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DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

METALLIC MINERALS SECTION

RECONNAISSANCE FOR SCHEELITE DEPOSITS IN THE SIR JOSEPH BANKS GROUP
Spencer Gulf, Off County Flinders.

by

A. H. Blissett
Assistant Senior Geologist

and

K. R. Warne
Geologist

21st May, 1965. D.M. 2249/64

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ABSTRACT

In the Sir Joseph Banks Group, Archaean arenaceous, arkosic and calcareous sedimentary rocks appear to have been folded and granitised prior to the deposition of the Adelaide System elsewhere in the State. During the later stages of metasomatism, scheelite and molybdenite were introduced, accompanied by quartz and small amounts of wolfram, chalcopyrite, galena and sphalerite. The presence of fluorite, tourmaline and scapolite implies that the volatile fluids contained fluorine, boron and chlorine.

During Tertiary times, the granitic basement was peneplained and covered by Tertiary to Recent deposits, now being eroded by wave action.

Mineralisation on Spilsby Island has been described in previous reports. A survey with ultra-violet lamps over the other islands revealed only a few small disseminations and rare thin veins of scheelite on Reevesby, Hareby and Boucaut islands.

INTRODUCTION

Molybdenite was identified by the Department of Mines in rock specimens collected on Spilsby Island in August, 1963 by a party of students from Scotch College supervised by the Headmaster (Mr. C. Fisher) and a Housemaster (Mr. J.L. Stephenson).

In late November and early December, 1963 a reconnaissance survey was made of the islands in the Sir Joseph Banks Group by a team led by Senior Geologist L.G. Nixon, operating from the Fisheries Research Vessel "Investigator" (P.J. Mitchell, master), and results have been described by Nixon (1964). Traces of scheelite were found associated with the molybdenite along the south-eastern coast of Spilsby Island. A little chalcopyrite (copper sulphide) was noted on Spilsby and Dalby islands, and also at the southern end of Reevesby Island. There are small amounts of wolfram, tungstite and scheelite on the northern coast of Hareby Island. In addition, a few hundred pounds of wolfram are said to have been extracted from Milne (Langton) Island between 1942 and 1944. Guano and phosphate rock were produced on a small scale from Marum Island about 1909.

This report describes subsequent surveys made by the writers who were also based on F.R.V. "Investigator". The islands were examined at night with ultra-violet lamps to detect scheelite whose characteristic whitish or faintly yellowish fluorescence can be distinguished from minute mollusca, fragments of shells, algae and excreta from sea birds which may also be fluorescent (and sometimes phosphorescent). Occurrences of scheelite were outlined by white paint and later studied in daylight. Between 6th January and 24th January, 1964, Spilsby Island was examined with the assistance of R. Besley (student) and M.A. Corbett (prospector). It was found that scheelite and molybdenite tend to occur together, and that they are apparently confined to the southern tip of the island. The deposit has been described at length in Blissett and Warne (1964). No fluorescent minerals were seen on Duffield Island. A few crystals of scheelite were seen on Hareby Island at the locality recorded by Nixon (1964).

A further visit was made to the islands from 8th March to 25th March, 1964, when the writers were assisted by prospectors T. Amtmanis and M.A. Corbett. An important operation was the landing on Spilsby Island of a party of 6 men from the Mining Branch to obtain bulk samples of mineralised rock as mentioned by Blissett and Warne (1964). The ultra-violet lamp survey was extended to Winceby, Reevesby, Marum, Partney, Lusby, Milne (Langton), Roxby, Boucaut and Stickney islands. Traces only of scheelite were seen on Winceby, Reevesby and Boucaut islands, but no significant mineralisation was observed elsewhere.

Mapping was carried out on aerial photographs with a scale of approximately 1 in. to 1200 feet. (See Plan 65-172). Sample or specimen localities are shown on Plan 64-749 and details are listed in Appendix IV.

During the course of the investigations, we were greatly helped by the friendly co-operation of the master and crew of F.R.V. "Investigator" and of Mr. P. Jacobs (Spilsby Island).

LOCATION AND COMMUNICATIONS

The Sir Joseph Banks Group consists of about 20 islands and low reefs off Eyre Peninsula in Spencer Gulf. The largest is Spilsby Island with a total area of about 1000 acres, being about 2 miles long and 1½ miles across at the widest point. It is 28 miles north of east from Port Lincoln where launches and light planes may be hired.

GEOGRAPHY

The islands have low-lying "whale-back" profiles of peneplained granite or granitic gneiss capped with kunkar and sand. The highest point in the group rises to 165 feet above sea-level, in the north-eastern portion of Spilsby Island.

The 15 in. isohyet crosses the islands though Mr. Jacobs has suggested that the average annual rainfall during the past 6 years has been little more than half this figure. He relies on tanks for drinking water; on wells for household use and on dams for stock. Two old wells on Reevesby Island are said to have once yielded brackish water from superficial deposits.

The islands have a cover of coarse grasses, low bushes, Mesembryanthemum and scattered casuarinas. Mr. Jacobs grazes about 500 sheep on Spilsby Island and Reevesby Island also has been used for grazing in the past.

GENERAL GEOLOGY

Archaean

Nixon (1964) described the geological setting of the Sir Joseph Banks Group and the present report supplements his account. On Eyre Peninsula, Johns (1961) referred to the

Archaean Flinders Group a complex assemblage of gneisses and migmatites, enclosing metasediments and also beds of quartzite and dolomite whose bedded sedimentary origin is unmistakable. The granitic rocks range from granitoid types with no or little foliation to foliated gneiss and injection gneiss. Gneiss may merge into hybrid migmatites consisting of intimately banded amphibolite and quartzo-feldspathic layers. It was concluded in agreement with earlier workers (Tilley, 1921; Jack, 1914, and others) that the gneissic rocks were produced by granitisation of a sedimentary sequence including quartzite, arkose and dolomitic rocks. Johns proposed also that granitoid rocks showing no sign of foliation are not younger intrusive granites, but were formed <u>in situ</u> by metasomatic processes during granitisation. Bands of amphibolite may be metamorphosed calcareous rocks or altered basic intrusive rocks.

The rocks in the Sir Joseph Banks Group appear to be similar to the crystalline basement on Eyre Peninsula, though no unmetamorphosed bedded sedimentary rocks were seen. Part of the mineralised granitic basement at the southern tip of Spilsby Island may have originated from the granitisation of arenaceous sedimentary rocks (Blissett and Warne, 1964), and further evidence is offered in the present report.

Petrologist D. Smale (Appendix III in Nixon, 1964) concluded that the rocks in the Archaean complex belong to the upper part of the amphibolite facies or to the granulite facies of metamorphism. Though no critical minerals were found in thin section, hornblende and plagioclase are common in the basic rocks and, where present, pyroxene has usually altered to hornblende. However, pyroxene is the dominant mafic mineral in a specimen of amphibolite from Reevesby Island and appears to be in equilibrium with hornblende. (This report, Appendix I, Specimen P 767; TS 13702).

In the Sir Joseph Banks Group, the crystalline basement includes granite gneiss and granites grading locally into adamellite and granodiorite. There appear to be two generations of amphibolite and also of microgranite. Veins of pegmatite are abundant. The following summarised sequence illustrates the relationships of the different rock types based on evidence from the various islands. It is possible that the rocks may all be associated with the same episode of granitisation and remobilisation. No age determinations have been made, and it is not known if there are younger granitic intrusions. The rocks exposed are the roots of a metamorphic complex where melting of granitised country rock may have taken place, to be locally injected into the surrounding paragneiss. Therefore apparently intrusive granites are not necessarily later injections of extraneous magma.

4. Pegmatites
3. Microgranite veins and dykes
2. Amphibolite veins and dykes
1. Granite and paragneiss, with interlayered microgranite and amphibolite

Granite and paragneiss

The granitic rocks have been discussed by D. Smale (See Appendix I, this report; and Appendix III in Nixon, 1964). They are chiefly granite and granitic gneiss, and range from granite with no evidence of foliation to schistose granite gneiss. They are composed of dominant potash feldspar (orthoclase and microcline), with lesser amounts of quartz. Plagioclase (andesine to oligoclase) is usually subordinate to potash feldspar, but is more abundant in adamellites examined from Stickney Island (P 754, TS 13693) and Reevesby Island (P 766, TS 13701). Plagioclase is dominant in granodiorite on Winceby Island (P 747, TS 13686) and on Reevesby Island (P 769, TS 13703). Granodiorite has been recorded also from Dalby and Spilsby Islands by Nixon (1964). The rocks often contain small amounts of biotite and rare hornblende, while accessory minerals include apatite, zircon and sphene.

The granitic rocks are typically grey in colour and porphyritic with tabular phenocrysts of orthoclase up to about 3 cms. long displaying Carlsbad-twinning. The phenocrysts tend to lie in parallel orientation but it is debatable whether these are flow structures within a granitic intrusion or if they have grown in place under the influence of metasomatism upon metamorphosed sedimentary rocks. Augen gneiss with well-rounded crystals of feldspar up to 2" in diameter was noted on the north-eastern tip of Reevesby Island and on the south-eastern coast of Partney Island; and granite with similar porphyroblasts occurs on the north-west of Winceby Island. The rocks resemble rapakivi granites, though the potash feldspar ovoids do not appear to be mantled with oligoclase. That flow has taken place is shown by local curving trains, spirals and knots of phenocrysts, but these could have been produced by mobilisation of granitised material.

Pink or reddish microgranite on Spilsby Island which might have been derived from arkose or feldspathic quartzite has been described in Blissett and Warne (1964). No evidence of chilling against coarse grey porphyritic granite was found and in places, the contact appears to be a zone of assimilation in which the microgranite has become porphyritic, so grading into the coarse granite. Similar lenses and block-like masses of microgranite or aplitic masses are common elsewhere on Spilsby Island, and also on Winceby, Reevesby and Boucaut islands. (See Plates 1, 2). Plate 3 illustrates a xenolith of cream coloured medium-grained granite within grey porphyritic granite on the south-west coast of Spilsby Island. Banded granites are common which may indicate original variation in texture and lithology of granitised sedimentary rocks. A typical example (from the southern tip of Spilsby Island) is shown in Plate 4. The banded formation is a long sinuous structure about four feet wide consisting of layered cream and grey porphyritic granite and fine microgranite within coarse grey porphyritic granite. The dark streaks are irregular bands of biotite. The structure has been dislocated by minor faults, striking north of west, some of which have been infilled with thin veins of microgranite or aplite. (The hammer head points to magnetic north). In places, irregular patches and schlieren of pink microgranite within coarse porphyritic granite may be almost completely assimilated remnants of sedimentary rocks, for example on the north-western edge of Stickney Island. Rounded grains of zircon were observed by the petrologist in a number of specimens of granitic rocks and also amphibolite, which supports the hypothesis that they may have been derived from sedimentary rocks (Appendix I, Specimens P 644, TS 13532; P 645, TS 13533; P 771, TS 13706). Some rocks are intimately mixed and may be described as migmatites. Gneiss is finely interbanded with amphibolite on Reevesby Island (P 678; TS 13703) and gneissic granite contains lenses and bands of pale medium granite on the southern shore of Moreton Bay on Reevesby Island. On the south-western tip of Winceby Island grey porphyritic gneissic granite is riddled with bands and streaks of pale yellowish pegmatite, and also bands and blebs of medium-grained granite.

Exposures of the "older" amphibolites are abundant, particularly on Winceby and Reevesby islands. Migmatites consisting of finely banded gneiss and amphibolite have been noted above (cf. also Johns, 1961, p. 17). Many bands of amphibolites appear to have been folded into tight structures which are probably best described as antiforms and synforms in the sense used by Bailey (1939) because it is not known whether they were originally calcareous sedimentary rocks or folded basic intrusive dykes or sills. An example on south-east Winceby Island is shown in Plate 5. A band of amphibolite 2 ft. wide occupies a synform within grey granite containing scattered rounded phenocrysts of pink feldspar. The structure strikes to 125° (magnetic) with a plunge of 45° in this direction. The amphibolite has a fine-grained granulitic texture and consists of plagioclase (calcic andesine) and hornblende, with an unusually high content of opaque minerals. Small amounts of clinopyroxene and biotite are present (Appendix I. Specimen P 750/64: TS 13689; Appendix III, A 1684). At the north-eastern extremity of Reevesby Island an isoclinal synform with a 2 ft. band of amphibolite plunges at 73° to 115° (magnetic).

