COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1969 / 7

Completion Report
BMR, Alice Springs No. 3 (Ringwood)
Northern Territory

by

A.J. Stewart

PART 1
of 2

Record No. 1969 / 7

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COMPLETION REPORT

BMR, ALICE SPRINGS NO. 3 (RINGWOOD)

NORTHERN TERRITORY

by

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Records 1969/7

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SUMMARY

BMR Alice Springs No. 3 (Ringwood) was drilled into a body of gypsum and anhydrite within the late Precambrian Bitter Springs Formation of the Amadeus Basin, Northern Territory. The body is located in the north-eastern part of the basin, 66 miles east of Alice Springs. The aims of the drilling were to examine the general nature and lithology of the body at depth, and to ascertain whether any associated deposits of sulphur or potash existed.

The well spudded on 24th July 1968 and reached total depth of 852 feet on 19th August 1968. The entire hole was rotary air-drilled and cored by a Mayhew-1000 rig of the Bureau of Mineral Resources. Continuous coring started at 107 feet and was maintained to 830 feet; overall core recovery was 92%. The hole was logged under contract by the Welex Division of the Halliburton Company, and the logs obtained were Laterolog (Resistivity), Spontaneous Potential, Acoustic Velocity, and Gamma Ray.

The well penetrated earthy, weathered gypsum from surface to 5 feet, and then entered mixed evaporite rocks consisting of gypsum with abundant fragments of anhydrite and interbeds of calcareous claystone. At 436 feet the well encountered dark grey-brown to black dolomitic siltstone, and these four rock-types formed an interbedded assemblage which extended from this level to total depth. Though gypsum and anhydrite are present throughout the core, gypsum predominates over anhydrite in the upper 250 feet, and is particularly abundant in the uppermost 85 feet; below 250 feet the two rock-types co-exist in approximately equal amounts. This relation indicates that the gypsum has formed by hydration of the anhydrite at the present location of the salt body. Local recrystallization of gypsum took place in the upper part of the body and formed cross-cutting veins of satin-spar; similar recrystallization of anhydrite took place in the lower part of the body.

The well encountered no fluids, sulphur, or potash, and is now plugged and abandoned.

INTRODUCTION

BMR Alice Springs No. 3 (Ringwood) was an exploratory well drilled into the gypsiferous core of the Ringwood Dome, which is situated 66 miles east of Alice Springs in the southern part of the Northern Territory. The drill site is 6 miles southwest of Ringwood homestead (Fig. 1), but is actually situated on Todd River Station; Todd River homestead itself is 24 miles west of the drill site. The hole was the first of three designed to explore the nature in depth of the numerous surface occurrences of gypsum that are associated with the late Precambrian Bitter Springs Formation, which is the lowest formation but one of the Amadeus Basin sequence. The objectives of the drilling were to investigate the general nature and lithology of the body, and to see whether any sulphur or potash are associated with the body.

The drilling was carried out by Drill Party No. 5 (1968; Mr E.H. Cherry, Party Leader) of the Petroleum Technology Section of the Bureau of Mineral Resources, using a Mayhew-1000 rig. Rotary air-drilling was used exclusively. A $7\frac{3}{8}$ inch hole was drilled to 85 feet (with a 3 foot core taken from 55 to 58 feet), 6 inch water bore casing was set and cemented at this depth, and a blowout preventor fitted. Drilling of $5\frac{1}{2}$ inch hole continued to 107 feet, at which depth continuous coring commenced and continued to 830 feet. A 15 foot core barrel was used equipped with a split inner tube and a $3\frac{15}{16}$ inch corehead which produced core $2\frac{1}{2}$ inches in diameter. From 107 feet to 300 feet the cores were drilled in groups of three (totalling 45 feet), followed by reaming of the whole 45 foot interval to $5\frac{1}{2}$ inches. Below 300 feet the hole was reamed to $4\frac{3}{4}$ inches after every sixth core. Conventional drilling resumed at 830 feet with a $4\frac{3}{4}$ inch bit, and continued to the total depth of 852 feet.

WELL HISTORY

General data

Well name and number:	BMR Alice Springs No. 3 (Ringwood)
Location:	Lat. 23° 53' S. Long. 134° 53' E.
Title holder:	None
Petroleum title number:	None
Area:	Amadeus Basin, Northern Territory
Total depth:	Driller: 852' Welex: 834', 816'
Date drilling commenced:	24th July 1968
Date drilling completed:	19th August 1968
Date well secured:	28th August 1968
Date rig released:	28th August 1968 (release delayed because of non-availability of logging unit)
Drilling time to total depth:	160¼ hours (drilling, coring, reaming)
Elevations:	Rotary table: 4' above ground level Ground level: 1,300' (approx.)
Status:	Plugged and abandoned

Drilling data

Drilling by:	Bureau of Mineral Resources, Canberra, A.C.T.
Drilling plant:	make: Mayhew type: '1000' rated capacity: 1,000' with 2⅜" drill pipe motors: AEC 600 and Leyland E.U. 400
Mast:	make: Mayhew type: tubular, 23' rated capacity: 40,000 lbs
Pumps:	make: Gardner Denver type: FG-FXG size: 5" x 6" motors: as for rig
Compressor:	make: Gardner Denver type: 2-stage reciprocating model: WXH motors: as for rig
Blowout Preventor:	make: Baash Ross size: 6" x 2⅜" model: 'Autolock' working pressure: 1,000 p.s.i.

