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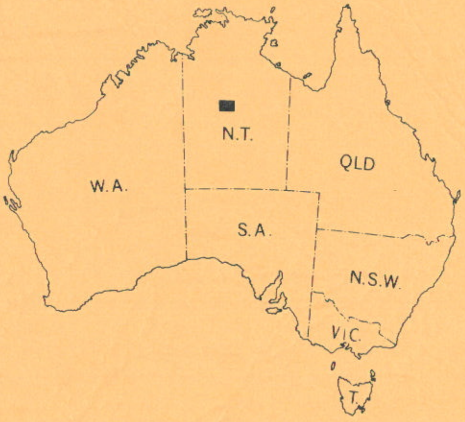
GREEN SWAMP WELL

NORTHERN TERRITORY



SHEET SE/53-13 INTERNATIONAL INDEX

DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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COMPILED BY P. J. KENNEWELL

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Explanatory Notes on the Green Swamp Well Geological Sheet

Compiled by P. J. Kennewell

The Green Swamp Well Sheet area is in the Tanami Desert, Northern Territory. It includes the southeastern part of the Wiso Basin and a small part of the Tennant Creek Block, and is between latitudes 19° and 20°S, and longitudes 132° and 133°30′E.

There are no permanent settlements in the area, and the only access is provided by a track extending westwards from Tennant Creek, 87 km to the east of the Sheet area. Cross-country travel is possible using a four-wheel-drive vehicle, but is difficult owing to sand dunes, scrub, spinifex and, in places, a lack of landmarks for navigation.

The climate is arid, with an annual rainfall of 300 mm and annual evaporation of 2750 mm. Mean temperatures range from a maximum of 37°C to a minimum of 24°C in January, and from a maximum of 25°C to a minimum of 10°C in July (Australia, Bureau of Census and Statistics, 1970).

Vegetation is typically xerophytic, with spinifex dominant on sand plains, light eucalypt and mulga scrub on gentle rises, and saltbush common on some claypans. Claypans in many parts of the Sheet area contain water after heavy rain. The area supports no industries.

Previous investigations

Davidson (1905) first crossed the Sheet area in 1900 on a prospecting expedition to the Tanami area in central-western Northern Territory. In 1909 Chewings sank a series of wells, including Green Swamp Well, across the Sheet area for a proposed stock route from Barrow Creek to Wave Hill. After visiting the Winnecke Creek area to the northwest, and the area along the Overland Telegraph line to the east, he later concluded (Chewings, 1931) that the 'Winnecke Creek Tableland Formation' (Wiso Basin sediments) formerly covered the area between those districts.

Aerial photographs at 1:50 000 scale were taken in 1950 by the RAAF.

In 1964 Aero Service Limited flew an aeromagnetic survey which extended over most of the Sheet area, showing 'magnetic basement' at less than 1000 m in parts of the Sheet area (Zarzavatjian & Hartman, 1964).

Wongela Geophysical Pty Ltd, under contract to BMR, carried out a helicopter gravity survey of the Sheet area, providing a map showing the Ooratippra Gravity High of the Georgina Regional Gravity Shelf extending over the northeastern part, and the Lander Regional Gravity Low extending over the southwestern part of the Sheet area (Flavelle, 1965; Fraser, Darby, & Vale, 1977). Photo-interpretation of the Sheet area was carried out in 1965 by Rivereau & Perry (1965) before a reconnaissance geological survey by BMR using a helicopter (Milligan, Smith, Nichols, & Doutch, 1966). This survey showed Palaeozoic sediments extending over the Sheet area, with a small area of Proterozoic sediments in the extreme northeast corner.

A stratigraphic drilling program carried out concurrently with this survey included five holes between 69 and 180 m deep in the Sheet area (Milligan et al., 1966). American Overseas Petroleum (1967) compiled a report on the Wiso Basin which included the Sheet area, and carried out an aeromagnetic survey which included most of the Sheet area (Adastra Hunting Geophysics, 1967) and showed anomalies at less than 500 m in many places, indicating that depth to basement is of that order throughout most of the Sheet area. Exploratory drilling has been carried out in the southeast corner of the Sheet area by Geopeko Ltd. Aerial photographs at a nominal scale of 1:80 000 were flown in 1971, and are available from the Division of National Mapping, Canberra.

