WATCHING FROM AFAR

Derek Keir and colleagues endure fierce heat and dust storms in one of the world's most hostile places to understand how continents break apart.

Surely the best way to understand how a continent splits apart is to watch it happen? Of course the answer is a resounding yes, and this is the reason why scientists return time and time again to the harsh conditions of the Afar Depression in north-east Ethiopia. Our reward – to witness the violent, once-in-a-generation separation of tectonic plates that is responsible for creating new oceans.

A glance at a globe shows you that the Red Sea is a narrow stretch of water separating Africa and Arabia. It's one of Earth's youngest oceans and is widening by an average of a metre during a human lifetime.

But in the Afar Depression on the edge of the Red Sea in Ethiopia, the African and Arabian plates haven't yet separated quite enough for water to rush into the gap and create a new stretch of sea. Since there's no water to hide geological activity, we can see and measure the natural processes that split one continent into two.

The spectacular geological event began in late September 2005 when Ethiopian scientists detected exceptional earthquake activity, opening of surface fissures and a small volcanic eruption in Afar. Remarkably, the tectonic plates had been relatively quiet for more than a century but in less than two weeks separated by nearly ten metres.

By mid-October 2005, a team including Cindy Ebinger (see *Planet Earth* Autumn 2006) and me had set up ten new seismometers in Afar to record earthquake and volcanic activity. Each seismometer was buried half a metre below the surface and left for three months to fill the storage disks with information, which meant return visits in the scorching summer heat to retrieve the data.

Incessant summer sun, dust and floods created a lottery of seismometer survival.

Derek Keir (left), James Hammond (centre) and Johannes (right) burying a new seismometer.

Come July 2006, Atalay Ayele from Addis Ababa University and I reluctantly returned to Afar. Our first stop was the town of Teru. The experience here showed why half our seismometers had failed. We arrived late afternoon with the temperature around 45°C. A brisk hot wind swept across the savannah plain and the sky was murky brown. 'There's going to be a dust storm, very soon,' warned Abdu, our Afar guide.

An ocean of sand

By morning, a five-foot-high sand dune had engulfed our seismic station, covering the energy giving solar panel and leaving only the GPS antennae peeping above an ocean of sand. Incessant summer sun, dust and floods created a lottery of seismometer survival.

But after nine months of testing fieldwork, we finally hit the jackpot. In mid-2006 activity had renewed, and this time our equipment was focused on Afar, listening to the injection of a two-metre-

> **If a sheet of magma cuts through to the surface, lava spews from fissures in the ground.**

Above: The land surface in Afar is ripped apart by faults and fractures. Below: Ato Getahun (left) and Feleke (right) rush to unload geophysical equipment and water from a military helicopter.

wide, ten-kilometre-long vertical sheet of molten rock into the top ten kilometres of the Earth's crust.

Satellite radar images showed that such sheets of molten magma were injected four times during 2006. Our accurately-located earthquakes not only showed that each injection lasted only a few hours, but also that magma moved sideways at roughly walking speed through the Earth.

The new data show that Arabia drifts away from Africa by adding multiple vertical sheets of new rock at roughly month-long intervals during episodes of rapid opening between separating tectonic plates.

If a sheet of molten magma cuts through to the surface then lava spews from open fissures in the ground! The Afar regional government largely ignored our warnings that another volcanic eruption was very likely, but in August 2007 nature proved us right by lighting the Afar sky with a fountain of fire not seen in Ethiopia for a century.

Needless to say, the Afar government is now interested in our research. We now expect the volcanic activity to continue sporadically for another five to ten years. All the while, nature teaches us about the remarkable forces that underpin plate tectonics. ❖

MORE INFORMATION

Nature, vol. 442, 2006 Magma-maintained rift segmentation at continental rupture in the 2005 Afar dyking episode.

Geophysical Journal International, vol. 171, 2007 Fault growth at a nascent slow-spreading ridge: 2005 Dabbahu rifting episode. Afar.

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See www.nerc.ac.uk/planetearth for the blog from Afar.