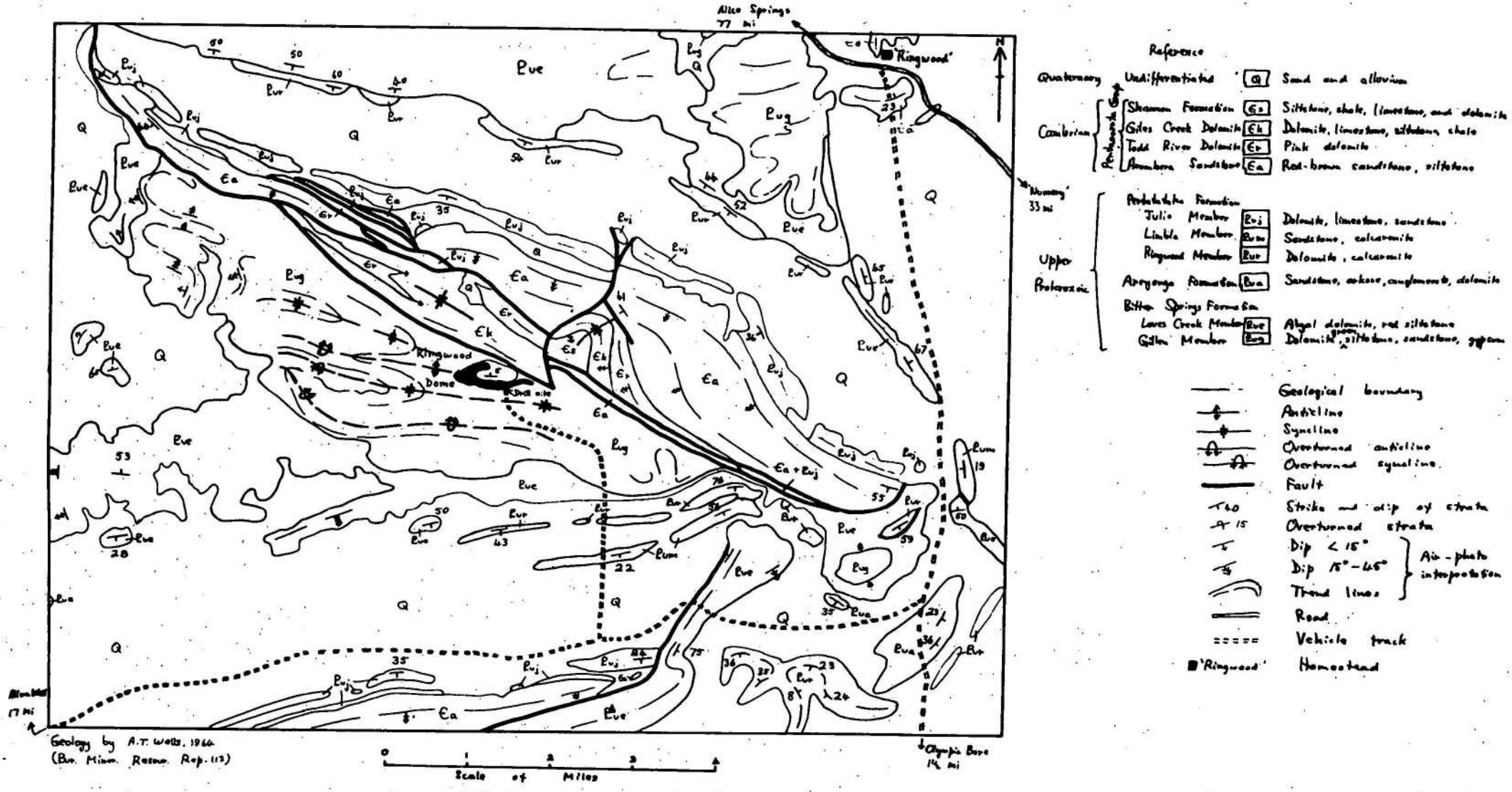

Fig. 1 Geological Map of Ringwood Dome and surrounding area. Gypsum core of dome shown in solid black.

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Hole sizes: surface to 85' : $7\frac{3}{8}$"
85' to 300': $5\frac{1}{2}$"
300' to T.D.: $4\frac{3}{4}$"

Casing strings: size: 6" x $\frac{3}{16}$" wall
grade: water bore
weight: 12 lbs/ft
set at: 85'

Casing cement: size: 6"
sacks cement: 15
cement rise: to surface
method: single stage, plug

Drilling fluid: interval: surface to 852'
type: air (hole was filled with saturated salt water for logging at T.D.)

Water supply: Water from the domestic bore at Ringwood homestead was used for all purposes.

Perforation and Shooting Record: nil

Plugging Back and Squeeze Cement Jobs: nil

Side-tracked Hole: nil

Fishing Operations:

Date	Hole depth	Hours lost	Fishing job	How recovered
31-7-'68	391'	$2\frac{1}{2}$ hours	Elevator plug failed and drill string dropped 75' to bottom of hole; compressed core barrel and bent 10 joints of drill pipe (150').	Fished out
14-8-'68	778'	$3\frac{1}{2}$ hours	$2\frac{3}{8}$" drill pipe twisted off.	Fished out

Logging and Testing

Ditch Cuttings

A continuous sample of the dust produced by the drilling was collected in a dry bucket placed beneath the rotary table and directly beside the hole. This was emptied at 5 foot intervals and duplicate samples of these taken and forwarded to BMR Canberra. Some difficulty was experienced in washing the cuttings after coring started, as the coring bits produced a very fine powder, the greater part of which washed away to leave practically no sample. Accordingly it was decided not to wash the bulk of the samples. The details are as follows:

Cuttings Samples Set 1	Cuttings Samples Set 2
0' - 150' washed	0' - 107' washed
150' - 830' unwashed	107' - 852' unwashed
830' - 852' washed	

Descriptions of the washed cuttings are set out in Appendix I.

Cores

Within the limits of drilling practice, continuous coring was maintained from 107 feet to 830 feet. The cores were cut with a 15 foot Triefus split inner tube core barrel using $3\frac{15}{16}$ inch hard-formation and soft-formation coreheads which cut $2\frac{1}{2}$ inch diameter cores. Rather slow progress was experienced during coring, as the hard-formation coreheads became clogged whenever they entered the soft claystone layers, and the soft-formation coreheads could barely penetrate the tough, dolomitic siltstone. The mixed lithology throughout the hole made selection of the most suitable corehead very difficult.

Fifty four cores were cut, all of them $2\frac{1}{2}$ inches in diameter. Recovery to 437 feet was 100%, and overall recovery was 92%. Details of the cores are set out in Table I.

TABLE I - Core intervals and recovery

	Interval			Recovery	
Core No	from	to	Footage	Length	Percent
1	55'	58'	3'	3'	100
2	107'	121' 2"	14' 2"	14' 2"	100
3	122'	137'	15'	15'	100
4	139'	152'	13'	13'	100
5	152'	166'	14'	14'	100
6	170' 4"	181'10"	11' 6"	11' 6"	100
7	182'	197'	15'	15'	100
8	197'	212' 4"	15' 4"	15' 4"	100

Core No	Interval from	to	Footage	Recovery Length	Percent
9	212' 4"	226' 4"	14'	14'	100
10	230' 2"	242'	11'10"	11'10"	100
11	242'	256'	14'	14'	100
12	256'	271'	15'	15'	100
13	274'	285' 6"	11' 6"	11' 6"	100
14	286' 6"	300'	13' 6"	13' 6"	100
15	300'	314'11"	14'11"	14'11"	100
16	317'	331' 6"	14' 6"	14' 6"	100
17	331' 6"	346' 6"	15'	15'	100
18	346' 6"	361' 6"	15'	15'	100
19	361' 6"	376'	15'	15'	100
20	376' 6"	391'	14' 6"	14' 6"	100
21	391' 4"	406'	14' 8"	14' 8"	100
22	407'	422'	15'	15'	100
23	422'	437'	15'	15'	100
24	437'	452'	15'	6'	40
25	454'	465'	11'	11'	100
26	465'	473'	8'	8'	100
27	473'	482'	9'	9'	100
28	483'	492'	9'	9'	100
29	492'	506'	14'	14'	100
30	506'	512'	6'	6'	100
31	512'	527'	15'	13'	87
32	527'	541' 7"	14' 7"	14' 7"	100
33	541' 7"	556'	14' 5"	10' + fragments	72
34	556'	571'	15'	10'	66
35	572'	582'	10'	10'	100
36	582'	596' 6"	14' 6"	14'	97
37	596' 6"	611' 6"	15'	15'	100
38	611' 6"	615'	3' 6"	3' 6"	100
39	615'	627'	12'	7'	58
40	627'	642'	15'	15'	100
41	647'	662'	15'	15'	100
42	662'	677'	15'	15'	100
43	677'	691' 6"	14' 6"	14' 6"	100

Core No	Interval from	to	Footage	Recovery Length	Percent
44	691' 6"	707'	15' 6"	8'	60
45	707'	722'	15'	12'	80
46	722'	737'	15'	12'	80
47	737'	752'	15'	12' 6"	83
48	752'	759' 6"	7' 6"	6' 6"	85
49	759' 6"	767'	7' 6"	7'	90
50	767'	778'	11'	9' 6"	80
51	797'	802'	5'	5'	100
52	802'	816' 6"	14' 6"	10' 6"	70
53	802'	816' 6"	14' 6"	10' 6"	70
54	822' 6"	830'	7' 6"	6' 6"	85

The total footage cored was 675' 5"; of this, 626' 6", or 92%, was recovered. Descriptions of the cores are set out in Appendix II.