Present investigation

The Green Swamp Well Sheet area was mapped in 1975 by BMR using a helicopter, as part of a reconnaissance geological survey of the southern Wiso Basin (Kennewell & Huleatt, in prep.). Although 1:80 000 scale aerial photographs were used for navigation, the geological Sheet was prepared by amending the 1:250 000 scale photo-interpretation map prepared from 1:50 000 scale aerial photographs.

A stratigraphic drill hole, BMR Green Swamp Well No. 6, was drilled to 337 m in 1975, and penetrated Wiso Basin sediments to total depth.

Physiography

Many landforms are typical of an arid environment, although some are relicts of an earlier, wetter period. The Sheet area is a plain with drainage from very gentle rises generally about 325 m elevation into broad, ill-defined valleys below 250 m elevation which are continuous with those containing the Lander River floodout in the adjoining Tanami East Sheet area to the west, and the Hanson River floodout in the Lander River Sheet area to the south. They drain northwards into Lake Woods in the adjoining South Lake Woods Sheet area. The formlines shown on the map were compiled from spot elevations obtained at 7-km spacings by the 1965 gravity survey, and give only a broad indication of relief. The area forms part of the Tennant Creek surface of Hays (1967). Five physiographic units are recognised (Fig. 1).

Low rises and pediments occur throughout the Sheet area, rising almost imperceptibly from the surrounding sand plain. Most rises are covered by lateritic gravel, although low rock outcrops and small scarps may be present. Vegetation is commonly sparse, and short creeks may incise the gently sloping surface. Pediments surrounding many rises consist of clayey sand with a few pebbles of the bedrock exposed on the adjoining rise, and are commonly covered by scrub.

Sand plains extend over most of the Sheet area, and are characteristically flat and featureless, with a monotonous cover of spinifex and sparse small shrubs.

Dunefields have developed in many parts of the Sheet area and grade laterally into sand plains. Wind has formed the sand into dunes up to about 10 m high, extending for up to 5 km. Their orientation is west-northwest, parallel to the prevailing winds. Spinifex growth has stabilised the dunes to a large extent.

The *Hanson River floodout* extends into the southeastern corner of the Sheet area where sand is reworked by the Hanson River after periods of heavy rain.

Calcrete areas and claypans are present throughout the Sheet area, but are a dominant landscape feature in the central and northern part, where they floor a large, indistinct, poorly drained depression. Calcrete mounds up to several metres

