LOW-DENSITY GEOCHEMICAL SURVEY OF THE RIVERINA REGION, SOUTHEASTERN AUSTRALIA: RESULTS AND APPLICATIONS

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INTRODUCTION

Low-density geochemical surveys provide a cost-effective means to assess the composition of near-surface materials over large areas. Many countries in the world have already compiled geochemical atlases based on such data. These have been used for a number of applications, including:

- Establish baselines from which future changes can be measured;
- Design geologically sensible targets for remediation of contaminated sites;
- Support decision-making regarding appropriate land-use;
- Explore for natural resources; and,
- Study links between geology and plant/animal health (geohealth).

A pilot project was initiated to help establish sampling and analytical protocols relevant to Australian landscapes and climates. The Riverina region (Figure 1) was chosen for this study because of its crucial economic, environmental and societal importance within the Murray-Darling Basin. The region is a prime agricultural area, is bordered to the south by the Victorian goldfields and is home to 11% of the Australian population. Results of this study are presented here.

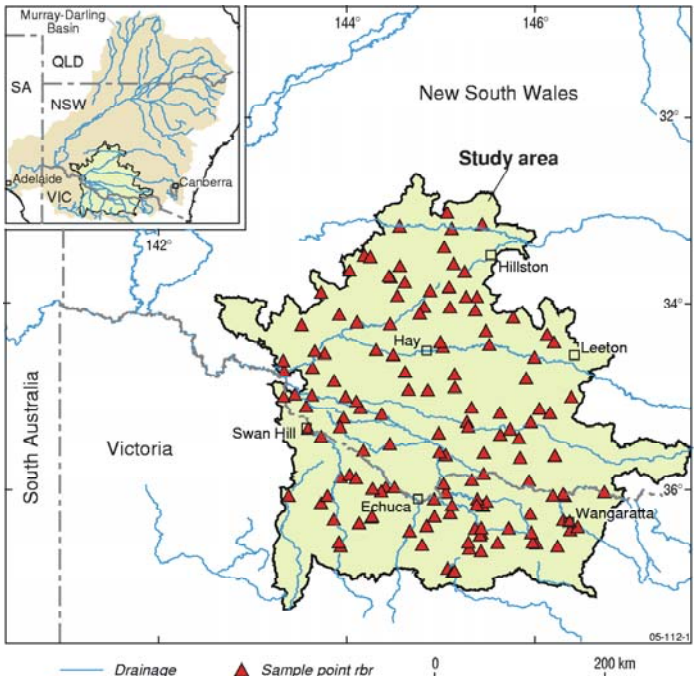

Figure 1: Location of the Riverina region and sampling sites.

METHODS

Using a hydrological analysis, 142 sites near the outlets of large catchments were selected within the 123,000 km^2 survey area (1 site per 866 km^2 on average). At each site, two 10-cm thick overbank sediment samples were taken, one at the surface ('top overbank sediment', TOS) and the other between 60 and 90 cm depth ('bottom overbank sediment', BOS). These were described, dried, sieved (< 180 µm) and analysed for 62 elements. Exploratory data analysis was undertaken and geochemical maps (various styles are shown here) were prepared.

RESULTS & DISCUSSION

The geology of the area is dominated by Cainozoic sediments found in low-relief plains over the vast majority of the Riverina. The eastern and southern fringes of the area form higher relief landforms developed on outcropping or subcropping Palaeozoic sedimentary, mafic and felsic volcanic and felsic intrusive rocks.

The geochemical results of the survey are independently corroborated by the good match between the distributions of K, U and Th concentrations in TOS and airborne gamma-ray maps (Th shown on Figure 2).

The distribution of Ca in BOS (Figure 3) indicates generally higher concentrations in the northern part of the study area, which is also reflected in higher soil pH values there. Such data have implications for soil fertility and management in agricultural areas.

In: Roach I.C. ed. 2005. *Regolith 2005 – Ten Years of CRC LEME.* CRC LEME, pp. 35-37.