Side-wall Sampling: nil

Well-logging

The hole was logged by the Welex Division of the Halliburton Company, and the logs run are summarized below:

Log type	Run No.	Depth Interval	Curves	Vertical Scale
Electric	1	84' - 804'	Spontaneous Potential	1" = 20'
		84' - 820'	Lateral (Resistivity)	1" = 20'
Gamma Ray	1	0' - 790'	Gamma Ray	1" = 20'
Acoustic Velocity	1	84' - 809'	Travel Time	1" = 20'

The logging contract called for a density log to be run, but the density tool was too wide to fit down the hole and no run was made. A short discussion on the results of the logging is given in Appendix III.

Gas-log: nil

Formation testing: nil

Deviation surveys: nil

Other well surveys: nil

GEOLOGY

Summary of Previous Work

Geological

The Ringwood Dome was found by A.T. Wells of the Bureau of Mineral Resources in June 1964, during the course of regional geological mapping of the southern half of the Alice Springs 1:250,000 Sheet area (Wells et al., 1968); in press). These authors described the dome as a mass of gypsum surrounded by domed-up sediments of the Gillen Member of the Bitter Springs Formation, and the gypsum was regarded as part of the Gillen Member which had moved at least some distance relative to the surrounding sediments into its present position. However, re-examination of the area during the drilling showed that no diapiric movement of the salt* body has occurred at the present level of exposure. Instead, the salt appears to be the filling of the core of a normal plunging anticline. The salt may have pierced the surrounding sediments at deeper levels, but this has not yet been proved or disproved. The term 'The Ringwood Dome' is used in this report to refer to the whole area of salt plus domed-up sediments.

Geophysical

The Bureau of Mineral Resources has prepared a preliminary Bouguer Anomaly map of the Alice Springs Sheet area, but the map scale is too small to reveal any anomaly, if one exists, at or near the Ringwood Dome.

Drilling

No deep drilling has been done in or near the Ringwood Dome. The nearest oil well which has intersected the Bitter Springs Formation is Ooraminna No. 1, drilled by Exoil (N.T.) Pty Ltd (Planalp & Pemberton, 1963), and situated 58 miles west of Ringwood.

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* 'Salt' is used in this report to refer to all the sulphates and chlorides (if any) present in the core of the Ringwood Dome. Rock-salt is referred to as 'halite'.

Abundant halite and small veinlets of anhydrite in shale were found in the Bitter Springs Formation in this well, but no large mass of gypsum or anhydrite was encountered. A similar situation has prevailed in the other deep wells which have intersected the Bitter Springs Formation, viz. Mount Charlotte No. 1 (McTaggart, Pemberton, & Planalp, 1965) and Erldunda No. 1 (Pemberton & McTaggart, 1965). Both these wells found abundant halite but little or no gypsum or anhydrite. On the other hand, large surface exposures of gypsum are common in the Bitter Springs Formation, but halite is not found in outcrop. All the known Bitter Springs halite lies in the eastern part of the Amadeus Basin, east of longitude 133° 10' (Fig. 2), whereas the numerous gypsum occurrences, with the exception of the one at Ringwood, are west of this line.

Summary of Regional Geology

The Ringwood Dome is situated in the Eastern MacDonnell Ranges, a belt of long and narrow valleys and ridges carved in the folded and faulted sedimentary formations of the Amadeus Basin sequence. These sediments were laid down under conditions of the miogeosynclinal shelf facies, and comprise sandstone, conglomerate, siltstone, shale, limestone, dolomite, and evaporites. Deposition began during the Late Precambrian, and by Middle Devonian times 20,000 feet of sediments had accumulated. During the Late Devonian, the northern part of the basin underwent several periods of diastrophism which were accompanied by the deposition of thick, non-marine, molasse-like sediments of Devonian to Carboniferous age. During the last period of diastrophism, the Alice Springs Orogeny, the sediments in the basin were folded into long, gently plunging anticlines and synclines which are somewhat similar in style to the folds of the Jura Mountains of Europe. In the north-eastern part of the basin, décollement occurred at two levels in the sedimentary sequence, a lower one within the Bitter Springs Formation and a higher one in the Lower Cambrian formations; at both these horizons the sediments include shale, siltstone, and evaporites.