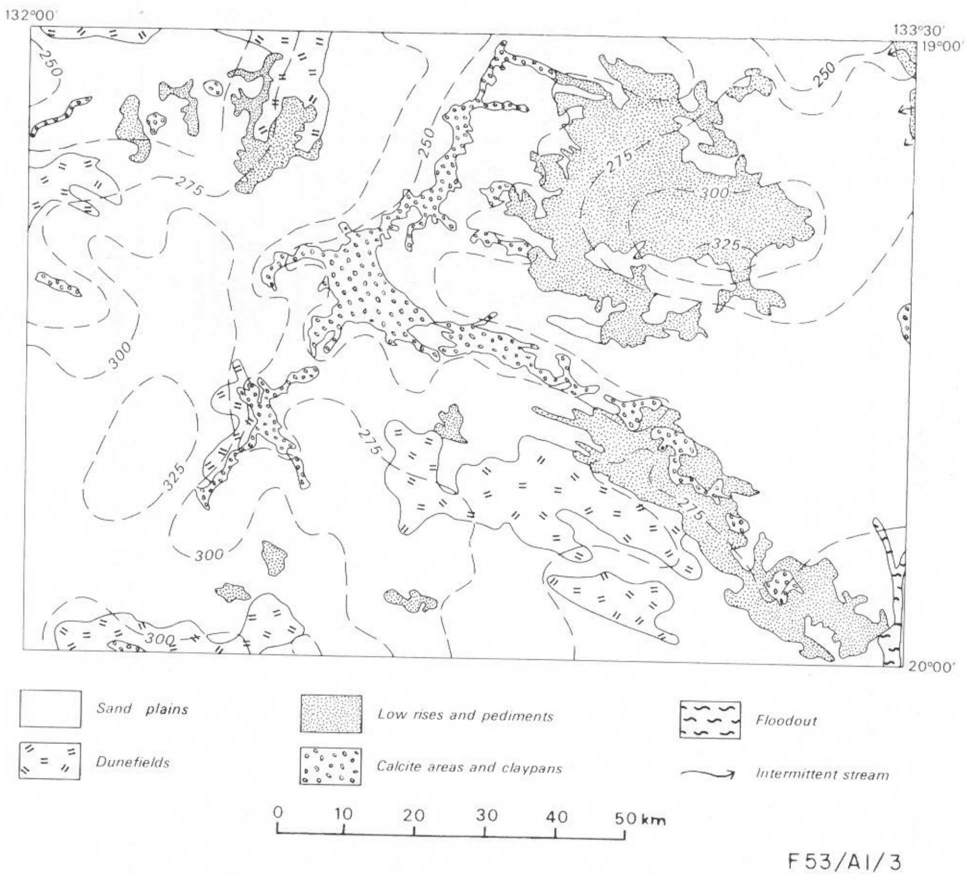

Fig. 1. Physiography.

high are separated by sand-filled depressions. Flat, rounded claypans form in the depressions, and contain water after heavy rain, although they are commonly dry with a suncracked surface.

STRATIGRAPHY

Palaeozoic rocks of the Wiso Basin extend under most of the Sheet area, overlying a basement of Proterozoic rocks of the Tennant Creek Block (Mendum & Tonkin, in prep.). A thin veneer of Cainozoic sediments reduces outcrop to small, low areas of commonly weathered rock. The stratigraphy is summarised in Table 1.

Proterozoic

Sediments and volcanics of the *Warramunga Group* (Dodson & Gardner, in prep.) do not crop out in the Sheet area, but are folded and faulted within the Tennant Creek Block 15 km east of the Sheet area, and may be present in the basement concealed beneath a cover of Palaeozoic rocks. Their age is Early Proterozoic (Mendum & Tonkin, in prep.).

TABLE 1. STRATIGRAPHY OF GREEN SWAMP WELL SHEET AREA

Era	*Period*	*Rock unit and symbol*	*Lithology*	*Est. max. thickness (m)*	*Distribution in Sheet area*	*Remarks*
CAINOZOIC	QUATERNARY	Qs	Red, fine, quartz, silty, and clayey sand—gypsiferous around salt lakes	8	Throughout	Unconsolidated; forms thin veneer over most of Sheet area; dunes developed in places; aeolian
		Ql	Sand, silt, clay, evaporites	10	Throughout	Unconsolidated; floors salt lakes and claypans; lacustrine
		Qg	Pebbles, cobbles, sand, silt, clay	3	Throughout	Unconsolidated gravel; caps low rises; residual soil, in part deflated
		Qc	Sand, rock fragments, silt, clay: colluvium	10	Throughout	Unconsolidated; underlies pediments extending from low rises
		Czt	Siliceous and dolomitic sandy limestone, chalcedony, fragments of underlying rock: calcrete	6	Central part; few outcrops throughout rest of Sheet area	Exposed in large depressions; commonly caps outcrops of carbonate rocks;
		Czs	Medium, well-sorted, well-rounded sandstone	?	Crops out at locality 36	Poorly consolidated; may fill shallow Tertiary basin; probably continental
?MESOZOIC	CRETACEOUS OR TERTIARY	KTc	Rock fragments in iron oxide matrix	5	SE part	Scree deposit preserved due to ferruginisation
		Buchanan Hills Beds KTb	Coarse, angular to rounded, poorly sorted quartz sandstone	5	Throughout, obscured by residual gravel deposits	Consolidated; weathered; unconformably overlies older rocks; exposed as framgents in residual gravel deposits; probably fluvial
PALAEOZOIC	ORDOVICIAN	Hanson River Beds Oh	Fine to coarse, poorly sorted and angular, or well-sorted and rounded sandstone, dolomite	300	S and SW parts	Very weathered; poorly exposed; overlies older rocks with probable unconformity; includes marine and possible fluvial sediments
	MIDDLE CAMBRIAN (TEMPLETONIAN)	Point Wakefield Beds Ꞓmp	Fine, angular, well-sorted sandstone, micaceous claystone ($Ꞓmp_2$) White silty calcareous claystone ($Ꞓmp_1$)	100	SE, NE, and NW parts; may underlie areas between them; dips S under Oh	May contain two distinct rock units separated by unconformity; unconformably overlies older rock units; includes marine sediments

