

# THE BREAKUP

Rumblings in eastern Africa signal the start of a new ocean.



Last September, geologist Gezahegn Yirgu flew by helicopter to an earthquake zone in a remote part of Ethiopia. Landing in a region that was still shaking from quakes and rumbling with volcanic activity, Yirgu felt excited and afraid.

"The whole scene looked as if the earth was deforming in front of our eyes," he says. "We were scared we might be caught up in an eruption. After a 30-minute survey, we decided to leave the area." Two hours later, a volcanic eruption spewed ash over the survey area.

Yirgu, a professor at Addis Ababa University, knew he was witnessing something rare. In the area where he landed, the Afar Triangle, a future ocean floor was forming on Earth's surface right before his eyes.

## ROCK PLATES

Not long after Yirgu reported his findings, geologists from around the world descended on the Afar Triangle. The rumbling, the ground splitting, and the eruptions had not ceased. "The process is not over," says Eric Calais, a geophysicist from Purdue University in Indiana.

The region is so geologically

active because it sits atop the intersection of three *tectonic plates*. A tectonic plate is a huge section of Earth's *crust* (the hard outer shell) and the top layer of the *mantle* (the softer interior). At the Afar Triangle, the Nubian, Somalian, and Arabian plates are slowly pulling apart, moving about as fast as a fingernail grows. Where plates separate, their borderline is called a *divergent boundary*.

Divergent plates do not separate smoothly. Along the boundary, they put stresses on the ground that can create *faults*, deep breaks in the crust. "Plates stick together on a fault until the stresses are too high," Calais says. "Then the fault ruptures." In Afar, the current rupturing episode is likely to include hundreds of earthquakes and more volcanic eruptions over the next few years. Such episodes probably occur every two hundred or so years, Calais says.

Cindy Ebinger, a geologist from the University of London, says two things happen when the Afar faults rupture. First, brittle parts of the plates near the faults break. "The stresses build up, then—*bang!*" Ebinger says. "Then the stresses build up again, and *bang!*" That stress-release cycle has been causing earthquakes in the region.

The breaks in the crust then release pressure on the hot rocks below. Normally, the pressure keeps the rocks solid. "It's like a can of soda when you open it," Ebinger says. In the same way opening a can lets out bubbles, cracking the crust allows some of the solid rock underground to become liquid rock, or *magma*. That pressure release has been causing the volcanic activity.

In Afar, the magma cools and becomes *basalt*, a dense, heavy rock. As the plates in the Afar region continue to move apart, more magma will keep surfacing. The buildup of so much heavy rock will eventually cause the crust to *subside* (sink). Water from the nearby Red Sea will fill the region,







**Left:** This volcanic vent opened in the Afar Triangle on Sept. 26, 2005. **Opposite page, left:** The same volcanic vent pictured here, seen from the air. The vent is 60 meters (197 feet) wide and 500 meters (1,640 feet) long. **Opposite page, right:** Cracks rip across the surface of the desert.



and the surrounding areas will become separate landmasses. East Africa will split up.

### MAGMA BUMP

Over the next few years, geologists will pay close attention to Afar, but not because they expect to see it sink soon. So much magma is bubbling up that Afar is rising slightly. "The place where magma is coming up today is at the crest of a wide bump," Calais says.

Instead, geologists will track ground movements in Afar. Most

divergent boundaries are hidden under the oceans they have already created, so researchers can't easily observe them. Divergent boundaries on the ocean bottom are termed *mid-ocean ridges*. Geologists will measure how fast the plates in Afar move and how much magma wells up between them.

Given enough time, the heavy rocks will eventually pull Afar down. "If you continue this process for millions of years, you will increase the distance between Arabia and Ethiopia," Calais says. "At the same

time, the area will continue to subside."

Right now, some parts of the Afar Triangle are already below sea level, but high ground still separates them from the Red Sea. That high ground will subside over the course of hundreds of thousands of years. "Eventually, water will come in," says Calais. "It will definitely look like a real ocean then." **CS**

## Making a New Seafloor

In the Afar Triangle (the orange region on the map), huge pieces of Earth's crust are pulling apart. Such activity is usually found under the sea at mid-ocean ridges. Magma bubbles up where the plates diverge, cools, and forms new, heavy crust, which is slowly pushed away.

