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A PETROLOGICAL STUDY OF THE SEDIMENTS FROM WATERHOUSE ANTICLINE No.1 WELL AMADEUS BASIN. NORTHERN TERRITORY.

by

G. Schmerber,
Institut Français du Petrole

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SUMMARY

This report is the result of the examination of cuttings obtained from Waterhouse No.1 Well drilled by Centralia Oil Pty Ltd in the Amadeus Basin.

Information has been obtained concerning the texture, the mineral constituents and the cementing media.

The two-fold subdivision into the Arumbera Sandstone and the Jay Creek Limestone, defined from surface mapping and drilling, has been substantiated.

Petrological correlations are possible between Ooraminna No.1 and Highway No.1 Wells.

INTRODUCTION

The Waterhouse Anticline No.1 well was drilled in the Amadeus Basin, Northern Territory, by Centralia Oil Pty Ltd on the axis of a large east-west trending anticline 40 miles S.W. of Alice Springs. The well location is approximately -

Latitude : 24°01'S.
Longitude: 133°32'E.

The aim of this study was to examine in detail the lithology of the sediments especially of the Jay Creek Limestone. The work carried out on the sediments includes a binocular microscopic examination of all the available material and a thin section analysis of selected cuttings and the bottom core.* A calcimetry log was prepared with an average interval of 50 feet. Staining tests for dolomite and calcite were carried out on selected thin sections. A brief study of heavy minerals was undertaken on sandstone and sandy siltstone from the cuttings.

DESCRIPTION OF LITHOLOGICAL UNITS

The sandstone unit in the basal part of the Waterhouse No.1 well can be correlated with the Arumbera Sandstone, and the overlying dolomite-siltstone unit, with the Jay Creek Limestone which crops out in the anticline structure. The well spudded in the Jay Creek Limestone, approximately 1225 feet below the top of the formation.

THE ARUMBERA SANDSTONE

This formation has been intersected from the bottom of the well, (drillers depth 3081 feet), (E.L. depth 3077 feet) to 2254 feet. The lithology comprises mainly ferruginous sandstone and interbedded siltstone with a progressive increase in clay content in the upper part.

The sandstones are red-brown, pink and rarely orange, generally medium to poorly sorted, ranging from silty to very coarse with angular to rounded quartz and feldspar; quartz content varies between 60% and 80% and there is 3% to 5% potash feldspar (microcline and orthoclase with some crystal outlines) and rare sericitized acid plagioclase. The lithic constituents are principally of igneous and some metamorphic origin, but also comprise conspicuous fragments of quartz-chalcedonic chert, probably from the Bitter Springs Formation. Below 2,700 feet there is a pebbly zone which consists of rounded quartz, quartzite and siliceous rock fragments. The lithic content is estimated to be below 5%. Muscovite, in fine flakes and locally some greenish brown, very altered biotite indicate subhorizontal bedding. A small amount of altered, brownish green glauconite occurs at 2770 and 2570 feet.

Accessory minerals, rounded tourmaline, zircon and some apatite, are rare; authigenic pyrite crystals occur throughout. The cementing media is composed of haematite coatings or interstitial haematite, quartz and a few locally well developed potash feldspar overgrowths, rarely kaolinite, and some dolomite pseudo-rhombs, which increases in the upper part of this unit.

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* The bottom core, broken into small pieces does not allow a complete petrological description.

Interbedded brownish red, dark grey and in minor amount greenish, micaceous, haematitic and chloritic, locally very sandy and dolomitic siltstone occurs, and increases up to 50% in the upper part of the Arumbera Sandstone. Clay, probably illite, is commonly associated with haematite.

Porosity: Most of the samples were recovered as loose sand grains, so that it was difficult to evaluate the porosity, however, some thin sections show good intergranular porosity. The Neutron log indicates good porosity in some sandstone horizons. It is probable that the primary porosity has been reduced by post-sedimentary cementation.

Contacts: The boundary between the Arumbera Sandstone and the overlying formation, the Jay Creek Limestone, must be defined as transitional with a progressive change in the lithology. Between 2,335 feet and 2,255 feet the sediments show an increase in carbonate content and a decrease in sandstones.