There are numerous blocks of xenolithic appearance. On the north-western coast of Winceby Island a block of amphibolite 10 ft. long and 4 ft. wide within foliated porphyritic granite has been intruded by veins of pegmatite, and by later microgranite which has shifted a band of pegmatite within the mass. Thin sections are described in Appendix I (Specimens P 747, TS 13686 and P 748, TS 13687). The granite on the northern coast of Winceby Island contains sheared patches of amphibolite cut by veins of quartz and pegmatite (Specimen P 749, TS 13688). Along the southern coast of Reevesby Island there are irregular inclusions, bands and streaks of amphibolite within grey and pink porphyritic granite.

Similar rocks were described from Stickney, Lusby, Marum and Reevesby islands by Nixon (1964).

Amphibolite veins and dykes

Many of the veins appear to be cross-cutting bodies intruded into the granitic basement. The amphibolites are usually dense black or greenish-black rocks composed of dominant plagioclase (andesine to labradorite) with abundant green hornblende and common biotite. Pyroxene is generally present and is the predominant mafic mineral in two specimens from Reevesby Island. D. Smale (in Appendix I, this report) concluded from his observations that the amphibolites appear to be metamorphic rocks of upper amphibolite facies, though they may have originally been gabbroic. The wider dykes are medium-grained and display spheroidal weathering. Nixon (1964) described what is probably a composite dyke 300 feet wide on the west coast of Reevesby Island, both margins of which appear to have been chilled at the contact with the host granite gneiss. A similar dyke is to be seen on the north coast of Winceby Island. The intrusions generally range in thickness from a few inches to about 6 feet and are numerous on the northern islands in the group. Compared with the "older" amphibolites, they have undergone little deformation, though they may be cut by later microgranite and pegmatite veins. Similar rocks on Eyre Peninsula have been recorded by Johns (1961).

Microgranite veins and dykes

Acidic intrusions are abundant and more widespread than the basic intrusions. They also may be crosscutting structures and in a number of localities, they cut the basic veins or dykes so that they represent a later phase. However, many of the veins appear to have been controlled by planes of foliation within the crystalline basement. Nixon (1964) commented that microgranites intrude amphibolite on Winceby Island and a similar relationship was noted by the writers elsewhere on Winceby and Reevesby islands. Aplitic dykes occur on Stickney, Boucaut and Reevesby islands (Appendix I. Specimens P 758, TS 13697; P 759, TS 13698 and P 769, TS 13704).

Many of the microgranite intrusions strike north-westerly or north-easterly, particularly on Winceby Island and the northern part of Reevesby Island.

Pegmatites

With a few exceptions described below, pegmatites are apparently younger than the amphibolite and microgranite intrusions. They consist essentially of large phenocrysts of potash feldspar, (either microcline or orthoclase), and quartz, with smaller amounts of biotite, hornblende or magnetite. Tourmalinised pegmatite occurs on the south-western coast of Winceby Island. (Appendix I. Specimen P 746; TS 13685). An unusual pegmatitic bulge 9 in. wide was noted on the south-western tip of Stickney Island. Scapolite forms more than 50% of the rock, the remainder of which consists of quartz, muscovite and chlorite. (P 757; TS 13696).

The pegmatites vary in thickness from about 3 in. to at least 6 ft. The thinner veins are usually simple in texture; the wider intrusions are composite, consisting of layers of pegmatite and medium to coarse grained granite with diffused boundaries.

In most cases, the pegmatite veins cut, and in places have dislocated the "younger" microgranite and amphibolite intrusions, for example, in the mineralised zone on Spilsby Island (Blissett and Warne, 1964). Microgranite is cut by pegmatite on the north-eastern corner of Reevesby Island. On the other hand, a thin microgranite vein on the northern coast of Reevesby Island intersects a 3 ft. band of amphibolite and has also clearly cut a pegmatite vein 1 ft. wide after the latter has been dislocated.

The pegmatites strike generally to the north-west or to the north-east, in a similar direction to the majority of the microgranites.

Tertiary to Recent

If Proterozoic, Palaeozoic and Mesozoic rocks were ever deposited in this region, they were stripped off prior to Tertiary sedimentation. The islands in the Sir Joseph Banks Group are low with a maximum altitude of 165 feet and they are probably the remnants of a Tertiary peneplain which might be the down-faulted extension of the 700 ft. erosion surface ("Lincoln Uplands") on Eyre Peninsula described by Johns (1961, p. 13). On the mainland, late Tertiary gravels and laterite resting upon the 700 ft. level are now being dissected by the present drainage system. Johns (ibid., pp. 26-27) suggested that kaolinisation and lateritisation of the peneplained basement took place under humid tropical conditions during the Pliocene, and that the Spencer Gulf region was faulted down in Pliocene-Pleistocene times (p. 32). The sequence on the islands is not clear. For example, on Spilsby Island the granite and gneiss has been kaolinised round much of the coastline and the altered rock is now being eroded away by wave action. Along the north-east and west coasts, kaolinised granite is overlain by up to about 7 ft. of silcrete; a grit or fine conglomerate composed of quartz fragments in a silicified kaolinitic matrix which appears to have been locally derived from granitic detritus and deposited upon an uneven weathered surface (See Plan 65-172 and Plates 6, 7). Both the silcrete (where present) and the kaolinised granite have been lateritised; they are overlain by up to about 16 ft. of soft mottled red and greenish-grey clay, succeeded by kunkar about 6 ft. thick. (See Plate 8). The sequence is complete only round the coastline; away from the coast the land surface rises gently and in a number of scattered exposures near the north coast and in the centre of the southern peninsula, a thin cover of kunkar rests directly upon unweathered granite. The most likely explanation is that decomposed granite, silcrete and clay may have once been more extensive and that they were eroded off the central portion of the island before the kunkar was deposited, possibly by the scouring effects of shallow water currents. Part at least of the kunkar is oolitic and thus probably of shallow marine origin (See below).

In the Sir Joseph Banks Group, the following Tertiary to Recent deposits are present:

6. Recent beaches; Clay pans; Local formation of phosphate rock and guano.
5. Dunes
4. Sand and loam
3. Kunkar
2. Mottled clay
1. Silcrete

(Kaolinised Granite)

The kaolinised granite or granite gneiss is brilliant white in colour and can usually be recognised by the tabular phenocrysts of feldspar kaolinised <u>in situ</u>. The most extensive outcrops are on Spilsby Island, particularly along the west coast, and on Roxby, Partney and Milne islands. A petrological description of the rock is given in Appendix I, Specimen P 760; TS 13699.

Silcrete

The rock is a pale creamy grey indurated grit grading to fine conglomerate composed of subrounded quartz fragments in a matrix of smaller, more angular grains of quartz and feldspar cemented by silicified kaolin. Leucoxene also may be present in the groundmass (Appendix I, Specimens P 641, TS 13529; P 642, TS 13530). The fact that the formation invariably rests upon kaolinised granite suggests that granitic detritus was washed into depressions and gutters in the weathered granite, as shown in Plate 6. (Silcrete is the grey formation in the foreground and it has filled an irregular embayment several feet deep in kaolinised granite to the left of the figure). In Plate 7, a cave has been cut in kaolinised granite resting on fresh granite and overlain by intricately weathered silcrete.

Silcrete outcrops over about ¼ mile along the north-eastern corner of Spilsby Island. On the west coast, kaolinised granite has been eroded by wave action into jagged reef-like outcrops capped by scattered remnants of silcrete, showing that the silcrete may once have been continuous but has been almost completely removed in recent times. Small patches were noted on the eastern and southern coasts of Boucaut Island, on the western coast of Hareby Island and on the southern shore of Home Bay on Reevesby Island. Silcrete may be present also on Partney, Roxby and Milne islands (Nixon, 1964).

D. Smale (Appendix III in Nixon, 1964) called attention to the resemblance of the silcrete to similar rocks forming the top of the Mid-Tertiary weathering profile in the Great Artesian Basin described by Wopfner (1964). An important difference is that in the Sir Joseph Banks Group, there is no ferruginous zone below the silcrete, though the upper part of the silcrete (or the top of the kaolinised granite) is iron-stained. This may be due to staining by iron-bearing solution leaching the mottled clays resting upon the duricrust surface, but the possibility cannot be discarded that there may have been a brief change of climate to more humid conditions during which the upper part of the silcrete was lateritised.

Mottled Clay

Soft mottled red and greenish clays up to about 16 ft. thick have been described by Nixon (1964). The dominant clay mineral is illite associated with subordinate amounts of kaolin; while the sand fraction consists chiefly of angular to subrounded grains of quartz with smaller amounts of feldspar and minor quantities of opaque minerals. Clays appear to be absent on Winceby, Marum, Dalby, Kirkby, Duffield, Boucaut, Stickney and Sibsey islands where kunkar, if present, rests directly upon granite or gneiss.

Kunkar

The apparent discordant relationship between the kunkar and older Tertiary formations in the interior of Spilsby Island has been discussed on an earlier page. It is a cream or white honeycombed nodular limestone with more compact tabular bands, up to about 10 ft. thick, and is usually partly stained pink, yellow and red. The limestone occurs on most of the islands in the group. Petrological descriptions of specimens from Spilsby and Reevesby islands are given in Appendix I (P 643, TS 13531; P 773, TS 13708; and P 774, TS 13709). The limestone is oolitic and pisolitic in places and contains subrounded to subangular grains of quartz and feldspar. Calcareous concretionary structures up to several cms. across were reported in TS 13708, and also in specimens recorded by Nixon (1964, Appendix III). This evidence indicates that at least part of the formation is a shallow water limestone whose marine origin is confirmed by the identification by N.H. Ludbrook of milioloids and echinoderm spines in a specimen from Partney Island (Nixon, 1964), though no diagnostic fossils dating the formation were found. It might be equivalent to the Pliocene limestone in Deep Creek (north-eastern Eyre Peninsula) mentioned by Miles (1952), and in southern Eyre Peninsula (Ludbrook, 1959; Johns, 1961).

Analyses for calcium carbonate, magnesium carbonate, alumina and phosphorus pentoxide in specimens from Spilsby, Roxby and Reevesby islands are given in Appendix II, Report AN 754-64.

Sand and Loam

The kunkar on the islands has been largely obscured by up to about 7 ft. of grey sandy loam and unconsolidated sand. Nixon (1964) recorded fish bones and shells of Recent age, both marine and freshwater. Sieve analyses showed that the sands are finer and less well-sorted than the dune sands on the islands. Heavy mineral separations are described in Appendix I (Specimens P659-P661; P674-P683). Heavy fractions were small, the minerals consisting mainly of ilmenite, magnetite or goethite with some garnet, and hornblende; and traces of zircon, tourmaline, epidote, rutile and sphene.

Reddish-brown sandy or silty loam occurs above the kunkar on the north-east coast of Spilsby Island. On Reevesby Island, Nixon (1964) recorded a small exposure of white limestone with Coxiella which lies on the kunkar or possibly within clay a little above the kunkar. According to N.H. Ludbrook, the rock is probably of Recent or sub-Recent age.

Dunes

White blown sand has formed three parallel lines of dunes in a prominent belt $\frac{3}{4}$ mile long on the north-west coast of Spilsby Island and lower dunes are present elsewhere on the island. Reevesby Island is a tied island which once consisted of four small islands now joined by sand dunes (See Plan 65-172). The aerial photographs show broad stretches of sand underwater southwards to Blyth Island which is almost entirely covered by blown sand.

The dunes are unconsolidated but they are being stabilised by coarse grasses and low bushes.

Recent beaches; Clay pans

The longest beaches have formed near stretches of dune sands, for example on Spilsby and Reevesby islands. It is likely that older dune sand has provided material for the formation of beaches and that in turn, wide beaches drying out, especially at low tide, present large surface areas to prevailing winds which pick up sand so that the dunes are tending to migrate inland.

At least three beach levels were noted on the north-western and north-eastern coasts of Spilsby Island. The oldest and highest beach is about 7 feet above present highwater level and has been fixed by vegetation. The next level is about 2 feet above HWL and is now in the process of being fixed. The present beach has cut into the two higher levels.

