An Antarctic volcano that just doesn't make any sense

April 7 2015, by Luca De Siena And David Macdonald

Deception wrong-footed scientists three times in ten years, and remains a mystery. Credit: Wikimedia

Only two volcanoes in Antarctica are active. There is Mount Erebus, which is roughly due south of New Zealand, and Deception Island, which lies about 850km south east of Cape Horn.

Mt Erebus has been erupting continuously over the last few decades. Yet the rather smaller Deception Island, in the South Shetland archipelago, is responsible for the largest known eruption in the Antarctic area.

This horseshoe-shaped cauldron-like structure, or caldera, was produced more than 10,000 years ago by an explosive eruption that scattered more than 30km^3 of molten rock. The result is an enclosed welcoming bay called Port Foster.

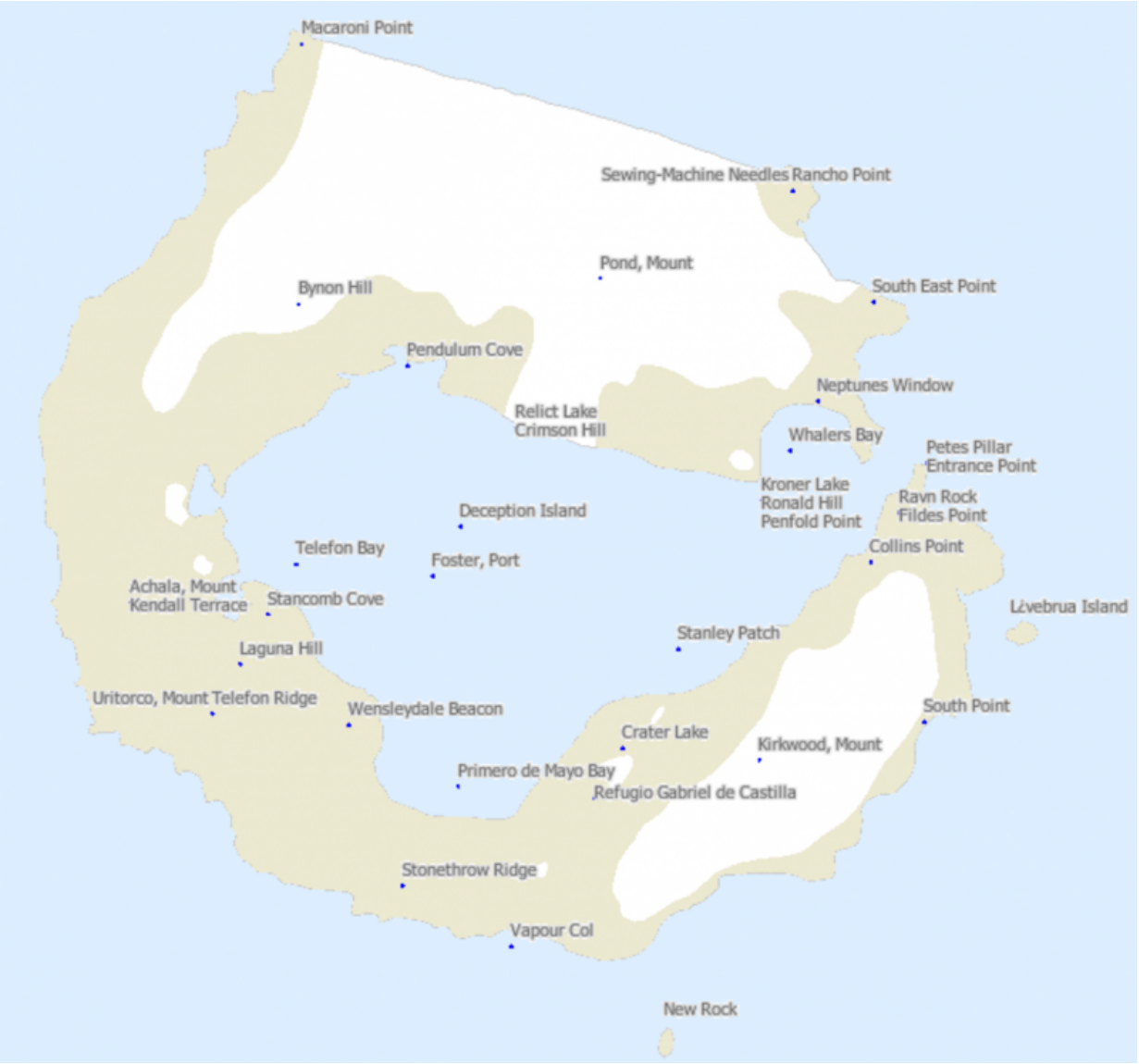
Deception was officially discovered by the British sealing captain William Smith in 1820 and was subsequently used for purposes such as seal hunting and whaling before finding its modern calling as a site for science and tourism. Maybe because you cannot see most of the volcano above the sea, tourists rarely appreciate its hidden destructive potential.

