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

1:250 000 GEOLOGICAL SERIES—EXPLANATORY NOTES

MOUNT PEAKE
NORTHERN TERRITORY

SHEET SF/53-5 INTERNATIONAL INDEX

COMPILED BY L. A. OFFE

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Explanatory Notes on the Mount Peake Geological Sheet

Compiled by L. A. Ofe

The Mount Peake 1:250 000 Sheet area, bounded by latitudes 21° and 22°S and longitudes 132° and 133°30'E, is situated about 200 km north-northwest of Alice Springs. It includes Central Mount Stuart, the so-called geographical centre of Australia.

The only settlements in the area are Anningie, Willowra, and Mount Barkly homesteads; all are centres for cattle grazing. The far northwest and west of the area includes the trackless, uninhabited, eastern portion of the Tanami Desert Wildlife Sanctuary.

Anningie and Willowra homesteads have landing grounds suitable for light aircraft, and an unsealed road which links Willowra homestead to the Stuart Highway also gives access by station tracks to water bores, dams, and wells in other parts of the Sheet area.

The area is part of the semi-arid climatic region of central Australia. The average annual rainfall recorded at Mount Peake, Willowra, and Anningie is 254, 265, and 266 mm, respectively. Most of the rain falls during the summer months. No temperature data are available from the area itself, but information recorded at Barrow Creek to the east and Yuendumu to the southwest indicates diurnal temperature ranges from about 36°C maximum to 22°C minimum in December, and from about 23°C maximum to 10°C minimum in June. The nearest weather station to the area which records hours of sunshine each day, evaporation, and wind direction is Alice Springs. In summer there are on average 10.4 hours of sunshine each day, and 389 mm of evaporation each month; the winter averages are about 9.0 hours and 131 mm. The wind is predominantly from the southeast throughout the year.

Geological Investigations

Literature on previous geological investigations of this area is listed in the bibliography.

John McDouall Stuart (1861), the first explorer in the area, visited Central Mount Stuart and many of the ranges to the west and northwest. He noted that Central Mount Stuart, Johns Range, and hills to the north towards Mount Peake were composed of red sandstone with isolated hills of granite and quartz reefs. Mounts Denison, Leichhardt, and Barkly were described as consisting of reddish-brown sandstone with conglomerate, conglomerate, and hard red sandstone, respectively.

* In 1861 Stuart named the highest point of the Nanga Range, Mount Denison, and the highest point of the Yindjirri Range, Mount Leichhardt. Subsequently, the names of the peaks have become transposed on published topographic maps, and the highest point in the Nanga Range appears as Mount Leichhardt, and the highest point in the Yindjirri Range as Mount Denison.
Thirteen years later, W. C. Gosse (1874) examined and named the Giles Range, and recorded mica, slate, and sandstone. H. Y. L. Brown (1896a, b) was apparently the first geologist to visit the area, and reported briefly on the geology of the northeastern corner of the Sheet area, and reported sparse outcrops of altered sandstone and quartz blebs associated with granite rocks. W. R. Murray (George & Murray, 1907) travelled from Central Mount Stuart to Mount Peake, and noted numerous quartz veins, quartzite, decomposed granite, quartzite capping granite, diorite, sandstone, and micaceous schist.

The Aerial Geological and Geophysical Survey of Northern Australia (AGGSNA, 1938) reported on the Anningie tin field, which had been discovered in 1935 by a local grazier, and the Bureau of Mineral Resources carried out radiometric investigations of it in 1949 (Daly & Dyson, 1963). In 1962 Rochow visited the area, and concluded there was little likelihood of it becoming a large tin producer (Rochow, 1963).

In 1958 BMR included a strip in the southwest of the Mount Peake Sheet area in an airborne magnetic and radiometric survey of the Mount Hardy region in the Mount Doreen 1:250 000 Sheet area (Carter, 1960).

From 1962 to 1965 the Mines Branch of Alice Springs carried out a study of groundwater supplies for irrigation use in the Willowra homestead area (Morton, 1965). Seventy-three holes were drilled during this survey, and seven reached basement.

A regional gravity survey conducted by BMR included the Mount Peake Sheet area (Flavelle, 1965; Whitworth, 1970).

In 1972 BMR geologists mapped at 1:100 000 scale the south-central part of the Sheet area. The northwestern part was mapped, using a helicopter, during the mapping of the adjacent Mount Theo 1:250 000 Sheet area, and the remainder, at 1:250 000 scale, was completed in 1974.

In 1976 the Geophysical Branch of BMR included the Mount Peake Sheet area in an airborne magnetic and radiometric survey.