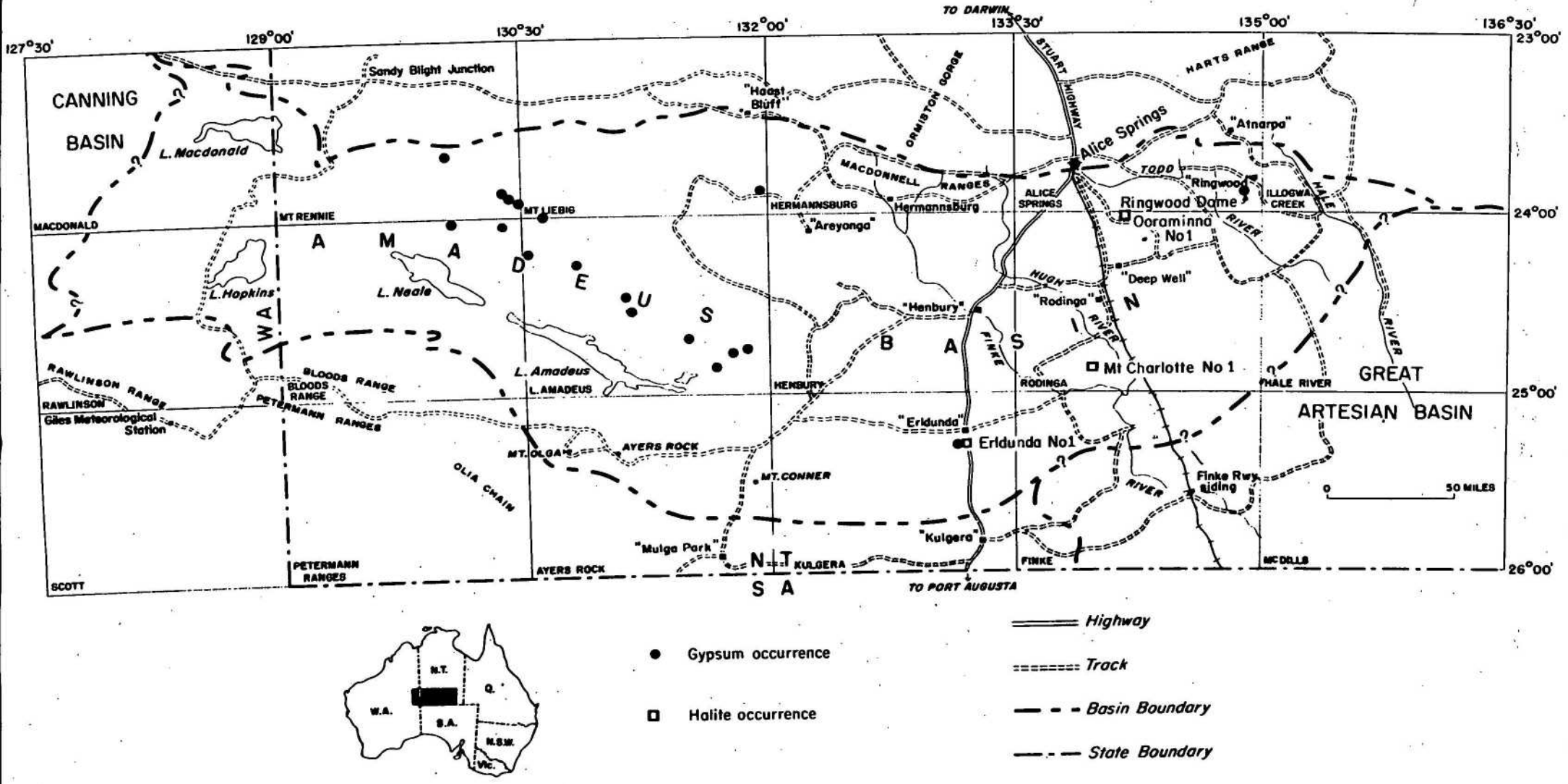

Fig. 2. Amadeus Basin showing position of known gypsum and halite occurrences in Bitter Springs Formation

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Southward movement of large masses of sediment took place along these décollement horizons, the detachment surface often starting in the lower horizon and then slicing up through the section to continue along the upper horizon. The distances moved were certainly of the order of miles, and may have been many miles; the author has suggested elsewhere (pers. comm. in Wells et al., 1967, p.150) that most of the sediments now preserved in the north-eastern part of the Amadeus Basin are allochthonous, and were emplaced as two large gravity slides which moved into their present positions by sliding southwards some scores of miles from their homeland on top of the basement rocks directly to the north of the basin. The Ringwood Dome is situated within a mass of sediments of the Bitter Springs Formation which is part of one of these allochthonous masses, and so the salt body has been transported some miles, perhaps many miles, from its place of origin.

The Ringwood Dome itself consists of a core of gypsum, anhydrite, 'dolomitic siltstone', and claystone, surrounded by an envelope of outward-dipping carbonate and clastic rocks. Both the salt body and surrounding rocks are part of the Bitter Springs Formation, which is the oldest carbonate-bearing unit of the Amadeus Basin sequence, and has an age of approximately 1100 m.y. (Wells et al., 1967). The Bitter Springs Formation is underlain conformably by the Heavitree Quartzite, which in turn lies with regional unconformity on the eroded surface of the metamorphic Arunta Complex, the basement of the Amadeus Basin. The Bitter Springs Formation comprises two members, the Gillen Member (lower) and the Loves Creek Member (upper); both members are about 1,500 feet thick. The Gillen Member comprises interbedded dolomite and shale, with some sandstone, limestone, and evaporites. The Loves Creek Member consists of a thick basal dolomite with abundant algal stromatolites, overlain by red, calcareous siltstone containing a few thick, solitary interbeds of soft, algal limestone and dolomite. The sediments of the Ringwood Dome all appear to belong to the Gillen Member.

The gypsiferous mass forming the core of the Ringwood Dome has a hook-shaped outcrop in plan, elongated east-west, and measuring 1 mile by ½ mile (Fig. 1). The mass forms a prominent steep-sided hill (Fig. 3) whose lower half is covered with white, earthy, weathered gypsum with a hummocky topography. The upper half of the hill is composed of limestone. Numerous steep-sided gullies radiate from the crest of the hill and reveal grey, bedded gypsum beneath the crust of earthy gupsum, which is only a few feet thick. Small blocky fragments of grey, fine-grained anhydrite can be found loose on the sides of the hill, but are not abundant.

The limestone which forms the capping of the dome is about 200 feet thick, and has an overall dip to the north of 5 degrees. The lower part of the limestone is yellow, friable, poorly thin-bedded, and contorted. The upper part is massive, and displays numerous algal stromatolites. About 10 feet of red limestone is present near the base of the capping. These beds are continuous with those which form the northern and western flanks of the dome, where there is also a fair amount of friable, blue-grey, algal limestone and friable, yellow-brown limestone breccia. These friable limestones are not present on the southern flank of the dome. Here, the gypsum is overlain by well bedded, tough, blue limestone, tough, yellow algal limestone, and then by laminated, micaceous siltstone, dolomite, and abundant fine to coarse-grained sandstone. These sediments are, in turn, not present on the northern flank of the dome. However, the two sequences of flank sediments are exposed in contact at the western and eastern ends of the dome, and here the friable and algal limestones of the northern flank can be seen to lens out beneath the tough limestone and clastic rocks of the southern flank. Clear exposures of algal stromatolites and cross-bedding indicate that the sediments on the southern flank are not overturned, but facings in the rocks of the other flanks and in the capping could not be determined, in spite of the fair abundance of algal fossils.

Fig. 3. View from south-west of central part of Ringwood Dome. The lower, deeply dissected part of the hill consists of white secondary gypsum encrusting the underlying primary gypsum; the upper part of the hill consists of limestone.

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Structurally, the Ringwood Dome is not a perfect dome. The structure is really an east trending anticline which plunges gently westwards at its western end, but has an isoclinal eastern end where both limbs dip steeply south. No plunge is discernible here, due to lack of outcrop, but the exposed gypsum tapers to a thin 'tail' only a few yards wide, suggesting that what plunge exists is probably eastwards. The gypsum almost certainly continues west along the anticline for some distance beyond its present area of exposure. The anticline is bounded on the north by a mass of Lower Cambrian carbonate rocks of the Pertaoorrta Group; these are in fault contact with the Bitter Springs sediments, and dip southwards beneath them. The continuity of beds of the Bitter Springs Formation on top of the anticline with those on its northern flank indicates that no diapiric movement (piercement) by the central salt body took place at the present level of exposure. This is probably to be expected in view of the closeness in specific gravities of the exposed rock-types of the area.

Lithological Description of Core

Introduction

The Composite Well Log which accompanies this report includes a lithologic log in columnar form (1" = 50'), and a more detailed version of this log (1" = 10') is held on the Alice Springs technical file at the Bureau of Mineral Resources in Canberra. Except for nine samples analysed by X-ray diffraction, all rock determinations are based solely on examination of the core at the drilling site.

The lithology of the Ringwood core is a heterogeneous mixture of four main rock-types: gypsum, anhydrite, 'dolomitic siltstone', and claystone.

