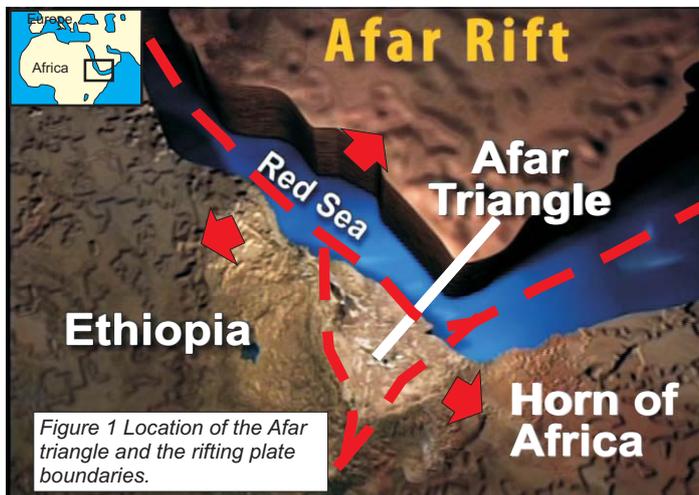


Journey into the hottest place on Earth

How to build a 3D volcano!

Dougal Jerram and Steve Smith take laser scanning to the very edge and build the ultimate 3D volcano in the hottest place on Earth.....

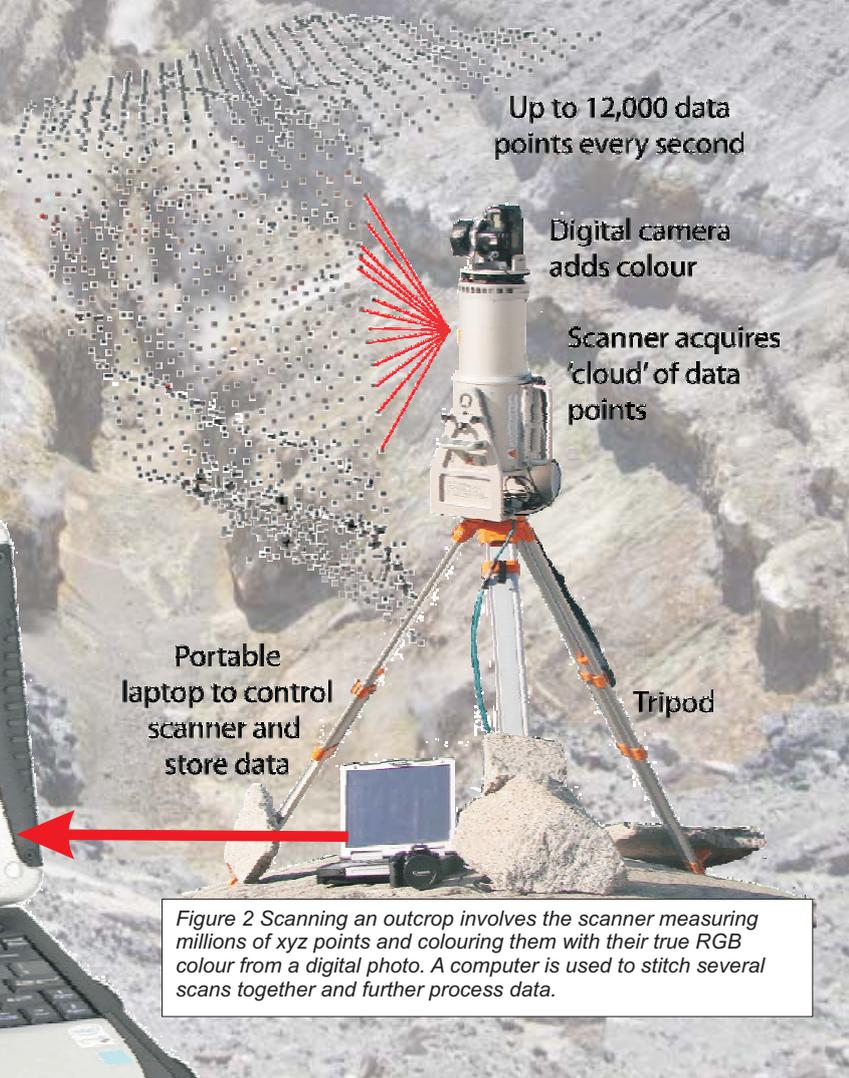


Volcanoes in the hottest place on Earth.

The East African rift and the Danakil desert in the Afar region of Ethiopia (fig 1) conjure up images of grand scenery, melting sunsets and the mysteries of the Afar tribal warriors. This is a truly special place where the mountains meet the sea, and rifting of two tectonic plates drives the birth of a new ocean. It is the home of countless volcanoes, faults and fissures as well as a striking variety of animals and humans who have adapted over time to the notoriously harsh environment. Our aim during a 3 week trip at the end of 2007 was to visit active fissures and volcanoes as part of a popular tv science expedition, and to capture these remarkable features using the latest 3D laser scanning technology; a virtual volcano hunt.