**PHYSIOGRAPHY**

In Perry’s and others’ (1962) geomorphological classification of the Alice Springs area, the Mount Peake Sheet area is included in the ‘northwestern plain’ division. The plain is covered with aeolian sand, red soil, and alluvium, and has an overall fall northwards from about 600 to 450 metres above sea-level. A more detailed subdivision of the Sheet area is shown in Figure 1.

*Calcrite plains* occupy two linear depressions in the land surface. Ingallan Creek follows a central north-south depression into the Lander River. A depression west of the Lander River has no well-defined runoff; it extends into the Mount Theo Sheet area to the west. *Alluvium* occurs about hills, along drainage channels, and as floodouts, and *red soil plains* often form low rises covered by arcuate mulga groves. *Aeolian sand* covers the flat plains away from the hills. *Ferricrete and gravel rises* occur throughout the Sheet area. The ferrcrete forms low hills or mesas up to 20 m high and the gravel a sinuous band within or marginal to red soil plains. *Hills and ridges* are mainly in the south of the Sheet area. Their form is largely dependant on rock type. Crystalline basement commonly forms low to moderate hills which in the Yundurbulu Range rise about 350 m above the plain. Feldspathic
quartz sandstone in the southeast of the Sheet area forms rounded hills up to about 350 m high. In the central-southwest part of the Sheet area quartzite forms moderate to high hills and ridges; Mount Leichhardt, at 1139 m, is the highest point in the Sheet area and about 550 m above the plain. Quartz veins occur as isolated steep-sided ridges up to about 40 m high in places.