The big blunder

Claimed in the past by the UK, Chile and Argentina, it provides a unique enclosed environment in which to monitor a "volcano under the ice". All three of those aforementioned countries financed observatories there in the 1960s (Spain added its own in 2000).

Yet two consecutive volcanic eruptions in 1967 and 1969 went unpredicted – remarkable failures in the history of volcano monitoring. Only the Argentinian and the Spanish observatories still exist.

Mud from down below



Deception Island from above. Credit: Wikimedia

The volcanic events at Deception fall into a rare category called subglacial eruptions. The island is situated in a place where there is a glacier on the ocean floor about 100m thick. Scientists would normally expect that if this were hit by lava from below, it would evaporate benignly into steam.

But the lava moving upwards at Deception has several qualities that made things happen differently: it moves slowly and it has high water content. This meant that it turned the glacier into meltwater as well as steam, creating a large overflow of mud to the surface. This was the main cause of the destruction of the UK and Chilean stations.

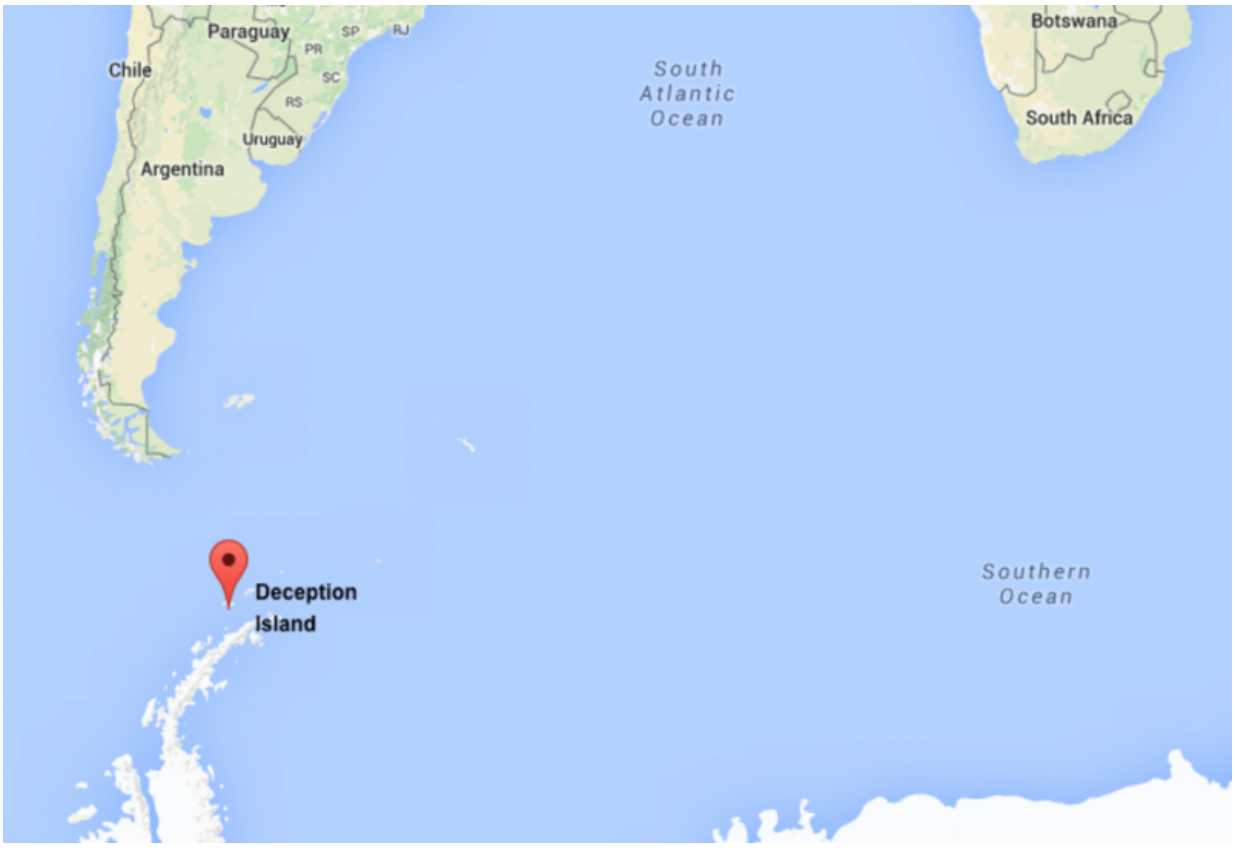
The reason why this melting was unexpected was because in scientific terms the glacier was "deceptively thin". The scientists were not expecting it to produce much more than steam. Ironically, the absence of larger glaciers is what made the island the most hospitable location in Antarctica.

