MESOZOIC PALAEOLANDSCAPE RECONSTRUCTION OF THE SOUTHERN EROMANGA BASIN: MINERAL EXPLORATION UNDERCOVER IMPLICATIONS FOR THE THOMSON OROGEN, CURNAMONA PROVINCE & THE GAWLER CRATON

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INTRODUCTION

The Thomson Orogen, Curnamona Province and the Gawler Craton are all highly prospective for mineral exploration, but widely covered by transported regolith. The transported regolith contains sediments and associated landscape features interpreted to be from the Mesozoic. This includes vast Mesozoic landsurface facets (palaeosurfaces), Cretaceous shorelines, Mesozoic sediment exposures and expressions of Mesozoic and sub-Mesozoic regolith interfaces.

THE EROMANGA BASIN

The Eromanga Basin is the largest of four Mesozoic structural sub-basins within the epicratonic Great Australian Basin (figure1) (Exon & Senior, 1976; Cramsie & Hawke, 1982a; Moore, 1986; Van Doan, 1988). The basin encompasses approximately 1 million square kilometers of inland Australia and spans four states or territories. Initial sedimentation within the basin began in the late Jurassic and continued through to the early Cretaceous. Sedimentary packages within the south of the basin are comprised of five main facies: the Jurassic fluvial Algebuckina Sandstone; Neocomian-Aptian fluvial to shallow marine Cadna-owie Formation; Aptian-Albian marine Bulldog Shale; Albian marine Oodnadatta Formation; and the Cenomanian fluvial, fossiliferous Winton Formation (Wopfner *et al.* 1970; Forbes, 1986; Moore, 1986, Kreig *et al.* 1995). Despite on the differing local stratigraphic nomenclature, these units are somewhat continuous throughout most of the southern basin. Dominant facies within these units include interbedded sandstones, siltstones and shales with conglomeratic lenses.

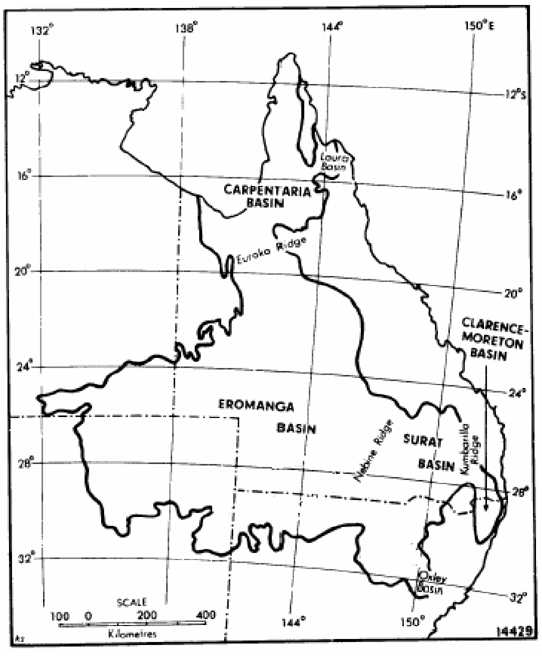

Figure 1. The Great Australian Basin, after Cramsie & Hawke (1982)

The south-eastern portion of the basin overlies metasedimentary rocks from the Cambrian Kanmantoo Orogen, Ordovician Thomson Orogen, and rocks from the Ordovician to early Carboniferous Lachlan Orogen (Cramsie & Hawke, 1982a). Most of the central southern margin overlies rocks of the Adelaidean sequence (Jack, 1930). Exceptions to this occur around the northern Flinders Ranges where sediments have been faulted onto granitic rocks (Jack, 1930). In the southwest the underlying rocks are the granites and gneisses extending from the Musgrave Ranges (Exon & Senior, 1976).

Historically, the basin has been renowned for its geohydrological potential, thought to be one of the world's largest sources of artesian water. Throughout the southern margins of the basin, economic resources hosted within the Mesozoic sediments include gold (Brown, 1881; Cramsie & Hawke, 1982b), opal (McNevin, 1975; Townsend, 1981; Cramsie & Hawke, 1982b), uranium, flint clay and gypsum (Cramsie & Hawke, 1982b; Forbes, 1986). The basin is also renowned for its petroleum potential, hosting oil and gas resources in the basal units in the centre of the basin (Sprigg, 1986).

