Planation surfaces below the Antarctic Ice Sheet

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All continents display large, flat erosional surfaces called planation surfaces. Indeed, planation surfaces are especially widespread on the continents of Africa and Australia. The prevalence of the water-rounded rocks that commonly cap their surfaces suggest these surfaces were formed by a heavy sediment-filled flow of water. Antarctica is no exception to planation features. Nunataks are mountains that stick up above the ice and planation surfaces have been carved on some of these mountains.[1,2]

Now found below Antarctic ice

An airborne geophysical survey was undertaken across the Institute and Möller ice streams, which drain 20% of the West Antarctic Ice Sheet.[3] The ice streams drain into the Filchner-Ronne Ice Shelf marine embayment and are grounded below sea level. Researchers discovered that in the bedrock below the ice, there is a zone of apparently flat and smooth topography between the deeper troughs and basins occupied by the two fast ice streams (figure 1). The smooth topography between ice streams is heavily dissected by U-shaped valleys and is composed of a higher surface and a lower surface, separated by a break in slope, as seen in the longitudinal cross-section (figure 1c). It is probably just one large roughly rectangular planation surface at two different altitudes, covering an area of about 30,000 km^2.

The area is covered by 1–2 km of ice. The bedrock below is folded sedimentary rock with granite intrusions that stick above the ice as nunataks, meaning the planation surface often cuts at an angle to the bedding. The present altitudes of the planation surface range from 200 m to –1,500 m, which if corrected for isostatic depression caused by the ice would have been 600 m to –1,100 m. The mean elevation before glaciation would have been 270 m below sea level. The researchers correctly interpreted the surfaces as pre-glacial.

Planation surfaces have also been discovered below the ice in other areas of Antarctica. The current planation surface under discussion was likely much larger:

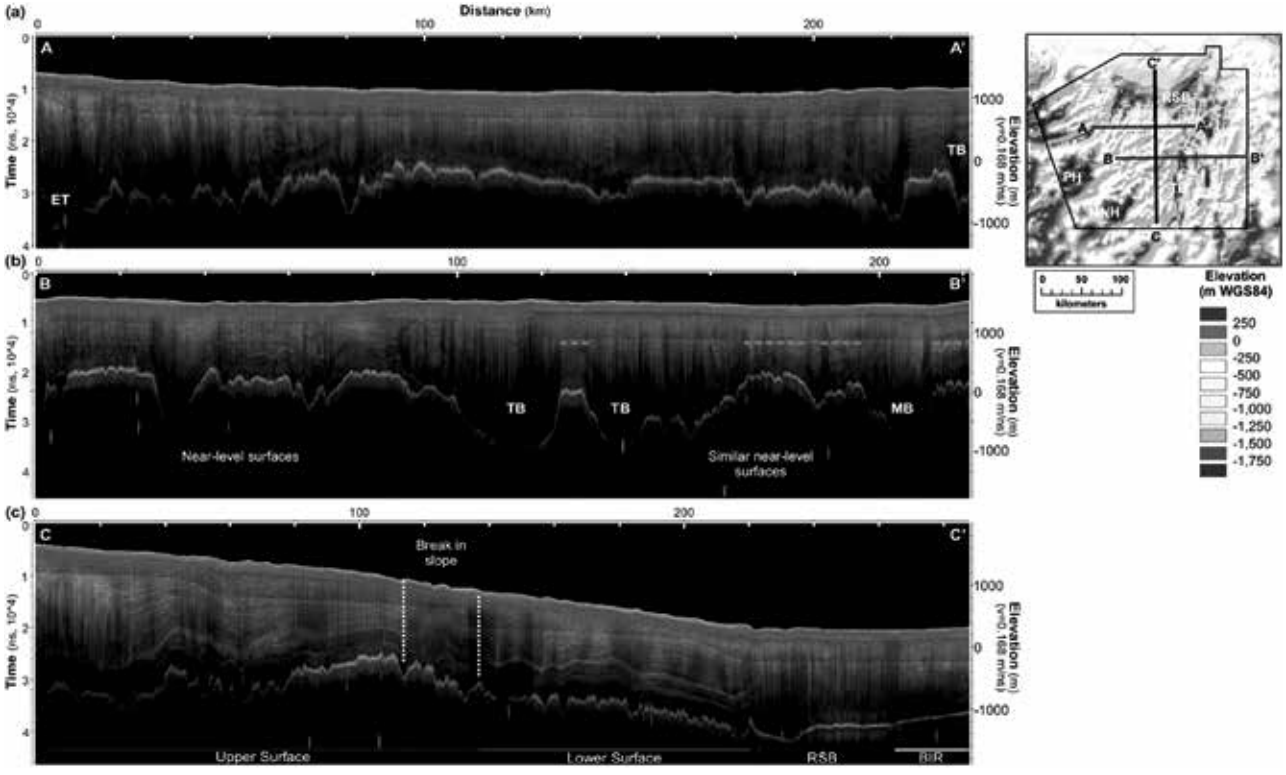

Figure 1. Radar echograms showing the dissected planation surfaces.[3] A–A′ and B–B′ are transects perpendicular to the ice stream flow and C–C′ is a transect parallel to flow, which is left to right. Exact locations of profiles are shown in the upper right. Notice also that the isochronous, volcanic layers in the ice form waves that are generally vertical with the bottom topography. Is this pattern an indication of little ice movement and youthfulness of the Antarctic Ice Sheet?[7,8]

> "Radar echograms, for example, hint at the existence of a more laterally continuous erosion surface extending across the Transitional and Marginal Basins … . As a result, only remnants of this surface, between basins, have remained."[4]

The researchers were puzzled about the origin of such a planation surface. They acknowledged the uncertainty and long debates over the origin of such surfaces. They have two favoured hypotheses: marine erosion or fluvial (river) erosion.

Marine erosion along the coasts of many previously glaciated areas does exist, e.g. along almost all the west coast of Norway. They are called strandflats, but their origin is also a mystery,[5] although marine abrasion is suggested. The problem with using strandflats as an analogue to the planation surface under discussion is that strandflats are only several tens of kilometres wide at most.[6] Moreover, strandflats are near the present sea level. Within the biblical framework, this is best explained by sea ice erosion during the Ice Age, particularly during deglaciation.

The researchers believe that river erosion could have formed planation surfaces. This seems to be the default explanation for planation surfaces worldwide. However, no one has observed the formation of a planation surface except on a very small scale. The only exception is when a river floods and planes its bank, but this is a very local occurrence compared to planation surfaces that are commonly tens of thousands of km^2 in area. The problem with the example under study is that the planing occurred at an average of 270 m *below* sea level. So, the researchers suggest that the area could have been tectonically higher in the past.

Planation surfaces indeed worldwide

The planation surfaces that are observed below the ice in Antarctica are similar to some of those found on other continents, and it could be argued that their formation is of similar origin. Sheet flow during the runoff of the Flood would have flattened the surface and deposited rounded rocks. This would have been followed by channelized erosion. The final phase of the Flood was at a time of differential vertical tectonics that would have broken up and/or eroded large planation surfaces, sometimes down into erosional remnants.

Antarctica is not an exception to the puzzling (for those who hold to uniformitarianism) geomorphological features seen on other continents. The valleys carved into the planation surface are thought to be glacial, but they could easily have been carved by channelized erosion and later modified by ice.

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