LITTER DAMS: A NEW METHOD OF MAPPING SURFACE DISPERSION VECTORS AT THE WHITE DAM PROSPECT, CURNAMONA CRATON, SA

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INTRODUCTION

A novel approach to measuring surface dispersion vectors has been developed at the White Dam Au-Cu prospect in South Australia. The use of 'stick dams', also known as 'litter dams', has allowed for the mapping of surface dispersion vectors to accompany detailed (1:2,000) regolith-landform mapping. This can also be used as a tool in interpreting geochemical results in areas of shallow transported cover and subdued topography. This work is part of a PhD project integrating regolith geochemistry, biogeochemistry and regolith-landform mapping, with an aim to improve the understanding of the expression of mineralisation in areas of shallow transported cover.

BACKGROUND

The White Dam Au-Cu mineralisation is 30 km NE of Olary, South Australia. The mineralisation is hosted in biotite-bearing quartzo-feldspathic gneiss of the Wiperaminga Subgroup of the Palaeoproterozoic Willyama Supergroup, with Au concentrated in biotite-rich selvages and leucocratic bands and veins within the gneiss (Cordon 1998). Compared with other Au-Cu prospects in the district, the White Dam mineralisation setting has relatively low Fe contents and does not show elevated levels of As, Ag, Ni, Cd, Sb or Pb (Cordon 1998). Although the cover thickness to mineralisation is <2 m, much of the mineralisation was not detectable by traditional soil geochemistry, with only a sub-cropping, weakly mineralised 'tail' of the mineralisation initially detected (Figure 1 point B). The sub-cropping portion of the mineralisation occurs on the upper slope of an erosional rise with shallow regolith. The landscape is dominated by shallow overland flow (sheetflow) deposits. These typically have a distinctive 'contour-band' surface pattern consisting of irregular sandy bands vegetated by bladder saltbush (*Atriplex vesicaria*) and black bluebush (*Maireana* spp.) between bands of sparse vegetation cover and pebbly surface lags. Litter dams occur around the contour-banded vegetation and on the interbands.

LITTER DAMS

Litter dams are collections of surface organic fragments including leaves, twigs and macropod droppings that have been dispersed and accumulated due to shallow overland flow (predominantly sheetflow). They mostly exhibit a curved, convex-downslope form and occur on a range of landforms within a variety of climates from tropical to arid. They occur on steep to very gentle slopes and may be ephemeral or remain stable for more than a decade (Eddy *et al.* 1999). The main controlling factors on litter dam formation are slope gradient, litter supply and rain fall event intensity, and the main control on the orientation of the convex down slope shape of the litter dams is slope gradient and subsequent surface water flow direction. At White Dam, litter dams are 10s of cm to 1 m long. Due to their relatively small size they are sensitive to subtle slope changes, and therefore to subtle variations in micro-topography in areas of subdued topography. These changes are important to constrain when characterising surface dispersion vectors.

At White Dam, litter dams occur on flat, sparsely vegetated plains, low erosional rises and hills. The litter supply from the chenopod shrubs in the area appears to be the main limiting factor controlling the presence or absence of litter dams at a particular site. Previous work has looked at litter dams from the perspective of revegetation of fire affected landscapes (Mitchell & Humphreys 1987, Eddy *et al.* 1999) and their influence on the erosive effects of raindrops, and the ability to act as sediment traps (Geddes & Dunkerley 1999). Koop (2001) found that litter dams formed from sclerophyllous vegetation were a self-maintaining feature of the landscape and acted as a detailed-scale equivalent to vegetation banding, exhibiting the same hydrological characteristics and forming due to the same processes. Field observations at White Dam support the scale equivalence and self-maintaining characteristics of litter dams formed from chenopod-derived litter.

METHODOLOGY

The methodology for determining surface dispersion vectors from litter dams, involves aligning a compass along the central axis of a curved litter dam, and taking a bearing in the direction of the downslope convexity (Figure 2).