From real Rocks to virtual Geology

A 3D laser scanner provides the opportunity to create true 'virtual' outcrops. By firing millions of laser-points towards the real outcrop, the scanner is able to record the position of the objects in front of it. In essence, it captures a 3D photograph, from which we can build high resolution geological models at a variety of scales. The scanner creates a 'point cloud' a collection of millions of points defining the 3D environment (fig 2), and then uses digital images taken using a conventional camera, specifically calibrated for the scanner, to colour the point cloud, ultimately generating a virtual 3D picture at mm resolution.



Journey into the Afar

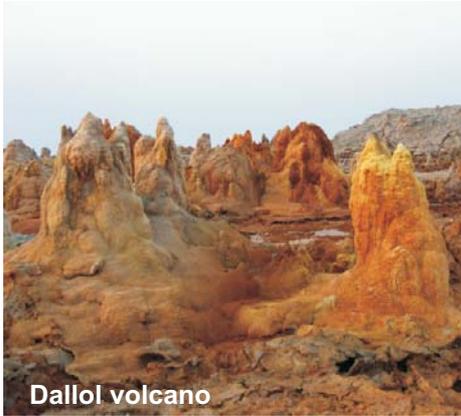
Arriving in the hottest place on earth is no mean feat. A three day camel ride from the mountains of the Ethiopian Plateau to a barren desert some 100 meters below sea level marks the first leg of the journey. There, in the Danakil Depression, we find some of the most extensive salt flats on Earth, a precious commodity that has been mined and traded for thousands of years. With camels packed up to the hinds with over 80kg of scanning equipment we then head off in search of the volcanoes and fissures, the main geological highlights of this expedition.



Camel train



Salt flats 100m below Sea level



Dalol volcano

Our first target was the Dabbahu fissure (see below), a steaming gap in the Earth's crust which appeared overnight in 2005. Again the trek was by camel, with all our kit strapped on the back. We would then set our sights on the final goal, the ascent and then descent into Erta Ale, one the oldest and most active lava lakes in the World.

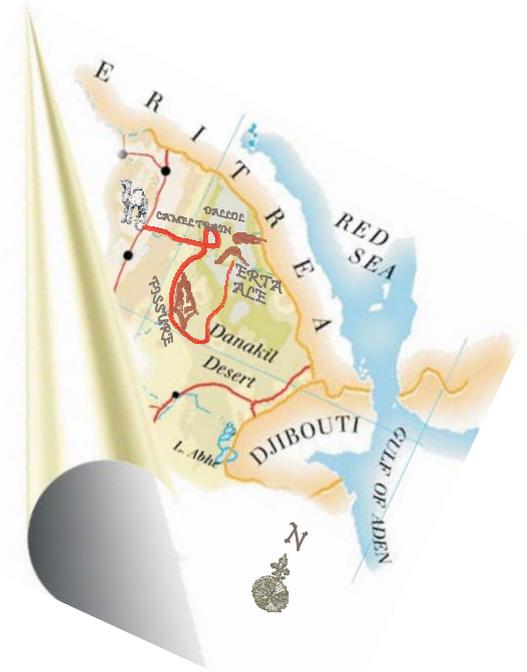


Figure 3 The route into the Danakil Desert and Afar triangle was long and hard. A camel train was our passage in and great desert wonders were passed on the way.



Sunset over the Ethiopian highlands

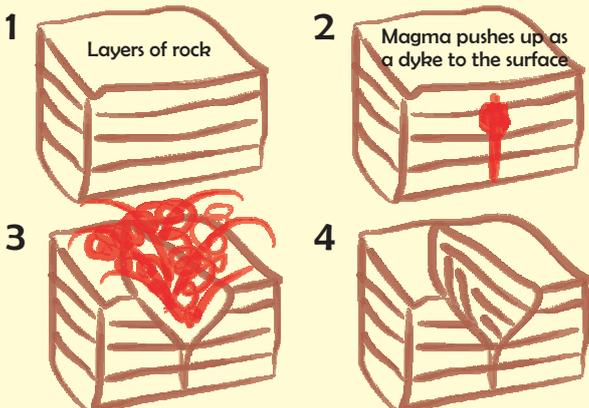
Earth splitting and steaming fissures

Our first geological wonder was the Dabbahu fissure, a gaping wound in the Earth created by rifting and a volcanic eruption virtually overnight in September 2005. Following a short camel strike en route to the fissure, we eventually arrived at this remotest of Earth's structures. As we approached the edge of the fissure we were presented with a sight straight from a Hollywood movie. The scale was unimaginable, and you really felt that the earth could just tear itself apart.

