Do 'laterite' soils take a million years to form?

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A common claim by long-agers is that 'lateritic' soils (red, subtropical soils high in iron and/or aluminium) are 'highly weathered'. That is, they typically form through slow chemical weathering, which means it can take millions of years to produce even one metre of soil.

Standard story of laterite formation

These types of soils are known as Oxisols and Ultisols. In Australia, they are known as Ferrosols and Red Kandosols, and some older names for these soils are Krasnozems and lateritic soils. However, for the rather broad typing of these soils, their origins are held to be pretty similar. The standard story goes something like this: in wet tropical (and subtropical) climates, minerals such as silicates are slowly dissolved and leached out of the soil, leaving the more insoluble iron and aluminium oxyhydroxides behind as the major soil constituents. These soils form part of what is known as the 'lateritic profile' (figure 1). This can be altered somewhat, e.g. if the climate has relatively little rainfall, this process is thought to be even slower, extending out over several million years.[1] These soils are thus called 'highly weathered' (when 'mature') because they are quite clearly altered rather drastically from what was likely their original state. It is the severity of the chemical alteration that leads long-agers to postulate million-year ages for these types of soils

Difficulties with the standard story

The first problem with this story is that nobody has actually observed a mature Ultisol or Oxisol form, so estimates of the time needed for their formation are dependent on one's assumptions about the past. It's usually not even the case that soil formation rates are directly measured to obtain dates. Rather, the dates and soil formation rates are usually derived from some sort of forensic dating method of constituents in the soil or associated volcanic rocks,[1] or sometimes through fossil 'dating', and not from direct measurements of soil formation.

Sometimes, laboratory experiments assuming 'classic' laterite formation conditions are appealed to for laterite formation rates (which include the Oxisols/Ultisols on top), and are also used to ground the notion that it takes a million years to produce 30 cm of soil.[2] However, even these measured rates face numerous counterexamples in the field: "Laterites on the foreshore at Darwin, Australia, include automobile bodies and other debris attesting to continued formation".[3] This is a systemic problem—observed soil formation (and chemical weathering[4]) usually progress faster than long-agers typically assume.[5–7] Moreover, soil formation typically occurs in an asymptotic rather than linear manner—it starts off fast and progressively slows through time.[5] Therefore, even if we take the soil formation rates as genuine, most of what we are measuring today in many 'stable' soils such as Oxisols are actually historic *minima* rather than historic averages.

Another problem with these experiments is the conditions they assume. In his analysis of these experiments, Nahon does not consider the possibility of catastrophic conditions—e.g. hydrothermal alteration of the bed-rock causing Fe and Al enrichment. As

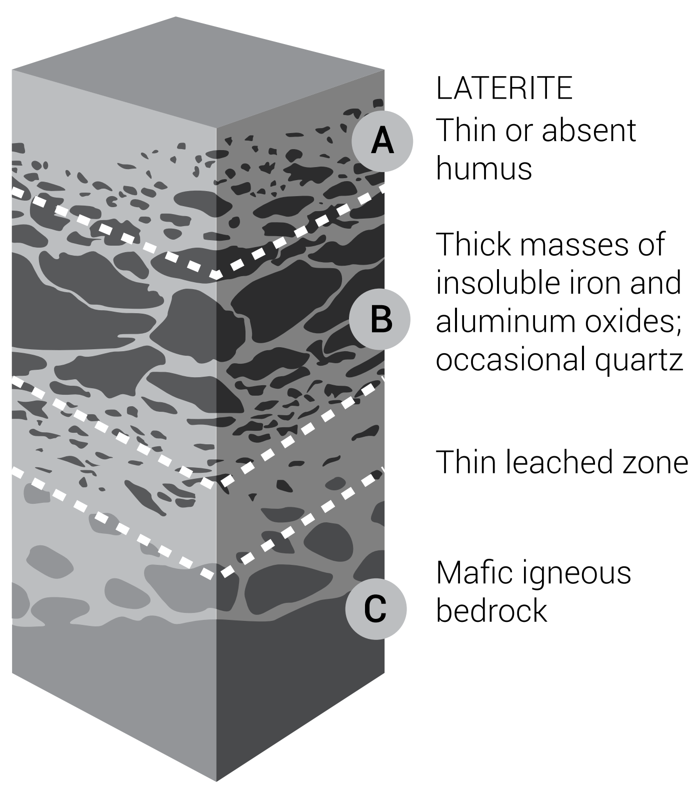

Figure 1. An idealized laterite profile is relatively simple and replicable.

paleopedologist Dr Gregory Retallack warns:

> "Alumina enrichment can be caused both by hydrothermal alteration and by weathering, so that care must be taken in interpreting aluminous rocks [bauxite] in highly deformed and very ancient terranes."[8]

I would suggest that in the context of competing frameworks this can be applied in principle to *all* cases of Fe and Al enrichment, especially in the light of research done since Retallack wrote this comment (see below).