The rounded hills in the east and southeast of the Sheet area are drained by the Anningie, Murray, Bloodwood, and Mount Peake Creeks. The Bloodwood and Murray Creeks have poorly defined channels leading to the Hanson River, and during abnormally wet seasons Bloodwood Creek drains into a surface depression near Mud Hut Well and Bore, and forms an extensive shallow lake. Highland areas in the south of the Sheet area are drained by the Lander and Hanson Rivers, and Ingallan Creek. The floodout of Ingallan Creek joins the Lander River.
<table>
<thead>
<tr>
<th>Age</th>
<th>Rock unit and map symbol</th>
<th>Maximum recorded thickness (metres)</th>
<th>Lithology</th>
<th>Stratigraphic relations</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUATERNARY</td>
<td>Qc</td>
<td></td>
<td>Colluvium and scree</td>
<td>Superficial cover</td>
<td>Deposits accumulated on the flanks of the quartz and feldspathic sandstone hills and ridges</td>
</tr>
<tr>
<td></td>
<td>QI</td>
<td></td>
<td>Calcrete</td>
<td>Superficial cover</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Qa</td>
<td></td>
<td>Alluvium, gravel, creek sand and silt</td>
<td>Superficial cover</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Qx</td>
<td></td>
<td>Acolian sand</td>
<td>Superficial cover</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Qr</td>
<td></td>
<td>Red soil</td>
<td>Superficial cover</td>
<td></td>
</tr>
<tr>
<td>Cenozoic</td>
<td>Czc</td>
<td>Fanglomerate and dissected colluvial mounds</td>
<td></td>
<td>Superficial cover</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Czg</td>
<td>Lag gravel, Ferricrete (buckshot) and quartz gravel</td>
<td></td>
<td>Superficial cover</td>
<td></td>
</tr>
<tr>
<td>TERTIARY</td>
<td>Tlf</td>
<td>25</td>
<td>Ferricrete. Black massive and nodular laterite</td>
<td>Locally overlies weathered and ferruginised granite</td>
<td>Drill-holes in the Willowra area have intersected the complete Tertiary weathering profile: ferruginous, mottled, and pallid zones</td>
</tr>
<tr>
<td></td>
<td>Ts</td>
<td>Silcrete</td>
<td></td>
<td>Superficial cover</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tld</td>
<td>Sandstone, silstone, conglomerate</td>
<td></td>
<td>Superficial cover</td>
<td></td>
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<tr>
<td></td>
<td>Tla</td>
<td>Deeply weathered rock</td>
<td></td>
<td>Superficial cover</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Undivided silcrete, ferricrete, and deep weathered rock</td>
<td></td>
<td>Superficial cover</td>
<td></td>
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<tr>
<td></td>
<td>Central Mount</td>
<td>800</td>
<td>Reddish-purple feldspathic sandstone, grey shale, grey-green calcareous pebble, limestone, grey arkose, arkosic conglomerate, tillite</td>
<td>Unconformably overlies $E_g$ and $E_g p$</td>
<td>Maximum thickness recorded in Mt. Peake Sheet area. Defined in Appendix</td>
</tr>
<tr>
<td></td>
<td>Stuart Formation</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>EEs</td>
<td></td>
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<tr>
<td></td>
<td>Amesbury Quartzite</td>
<td></td>
<td>Bedded white orthoquartzite; rare granite to pebble conglomerate</td>
<td>Unconformably overlies $E_g$ and $E_g p$</td>
<td>Crops out N of Djilbari Hills only. Defined in Appendix</td>
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<td></td>
<td>Member Parusa</td>
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<tr>
<td></td>
<td>Vaughan Springs Quartzite</td>
<td>700</td>
<td>Cross-bedded quartz sandstone, conglomerate; rare shale</td>
<td>Unconformably overlies flaser granite and porphyritic granite</td>
<td>Unconformity with flaser granite exposed only on S side of Nanga Range</td>
</tr>
<tr>
<td>Age</td>
<td>Rock unit and map symbol</td>
<td>Maximum recorded thickness (metres)</td>
<td>Lithology</td>
<td>Stratigraphic relations</td>
<td>Remarks</td>
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<td></td>
<td></td>
<td></td>
<td>Porphyritic and even-grained granite</td>
<td>Intrudes Lander Rock Beds. unconformably overlain in the southeast by the Central Mount Stuart Formation. Unconformably overlain by the Vaughan Springs Quartzite and the Central Mount Stuart Formation.</td>
<td>Deformed to various degrees. Contains xenoliths of granite gneiss and fine-grained quartzose gneiss. Includes several granite masses, not necessarily of the same age. Preliminary isotopic dating by BMR of an upfold dyke cutting the granite has indicated an age of 1640 ± 100 m.y. (L. P. Back, BMR, personal communication, 1975)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Porphyritic granite, flaser granite</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rapakivi-textured granite. Contains xenoliths of Mount Stafford Beds</td>
<td>Intrudes Mount Stafford Beds</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Mica schist and hematite-, feldspar-, and muscovite-quartz sandstones</td>
<td>Conformably overlies Mount Thomas Quartzite. Schist intruded by tourmaline-bearing pegmatite</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bedded white metamorphosed orthoquartzite; minor metamorphosed tourmaline-bearing orthoquartzite</td>
<td>Apparently concordant contact against granite; faulted against granite elsewhere</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1300</td>
<td>Spotted cordicite and andalusite hornfels and layered hornfels. Hornblendite or pyroxene hornfels near intrusive granite</td>
<td>Intruded by basic rocks and Annatjira Granite. Interfingers with P11 in NW of Napperby Sheet area to S</td>
<td>Low-grade hornfels in SW to high-grade pyroxene hornfels in NE Greenschist to lower or middle amphibolite facies. Hornfels near granite intrusions. Cross-bedding in phyllite.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Phyllite, schist, biotite gneiss and metapsammite</td>
<td>Intruded by granite and amphibolitized basic rock</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Metabasalt, amphibolite</td>
<td>Unconformably overlain by the Central Mount Stuart Formation at Mount Browne</td>
<td>Altered locally to chlorite-rich rock; cut by calcite-chlorite veins</td>
</tr>
</tbody>
</table>

TABLE 1. STRATIGRAPHY OF THE MOUNT PEAKE 1:250,000 SHEET AREA—(continued)
STRATIGRAPHY

The stratigraphy of the Sheet area is summarized in Table 1. The area consists of isolated outcrops of Early Proterozoic metasedimentary and metabasic rocks, and Carpentarian granites of the Arunta Block, which form basement to unconformably overlying indurated Adelaidian to Early Cambrian sediments. The crystalline basement and sedimentary rocks are unconformably overlain by large areas of Tertiary and Quaternary sediments.

STRUCTURE AND GRAVITY

The interpretation of solid pre-Tertiary geology shown on the Mount Peake 1:250,000 Sheet area map is based on surface exposure and borehole data. Gravity form lines shown on the map (see also Figure 2) were drawn using data collected during a BMR regional gravity survey (Flavelle, 1965).

Granite in the southwest of the Sheet area, intruding basement metamorphics and overlain by indurated sediments, corresponds closely in inferred areal extent to the large gravity low in the Sheet area (Yuendumu Regional Gravity Low).

