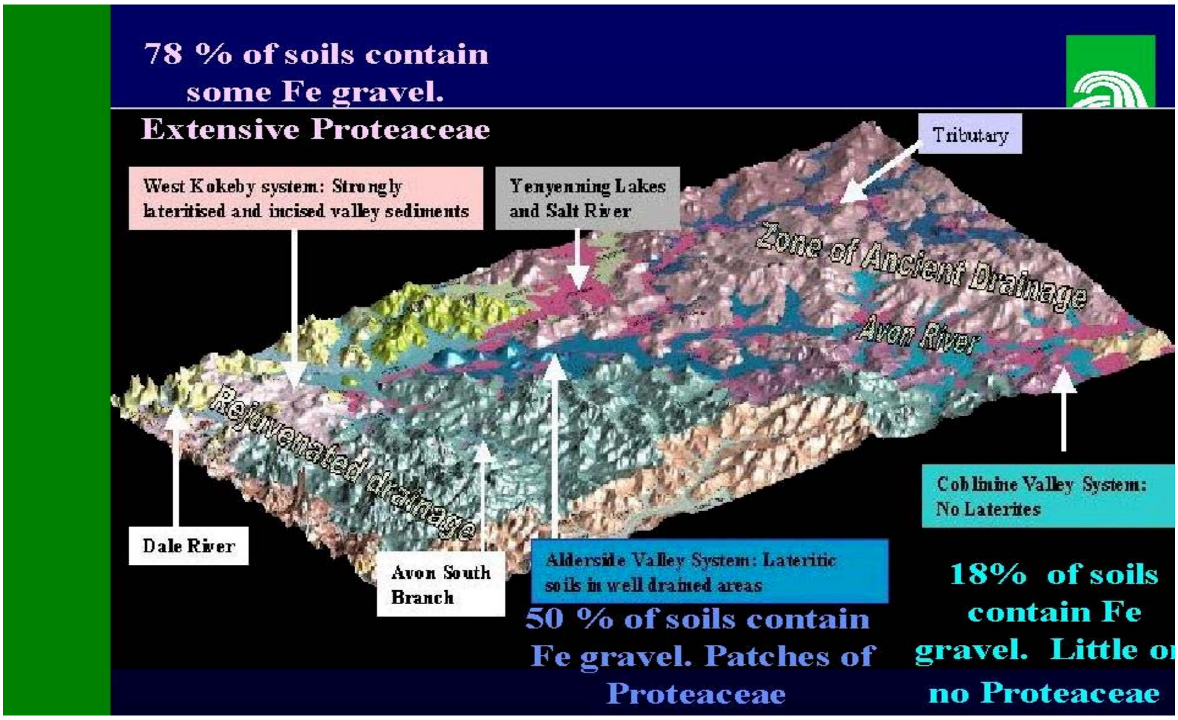
Landscape inversion: West Kokeby System and adjacent sediments to the west (Eastern Darling Range Zone) and east (Alderside System).

This document briefly discusses association between landscape rejuvenation, breakaway structures and soil distribution in sections of the Avon valley straddling the western margin of the Yilgarn block.
Figure *a* shows a relief model of soil systems of the tectonically affected area around Brookton. The view is from the south and vertical exaggeration is 15 times. Salinity in the valleys is mapped red and can be used as a surrogate for down-channel gradient and drainage. In other words, the more sluggish the drainage the more widespread the salinity (red). The classic scenario is increasing salinity in downstream flats as seen in the tributary river running into the Avon from the east. However, in the case of the main Avon branch, salinity in the lower reaches has been reduced, relative to the upper reaches, by rejuvenation.

Upstream, in the Coblinine System (light blue), where salinity and sluggish drainage become dominant, one rarely encounters Lateritisation and associated Proteaceae. But as one progresses further downstream towards the 'slightly' rejuvenated and less saline Alderside System (dark blue), one starts to encounter patches of 'young' laterite under Proteaceae on the flat valley sediments. Down stream of that one encounters rejuvenated sediments of the ancestral Avon river, demarcated by the Kokeby system (light pink area). This system is characterised by smooth, rounded interfluves vegetated by Proteaceae growing on lateritised paleo-valley sediments.

Pain and Ollier (1995) argued that relief inversion is so widespread in areas containing lateritic and silcrete duricrusts that it deserves to be included in a general model of landscape evolution. Indeed the graphic presentation of our Avon valley survey data, in Figure *a* below, argues, as Pain and Ollier might have, for inversion of the old Avon valley sediments and continuity of such inverted relief with normal flat valley relief further upstream (readers not familiar with these concepts are referred to Pain and Ollier, 1995).