TABLE 1. STRATIGRAPHY OF GREEN SWAMP WELL SHEET AREA—*(Cont.)*

Era	*Period*	*Rock unit and symbol*	*Lithology*	*Est. max. thickness (m)*	*Distribution in Sheet area*	*Remarks*
PALAEOZOIC	MIDDLE CAMBRIAN (ORDIAN)	Lothari Hill Sandstone Ꞓml	Red, fine, subrounded to subangular silty quartz sandstone, dolomitic in parts; rare siltstone	100	Probably underlies N part; dips S under younger formations	Conformably overlies Ꞓmh with gradational contact; supra-tidal to intertidal, possibly shallow marine near base
		Hooker Creek Formation Ꞓmh	Red-brown, laminated, micaceous, dolomitic siltstone, siltstone, silty dolomite	170	Probably underlies NW part and extends under all but NE corner beneath younger rocks	Conformably overlies Ꞓmm with gradational contact; tidal to shallow marine
		Montejinni Limestone Ꞓmm	Grey, finely to medium crystalline dolomite, dolomitic siltstone, siltstone, gypsum veins	200	Extends under all except NE corner, concealed beneath younger rocks	Basal unit of Wiso Basin sequence; unconformably overlies older rocks; marine to supratidal. Section only
	EARLY CAMBRIAN	Helen Springs Volcanics Ꞓlh	Tholeiitic basalt	?30	Do not crop out	Extensive rock unit in N Australia; may be present, concealed beneath younger rocks; unconformably overlies older rocks
PROTEROZOIC	EARLY PROTEROZOIC TO EARLY CARPENTARIAN	TOMKINSON CREEK BEDS: Ᵽt	Sediments, minor volcanics	Several thousand	NE corner	Shown on solid geology map, as many areas underlain by Tomkinson Creek Beds are covered by sand; probably forms basement to Wiso Basin sequence in many parts of Sheet area
		TOMKINSON CREEK BEDS: Morphett Creek Formation Ᵽtm	Feldspathic sandstone, siltstone, shale	Several thousand	Extreme NE corner	Resistant; forms topographic rises
		TOMKINSON CREEK BEDS: Hayward Creek Formation Ᵽth	Coarse, well-rounded silicified quartz sandstone	Several thousand	Extreme NE corner	Resistant; forms topographic rises
	EARLY PROTEROZOIC	Warramunga Group	Sediments, minor volcanics	Several thousand	Do not crop out	May be present in basement to Wiso Basin sequence, concealed beneath younger rocks

The *Tomkinson Creek Beds* (Ꝑt) (Dodson & Gardner, in prep.) crop out in the northeast corner and are Early Proterozoic to Early Carpentarian in age (Mendum & Tonkin, in prep.). The *Hayward Creek Formation* (Ꝑth) crops out as strike ridges of pale brown silicified quartz sandstone which is typically coarse-grained, well-rounded and cross-bedded, and probably several thousand metres thick. The *Morphett Creek Formation* (Ꝑtm) is interpreted as extending into the Sheet area from the adjoining Tennant Creek Sheet area (Mendum & Tonkin, in prep.), where it consists of feldspathic sandstone, siltstone, and shale.

Other formations of the Tomkinson Creek Beds, including both sediments and volcanics, may be present beneath the Sheet area, obscured by Cainozoic or Palaeozoic sediments.

Palaeozoic

The *Helen Springs Volcanics* (Єlh) (Randal & Brown, 1969) do not crop out in the Sheet area, but occur as discontinuous flows at the base of the Palaeozoic sequence in the neighbouring Helen Springs Sheet area to the northeast, and may be present as similar flows in the Sheet area. The tholeiitic basalts are Early Cambrian, probably do not exceed several tens of metres in thickness, and correlate with the Antrim Plateau Volcanics in the neighbouring Winnecke Creek Sheet area to the northwest.

The *Montejinni Limestone* (Єmm) (Traves, 1955) is the basal formation of the Wiso Basin sequence and probably extends under all of the Sheet area except the northeastern corner.

