AN INTEGRATED GEOSCIENCE APPROACH TO SALINITY HAZARD MAPPING

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The Gilmore airborne electromagnetics (AEM) area (Lawrie *et al.* 2000), located SE of West Wyalong, NSW, was used as a case study in developing an integrated geoscience salinity hazard mapping methodology. This methodology uses multiple geoscience data sets and current conceptual understanding of regolith hydrology in developing a literally/conceptually bottom-up approach to the problem of dryland salinity hazard mapping.

In order to compile a salinity hazard map for an area and manage salinity effectively we need to know three critical factors: 1) the distribution of salt in the ground; 2) the material within which the salt is stored; and 3) the movement of this salt through the landscape. Most previous methodologies for mapping salt hazard, be they quantitative or qualitative, have been based on the hidden assumption that the surface landscape is similar to the subsurface buried palaeo-landscape (e.g., Searle & Baillie 2003). This has led to the development of top-down approaches to salinity hazard mapping, where surface data and maps are used as surrogates to define the subsurface. This assumption has proved to be invalid in many areas (e.g. Clarke 1998, Lawrie *et al.* 2000). In the Gilmore AEM area the current land surface is flat and a few ephemeral streams pass through it; however, the palaeo-landscape has over 80 m of relief and consists of a series of canyons, basins and river channels. In order to manage salinity in such areas, an understanding of the three-dimensional regolith architecture is critical and hence a bottom-up approach is necessary. This work adopted a bottom-up, geographic information system (GIS)-based approach. Stemming from the three critical factors three GIS layers were developed using different data sets.

The first GIS layer, the distribution of salt in the ground, can be derived directly from the AEM data set. Image analysis software package packages such as ER-Mapper can be used to perform computer-assisted classification of conductivity ranges within each conductivity depth slice (CDI) to produced a simplified representation of the 3D distribution of salt through the landscape.

The second GIS layer consists of an interpretation of the 3D regolith stratigraphy in the area. The combination of this and the first layer is crucial in understanding the materials in which salt is stored in the landscape. It was compiled by using multiple geoscience data sets to construct a regolith materials interpretation of each AEM CDI slice. The key data sets used include: lithological drilling information; solid geology; regolith-landform map; aeromagnetics; digital elevation model; and AEM. Lithological drilling information was used as the primary data set and the AEM was then used to extrapolate the lithological data from the drill location, as it was recognised that the distribution of conductivity in the Gilmore area was closely but not exclusively related to regolith materials. The regolith-landform units into which the regolith layer was subdivided consisted of: saprock; saprolite; and four subdivisions of quaternary transported sediments. Transported sediments were subdivided based on the recognition of five distinct sedimentary units within drill holes. A conceptual model for the distribution of these five units was compiled based on an iterative process and subsequently only four of the five units could be differentiated within the CDI slices. Along with the drilling information and AEM data sets the solid geology, regolith-landform map and digital elevation model provided the bottom and top boundaries to the interpretation. The aeromagnetic data set proved to be very useful in delineating structural barrier to surface sediment transport and palaeochannels in areas of low magnetism.

The third GIS layer (that is, the movement of salt through the landscape) is largely an integration/interpretation of the other two layers. In other words, areas of recharge and discharge as well as the degree of salt movement can be determined from the distribution of salt and regolith materials in the landscape. This approach is still currently in the developmental stage and additional datasets such as rainfall, water table depth, etc., may be included in the interpretation. The corollary of this process is that not only is salt that is a hazard delineated, but areas with fresh groundwater are also identified, thereby adding value to the methodology.

From the development of the 3D regolith stratigraphy, a series of relationships between the underlying geology and the palaeo-landscape were derived. These broad generalisations in conjunction with additional

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information regarding the geology, aeromagnetics and borehole data outside of the AEM area can be used to classify what regolith materials one can expect outside of the AEM area. While this process has the potential to add a significant amount of understanding to a region, it will not give sufficient information to constrain the vertical distribution of materials if drilling information is not available.

One of the key results of this study is that not only can AEM be used to identify where salt is in the landscape, but it can also be used in conjunction with other data sets to develop a three dimensional regolith stratigraphy of an area and thereby produce a conceptual model for ground water flow. This approach identifies potentially mobile salt in the landscape and thereby provides the key information necessary to produce meaningful salinity hazard maps.

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