We understand these subglacial eruptions much better now than we did in the 1960s. Nowadays there are hazard maps to make visitors aware of the higher-risk spots on the island.

The Deception enigma

Yet from a volcanic point of view, Deception is a great puzzle. Many volcanoes are caused by subduction, which is where two of the Earth's tectonic plates crash against one another, sending one plate down and pushing the other upwards. A classic example is the Cascade range in the north-western US, whose most famous volcano is Mt St Helens. The ones that scientists have observed happen on land.

Most volcanoes at sea are like Hawaii and the Azores, which we describe as hot spots. Instead of taking place near the points between tectonic plates, these are holes in the ocean floor where there is a direct line to the Earth's mantle. The same goes for submerged calderas in the middle of the ocean, of which there are some examples near Japan.



Credit: Google Maps

For a time, scientists thought that Deception might be an unusual example of subduction happening in the ocean. But a more recent hypothesis is that the South Shetlands may be what we call a rift zone. This would mean that it is on a point where plates meet, but instead of colliding, there are gaps from them moving away from each other, creating new oceanic crust in the process. A good example of a rift zone is the Iceland, as can be seen in the video eruption below.

The hydrocarbon connection

Detailed geophysical surveys have been carried out across Deception

since 2000, mainly financed by Spanish projects. UK geological research on the island has also been extensive.

You may be wondering why governments have spent so much on research there. Don't be fooled into thinking that this is some kind of place of virtue where different nations fund research just to understand how our Earth works.

Rifts fill up with the remains of volcanic explosions and other sediment eroded from the margins of the valley. This process is critical for the production of oil. Located at the western edge of the arc, Deception is the ideal place to observe rift processes because of the natural harbour, which shelters scientists from the harsh Antarctic weather.

Rifting is the reason for all the oil in the North Sea. The oil is not deposited where the rift is located, but some distance away. In the same way, there is almost no likelihood of an oil discovery on Deception. But understanding the process of rifting there will be a strong indication that there is oil to the north of the South Shetland Islands. It would also confer an exploration advantage worldwide – so Deception without oil is as valuable as Deception with oil.

So Deception could be the key to unveiling how rifts form and where oil is, in places where resources are unexploited. In an era where the political claims to the Antarctic have long since receded, that should ensure that this frozen corner of the world remains important for some time to come.

Source: The Conversation