REGOLITH-LANDFORM MAPPING WITHIN HERRMANNS CATCHMENT, MOUNT LOFTY RANGES, SA

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INTRODUCTION

Hermanns Catchment has been the focus of numerous detailed soil-landscape studies and some mineral exploration interest over the past three decades (CRAE 1975, Fitzpatrick *et al.* 1996, Skwarnecki *et al* 2002, Baker & Fitzpatrick 2003, Merry *et al.* 2002). Much of this research has made important contributions to regolith geoscience. Previous regolith-landform mapping in the area however has been conducted at a very broad scale, and there has been very little geomorphological research conducted in the catchment, giving a very generalized representation of the regolith-landform complexity of the area (Skwarnecki *et al.* 2002). The objective of this presentation is to outline and discuss a detailed regolith-landform map and regolith-landform units (RLUs) that have been recently produced of the area (Figure 1, Table 1). The 2 km^2 catchment includes examples of much of the variety of soil-regolith and landform attributes and processes that exist throughout the landscapes of the Mount Lofty Ranges, and such a map should be of value to further research conducted within the catchment and the wider region.

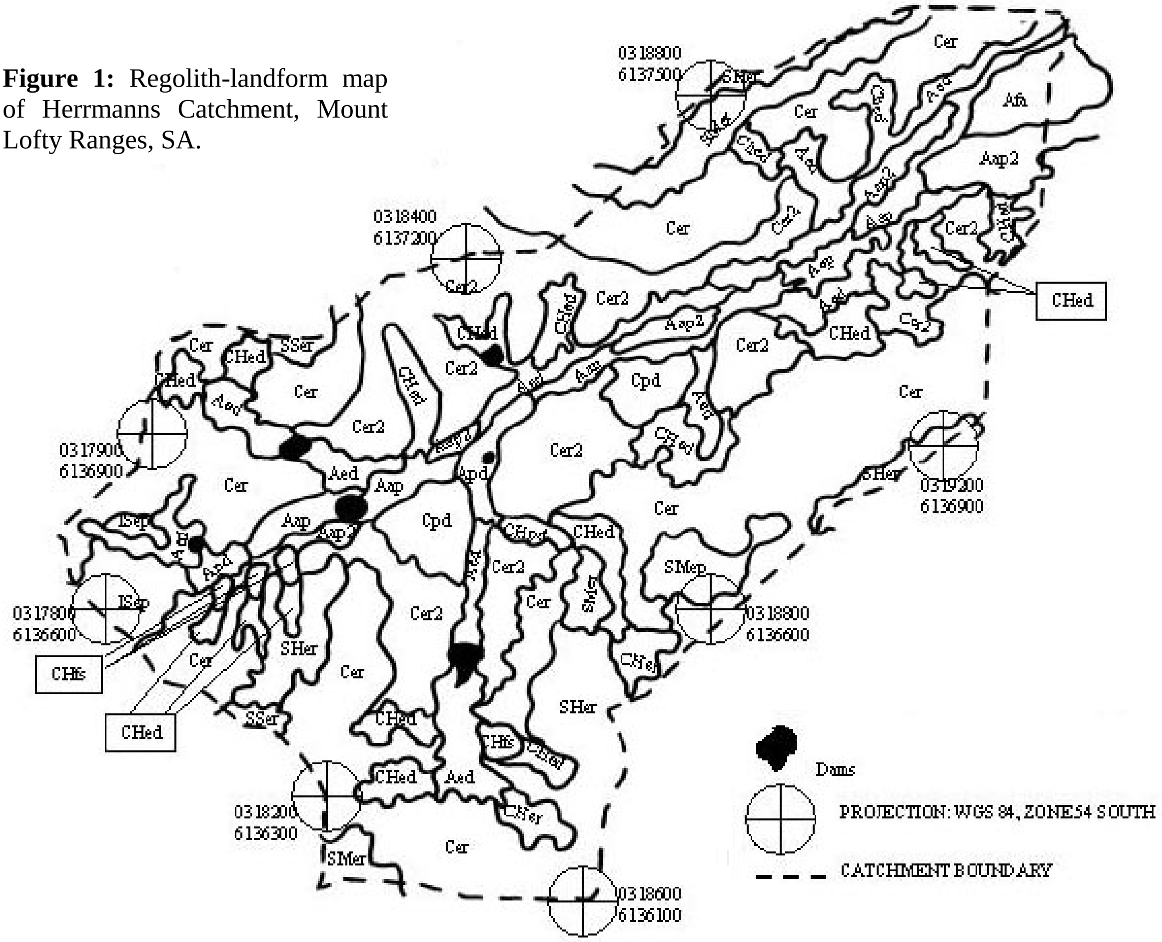

Figure 1: Regolith-landform map of Herrmanns Catchment, Mount Lofty Ranges, SA.

SETTING

Herrmanns Catchment is located 10 km east of Mount Torrens, approximately 45 km east of Adelaide, in South Australia's Mount Lofty Ranges. The catchment includes the Mount Torrens Prospect, which is centred on a minor Pb-Zn mineralisation occurrence within calc-silicate rocks at the base of the Talisker Calc-siltstone (Skwarnecki *et al.* 2002). The Talisker Calc-siltstone has a near-north-south strike and a near-vertical dip and runs through the centre of the catchment. The Backstairs Passage Formation and Tapanappa Formation also strike through the catchment, lying to the east and west of the Talisker Calc-siltstone, respectively (Drexel & Preiss 1995). These rocks are part of the Cambrian Kanmantoo Trough of the

Adelaide Geosyncline, and are erratically covered with deposits of undifferentiated Tertiary and Quarternary sediments (Drexel & Preiss 1995).

PREVIOUS WORK

