Island Arc Magmatism: Santorini

Santorini: The Western Island

Narrator:
Moving to a new location, look at the cliffs of Therasia, the western island of the Santorini group. Here we find a fourth Minoan layer away from the caldera walls on the outer slopes of the volcano. This is the Minoan ignimbrite, deposited from pyroclastic flows. Its smooth and gently-dipping surface extends onto a flat, coastal plain. The ignimbrite is poorly stratified, and contains abundant lithic fragments. About twenty cubic kilometres of magma were erupted overall, and since this matches quite well with the volume of the submarine depression in the north, we can be confident that the Minoan eruption produced at least the northern part of the caldera. In fact, there is evidence for two earlier caldera forming events when the volcano 'blew off its top', as it were. So there have been repeated cycles of constructive and destructive volcanism over the last 100,000 years at this island arc volcano. Underneath Fira one of the older caldera depressions is now infilled by Skaros lavas. That's the interpretation for the truncated stratigraphy here. Along the cliff top the Minoan layer is easy to pick out. Look at its thickness. Near to Fira the thickness obviously is irregular due to the quarrying operation. But what happens to its thickness along the traverse as we follow it south round the caldera wall towards the peninsula of Akrotiri? Also en route look out for the road from the port of Athinios which zigzags climbing up the metamorphic basement, which outcrops here. You can recognise the products of Minoan eruption over most of Santorini, and on the Akrotiri Peninsula about ten kilometres from the quarry there's a section that contains the same units as at Fira.

Dr Richard Thorpe:
At the base we have an airfall, which here contains a small break just below its top. It's resting on older, weathered, volcanic rocks, and above the airfall we have this finely stratified surge deposit. Now the interesting thing about this deposit is that the thickness of the units are all less; for example, the airfall is only about thirty centimetres thick in this section, so what volcanologists do is to go to different localities all over Santorini and measure the thickness of the different layers.

Narrator:
If we do this for the airfall deposit a pattern emerges and we can draw contours of the thickness, measured in centimetres. This is an isopach map and it shows that the prevailing winds blew the ash to the south-east. The pattern continues into the Mediterranean to Crete, Turkey and beyond, as these measurements taken from cores in the sea bed reveal. On Santorini the thickest airfall layers must be close to the vent. Its location lies very near the site of the most recent eruptions on the Kameni Islands. The map suggests that the Minoan vent and the modern vent line up along a line of crustal weakness. And the idea receives support from features we find only in the north-eastern corner of the main island. Cutting the northerly lava piles are a swarm of basaltic and andesitic dykes. Some of them fed lava flows at the surface, but have now been exposed by the caldera collapse. All the dykes strike north-east/south-west, parallel with the proposed lines of weakness. You can see the nice jointing extending across the dyke from the margins. This is a really superb example, giving the three-dimensional shape of the dyke. More recent magma passageways than these lie beneath the centre of the caldera and have allowed the volcano to start to rebuild itself following the Minoan eruption. The resulting Kameni Islands are the uppermost part of a 400 metre thick lava shield which first emerged in 197 BC. Since then ten more eruptions have been observed on the Kamenis. All produced lava but at least some discharged ash and noxious fumes.