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## RANGELAND TYPES IN THE WESTERN AUSTRALIAN GOLDFIELDS

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### SETTING THE SCENE

Forty five million years ago Kalgoorlie was on the 52°S parallel of latitude where Heard Island is today. It was a very different environment of lush vegetation, vast rivers, and the Eocene Sea lapping the shores of the higher ground around Kalgoorlie.

For the next 40 million years as Kalgoorlie drifted 2400 kilometres north to its present position the environment changed in sympathy with the prevailing global conditions and its new global latitude. The change to hot and humid conditions encouraged deep weathering to many hundreds of metres. This has given rise to the weathered profiles we see today of red oxidised upper zones to the pallid zones so often found at the base of breakaways. The duricrust upper surfaces commonly found around these arid parts developed directly as a product of a former 'green' Australia rather than the brown one we are more familiar with today.

### WHERE'S KALGOORLIE TODAY?

Kalgoorlie is located within the Archean Yilgarn Craton which is a predominantly massive granite and gneiss landscape extending some 900 kilometres N/S by 750 kilometres E/W dating back 2900 – 2500 million years. Greenstone intrusions of altered sedimentary and volcanic rocks have their genesis of similar date but are more confined to linear formations with a distinctive NNW trend. The mineralisation within these geological zones is the cause of the continued prosperity of the region. Gold and nickel are the 'wealth' minerals currently being extracted by massive open cut mining operations.

The greenstone belts and artificial hills of mining overburden provide the only significant relief in an otherwise flat landscape. In between the belts are extensive stretches of granite country with typical alternations of sandplain, low breakaways and granite tors. Relief rarely exceeds 100 metres above a plain that was elevated by early tectonic uplift to about 400 metres above sea level.

Playa lakes and palaeodrainage lines of extensive proportions occupy the lowest part of the landscape. Eocene sediments and plant remains give weight to the theory of the proximity of the great inland Eocene Sea. The drainage lines are now endoreic but once formed a dendritic chain that flowed through to the ancient oceans that covered the Nullarbor to the east and southeast. To the west of Kalgoorlie all drainage flows generally westward into the Swan-Avon basin and ultimately to the Indian Ocean.

The playas around Kalgoorlie receive water as run-off or from heavy rain forming shallow pools of brine which move across the salt crusted surface with the wind. At rare intervals the water levels will rise above two metres and on rarer occasions will flow through the palaeodrainage systems (last event was 1992) to be soaked up by the limestone karst of the Nullarbor.

### CLIMATE CHANGE

From the Mesozoic until 2.4 million years ago the climate of Kalgoorlie was probably warm and moist, after which aridity set in, salt weathering was predominant and aeolian deposition of sands and calcareous clays started shaping the new landscape, and vegetation changed to its more modern appearance. Today Kalgoorlie enjoys a semi-arid climate (non-seasonal desert) with daily temperatures ranging from 16.5°C to 33.5°C (Jan.) and 4.8°C to 18.2°C (July). Rainfall is spread throughout the year with June being the wettest month from southwest frontal activity; whereas rain in the summer season tends more from thunderstorms from the north. Mean annual rainfall is 260mm, mean evaporation is 2664mm/year.

## **PREDOMINANT LANDSCAPE AND VEGETATION ASSOCIATIONS**

Kalgoorlie's landscapes are not particularly unique in the arid outback; there are many examples of similar landforms throughout WA and neighboring states. The landforms seen around Kalgoorlie today are the product of a very long process of weathering that has literally inverted the landscape. Popular erosional sequence theory puts most of the indurated fericrete and silcrete duricrusts that occupy the highest part of today's arid landscape at the bottom of the valleys during the early Cretaceous. The broad river valleys of this ancient world, fed by copious water during these wetter times, provided the ideal conditions for iron and silica to concentrate and cement in the valley floors. Tertiary weathering then eroded the softer surrounding regolith while the valley duricrust protected the underlying strata. The result is an inverted landscape of breakaways and erosional slopes usually on an unconformal saprolite sequence.

The evolution of the vegetation associations within the Kalgoorlie area is somewhat unique within the arid zone, being on the boundary between two botanical districts. The divide (known locally as the Mulga-Eucalypt line) trends northwest and marks the northern extent of the dominance of eucalypt woodlands. To the south the country becomes sandier and heath scrub dominates. In species richness the general rule of WA sandplains being the most diverse is reversed in the proximity of Kalgoorlie. Twenty-four of the 47 eucalypt species grow as trees rather than mallee, and nowhere in the world do trees grow as tall in such an arid environment.

The variation of depth and fertility of soils across the landscape gives rise to a corresponding catena of vegetation. Typically the deeper and the more fertile soils of the broad valley floors and undulating plains will support the elegant salmon gum (to 15 metres high) or other eucalypt species. Where the soils become more saline the typical melaleuca understory will be replaced by saltbush. Progressing upslope, the shallower less fertile soils support lower mixed eucalypt woodlands and sparser undergrowth. The vegetation on hills and breakaways is more base rock dependant but will generally be low scrub and mallee; granite and greenstone geology have their own characteristic assemblages. On the highest landscapes sandplains overlaying laterite form an aeolian surface dominated by mallee, heath and spinifex. In the very low landscapes of the playas and palaeodrainages the vegetation grades from complete absence on the lakebed floors through samphire shrublands on the playa margins to mixed eucalypt/saltbush/bluebush communities on the higher margins.

## **COMMERCIAL LANDSCAPES**

The commercial exploitation of Goldfields' vegetation started with the discovery of gold in the 1890's. Thirty million tonnes of eucalypt and mulga were harvested for fuel and mining timber in 70 years to 1960 mostly from the undulating plains landscape to the south and west of Kalgoorlie. Sandalwood continues to be taken for its fragrant appeal and a boutique market is developing which capitalises on the fine grain and hardness of local timber. Pastoralism is the most extensive use of native vegetation but its domination of the landscape is overshadowed by the ubiquitous and intensive nature of gold and nickel mining.

**Further reading** – this paper contains material generalised from the following references:

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