Gypsum

Two varieties of gypsum are present in the core. Most of the gypsum is a crystalline, pale grey, medium to coarse-grained rock which is fairly massive itself, but commonly contains numerous films and laminae of grey clay, resulting in a laminated to thin-bedded appearance. The second variety, from here on referred to as 'acicular gypsum', is composed of a colourless, coarse-grained, fibrous aggregate of long slender needles. This gypsum forms tabular dyke-like veins up to 4 inches thick, with the needles oriented perpendicularly (or nearly so) to the contacts of these veins; the rock is a variety of satin-spar.

Anhydrite

Anhydrite forms three different varieties in the core. The most abundant is a grey, fine-grained, laminated rock, calcareous* in places and generally forming large fragments surrounded by gypsum. Only one sample of this rock has been X-rayed (Sample 4 in Table II), and future work will probably modify the use of the term throughout the core descriptions. The second variety of anhydrite (Samples 1, 3, 5, and 9 in Table II) is a crystalline, medium-grained, bluish-grey rock, commonly with a speckled appearance; on broken surfaces the grains show a linear alignment. The third variety of anhydrite (Sample 8, Table II) is similar to the second, but has a different mode of occurrence. This anhydrite is a clear, pale blue, crystalline mineral which forms the matrix of the 'siltstone' breccia (see below); in a few places, e.g., at 584 feet, a single large crystal of this anhydrite encloses numerous 'siltstone' fragments over a distance of several inches, so that the rock has a coarse, poikilitic texture. Blue anhydrite also fills cross-cutting veins and cracks in the 'siltstone' breccia, and in these cases a thin layer of prismatic gypsum usually separates the blue anhydrite from the 'siltstone', with the gypsum prisms oriented at right angles to the lithologic contacts (Fig. 4).

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* 'Calcareous' in this report means 'calcite-bearing'.

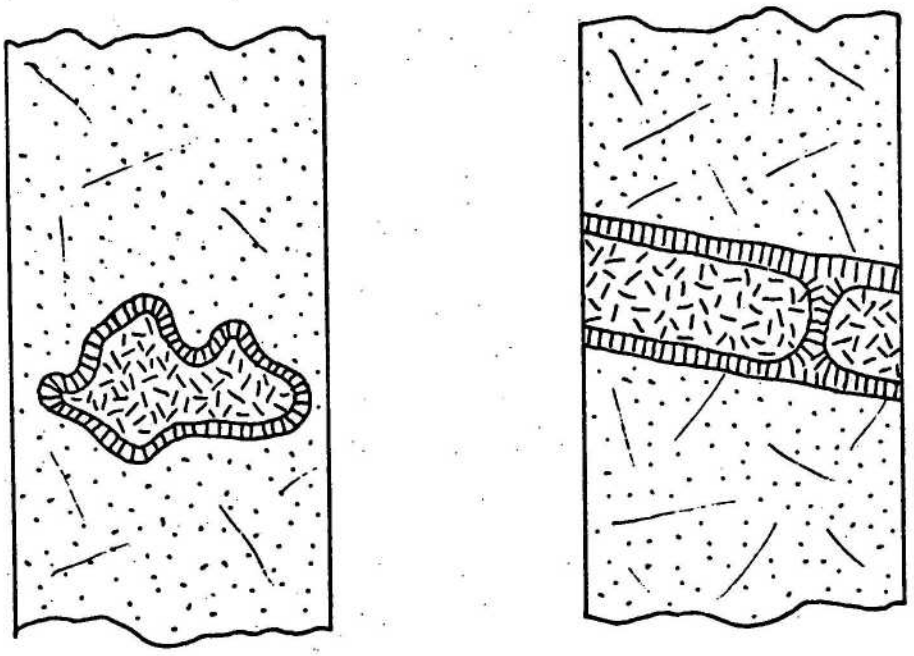

Fig. 4 Sketches showing relationships of blue anhydrite, prismatic gypsum, and 'dolomitic siltstone'.

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TABLE II - X-ray analysis of selected samples

For each sample, the minerals are listed in order of decreasing abundance.

Sample	Depth	Term used in this report	Minerals identified by X-ray
1	556' 6"	Crystalline anhydrite	Anhydrite
2	560' 0"	'Dolomitic siltstone'	Quartz + dolomite
3	560' 0"	Crystalline anhydrite	Anhydrite + quartz + dolomite + gypsum
4	635' 0"	Laminated anhydrite	Anhydrite + gypsum + trace of quartz
5	658'11"	Crystalline anhydrite	Anhydrite + dolomite + quartz
6	759' 3"	'Dolomitic siltstone'	Quartz + dolomite + gypsum + trace of anhydrite
7	763' 0"	'Dolomitic siltstone'	Dolomite + gypsum + quartz
8	763' 0"	Pale blue anhydrite	Anhydrite
9	814' 9"	Crystalline anhydrite	Anhydrite + dolomite + trace of quartz

Analyst: G. Berryman

'Dolomitic siltstone'

The term 'dolomitic siltstone' (or 'siltstone') is used to refer to a dark grey to grey-brown to black, very fine-grained, tough, colour-laminated rock which is almost everywhere brecciated. X-ray analyses of three samples of this rock (Samples 2, 6, and 7 in Table II) indicate that it consists of a mixture of quartz, dolomite, and gypsum, in different proportions from place to place. In some places the rock is a silty dolomite, in others a gypsiferous dolomite. However, it is not possible to determine its composition from field examination alone, and so the term 'dolomitic siltstone' is used to refer to all occurrences of this rock; future work will probably revise most of the applications of this term in the core descriptions. The gamma ray log (Appendix III) indicates that the clay content of the 'siltstone' is very low, close to that of the overlying gypsum and anhydrite.

Claystone

The claystone is grey, soft and friable, non-bedded, calcareous, and generally has thin, uneven, tabular masses of prismatic to acicular gypsum associated with it. The claystone forms discrete interbeds in the core up to 4 feet thick.

The core descriptions, which are given in detail in Appendix II, are summarized below into four sections.

0-107 feet

Cuttings from surface to 85 feet consist of a mixture of colourless, broken prisms of gypsum, and fragments of grey to white, massive, fine-grained gypsum or anhydrite, plus a few small pieces of grey, calcareous claystone. From 85 to 107 feet only fragments of massive gypsum (or anhydrite) and claystone are present.

107-250 feet

The core from 107 to 250 feet is composed mostly of medium to coarse-grained gypsum which almost everywhere carries films and laminae of calcareous clay. In the upper and lower thirds of this interval there are discrete fragments of anhydrite in the gypsum, so that the rock is a breccia, and a 2 foot interval from 135 to 137 feet consists solely of brecciated anhydrite with no gypsum. The middle third of this interval has a fair amount of massive gypsum which is almost free of anhydrite. Throughout the whole interval are nineteen beds of calcareous claystone with associated tabular masses of gypsum. Some claystone beds also carry angular fragments of coarse-grained gypsum, and three of the claystones are accompanied by abundant disseminated pyrite. Euhedral interpenetrating pyritohedral twins of pyrite up to $\frac{1}{2}$ inch across occur in the shaley anhydrite at 110 feet. The core is cut across at a number of places by veins of acicular gypsum.