It was intersected in BMR Green Swamp Well No. 6 stratigraphic hole, where it is at least 157 m thick. Grey, finely to medium crystalline dolomite is dominant with red, grey, and green dolomitic siltstone and siltstone beds. Gypsum veins occur in cores from BMR Green Swamp Well No. 6. Dolomite outcrops overlain by calcrete in the central-north of the Sheet area are mapped as undivided Montejinni Limestone and Hooker Creek Formation, as similar rock types are present in both formations, and the stratigraphic position of the dolomite is impossible to determine in the neighbouring Winnecke Creek Sheet area. An early Middle Cambrian age is inferred from a fauna including *Biconulites, Acrothele* and other phosphatic brachiopods, and echinoderm fragments, and the alga *Girvanella* (Milligan et al., 1966). The fauna suggests a correlation with the Gum Ridge Formation of the Georgina Basin (Öpik, 1957). Features of a sabkha depositional environment are present in drill cores from the formation, and together with the fossils indicate deposition under marine to supratidal conditions.

The *Hooker Creek Formation* (Єmh) (Kennewell & Huleatt, in prep.) does not crop out in the Sheet area, but is probably present beneath aeolian sand in the northwest, and extends under all but the northeast corner of the Sheet area. BMR Green Swamp Well No. 6 showed it to be 162 m thick and to contain mainly red-brown, laminated, partly bioturbated dolomitic siltstone which grades into siltstone and silty dolomite in beds up to 10 m thick. It overlies the Montejinni Limestone with a gradational contact. In the neighbouring Winnecke Creek Sheet area (Huleatt, 1978) it contains a fauna including *Biconulites* and hyolithids, *Acrotreta, Acrothele* and linguloid brachiopods, echinoderm ossicles, and *Redlichia* and ptychopariid trilobites. Numerous small oncolites are also present. The fossils indicate a lower Middle Cambrian (Ordian) age and, together with the lithological characteristics of the sediments suggest a tidal to shallow marine depositional environment.

The *Lothari Hill Sandstone* (Єml) (Kennewell & Huleatt, in prep.) probably underlies the northern part of the Sheet but does not crop out. BMR Green Swamp Well No. 4, in the central-south, penetrated the greatest recorded thickness of the formation, 94 m of brown-weathering, white sandstone which is quartzose, fine-grained, subrounded to subangular, silty, and dolomitic in parts. Sparse beds of white soft fissile silty claystone, and rare beds of grey cryptocrystalline chert and white microcrystalline dolomite are also present. It probably extends in the subsurface under all but the northeastern part of the Sheet area, and is Middle Cambrian (Ordian) as it conformably overlies the Hooker Creek Formation, of that age, and is unconformably overlain by the Point Wakefield Beds, which are partly Middle Cambrian (Templetonian). A supratidal to intertidal depositional environment, possibly with marine deposition in the basal part of the unit, is inferred (Huleatt, 1978).

The *Point Wakefield Beds* (Єmp) (Kennewell & Huleatt, in prep.) form a poorly known sequence which crops out in the southeast, northeast and northwest parts of the Sheet area and may underlie the areas between, covered by a thin veneer of sand or calcrete. Two distinct rock types, possibly belonging to two distinct rock units, are recognised in the Beds, and are shown in the interpretation of solid geology on the accompanying map sheet. White calcareous claystone, silty in parts, preserved only as fragments in calcrete, may form one rock unit (Єmp$_1$). White silty claystone, chalcedonic in parts, of the Point Wakefield Beds from locality lat. 19°20′S, long. 133°37′E in the adjoining Tennant Creek Sheet area contains ptychopariid trilobites from which a Templetonian (early Middle Cambrian) age has been determined (Dr P. Jell, University of Queensland, pers. comm., 1976), and phosphatic brachiopods. The mapped extent of this unit is based on the presence of small depressions in the sand plain, and discontinuous outcrops of calcrete in the broad ill-defined valleys, interpreted as forming a thin capping on this poorly exposed unit.

