The high-level peneplains of southern Norway cut across rocks of different resistances to erosion

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The Palaeic landscape of southern Norway was originally defined by Reusch (1901) as the near-flat plateaus at higher elevation than the deeply incised valleys and fjords. We have used the techniques of Stratigraphic Landscape Analysis (Green et al., 2013; Lidmar-Bergström et al., 2013) to show that the Palaeic landscape consists primarily of three extensive low-relief surfaces, incised by deep valleys and fjords and with areas of alpine landscape above the highest surface. These surfaces were first identified by Bonow et al. (2003) in the area that they called the Kjølen Mountains bounded by the alpine Jotunheimen, Rondane and Dovrefjell Mountains.

The highest surface (that we have named the Halling surface) is found only in scattered remnants at altitudes of 1700 to 1900 m above sea level (asl), typified by the low-relief surface found on the Hallingskarvet Ridge. The lowest surface is most extensive on eastern Hardangervidda (the Hardanger surface), at an altitude of around 1200 m asl, but extensive remnants extend north-eastwards at altitudes down as low as 900 m asl from Hardangervidda around Gudbrandsdalen to the Kjølen area. The middle surface (the Joste surface) is found at altitudes of 1400 to 1700 m around the western margins of Hardangervidda and to its north through Skarvheimen and forms the surface supporting the ice caps around Jostedalsbre.

On Hardangervidda, the Hardanger surface coincides approximately with the outcrop of the Base Cambrian Unconformity (BCU) (Japsen et al. 2018) but is cut above remnants of Cambro-Ordovician metasediments (phyllites) where they are faulted or folded down and below the BCU where it is folded or faulted upwards to above the summit of Gaustafjellet.

All three surfaces cut across rocks of different resistances to erosion: Precambrian gneisses, phyllites and overthrust Caledonian nappes. In places an escarpment separates a higher surface eroded into rocks of lower resistance (phyllites) from a lower surface cut into rocks of higher resistance (e.g. Precambrian gneisses). These observations show that the surfaces are independent of the rocks into which they have been eroded and that they must have been formed by erosion graded to an external base level; sea level as there is no other extensive resistant surface. The surfaces are therefore peneplains. A higher surface must also have been uplifted so that the next, lower surface could have formed. All the surfaces must also have been uplifted after formation of the lowest peneplain to start incision of valleys. Isostatic response to the incision would then have lifted them to reach their present elevations.

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