Heavy mineral separation from beach sands are described in Appendix I, Table I. In most of the samples, the heavy fraction was small, consisting chiefly of ilmenite, magnetite or goethite. Corundum was reported in three samples. Sand containing black mineral bands from Reevesby Island consisted of quartz and feldspar with abundant ilmenite; smaller amounts of magnetite, martite and hornblende; and traces of garnet, hypersthene and zircon. (Sample P 90; PS 8110).

Clay and salt pans have formed on Spilsby and Reevesby islands. The most extensive deposit lies behind the southern part of the sand dunes near the north-western coast of Spilsby Island and is almost ¼ mile long. It may represent a former lagoon cut off by a regression of the sea in comparatively recent times, possibly at the same time as the stranding of the older beach.

STRUCTURAL GEOLOGY

The probable derivation of the granite gneiss and granite; "older" amphibolite and microgranite, from the granitisation and metasomatism of Archaean sedimentary rocks has already been discussed. In the southern part of Eyre Peninsula, Johns (1961) showed that there the sedimentary formations were folded before granitisation. Thomson (1964) observed that in northern Eyre Peninsula, folding and granitisation took place before the intrusion of late or post-orogenic granites which W. Compston has shown are about 1600 million years old, and thus older than the upper Proterozoic Adelaide System. There has been no further deformation of this basement, except for block faulting, since "older" Proterozoic times.

At the southern end of Eyre Peninsula, the Archaean rocks were folded into structures with gently curving axes trending NNE which swing towards the NNW farther north. The axes dip generally steeply eastwards, and crossfolding has separated the structures into elongated domes and basins.

On the islands of the Sir Joseph Banks Group, there are no unaltered Archaean sedimentary rocks and during the reconnaissance there was insufficient time to make a detailed study of the complex structures within the granitic basement and associated rock, though many observations were made throughout the islands. (See Plan 65-172).

On Winceby Island and on the northern portion of Reevesby Island, the dominant structural trend is to the north-west. Apparently folded amphibolites plunge to the north-west and south-east. Foliation or layering in gneiss have a preferred orientation in this direction and may have been imposed by original variation in lithology of granitised sedimentary rocks. Johns (1961, p. 29) stated that in southern Eyre Peninsula, ghost bedding structures are in a similar direction to the foliation or schistosity produced in the formations. Thus it is possible that in the northern part of the Sir Joseph Banks Group, the Archaean beds were closely folded along north-westerly axes which partly controlled the intrusion of later amphibolite and microgranite veins, and also faulting along a mylonitic zone on Reevesby Island. In the central part of this island, structures trend to the north-east in a similar direction to those on the south coast of Partney Island and have apparently been faulted. Farther south, a dominant trend is not apparent, though along the south coast, lineation strikes E-W.

In the rest of the islands, trends are less prominent, though many structural features strike north-westerly on Boucaut, Duffield and Stickney islands.

The joint pattern is complex and may have resulted from epeirogenic movements at different periods from Proterozoic to Tertiary times, as well as from the Archaean or early Proterozoic orogeny. A statistical study made by Nixon (1964) indicated that the dominant trend is to the north-east, with steep north-westerly and south-easterly dips. Near the southern tip of Spilsby Island, many thin veins of quartz containing scheelite and molybdenite strike between north-west and north-east and may have filled joint planes produced in the final stages of the episode of granitisation.

It is possible that the basement rocks in the islands occupy a complex upfold upon which crossfolding has imposed a marked north-westerly trend in contrast to the dominant NNE strike on Eyre Peninsula. Whether or not the rocks are older than those on the coast of the mainland is a matter for conjecture. However the amphibolite-bearing rocks on Winceby Island and at the northern end of Reevesby Island invite comparison with similar rocks between Tumby Bay and Port Lincoln which Johns (1961) placed in the Hutchinson Group, thought to overlie the Flinders Group.

ECONOMIC GEOLOGY

Metallic Mineral Deposits

The deposits may be grouped as follows:

a. Within irregular quartz veins or lenses and masses of quartz.

b. As disseminations, aggregates and pods within host rocks.

Irregular quartz veins; lenses and masses of quartz

The most important are those at the southern end of Spilsby Island containing molybdenite (molybdenum disulphide, MoS_2) and scheelite (calcium tungstate, $CaWO_4$) described by Blissett and Warne (1964). The veins appear to occupy fracture or thin shear planes, many of which strike in directions ranging between north-westerly and north-easterly.

On the north coast of Hareby Island, J.E. Johnson found a quartz vein containing wolfram (Iron, manganese tungstate - (Fe, Mn) WO_4) partly oxidised to yellow tungstite (WO_3), together with scheelite (Nixon, 1964). The ultra-violet lamps revealed scattered scheelite crystals over a width of not more than 1 ft. at this locality and none were found elsewhere on the island.

Department of Mines records show that 411 lbs. of wolfram were recovered from the north coast of Milne (Langton) Island between 1942 and 1944. No traces of scheelite were found, and the small deposit of wolfram appears to have been removed.

Thin barren quartz veins parallel or sub-parallel with foliation or schistosity were noted on Spilsby, Hareby, Winceby, Duffield, Boucaut and Reevesby islands. A few small fluorescent crystals which are probably scheelite were revealed in a thin vein on the east coast of the northern portion of Reevesby Island. A number of scattered crystals were noted near patches of quartz in coarse porphyritic pink granite on the north-eastern coast of Boucaut Island.

Disseminations, aggregates and pods in host rock.

In the mineralised zone on Spilsby Island, both molybdenite and scheelite are irregularly distributed through red granite and grey porphyritic granite. Small cavities remain after the weathering out of molybdenite (Blissett and Warne, 1964). Nixon (1964) recorded granodiorite with rounded aggregates of scheelite, minor amounts of cassiterite (tin oxide- SnO_2), pyrite, molybdenite, and a little chalcopyrite partly altered to covellite which in turn has altered to chalcocite. Irregular patches of fluorite occur in places with chalcopyrite. He also noted a little chalcopyrite, sphalerite and marcasite in granodiorite on Dalby Island, and traces of chalcopyrite in amphibolite at the southern end of Reevesby Island.

D. Smale reported traces of purple fluorite in several thin sections of granitic rocks from Spilsby Island (Appendix I, P 644, TS 13532; P 645, TS 13533; P 649, TS 13537). Biotite is partly replaced by fluorite in specimens from Stickney Island (P 754, TS 13693; P 755, TS 13694).

Mention has been made in an earlier section of pegmatite with black tourmaline on Winceby Island and containing green scapolite on Stickney Island.

Phosphates

About 80 tons of guano and phosphate rock containing some 30% tricalcic phosphate were produced from the south-eastern corner of Marum Island (Inspector H. Jones, 1909). Large numbers of cormorants and gulls nest on Winceby Island, particularly on the north-eastern side, and a thin crust of guano is forming locally on loose sand or sandy loam. A sample assayed 14% phosphorus pentoxide (P_2O_5) though the deposits are small and of no immediate economic importance. (Appendix II, Report AN 754-64). Nixon (1964) reported fresh guano on sand at the eastern tip of Milne (Langton) Island and commented that the granite surface of English Island is coated with it.

Only small amounts of P_2O_5 were found in assays of specimens of kunkar from Spilsby, Roxby and Reevesby islands (Appendix II, Report AN 754-64).

The deposits appear to be geologically young, with little replacement of the kunkar on the islands, except for the exhausted outcrop on Marum Island. However, no comprehensive search for phosphates was made.

Trace Elements

Spectrographic analyses are listed in Appendix II, Reports AN 722-64, 723-64. It was shown in Blissett and Warne (1964) that in the host granite in the mineralised zone on Spilsby Island molybdenum is anomalous compared with granitic gneiss on the north-eastern coast. In specimens from Winceby, Stickney, Boucaut and Reevesby islands, molybdenum is low, except for a sample of ferruginous grit (A 1707/64) from Reevesby Island which contains 400 parts per million. There are traces of copper and zinc on Winceby and Reevesby islands. Small tin anomalies occur on Reevesby Island, where 1500 p.p.m. of vanadium was reported in the grit mentioned above. Scandium is generally anomalous, with a maximum of 150 p.p.m. in amphibolite from Winceby Island. Titanium is ubiquitous, probably reflecting the presence of ilmenite in the granitic rocks reported by Nixon (1964) and also sphene. Over 3% of titanium was reported in a sample of beach sand from Reevesby Island (A 1713).

Large anomalies for rubidium were indicated, so the samples containing the highest amounts were re-submitted for chemical analyses. The highest assay was 0.052% rubidium in Sample A 1698 from Stickney Island. It is presumably bound up in the structure of potash feldspar and mica within the granitic rocks.

Ore Genesis

The mineral deposits were probably formed by fluids concentrated during the final stages of the cooling of the granitised country rock and of re-mobilised granitic material. Fracture planes, planes of foliation and cavities in the granitic complex provided channelways into which molybdenite and scheelite or wolfram were introduced followed by pyrite, chalcopyrite, quartz and fluorite. Most of the pegmatites appear to be barren, though the presence of tourmaline-bearing pegmatite on Winceby Island suggests there may have been small amounts of boron-carrying fluids, while scapolite in pegmatite on Stickney Island shows that there was also some chlorine.

Beach Sands

As mentioned previously, the beach sands contain only small amounts of opaque heavy minerals. Locally, there are small concentrations in conspicuous thin bands and streaks of black minerals. Samples from Reevesby Island contained ilmenite with smaller quantities of magnetite or goethite and martite. (Appendix I, Sample P 90, PS 8110; P 764, PS 8108; P 765, P 58109). Similar results were obtained for a sample from Hareby Island (Table I, P 686, PS 8009). Rutile, zircon and garnet are comparatively rare.

CONCLUSIONS

Apart from the scheelite associated with molybdenite in the southern portion of Spilsby Island discussed in a previous report, traces only of scheelite were found on Hareby, Reevesby and Boucaut islands. Small amounts of wolfram occur on Hareby Island and a few hundred pounds were once produced on Milne (Langton) Island. There are traces of chalcopyrite, galena and sphalerite on several islands. In places, beach sands contain thin black mineral bands of ilmenite. No concentration of minerals was seen which might be of economic value.

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LIST OF PLATES

LIST OF PLATES
(contd.)

APPENDIX I

PETROLOGICAL REPORTS

PETROLOGICAL REPORTS

Australian Mineral Development Laboratories

Locality: Spilsby Island

Material: Granitic rock specimens

P. 640/64: HB5/64: TS 13528 6128 RS 102

This is a fairly coarse porphyritic granitic gneiss with a grain size of 0.6 - 2 mm. Large, aligned, colourless, Carlsbad-twinned, string-microperthitic orthoclase crystals are abundant, and the rock resembles some previously described from Spilsby Island. Microperthitic orthoclase, quartz, plagioclase (oligoclase), myrmekitic intergrowths and biotite make up the rest of the rock. Much of the quartz is fairly fine-grained, and it is possible that the rock has undergone some microbrecciation and recrystallization. Opaques, apatite, rounded zircons and secondary chlorite are accessory minerals associated with the biotite.

P. 644/64: Spilsby KRW 18/64: TS 13532 6128 RS 113

This is a granite similar to the coarser part of P 15/64. It has a grain size of 0.1 to more than 10 mm. Large, string-microperthitic crystals of potash feldspar (largely microcline) are abundant, though not as large and prominent as in P 15/64. Potash feldspar and quartz are the dominant minerals; plagioclase (oligoclase) is fairly common. Some myrmekitic intergrowths are present. Brown biotite is the only ferromagnesian mineral present; it forms 3-5 per cent of the rock. Much of it has been rather altered, and it now contains amorphous ferruginous material and a very small amount of fluorite. Zircon (in fairly rounded grains) and apatite are accessory, and are generally associated with the biotite.

