Deep weathering patterns on the Fennoscandian shield in northern Finland

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The nature of the regolith that existed on the shields of the Northern Hemisphere at the onset of ice sheet glaciation is poorly known. In northern Finland, a deeply weathered Late Neogene landscape is exceptionally preserved in the ice sheet divide zone. Using geochemical attribute data of a large percussion drilling dataset of the Geological Survey of Finland, we explore the weathering patterns in this unique area. We use a variant of the Weathering Index of Parker (WIP) as a proxy to assess the intensity of weathering.

The research shows that the topography of central Lapland is closely linked to its geology and structure. All these factors influence weathering patterns. Before the onset of glaciation, resistant granulite, granite, gabbro, metabasalt and quartzite hills had many fresh rock outcrops, including tors, and areas with thin (<5 m) grusses. Plains developed across less resistant biotite gneisses, greenstones and belts of alternating rock types were mainly weathered to thick (10-20 m) grusses with WIP_{fines} values above 3000 and 4000. Beneath valley floors developed along mineralised shear and fracture zones, weathering penetrated locally to depths of >50 m and included intensely weathered kaolinitic clays with WIP_{fines} values below 1000.

Three-part clay-gruss-saprock profiles occurred only in limited areas. In those cases, the weathering profiles reached up to 100 m in depth. Two-part gruss-saprock profiles are widespread, with saprock thicknesses of >10 m. However, incipient weathering and supergene mineralisation also extend to depths of >100 m in mineralised fracture zones.

Although the glacial erosion has been very limited (<20 m) in the ice-divide zone of northern Finland, glacial erosion and local glacial transport have led to widespread incorporation of this saprolith material into tills. Reworked weathered material has a major influence on till geochemistry, heavy mineralogy and the fines fraction of the till matrix. Recognition of this influence is important for minerals prospecting protocols.