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SOME OBSERVATIONS ON LATERITES IN THE NORTHERN TERRITORY

by

D.A. White.

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CONTENTS.

SUMMARY

In the Northern Territory laterites are formed in situ as: (i), an illuvial soil horizon; and (ii) a chemical lake laterite deposit. The end product of extensive weathering processes of certain favourable beds is considered by some to be a true mature laterite, whereas others believe it is merely a duricrust.

The denudation of laterite and transportation, deposition and cementation of the fragments with other rock fragments result in a detrital laterite deposit.

Water-rounded rock fragments in the detrital laterites are readily coated and cemented with iron oxides and resemble the pisolites in the ferruginous zone of the lateritic profile. This similarity results in an exaggeration of the true extent of laterization.

The similarity in environmental conditions between the process of precipitation of uranium minerals and laterization is discussed.

True mature and detrital laterites are illustrated by photographs.

INTRODUCTION

Laterite is particularly widespread in the northern part of the Northern Territory - the Northern Lateritic Plains - where it has been encountered by geologists in their examination of radioactive anomalies in recent years.

It is not intended to review the literature on laterites, as this has been done elsewhere (Prescott and Pendleton, 1952), but to place on record some observations of the present author during field work in 1953 in the Northern Territory.

The author appreciates the assistance in discussions with L.C. NOAKES, D.M. TRAVES, B.P. WALPOLE and other officers of the Bureau of Mineral Resources, Canberra.

TYPES OF LATERITE

The overseas laterite classification into high and low level types is not favoured in the Northern Territory. This classification leads to confusion as to origin, since it does not consider the important controlling factors in laterite formation, viz: lithology of the parent rock and physiography at the time of laterization.

Laterites are formed in situ either by the extreme weathering of suitable rocks, or as an illuvial soil horizon by processes related to fluctuations of the water table under conditions of a heavy rainfall and a long period of dryness, similar to that experienced at present in the Northern Territory. These processes are not clearly understood, but they produce a deposit, residue or concentration, of iron and aluminium oxides by the removal of silica, alkalies and alkaline earths. The end product of weathering under tropical conditions in the Northern Territory is generally porous and rich in iron and aluminium oxides. Since rock weathering and soil formation are part of the same continuous process (Jenny, 1941), it is difficult to distinguish between the laterites formed as the ultimate residue from weathering processes and those resulting from movement and concentration within the soil profile. However it is debatable whether the end product of weathering alone of suitable rocks under tropical conditions would produce a true mature laterite. From present observations, the ferruginous end product of weathering approximates a duricrust (Woolnough, 1927 and Noakes, 1949) or at the most a youthful laterite, whereas that formed as an illuvial soil horizon is a true mature laterite i.e. a laterite with a well formed lateritic profile.

L.C.Noakes and D.M.Traves(1949) stated that the depth of laterization and the formation of the lateritic profile depends upon the lithology of the parent rock. This is, in the opinion of the author, an important factor in the formation of laterites in the Northern Territory and one which has been under-estimated in the past. It has been observed that hematitic and pyritic slates, especially if they are brecciated, yield good laterites. Sandstones weather to produce a narrow laterite capping, and shales and slates are more deeply laterized. Laterites do not form over massive quartzites.

The physiography envisaged at the time of laterization is a slightly undulating surface of such a slope as to produce and hold a stable soil over a long period.

Initial slight changes in surface slope initiated denudation by stream action and this process was increased by uplift or warping of the laterized surface, thus producing the isolated laterite mesa cappings of the present day. Hence as a result of peneplanation, uplift and dissection, it is possible that former low level lateritic illuvial soil horizons now occupy higher levels.

A special and more restricted laterite is the lake laterite, which according to Fermor (1911) is a chemical deposit of the bog iron type, requiring lacustrine conditions. Lake laterite has been referred to by Christian and Stewart (1946) in the Finnis Land System of the Katherine-Darwin region, and Prescott and Pendleton (1952) record several examples in Australia. Some of the Northern Territory occurrences may have been confused with the more wide-spread detrital laterite (see later), as the position of the lake laterite in the authors' cross section of the Finnis Land System, their brief description of its presence "at the base of stony hills" and its close relationship with the deposition of the alluvial flats, correspond to the properties of the detrital laterite.