Most outcrops of the Point Wakefield Beds are of a second rock unit (Єmp$_2$) which may overlie the silty claystone with very slight unconformity. The unit contains red to white, fine-grained, angular, well-sorted sandstone with low-angle cross-bedding and bioturbation in parts, interbedded with red-brown or white, typically laminated, bioturbated micaceous claystone which is silty in parts. This unit is more extensive than the white claystone and forms a thin veneer on older sediments in the Sheet area, and on Proterozoic rocks in many parts of the adjoining South Lake Woods Sheet area. Well-rounded and sorted sandstone containing a few pebbles and silicified by quartz overgrowths crops out at localities 10 and 50 in the central-east, and although mapped as Point Wakefield Beds, could be either the Tomkinson Creek Beds or a basal conglomeratic part of the Hanson River Beds. The age of this unit is between Middle Cambrian and Ordovician (middle Arenigian), the earliest known time of deposition in the overlying Hanson River Beds. The exposed sediments in the Point Wakefield Beds are interpreted as shallow marine in origin. The greatest recorded thickness of the silty calcareous claystone (Єmp$_1$) is 26 m in BMR Green Swamp Well No. 1, and of the sandstone and claystone (Єmp$_2$) 22 m at Point Wakefield in the southeast corner. The total thickness of the Beds is uncertain, but probably does not exceed 100 m.

The *Hanson River Beds* (Oh) (Milligan, 1976) underlie the southern and southwestern part of the Sheet area, but are very poorly exposed and little is known of their nature and age in the Sheet area. Most rocks are exposed as lateritised rubble on low rises, or as low, highly weathered pavements and consists of fine to coarse-grained sandstone which is generally poorly sorted and angular, but is well sorted and rounded in parts, and which has quartz overgrowths on grains in some places. Dolomite crops out in the walls of a sinkhole at locality GSW5 (grid ref. 24147923). The poorly sorted sandstones could belong to the Buchanan Hills Beds, and the well-sorted sandstones with quartz overgrowths to the Proterozoic Hatches Creek Group. The thickness of the Beds in the Sheet area is not known; in the adjoining Lander River Sheet area a seismic survey (Ray Geophysics, 1967) shows that they are part of a sequence about 300 m thick on the northern end of the Lander Trough (Kennewell, Mathur, & Wilkes, 1977), and that the sequence thins northwards. The nature of the contact with the underlying rock units is uncertain. Although a small outcrop of sandstone interpreted as Hanson River Beds caps the Point Wakefield Beds at Point Wakefield in the southeast, the contact is not exposed. Poor exposure makes determination of the environment in which the Beds were deposited difficult, but dolomite at locality 5 is of shallow marine origin, as are faunas from rocks of at least two different ages in the adjoining Lander River Sheet area. The poorly sorted sandstones, however, may be of fluvial origin.

The age of the Beds in the Sheet area is uncertain, but in the adjoining Lander River Sheet area dolomites contain faunas of middle Arenigian and late Arenigian to early Llanvirnian (both Ordovician) ages; the sequence in the Sheet area probably underlies these dolomites and is between Templetonian (Middle Cambrian) and Arenigian (Ordovician) in age.

Cretaceous or Tertiary

The *Buchanan Hills Beds* (KTb) (Kennewell & Huleatt, in prep.) are exposed only as very weathered fragments in residual gravel deposits, and probably underlie low rises in many parts of the Sheet area. In surrounding Sheet areas poorly sorted, angular to rounded, coarse-grained quartz sandstones are typical, and a Cretaceous or Early Tertiary age is inferred. The Miocene laterite soil profile is developed on the unit, providing a younger limit, and its thickness, lithology, flat-lying attitude, and occurrence on the edge of a large gentle slope over which rivers are presently flowing in the neighbouring Winnecke Creek Sheet area suggests a fluvial origin and an age slightly older than that of the laterite soil profile (Huleatt, 1978).

Laterite conglomerate (KTc) crops out in the southeast as elongate ridges and, at locality 27, consists of large lateritised fragments derived from the Point Wakefield Beds enclosed in a matrix of iron oxide. Only 3 m of conglomerate is exposed, and its total thickness is probably little more. A laterite soil profile is overlain by the Miocene Camfield Beds in the Wave Hill Sheet area to the northwest (Bultitude, 1973) and if iron oxides deposited during formation of the same laterite profile cemented the fragments in the Sheet area, the deposit must be pre-Miocene. It probably originated as scree.

Cainozoic

An *unnamed sandstone* (Czs) which is medium-grained, well-sorted, and well-rounded, crops out at locality 36 in the central-southeast. It is poorly consolidated, bedded, and contains vertical holes 1 mm across. Its thickness and extent are uncertain, and the sandstone may correlate with sediments in the Cabbage Gum Basin, a shallow, presumed Tertiary, basin in the adjoining Tennant Creek Sheet area (Mendum & Tonkin, in prep.).