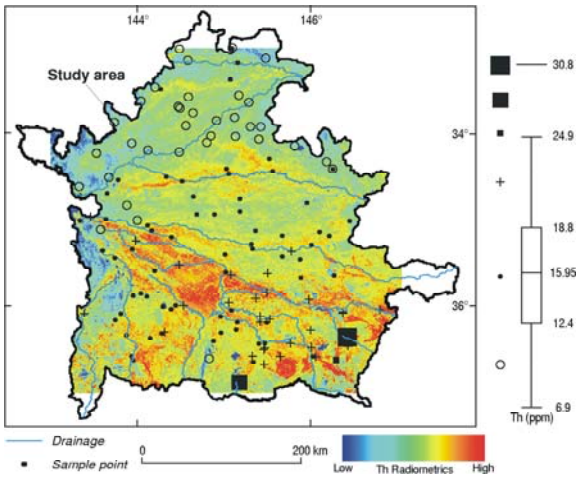

Figure 2: Geochemical map of total Th (ppm) in TOS Riverina overbank sediment samples analysed by Instrumental Neutron Activation Analysis (symbols) overlain on airborne gamma-ray Th distribution (colours). Airborne data from the Departments of Primary Industries of Victoria and New South Wales. The boxplot scale shows the minimum value (lower whisker), 25th percentile (lower hinge, or edge of box), median (centre of box), 75th percentile (upper hinge), 1.5 x hinge spread above upper hinge (upper whisker) and outliers (values >1.5 x hinge spread above upper hinge).

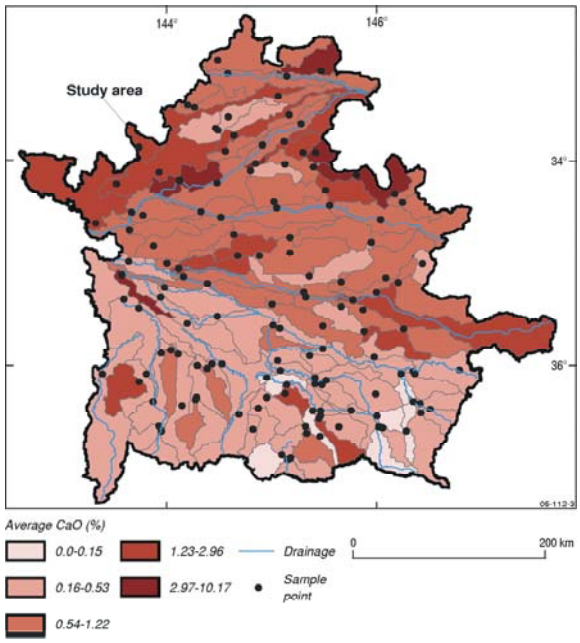

Figure 3: Geochemical maps of total CaO (wt. %) in BOS Riverina overbank sediment samples analysed by X-Ray Fluorescence.

In terms of applications to mineral exploration, dispersion trains of typical pathfinder elements for gold mineralisation, like As and Sb (Figure 4) are clearly documented by the smoothly decreasing concentrations from south (near the Victorian goldfields) to north (over sediments from the Murray basin).

Chromium is an element that can be associated with ill-health in animals and humans when present over certain levels. Figure 5 shows the distribution of Cr in BOS sediments. There is a smooth increase in Cr concentration from north to south, and the two sites with the highest values can be correlated with a ridge of Cambrian mafic volcanics. High total Cr concentrations in the Riverina are unlikely, however, to lead to serious health problems as only a very small proportion of Cr will be bioavailable.