The main focus of previous research in the catchment has been on inland saline land and saline sulfidic soils, from pedological, mineralogical, hydrological and physio-chemical investigations (Fitzpatrick *et al*. 1996; Skwarnecki *et a.* 2002). The previous work undertaken in the catchment has lead to an understanding of the landscape processes shaping the catchment, and provides a significant example of how science has helped landholders and local Landcare groups to manage landscapes. It has also helped to improve approaches and practices to mineral exploration, and incorporates linkages between the CRC LEME programs of mineral exploration, natural resource management and education & training.

The climate, substrate and topography of the catchment have combined to create two perched wetlands (maximum diameter is approximately 40 m, about 500 m apart) within the catchment. These are supplied with a seasonally variable amount of saline-sulfidic groundwater that becomes geochemically enriched through the weathering of the sulfides and the Talisker Calc-siltstone (Fitzpatrick *et al.* 1996, Skwarnecki *et al*. 2002). This has lead to the development of sulfidic materials associated with acid sulfate soils. These include secondary sulfides containing pyrite and sulfuric horizons of oxidised sulfidic materials containing a variety of oxy-hydroxysulfate and oxide minerals, which precipitate as a result of evaporation (Fitzpatrick *et al.* 1996). Different levels of oxidation of the original sulfidic materials have produced minerals such as jarosite, natrojarosite and plumbojarosite in sulfuric horizons overlying the mineralized zone (Skwarnecki *et al*. 2002). Hematite, maghemite, and goethite occur in Herrmanns Catchment and are associated with the soils and ferruginous saprolite (Skwarnecki *et al*. 2002). Precipitates of ferrihydrite and schwertmannite in stream waters, and halite and gypsum in sandy alluvial sediments also occur in the Herrmanns Catchment (Fitzpatrick & Self 1997). Significant land clearing for agricultural usage has occurred in the catchment, which has resulted in a significant increase in the size of the saline seepage (Merry *et al.* 2002).

REGOLITH-LANDFORM UNITS

Regolith-landform map key shown in Table 1.