As the electric and the gamma-ray neutron logs do not show any marked break, the limit has been picked at the first appearance of sandstone in the cuttings logs.

Lithification: In this predominantly sandstone unit, the diagenetic processes have been very strong. Following the deposition of haematite, a strong silicification and potash feldspathization has taken place, resulting in overgrowths on the detrital grains in sandstones which had sufficient primary porosity. In the sandstones, as in the siltstones, a variable development of carbonate minerals, especially dolomite, followed the silicification.

Environment: The Arumbera Sandstone was deposited in shallow marine conditions, probably a deltaic environment. The presence of dominant quartz sandstone, with altered feldspar, igneous and sedimentary rock fragments, rounded tourmaline, zircon and apatite suggests a very mature sandstone, with a source area of igneous and sedimentary rocks.

JAY CREEK LIMESTONE

This formation has been intersected from the surface to 2254 feet; the lithology is predominantly siltstone and shale with thin interbedded carbonate rock horizons, mainly dolomite. The siltstone and shale sequence represents 63% of the total thickness and the carbonates only 33%.

This formation cannot be subdivided into lithological subunits because of the homogeneity of the sediments through the whole thickness of 2255 feet.

The following paragraph deals more with general aspects of the lithology, considering environmental factors and diagenetic changes.

The dolomites are light tan, grey, red-brown and locally greenish, dense and compact, also laminated, microcrystalline and in minor amount cryptocrystalline, and slightly calcareous. The average ratio of calcite to dolomite is 1 to 10. Between 2252 and 1872 feet there is a dolomitized limestone sequence. Through the total thickness, grey to black, rarely pinkish microcrystalline chert is present. The shape of these grains suggests that they were originally nodules, but it is possible that some of them were in laminae; intergranular microcrystalline calcite occurs in this chert.

In numerous dolomitic horizons, pellets, lumps, and pseudo-oolites have been noticed, which have haematite coatings. Some of the recrystallised elongated or rounded structures could be algal structures. Some very fine glauconite pellets occur at about 1700 feet.

Intergranular haematite, some authigenic pyrite crystals and black matter, in fine lines or in stylolites are present.

The siltstone and shale interbeds vary from 5 to over 100 feet thick down to 1790 feet, but below this depth the siltstone is thinner and rarely over 30 feet thick; it has more interbeds of dolomite and is mostly hard to blocky but in part softer, fissile, and grades into shale.

Interbedded with this brownish red and green siltstone there are also some blackish bands of micaceous, haematitic and in places chloritic siltstone and silty shale; dolomite pseudo-rhombs occur throughout. Anhydrite, gypsum and very rare rounded baryte crystals are present and occur probably in fissures or veins. Clay minerals are present in minor amount.

Rounded, medium to coarse grained, locally conglomeratic, quartz and igneous grains are frequent in numerous horizons especially about 1700 feet. These grains occur mainly in siltstone but are also present in the carbonate beds.

Porosity: Some good porosity has been observed in cuttings and is also indicated by the neutron log.

In cuttings, numerous fine fractures, more or less filled with calcite, small vugs and in places intercrystalline voids have been observed. In some cases, especially at 450 feet and between 1700 and 1800 feet, a very good average porosity is indicated by the neutron log.

Lithifications: Diagenetic changes have taken place by strong silicification in the form of chalcedonic (now recrystallized to microcrystalline quartz-chalcedony) developed in the carbonate beds and as a dolomitization which has completely changed the primary limestone and more or less the siltstone-shale sequences.

Post-sedimentary fissures have been filled by anhydrite and gypsum.

Environment: The Jay Creek Limestone was deposited in a shallow marine to coastal environment where abundant algal growths developed. The depositional site was subject to periodic influx of mature quartz and rock fragments which indicates a higher water energy or active erosion in the continental source area.

CONCLUSIONS

The description of the sediments intersected by the Waterhouse Anticline No.1 well shows:

The Arumbera Sandstone is a poorly sorted, very fine to very coarse grained quartz and feldspathic sandstone, with mature heavy minerals, haematite coatings and quartz overgrowths. These petrological characteristics have been previously noticed in Alice No.1 and Ooraminna No.1 wells.