A further important occurrence of laterite in the Northern Territory is the detrital laterite, which consists predominantly of transported material comprising fragments of laterite and other rocks. The detrital laterite is essentially a wash deposit - a conglomerate - which in the Northern Territory contains water worn fragments of members of the Brocks Creek and Mullaman Groups. The porous nature of the detrital laterite provides easy access for percolating waters and it is readily and deeply cemented to form a hard surface capping. Rock fragments may constitute up to 50% or more of the detrital laterite, and when these fragments are rounded in transport and coated with iron oxides, it is difficult to distinguish them from the pisolites of the ferruginous zone in the lateritic profile. The matrix of the detrital laterite is deeply weathered and numerous channels are formed. Bedding is sometimes discernible in the detrital laterite.

The vesicular, pisolitic and conglomeratic detrital laterite can be distinguished from the laterites formed in situ, by the absence of a lateritic profile and by the presence of water worn rock fragments. The detrital laterite is generally found as old river terraces. The age of the detrital laterites is pre-Recent and post-laterization.

Detrital laterite deposits present an exaggerated effect of weathering and exposure of the land surface, because of the ease of cementation of the conglomeratic deposit and their resemblance to the ferruginous zone of the lateritic profile formed in situ.

The detrital laterite is more widespread than is generally believed. It may be that some of the lake laterite in the Finnis Land System of Christian and Stewart (1946) is in fact detrital laterite. The detrital laterite has been recognised in the following areas in the Northern Territory:-

(i) A river terrace of "laterite" east of C costean at the Brodribb uranium prospect, which was mapped by F. Frankovich in 1952.

(ii) A quarter of a mile north and south of the Ella Creek uranium prospect, Brodribb.

(iii) East and west of the Stuart Highway between Brodribb and the Batchelor roads.

(iv) Along the Brodribb Highway to the Darwin-Birdum Railway line, and several miles north and south of this junction.

(v) Eight miles south of the Rum Jungle Station.

(vi) In gravel pits nine miles south of the Edith River along the Stuart Highway.

(vii) In the Mt. Fitch area.

(viii) As river terraces along the eastern tributaries of Barretts Creek, Brocks Creek area.

The author believes that since an important factor in the formation of laterites is the lithology of the parent rock, it is possible to predict the unexposed parent rock from the characteristics of the lateritic profile i.e. thickness, texture and composition of the zones. Similarly it follows that if different processes were involved in the formation of laterites, these differences would be reflected in the depth and development of the lateritic profile. Hence the laterites formed as the end product of weathering processes could be distinguished from the mature illuvial soil horizon laterites by their youthful lateritic profile. Lake laterite deposits do not possess a lateritic profile. These facts are readily recognised in cuttings and costeans, but where exposures of this kind are absent, interpretation of surface exposures must be based on experience.

LATERITES AND URANIUM MINERALISATION

It is important to be able to recognise the different types of laterites, as frequently they are associated with radioactive anomalies. Anomalies over true mature laterites and possibly extreme cases of leached parent rock will have a definite relationship to mineralization at depth, as the mode of formation of the laterites implies transport of lateritic and non-lateritic constituents, either upwards by capillary forces, or downwards under the influence of gravity, assisted in each case by fluctuations in the water table.

In this connection it is interesting to note that the high mobility of Fe^{2+} ions in the soil profile and the ability of Fe^{2+} ions to precipitate pitchblende, U^{4+}, from UO_2^{2+} ions at room temperatures, suggest a close genetic relationship between the formation of mature laterites and the deposition of uranium minerals from circulating ground-waters. The environmental conditions for the two processes have been verified experimentally by ARDEN (1950) and GRUNER (1952), and they are in agreement with the anaerobic conditions envisaged by Campbell (1917) as having been established by the rising water table over geological time. Hence it is not suprising to find many radioactive anomalies associated with true mature laterites in the Northern Territory.