Alluvial Sediments

These materials comprise varying amounts of sand, silt and clays situated within predominantly depositional landforms, including active and ancient channels, drainage depressions, plains and wetlands. Exposed lithologies include lithic fragments, dominantly angular quartz and small rounded ironstone gravels in the walls and floor of the incised channels. The landforms containing alluvial sediments exist in the major drainage depressions and grade between alluvial plains, erosional plains, drainage depressions and depositional plains. The main attribute distinguishing these landforms is the landform's slope gradient, where depositional plains have lower slope (and channel) gradients compared to the alluvial plains which contain a mixture of depositional and erosional landforms. By identifying two alluvial plain types (Figure 1, Figure 2 and Table 1) this mapping differentiates between the area containing the active incised stream and the areas surrounding the stream that are still potentially prone to water inundation, and possibly represent palaeo-alluvial plains.

Figure 2: Photo looking southeast from an area in the centre of Herrmanns Catchment (318348E 6136838N). The photo shows an interpretation of the Aap RLU in the foreground, which grades into the elevated ground of a Cpd unit and into the rise of the Cer_2 and Cer RLU in the background.

Colluvial Sediments
These sheetflow and colluvial materials occur on the slopes flanking the catchment, and represent sediment transport that broadly moves down-slope and is not associated with channelised flow. Sand, silt and clays are the main sediment lithologies. The transition between the sheetflow and colluvial units is marked by subtle changes in slope gradient and transport processes. Sheetflow units generally mark areas of shallow overland water flow, whereas the colluvial sediments include materials predominantly mobilised by slope creep, slides and limited flows and falls, most especially associated with steeper slopes. The colluvial sediments grade laterally downslope into alluvial sediments associated with alluvial landforms along the axis of valley systems and drainage depressions.

Figure 3: Photo looking northeast from a position near the only Aep RLU in Hermanns Catchment (0318985E 6137259N). The Aep unit is not seen in the photo, although the transition between the Cer2, Aap2 and Aap RLUs can be seen in the photo. The boundaries of each RLU are highlighted by the angle of slope in the landscape and a change in vegetation.

Aeolian Sediments
Aeolian ascessions have probably occurred across much of the catchment during its landscape development, however, there are several discrete areas that have been interpreted as having been dominated by aeolian deposition. These include well-sorted, rounded and spherical quartz sand-dominated sandplains that are in the western portion of the catchment near the catchment boundary. These deposits appear to be mostly relict and feature eroding margins. Their location conforms to areas where reduced erosion has facilitated a locally greater preservation potential of these materials.

Weathered Bedrock
These units include the exposed bedrock on moderate relief rises and slope areas. Criteria to distinguish between moderately weathered and slightly weathered rock were based on the degree of ferruginisation, as well as how easily the exposed rock breaks (with less weathered units containing fewer weathered minerals, less ferruginisation, and if not ferruginised are generally more easily fragmented). The exposures of the Kanmantoo Trough bedrock types and the ferruginous saprolite mapped by Skwarnecki *et al* (2002) are included in these weathered bedrock units. The weathered bedrock is mostly exposed in the higher parts of the catchment, in association with erosional landforms.

DISCUSSION
The previously completed RED scheme regolith-landform map, geological outcrop maps (Skwarnecki *et al*. 2003), and soil maps (Fitzpatrick *et al*. 1999) were compared to the regolith-landform map created in this study (Figure 1 and Table 1). The regolith-landform map in many parts of the catchment includes similar polygon boundaries and shows equivalent broad landscape features to those shown in many of the previous maps, such as saline scald areas and upslope encroaching drainage depressions. The mapped Aed RLUs in this exercise show consistent correlation with the Aquic Haploxeralfs soil taxonomy units detailed in soil maps by Fitzpatrick *et al*. (1999). Many additional features included on the new regolith-landform map were delineated by very subtle landform attributes, such as breaks in slope as well as subtle lithological differences (Figures 1-3).

CONCLUSION
Interpretations from this work show that a regolith-landform mapping framework includes features traditionally included on geology, topographic, and soil maps. This is largely because the regolith represents the interface within which geology, biology, pedology and hydrology (to name a few) interact. Thereby, a regolith-landform map exists as a tool to add to landscape information and can prove informative at any stage within an investigation. With regard to Herrmanns Catchment, regolith-landform information has proven

valuable to understanding the soil processes/pedogenesis, origin of saline and sulfidic seepages and eroded soil features.