The Jay Creek Limestone is an interbedded siltstone and dolomite unit, with siltstone predominant. The unit contains a great amount of chert and different grain types in the carbonate rocks, and some rounded quartz clastics throughout. These characteristics provide a good correlation with the same formation in Highway No.1 well.

REFERENCES

FEHR, A. - Petrological study of cambrian sediments in Alice No.1 well, Amadeus Basin, (N.T.). Bur. Min. Resour. Aust. Rec. 1966/5.

SCHMERBER, G. - A petrological study of the sediments from Ooraminna No. 1 well, Amadeus Basin (N.T.). Bur. Min. Resour. Aust. Rec. 1966/82.

WILLIAMS, G.K. - Final report Centralia Oil Pty Ltd, No.1 Waterhouse Anticline, Northern Territory, Australia 1965.

(SHEET 1.)

Lat. approx. ..... 24° 01' S.

Long. approx. ..... 133° 32' E.

Elevation ..... 2 feet above G.L.
(G.L. not indicated)

WATERHOUSE ANTICLINE No. 1.

CENTRALIA OIL PTY. LTD.
AMADEUS BASIN
NORTHERN TERRITORY

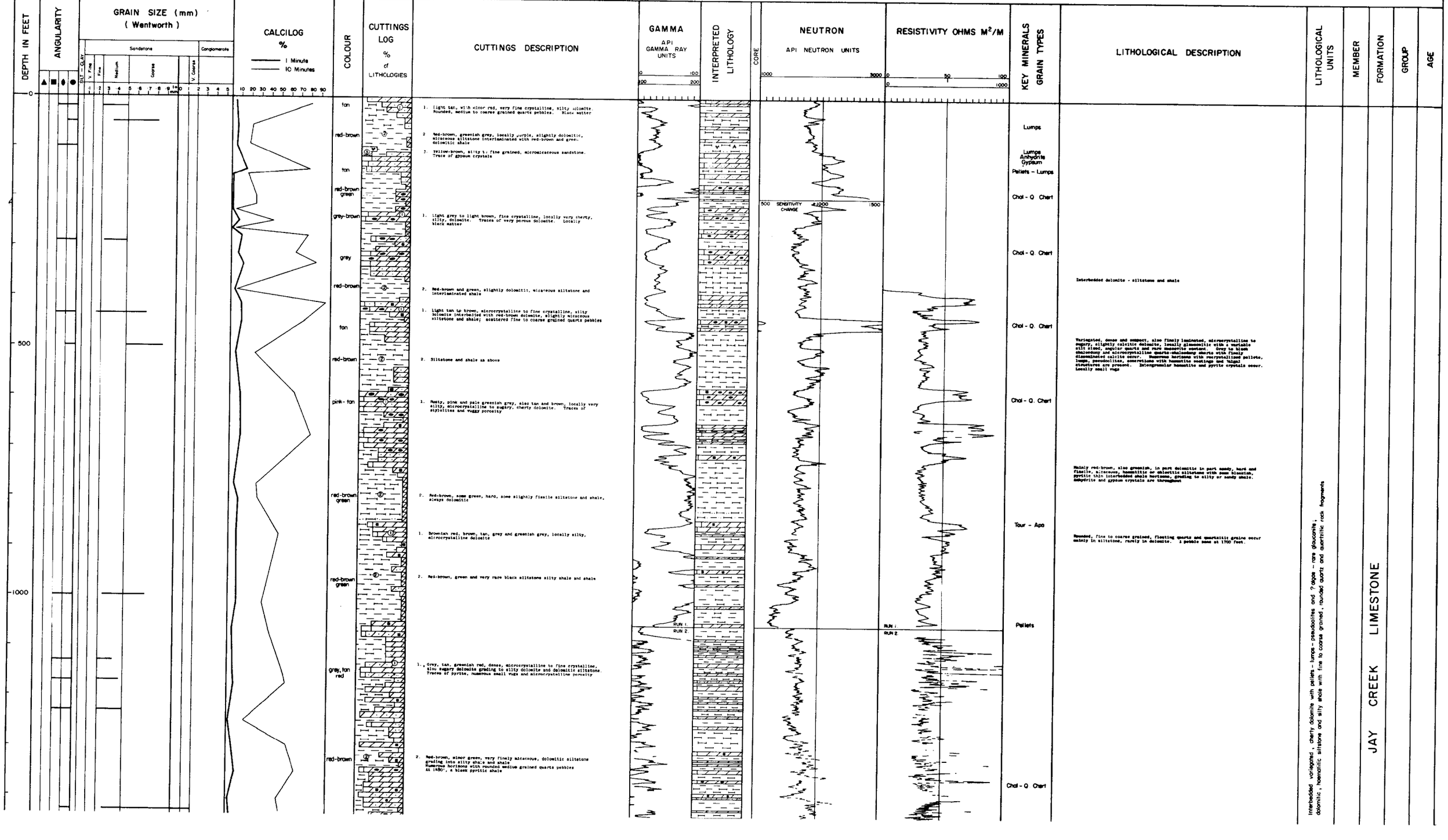
SCALE

FEET 100 50 0 100 200 300 FEET

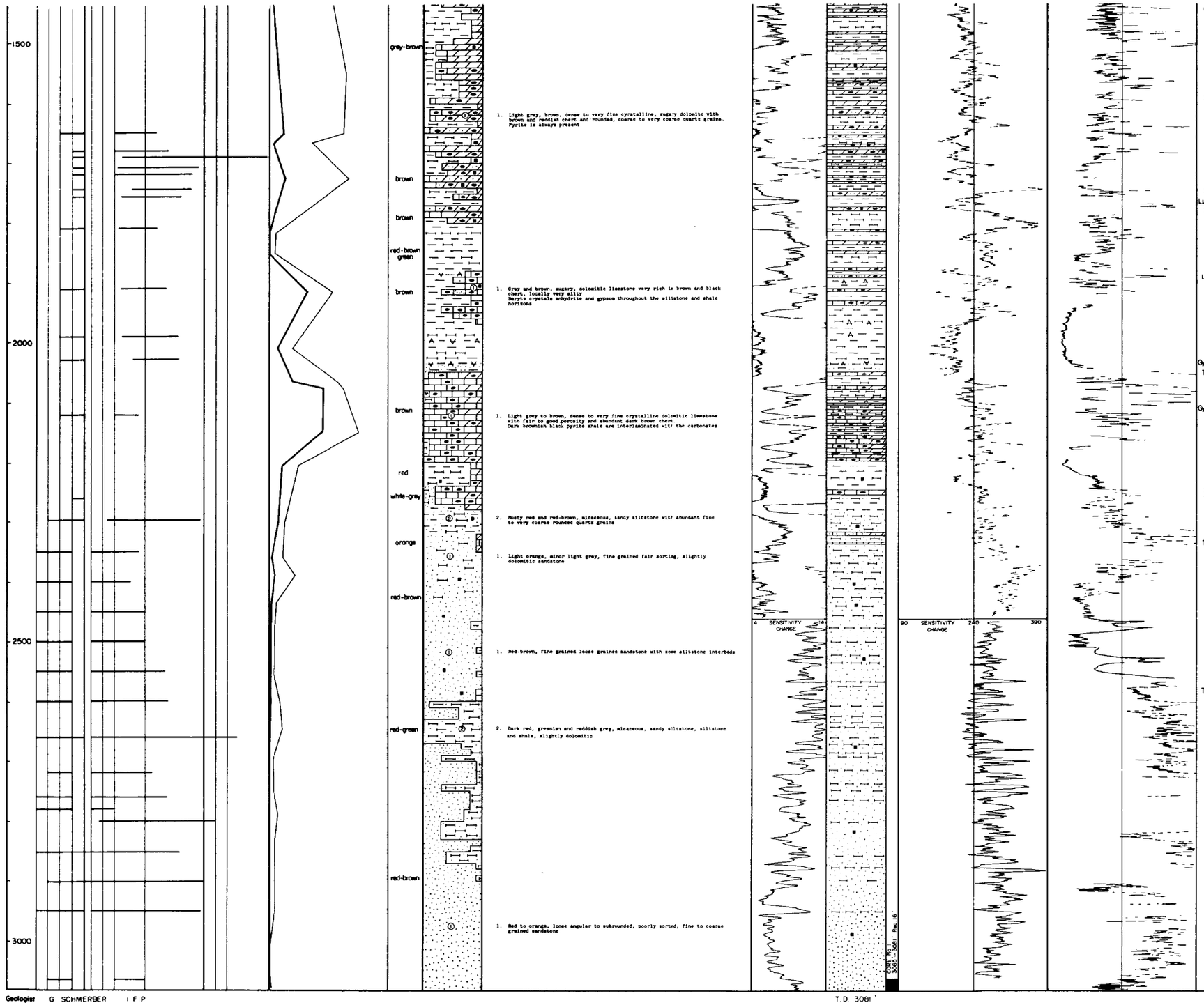
REFERENCE

Sandstone
Siltstone
Shale
Silty, sandy carbonate
Limestone
Dolomite
Anhydrite, Gypsum
Chalcedony chert
Pyrite

Apa	Apatite
Chal - Q Chert	Chalcedony - quartz chert
Tour	Tourmaline
Zir	Zircon



(SHEET 2)



1. Light grey, brown, dense to very fine crystalline, sugary dolomite with brown and reddish chert and rounded, coarse to very coarse quartz grains. Pyrite is always present

1. Grey and brown, sugary, dolomitic limestone very rich in brown and black chert, locally very silty