Figure *a*



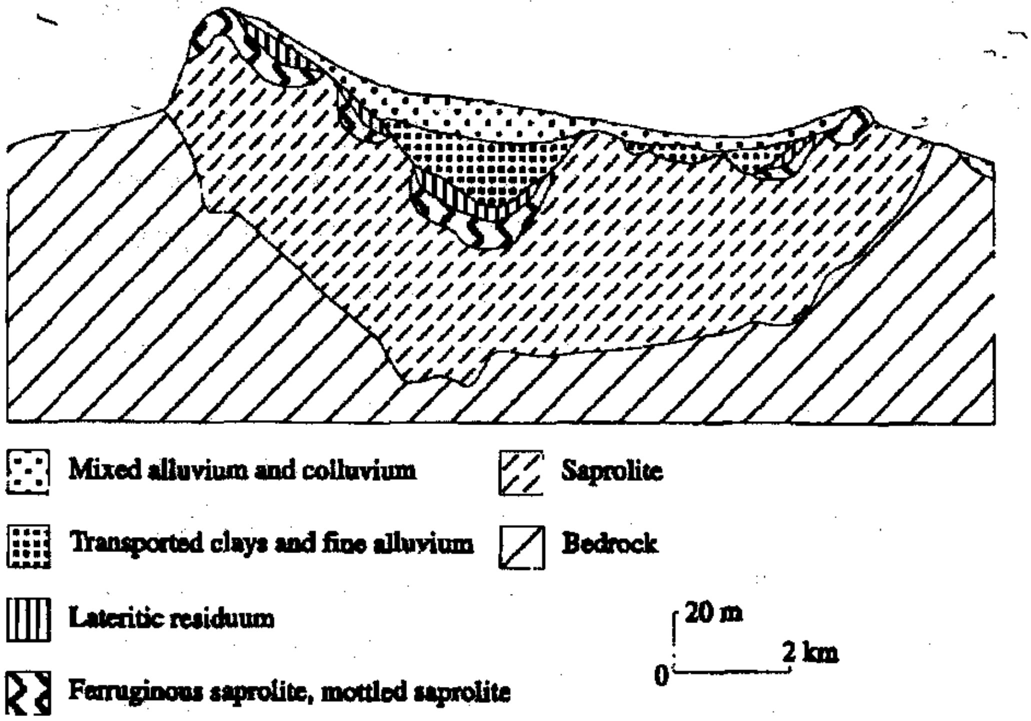


Figure *b* Regolith structure in the Yilgarn (after Anand and Smith 1993)

However, we do not subscribe to their view that the ‘breakaway’ structure seen in Figure *b* results from the exposure of laterite that originally formed on a valley flank. (In any case, such structures are not apparent on the Kokeby sediments for reasons that we give later).Problems mount when one encounters crestal laterites said to be of Tertiary age adjacent to paleo-valley systems containing sediments from the Early Tertiary. Further more, there is nothing in Figure *b* to suggest that the alluvia encountered is anything other than locally derived and post dates the ferricretes. This leads to uncertainties with Pain and Ollier’s claim that the saprolite enclave in Figure *b* betrays the anaerobic conditions of a once waterlogged valley.

However, all the formations shown in Figure’s *a* and *b* are to be expected from the conclusions drawn by Verboom and Galloway (2000), Pate *et al.* (2001) and Verboom and Pate (2003) regarding the niche construction and niche protection activities of plants and microbes.

Firstly, the arrangement of soil landscapes presented in Figure *a* , fits with Proteaceae colonisation and laterite formation accompanying headward incision and concomitant leaching of valley sediments.

Secondly, rejuvenation involving the removal of lateritic regolith and exposure of apatite (P) rich crystalline basement, as seen on the margins of the Eastern Darling range zone and in Figure b, suppresses Proteaceae and laterite formation on denuded elements of land. It also stimulates microbes to actively protect their remaining laterite niche against further erosion and destruction and ultimately replacement by York gum- Jam communities. To do this they make duricrust in strategic locations.

The niche protection activity alluded to above
a) explains the regolith arrangement on breakaways (mesa edges) shown in *Figure b* (for more see Verboom & Galloway, 2000) and
b) builds on McFarlane's (1995) and Eggleton and Taylor's (1998) concept that edge hardening and kaolinite preservation causes the landscape to evolve characteristic scarps and backslopes as surrounding superficial materials erode and regolith materials dissolve.

Thirdly, it is also reasonable to suppose that niche construction activities, such as the mining of nutrients like P by microbes(see comments in Eggleton and Taylor, 1998) and their concentration in ferricretes result in the gradual deepening of the Pallid zone across a reasonably sharp 'weathering' front. Interestingly, the possibility that micro-organisms shaped such weathering features was considered long ago by Holland (1903). Such activity also explains the kinds of weathering enclave seen in Figure *b*. and the co concentration of micro nutrients, such as Cu, Zn, Mo, Mn, and Co, with P in ferricretes.

We contend that the above kinds of microbial activity are fuelled by carboxylates injected into the lateritic residuum by habitat plants. Precisely how energy percolates and moves out from the cluster root source and how P, Fe and some micro-nutrients move up from the basement is not known. Clearly the whole subject requires a deeper understanding of the ecology of soil microbes and their supporting plants.

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