P. 645/64: Spilsby KRW 19/64: TS 13533 6128 RS 114

This is partly granite and partly microgranite. The two are in juxtaposition; there is no "contact zone" in any way distinguishable from them, though at the contact itself a little microbrecciation may have taken place, and myrmekitic intergrowths appear a little more common. Mineralogically the rocks appear to be almost identical, the only major difference being one of grain size; in the granite it is 1-15 mm, and in the microgranite 0.1 - 1.5 mm. Quartz and string-microperthitic potash feldspar (both orthoclase and microcline) are the dominant minerals; oligoclase is minor, and is commonly associated with myrmekitic intergrowths. Biotite is present to about the same extent as the plagioclase (about 5 per cent) in the microgranite, but is slightly less common in the coarser part of the rock. Some of the biotite has been altered to ferruginous material, ?chlorite, and a trace of purple fluorite. Zircon, apatite and opaques are accessory minerals; some of the zircons are rounded, but others are fairly euhedral.

P. 646/64: Spilsby KRW 20/64: TS 13534 6128 RS 115

This rock has a granitic part and an aplitic part; there is no distinguishable contact zone between them. The granite has a grain size of 0.3-15 mm, and string-microperthitic microcline (commonly Carlsbad-twinned) is the dominant mineral. Quartz is fairly common, but

P. 646/64 (contd.)

oligoclase (sericitized) and myrmekite are, like biotite, present only in minor quantities. Zircon and apatite are accessory. The biotite has generally been fairly severely altered, and much of it is green; quartz and opaques appear to be common alteration products.

The aplite has a grain size of 0.1 - 0.7 mm. Potash feldspar (mostly microcline, but not notably microperthitic) is again the dominant mineral, but quartz is also common. Oligoclase occurs in minor quantity, and is rather sericitized. Ferromagnesian minerals are virtually absent, but a trace of altered green biotite is present.

P. 647/64: Spilsby KRW 21/64: TS 13535 6128 RS 116

This is an aplite with saccharoidal texture and a grain size of 0.2 - 2 mm. Potash feldspar (both microcline and orthoclase, and generally string-microperthitic) is dominant, but quartz is also common. Plagioclase (oligoclase) is fairly common, and generally sericitized. Traces of muscovite are present, but ferromagnesian minerals are absent.

P. 648/64: Spilsby KRW 22/64: TS 13536 6128 RS 117

This is a fairly coarse granitic gneiss with a grain size of 0.5-15 mm. Some mineral segregation has taken place; in much of the rock large, aligned crystals of string-microperthitic microcline are fairly common, while in narrower, finer bands (about 1 cm thick) biotite is fairly prominent, and the large feldspar crystals are absent. Potash feldspar and quartz are the dominant minerals overall, but oligoclase (usually sericitized) is not uncommon. Biotite is present to a minor extent (though commoner in the finer parts of the rock); it is somewhat altered, partly to muscovite, partly to green ?amphibole, and partly to brown ferruginous material. A trace of apatite is present.

P. 649/64: Spilsby KRW 23/64: TS 13537 6128 RS 118

This is a granite with a grain size of 0.25 - 5 mm. Quartz and orthoclase are the dominant minerals, though plagioclase (oligoclase) and microcline are fairly common. Some of the plagioclase is antiperthitic. Myrmekitic intergrowths are present. Biotite is a minor constituent, and is commonly altered to chlorite, brown ferruginous material, and a trace of fluorite. Zircon and apatite are accessory.

P. 650/64: Spilsby KRW 34/64: TS13538 6128 RS 104

This is a granitic gneiss similar to P 640/64: HB 5/64: TS 13528 in that it contains large, aligned, Carlsbad-twinned crystals of microperthitic orthoclase; however, in P 650/64 they are orange instead of white, as a result of iron-staining. Quartz and microperthitic potash feldspar (both orthoclase and microcline) are the dominant minerals. Sericitized plagioclase (oligoclase) is also fairly common, and is associated with myrmekitic intergrowths. Rather altered biotite forms about 5 per cent of the rock; most is greenish and associated with opaques, and some has been altered to green actinolitic amphibole. Zircon and apatite are accessory; many of the zircons have been only a little rounded.

Locality: Winceby, Stickney, Boucaut and Reevesby Islands

Material: Rock specimens

Most of these rocks are acidic gneisses or basic amphibolites, though some possible aplitic and pegmatitic ones are also present. While most are obviously metamorphic, distinctive metamorphic minerals are absent, and it is not possible to determine specifically the facies of metamorphism represented.

The conclusion was reached in a previous report (AMDL Report MP 2026 etc.-63, 28th February, 1964) that most rocks from the Sir Joseph Banks Islands belonged to the upper amphibolite facies. What little evidence there is from the rocks described in the present report, such as the abundance of hornblende in the basic rocks, and the alteration of pyroxene to hornblende in P772/64, suggests that for these also the upper amphibolite facies is the most appropriate; there is no definite evidence to suggest any other facies, though P767/64 has rather more pyroxene than might be expected in an amphibolite.

Acidic Rocks

Most of these are granitic gneisses, consisting mainly of microperthitic potassium feldspar (generally microcline), rather less quartz, minor plagioclase (oligoclase) and a small quantity of mafic material, chiefly biotite with rare hornblende. The intensity of their gneissosity varies considerably, being very weak in P 751 and P 756, but very marked in P 753. The plagioclase content also varies; while it is very small in P 755, P 756, P 769 and P 770, it is considerably larger in P 752 and P 753; in P 754 and P 766 it is sufficiently high for the rock to be regarded as adamellitic rather than granitic; in P 768 plagioclase is the dominant feldspar, and the rock is thus granodioritic.

The content of mafic minerals is always low, but is lower than usual in P 756 and P 770. Biotite is the commonest, but hornblende is equally common in P 770, and also present in P 752, P 753, P 754, P 766 and P 768. Opaques are a persistent minor constituent; apatite, zircon and sphene are usually accessory

In P 769 mafic minerals are so rare as to suggest that the rock may have been originally aplitic. Two rocks, P 758 and P 759, appear to be aplitic without being gneissose; in these microcline is dominant, with quartz also common; plagioclase and muscovite are minor; mafic minerals are absent, except for a trace of opaques in P 759.

In P 755 a granitic rock and a banded granitic gneiss are in contact. The banding is on a much finer scale and much more prominent than in any of the other gneisses, though it is caused as usual by concentration of small biotite flakes. Microcline and quartz are the dominant minerals, as they are in the granitic part. However, the orthoclase in the coarse part is strongly microperthitic, and resembles that in the aplite P 758. The coarse part as a whole is very similar to the non-tourmalinized part of P 746, particularly in hand specimen, though the unusually large exsolution bodies of plagioclase which characterize P 755 are not present in P 746. No trace of tourmaline was observed in P 755.

A rock which is probably pegmatitic is P 757. This is highly distinctive in that it contains more than 50 per cent scapolite; no specific reference in the literature to such a rock has been located by the writer, though references have been made to scapolite associated with pegmatite. Knowledge of the field occurrence would be of vital importance in any further discussion of this rock.

Basic Rocks

These are all amphibolites, though some contain considerable quantities of pyroxene. Most are medium-grained, and with one notable exception (P 772) are finer than the acidic gneisses. Plagioclase (andesine-labradorite) is the dominant mineral in most specimens, though in the basic parts of P 747 and P 748 mafic minerals are dominant. Though green hornblende is generally the dominant mafic mineral, in P 767 and P 772 pyroxene predominates. Biotite is usually common and the pyroxene content varies widely. However, both biotite and pyroxene are absent in P 771, where plagioclase forms about 90 per cent of the rock; they are very minor in P 750, and in P 749 pyroxene is absent though biotite is present; P 750 is fairly distinctive on account of its relatively large content of opaques.

Most of the amphibolites have saccharoidal texture; nothing can be seen of an ophitic texture in any of the specimens, and they all appear fairly definitely to be metamorphic, though they may originally have been gabbros.

Hornblende and biotite are obviously stable together, though in P 772 segregation of biotite into aggregates 5 to 10 mm across has occurred. Pyroxene crystals are rimmed by hornblende in the same rock, and it is apparent that it has been in an environment where hornblende is stable rather than pyroxene. However, in P 767 two pyroxenes, hornblende and biotite occur together, and there is no indication of any one of them being unstable in the assemblage, though some evidence is present that pyroxene formed after hornblende. It should probably be assumed that P 767 has been affected by a local increase in the grade of metamorphism beyond that prevailing.

No gneissosity is generally visible in the amphibolites, though in P 747 there is a suggestion of a preferred orientation of biotite flakes.

P. 746/64: Winceby KRW 1/64: TS 13685 6129 RS 8

This is a tourmalinized pegmatite, of fairly coarse grain size. Microcline is the dominant mineral, though quartz and tourmaline are common. All the black material in the specimen is tourmaline; It has a somewhat coaly lustre in hand specimen, and in thin section it is strongly pleochroic from light brown to black; it may be schorlite. Most of the microcline appears to be perthitic, containing minute exsolution strings of plagioclase. Very minor plagioclase grains about 1 mm across (sericitized oligoclase) are present, though even these may be exsolution bodies; they tend to be associated with muscovite.

The tourmaline is abundant in one part of the rock, but is almost absent elsewhere, where quartz forms about 30 per cent and feldspar about 70 per cent, and the grain size is 2 to 10 mm. In the tourmaline-rich part of the rock about 30 per cent of each of quartz and feldspar is present, the remainder being tourmaline with an apparent grain size of 1 to 2 mm, though many of the grains are in optical continuity, and some of the larger crystal individuals provided with the specimen are 10 mm across. In general the tourmaline appears to be intergrown with feldspar but not with quartz, as though the incoming tourmaline has replaced or formed from the feldspar.

P. 747/64: Winceby KRW 2/64: TS 13686 6129 RS 9

This specimen consists of an amphibolite and a granodiorite in contact.

The amphibolite has a grain size of 0.2 to 0.7 mm, and consists of hornblende, feldspar, biotite and pyroxene (polyaugite). The feldspar is almost entirely labradorite. The texture is somewhat saccharoidal, varied slightly by

P. 747/64 (contd.)

small scattered aggregates of biotite flakes.

The granodiorite has a grain size of 0.2 to 1.5 mm. Quartz and albite-oligoclase are the dominant minerals. Biotite is a minor constituent, and minor myrmekitic intergrowths are present.

The contact is abrupt. A considerable amount of brecciation has taken place in the amphibolite; biotite appears to be concentrated along the contact, and a zone about 1 mm thick consists of brecciated biotite and plagioclase. Much of the finer, more severely brecciated biotite is aligned approximately parallel to the contact. The actual line of the contact appears to consist of a mass of small parallel biotite flakes, a few of which appear to have altered to chlorite. Some small contact effects show in the granodiorite, such as a slight lessening of grain size, which may be due to some brecciation and recrystallization, but there can be no doubt that the amphibolite has provided most of the brecciated material.

P. 748/64: Winceby KRW 3/64: TS 13687 6129 RS 10

This specimen consists of a granite and an amphibolite in contact.

The granite has a grain size of 0.5 to 5 mm and consists predominantly of microperthitic microcline (Carlsbad-twinned) and quartz. Plagioclase (sodic andesine) occurs sparsely, and is mostly fairly severely sericitized. Minor myrmekitic intergrowths are present, and minor biotite. Muscovite is rare.

The amphibolite is of the same type as that in TS 13686, and has a grain size of 0.2 to 1 mm. Green hornblende forms a little over half this portion of the rock, and the rest consists of plagioclase (oligoclase-andesine), biotite and pyroxene (polyaugite). The plagioclases appear to be of approximately the same composition in both rock types.

As in TS 13686 the contact is abrupt, though there is a zone in the granite for a thickness of about 3 mm adjacent to the contact in which the texture is hornfelsic, and the average grain size is 0.4 to 0.5 mm; the mineralogical composition, however, is much the same as in the rest of the granite. At the contact the biotite has been comminuted, and lies in small flakes parallel to the length of the contact. It is not clear which of the two rock types has undergone brecciation; it almost appears that both may have undergone it to a minor extent. There is no zone effect in the amphibolite such as there is in the granite, but there is an irregular, narrow (1 to 2 mm) band rich in biotite about 2 mm away from the contact. It is not clear whether this is gneissic banding or a contact effect; the former appears more likely.

P. 749/64: Winceby KRW 5/64: TS 13688 6129 RS 11

This is a very dark grey amphibolite similar to the preceding specimens, with a grain size of 0.1 to 1 mm. Plagioclase (calcic andesine) and green hornblende each form about half the rock. Brown biotite is a minor constituent, and opaques are accessory. Though some of the hornblende is almost euhedral, the plagioclase is quite anhedral. Some of the long, thin biotite flakes appear to cut some of the hornblende crystals. There appears to be a slight tendency for the biotite to show a preferred orientation.