Acknowledgements: Rob Fitzpatrick provided the motivation to work in the catchment and to test the viability of a Regolith-Landform map within such a terrain. The abstract has also benefited greatly from his comments. We hope that Rob and others in his research team find value in this new map. Rob also developed the strong relationships with the landholders in the catchment, thus allowing access to properties. Discussions with Mark Thomas and Andrew baker have also proved extremely valuable. CRC LEME and CSIRO are also thanked for their support.

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Table 1: Regolith-landform map key

WEATHERED BEDROCK

$SSer_1$ – Slightly weathered bedrock on an erosional rise. Dominated by slightly ferruginised saprock with minor quartz veins.

$SMer_1$ – Moderately weathered bedrock on an erosional rise. Dominated by ferruginous saprolite and quartz veins, with minor colluvial sediments.

$SMep_1$ – Moderately weathered bedrock on an erosional plain. Dominated by ferruginous saprolite, with minor quartz clasts derived from quartz veins. The landform is in the higher topographic areas, with low slope gradients and topographic relief (erosional plain).

$SHer_1$ **–** Highly weathered bedrock exposure on an erosional rise. Dominated by highly ferruginised saprolite, with minor quartz clasts derived from quartz veins and sporadic large (1-5 m diameter) quartz vein outcrop.

COLLUVIAL SEDIMENTS

Cer_1 – Colluvial sediments on an erosional rise. Light-brown silt and sand on the upper slopes of rises. Dominated by poorly sorted, angular lithic fragments. Vegetation is dominated by pasture, with some stands of eucalypt trees.

Cer_2 -Colluvial sediments on an erosional rise. Light-brown silt and sand within the footslope of rises. Dominated by angular lithic fragments. Vegetation is dominated by pasture, with sparse eucalypt trees.

Cdp_1 – Colluvial sediments on a depositional plain. Red-brown sandy loam on small terraces at the foot of slopes and flanking alluvial systems.

$CHer_1$ – Sheetflow sediments on erosional rise. Light-brown silt and sand on a moderate relief slope.

$CHed_1$ – Sheetflow sediments within a drainage depression. Light-brown silt and sand within the head of gully and drainage systems.

$CHfs_1$ – Sheetflow sediments within sheetflood fans. Dark-brown sandy loam within small intersection point fans at the terminal end of small drainage depressions.

AEOLIAN SEDIMENTS

$ISep_1$ – Aeolian sand on erosional plains. Red-brown well-sorted and rounded, quartzose sand on a low relief landscape facet. Surrounded by eroding margins.

ALLUVIAL SEDIMENTS

Apd_1 – Alluvial sediments on a depositional plain. Dark-brown clays, silts, sands and gravels on a broad, low-relief fan shaped depositional area. Minor, small incised channel, exposing sediments with angular lithic clasts (25-50 mm diameter). Vegetation is dominated by a wetland community with sedges and small eucalypt trees.

Aed_1 – Alluvial sediments within a drainage depression. Red-brown sands, silts and clays within gullies and small valleys

Aap_1 –Alluvial sediments within an alluvial plain. Sand, silts and clay associated with the main drainage channel and adjacent depositional plain and channel lags. The channel is incised and varies between being meandering and straight in sections.

Aap_2 – Alluvial sediments within an alluvial plain. Light-brown quartzose silt and sand on low relief depositional landforms associated with the incised stream channel. Grasslands are the dominant vegetation community, with sporadic (> 1 m trunk diameter) eucalypt trees.

Aep_1 – Alluvial sediments on an erosional plain. Yellow micaceous clay within a low relief erosional scald area. White and brown mottled surface crusts, and minor angular lithic clasts (5 to 50 mm diameter). Minor incised drainage channels. Sparse vegetation cover, with very minor patches of native grasses and eucalypt trees.

Afa_1 – Alluvial sediments within an alluvial fan. Brown sand, silt and clays on less constrained floodout zones, downstream from channel intersection points.