250-436 feet

From 250 to 436 feet the core consists almost entirely of a mixture of colourless, medium to coarse-grained gypsum and grey laminated anhydrite, in approximately equal amounts. The anhydrite forms large tabular fragments surrounded by the gypsum, and though disturbed to some extent, they still possess a subparallel orientation so that the rock has both a partly bedded and a partly brecciated appearance. Six beds of calcareous claystone are present in this interval, all but one of them accompanied by uneven tabular masses of acicular gypsum. Pyrite occurs only in the uppermost of these six beds, and forms euhedral interpenetrating pyritohedral twins. About a dozen thick veins of coarse-grained, acicular gypsum cut the core; some of them, particularly those near 345 feet, have layers of grey clay up to $\frac{1}{4}$ inch thick along each contact with the enclosing host-rock.

436-852 feet

From 436 to 852 feet the core consists of intervals 20 to 30 feet long composed of gypsum-anhydrite breccia (as above) separated by somewhat shorter intervals of 'dolomitic siltstone'. Disseminated pyrite is an abundant accessory. Most of the 'siltstone' is brecciated, and the fragments are enclosed in a subordinate matrix composed of clear, pale blue anhydrite, or less commonly of white to grey gypsum.

At several places in the core below 511 feet, crystalline anhydrite is present, medium-grained, speckled bluish-grey, and with accessory pyrite. Locally, the core is composed wholly of this rock-type, e.g., at 557 feet (Fig. 5), but usually it forms thin, contorted beds, lenses, or tongues up to 2 inches thick accompanied by fine-grained, laminated anhydrite and white, coarse-grained, massive to acicular gypsum, the three rock-types forming a contorted and interlayered mixture. A $\frac{1}{4}$ inch layer of oriented prismatic gypsum usually separates the crystalline anhydrite from the two other rock-types. At 703 feet pyrite is concentrated along the margins of crystalline anhydrite layers. This mixed and contorted rock forms about eight sporadic but distinctive occurrences in the core, each only a few feet long.

Twenty two beds of calcareous claystone with fragments of coarse-grained gypsum are present below 436 feet; only one claystone contains pyrite, at 772 feet. Cross-cutting veins of gypsum are present in the core, but are far less common below 436 feet than above.

The interval from 830 to 852 feet is represented only by cuttings. While washing one set of these cuttings, a dark brown to black slime collected on the surface of the washing water. Presumably this was organic matter. When the slime was skimmed off, small but clearly visible streaks of oil remained floating on the water.

The results of semi-quantitative spectrographic analysis for potassium and boron in samples of drill core from the Ringwood Dome are presented in Table III. A sample from 820'0" gave the highest values for potassium (0.33%), boron (0.24%) and bromide (10 p.p.m.).*

Table III - Spectrographic analysis of samples of drill core from the Ringwood Dome.

Registered Number	K%	B (p.p.m.)	Depths
68.09.0175	<0.5	50	245'8"/250'4"/255'4"
76	1.0- 0.5	1600	230'2"/235'3"/240'3"
77	<0.5	50	305'1"/310'/314'11"
78	<0.5	50	139'/152'
79	<0.5	100	350'3"/355'5"/360'2"
80	<0.5	30	107'0"/121'2"
81	<0.5	50	122'/137'
82	<0.5	30	152'0"/166'0"
83	<0.5	50	55'0"/58'0"
84	<0.5	30	200'3"/205'/210'5"
85	<0.5	50	215'/220'2"/225'2"
86	<0.5	16	184'11"/190'4"/195'3"
87	<0.5	50	170'4"/175'3"/180'5"
88	<0.5	100	275'2"/280'/285'3"
89	<0.5	160	260'3"/265'2"/270'
90	<0.5	300	290'3"/295'1"/300'
91	<0.5	50	440'0"/443'0"
92	<0.5	100	380'2"/385'0"/390'2"
93	<0.5	500	319'6"/324'11"/330'1"
94	<0.5	160	365'4"/370'2"/375'1"
95	<0.5	100	410'2"/415'0"/420'0"
96	<0.5	160	335'0"/340'5"/345'0"
97	<0.5	50	454'0"/459'11" /465'0"
98	<0.5	<16	425'0"/430'0"/435'4"
68.09.0199	<0.5	50	395'3"/400'0"/405'4"

Small white deposits in some samples were high in calcium, presumably gypsum.

Analyst J. Weekes, B.M.R.

