COLLUVIAL SLOPES: NOT NECESSARILY SIMPLE REGOLITH-LANDFORM UNITS

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Colluvial slope landforms are characterised by low slope angles and smooth texture, i.e., they are not lumpy. They are reasonably easy to identify from stereo airphotos, ground observation, high quality DEMs and other forms of remote sensing. Once you have found a colluvial slope it is not difficult to draw a map polygon encompassing the slope, label it, and write a map reference description based on the fact that you have recognised the landform and the sort of regolith that should be present. Let's face it, if it is a colluvial slope, it should have colluvial deposits on it. So your map description may say:

'Sheetwash colluvium deposited on low angle colluvial slopes.'

Technically correct, but how useful? Is the colluvium sandy, clayey, gravelly? How does it hold/transmit water? If you've kicked a bit of the soil or dug a shallow pit or hand-augered a hole you might have an idea of the texture of the colluvium. If it's full of gravel you might say 'gravelly' or 'coarse textured' in your description. Thus a farmer using the map might know to expect difficult tilling conditions. But what about what is between the gravelly bits. Is there air, sand or clay between the lumps? Adding the matrix composition (if there is a matrix) will tell a land manager a bit more about the hydrological properties of your (and his) colluvium. But if you really want to make a good job of your map, and know what is happening at depth beneath our colluvial slope, you might have quite a job in front of you.

But why should you want to know what is going on at depth? If you have described what materials are present near the surface, and provided a landscape description, that might be good enough for many situations. If the landscape has evolved simply, and the materials are in-phase with the landscape, you may have hit it lucky, and what is at the surface will reflect what is happening at depth. But if there has been a complex landscape history, the chances are that monsters may lurk beneath your simple colluvial slope, and the surface will not be the key to the depths.

Why should we know about the depths? This is the location of the factories that contribute to geochemical anomalies or the stores that hold salt and water. No point in doing standard geochemical sampling if your colluvial slope masks 30 m of Cenozoic sediment before you get to prospective basement, or modelling simple water and salt flow through a slightly porous medium when there are palaeochannels hidden by the simple slope.

This might all sound a bit far fetched, but there are plenty of surprises when you start burrowing into the literature, or drilling holes in what appear to be simple situations. And of course the key is that slowly evolving landscapes as we have in Australia seldom have a simple history, and surface form may well be out of step with preserved surficial materials.

Two examples of materials beneath colluvial slopes that would not be easily predicted from simple surface observation follow, based on data from holes drilled by Geoscience Australia.

BROKEN HILL

Deep crustal seismic surveys carried out by the Australian National Seismic Imaging Resource (ANSIR) use truck-mounted vibrators for their wave energy, but used to rely on explosives in drill holes. Two seismic lines shot across the Broken Hill region in 1996 used 40 m holes spaced at 240 m distance for explosives. The GA Broken Hill hard rock project actually had the foresight to employ the author to collect and describe cuttings samples from these holes. A north-south line south of Broken Hill included a nine km long colluvial slope, characterised by red loamy soil and lag with vegetation arranged in a "tiger stripe" or contour-banded pattern. Basement outcrop was present at the top of the slope, and around a creek at the base of the slope. If might have been a reasonable assumption that weathered basement rocks were present beneath colluvial soil throughout the slope. However, the drilling revealed that 24 holes from the middle to lower parts of the profile intersected Cenozoic sediments reaching at least 40 m thick in nine of the holes. The transect had crossed a Tertiary palaeovalley filled with sediments at the edge of the Murray Basin. It should be obvious that while it might be worthwhile carrying normal geochemical soil sampling over parts of the slope that

In: Roach I.C. ed. 2004. *Regolith 2004.* CRC LEME, pp. 101-102.

were underlain by shallow basement materials, the area underlain by Cenozoic sediment over basement would require different sampling techniques.

WELLINGTON

CRC LEME has carried out investigations into regolith thickness and composition in the Wellington area this year, in order to help fine tune how salt is stored in an agricultural landscape. As part of the work, shallow aircore holes drilled to rig refusal were located in transects across valleys, samples of cuttings were analysed for salt and moisture content and ground conductivity was measured by downhole wireline logs and ground EM. Several of the drill holes intersected palaeovalleys below colluvial slopes filled with gravelly sediment with a clayey to sandy matrix and regolith carbonate. For the most part the slopes were underlain by soil about one metre thick directly over saprock, but the palaeochannel deposits were tested to be at least 12 m thick by drilling, and the ground EM suggests that maximum thickness may be > 20 m.

This material is expected to differ greatly in hydrological properties from the local bedrock (Silurian andesitic volcanics) and saprolith. EC 1:5 values up to 375 µS/cm are present, and it is concluded that this material could form both an important salt store and a water conduit. Thus its presence or absence is crucial in modelling water flow through the area, and predicting where salt stores lie.

In hindsight these deposits might have been recognised from careful surface observation. The ground surface has a lag of scattered stone, similar to other parts of the slopes, but some of the clasts are rounded, and not of the lithology of local bedrock. More importantly, radiometrics may help determine the distribution of the palaeochannels. The area around the known palaeochannels has a lower K/Th value than the surrounding areas underlain by andesitic volcanics. A ratio of 3.5 seems to be a reasonable differentiator—below this indicates palaeochannel sediment, above this indicates basement. This is yet to be field checked.

Acknowledgements: The author publishes with the permission of the CEOs of Geoscience Australia and CRC LEME, and thanks Colin Pain and Jonathon Clarke for reviewing this manuscript.