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

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Iceland, one of the wildest and bleakest places on the planet. Looking at this frozen landscape, it's hard to imagine its fiery volcanic origins. But Iceland is far from finished.

These are basalt eruptions, and they're building the crust of Iceland. In this video we'll examine how the formation of this ocean island is related to both crustal and mantle processes. We'll use field evidence to see how magma moves in the crust, and we'll use information on basalt compositions to help us gain insight into melting conditions in the mantle beneath Iceland. Here's a map of Iceland. This ocean island is about 350 kilometres north-south, by 500 kilometres east-west. So why is there dry land here when the mid Atlantic ridge to the south-west and to the north lies underwater? The answer must surely lie in the on-land continuations of these mid-ocean ridges; these are the western rift zone and the eastern rift zone. We'll begin by investigating the western rift zone.

Everything behind me is basalt, even the mountains are basalt. Basalt is a basic building block of the ocean crust; it's also the basic building block of Iceland. Now let's take a look at what a typical basalt looks like. First of all notice it's a grey colour. The grey material is very fine-grained, and that tells you that the basalt cooled very quickly. There are also a number of holes in the basalt, and these are vesicles which were once filled with gas. In addition, there are white specs dotted throughout the basalt; this is a mineral called plagioclase feldspar. Plagioclase feldspar is the only mineral in this particular rock. But where did it come from? Let's go and find out.

The basalt we looked at earlier was part of a lava flow, and to find its source I've travelled twelve kilometres up the lava flow to here, and this is it. This is a basaltic crater we're in now. There are two lines of evidence that suggest that it was the source of the lava flow. First of all we've travelled up, and this is the topographically highest part of the lava flow. The lava has flowed downhill from here. And secondly, when we look at the crater itself, we see that it's made up of bubbly lava – look, it's very light. This is full of vesicles and that's typical of material found in craters. But is there just one crater here? No, there's not. Ahead of me there are two or three craters and behind me there are four. These craters form a line, but not just randomly distributed, they form a very distinct line.

This is a basalt eruption, and the lava is erupting through a distinct line, which we call a fissure. When the fissure eruption ends, a line of steaming basalt craters remains. There are many such ancient fissures in the western rift zone. But there are also many steep- sided ridges in the western rift zone. What do these tell us? Again, this is basalt, but it's unlike any basalt formation we've seen so far. That's because this was formed under ice. Instead of being able to flow away freely, this basalt has chilled everywhere it met the ice to form a steep-sided ridge. Above the ridge the ice was probably two or three hundred metres thick.

But not all basalt eruptions in the western rift zone are fed by fissures. Let's look at an example. This is another basalt lava flow. It looks quite different to the plagioclase-rich basalt flow we saw earlier. For instance, this one is much smoother; it doesn't have the humps and bumps we saw in the plagioclase-rich basalt. Let's take a look at what this one is. When I look in here I see lots of little green crystals which I'm quite certain are olivine. So this is an olivine-rich basalt. So let's go uphill and find the source of this olivine-rich basalt lava.

This is a shield volcano in the western rift zone, and it's been constructed of basalt lavas that have erupted through a single vent, not through a linear fissure. I've climbed up the flanks of the shield volcano; I'm now at the summit, in the mist. And what do I find? I find a large crater, not visible from below, but here it is. At one point this large crater was filled with lava right to the brim, which sent a number of lava flows down the flanks. And one of those flows is the one from which we collected the olivine-rich basalt earlier.

Although field observations can't give us the composition of a basalt, a chemical analysis can, and when we analyse the basalt forming this shield volcano, it turns out to be an olivine tholeiite. Such compositional information provides clues about melt generation processes in the mantle beneath this part of Iceland, and we'll use this information later.