Calcrete (Czt) crops out in a large west-trending depression in the central part and at isolated places in sand plain in many other parts of the Sheet area. The finely crystalline, siliceous and dolomitic limestone contains quartz grains, and fragments of calcareous claystone, recrystallised dolomite, or poorly sorted, angular lateritised sandstone towards the base of incised outcrops. Chalcedony is dominant in many places. The greatest observed thickness of calcrete in outcrop is 4 m at locality 12 in the central part of the Sheet area, and its total thickness probably does not exceed 6 m.

Colluvium (Qc) is present throughout the Sheet area underlying pediments extending from many low rises. Sand is the main constituent, but silt, clay, and rock fragments from nearby rises are carried by soil creep and small streams to form deposits probably no more than 10 m thick.

Gravel (Qg) caps many low ridges throughout the Sheet area, overlying areas in which bedrock is near the surface. Pebbles and cobbles of the underlying rock type are generally highly lateritised and enclosed in an unconsolidated matrix of sand, silt, and clay. Wind and water action has commonly deflated the deposit, leaving it no more than several metres thick. In most places the underlying rock type can be recognised from the fragments preserved in the gravel.

Lake deposits (Ql) floor claypans and salt lakes in channels and depressions throughout the Sheet area. Sand, silt, and clay are poorly sorted and become sun-cracked after dry periods. A crust of gypsum with traces of halite forms after evaporation of water from salt lakes. Most lake deposits are probably thinner than 10 m; BMR Green Swamp Well No. 4, in the central north of the Sheet area, was located in a large channel near claypans, but commenced drilling in bedrock (Milligan et al., 1966), indicating that the deposits are thin.

A thin blanket of *sand* (Qs) covers almost all the Sheet area, surrounding the areas of gravel and colluvium. It is quartzose, red owing to staining by iron oxides, silty and clayey, and typically fine-grained. Gypsum may be present around salt lakes. Wind action has produced longitudinal dunes which trend east-southeast in some places, are up to 6 km long, and reach a height of about 5 m. Drilling in the sand plains did not penetrate any more than 3 m of sand.

STRUCTURE

Folded Proterozoic rocks underlie the northeast corner of the Sheet area, and are overlain elsewhere by very gently folded Palaeozoic sediments of the Wiso Basin.

The presence of Proterozoic rocks at depths less than 500 m is indicated by relatively shallow aeromagnetic anomalies in many parts of the Sheet area (Adastra Hunting Geophysics Pty Ltd, 1967).

Proterozoic quartzites of the Tomkinson Creek Beds are the only basement rocks known to crop out, and the prominent Hayward Creek Formation in the extreme northeast of the Sheet area is photo-interpreted to be folded with a north-northwest axis and to dip steeply northeast at one locality. The structure of other outcrops is uncertain. Faulting occurs within similar rocks in the adjoining South Lake Woods Sheet area (Kennewell, 1977) and is probably present, obscured by aeolian sand, in this Sheet area.

Sediments of the Wiso Basin are almost flat-lying, though correlations between stratigraphic drill holes suggest a slight thinning northwards of the Ordian (Middle Cambrian) rocks; this indicates a shallow northward continuation of the Lander Trough, which underlies the Lander River Sheet area to the south.

An unconformity representing a period of slight folding separates the Ordian sediments from the Templetonian Point Wakefield Beds, which are an almost flat-lying sequence in the Sheet area. Curved trend lines on outcrops of these beds in the east of the Sheet area (e.g. locality 59, Grid ref. 322857) result from exposure of flat-lying beds on gently undulating topography.

Several episodes of very slight folding may have occurred during deposition of the Hanson River Beds, but are impossible to define because of poor outcrop of the deformed rocks.

Several lineaments have been photo-interpreted in the Sheet area, but their nature is unknown.

GEOLOGICAL HISTORY

During late Early Proterozoic and Early Carpentarian time sand, silt, shale, and possibly carbonate and rare lavas of the Tomkinson Creek Beds were deposited on a basement of Warramunga Group rocks. Folding and subsequent erosion occurred before Early Cambrian time, when tholeiitic lava (Helen Springs Volcanics) was extruded on an eroded landscape in surrounding areas and may also have covered parts of the Sheet area.