Fig. 2. Bouger anomalies.
The north of the Sheet area is part of the Willowra Regional Gravity Ridge (Flavelle, 1965). Flavelle (1965) and Whitworth (1970) consider that the ridge outlines a zone of metamorphic rocks denser than the surrounding rocks and, as there is a close areal correlation between the gravity high and a mineralized zone on the Barrow Creek 1:250 000 Sheet area to the east, they suggest that the gravity ridge may also outline a zone of mineralization extending west from the Barrow Creek 1:250 000 Sheet area. In contrast to the southwest, which appears to have sufficient granite, low density basement rocks, and lithified sediments to produce the observed gravity low, the north of the area consists of sparse granite outcrops and possibly denser metamorphic basement rocks. The gravity contrast from southwest to north may be directly related to the abundance of granite intruding basement.

A prominent gravity gradient separates the Yuendumu Regional Gravity Low to the southwest from a broader gentle low to the northeast. The gradient strikes northwest in the southeast of the Sheet area and swings westward in the south central part. The broad low in the northeast corresponds to the Central Mount Stuart Formation, a sedimentary pile 800 m thick. Barlow (BMR, personal communication, 1975) has suggested that the gravity gradient could be produced by the northern and northeastern contact of a low-density granite batholith with the adjoining country rock, using a density contrast of 0.15 g/cm³ which persists to a depth of 8 km. Anifoff and Shaw (1973) postulated that the northwest-striking part of the gravity gradient is due to an ancient, major, deformed crustal zone. Northwest-trending quartz-filled faults coincide with this postulated deformed zone. The 800-m thick sedimentary pile on the northeastern side of this lineament suggests that the zone of deformation was active during the deposition of the Central Mount Stuart Formation, and that the southwestern block rose relative to the northeastern block.

GEOLOGICAL HISTORY

The Lander Rock Beds and the Mount Stafford Beds are considered to be the oldest rocks cropping out in the area. They are believed to have been pelitic and psammitic marine sediments which have been indurated, intruded by mafic igneous rocks, regionally metamorphosed to upper greenschist and middle amphibolite facies assemblages, and intruded by more mafic igneous rocks. After these beds were folded, the shallow marine sediments of the Reynolds Range Group were deposited. In the southeast of the Reynolds Range (Napperby 1:250 000 Sheet area), both the Lander Rock Beds and the Reynolds Range Group have been metamorphosed to low-pressure granulite-facies assemblages. In the Mount Peake 1:250 000 Sheet area the metamorphic grade is lower (greenschist facies), and the area is intruded by Carpentarian granite. Locally, the granite has thermally metamorphosed the intruded sediments to pyroxene hornfels.

The Vaughan Springs Quartzite was deposited on crystalline basement in a shallow marine environment during the Adelaidian. The Central Mount Stuart Formation was deposited on crystalline basement from the late Adelaidian to early Cambrian, and in places includes pockets of tillite at its base. The Central Mount Stuart Formation was metamorphosed under zeolite facies conditions, and both the Vaughan Springs Quartzite and the Central Mount Stuart Formation were folded.
The metamorphic events, following the initial metamorphism of the Lander Rock Beds, were generally low grade in the Mount Peake Sheet area, and resulted in only partial retrogression of the higher metamorphic amphibolite-facies assemblages of the Lander Rock Beds.

Many faults in the area were active at least until the folding of the Central Mount Stuart Formation. The faults commonly trend northwest, and often contain brecciated and silicified quartz.

During the late Cretaceous or early Tertiary or both, ferricrete and silcrete formed over weathered bedrock, and colluvial mounds flanking the Central Mount Stuart Formation and the Vaughan Springs Quartzite exposures were partly consolidated to fanglomerate. In the Wilkowra homestead area, up to 30 m of unconsolidated sand, silt, clay, and minor calcareous beds was deposited over the ferricrete. Morton (1965) suggested that these fluvial sediments are comparable lithologically with sediments exposed near Alcoota homestead (Alcoota 1:250 000 Sheet area), which contain vertebrate fossils of late Miocene or early Pliocene age (Woodburne, 1967).

Following Tertiary sedimentation, erosion dissected the partly consolidated colluvial mounds, and in places exposed and dissected silcrete and ferricrete horizons (e.g., Mount Peake/Conical Hill area). Outwash adjacent to eroded ferricrete and quartz veins commonly consists of lag gravel composed of pieces of ferricrete and quartz.

Quaternary red soil, calcrite, colluvium, aeolian sand, and alluvium were the last materials to be deposited.

ECONOMIC GEOLOGY

Known mineral deposits in the Mount Peake Sheet area are small and generally too low-grade to warrant mining at this time. Some occurrences are of mineralogical interest only.