Radioactive anomalies associated with detrital laterite should be investigated with caution. The majority of the constituents of detrital laterite have not formed in situ, and represent transported material from other areas, so that it has little relationship to the underlying rock formations. Radioactive anomalies over thick deposits of detrital laterite are due to the accumulation of fragments from radioactive beds or to radioactive laterite fragments washed in from adjoining areas. If radioactive anomalies are present over thin detrital laterite deposits, it may be that the deposits coincide with and only partially blanket radioactive beds underlying them, with the result that a second or third order anomaly is recorded.

CONCLUSIONS

Various types of laterites are present in the Northern Territory and their distinction depends upon the presence and development of the lateritic profile and the nature of the lateritic constituents. This knowledge is important in the investigation of laterites associated with radioactive anomalies and their recommendation for drilling.

The similarity between the environmental conditions necessary for the precipitation of U^{4+} by Fe^{2+} ions and the formation of true mature laterites probably explains their frequent association with radioactive anomalies.

The presence of detrital laterites in the northern part of the Northern Territory provides evidence of conditions in post-laterization times, at some time in the Tertiary. The size and well rounded shape of the pebbles in detrital laterites suggest strong denudation forces in those times.

Detrital laterites in the Brodribb, Mt. Fitch and Waterhouse areas in the Northern Territory had not previously been recognised.

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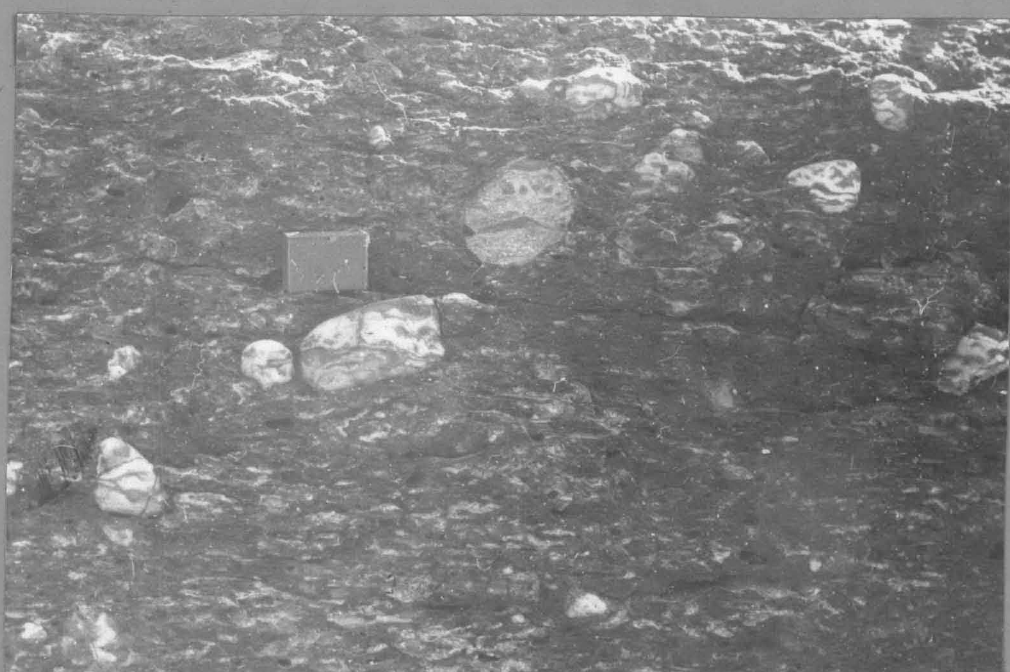
NO. 1 — A RIVER TERRACE OF DETRITAL LATERITE
BRODRIBB, N.T.

NO. 2 — A CLOSE VIEW OF THE RIVER TERRACE OF DETRITAL LATERITE SHOWN IN NO. 1. NOTE THE LARGE WATER WORN FRAGMENTS AND LATERITIC AND VESICULAR MATRIX OF THE DETRITAL LATERITE.

