LANDFORM

IRON-STONE GRAVELS AND NATIVE VEGETATION

Jim Barrow

IN a previous article in *Western Wildlife*, Vol. 5 No.3, 'How South-west WA's Landscapes Formed" we noted that much of the South West is very sandy. That is true but there is another important characteristic. There is also a lot of iron-stone gravel, sometimes cemented into massive horizons we call break-aways. So why so much iron?

Iron metal loves oxygen. That is why our cars keep rusting. Once iron has grabbed enough oxygen, it is very stable. That is why soils are usually reddish brown. The colour is largely due to iron oxides and these are so stable that they get left behind as other materials weather away. The colour depends partly on the kind of oxide: warm conditions are more likely to produce an oxide called haematite and hence reddish colours; cooler conditions are more likely to produce an oxide called goethite (yes, it is named for the German poet - who was also a mineralogist) and hence yellow-brown colours. This is why soil colour tends to be redder as we move north. The colour is modified by organic matter - low amounts of organic matter explains why many soils of the inland are so bright.

However, iron can become mobile under some conditions. One of these is if you can pinch some of the oxygen from the iron metal - that is you can 'reduce' the iron a bit. You can do this under waterlogged conditions as the decomposition of organic matter uses up the oxygen. The iron can then move around with the water and if the water comes back to the surface the iron will get re-oxidised to the stable form. This is probably the origin of the iron-stone soils on the Western Australian coastal plain.

If you break up some of the iron-stone gravel and look at it with a lens you can see that the round particles consist of concentric layers. The rounded particles are often further cemented together by more material. The standard explanation is that this was due to alternating periods of wet and dry. During the wet periods, the iron was reduced and moved around. During the dry periods it was re-oxidised and stabilized. By this argument, the whole of the south west was at one stage covered by a blanket of this material and by implication the climate must have been pretty extreme at that time with alternating wet and dry seasons. The break-aways are then supposed to be the remnants of this material left behind as the rejuvenated streams cut back.

This widely-accepted picture has recently been questioned. There is another way iron could become mobile. Many of our native plants secrete large amounts of citrate from their roots. Dryandras and banksias are very good at this. The citrate dissolves iron oxides and this releases some of the phosphate locked up by the oxides - one reason why these plants can grow in such low-P soils. Citrate doesn't last very long in soils. It gets eaten by the soil bugs. So you have another mechanism by which soil iron can have alternating cycles of mobility and stability: mobile while the citrate is there, fixed when the bugs have eaten it. According to this theory, the break-aways are not remnants of a previous blanket of iron oxides but faces that are exposed to air so the bugs can thrive and oxidise the citrate there. They are not remnants but are forming still. They too exist because of Gondwana. The upheavals associated with its formation injected lines of more-basic rocks (called dykes) into the granite. These dykes are richer in iron. It is on them that the break-aways form. We have always argued that banksias and dryandras grow on these soils because they can survive the pretty tough conditions. That is still true, but the extra dimension is that maybe the plants cause the tough conditions.

So the overall picture of a flat, boring, sandy landscape becomes much more complex when we look at it in detail. Both on a large, and on a small scale there is a great deal of complexity. This complexity is one reason for the extraordinary diversity in the flora as each species finds its own niche within the complexity. The ancient nutrient-deficient soils have forced plants to come up with different strategies to cope thus producing further diversity. Further, there has been a very long period without major catastrophe to bring the vegetation back to a few species. Contrast northern Europe - the standard against which we have tended to compare ourselves. There the ice age scraped everything clean and the Alps provided a barrier to subsequent invasions. Consequently, the whole of Britain has only about the same number of plant species as the Fitzgerald River National Park. There have, however, been great stresses as the climate waxed and waned and this caused species ranges to expand and contract. This was another factor in increasing diversity as separation permitted species to diverge.

Ironstone gravel is common to many wildflower photos. Did the ability of many native plants to excrete citrate contribute to the formation of this gravel?

Jim Barrow is a "semi-retired" CSIRO scientist.
Email jimb@ccmar.csiro.au