Nahon does, however, acknowledge that these laterites can be relict, which complicates the dating of laterite profiles (including the soils on top of them). However, the issue of the initial conditions of the parent material takes on a new significance in the light of the Genesis Flood. Most long-agers tend to assume the initial conditions for the parent material of these soils was unaltered bedrock—an assumption that simply does not fit with the Flood explanation. As Retallack said, separating weathering from hydrothermal alteration as the cause of Al and Fe enrichment can be tricky. Moreover, there are instances of supposed 'paleosols' of Oxisols such as bauxite deposits where it is practically certain that the bauxite was produced geologically rather than through soil formation.[9,10]

Indeed, in many cases there may be little relationship between the soil parent material and the subjacent regolith. Klevberg and Bandy note:

> "Although much effort has been exerted in determining epigenetic pathways in response to climate, many physils identified in North American soils appear to be inherited from parent material unrelated to subjacent regolith".[11]

This means much of the material in soils is likely explained by transport rather than *in situ* weathering.

Another problem with the 'orthodox' laterite tale is the geographical distribution of Oxisols and Ultisols. Many are (or were, in the case of bauxitic and lateritic paleosols according to the evolutionary framework) located in climates not conducive to the conventional story of their formation.[12] Note that this is also the case for many Ultisols in southeastern Australia. In this case, many investigators propose that these soils were either deposited from elsewhere or developed from already-weathered bedrock.

Another solution?

Not even 'classical' tropical climate lateritic profiles (and their Oxisols and Ultisols) are immune from revision. Deposition has even been hypothesized as the origin of the Weipa Bauxite.[13] Weipa fits the typical climatic picture perfectly, so why the change? The researchers point out one very telling fact:

> "If one takes a moment to think how a 3-m thick layer of loose pisoliths could form over an area of about 11,000 km^2 by *in situ* weathering, one will immediately recognise the problem we have with its origin."

This is one of many signs in the recent literature that researchers are looking for alternative (typically more catastrophic, or at least more conducive to catastrophic formation) ways to explain laterites and bauxites that do not fit the traditional '*in situ* weathering' explanation.[14,15]

Of course, even the new hypotheses are still given in a 'deep time' context, but there is room for development of those ideas in a Flood context. They essentially posit that lateritic material formed through the lateral movement of iron in solution into river valleys (as opposed to the vertical movement of the traditional story). They cemented there, and then through extensive erosion of the surrounding land relief inversion occurred, leaving lateritic duricrusts on top of mesas (and perhaps even entire plateaus, such as Weipa Plateau). This may be somewhat plausible in a deep time framework of a river valley, but it may still struggle to explain the scope of bauxite deposits the size of the Weipa Plateau. However, the special conditions of the Flood provide the hydrothermal and chemical conditions needed for fast production of Al and Fe enriched minerals, enable the mass movement of such material, and provide a large-scale mechanism for relief inversion in the latter stages of the Flood to create the lateritic mesas *and* plateaux the size of Weipa Plateau.

As for the Ultisols and Oxisols as soils—their formation probably depends more on the initial post-Flood state of their parent material than on the climate for their formation. This parent material was likely chemically altered during the Flood, possibly by hydrothermal solutions. Moreover, climates were probably wetter just after the Flood, with lots of residual organic matter and water still at or near the surface, so soil-forming mechanisms probably operated much faster then than now.[16]

Conclusion

The recent literature on soils provides some potential solutions for the formation of Ultisols and Oxisols within a Genesis Flood framework. Although more work clearly needs to be done on this, the general direction of some of the more recent literature on laterite and bauxite formation is encouraging. It appears to provide some useful ideas that can not only help us refute the 'orthodox' speculations of long-agers about these types of soils, but suggest avenues for providing biblical explanations of these rather enigmatic formations.

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