We managed 3 scans around the edge of the fissure before being beaten back by noxious gasses. This would have to be our lot here as the main goal of the expedition, Erta Ale, loomed before us.



Dabbahu Fissure from the air

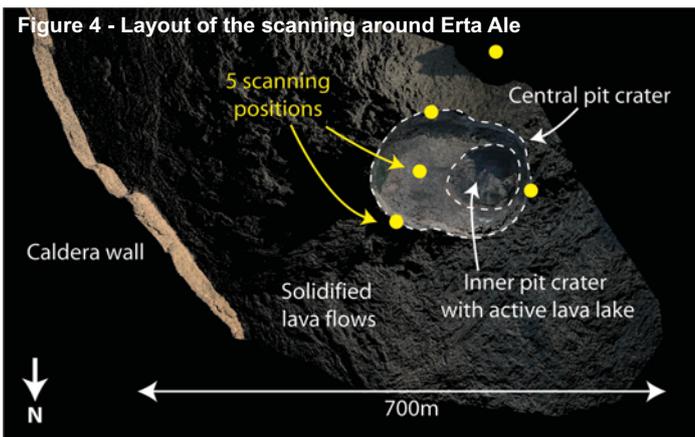


Fissure opens and magma erupts in a dramatic overnight event



Scanning the Dabbahu Fissure

ERTA ALE Gateway to hell or Geological Heaven?

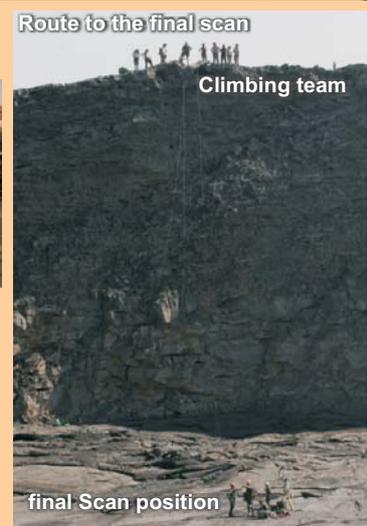


Bubbling lakes of lava

Erta Ale is one of the oldest and most active known lava lakes, and gazing down into its fiery cauldron one can imagine why in local Afar legend it's thought of as the 'Gateway to Hell'. After another long camel trek we found ourselves camping at the edge of the summit caldera which hosts the north and south pit craters. The south crater contains the active, bubbling lava lake, glowing red at night and constantly turning over like boiling porridge. Our objective was to capture the first 3D laser scan from within an active volcano. We started to position scans around the caldera and along the rim of the crater (fig. 4). The final scan was the key to unlocking Erta Ale's secrets and bringing the 3D model to life, but it would be a daring one - involving an abseil into the crater itself!

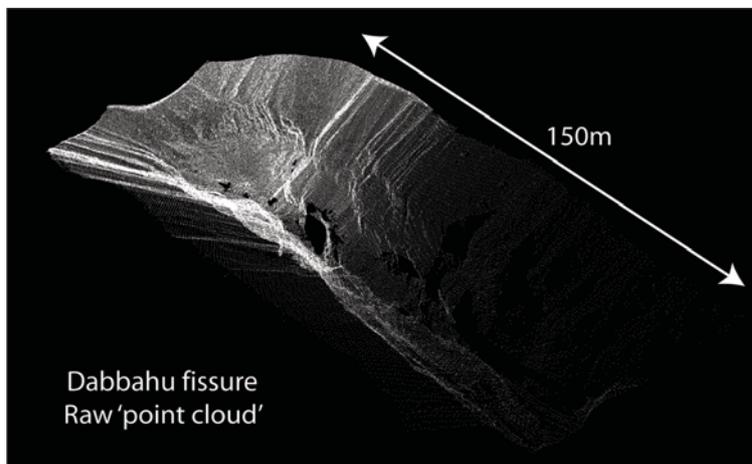
After a 3 week expedition filled with desert dust and camel spit, with wonder and amazement at the jewels the Danakil desert has to offer, a catalogue of breathtaking views, and the humour and resilience of the Afar people, we found ourselves dangling over the edge of a live volcano! The mix of adrenaline on the abseil and the strange peacefulness and eerie calm as we touched down on the crater floor is almost impossible to convey. The culmination of a journey which had tested the limits of our capabilities, joined strangers that would leave as friends, and provided so many wonderful experiences, brought us together to gaze into the gateway to hell and to find geological heaven.

Into the volcanoes mouth - getting the final scan!

