,” Humphreys says. “But it's not this vigorous plume that just blasts through everything.”

2 Which of the following aspects of the article is NOT thoroughly discussed?

(A) the slab's role in the first magma outpourings

(B) how the slab has stopped subsequent mantle plumes

(C) a new theory about how the Yellowstone caldera may have formed

(D) how the scientists know that the caldera was formed more recently than the first magma outpourings

3 Which of the following statements accurately represents the article's central ideas?

(A) Scientists are feeling very surprised to learn that they were completely wrong about the reasons for the Yellowstone supervolcano.

(B) Scientists used a simulation to discount one theory on the creation of the Yellowstone supervolcano and they have decided on a new theory.

(C) A simulation showed scientists that one of their theories about the Yellowstone supervolcano was incorrect, leading them to search for new theories.

(D) A simulation helped scientists prove that a popular theory was wrong, and this understanding has begun to reshape the field of geological studies.

4 Which sentence from the article would be MOST important to include in a summary?

(A) The plume could not have reached the surface because it was blocked by a slab from an ancient tectonic plate.

(B) “No one had modeled it this vigorously,” says Brandon Schmandt, a geologist at the University of New Mexico who was not involved in the study.

(C) No matter how they tweaked the parameters, Liu and Leonard could not re-create most of the recent eruptions.

(D) The slab in question was driven deep into Earth’s mantle about 100 million years ago when the Pacific and North American plates began converging.