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RIVERINA REGION GEOCHEMICAL SURVEY, SOUTHERN NEW SOUTH WALES AND NORTHERN VICTORIA

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ABSTRACT

A low-density geochemical survey of a large region was carried out for the first time in Australia in the Riverina region of southern New South Wales and northern Victoria. Samples of transported regolith were collected at 142 sites in a 121,807 km^2 area, giving an average sample density of ~1 site per 860 km^2. The sampling sites were strategically located near the lower end of large catchments so as to target transported regolith materials that best represent all source lithologies within each catchment. Floodplain or overbank settings accumulate sediments that generally are fine grained and well mixed, and as such are best able to yield a sample representative of the average composition of the catchment. We call these sediments 'outlet sediments' because in some cases they also include an aeolian component.

At each site, a surface sediment sample ('top outlet sediment' or TOS) was collected from a depth of 0 to 10 cm and a deeper sediment sample ('bottom outlet sediment' or BOS) was collected from a depth of ~60-90 cm. The TOS sample was well mixed over the area of a shallow pit and the BOS sample was collected from 3-5 auger holes (or over the bottom of a soil pit) in order to account for local soil heterogeneity (composite samples). At two sites, complete soil profiles were sampled at 10 cm intervals from 0 to 80 cm depth. All regolith samples were described in terms of texture, colour and pH, and each sampling site was described and photographed. At selected sites of the western and northern parts of the study area, leaves of River red gum (*Eucalyptus camaldulensis*) were also collected to compare to the sediment geochemistry.

In the laboratory, a split of each bulk sediment sample was subjected to laser particle size analysis (LPSA) and to pH 1:5 (soil:water solution) and electrical conductivity (EC) 1:5 measurements. The remainder of the sample was dried and split into two parts, one for archiving, the other for analysis. The split for analysis was sieved and the <180 um fraction was submitted for analysis for over 60 elements by X-ray fluorescence (XRF), inductively coupled-mass spectrometry (ICP-MS), instrumental neutron activation (INAA) and ion selective electrode (ISE) analyses at Geoscience Australia (XRF, ICP-MS), Becquerel Laboratories in Sydney (INAA) and ALS Chemex in Brisbane (ISE) laboratories. Sequential digestions of the sediments using ammonium acetate, 0.1 M and 0.25 M hydroxylamine hydrochloride were carried out with the leachates analysed by ICP-MS at Geoscience Australia. Heavy mineral fractions were separated by panning and separation using tetrabromoethane (density 2.955) and analysed by AutoGeo SEM at CSIRO Exploration & Mining (Perth). Plant samples were dried and milled then analysed by XRF and ICP-MS at Geoscience Australia. All resulting data are given in Appendices, as are quality control results.

Geochemical patterns displayed by mapping the concentration distributions of all elements in the TOS and BOS show the influence of nearby outcropping bedrock in the southeastern and eastern parts of the study area. This includes the observation of dispersion, probably both laterally across the basin and vertically through the sediment cover, of elements related to mineralisation, e.g., Au, Sb, As from the Victorian goldfields to the south, and Ag and Zn from base metal mineralisation in the Lachlan Fold Belt to the east. Results from the soil profiles show that there are significant geochemical changes occurring with depth, so that sampling both a TOS and a BOS sample in the overall survey will give additional information. Geohealth implications of this survey have been discussed in detail by Lech and Caritat (2007, Geochemistry: Exploration, Environment, Analysis, 7: 233-247). Sequential digestions show that many elements reside almost exclusively in resistate minerals (e.g., Zr in zircons), whereas other elements such as Pb, U and Ce are also hosted in more labile fractions (in carbonates, Fe- and/or Mn-oxyhydroxides, and as adsorbed species on surfaces). Heavy mineral analysis reveals that zircons are virtually ubiquitous (wherever there are enough heavy minerals to separate a sufficient quantity) and chromite in the BOS is spatially related to the presence of Cambrian mafic rocks in outcrop or under cover. River red gum leaf chemistry does not appear to be a useful sampling medium for mineral exploration in the western and northern parts of the Riverina region, but it gives insights into biological uptake of elements from the soil and groundwater.

The Riverina geochemical survey demonstrates that outlet sediments are a useful and ubiquitous sampling medium in Australia and that applying a low-density approach is both very informative and cost-effective for geochemical surveys over large areas.