P. 750/64: Winceby KRW 7/64: TS 13689 6129 RS 12

This is a dark grey amphibolite with a more markedly granulitic texture than the preceding specimen. It has a grain size of 0.1 to 0.4 mm. Plagioclase (calcic andesine) and hornblende each form nearly half the rock. Opaques occur to an unusual extent, and are almost a minor constituent rather than accessory. Rare clinopyroxene is present, considerably less common than the opaques. Biotite is present, but to no greater extent than the clinopyroxene. These features make this amphibolite distinct from the preceding specimens.

P. 751/64: Winceby KRW 9/64: TS 13690 6129 RS 13

This is a reddish granitic gneiss with a grain size of 0.1 to 1 mm. The grains are markedly anhedral with crenulate boundaries. Quartz and microperthitic microcline are the dominant minerals. Biotite is a minor constituent forming about 2 per cent of the rock; it has commonly been partly altered to opaque ferruginous material. A small amount of plagioclase (antiperthitic sodic oligoclase) is present, and rare myrmekitic intergrowths. Opaques are accessory. The gneissosity is the result of weak local concentration and alignment of biotite and opaques.

P. 752/64: Winceby KRW 11/64: TS 13691 6129 RS 14

This is a pale brownish-grey granitic gneiss with a grain size of 0.2 to 2 mm, possessing a well-developed gneissosity showing better in hand specimen than in thin section; it is due to local concentration and alignment of biotite and hornblende. Potassium feldspar and quartz are the dominant minerals. The feldspar is mostly string-microperthitic orthoclase, but microcline is also common. Scattered augen of potassium feldspar, up to 5 mm or more across, form 5 to 10 per cent of the rock. Plagioclase (slightly antiperthitic oligoclase) is common, but it forms less than one-third of the total feldspar. Minor myrmekitic intergrowths are present. Ferromagnesian minerals form about 5 per cent of the rock; biotite is dominant amongst them, but green hornblende is also present. Zircon, apatite and opaques are accessory.

P. 753/64: Winceby KRW 13/64: TS 13692 6129 RS 15

This is a pinkish granitic gneiss similar to the preceding specimen, with marked gneissosity, and a grain size of 0.2 to 2 mm. Microperthitic microcline is the dominant mineral, forming 50 to 60 per cent of the rock. Microperthitic orthoclase is also fairly common, some in large crystals with Carlsbad twins. Quartz forms 10 to 20 per cent, and plagioclase (oligoclase) about 10 per cent of the rock. Myrmekitic intergrowths are minor. Biotite is almost the only ferromagnesian mineral present, though rare green hornblende and opaques occur; as usual, they have a smaller grain size than the felsic minerals; they form about 5 per cent of the rock. Their localization as seen in the hand specimen produces the gneissosity, though it appears very irregular microscopically.

P. 754/64: Stickney KRW 4/64: TS 13693 6128 RS 120

This is a medium grey adamellitic gneiss. Though the grain size is generally 0.1 to 1 mm, some coarser feldspar crystals occur (up to 10 mm across) aligned with their lengths parallel to the gneissosity, indicated in this specimen more by variation in the grain size of the felsic minerals than in the preceding specimens, though alignment of the mafic minerals is a contributing factor.

Feldspar is the dominant mineral, but this rock is rather unusual in that plagioclase (oligoclase) is nearly as common as potassium feldspar (microcline and orthoclase). However, most of the larger crystals are microperthitic potassium feldspar. Quartz is only a little less abundant than feldspar. Myrmekitic intergrowths are minor.

Mafic grains form 5 to 10 per cent of the rock; nearly all are biotite, but opaques and hornblende (partly altered to biotite) are also present. Rarely the biotite can be seen altering to purple fluorite. Sphene, zircon and apatite are accessory.

P. 755/64: Stickney KRW 5/64: TS 13694 6128 RS121

This specimen consists of pale brown granitic gneiss in contact with a pegmatite. The coarse (pegmatitic) part strongly resembles the non-tourmalinized part of P 746. The contact between the two rock types is emphasized by a more mafic band about 2 mm thick occurring at the edge of the fine material; two similar bands also occur further away from the contact. The fine part has a grain size of 0.06 to 0.6 mm, and the coarse part 0.6 to 6 mm. Quartz and microcline are the dominant constituents of both parts of the rock; both parts contain a little plagioclase (oligoclase), and myrmekitic intergrowths are not uncommon.

A distinctive feature of the coarse part is the presence of unusually strongly perthitic orthoclase. Mafic minerals are virtually absent, apart from minor traces of magnetite and biotite.

In the fine part mafic minerals may form up to 5 or 10 per cent of the darker bands, but they are virtually absent elsewhere. Most of the mafic grains are biotite, but some opaques are present. Rare fluorite is present as an alteration product of the biotite. Zircon and apatite are accessory.

P. 756/64: Stickney KRW 7/64: TS 13695 6128 RS122

This is a greyish-pink granitic gneiss. The only gneissosity observable appears to be due to aligned elongation of the quartz grains. The grain size varies from 0.1 to 5 mm. Feldspar forms 70 to 80 per cent of the rock, and quartz about 20 per cent. Most of the feldspar is microcline (string-microperthitic and bead-micro-perthitic). A little plagioclase (oligoclase) is present in large crystals, the inner part of which has been severely sericitized, but the outer part of which is fresh. Minor myrmekitic intergrowths are present. Mafic minerals form only 1 to 2 per cent of the rock. Biotite is the commonest, some being partly altered to greenish amphibole and a very little fluorite. Opaques are very minor.

P. 757/64: Stickney KRW 9/64: TS 13696 6128 RS124

This is a medium green-grey, possibly pegmatitic rock consisting mainly of scapolite and quartz. It has a grain size of 0.5 to 10 mm. Scapolite forms over half the rock, and is pale green in hand specimen. Muscovite is a common minor mineral (5-10%), and chlorite and opaques are slightly less common. A very small amount of calcite is present, which, like the muscovite and chlorite, appears to be secondary; together with opaques these minerals occur in masses which are probably the result of alteration of

P. 757/64
(contd.)

a former mineral. The masses seldom exceed 1 mm across, in contrast with the rest of the rock which has a general grain size of 2 to 5 mm. The scapolite is generally fresh, but muscovite, with calcite, with chlorite, or on its own, is present to a minor extent as an alteration product.

P. 758/64: Stickney KRW 11/64: TS 13697 6128 RS123

This is an off-white rock which appears to be an aplite; it has a grain size varying from 0.1 to 6 mm. Quartz and microcline (some microperthitic) are the dominant minerals; some of the potassium feldspar has distinctively coarse, elongated ex-solution bodies at a high angle to the cleavage, somewhat similar to those in the coarse part of P 755/64: TS 13694. Slightly sericitized plagioclase (calcic oligoclase) is also common. Muscovite is present in fairly small, rare, very irregular flakes. Myrmekitic intergrowths are virtually absent. No mafic minerals are present.

P. 759/64: Boucaut KRW 3/64: TS 13698 6128 RS 105

This is a reddish aplite similar to the preceding specimen, consisting almost entirely of feldspar and quartz. The grain size is 0.5 to 1.5 mm though some crystals are present up to 8 mm across. The large crystals are quartz, associated with a concentration of coarse grains of string-microperthitic microcline; this feldspar is the dominant mineral in the rock, of which it forms 70 to 80 per cent. Quartz forms most of the remainder, but accessory plagioclase (?oligoclase) is present, sometimes associated with myrmekitic intergrowths. Opaques are also accessory.

P 760/64: Boucaut KRW 1/64: TS13699 6128 RS 107

This is a kaolinized granite. Unaltered grains form just under half the rock. The dominant grains are quartz, which form 20 to 30 per cent of the rock, but grains of microperthitic orthoclase are almost as common; in most of the latter the exsolution strings have been leached or kaolinized. In some parts of the rock the quartz and feldspar are still in close association, not separated by any great quantity of kaolin. However, in general kaolin forms 50 to 60 per cent of the rock. Opaques and zircon are accessory.

Heavy minerals form less than 0.1 per cent by weight of this sample. Most consist of rather ill-defined goethite material; zircon is very minor.

P. 766/64: Reevesby KRW 3/64: TS 13701 6128 RS 84

This is a pale pinkish-brown adamellitic gneiss with a grain size of 0.25 to 5 mm. Quartz, microcline and plagioclase (oligoclase) are the dominant minerals, and are about equally common. Myrmekitic intergrowths are very commonly present around the boundaries of the plagioclase crystals. Mafic minerals form about 5 per cent of the rock; biotite is the dominant one, though green hornblende, minor opaques and sphene are also present; their grain size is generally somewhat smaller than that of the rest of the rock, and they tend to be localized in small, elongated patches in which the individual flakes are aligned. The hornblende is not generally as fresh as the other mafic minerals, and has been partially altered

P. 766/64
(ctd.)

to brown ferruginous material. Apatite and zircon are accessory.

P. 767/64: Reevesby KRW 5/64: TS 13702 6128 RS 85

This is a dark grey amphibolite; the plagioclase has a grain size of 0.5 to 2 mm, and the mafic minerals 0.1 to 1.0 mm. The plagioclase is calcic andesine to sodic labradorite, and forms 60 to 70 per cent of the rock. Pyroxene (hypersthene and polyaugite) hornblende and biotite are all common, but the pyroxenes predominate slightly over the other mafic minerals and hypersthene may be slightly more common than polyaugite. None appears definitely to be forming from any other, though pyroxene in one place in the thin section appears to be rimming hornblende and may therefore be a later product of crystallization. Hornblende and biotite appear fairly definitely to be contemporaneous. Some apparent hornblende inclusions occur in biotite and in pyroxene, and a few apparent pyroxene inclusions occur in hornblende. Rare, round quartz inclusions are present in both pyroxenes.

P. 768/64: Reevesby KRW 6/64: TS 13703 6128 RS 87

This consists of apparently interlayered acidic gneiss and basic amphibolite, each layer being 1 to 2 cm thick. Each passes into the other without a definite microscopic contact, the texture remaining similar across it.

The amphibolite has a grain size of 0.3 to 1 mm, and consists of approximately equal quantities of mafic minerals and plagioclase. Most of the mafic material is hornblende, but much is biotite. The plagioclase is calcic oligoclase to sodic andesine, and much of it is antiperthitic. Quartz, though present, is fairly sparse. Opaques and apatite are accessory.

The acidic gneiss has a grain size of 0.5 to 5 mm, and consists mainly of quartz and plagioclase (oligoclase-andesine), much of which is untwinned. The feldspar forms a little over half the rock; relatively little of it is orthoclase. Biotite and a little hornblende are scattered very irregularly through the rock, and patches up to several millimetres across may be almost pure biotite; however, mafic minerals on the whole do not form more than about 5 per cent of this part of the rock. Sphene is accessory.

P. 769/64: Reevesby KRW 8/64: TS 13704 6128 RS 88

This is a reddish acidic gneiss, probably aplitic, with a grain size of 0.3 to 2 mm. Feldspar forms 70 to 80 per cent of the rock, and quartz nearly all the remainder. Most of the feldspar is microcline, though a minor amount of plagioclase (calcic oligoclase or sodic andesine) is present. Myrmekitic intergrowths are minor. Biotite is rare on the whole, but in one side of the specimen is more common than elsewhere - an effect of the gneissosity. The reddish colour of the rock is probably due to fine-grained dusty hematite in the feldspar.

P. 770/64: Reevesby KRW 10/64: TS 13705 6128 RS 83

This is a very coarse, pinkish granitic gneiss with a grain size of 0.5 to 20 mm. Feldspar is the dominant constituent, forming 80 to 90 per cent of the rock; most is microcline, but some orthoclase is present, and also a little plagioclase (sodic andesine, generally antiperthitic). Some of the feldspar grains show marked strain or bending. Myrmekitic intergrowths are minor. The remainder of the rock consists mostly of quartz, but some irregularly distributed mafic grains are present. Biotite and strongly-coloured green hornblende occur in about equal quantities, forming up to 20 per cent of some parts of the rock, but on the whole they form only 3 to 5 per cent. Zircon is accessory.

