Iceland: ridge, plume and basalt
New land on the Island of Vestmannaeyjar

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We're now going to go where new land is being created. We're going to the islands of Vestmannaeyjar. Vestmannaeyjar is the name given to a group of islands off Iceland's south coast, most of which formed during the past ten thousand years. There have been many eruptions here and although the majority of these have been submarine, some have built new islands.

The two most recent eruptions created the island of Surtsey in the 1960's and added to the existing island of Heimaey in 1973. But why are new islands being created here when the nearest spreading ridge is so far away? When we look at the composition of the basalts erupted in Vestmannaeyjar, we get a surprise. These basalts to be silica-undersaturated – they are alkali basalts. This suggests that something unusual is happening in the zone of melt generation beneath these islands.

Here's a west-east cross-section along Iceland's south coast, from the western rift zone (on the left) to Vestmannaeyjar (on the right). The olivine tholeiites erupted at the western rift zone are generated by about twenty percent shallow partial melting of the mantle. In contrast, the alkali basalts erupted at Vestmannaeyjar are generated by smaller degrees of partial melting at much greater depths. The slight bump on the solidus under Vestmannaeyjar suggests that something is affecting the thermal structure of the lithosphere in this area. We'll look at this later, but for now let's summarise what we've uncovered about the eastern rift zone.

In the eastern rift zone, we've seen a much wider range of basalt types we have quartz tholeiites, olivine tholiates and alkali basalts. But there's much more quartz tholiate in the eastern rift zone. Alkali basalt is only found in abundance in the islands of Vestmannaeyjar. Now there's a model that puts all of this together. The eastern rift zone is seen as being a young developing rift which is propagating its way through older, pre-established crust. But we still need to explain what triggers the partial melting deep beneath Vestmannaeyjar that produces alkali basalt primary melts. This is a cross-section from Barõarbunga to Vestmannaeyjar. Notice how much thicker the crust is at Vestmannaeyjar.

Now remember that the eastern rift zone is propagating to the south-west, and two consequences of this are that erupting tholeiites travel in the crust to the south-west and, more importantly, that there is lateral flow of hot mantle towards the south-west. This changes the thermal structure of the lithosphere and the zone of melt generation has only recently reached as far as Vestmannaeyjar. So here is the explanation why silica-undersaturated basaltic magmas are erupted at Vestmannaeyjar.