THE DEVELOPMENT OF EARTHY FABRIC IN SANDY PALEOCHANNELS AND SOURCE BORDERING DUNES IN THE PILLIGA

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The term 'earthy fabric' has been used in Australia for several decades and commonly refers to apedal, coherent soil material with numerous pores (e.g. Northcote 1979, McDonald *et al.* 1990). In sandy materials the earthiness may be attributed to a combination of clay and sesquioxide coatings of the mostly quartz sand and the packing of these grains. The developed coherence distinguishes it from single grain sand since in the dry state the latter completely collapses when disrupted. In contrast the former retains coherence until sufficient force is applied at which point a puff of fine dust is often released as collapse occurs. This distinction in behavior is not often appreciated outside soil science for it is common to find both materials described as having a grain support fabric. Even so, the earthy fabric term in soil science is a field-based descriptor. In soil micromorphology a direct equivalence has yet to be firmly established. It best fits some of the grain-coating (chlamydic) and/or partly infilled pore (iunctic) fabrics sequences described by Brewer (1979). The origin of these fabric sequences remains uncertain although repeated wetting and drying and sometimes illuviation is invoked (Brewer *et al.* 1983). However, in one study the earthy fabric of a topsoil was described as biofabrics produced by soil fauna (Humphreys 1994). Clearly, the development of fabrics in general and fabric sequences in particular requires further study. The present study seeks to address this issue by examining the development of earthy fabric in sandy paleochannel and source bordering dunes in the sub-humid Pilliga region in north-central NSW.

Both the paleochannel and source bordering dunes contain single grain sand (SGS) and earthy fabric. The former occurs in the basal portion of these deposits and in contemporary channel deposits. The earthy fabric is confined for the most part to the upper 1-3 m of the paleochannels and source bordering dunes. It always overlies single grain sand at depth and is absent from any contemporary channel deposit. In addition, there is a distinct change in colour and magnetic susceptibility with depth associated with these fabrics. The earthy fabric material is associated with strong yellow to red colours and higher mineral magnetics whereas the SGS pales with depth (pale yellow to white) with low magnetic susceptibility. If the paleochannels originally consisted of clean pale sands it would seem that the development of an earthy fabric represents an example of post-depositional modification or pedogenesis. Nevertheless, for this to occur there are four things that require an explanation: (i) the source of the silt; (ii) how the silt is incorporated into the older sand deposits and retained; (iii) the development of coatings on the sand grains; and (iv) the absence of the silt fraction with depth in these older units.

The silt component consists of rounded to sub-rounded quartz with a modal size of 30-40 µm which is characteristic of aeolian dust across this part of SE Australia and is the same material recognized as loess-like at sites to the south-east of the Pilliga (Humphreys *et al.* 2002). This silt mode, therefore, appears to be a ubiquitous feature in many soils on the western slopes and tablelands of NSW and hence its presence in 40,000 to 60,000 year old paleochannels and source bordering dunes is not surprising. The widespread occurrence of this silt mode suggests a source farther to the west but more research is required to confirm this. The precise means by which silt is incorporated into the host sandy deposits remains uncertain even though two possibilities seem viable. Once deposited on the surface it might be expected that these silt particles move downwards in the void space between the framework grains, becoming trapped at points of constriction where the larger grains come in contact. Nevertheless, this type of explanation may not account for the depth to which silt occurs in these deposits. One way of achieving deep mixing is via soil fauna and there is clear evidence of both ant and termite activity at depths > 2m. The formation of grain coatings is much more problematical since in the present day channel deposits the sand grains have at best very thin sesquioxidic coatings. Hence, to achieve thick grain coatings both a source and a mechanism for emplacement is required. In terms of source it is likely that silt grains arrived with an intact coating, as it is well known that such grains are transported during contemporary dust storms. Furthermore, these dust storms also carry finer materials that could become part of the grain coating. How the fine material is added to the grain surface remains to be resolved. Brewer *et al.* (1983) considered that wetting and drying is probably involved implying the transport of fine particles in suspension with some settling and subsequent affixation

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to a grain surface during the drying phase. Presumably the coating thickness develops with repeated wetting and drying. However, there must be a limit to this since all void space is not filled, i.e. an earthy fabric is maintained. Finally the absence of silt and even grain coatings at depth in these deposits implies that either these fabric building entities have not reached this zone and/or that the entities are removed as fast as they are supplied. Again there is no clear answer on this since there is no obvious reason why the silt and grain coating material cannot/does not penetrate deeper. It is apparent that often the base of paleochannels is moister and that during wetter periods the pale basal sands are very moist indicating reducing tendancies. It is possible that groundwater movement removes fine particles in solution (leaching) and mechanically (pervection—cf. Paton 1978). We suggest that the mechanism proposed here may be applicable to many other similar soils/sediments with the fabric arrangement noted here especially as Australia contains large expanses of such soils. These include Earthy Sands, the sandier types of Yellow Earths and topsoils of many texture contrast soils especially the Podzolics and Solodics (Hubble *et al.* 1983). Furthermore, we suggest that the development of earthy fabric represents a high degree of pedological organization which is contrary to the view currently held in Australia.

REFERENCES

BREWER R. 1979. Relationships between particle size, fabric and other factors in some Australian soils. *Aust. J. Soil Research* **17**, 29-41

BREWER R., SLEEMAN J.R. & FOSTER R.C. 1983. The fabric of Australian soils. *In: Soils: an Australian viewpoint.* Division of Soils, CSIRO, Melbourne, 439-476.

HUBBLE G.D., ISBELL, R.F. & NORTHCOTE K.H. 1983. Features of Australian soils. *In: Soils: an Australian viewpoint.* Division of Soils, CSIRO, Melbourne, 17-47.

HUMPHREYS G.S. 1994a. Bioturbation, biofabrics and the biomantle. *In:* RINGROSE-VOASE A.J. & HUMPHREYS G.S. eds. *Soil Micromorphology: Studies in Management and Genesis.* Developments in Soil Science 22, Elsevier, Amsterdam, 421-436.

HUMPHREYS G.S., HESSE P.P., PETERSON E.K., CAMPBELL J. & CONACHER P. 2002. Loess-like deposits at Blayney, south-eastern Australia. 17th World Soil Congress. CD Rom. Symposium 47.

MCDONALD R.C., ISBELL R.F., SPEIGHT J.G., WALKER J. & HOPKINS M.S. 1990. *Australian soil and land survey field handbook.* Inkata Press, Melbourne.

NORTHCOTE K.H. 1979. *A factual key for the recognition of Australian soils.* Rellim Technical Publications, Adelaide, 123 pp.

PATON T.R. 1978. *The formation of soil material.* Allen & Unwin, London.

PATON T.R., HUMPHREYS G.S. & MITCHELL P.B. 1995. *Soils: a new global view.* University College London Press.