Chromium

Dark green veins up to 3 cm thick cut granite 1 km east of the abandoned Mount Esther homestead (grid reference: 33355746). The veins consist of spinel (containing approximately 30% Cr₂O₃), fuchsite (containing approximately 4% Cr₂O₃), and quartz (R. N. England, BMR, personal communication, 1976). The total rock contains 4 ppm Cu, 1.7% Fe, 19 ppm Li, 131 ppm Mn, and 3 ppm Ni (B. I. Cruikshank, BMR, personal communication, 1976).

Copper

Small fragments of granite piled near the corner of an old lease on the western side of Mount Browne in the southeast contain malachite on joint surfaces.

A local grazier has stated that secondary copper minerals in amphibolite occur on the western side of the Stony Creek catchment area (approximate grid reference: 31255820). Unfortunately the fiand could not be located during the 1974 survey.

A ferricrete specimen from Wilgibinda Hill in the northwest contains 0.79% copper. The hill consists of tubular laterite, and the name 'Wilgibinda' is aboriginal for worm-eaten tooth.
Lander resulted assembly.

Central contain... 

Fluorspar

During the 1974 mapping, a fluorite-quartz vein was found about 2 km south-southwest of the old Mount Esther homestead. The vein cuts basement granite, but is truncated by the basal beds of the overlying Central Mount Stuart Formation.

Accessory fluorite occurs in the granite of the Ennungan Mountains, Yundurbulu Range (Anmatjira Granite), and the granite on the eastern side of the Nanga Range.

Iron Sulphide

The red beds of the Central Mount Stuart Formation locally contain cubes and pyritohedra up to 6 mm across of limonite after pyrite.

Cubic voids, possibly after pyrite, are present in a partly brecciated quartz vein (grid reference: 34105667) which cuts the basal beds of the Central Mount Stuart Formation near the Stuart Highway.

Pyrite and galena are present in quartz scree derived from a quartz vein which cuts the Central Mount Stuart Formation and underlying granite on the west side of Mount Browne.

Pyrite and pyrrhotite occur in hornfels adjacent to the pegmatites veins in the Anninie Tin Field (Fruzzetti & Morlock, 1974).

Ironstone

All ironstone (i.e. ferricrete) examined during the survey is probably related to the weathering profile which formed during the late Cretaceous or early Tertiary or both.

Table 2 lists metal content of three ironstones analysed from the Sheet area. None of the samples shows any cellular structure.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Grid reference</th>
<th>Cu</th>
<th>Pb</th>
<th>Zn</th>
<th>Ni</th>
<th>Bi</th>
<th>Mn</th>
<th>An</th>
<th>Ag</th>
<th>Se</th>
<th>Hg</th>
<th>Fe</th>
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<td>27396759</td>
<td>18</td>
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<tr>
<td>74110190</td>
<td>29776726</td>
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</tbody>
</table>

Results in ppm unless otherwise shown. Method: AAS, except for Se and Hg (both XRF). Analysts: A.M.D.L., Report AN 3566/76.

Lead

The Mount Peake lead show, also known as Griffiths lead show, is located about 4 km south-southwest of Conical Hill in the east-central part of the Sheet area. The deposit consists of galena-bearing quartz veins cutting coarse-grained amphibolite. The mineralised zone has been cored twice to a depth of about 1.5 metres. Lenses of galena-bearing quartz have been found over an area of 15 m by 5 m, and the grade has been estimated over this area at 0.5 percent (Anon., 1961).
Small occurrences of galena have been found along joints and minor shears in an amphibolite cropping out in the Anningie Tin Field (Crohn, 1962).

Galena and pyrite occur in quartz scree on the western side of Mount Browne. The quartz rubble is derived from a nearby quartz-filled fault which cuts both the basement granite and the overlying Central Mount Stuart Formation.

**Lithium**

Lithium mica (lepidolite), lithium tourmaline (elbaite), and lithium pyroxene (spodumene) have been identified in pegmatite about 4 km northeast of the Anningie tin field (Pontifex, 1965).

**Manganese**

Black earthy masses up to 1 m across of pyrolusite cementing quartz fragments occur locally along a northwest-trending, quartz-filled fault, 1.5 km southeast of Murray Creek Dam in the southeast of the Sheet area.