NO. 3 — A SMALL DEPOSIT OF DETRITAL LATERITE. THE LATERITE DOES NOT CONFORM TO THE PRESENT STREAM AND IT FORMS A RIVER BAR AND A SMALL DAM. ON THE BRODRIBB HIGHWAY, FOUR MILES WEST OF THE BRODRIBB.

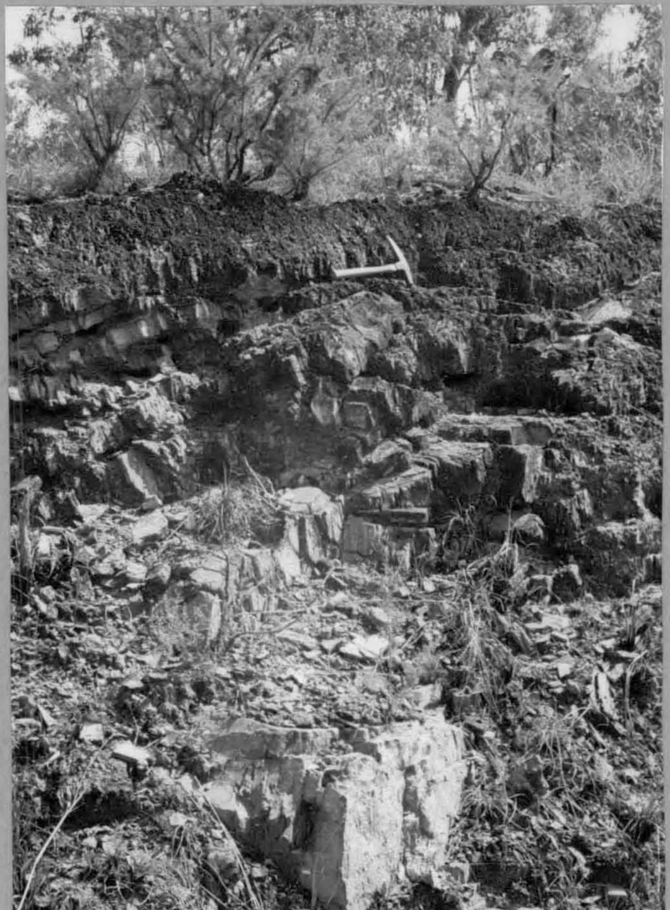
NO. 4 — A CLOSE VIEW OF THE RIVER BAR OF DETRITAL LATERITE SHOWN IN NO. 3. NOTE THE CONGLOMERATIC TEXTURE.

NO. 5— A CLOSE VIEW OF A DETRITAL LATERITE. NOTE THE LATERITIC AND VESICULAR MATRIX. BRODRIBB, N.T. MATCHBOX, TOP CENRE.