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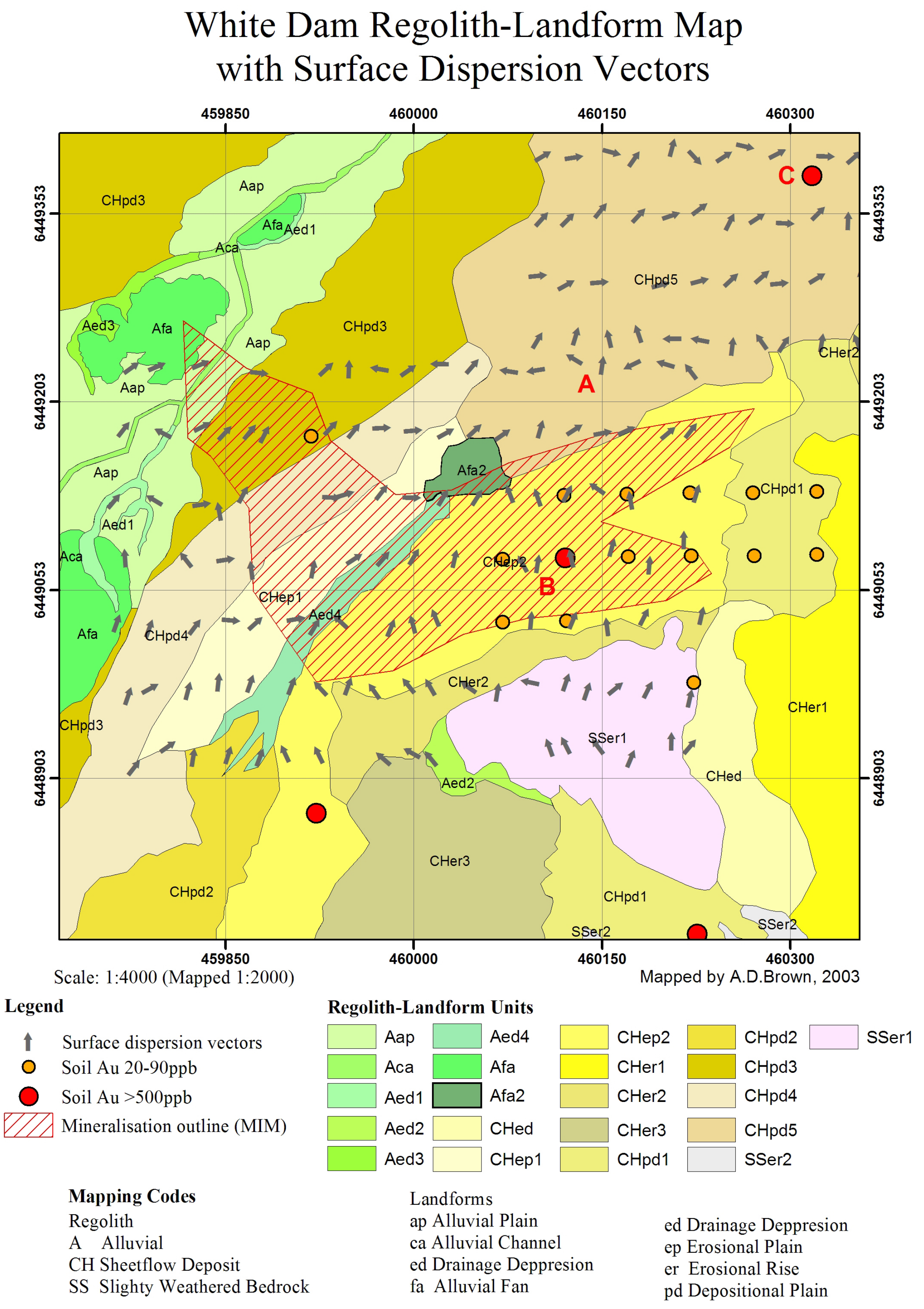

Figure 1: Regolith-Landform map of White Dam Prospect, South Australia. Surface dispersion vectors shown as grey arrows. Point A highlights an area where a previously unmapped erosional rise that was detected by changes in dispersion vectors. Point B shows the location of subcropping mineralisation. Point C indicates a transported Au anomaly on a depositional plane.