**Phosphate Minerals**

Light green veins of leucophosphite \( (K_2\text{Fe}_2\text{Al})_3\text{PO}_4\text{OH}_{1.6}\text{H}_2\text{O} \) are present in amphibolite about 5 km south-southwest of Conical Hill (grid reference: 30426186). Potassium aluminium and iron aluminium phosphates may also be present (G. W. R. Barnes, BMR, personal communication, 1974). The mineral(s) possibly formed by the reaction of bird guano with the amphibolite (Simpson, 1932).

Pale blue variscite \( (\text{AlPO}_4\cdot 2\text{H}_2\text{O}) \) occurs in fractures in vein quartz 2.3 km northwest of Amesbury Bore (grid reference: 31705961). Like the leucophosphite, it too appears to be a relatively recent deposit.

**Tantalum**

Minor tantalite is associated with the cassiterite of the Anningie tin field (AGGSNA, 1938; Fruzzetti & Morlock, 1974).

**Tin**

The Anningie tin field, located about 19 km north of Anningie homestead, was discovered in 1935 by a local grazier. The tin occurs as cassiterite in tourmaline and muscovite-bearing pegmatite veins, and is present as randomly distributed patches within the pegmatite (AGGSNA, 1938; Rochow, 1963). A small amount of tantalite is also present. Mining of the clavial tin around the veins continued until 1944, but production was small. The Reward Claim was apparently the most productive, with concentrations averaging ‘13 lb per cubic yard’ (Rochow, 1963). Bismarck’s tin prospect (1.5 km southeast of the Reward Claim) was drilled in 1973 by the Mines Branch, Department of the Northern Territory (Fruzzetti & Morlock, 1974). They concluded that sufficient ore was present in the pegmatites to warrant using a bulldozer to mine the uppermost 2.5 m of ground.

A local grazier reported that alluvial tin has been found by aboriginals in a creek at the foot of the Nanga Range. This report has not been confirmed.
Uranium

A brief radiometric investigation of the Anningie tin field in 1949 located only one radiometric anomaly (Daly & Dyson, 1963). A sample collected from the area contained about 0.02 percent uranium, and it was concluded that the area warranted no further investigation as a source of radioactive minerals.

The granite masses on the southern margin of the Sheet area and the northern margin of the adjoining Napperby Sheet area generally contain above-average concentrations of uranium (Paltridge, 1973). The granites crop out in the headwaters of several of the present-day streams and also of the older buried drainage systems flowing to the north, and thus uranium may be present in the Tertiary Willowra Basin of the Lander plain.

Water

Details of all water bores in the Sheet area are available at the Resident Geologists Office, Mines Branch, Alice Springs.

Willowra Basin. In 1963 the Water Resources Branch, Northern Territory Administration, Alice Springs, drilled 45 holes in the Willowra homestead area in an attempt to assess the suitability of groundwater for irrigation. During 1965 a further 28 holes were drilled. A basement depression containing late Tertiary and Quaternary sediments was delineated, and has been referred to as the Willowra Basin (Morton, 1965). Aquifers occur in the deeply weathered bedrock and the Tertiary and Quaternary fluvial sediments. The deeply weathered bedrock generally provides poor-quality water, and the quantity depends on the permeability of the weathered zone. The main aquifer in the Tertiary sediments is a lower-channel sand separated by an aquiclude of clay and silt from an upper-channel sand. The Quaternary aquifers—the present-day channel sands—are unreliable sources of water. Recharge occurs when the rivers flow, but with seepage into the underlying Tertiary sediments the sands gradually empty.

From data obtained from drillholes put down in the area from the western side of the Walabamba Hills westwards to the Lander River it appears that the Tertiary basin outlined during the groundwater survey around Willowra station extends to the south, and maintains good aquifers in the deep alluvium. From Barkly to Koonoomurra to Ingallana Bore, gravel, sand, and clay extend to a depth of at least 45 m. From the Walabamba Hills to Ingallan Creek, groundwater is tapped from the Quaternary sands as well as from the Tertiary and weathered basement zones. The area can be expected to supply good quantities of good-quality water from Tertiary aquifers.

The Murray, Anningie, Bloodwood, and Mount Peake Creeks drain an area composed of basement metasediments, granites, and the feldspathic and quartzitic beds of the Central Mount Stuart Formation. The bores in this drainage area have generally tapped variable quantities of poor-quality water. To supplement water supplies, dams have been constructed at suitable sites in the headwaters of some of the creeks. The central part of the area has been drilled to a depth of about 65 metres (bore numbers 201, 202). Results were disappointing; very saline water was intersected in the first hole, and seepage in the second hole. Available groundwater in this area appears to come mainly from the weathered basement zone. After very wet seasons the area around Mud Hut Well and Bore becomes an extensive shallow lake.
The southwestern part of the area is crossed by the Lander River and its tributaries, and by Cockatoo Creek. These systems drain the ranges farther south. Cainozoic cover in the catchment zone is thin, and the only appreciable thickness in the southwestern part of the sheet area appears to be the floodout of Cockatoo Creek. Bore holes along the Creek have intersected stock water at about 52 metres. Recharge is probably from the weathered basement zone.