P. 771/64: Reevesby KRW 12/64: TS 13706 6128 RS 95

This is a greenish-grey amphibolite with a fairly constant grain size between 0.2 and 1 mm, and markedly saccharoidal texture. Most of the rock (about 90 per cent) consists of plagioclase (sodic andesine), some of which is antiperthitic. Mafic minerals form about 10 per cent of the rock, and are generally somewhat smaller than the felsic minerals; they appear as small, evenly distributed black spots in the hand specimen. Hornblende is the main mafic mineral, but opaques are also present. Potassium feldspar is rare, and generally associated with myrmekitic intergrowths. Rounded zircons and apatite are accessory.

The rock is generally very fresh, but rarely it has been weathered, resulting in severe sericitization of the feldspar and partial chloritization of the hornblende.

P. 772/64: Reevesby KRW 15/64: TS 13707 6128 RS 90

This rock is distinctive in hand specimen, its most notable feature being that about 15 per cent consists of black spots 2 to 10 mm across. These are "clots" consisting almost entirely of large flakes of biotite. The rock is a brownish, fairly coarse amphibolite, having a grain size of 0.3 to 4 mm. A little over half of it consists of plagioclase (labradorite), and most of the remainder consists of pyroxene, hornblende and minor biotite, the latter being common only on account of its presence in the "clots". It is fairly readily apparent that hornblende is forming by alteration of the pyroxene as noted previously in P 515/63: LN Reevesby 4: TS 13101*. A little quartz is present in small blebs associated with hornblende, and may be a co-product of the alteration of the pyroxene. Such association of quartz and hornblende was observed in P 514/63: JJ Reevesby 8: TS 13100*. Numerous small "islands" within the pyroxene crystals have a different orientation from the host-crystal, and are probably an effect of incipient alteration similar to that noted in P 514/63: JJ Reevesby 8: TS 13100*. The relation of P 514/63 to this specimen in the field may be worthy of note.

* AMDEL Report MP 2026 etc.-63, 28th February, 1964, "Rocks from the Sir Joseph Banks Islands".

Locality: Spilsby and Reevesby Islands

Material: Grit, sandstone and kunkar

P. 641/64: Spilsby KRW 1/64: TS 13529 6128 RS110

This is a protoquartzite (probably a silcrete), of the same type as P 555/63: LN Spilsby 1: B 13293. The description of P 555/63 in Report MP 2026 etc.-63, February 1964, is in the main applicable to this specimen. Subrounded quartz grains, 0.5-1.5 mm across, form 50-60 per cent of the rock. About half the matrix consists of smaller, angular to subangular quartz grains 0.06-0.3 mm across; the remainder consists of a mass of leucoxene in cryptocrystalline silica or opal. Some of the quartz grains appear to have been affected by solution. Parts of the rock appear fairly porous and contain fairly numerous voids 0.01-0.02 mm across. Accessory minerals among the grains do not appear to be present.

P. 642/64: Spilsby KRW 2/64: TS 13530 6128 RS 128

This is a feldspathic quartzite. Subangular to subrounded sand grains, 0.1-2 mm across, form 30-40 per cent of the rock. Quartz is dominant among the grains, but string-microperthitic orthoclase forms nearly a third of them. In these feldspar grains most of the exsolution bodies have been leached out, though a few small patches, generally in the centres of larger grains, have not been leached. The matrix consists of an isotropic mass, very white in hand specimen, but pale brown in thin section, with a low refractive index (about 1.47) and much harder than ordinary kaolin could be expected to be. Examination by x-ray diffraction methods showed it to consist of kaolin and opaline silica. This would be in accordance with a near surface origin in which solution and redeposition of silica was an important process.

P. 643/64: Spilsby KRW 7/64: TS 13531 6128 RS 106

This is a fairly poorly-cemented, fine-grained, sandy limestone, presumably a kunkar. Sand grains (mostly quartz) form about 10 per cent of the rock. The rest consists of oolites of very fine-grained (1 micron) brownish calcite cemented by slightly coarser (2 microns) calcite. The oolites vary from 0.02-0.7 mm across, and a few pisolitic structures are present up to 10 mm across. The sand grains are subangular to subrounded, and 0.03-0.7 mm across. In addition to quartz a little potash feldspar is present and also a trace of hornblende.

P. 773/64: Reevesby KRW 18/64: TS 13708 6128 RS 92

This is a dark, fine-grained limestone, presumably kunkar. Much consists of calcareous oolitic and pisolitic structures of widely varying sizes in a matrix of fine-grained calcite. The smallest are about 0.03 to 1 mm across, and aggregates of these may constitute larger pisolitic structures up to about 10 mm across. In turn, aggregates of the larger structures form concretionary bodies up to several centimetres across, bounded by a layer of paler calcite. The small structures and the matrix between the larger structures consist of very fine-grained calcite with a grain size of 1 to 2 microns; this appears to contain a considerable amount of what is probably exceedingly fine organic carbon, which causes the dark colour of the specimen. Scattered

P. 773/64
(contd.)

through all the darker parts of the rock and forming about 5 per cent of it are subangular to subrounded grains 0.03 to 0.6 mm across. Most of these are quartz but some are plagioclase.

P. 774/64: Reevesby KRW 19/64: TS 13709 6128 RS 93

This is a probable kunkar; it appears to contain less organic material than the preceding specimen, and is thus of a considerably lighter colour. It consists largely of calcite with a grain size of about 2 microns. Oolitic structures do not appear to be present, though a few parts have a slightly botryoidal appearance on a fine scale. The rock is banded, some parts containing more sand than others, and some being more homogeneous in structure than others; some narrow bands are almost white, while the colour of most of the rock is pale reddish-brown. The sand grains form between 5 and 10 per cent of the rock, and may be up to 1 mm across. Quartz forms most of them, but microcline and orthoclase are also present, with a trace of hornblende and opaques.

Locality: Spilsby, Duffield, Hareby and Reevesby Islands.

Material: Beach sands, dune sand and sand overlying kunkar.

For heavy mineral separation

The results are summarized in Table 1.

In most of the sands the heavy fraction was very small or negligible. In some of those in which the heavy fraction was less than 0.1 per cent it was able to be examined, but in others examination was impracticable. No scheelite was found in any of the specimens, and no molybdenite save a probable trace in P 657/64: HB 15. Mineragraphic examination of two specimens was carried out (P 668/64: KRW 14: PS 8010, P 686/64: KRW 3: PS 8009), where there seemed to be any likelihood of the presence of unusual opaque minerals, and the amount of heavy fraction present allowed it. However, the suspect opaque grains were too scarce to be seen in a polished section. The presence of corundum in three specimens if noteworthy.

The specimens shown in Table 1 came from the following localities.

Sample Mark	Locality	Type of sample
P. 651/64 - P. 657/64	Spilsby Island	Beach sand
P. 658/64 6128 RS 111	Duffield Island	" "
P. 659/64 - P. 661/64	Spilsby Island	Sand overlying kunkar.
P. 662/64 - P. 673/64	Spilsby Island	Beach and dune sands.
P. 674/64 - P. 683/64	Spilsby Island	Sand overlying kunkar.
6128 RS 97 → 99 P. 684/64 - P. 686/64	Hareby Island	Beach sand
P. 688/64 - P. 690/64	Duffield Island	Beach sand.

Locality: Boucaut and Reevesby Islands

Material: Sands and sandstone for heavy mineral separation.

Note: The samples (P.760-P.765) submitted for heavy and opaque mineral identification did not all contain sufficient quantities of heavy minerals to warrant examination in polished section; all those where observable quantities of opaque minerals were present have been examined, however.

P. 760/64: Boucaut KRW 1/64: TS 13699 6128 RS 107

This is a kaolinized granite. Unaltered grains form just under half the rock. The dominant grains are quartz, which form 20 to 30 per cent of the rock, but grains of microperthitic orthoclase are almost as common; in most of the latter the exsolution strings have been leached or kaolinized. In some parts of the rock the quartz and feldspar are still in close association, not separated by any great quantity of kaolin. However, in general kaolin forms 50 to 60 per cent of the rock. Opaques and zircon are accessory.

Heavy minerals form less than 0.1 per cent by weight of this sample. Most consist of rather ill-defined goethitic material; zircon is very minor.

P. 761/64: Boucaut KRW 4/64 6128 RS127

Quartz	60%(a)	Heavy fraction	
Feldspar	25%	Hornblende	40%
Shell material	15%	Opaques	20%
Sponge spicules	Trace	Hypersthene	10%
Heavy fraction	0.1%	Garnet	10%
		Tourmaline	Trace
		Allanite	Trace
		Zircon	Trace

(a) percentages are by weight.

P. 762/64: Reevesby KRW 1/64: TS 13700 6128 RS 86

This is a brown ferruginous sandstone. The sand grains form a little over halfthe rock and are 0.2 to 2 mm across; they are generally angular or very angular. About half the grains are quartz, but string microperthitic microcline and orthoclase are common; most of the feldspar grains are larger than the quartz grains. Rare plagioclase (?oligoclase) is present, and a trace of zircon. The matrix forms only part of the remainder of the rock, as voids are common; it appears to be goethite. The edges of the specimen have a matrix of clay instead of goethite; voids are as common as elsewhere in the rock.

The heavy fraction consisted almost entirely of goethite from the matrix; it formed 13 per cent of the specimen, though this figure may have been rendered inaccurate by the large amount of fine ferruginous material pervading both light and heavy fractions.

P. 763/64: Reevesby KRW 13/64: PS 8107 6128 RS 94

Quartz	40%	Heavy fraction = 50%
Feldspar	10%	
Opaques	25%	
Hypersthene	5%	
Hornblende	20%	
Clinopyroxene	Trace	
Zircon	Trace	

The opaques consist mostly of ilmenite, but magnetite is fairly common.

P. 764/64: Reevesby KRW 17/64: PS 8108 6128 RS 91

Quartz	80%	Heavy fraction	
Feldspar	20%	Hornblende	30%
Sponge spicules	Trace	Opaques	70%
Heavy fraction	0.9%	Tourmaline	Trace
		Garnet	Trace

The opaques consist mainly of ilmenite, with subdominant goethite and magnetite. Martite is minor.

P. 765/64: Reevesby KRW 21/64: PS 8109 6128 RS 89

Quartz	40%	Heavy fraction = 48%
Feldspar	10%	
Shell fragments	10%	
Hypersthene	10%	
Opaques	1%	
Hornblende	30%	
Tourmaline	1%	
Clinopyroxene	5%	

The opaques consist mainly of ilmenite, with subdominant magnetite and minor martite.

Locality: Reevesby Island

Material: Black beach sands for heavy mineral separation

P. 90/64: HB 64/64: PS 8110 6128 RS 96

The heavy mineral suite forms 35 per cent by weight of this sample. The following results were obtained:

Quartz	Very abundant
Feldspar	Common
Ilmenite	Abundant
Magnetite	Sparse
Martite	Rare
Hornblende	Rare
Garnet	Trace
Hypersthene	Trace
Zircon	Trace

Very abundant	40%	Abundant	20-40%	Common	10-20%
Sparse	5-10%	Rare	1-5%	Trace	1%

Investigated by: D. SMALE

Officer in Charge, Mineralogy Section: H.W. FANDER

L. WALLACE COFFER
Director.

TABLE 1: RELATIVE ABUNDANCES OF HEAVY MINERALS

	P651 HB6	P652 HB7	P653 HB8	P654 HB9	P655 HB10	P656 HB11	P657 HB15	P658 HB3 RSIII	P659 HB12	P660 HB13	P661 HB14	P662 P663	P664 KRW10	P665 KRW11	P666 KRW12	P667 KRW13
Shell fragments	A	–	–	VA	VA	A	–	–	–	–	–	–	–	VA	–	–
Corundum	–	T	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rutile	–	–	C	–	–	–	–	–	T	R	S	–	–	–	–	–
Sphene	–	–	T	–	–	–	–	–	R	–	T	–	–	–	–	R
Monazite	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–
Sillimanite	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Zircon	R	–	A	–	–	R	–	–	S	S	S	–	–	–	–	S
Garnet	–	–	–	–	–	C	R	R	R	C	S	–	–	–	–	R
Epidote	–	–	–	–	–	–	–	–	–	–	T	–	–	–	–	–
Tourmaline	–	–	–	–	–	–	–	–	–	–	S	–	–	–	–	R
Biotite	A	A	R	–	C	R	S	A	–	–	–	–	–	R	–	R
Hornblende	–	A	–	–	S	R	A	S	S	C	C	–	–	S	–	A
Clinopyroxene	–	–	–	–	–	–	R	R	–	–	–	–	–	–	–	–
Hypersthene	–	–	–	–	–	–	C	R	S	–	–	–	–	–	–	T
Pyrite[1]	–	–	–	–	–	–	–	–	–	–	?T	–	–	–	–	–
Goethite[1]	S	S	C	–	–	S	–	–	–	–	–	–	–	–	–	–
Molybdenite[1]	–	–	–	–	–	–	?T	–	–	–	–	–	–	–	–	–
Ilmenite[1]	S	–	S	–	–	C	A	C	A	C	C	–	–	C	–	A
Magnetite[1]	C	R	–	–	–	C	T	C	A	A	C	–	–	S	–	A
Opaques (Total)	A	A	A	R	C	A	A	A	VA	A	A	–	–	A	–	VA
%Heavy Fraction	tr	tr	tr	tr	tr	0.1	tr	tr	tr	tr	0.2	Nil	tr	0.1	tr	0.1

All from Spilsby Is. except P 658 from Duffield Is.