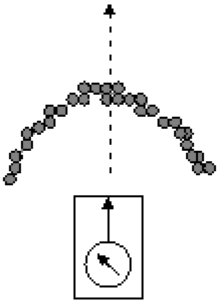

Figure 2: simplified illustration of a litter dam, with a compass aligned along the central axis of the convex downslope curve to measure the orientation of the dispersion vector.

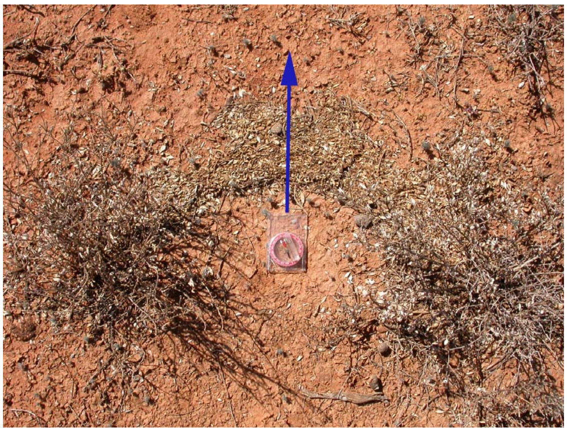

Figure 3: a litter dam located between two bladder saltbushes, composed of leaves, twigs and macropod droppings, with blue arrow indicating the dispersion direction.

The ideal litter dam for measuring dispersion vectors has a well-formed, convex-downslope shape (Figure 3), allowing for confident alignment of the compass along the central axis of the curve. Some litter dams may show multiple downslope convexities (Figure 4, 5). In practice this ideal shape may not be present at all sites, however a convex-downslope direction can almost always be determined, and a bearing taken. When selecting a less than ideal litter dam, it is important to carefully align the compass along the axis with respect to the convexity in the downslope direction (Figure 6).

At some locations litter dams may form as elongate shadow deposits behind vegetation or other obstacles. If no other litter dams are present these can be used by taking a bearing along the long axis of the deposit.

Litter dams are a sensitive indicator of water flow directions, and when dealing with small dams in areas of uneven micro-topography, it possible to find a number of dams with some variation in orientation. In these cases it is best to select a dam for measurement that is most representative of the range of orientations at that site. This can be done by taking a large number of measurements from a given site and deriving an average or median measurement (Figure 7).

Figure 4: Litter dam composed of leaves twigs and macropod droppings, with multiple downslope convexities indicating dispersion direction.

Figure 5: Another example of litter dams showing multiple downslope convexities.

An initial sampling of 100 litter dams was undertaken in area of 150 x 320 m, covering a range of landforms with strongly discernable to weakly discernable surface flow vectors to develop and test the method. The results from this initial work correlate well with the orientation of features such as drainage depressions, slopes and low rises in the area, and are able to highlight internally consistent flow vectors in areas of extremely subdued topography such as alluvial and depositional plains.

Litter dam measurements were taken every 25 m along east-west lines with 50 m line separation, spaced to coincide where possible with the locations of surface soil and bladder salt bush samples taken for chemical analysis over the White Dam mineralisation. As litter dams were not present at all sampling sites, measurements where taken as close as possible to each sampling point or omitted if not present.

Figure 6: Litter dam with more subtle convexity, compass is aligned along central axis and parallel to flatter curve.

RESULTS AND DISCUSSION

In total, 162 surface dispersion vectors were recorded at 50 x 25 m spacing, to include the 50 x 50 m geochemical sampling grid, and a large depositional plain to the northeast. These vectors were plotted in ArcGIS and overlain on a 1:2,000 regolith landform map (Figure 1). The dispersion vector measurements show a predominantly northerly dispersion from the erosional rise where mineralisation was indicated by MIM's geochemistry, and a range of north to east trending dispersion vectors in low-lying areas where the mineralisation is covered by up to 2 m of regolith. By plotting the vectors as arrows (Figure 1), it is possible to follow dispersion pathways across the landscape, and to identify variations in micro-topography that may not have been identified during field mapping that are less than the resolution of most digital elevation models (DEMs).