Barytc crystals anhydrite and gypsum throughout the siltstone and shale horizons

1. Light grey to brown, dense to very fine crystalline dolomitic limestone with fair to good porosity and abundant dark brown chert
Dark brownish black pyrite shale are interlaminated wit? the carbonates

2. Rusty red and red-brown, micaceous, sandy siltstone wit? abundant fine to very coarse rounded quartz grains

1. Light orange, minor light grey, fine grained fair sorting, slightly dolomitic sandstone

1. Red-brown, fine grained loose grained sandstone with some siltstone interbeds

2. Dark red, greenish and reddish grey, micaceous, sandy siltstone, siltstone and shale, slightly dolomitic

1. Red to orange, lonee angular to subrounded, poorly sorted, fine to coarse grained sandstone

Orange and brownish red, locally silty, shale very rich in clay and haematite, slightly dolomitic, with rounded coarse quartz grains, anhydrite and gypsum

Cherty limestone and interlaminated siltstone and shale

Light to dark brown, also white, microcrystalline to sugary, slightly dolomitised limestone, very rich in chalcedony and quartz-chalcedony chert with numerous black laminations

Interlaminated dark brown, pyritic shale, brownish red siltstone and sandy siltstone with some anhydrite, gypsum and baryte

Interbedded, ferruginous, fine to coarse grained sandstone, siltstone, silty shale and some silty, very thin dolomitised limestone beds

Quartz and feldspathic sandstone grading to siltstone