VA = Very Abundant = greater than 40%
C = Common = 10-20%
R = Rare = 1.5%
A = Abundant = 20-40%
S = Sparse = 5-10%
T = Trace = Less than 1%

1 Abundances of specific opaque minerals have been included in "Opaques (Total)".

TABLE 1: RELATIVE ABUNDANCES OF HEAVY MINERALS

	P668 KRW14 PS8010	P669 KRW24	P670-P678	P679 KRW29	P680 KRW30	P681 KRW31	P682 KRW32	P683 KRW33	P684 KRW1 RS97	P685 KRW2 RS98	P686 KRW3 PS8009 RS99	P687 KRW4 RS100	P688 KRW1	P689 KRW2	P690 KRW3
Shell fragments	–	VA	–	–	–	–	–	–	–	–	–	–	–	–	VA
Corundum	–	T	–	–	–	–	–	–	–	–	R	–	–	–	–
Rutile	–	–	–	–	–	–	–	–	T	R	R	–	–	–	–
Sphene	–	–	–	–	–	T	–	–	–	–	–	–	–	–	–
Monazite	T	T	–	T	–	–	–	–	T	R	–	–	–	–	–
Sillimanite	?T	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Zircon	S	–	–	–	–	R	–	–	R	T	–	–	–	–	–
Garnet	S	R	–	S	–	R	S	–	R	S	R	–	–	–	–
Epidote	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tourmaline	R	–	–	R	–	–	R	–	–	–	R	–	–	–	–
Biotite	S	–	–	–	–	A	–	–	–	–	–	–	–	A	C
Hornblende	A	–	–	R	–	S	C	–	R	R	C	–	–	–	–
Clinopyroxene	R	R	–	–	–	–	–	–	–	–	–	–	–	–	–
Hypersthene	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pyrite[1]	?T	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Goethite[1]	–	–	–	–	–	?C	A	–	T	–	–	–	–	A	A
Molybdenite[1]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ilmenite[1]	A	–	–	A	–	C	C	–	A	A	A	–	–	–	–
Magnetite[1]	A	–	–	A	–	A	A	–	A	A	A	–	–	C	A
Opaques (Total)	VA	R	–	VA	–	VA	VA	–	VA	VA	VA	–	–	VA	VA
%Heavy Fraction	0.2	tr	tr	0.3	tr	0.2	0.1	tr	3.2	2.3	0.6	tr	tr	0.1	0.3

VA = Very Abundant = greater than 40%
C = Common = 10-20%
R = Rare = 1-5%
A = Abundant = 20-40%
S = Sparse = 5-10%
T = Trace = Less than 1%

1 Abundances of specific opaque minerals have been included in "Opaques (Total)".

P.668-P.683 Spilsby Is.
P.684-P.687 Hareby Is.
P.688-P.690 Duffield Is.

APPENDIX II

CHEMICAL AND SPECTROGRAPHIC ANALYSES

REPORTS AN 722-64: AN 723-64

Australian Mineral Development Laboratories

CHEMICAL ANALYSES FOR RUBIDIUM IN ROCK SAMPLES
SIR JOSEPH BANKS GROUP

Sample Mark		Rubidium (Rb) %
A 1694/64	KRW/W8/64 (Winceby Is.)	0.041
A 1698/64	KRW/S2/64 (Stickney Is.)	0.052
A 1699/64	KRW/S3/64 (Stickney Is.)	0.047
A 1704/64	KRW/B2/64 (Boucaut Is.)	0.039
A 1707/64	KRW/R1/64 (Reevesby Is.)	0.013
A 1708/64	KRW/R2/64 (Reevesby Is.)	0.032
A 1709/64	KRW/R4/64 (Reevesby Is.)	0.015
A 1710/64	KRW/R7/64 (Reevesby Is.)	0.045
A 1711/64	KRW/R9/64 (Reevesby Is.)	0.018
A 1712/64	KRW/R11/64 (Reevesby Is.)	0.013
A 1714/64	KRW/R14/64 (Reevesby Is.)	0.015

Analyses by: D. McPHARLIN

Officer in Charge, Analytical Section: T.R. FROST

REPORT AN 754-64

Australian Mineral Development Laboratories

CHEMICAL ANALYSES OF KUNKAR AND LOAMY SAND.

Sample Mark		Calcium Carbonate $CaCO_3$ (%)	Magnesium Carbonate $MgCO_3$ (%)	Aluminium Oxide Al_2O_3 (%)	Phosphorus Pentoxide P_2O_5 (%)
6128 RS 101 A150/64	HB62/64	72.3	5.0	2.1	0.26
6128 RS 112 A151/64	HB63/64	76.2	3.7	1.6	0.088
A152/64	KRW/R20/64	64.8	6.7	3.6	0.042
6129 RS 16 A153/64	HB65/64	-	-	-	14

A 150/64 - Kunkar, Centre of north coast, Roxby Is.

A 151/64 - Kunkar, S.W. coast, north of dam, Spilsby Is.

A 152/64 - Kunkar, Reevesby Is.

A 153/64 - Loamy sand, Winceby Is.

Analyses by: C. ROBINSON

Officer in Charge, Analytical Section: T.R. FROST

REPORTS AN 722-64: AN 723-64

Australian Mineral Development Laboratories

SPECTROGRAPHIC ANALYSES OF ROCK SAMPLES - SIR JOSEPH BANKS GROUP.

Sample Mark 6128	Molybdenum (Mo)	Copper (Cu)	Lead (Pb)	Zinc (Zn)	Cobalt (Co)	Nickel (Ni)	Tin (Sn)	Cadmium (Cd)	Bismuth (Bi)	Silver (Ag)	Beryllium (Be)	Gallium (Ga)	Zirconium (Zr)	Manganese (Mn)	Titanium (Ti)(%)	Vanadium (V)	Barium (Ba)	Scandium (Sc)	Lithium (Li)	Strontium (Sr)	Rubidium (Rb)
A1 692 KRW/W4	2	100	15	180	30	300	2	x 3	1	0.1	x 1	10	15	2000	0.4	500	400	150	700	500	1200
A1 693 KRW/W6	2	300	20	120	40	100	7	3	1	0.3	x 1	12	10	250	0.1	400	8	5	600	12	600
A1 694 KRW/W8	2	20	50	x 20	2	4	x 2	x 3	1	0.2	x 1	10	15	80	0.04	25	150	3	400	100	4000
A1 695/KRW/W10	2	20	30	25	7	6	8	x 3	1	0.2	x 1	12	250	250	0.35	100	1000	30	700	300	3000
A1 696 KRW/W12	2	12	25	25	5	3	6	x 3	1	0.3	x 1	12	100	200	0.3	50	800	40	500	200	3000
A1 697 KRW/S1 RS119	2	6	25	x 20	1	3	x 2	x 3	1	0.2	x 1	15	15	30	0.03	18	120	1	300	150	3000
A1 698 KRW/S2	3	4	35	x 20	2	2	3	x 3	1	0.1	x 1	15	100	120	0.20	40	400	20	400	200	4000
A1 699 KRW/S3	2	13	30	25	5	4	5	x 3	1	0.2	x 1	15	200	200	0.30	50	700	30	600	250	4000
A1 700 KRW/S6	1	4	50	x 20	1	2	3	x 3	x 1	0.1	x 1	12	50	70	0.10	15	50	4	400	100	3000
A1 701 KRW/S8	12	50	25	20	3	5	x 2	x 3	2	0.4	1	15	400	150	0.25	25	200	4	600	400	2000
A1 702 KRW/S10	2	5	50	x 20	x 1	2	x 2	x 3	x 1	x0.1	x 1	12	40	20	0.025	12	40	2	250	80	2500
A1 703 KRW/B1	5	40	15	x 20	2	3	5	x 3	2	0.6	x 1	15	500	50	0.25	18	100	25	300	60	700
A1 704 KRW/B2	2	18	45	x 20	x 1	2	2	x 3	x 1	0.1	x 1	10	150	30	0.10	10	400	1	200	250	4000
A1 705 KRW/B4	x 1	20	18	x 20	1	4	x 2	x 3	1	0.2	x 1	7	20	20	0.025	5	700	x 1	300	500	2000
A1 706 KRW/BR1 RS108	2	18	40	20	2	3	8	x 3	1	0.2	x 1	12	400	120	0.3	20	1000	40	400	250	3000
A1 707 KRW/R1	400	50	40	40	30	100	2	3	1	0.1	x 1	5	40	90	0.04	1500	300	40	60	20	2000
A1 708 KRW/R2	4	30	60	25	7	10	4	x 3	x 1	0.3	x 1	12	120	250	0.2	100	800	15	400	300	3000
A1 709 KRW/R4	3	200	20	100	30	100	7	3	1	0.3	x 1	15	15	180	0.08	700	15	7	400	15	2500
A1 710 KRW/R7	3	20	50	x 20	1	2	3	x 3	x 1	0.2	x 1	8	70	40	0.12	30	250	12	300	150	4000
A1 711 KRW/R9	18	30	40	25	5	8	8	x 3	x 1	0.2	x 1	10	400	250	0.3	150	1200	40	400	500	3000
A1 712 KRW/R11	1	15	30	25	2	2	15	x 3	x 1	0.1	x 1	15	400	300	0.3	150	1200	30	300	700	2500
A1 713 KRW/R13	7	10	20	250	30	50	15	x 3	1	0.4	1	5	300	2500	xx3	400	250	50	250	400	1000
A1 714 KRW/R14	3	150	18	120	30	80	18	3	1	0.1	x 1	12	30	1000	0.5	500	250	100	500	400	2000
A1 715 KRW/R17	2	8	15	x 20	1	5	4	x 3	1	0.4	x 1	6	40	150	0.25	30	500	2	150	150	800
A1 716 KRW/R21	2	35	18	100	25	70	12	3	1	0.1	x 1	8	30	1000	0.7	800	300	120	400	800	1200
		>100				>100	>10									>400					

SPECTROGRAPHIC ANALYSES OF ROCK SAMPLES - SIR JOSEPH BANKS GROUP (contd.)

A 1692/64 to A 1696/64 - Samples from Winceby Is.
A 1697/64 to A 1702/64 - Samples from Stickney Is.
A 1703/64 to A 1705/64 - Samples from Boucaut Is.
A 1706/64 - Sample from Boucaut Reef
A 1707/64 to A 1716/64 - Samples from Reevesby Is.