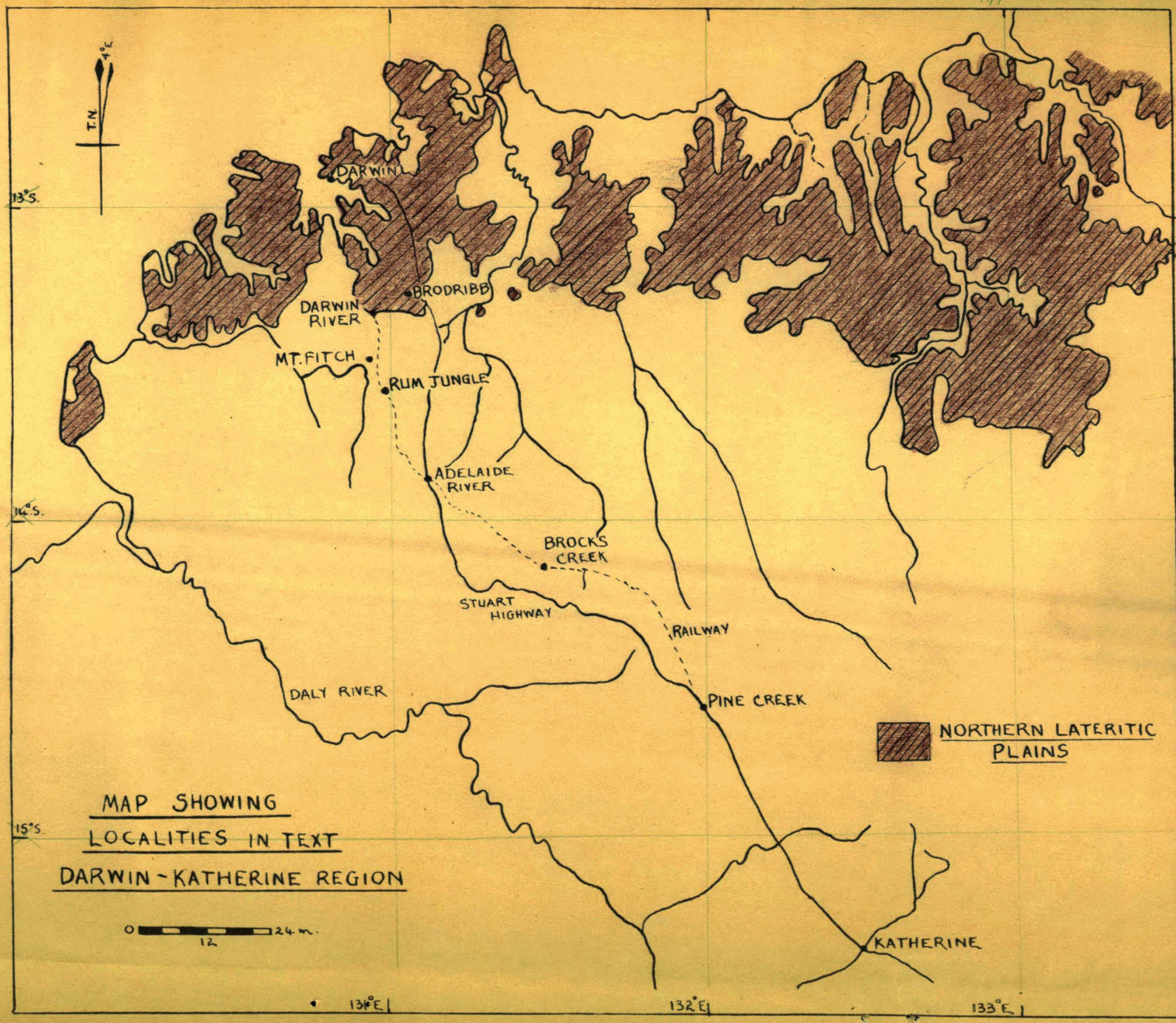


NO. 6— A CLOSE VIEW OF A DETRITAL LATERITE. EIGHT MILES SOUTH OF THE RUM JUNGLE RAILWAY STATION, N.T. MATCHBOX, LEFT CENTRE.

NO.7— LATERITE FORMED IN SITU BY THE EXTENSIVE LEACHING OF SLATES. NOTE THE SLATY CLEAVAGE PRESERVED IN THE LATERITIC END PRODUCT. IN A RAILWAY CUTTING SEVEN MILES NORTH OF THE SOUTHPORT RAILWAY STATION, N.T.



NO. 8— A THIN DEPOSIT OF LATERITE FORMED OVER MASSIVE SANDSTONE. COMPARE THE THICKNESS OF THE LATERITE WITH THAT FORMED OVER THE SLATE IN NO. 7. NO.8. IS IN THE SAME RAILWAY CUTTING AS NO. 7.


Approx 132° 26'
T.N.
4°E.
DARWIN
Approx 12° 32'
13°S.
BRODRIBB
DARWIN RIVER
MT. FITCH
RUM JUNGLE
ADELAIDE RIVER
Approx 13° 24'
14°S.
BROCKS CREEK
STUART HIGHWAY
RAILWAY
DALY RIVER
PINE CREEK
NORTHERN LATERITIC PLAINS
15°S.
MAP SHOWING
LOCALITIES IN TEXT
DARWIN - KATHERINE REGION
0
12
24 m.
KATHERINE
131°E
132°E
133°E