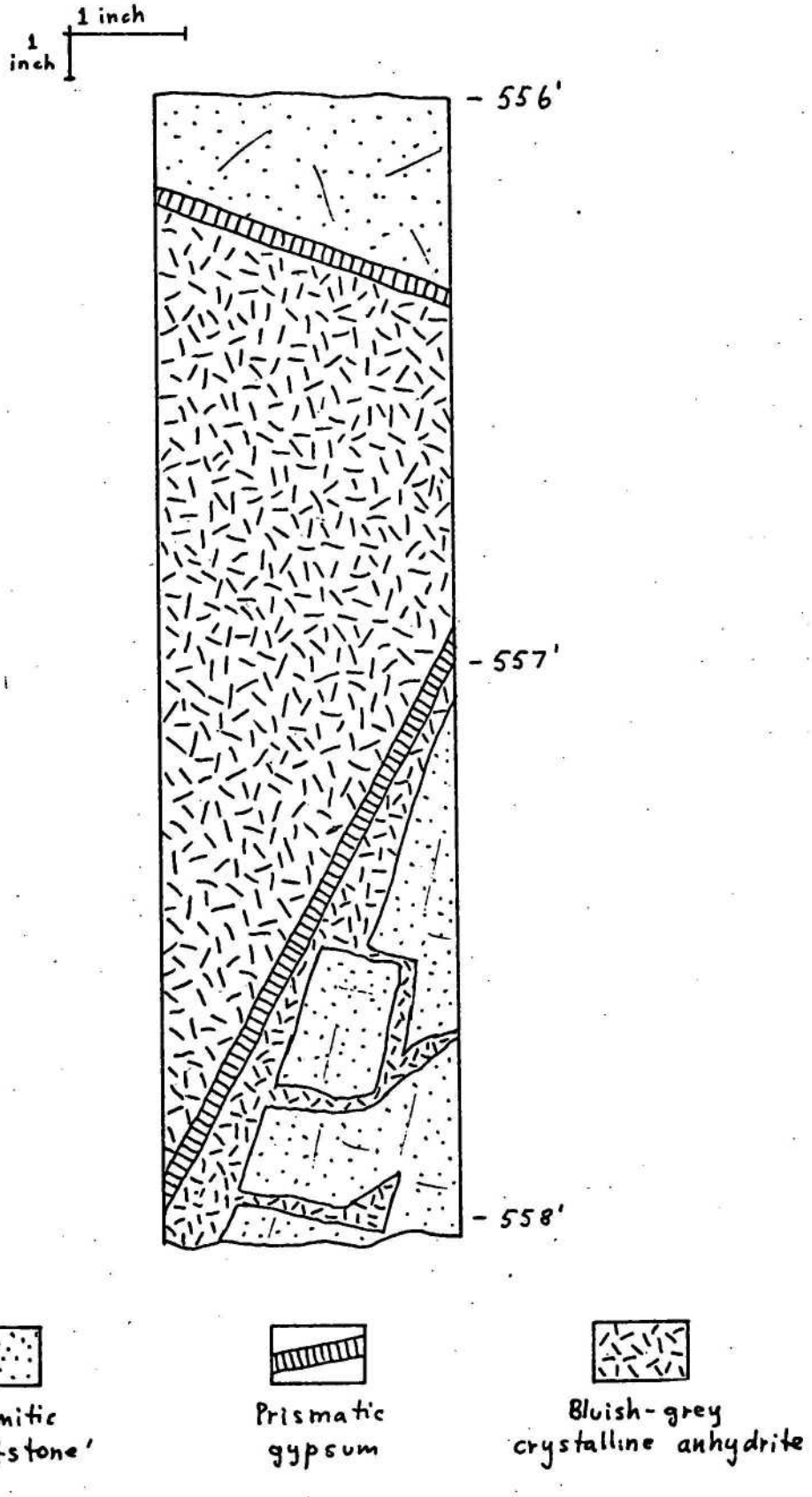

Fig. 5 Sketch of crystalline anhydrite mass in 'dolomitic siltstone' between 556 and 558 feet.

Registered No.	K%	B%	Br (p.p.m.)	Depths
69.66.0500	0.03	<0.005	<5	230'2" - 230'4"
1	0.13	0.02	<5	235'3"- 235'5"
2	0.09	0.03	<5	240'1½"-240'3"
3	0.11	0.01	<5	470'3"
4	0.02	0.005	N	475'0"
5	0.30	0.21	10	480'3"
6	0.02	<0.005	N	485'0"
7	0.04	0.005	N	490'2"
8	0.04	0.01	<5	495'6"
9	0.02	<0.005	N	500'0"/505'1½"
.0510	0.10	0.04	N	510'1"
11	0.03	<0.005	N	515'3"/520'1"/525'1"
12	0.02	<0.005	N	530'½"/535'5"/540'3"
13	0.04	<0.005	N	545'4"/550'4"
14	0.02	0.005	<5	555'4"
15	0.01	<0.005	<5	560'0"
16	0.02	<0.005	N	565'0"/570'6"
17	0.02	<0.005	<5	575'3"
18	0.02	<0.005	5	580'2"
19	0.05	<0.005	N	585'7"/590'1½"/595'5"
.0520	0.05	0.01	N	600'1½"/605'2"/610'0"
21	0.02	<0.005	<5	615'0"
22	0.05	0.02	N	617'0"/622'0"/625'0"
23	0.04	0.01	N	630'3"/635'0"/640'1½"
24	0.02	<0.005	N	646'10"/650'5"/655'0"/660'4"
25	0.09	0.01	N	665'2"/670'0"/675'1"
26	0.03	<0.005	<5	680'0"
27	0.06	0.01	N	685'2"/690'5"
28	0.20	0.15	N	700'0"/705'3"
29	0.04	0.005	N	710'0"/715'1"/720'1"
.0530	0.07	0.005	N	725'0"/730'1"/735'0"
31	0.04	0.005	<5	740'0"/745'1"/750'2"
32	0.05	0.005	<5	755'2"
33	0.02	<0.005	N	760'3"/765'2"
34	0.04	<0.005	N	770'1"/775'3½"
35	0.04	0.005	<5	800'1"
36	0.04	<0.005	N	806'0"/810'0"/815'0"
37	0.33	0.24	10	820'0"
38	0.04	<0.005	N	825'0"/830'0"

Analyses - A.M.D.L. (AN2/1/0 - 312/70)
N - Not determined

Note: The analysis results are for composite samples where two or more depths separated by an oblique stroke are given for one registered sample number.

* See page 16.

The lower limit of detection for the potassium analyses carried out by the B.M.R. was 0.5% whereas the limit for the analyses made by A.M.D.L. was 5 ppm. In addition only the evaporitic part of the core was selected and analysed by B.M.R. whereas the whole core sample was crushed and analysed by A.M.D.L. Hence the A.M.D.L. figures are probably more truly representative of the potassium content of the core and the sampling technique would explain the higher figure for sample 68.09.0175 (0.5 - 1.0% K) compared with samples 69.66.0500 - 0502 (0.03, 0.13, 0.09% K respectively) which were from the same depths.

DISCUSSION AND CONCLUSIONS

In spite of the considerable heterogeneity throughout the Ringwood core, several distinct changes in lithology are evident. They can be summarized thus:

1. 'Dolomitic siltstone' is abundant below 436 feet, but is absent above this depth. Concomitantly, the gypsum-anhydrite breccia, which forms 90% of the core above 436 feet, is reduced to roughly 50% of the core below this depth.

2. Both the massive and acicular gypsum are most abundant in the top 250 feet of core, and their abundances decrease with depth below this level. Acicular gypsum is particularly common in the uppermost 85 feet.

3. Fine-grained, laminated anhydrite is most abundant between 250 and 436 feet.

4. Crystalline anhydrite is only found below 511 feet.

5. Pale blue anhydrite is only found associated with the 'dolomitic siltstone'.

6. Below 436 feet abundant pyrite occurs with the 'dolomitic siltstone', but is almost entirely absent from the claystone. Above 436 feet pyrite is much less abundant, but what pyrite exists is found with the claystone beds.

Origin of the Ringwood evaporite deposit

It is more or less generally accepted that thick marine evaporites form when extensive evaporation of sea-water takes place in a marginal basin which has only a shallow connection with the open ocean across a bar or swell (Borchert & Muir, 1964). In the best known area of this type of deposition, the Zechstein Basin of Western Europe, there are at least three sequences of evaporite deposition. All three have carbonate at the base, commonly bituminous, with limestone at the base of the lowest sequence and dolomite at the base of the second and third.

Each carbonate is overlain by anhydrite and then by halite. Potash and magnesium salts overlie the halite of the second sequence, but are absent from the others. The sequence of carbonate-anhydrite-halite-potash/magnesium salts indicates a continuous increase in the concentration of the evaporating sea-water, and Borchert and Muir have stressed that the most important factor causing this is continuous uplift of the bar or swell at the entrance to the basin, so that the supply of sea-water which enters the basin to replace that lost by evaporation is constantly reduced in amount. If the process is allowed to go to completion, salts rich in potassium chloride precipitate last. Various accidents can interrupt or terminate the ideal sequence, and cyclic deposition, wherein form such sequences as carbonate-anhydrite-carbonate, is also well known, e.g., in the northern Williston Basin of North America (Porter & Fuller, 1959).

The rocks in the Ringwood core appear to conform quite well to the general pattern of marine evaporite deposition. The grey-brown to black 'dolomitic siltstone' in the lower half of the core, accompanied by organic matter and disseminated pyrite, is clearly the sediment deposited when circulation in the basin first became restricted by the rise of the bar or swell at the entrance. As the concentration of the sea-water increased, calcium sulphate precipitated, either as gypsum or anhydrite.