Brownish red, fine to coarse grained, locally with floating conglomeratic grains, medium sorted, angular to subrounded sandstone with 60 to 80% quartz, 5% orthoclase microcline, altered plagioclase, volcanic metamorphic and sedimentary cherts, very rare muscovite and some altered glauconite, rounded tourmaline, zircon and rutile are present
Cement : haematite coatings, quartz overgrowths, small amount of kaolinite and dolomite rhombs

Generally brownish red, minor amount greenish, hard, locally very rich in muscovite siltstone and sandy siltstone, haematitic, locally chloritic and pyritic with a progressive increase to dolomite

Quartz sandstone with rare interbedded siltstone

Fine to very coarse grained, poorly sorted, angular to rounded, mostly unconsolidated quartz sandstone with 75% quartz, some K feldspar (orthoclase and microcline) volcanic and especially sedimentary rock fragments (chalcedony chert), very rare muscovite and greenish biotite, accessory minerals are rounded tourmaline, zircon, pyrite crystals
Cement : haematite coatings, quartz and some K feldspar overgrowths and 1 to 5% of dolomite

Brown, cherty, dolomitised limestone with interformindated siltstone

Brownish-red, fine to coarse, poorly sorted quartz and feldspathic sandstone with haematite coatings, quartz overgrowths and dolomite cement ; rare glauconite , rounded tourmaline - zircon - apatite interformindated ferruginous micaceous siltstone

PERTAOORTA

CAMBRIAN

ARUMBERA SANDSTONE

Geologist G SCHMERBER I F P

T.D. 3081'

To Accompany Record 1966 / 137

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