Bores in the Western Creek-Giles Range area indicated poor quantities of poor-quality water available from the shallow weathered basement.

Groundwater along and adjacent to the Hanson River is generally suitable for domestic use. The supply is variable where the bores draw from the Quaternary river sediments. In bores 66 and 69 the holes bottomed in probable Tertiary sediments, suggesting the existence of a Tertiary basin extending from the eastern side of the Djibari Hills on to the Barrow Creek Sheet area to the east. Browns Yard Bore taps water with a salinity of 5959 ppm total dissolved salts. This may be attributed to contamination by saline water from weathered basement southwest of the bore.

Areas in the west, northwest, and north-northeast do not appear to contain any substantial groundwater aquifers. Tertiary laterite and sparse basement outcrop may indicate an extensive shallow weathered basement zone. Any aquifer in this area would therefore be expected to be confined to the weathered basement zone, and contain poor-quality water. In the northwest of the sheet area numerous scattered eucalypts indicate moisture close to the surface. Surface features trending approximately north-south in this area were identified by photo-interpretation as old river channels.

Calcrite outcrop delineates a shallow northwest-trending depression west of the Lander River, and probably indicates a shallow water-table. One hole drilled in this depression produced 2.2 l/sec. of good-quality water at 29 m total depth.
APPENDIX

DEFINITIONS OF ROCK UNITS

_Central Mount Stuart Formation (Pliocene)_

The name of this unit is derived from Central Mount Stuart (grid reference 34005762, Mount Peake 1:250 000 Sheet area), the highest point in the Johns Range and the so-called geographical centre of Australia.

The Central Mount Stuart Formation crops out in the southeast of the Mount Peake 1:250 000 Sheet area, southwest of the Barrow Creek Sheet area, north of the Alcoota Sheet area, and as outliers in the northeast and central-western part of the Napperby Sheet area. It may underlie the sediments of the Wiso Basin in the Lander River Sheet area (Kennedell & Ofte, in prep.).

The type section was measured in the Johns Range and is in two parts, because the basal unconformity is exposed at one locality, whereas the top of the sequence is situated at another locality, 4 km from the first and separated from it by a northwest-trending fault. The topmost bed of the lower part of the section was traced by airphoto interpretation along strike from the southwestern block across the fault into the northeastern block, and the upper part of the section measured from there to the summit of Central Mount Stuart.

The basal unit of the Central Mount Stuart Formation varies locally in rock-type. South of Central Mount Stuart the basal bed consists of glacial tillite, and is overlain by a thin limestone bed, calcareous shale, and green or red shale. The shale is overlain by a monotonous sequence of cross-bedded red and purple feldspathic quartz sandstone, which contains minor granule beds and flattened clay pellets. Some exposures of the latter sequence display graded bedding, ripple marks and current scour. The northern exposures of the unit in the Mount Peake Sheet area consist of a basal orthoquartzite (Amesbury Quartzite Member) about 20 m thick, and this is overlain by feldspathic quartz sandstone. In the Barrow Creek Sheet area, the formation begins with brown silty sandstone, siltstone, and pebble conglomerate, followed by red arkose, sandstone, and greywacke, with interbeds of siltstone and rare dolomite (Smith & Milligan, 1964). In the Alcoota Sheet area, the formation comprises: (i) a local basal unit of grey or white feldspathic quartz sandstone with lenses of conglomerate, (ii) a thick extensive unit of red lithic feldspathic quartz sandstone and shale with calcareous sandstone at the base and dolomite near the base, plus some grey sandstone and siltstone interbeds, and (iii) an upper unit of quartz sandstone and feldspathic quartz sandstone (Shaw and others, in prep.). In the northeast of the Napperby Sheet area the Central Mount Stuart Formation consists of quartzite, tillite, varved shale, and conglomerate (A. T. Wells, BMR, pers. comm. 1978). At some localities siltstone and feldspathic sandstone are also present. In the western part of the Napperby Sheet area several gently dipping sedimentary outliers of Central Mount Stuart Formation crop out and consist of rare glacial tillite, granule and pebble conglomerate, shale, quartz sandstone and feldspathic sandstone.