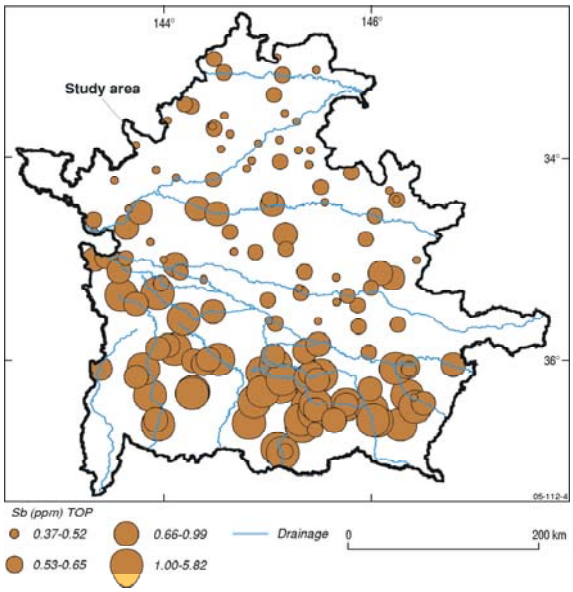

Figure 4: Geochemical maps of total Sb (ppm) in TOS Riverina overbank sediment samples analysed by Instrumental Neutron Activation Analysis.

Conversely, some elements can be present at concentrations that are too low for optimum plant growth, such as potentially Mo here (Figure 6). The distribution map for this element shows a general decrease from south to north. Given its lower bioavailability in acid soils, Mo is likely to be deficient in the south of the region, despite higher total concentrations here. Farmers report the necessity to use Mo-enriched fertilisers in this area.

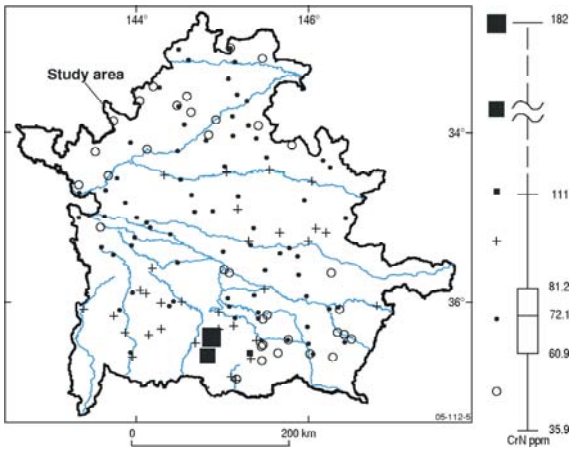

Figure 5: Geochemical maps of total Cr (ppm) in BOS Riverina overbank sediment samples analysed by Instrumental Neutron Activation Analysis. For boxplot scale explanation, please see Figure 2.

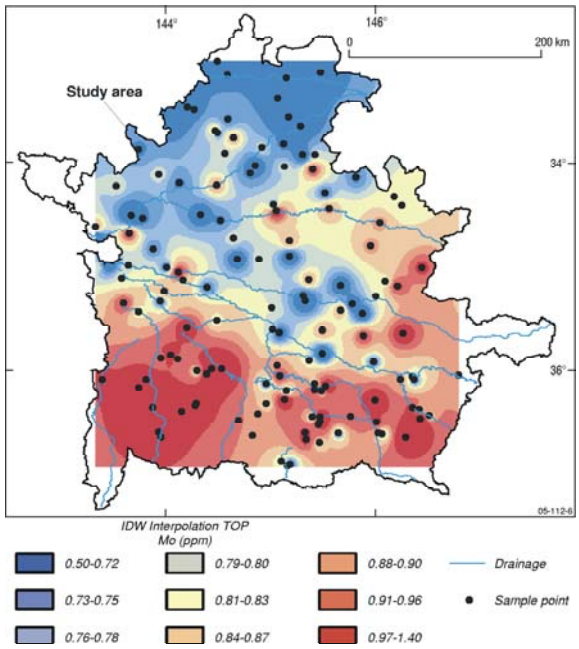

Figure 6: Geochemical maps of total Mo (ppm) in TOS Riverina overbank sediment samples analysed by ICP-MS.

CONCLUSIONS

Low-density geochemical surveys can be conducted in Australia using common regolith sampling media. They provide a cost-effective, internally consistent dataset that can be used by to support a variety of critical economic, environmental and societal decisions.