Results in parts per million, except for Titanium (Ti) (in %)
x Indicates "less than"
xx Indicates "more than"

Gold (Au) - All samples less than 3 ppm.
Tungsten (W) - All " " " 20 ppm (except A1713/64 = 20 ppm)
Arsenic (As) - " " " " 100 ppm
Antimony (Sb) - " " " " 30 ppm
Mercury (Hg) - " " " " 0.15 ppm
Tantalum (Ta) - " " " " 100 ppm
Niobium (Nb) - " " " " 50 ppm
(See also chemical analyses for Rubidium (Rb))

6128

	A 1692/64	Amphibolite
	A 1693/64	Amphibolite
	A 1694/64	Micrograrite
	A 1695/64	Granite
	A 1696/64	Porphyritic granite
RS119	A 1697/64	Microgranite
	A 1698/64	Porphyritic granite
	A 1699/64	Porphyritic granite
	A 1700/64	Granite
	A 1701/64	Scapolite pegmatite
	A 1702/64	Aplitic microgranite
	A 1703/64	Silcrete
	A 1704/64	Silcrete

6128

	A 1705/64	Sand
RS108	A 1706/64	Schistose granite
[redacted]	A 1707/64	Ferruginous grit
[redacted]	A 1708/64	Porphyritic granitic gneiss
	A 1709/64	Amphibolite
	A 1710/64	Red banded microgranite
	A 1711/64	Porphyritic granitic gneiss
	A 1712/64	Grey microgranite
	A 1713/64	Beach sand
	A 1714/64	Spotted amphibolite
	A 1715/64	Beach sand
	A 1716/64	Beach sand

Analyses by: G.R. HOLDEN

Officer in Charge, Analytical Section: T.R. FROST

L. WALLACE COFFER,
Director.

APPENDIX III

ROCK ANALYSES

(AMDEL Report AN 721/64.)

6128
RS108

ROCK ANALYSES

ANALYSIS
per cent

		1 A1684/64	2 A1685/64	3 A1686/64	4 A1687/64	5 A1688/64	6 A1689/64	7 A1690/64	8 A1691/64
Silica	SiO_2	47.9	74.8	70.7	71.2	74.4	67.5	58.6	74.7
Aluminium oxide	Al_2O_3	13.2	13.3	14.7	14.1	13.5	15.6	21.0	12.9
Ferric oxide	Fe_2O_3	3.40	1.13	1.51	0.94	1.48	1.25	1.84	1.29
Ferrous oxide	FeO	11.0	0.84	2.10	2.40	0.51	2.80	2.10	0.88
Magnesium oxide	MgO	6.55	0.24	0.58	0.59	0.16	0.95	0.70	0.16
Calcium oxide	CaO	10.3	0.97	1.91	2.00	0.73	2.62	5.25	1.27
Sodium oxide	Na_2O	3.00	2.40	2.85	2.45	2.20	2.65	4.70	2.45
Potassium oxide	K_2O	0.92	5.95	4.90	5.30	6.25	5.30	4.70	5.20
Water over 100°C	H_2O+	1.09	0.32	0.46	0.36	0.50	0.57	0.31	0.36
Water at 100°C	H_2O-	0.11	0.11	0.11	0.06	0.21	0.14	0.16	0.19
Carbonate	CO_2	0.35	0.04	0.04	0.06	0.06	0.04	0.05	0.04
Titanium oxide	TiO_2	1.62	0.20	0.46	0.45	0.17	0.54	0.51	0.37
Phosphorus pentoxide	P_2O_5	0.15	0.03	0.08	0.09	0.03	0.12	0.11	0.05
Manganese oxide	MnO	0.24	0.02	0.04	0.05	0.01	0.06	0.06	0.02
		99.8	100.4	100.4	100.1	100.2	100.1	100.1	99.9

1. A 1684/64. Amphibolite, Winceby Is.
2. A 1685/64. Pink fine to medium-grained microgranite, Winceby Is.
3. A 1686/64. Gneissic granite, Winceby Is.
4. A 1687/64. Porphyritic granite ("Rapakivi" type), Winceby Is.
5. A 1688/64. Banded red aplitic microgranite. Reevesby Is.
6. A 1689/64. Coarse porphyritic granite gneiss ("Rapakivi" type). Reevesby Is.
7. A 1690/64. Grey microgranite, Reevesby Is.
8. A 1691/64. Pink microgranite, Boucaut Reef.

Analyses by: MR. HANCKEL, R. EDMONDS and L. CASTANELLI
Officer in Charge, Analytical Section: T.R. FROST

L. WALLACE COFFER,
Director.

APPENDIX IV

SPECIMEN LOCATIONS (SEE PLAN 64-749)

SPECIMEN LOCATIONS ON PLAN 64-749

Island		Location & Field Nos.	Chemical Analyses Mark No.	Spectrographic Analyses Mark No.	Rock Analyses Mark No.	Petrological Mark No.		Mineragraphic or Heavy Minerals Mark No.	
Winceby	1.	W12 KRW7	–	A 1693/64	A 1684/64	P 750/64		–	6129 RS12
	2.	W1	–	(A 1694/64	A 1685/64	–		–	
			–	(A 1695/64	A 1686/64	(P 751/64	KRW 9	–	RS13
			–	–	–	(P 752/64	KRW 11	–	RS14
	3.	W3	–	–	–	P 746/64	KRW 1	–	RS8
	4.	W7	–	–	–	(P 747/64	KRW 2	–	RS9
			–	–	–	(P 748/64	KRW 3	–	RS10
	5.	W9	–	A 1692/64	–	P 749/64	KRW 5	–	RS11
	6.	KRW~~10~~ 13/64	–	A 1696/64	A 1687/64	P 753/64		·	RS15
	7.	HB65/64	A 153/64	–	–	–		–	RS16
Reevesby	8.	R13	–	A 1711/64	A 1689/64	P 770/64	KRW10	–	6128 RS83
	9.	R2	–	A 1708/64	–	P 766/64	KRW 3	–	RS84
	10.	R3	–	A 1709/64	–	P 767/64	KRW 5	–	RS85
	11.	R1	–	A 1707/64	–	–		P 762/64	RS86
	12.	R4	–	–	–	P 768/64	KRW 6	–	RS87
	13.	R8	–	A 1710/64	A 1688/64	P 769/64	KRW 8	–	RS88
	14.	KRW21/64	–	A 1716/64	–	–		P 765/64 KRW21	RS89
	15.	RW12	–	(A 1714/64	–	P 772/64	KRW 15	–	RS90
	16.	RW12	–	(A 1713/64	–	–		P 763/64 KRW13	RS94
	17.	RW10	–	A 1712/64	A 1690/64	P 771/64	KRW 12	–	RS95
	18.	RB11	–	–	–	–		P 90/64 HB~~64~~/64	RS96
	19.	KRW18/64	–	–	–	P 773/64	KRW 18	–	RS92
		KRW19/64	–	–	–	P 774/64	KRW19	–	RS93
	20.	KRW17/64	–	A 1715/64	–	–		P 764/64 KRW17	RS91
Hareby	21.	KRW1-3/64	–	–	–	–		P 684-P686/64	6128 RS97→99
	22.	KRW4/64	–	–	–	–		P 687/64	RS100
Roxby	23.	HB62/64	A 150/64	–	–	–		–	6128 RS101
Stickney	24.	S1	–	(A 1697/64	–	–		–	6128 RS 119
			–	(A 1698/64	–	–		–	
	25.	S12	–	A 1702/64	–	P 758/64	KRW 11	–	RS123
	26.	S8	–	A 1701/64	–	P 757/64	KRW 9	–	RS124
	27.	S7	–	A 1700/64	–	P 756/64	KRW 7	–	RS122
	28.	S5	–	–	–	P 755/64	KRW 5	–	RS121
	29.	S4	–	A 1699/64	–	P 754/64	KRW 4	–	RS120

Island		Location & Field Nos.	Chemical Analyses Mark No.	Spectrographic Analyses Mark No.	Rock Analyses Mark No.	Petrological Mark No.	Mineragraphic or Heavy Minerals Mark No. 6128	
Duffield	30.	HB3/64	–	–	–	–	P688-P690/64; P658/64	RS111
Boucaut	31.	KRW2/64	–	A 1704/64	–	P 759/64	– 6128	RS 105
	32.	KRW1/64	–	A 1703/64	–	–	P760/64	RS 107
	33.	KRW4/64	–	A 1705/64	–	–	P761/64	RS 127
Boucaut Reef	34.	BR1/64	–	A 1706/64	A 1691/64	–	–	RS108
Spilsby	35.	KRW7/64	–	–	–	P 643/64	– 6128	RS106
	36.	KRW6/64	–	–	–	–	P675/64	
	37.	HB5/64; ~~KRW34/64~~ KRW 34/64	A 34/64	–	–	P 640/64; P 650/64.	–	RS102 RS104
	38.	HB6/64	–	–	–	–	P651/64	
	39.	HB7/64	–	–	–	–	P652/64	
	40.	HB8-11/64	–	–	–	–	P653-P656/64	
	41.	KRW4/64	–	–	–	–	P663/64	
	42.	KRW3/64	–	–	–	–	P662/64	
	43.	KRW1/64	–	–	–	P 641/64	–	RS110
	44.	KRW2/64	–	–	–	P 642/64	–	RS128
	45.	KRW5/64	–	–	–	–	P674/64	
	46.	HB15/64	–	–	–	–	P657/64	
	47.	HB12/64	–	–	–	–	P659/64	
	48.	HB13/64	–	–	–	–	P660/64	
	49.	HB14/64	–	–	–	–	P661/64	
	50.	(NOT USED)	–	–	–	–	–	
	51.	HB60-61/64(L.P.)	A 146/64	–	–	P 88/64	–	
	52.	KRW23/64	–	–	–	P 649/64	–	RS118
	53.	KRW19-22/64	–	–	–	P 645-648/64	–	RS114-117
	54.	KRW18/64	–	–	–	P 644/64	–	RS113
	55.	KRW33/64	–	–	–	–	P683/64	
	56.	HB63/64	A 151/64	–	–	–	–	RS112
	57.	KRW31/64	–	–	–	–	P681/64	
	58.	KRW32/64	–	–	–	–	P682/64	
	59.	KRW25/64	–	–	–	–	P670/64	
	60.	KRW24/64	–	–	–	–	P669/64	
	61.	KRW26/64	–	–	–	–	P671/64	
	62.	KRW27/64	–	–	–	–	P672/64	
	63.	KRW28/64	–	–	–	–	P673/64	
	64.	KRW29/64	–	–	–	–	P679/64	

Island	Location & Field Nos.	Chemical Analyses Mark No.	Spectrographic Analyses Mark No.	Rock Analyses Mark No.	Petrological Mark No.	Mineragraphic or Heavy Minerals Mark No.
Spilsby (Contd.)	65. KRW30/64	-	-	-	-	P680/64
	66. KRW15/64	-	-	-	-	P676/64
	67. KRW16/64	-	-	-	-	P677/64
	68. KRW17/64	-	-	-	-	P678/64
	69-73. KRW10-14/64	-	-	-	-	P664-668/64

PLATES

1. Probable granitised arkose, Spilsby Is.

2. Probable granitised arkose, Boucaut Is.

3. Xenolith of medium granite, Spilsby Is.

4. Probable granitised sedimentary rocks, south Spilsby Is.

5. Synform in amphibolite, Winceby Is.

6. Silcrete on kaolinised granite, NE Spilsby Is.

7. Cave in kaolinised granite, overlain by silcrete.
N.E. Spilsby Is.

8. Kunkar overlying clay, silcrete and granite.
NE Spilsby Is.

With acknowledgements to L.G. Nixon, S. Robson, J.E. Johnson

To accompany a report by A.H. Blissett & R.R. Warne

S.A. DEPT. OF MINES

Associated Drawing	No.	No.	Amendment	Exd.	Date

Req. No.
D.M.
Compiled from

GEOLOGY OF THE ISLANDS IN THE SIR JOSEPH BANKS GROUP

Approved | Passed
Director of Mines

Drn.
Tcd. B.L.S.
Ckd.
Exd.

Scale: As shown

65–172

Date 9-3-66

Compiled from uncontrolled mosaic by Dept. of Lands

To accompany report by A.H. Blissett and K.R. Warne

S.A. DEPT. OF MINES

LOCALITY PLAN - SIR JOSEPH BANKS GROUP SHOWING SAMPLE LOCATIONS

Associated Drawing	No.	No.	Amendment	Exd.	Date

Req. No.
D.M.
Compiled from

Approved | Passed
Director of Mines

Drn. R.G.H.
Tcd.
Ckd.
Exd.

Scale: 1 inch to 1 mile approx.
64-749
Dn
Date 14 - 9 - 64