Putative Deep weathering profiles in the Arctic

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INTRODUCTION

Weathered rock profiles are widespread throughout Europe, where they form blankets often >50 m thick, such as in the Scandinavian Mountains, Fennoscandian Shield, British Isles, and the central European mountain and upland belts. All of these are characterized by abundance of Mesozoic and Cenozoic geology weathered to kaolinite-rich saprolite. Remnants of deeply weathered basement rocks in Norway occur along structurally defined zones of crustal weakness, where locally-continuous saprolite layers can be up to 100 m in thickness. This likely had a substantial impact on the geomorphological evolution of the topography of Norway, since erosion of the sedimentary succession does not seem sufficient to explain the observed immature Alpine-type topography.

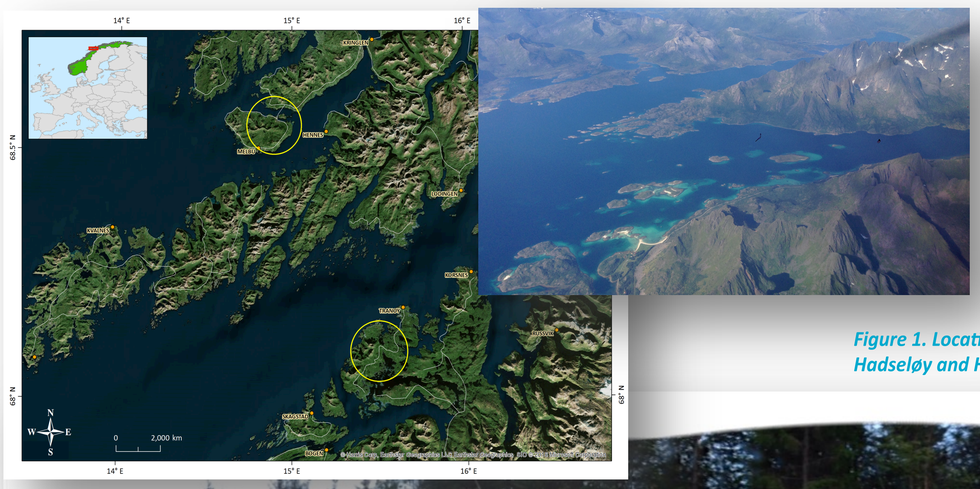

Figure 1. Location and modern landscape in the Hadseløy and Hamarøy sample areas.

RESULTS

On the islands of Hadseløy and Hamarøy (Figs. 1 and 2), two localities within the Arctic Circle of Norway, two sites were studied that display apparently deep weathering profiles up to ~30m thickness, containing relic boulders preserved at different stages of spheroidal weathering. Fresh samples yield andesitic and dacitic geochemical compositions. Mineral compositions comprise of plagioclase and potassium feldspar, varying from ~40-55wt% and ~25-30wt%, respectively, along with quartz 4-11wt%, and minor <3% vermiculite.

In both localities, samples contain Al_2O_3 at ~16wt%, Na_2O at ~5.0wt%, and CaO at ~2.0-2.8wt%. SiO_2/Al_2O_3 ratios vary from ~3.4 to 3.9, and TiO_2/Na_2O ratios display values from ~0.12-0.23 (for Hadseløy) and ~1.6-2.0 (for Hamarøy). Chemical Index of Alteration (CIA) clusters at ~50 in both localities. La/Ce, Y/Ba ratios display no significant variability at ~0.5-0.6 and ~0.01-0.04, respectively; and Zr/Sr ranges from ~0.6-2.5 and ~0.035 in Hadseløy and Hamarøy, respectively. Elemental ratios of mobile to immobile elements do not fluctuate throughout the profiles (Figs. 3, 4 and 5).

Deep weathered profiles?

Figure 2. Weathered profile at Hamarøy.

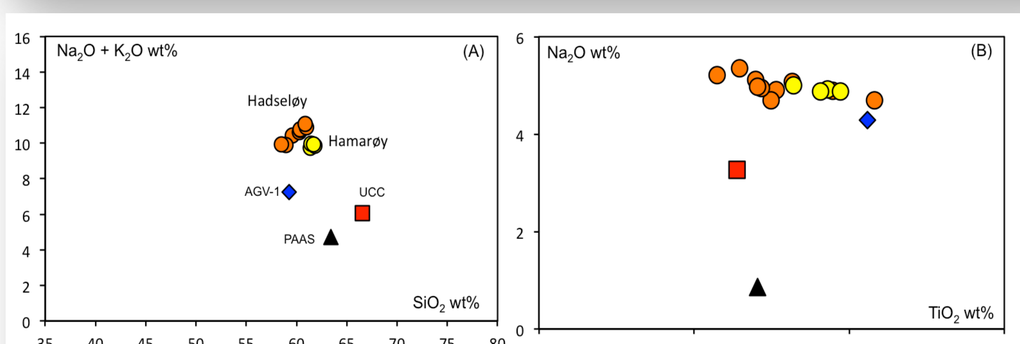

Figure 3. (A), (B), (C), (D) Major oxides variability in the sample sets. (E) Chemical Index of Alteration clustering at ~50 unweathered rock. (E) Sr concentration versus silica content.

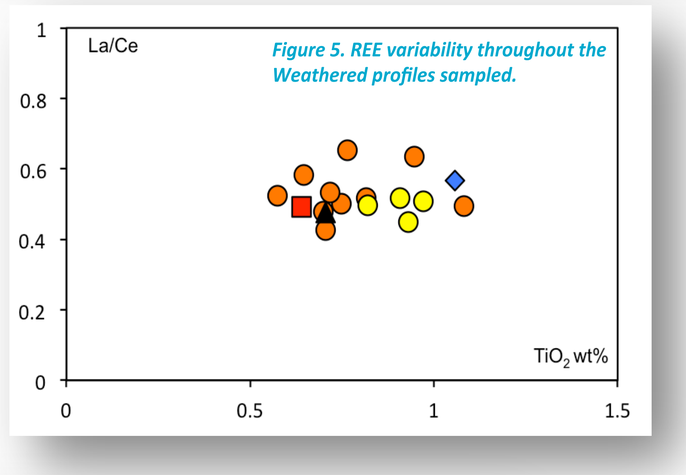

Figure 5. REE variability throughout the Weathered profiles sampled.

Figure 4. Two examples of deep weathered profiles at Hadseløy and Hamarøy.

Conclusion

The Norwegian Arctic landscape displays pockets of deeply weathered profiles, which could represent the remnants of a formerly extensive weathered blanket. These weathered profiles could have been preserved in areas where glacial ice was not erosive or was stagnant. These saprolitic pockets could be the result of grusification of coarse-grained rocks developed on specific palaeolandscape features. Their relationship to weathering processes and climatic changes is uncertain.

FOR FURTHER INFORMATION
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