An example of the identification of features not initially mapped occurs at near the southern extent of CHpd5, which is the large depositional plain in the NE of the map. The east-west line of vectors above point A in Figure 1 show a distinct change in orientation of the vectors to the N and S, and follow up field work has shown that there is a low rise within the plain that was not noticed during initial mapping. Another approach to analysing the surface dispersion vector data has been to plot the vectors as rose diagrams to graphically portray the dominant flow directions. An example of this approach is shown in Figure 7, which is the rose diagram for all the data taken across the White Dam area. This diagram shows that the most dominant flow directions are to the NNE with a range of flow vectors approaching the NE. There are also significant populations of NNW and easterly flow vectors. Rose diagrams have also been plotted with the data grouped by the regolith-landform unit that they occur within, and this highlights variations in flow vectors between regolith-landform units.

Currently methods such as contouring the data or generating flow surfaces are being used to identify ‘domains’ of comparable flow. Figure 8 shows a preliminary example of this approach, with an inverse distance weighted surface that has been generated using 16 equal interval divisions of the surface dispersion vectors. Areas with a west to north-north-west flow appear in blue and are quite distinct from the predominantly north to east flow shown in red tones.

IMPLICATIONS FOR MINERAL EXPLORATION

Traditionally the plotting of surface dispersion vectors has been done by generating dispersion maps from digital elevation models (DEMs), or from estimates during field mapping. The mapping of dispersion vectors from ’litter dams’ give the exploration geologists a simple and direct method, that can be used at scales beyond the resolution of DEMs currently available, and is both detailed and accurate. The information gained by mapping surface dispersion vectors allows for greater confidence in analysing geochemical results and has the potential to save time and money by allowing for the identification and lower ranking of transported anomalies, especially when used as a data layer in conjunction with detailed regolith-landform maps.

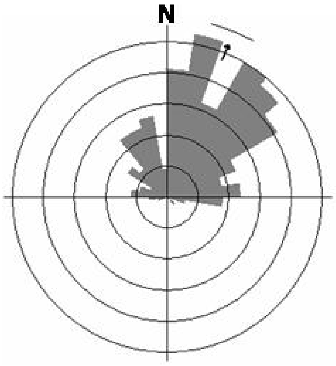

Figure 7: Rose diagram of all dispersion vectors recorded over White Dam, with mean arrow and error range shown. Diagram shows the dominant NNE and NE flow vectors, with significant flows also to the NNW and E.

FURTHER WORK

Continuing work at White Dam will integrate geochemical and biogeochemical results and surface dispersion vectors, to improve the interpretation geochemical data and the expression of mineralisation in areas of shallow transported cover.

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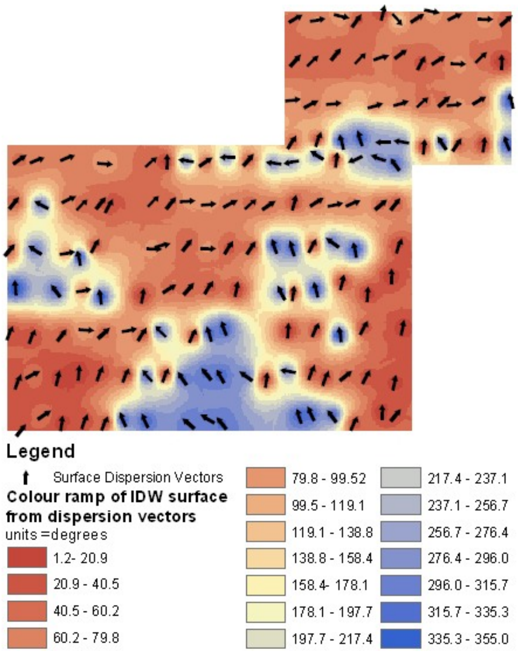

Figure 8: An inverse distance weighted surface generated from dispersion vectors. Blue areas show flow to the W-NNW that is distinct from the more dominant N-E flow over the prospect.

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