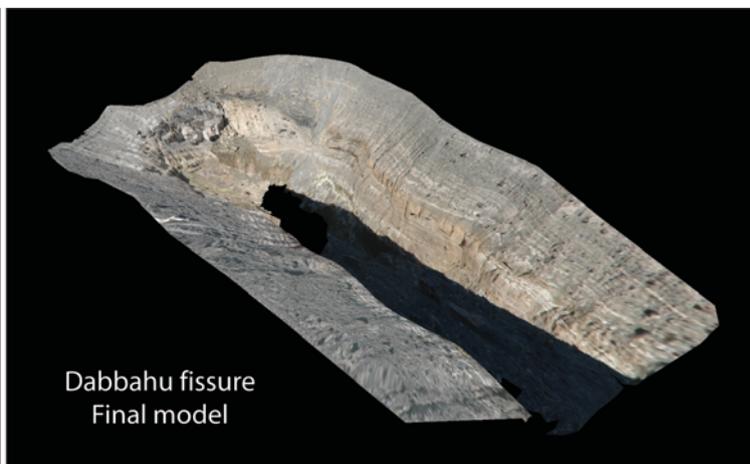


To get the full 3D crater of Erta Ale we needed to scan around the crater from the very rim (roped up for safety), and finally we would need to get ourselves and 80kg of kit down into the lower ledge of the volcano to get that vital all important scan for the complete 3D model.

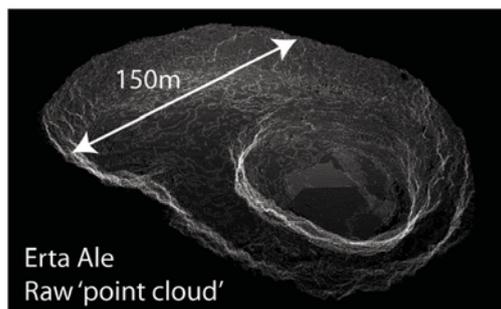
3D volcano models - Erta Ale & Dabahu Fissure



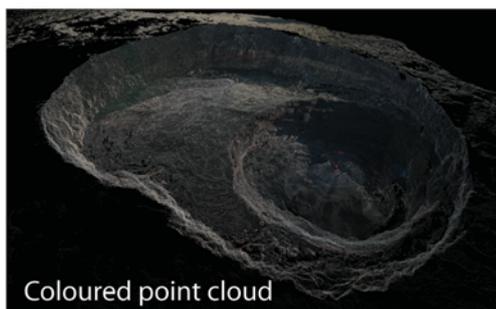
Dabbahu fissure
Raw 'point cloud'



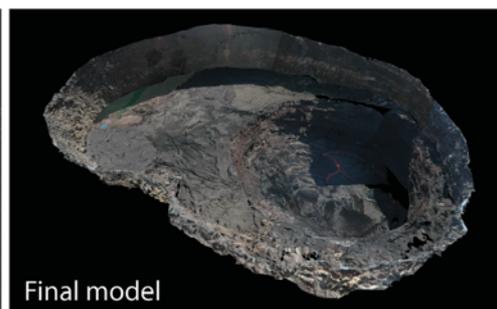
Dabbahu fissure
Final model



Erta Ale
Raw 'point cloud'



Coloured point cloud



Final model

The final 3D models represent the first ever laser scans of Dabahu fissure and of live active lava lake, Erta Ale. These 3D earth models provides snap shots of exactly what these features were like at the time, form the basis from which our future understang of how these structures will develop, and allow the study of features deep down into the structures where its too dangerous for man to go...a window into the hottest place!

View into final fissure model



View into final Erta Ale model



Postcard from a Camel train

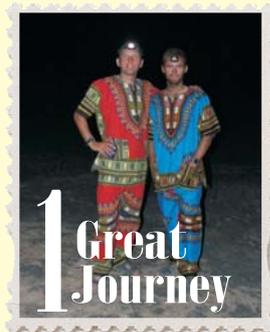
Dear Geoscientist

We have had an amazing journey through the desert.

We have travelled with camels, visited steaming fissures and ended up looking into the belly of the Earth at Erta Ale. A really fantastic experience which would not have been possible without the help from the great people at Lion Television, Expedition Media, Remote Trauma, our Climbing and saftey crew, a great team of drivers & cooks and camel herders, and our travelling companions; Kate Humble, Steve Leonard, Richard Wiese, Mukal Agarwal, Susan Purvis.

*Cheers!
Dougall & Steve*

'The Hottest Place on Earth'
Featured on BBC1, the
Discovery Channel
and BBC Worldwide



Links

Dougall Jerram's website - www.dougalearth.com

Steve Smith - <http://romat.rm.ingu.it/Members/smith>

Lion Television - www.liontv.com

Expedition Media - www.expeditionmedia.co.uk

Remote Trauma - <http://remotetrauma.co.uk>

Geospatial Research - www.geospatial-research.com

Scanner - www.riegl.com