Reviewed research article

Removing the ice cap of Öræfajökull central volcano, SE-Iceland: Mapping and interpretation of bedrock topography, ice volumes, subglacial troughs and implications for hazards assessments

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Abstract – *The ice covered active Öræfajökull central volcano forms a mountain range extending south from the central Vatnajökull ice cap, SE-Iceland. The high elevation span (7–2110 m a.s.l.) and extreme precipitation of this coastal part of Vatnajökull results in large mass turnover and high dynamic activity. Here we present bedrock and surface digital elevation models (DEMs) of Öræfajökull ice cap and its many outlets. The bedrock DEM is derived from radio echo sounding profiles and point measurements carried out in 1991–2012, and the surface from airborne LiDAR surveys in 2010–2011. At the centre of Öræfajökull is a ∼14 km^2 caldera containing 4.3 km^3 of ice, reaching ice thickness of 540 m. Most of the caldera drains meltwater eastwards to Kvíá river while the rest drains mainly westwards to Virkisá river. The caldera floor of Öræfajökull is smooth and volcanic mounds and ridges appear almost absent. An exception is a small topographic mound, beneath ∼400 m of ice, near the water divides between Kvíá and Virkisá. The bedrock topography also suggests a separate caldera collapse, ∼6 km^2 and ∼150 m deep, within the main caldera. The subglacial topography implies an older highly eroded caldera north of the Öræfajökull summit (Hvannadalshnúkur 2110 m a.s.l.), similar in size to the present main caldera. The outlets of Öræfajökull, currently in some places up to 550 m thick, have excavated troughs reaching as far as 220 m below current sea level. Based on estimates of the present sediment transport rate in the rivers draining Öræfajökull, and the volume of the troughs, it would take over ∼4000 years to form these troughs. Hence, it is unlikely that they were all excavated during the Little Ice Age. Marginal lakes will continue to grow and new ones form in the troughs as the outlets retreat in the coming decades, assuming current climate conditions or climate warming. The distribution of ice volume and area with elevation is however quite different from one outlet to another, suggesting variable glacier response to changing climatic conditions. A persistent temperature rise of 0.5–1.0°C may cause the lowest outlets to disappear completely, while the outlets with accumulation areas high up at the Öræfajökull caldera will survive even the warmest predicted climate scenarios.*