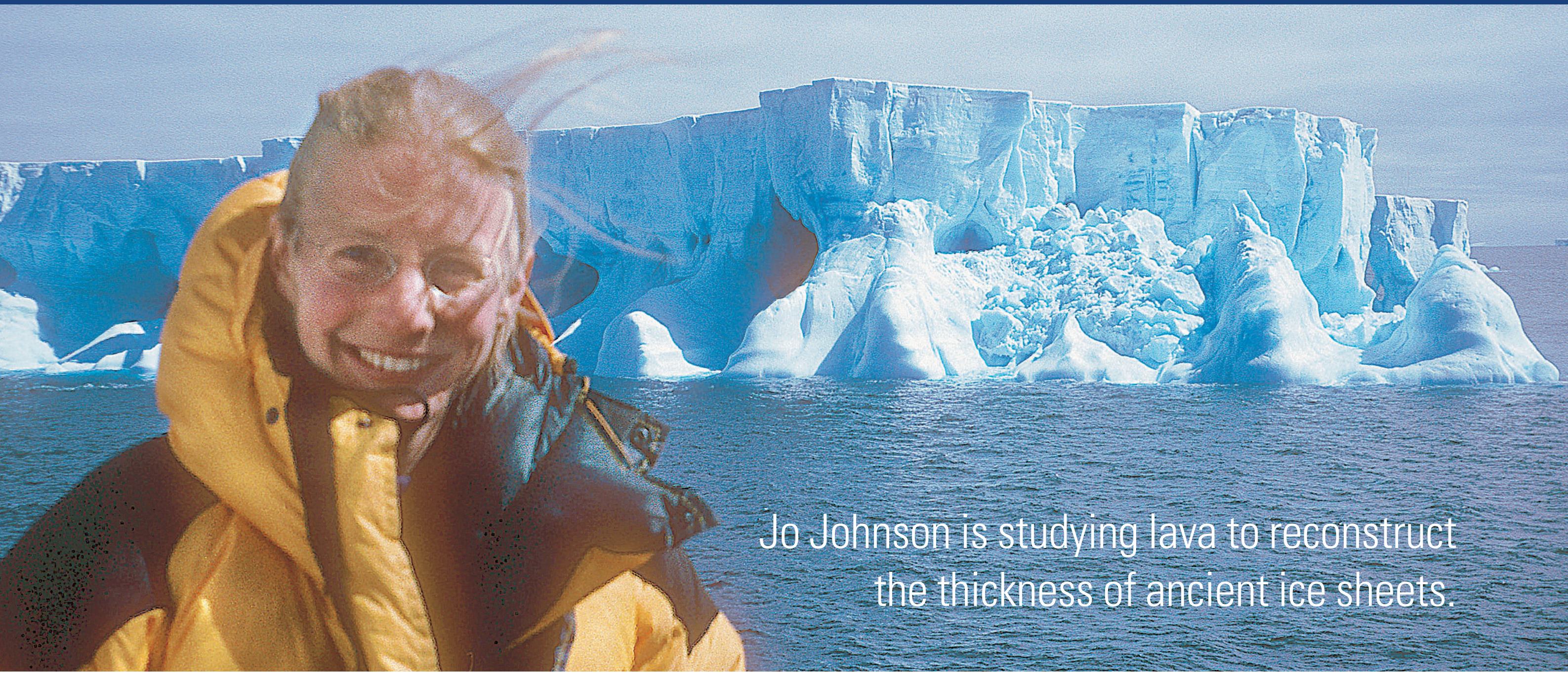
Ancient **Antarctica**



Jo Johnson is studying lava to reconstruct the thickness of ancient ice sheets.

If global temperatures continue to increase, we could be in for a watery existence. Melting the Antarctic ice sheet could produce enough water to raise global sea levels by 60m, engulfing major towns and cities around the world. But is this likely?

My colleague John Smellie and I are studying the signatures past ice sheets leave in volcanic rocks. Looking back may help us look forward.

When lavas erupt into water they cool very quickly and minerals called zeolites crystallise. We've been investigating whether zeolites that formed in seawater and freshwater – usually meltwater from ice – exhibit different chemical signatures. If they do, it should be possible to show whether ice was present when a lava erupted.

> 'Looking back may help us look forward.'

The Antarctic Peninsula is highly sensitive to climate change because it contains steep-sided mountains and rapidly accumulates snow. Within the last decade, several ice shelves on the Antarctic Peninsula ice sheet have collapsed, most notably Larsen B in 2002.

We studied the Mount Haddington volcano that formed James Ross Island, approximately 50km east of the Antarctic Peninsula. Mount Haddington produced huge lava-fed deltas. These have characteristic flat-lying lava caps over thicker layers of broken rock (called breccia). Breccias form when lava erupts into water and cools quickly. We think most of the lavas erupted within ice, but then flowed into the sea.

I looked at samples where I had good field evidence for the eruption environment. For example, breccia lying near fossil shells probably formed in a marine environment, whereas scratched rock surfaces suggest flowing glaciers. To see if the chemical compositions of zeolites matched field observations, I compared them with reference rocks I know formed in salt- or freshwater, using a technique called electron probe micro-analysis.

Several samples matched our field interpretations of ancient environments. A geologically young sample (100,000 years old) was collected high up in a lava-fed delta, very close to, but below the passage zone (the zone between the brecciated lavas erupted into water and the non-brecciated lava erupted into the air – think of it as a fossil water level). In this case, the passage zone was at 600m altitude. We know that sea level was not this high 100,000 years ago; the only plausible interpretation is that the water level must represent ice thickness at that time. So I was delighted that zeolites in this rock appeared to have crystallized in freshwater.

Not all the analyses matched up, and we'll need to do more research. However, our early results suggest that zeolites can indeed tell us about ancient environments. Combined with the age of lavas, this information will allow us to reconstruct ice sheet thicknesses and see how the Antarctic Peninsula Ice Sheet responded to rising temperatures millions of years ago. This might tell us what to expect in the future.

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