CONTEMPORARY LANDSCAPES

In the south of the basin the contemporary landscape is dominated by extensive plains of Mesozoic sediments, occasionally capped by younger sediments from later basins. These plains can be linked to different stages of Mesozoic sedimentation, and the various morphotectonic and geomorphic processes that have been occurring since. Often, these surfaces are best preserved where the sediments have been indurated (Twidale & Campbell, 1995; Twidale & Bourne, 1998), or where there is an extensive 'armoring' cover (Davey & Hill, 2005). In the Tibooburra-Milparinka area near the boundaries of the Thomson, Kanmantoo and Lachlan orogens, these surfaces have been extensively faulted and folded by the neo-tectonism, thought to have been active in the area since the deposition of Palaeogene sediments (Hill, 2005; Hill *et al*. 2005; Davey & Hill, 2005; McAvaney & Hill, this issue). This has resulted in the formation of uplifted fault block surfaces. While these surfaces have experienced minor exhumation and etching, the preservation of their form has been attributed to the abundant quartz lag typically capping these surfaces (Davey & Hill, 2005). Similar faulted Mesozoic sediment surfaces are widespread throughout the Curnamona Province, particularly around the Mt Babbage Inlier in the northern Flinders Ranges. Here the surfaces have also been faulted, however, preservation has be attributed to at least partial induration of many of the Mesozoic sediments (Norton, 1983).

Extensive transported regolith profiles are extensive along the southern basin margin, and are previously thought to be deep (Van Doan, 1988). While this may be true for the central areas within the basin, it is not necessarily the case for the southern margin. Recent studies around the southern margin have shown that in many places the Mesozoic sediment surfaces are covered by a thin veneer of surficial sediment (Davey & Hill, 2005). Unconformably overlying some of the Mesozoic sediment surfaces in the south are sediments from the Lake Eyre Basin and the Bulloo-Bancania Basin, which are best preserved where they have been silicified (Alley, 1998).

Bedrock inliers either protruding through or surrounded by Mesozoic surfaces, occur within this region, including the pre-Cambrian Denison Ranges and the Stuart's Range Inliers in South Australian portion of the Curnamona Province (Jack, 1930), and the small granitic exposures of the Eulo Ridge and the Ordovician-Devonian Tibooburra-Milparinka Inliers (ie. the 'Tibooburra Ridge') in the Thomson Orogen (Cramsie & Hawke, 1982a).
Directly surrounding many of these bedrock inliers are relics of Cretaceous shorelines. Here, deposits of rounded quartz and local bedrock clasts are preserved in small 'bays' indicating the degree of the marine transgression during the early-Cretaceous.

IMPLICATIONS FOR MINERAL EXPLORATION THROUGH COVER

It is becoming increasingly evident that traditional exploration techniques such as drilling, are becoming less effective and expensive in areas such as the southern Eromanga Basin. New exploration techniques involving the use of regolith materials and biota are now being developed and employed in these areas (Hulme & Hill, 2004; Dart, 2005; Gibbons & Hill, 2005). These techniques are proving to be highly successful in locating anomalous regions, potentially hosting mineralisation (Hulme & Hill, 2004 & 2005; Reid & Hill, 2005). The use of biota and regolith materials (such as regolith carbonate accumulations), have been recently successfully employed within the southern Eromanga Basin (Hill, 2004; Brown & Hill, 2004; Hulme & Hill, 2004; Gibbons & Hill, 2005; Tucker & Hill, this issue). As a result of much of this work, it has been recognized that the Mesozoic sediment surfaces, and in particular the Mesozoic and sub-Mesozoic interface potentially host economic resources (Hill, 2005; Hill *et al*. 2005). These studies have identified the need to gain a better understanding of the landscape, in particular the Mesozoic landscape of these regions.
While contemporary landscape features interpreted to be from the Mesozoic have been altered and changed by recent geomorphic and morphotectonic process, they provide a basic insight into facets of the landscape from that time.

CONCLUSION

Mesozoic landscape features that host significant economic resources dominate the southern margins of the Eromanga Basin. Previous localized regolith and landscape research within the area has highlighted the need for a more rigorous and robust landscape evolution model with particular attention on the Mesozoic. In order to gain a better understanding of the landscape and thus its exploration potential, it is essential to develop an understanding of the Mesozoic landscape.

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