Eight hundred metres of Central Mount Stuart Formation crop out at the type section.
In the Mount Peake Sheet area the Central Mount Stuart Formation rests unconformably on granite, gneiss, and amphibolite of the Arunta Block. No unit overlies the formation in this Sheet area, and the top of the formation is eroded. In the Barrow Creek Sheet area, the Central Mount Stuart Formation rests unconformably on granite and metamorphic rocks of the Arunta Block, and is conformably overlain by a formation which contains Early Cambrian fossils (Smith & Milligan, 1964). The overlying unit was designated the Grant Bluff Formation by Smith & Milligan, but later work by Shaw and others (in prep.), has shown that this unit is lithologically more similar to the Mount Baldwin Formation, which also contains Early Cambrian fossils and conformably overlies the Grant Bluff Formation in the Huckitta 1:250 000 Sheet area. Drilling near Mount Skinner in the Alcoota Sheet area (Shaw and others, in prep.) found that the Grant Bluff Formation underlies the Central Mount Stuart Formation. However, various rock-types in the lower part of the Central Mount Stuart Formation and in the upper part of the Grant Bluff Formation are lithologically similar to each other, and thus it appears that the lower part of the Central Mount Stuart Formation is a facies equivalent of the upper part of the Grant Bluff Formation. Shaw and others (in prep.) also suggest that the boundary of the Central Mount Stuart Formation and Grant Bluff Formation may be time-transgressive, i.e., it rises up-section to the south and brings the Grant Bluff Formation directly underneath the Mount Baldwin Formation.

The presence of fossil molluscs, worm burrows, and other trace fossils indicates a very early Cambrian age for the unit that overlies the Central Mount Stuart Formation in the Barrow Creek Sheet area (Smith & Milligan, 1964; Daily, 1974; Shaw and others, 1975). A trace fossil found in the interval from 300 to 500 m above the base of the type section of the Central Mount Stuart Formation was identified as Hallidaya brueri (M. R. Walter, BMR, personal communication, 1975). The same fossil occurs in the lower part of the Arumbera Sandstone of the Amadeus Basin (Wade, 1969), well below the Precambrian/Cambrian boundary, which is in the upper part of the Arumbera Sandstone (Glassner, 1969). Hence most of the Central Mount Stuart Formation is late Precambrian; the uppermost part may be earliest Cambrian.

The unit was originally named the Central Mount Stuart Beds by Smith & Milligan (1964). However several excellent exposures of the lower boundary of the unit are now known and the upper boundary coincides with the base of a conformably overlying formation in the Barrow Creek 1:250 000 Sheet area. Hence the Beds are re-defined as the Central Mount Stuart Formation.

Amesbury Quartzite Member (Esq)

This unit is named after Amesbury Bore in the southeast part of the Mount Peake Sheet area (grid reference, 31835938). It is known only in the Mount Peake Sheet area where it crops out from 7 km northeast of Amesbury Bore to 29 km farther northwards. The type section is situated 16 km east-northeast of Amesbury Bore (grid reference, 33345990).

The unit typically consists of cross-bedded and locally ripple-marked, medium to coarse-grained orthoquartzite, and white quartz sandstone containing clay galls, commonly with a pebble or granule conglomerate at the base. At the type section the sequence unconformably overlies weathered granite and begins with 0.5 m of poorly sorted conglomerate consisting of subrounded pebbles of white quartz, claystone, and shale, in a quartz sandstone matrix. This is overlain by about 20 m of
coarse-grained colourless orthoquartzite, feldspathic in the lower part, but clean above, medium-bedded, moderately rounded, and blocky. There is no other rock type above the quartzite. The thickness of the Amesbury Quartzite Member at the type section is estimated at 20 m.

Granite of the Arunta Block nonconformably underlies the Amesbury Quartzite Member at the type section. The member is conformably overlain by reddish-purple feldspathic quartz sandstone typical of the Central Mount Stuart Formation. Four kilometres north-northwest of Boko Bore (grid reference, 33266125) in the eastern part of the Mount Peake Sheet area, the Amesbury Quartzite Member is conformably overlain by laminated siltstone and fine-grained micaceous sandstone, followed by feldspathic quartz sandstone with clay galls. This is succeeded by a covered interval, and then by medium to coarse-grained purple-brown to white feldspathic quartz sandstone.

The Amesbury Quartzite Member is Late Proterozoic in age, because feldspathic-quartz sandstone which overlies it, to the south (at Central Mount Stuart) contains the trace fossil *Hallidaya brueri* of latest Precambrian age.
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