Iceland: ridge, plume and basalt
Volcanism in the eastern riftzone

Dave Garvie
We're now going into the heart of Iceland, to the eastern rift zone. Now one pronounced difference is that the western rift zone is continuous with the offshore spreading ridge, whereas the eastern rift zone is not, because of a transform fault zone. So now let's look at how basalt volcanism is organised in the eastern rift zone.

Fissure swarms in the eastern rift zone are different to those in the western rift zone, because they are always connected to a central volcano. A central volcano is a volcanic structure beneath which is a magma chamber that traps basaltic magmas as they ascend from the mantle. In Iceland a central volcano, plus its one or two fissure swarms, is called a volcanic system, and this map shows the volcanic systems in the eastern rift zone. But we're only going to examine one of these, Barõarbunga centre volcano, and its fissure swarms.

So let's now spend some time looking at one eruption in detail – the 1480 AD eruption from Barõarbunga's south-west fissure swarm. Well, behind me here we have a large centre volcano under the ice. This is called Barõarbunga, and its fissure swarm to the south-west is called Veiõivötn and that's where we're going to next. This is the youngest basalt eruption in this fissure swarm. It happened in 1480 AD. It started life under a centre volcano some seventy kilometres to the north-east, and it continues for over thirty kilometres to the south-west.

A chemical analysis of the basalt in this 1480 AD fissure eruption shows it to be a quartz tholeiite. In fact, a great many of the basalt eruptions in the eastern rift zone are quartz tholeiite. Now let's move to where this quartz tholeiite fissure stopped at the Torfajökull volcano.

We're now near the south-west end of this youngest basalt fissure eruption and here the erupting fissure has met water and has reacted violently to produce this large explosion crater. As we move further to the south-west, to the very end of the fissure, we will find features that will help to link this single eruption to the large scale processes that have created Iceland.

Through the valley is the large basaltic explosion crater we've just come from. A little further in the fissure we have another basaltic explosion crater, this time a little bit smaller. But over here, flowing down into the lake, we have something quite, quite different. This is a rhyolite lava flow. Let's go down and take a look at this rhyolite lava flow. Rhyolite is a rock much richer in silica than basalt, and it produces much thicker lava flows. Its importance is simply that it has different physical properties to basalt, so when basalt meets rhyolite there's some characteristic features that can be observed in the field. This rhyolite lava flow is about four times my height, but if we look over there we can see another rhyolite lava flow that dwarfs the tents and vehicles at its foot. These rhyolite lava flows were erupted at the same time in 1480 AD, that's the same time as the basalt fissure to the north-east of here.

Here's a rhyolite from this flow. Let's look at what's in it. First of all I note that there are small grey inclusions. These are actually basalt. What interests me is the wispy nature of the contact between the basalt inclusion and the rhyolite. This tells me that the basalt and the rhyolite must have been molten when they were mixed together. Now there is five times as much basalt in this rhyolite as there is in the thicker flow, and the thicker flow is really where the basalt fissure ended.

Let's try and put this evidence together and see what it tells us about the bigger picture. We have a basalt eruption which started under the Barõarbunga centre volcano, continuing

through Veiõivötn, and here it encountered a rhyolite magma chamber under the Torfajökull volcano. Now this hasn't just happened in isolation. It's happened five times in the last five thousand years. That's a remarkable change in the behaviour of the Turvehice volcano. Now what this is telling us is that the entire rift zone, the entire eastern rift zone, is migrating towards the south-west. This is a major change in the dynamics of the Icelandic rift system.