The sea transgressed the Sheet area in Middle Cambrian (Ordian) time and dolomite, dolomitic silt, and sand were deposited in it, and on tidal flats and supratidal areas (Montejinni Limestone, Hooker Creek Formation, and Lothari Hill Sandstone). After gentle tilting, a short period of erosion formed a flat land surface which was subsequently flooded by a sea in which silty calcareous claystone, sand, and silty clays were deposited (Point Wakefield Beds).

Uplift and erosion probably took place during Late Cambrian or Early Ordovician time before deposition of sand, silt, clay, and carbonate (Hanson River Beds), at least partly under marine conditions. The depositional history of these sediments is probably complex, as marine transgressions took place during at least two different times and some sediments may have been deposited by rivers. Little is known of the subsequent geological history, although some very slight folding may have been produced during the Alice Springs Orogeny, which probably affected the Lander River Sheet area to the south (Kennewell & Offe, 1979).

Sands were probably deposited by rivers during Late Cretaceous or Early Tertiary time (Buchanan Hills Beds) before a wet period during which a laterite soil profile developed. Erosion of the weathered rocks and cementation of scree by iron oxides took place during either this or a later period of lateritisation (laterite conglomerate). The laterite crust was subsequently removed by erosion, leaving weathered rocks exposed, and a large shallow drainage system developed on the almost flat surface. Sand was deposited in at least one area, possibly in a shallow depression (unnamed sandstone), and calcrete developed in the drainage system, in places over carbonate rocks.

Most surficial units formed during Quaternary time, with gravel forming on rises and being washed into valleys as colluvium, and both sand plains and lake deposits developing.

ECONOMIC GEOLOGY

Water

No permanent surface water is present in the Sheet area, but fresh water remains in claypans for several months after rain.

The groundwater potential of the Tomkinson Creek Beds is untested, but bores on Banka Banka station, 60 km northeast of the Sheet area, have been abandoned because of failing supply and poor-quality water (Randal, 1973), and the prospects of obtaining water from these rocks in the Sheet area are poor.

The water resources of the Palaeozoic sediments were tested in 1965 by the BMR drilling program (Milligan et al., 1966).

The Montejinni Limestone yielded 8500 litres per hour of water containing 2330 ppm total dissolved salt in BMR Green Swamp Well No. 1 stratigraphic hole, and should be a good source of water in many parts of the Sheet area. The Hooker Creek Formation produced 3400 litres per hour in BMR Green Swamp Well No. 2 and a large flow in BMR Green Swamp Well No. 4; total dissolved salts were 3203 ppm and 1186 ppm, respectively. It may be a useful aquifer in parts of the Sheet area. The Lothari Hill Sandstone produced only a seepage in BMR Green Swamp Well No. 3, but a flow of about 8000 litres per hour with 2830 ppm total dissolved salts in BMR Green Swamp Well No. 5, and a large salty flow in BMR Green Swamp Well No. 4; it may be a good source of salty water. Calcareous claystone of the Point Wakefield Beds yielded no water when penetrated by BMR Green Swamp Well No. 1, but the sandy rocks of the Beds have not been tested. The Hanson River Beds produce up to 6000 litres per hour of generally good stock-quality water in the adjoining Lander River Sheet area (Kennewell & Offe, 1979) and may yield similar supplies in the Sheet area. The Buchanan Hills Beds probably are not present below the water-table.

The unnamed sandstone could be an excellent source of water if present below the water-table, as similar rocks in the Cabbage Gum Basin, 75 km east of the Sheet area, contain good supplies of potable water, and provide a water supply for the town of Tennant Creek. Calcrete produces supplies of water in many parts of the Northern Territory, and may contain aquifers in the Sheet area.

Although the standing water level in BMR Green Swamp Well No. 4 was 4 m, it ranged from 18 to 84 m in the other holes mentioned above (Milligan et al., 1966).

Petroleum

Lack of thick Palaeozoic sediments makes the petroleum potential of the Sheet area negligible. Traces of bitumen were found in the Montejinni Limestone in BMR Green Swamp Well No. 1, but the unit is tight, no reservoir rocks are present, and no structural or stratigraphic traps are known.

Construction materials

Gravel and weathered rock may be bulldozed to construct roads.

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