ABSTRACT

At the Mount Torrens prospect, minor Pb-Zn-Ag mineralisation in calc-silicate rocks occurs at the base of The Girilambone region between Cobar, Nyngan, Bourke and Nymagee in western New South Wales has an extensive regolith composed of *in situ* and transported materials of greatly varying thickness (ca. 2-100 m). This regolith obscures the underlying bedrock and its contained ore deposits. It presents major challenges for mineral exploration in the region, particularly for surface techniques. The regolith geology and related surface processes also control soil types, landform features and landscape stability, important for agriculture and natural resource management.

The regolith composition, architecture and geochemistry of the region were investigated during a three year collaborative project between CRC LEME and the Geological Survey of the NSW Department of Primary Industries. This study combined data from regional regolith-landform-mapping and information obtained by air core drilling and sampling along a series of roadside traverses to produce an integrated three dimensional understanding of the regolith. Five 1:100 000 scale regolith-landform maps were produced (BYROCK, SUSSEX, COOLABAH, CANBELEGO and HERMIDALE). A total of 247 air core holes were drilled at depths ranging from 3 to 82 m, generally spaced between 1 and 4 km along 12 traverses mostly in an east to northeasterly orientation (7571 m of total drilling).

Drill cuttings were logged visually and with the aid of a PIMA. Samples were collected for geochemical analysis and partial X-ray diffraction analysis from composites of 1 m intervals in the top 9 m and from larger interval composites below this. The project was conducted in three stages with detailed reports produced at the end of each stage.

Most of the Girilambone region is covered by colluvial and alluvial sediments with scattered areas of weathered bedrock rises (9-30 m relief). There is a significant component of wind blown dust in the soils. Palaeochannel systems are important and contain at least two major depositional sequences: an older clay-rich estuarine to marine and fluvio-lacustrine sediment sequence; and a younger colluvial-alluvial sequence of silts, sands and ferruginous gravels. Regolith-landform mapping and dating of key regolith materials has established the landscape history back to the Early Jurassic. This history reflects dominant subaerial exposure, with some marine incursion to the north, since the Mesozoic. There has been ongoing weathering, erosion and deposition controlled by bedrock composition, climate change, changes in base level and some neo-tectonic activity. A landscape evolution model has established the regional pathways for regolith transport and element dispersion.

Over 3360 samples collected by drilling were analysed using a multi-acid (hydrofluoric-perchloric-hydrochloric) digest followed by ICP OES and MS analysis (for Al, Ca, Fe, K, Mg, Mn, Na, P, Ti, Ag, As, Ba, Bi, Cd, Co, Cr, Cu, Mo, Ni, Pb, S, Sb, Sr, V, W, Zn, Zr). Sample splits were subjected to an aqua-regia digest and analysed for gold by solvent extraction and graphite furnace AAS. Bottom of the hole samples (mostly saprock) from each hole were also separately analysed by XRF for major elements (Al, Ca, Fe, K, Mg, Mn, Na, P, Si, Ti) and by ICP OES and MS following multi-acid digest of fused glass discs for some trace elements (Ag, As, Ba, Be, Bi, Cd, Ce, Cl, Cr, Cs, Cu, Dy, Er, Eu, F, Ga, Gd, Ge, Hf, Ho, La, Lu, Mo, Nb, Nd, Ni, Pb, Pr, Rb, S, Sb, Sc, Sm, Sn, Sr, Ta, Tb, Th, U, V, Y, Yb, Zn, Zr). Geochemical data have been used to characterise different regolith materials, establish parent rock types, estimate the degree of chemical weathering and identify important regolith-related element associations. It is clear that trace element dispersion has been controlled by the particular regolith processes operating under different and contrasting weathering regimes.

The project has established geochemical dispersion models for the Girilambone region. Areas

worthy of further investigation by mineral explorers have been identified.