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A fingerprint of periglacial chemical weathering and its application to blockfield origins

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A review of published literature was undertaken to determine whether a fingerprint of chemical weathering in regoliths subjected to periglacial conditions during their formation can be established. If present, this fingerprint would be applied to the question of when blockfields in periglacial landscapes were initiated. These blocky diamicts are usually considered, from abundances of clay-sized particles and the presence of secondary minerals such as kaolinite and gibbsite, to represent remnants of regoliths that were chemically weathered under a warmer than present, Neogene climate. Blockfields would therefore indicate surfaces that have undergone only a few meters to a few 10s of meters of erosion during the Quaternary, thereby providing a potentially important marker for constructing envelope surfaces and calculating volumes of erosion, attributable, primarily, to glacial processes. In this study, clay and silt abundances and secondary mineral assemblages from blockfields were compared with those in other regoliths, both from periglacial and non-periglacial settings. From this analysis, a fingerprint of chemical weathering in periglacial landscapes was identified. A mobile regolith origin under, at least seasonal, periglacial conditions is indicated where clay(%)≤0.5*silt(%)+8 across a sample batch. This contrasts with a mobile regolith origin under non-periglacial conditions, which is indicated where clay(%)≥0.5*silt(%)-6 across a sample batch. Clay/silt ratios display a threshold response to temperature, or more precisely to the freezing point of water. However, there is little response to precipitation or regolith residence time. Lithology controls clay and silt abundances, which increase from felsic, through intermediate, to mafic compositions, but does not control clay/silt ratios. A range of secondary minerals, which frequently includes interstratified minerals and indicates high local variability in leaching conditions, is also commonly present in regoliths exposed to periglacial conditions during their formation. In contrast to clay/silt ratios, secondary mineral assemblages vary according to regolith residence time, temperature, and/or precipitation. A microsystems model, which captures the 3-dimensional permeability structure of the regolith, is invoked as a conceptual framework in which to interpret the concurrent formation of the observed secondary mineral ranges. According to the fingerprint of chemical weathering in periglacial landscapes, there is generally no evidence of blockfield origins under warmer than present, Neogene climates. Nearly all blockfields in periglacial landscapes appear to be a product of Quaternary physical and chemical weathering. A more dominant role for periglacial processes in further bevelling elevated, low relief, non-glacial surface remnants in otherwise glacially eroded landscapes is therefore indicated.