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Exploring the use of weathering indexes in an alluvial fan chronology

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Alluvial fan sediments can act as an archive of local environmental history. Two borehole cores (FN 350 cm and AG 850cm) from Holocene alluvial fans located in the Qu'Appelle Valley in southern Saskatchewan were analyzed in order to identify how changes in land use of upland catchment plateaus modified the pattern and rate of sediment delivery to the fan.

Due to the lack of material for radiometric dating a chronology of depositional events within the alluvial fans was established by using lithostratigraphy data of soils and sediments. In order to establish a more detailed relative chronology we evaluated if weathering indexes (the Parker Index, the CaO/ZrO_2 molar ratio, the Product Index) originally developed for studies of in situ weathering of bedrock, are suitable to assess sediment weathering within alluvial fan sediments. To quantify the degree of weathering within the sediment samples the three indexes of weathering were calculated using the proportions of elements measure by Energy Dispersive X-ray Spectroscopy and there is an inverse relationship between weathering index and sample age.

For further statistical analyses the fan sediments were classified into three groups: a sheet flow facies of well sorted silt loam and sandy loam textures, bed load facies characterized by high sand and gravel content and layers with high organic matter in combination with higher clay content indicative of in situ weathering and soil development. First results show that the Product Index may be the most suitable weathering index to indicate weathering or input of less weathered sediment within the sheet flow and bed load facies. In general, the weathering indexes do not take into account complexities of the weathering processes nor the overall environmental conditions in an alluvial fan. But chemical weathering indexes accompanied by geophysical and geo-chemical information have value, especially when the amount of sample material is limited.