At this stage it is not possible to decide which of these salts formed the initial sulphate deposit at Ringwood. In general, gypsum precipitates when sea-water is concentrated to about $3\frac{1}{2}$ times its normal salinity. Recent experimental work by Hardie and Eugster (1966) indicates that the precipitate will be gypsum at all temperatures up to 57°C (135°F); above this temperature anhydrite will form. Anhydrite can be expected to form at normal temperatures (25°C) only if the sea-water concentration rises to 10 times its normal value, which is close to saturation with halite. Such brines as these occur as ground-water in the coastal plain along part of the Persian Gulf

(Kinsman, 1966), and interstitial anhydrite is forming there at the present time. However, this is not the normal marine evaporite environment. The fine-grained, laminated texture of the anhydrite at Ringwood does suggest a primary origin (though future thin section examination may indicate otherwise). However, even if gypsum did form the primary deposit, the rise in temperature during subsequent burial would convert it to anhydrite (MacDonald, 1953).

The extensively interbedded nature of the sulphate-'dolomitic siltstone'-claystone assemblage indicates a fluctuating environment, but eventually conditions became more stable and only calcium sulphate precipitated, though still accompanied at times by influxes of clay (wind-blown?). The algal limestone which overlies the gypsum indicates that the evaporite deposition was terminated by a fairly sudden return to normal marine conditions, wither because of collapse of the bar or swell at the basin entrance, or because of slight but general subsidence of the whole area.

The distribution of pyrite in the Ringwood evaporite deposit is probably related to the distribution of organic matter. When the ocean circulation became restricted at the start of the marginal basin's history, euxenic conditions existed at the bottom of the basin, but normal marine conditions prevailed elsewhere. Marine organisms (algae) could still exist in the upper part of the water, and after death would sink to the bottom of the basin and provide the bacteria for the reduction of dissolved sulphate to sulphide, which then precipitated as pyrite by reaction with dissolved iron. Pyrite is thus associated with the dark 'dolomitic siltstone', and its absence from the claystones in this part of the core may have resulted from the depletion of dissolved iron due to its removal as pyrite in the 'siltstone'. As evaporation proceeded, the water became too saline for algae to exist, and the only organic matter available would have been that which blew into the basin with the windblown clay, and so pyrite would only form during times of clay deposition.

The reduction of sulphate to sulphide is accompanied by the oxidation of organic matter to carbon dioxide and water. The carbon dioxide would react with dissolved calcium and precipitate as calcium carbonate, thus accounting for the calcite in the claystones, particularly in the later stage of evaporation, when only calcium sulphate was precipitating directly from solution.

Metamorphism

A distinctive feature of the Ringwood core is the evidence of metamorphic changes. For example, both forms of gypsum, the massive and the acicular, are most abundant in the upper part of the core, and become less abundant with increasing depth, whereas anhydrite becomes more abundant with depth. This indicates that the massive gypsum has formed by hydration of the anhydrite, presumably by reaction with ground-water, at the present location of the salt body, and this process of replacement could account for the partly bedded, partly brecciated appearance of the gypsum-anhydrite rock, in that the anhydrite fragments are remnants not yet replaced by gypsum. Later, the gypsum was mobilized locally and recrystallized to form the veins of acicular gypsum which cross-cut all the pre-existing rocks.

The crystalline anhydrite, with its lineated texture, probably formed by mobilization and recrystallization of the fine-grained, laminated anhydrite, and the coarsely crystalline and in places poikilitic texture of the blue anhydrite matrix of the 'siltstone' breccia also indicates recrystallization of anhydrite. The colour of the blue anhydrite may be the result of irradiation from occluded radioactive elements (Przibram, 1956).

There is also evidence to suggest that metamorphic differentiation has taken place in the rocks of the Ringwood core. This includes phenomena such as the layers of grey clay along the margins of some of the cross-cutting veins of acicular gypsum, and the concentrations of pyrite along the margins of crystalline anhydrite layers

at 703 feet. The uneven, tabular masses of prismatic to acicular gypsum associated with the gypsum beds may also have formed by metamorphic differentiation and recrystallization of an originally more intimate mixture of gypsum and clay. The interpenetrating twins of pyrite are presumably growth twins which may also have formed by the recrystallization of disseminated pyrite.

Summary of Geological History

The geological history of the Ringwood Dome area can be summarized as follows:

1. Formation of basin with restricted circulation on margin of Late Precambrian Bitter Springs sea; deposition in this basin of 'dolomitic siltstone', then calcium sulphate, possibly as anhydrite; return to normal marine conditions, deposition of algal limestone.

2. Burial of Bitter Springs sediments beneath remainder of Amadeus Basin sequence; conversion of any existing gypsum to anhydrite.

3. Tectonic transport of evaporite deposit sometime during the late Devonian or Carboniferous, either within thrust slice or gravity slide; concomitant folding of Bitter Springs Formation, formation of Ringwood Dome, brecciation of 'siltstone', contortion of evaporites, mobilization and recrystallization of anhydrite.

4. Erosion to present day; hydration of anhydrite to gypsum in upper part of evaporite body, recrystallization of gypsum to form veins of satin-spar, exposure of salt body beneath limestone capping.

Thus, the salts in the centre of the Ringwood Dome appear to be the product of typical marine evaporite deposition and recrystallization. The formation of these evaporites so long in advance of Palaeozoic time is of considerable interest to theories of atmospheric evolution (Cloud, 1968).

ACKNOWLEDGEMENTS

The author wishes to thank Mr and Mrs M. Collings of Ringwood Station and Mr R. Peters of Todd River Station for their hospitality and assistance during the drilling. He also wishes to acknowledge the assistance of Mr Andrew Glikson, who acted as well-site geologist for one week, and first recognized anhydrite in the drill core.

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ADDENDUM

After this report was completed, it occurred to me that the massive algal limestone capping the Ringwood Dome might be part of a stromatolitic algal reef, and that the friable limestone and limestone breccia on the northern and western flanks of the dome might be the talus slopes of this reef. If this is so, the gypsum and anhydrite in the core of the dome constitute a 'back-reef' evaporite deposit, and the dolomite, siltstone, and sandstone on the southern flank of the dome are the sediments deposited on the landward side of the 'back-reef' basin (Fig. 6). The algal limestone now overlies the evaporite, indicating that the reef migrated laterally with time, presumably in response to a southward marine transgression across a gently north-sloping and subsiding land surface. However, the dolomite and clastics of the southern flank of the dome dip to the south, and so cannot be the landward sediments of this transgression; they could however, be the landward sediments deposited during subsequent regression to the north. The evaporite deposit would therefore be a lens (Fig. 7a) with the Ringwood Dome situated near its southern margin (Fig. 7b). The narrow eastern end of the gypsum outcrop at Ringwood may be the actual edge of this lens, implying that this part of the anticline plunges west, not east as suggested earlier. As there is no evaporite above the algal limestone, the northward regression may have taken place in response to elevation of a virtually horizontal sea-floor, where no reef formed and the terrigenous clastics interfingered directly with normal marine limestone.

A.J.S. September 1969

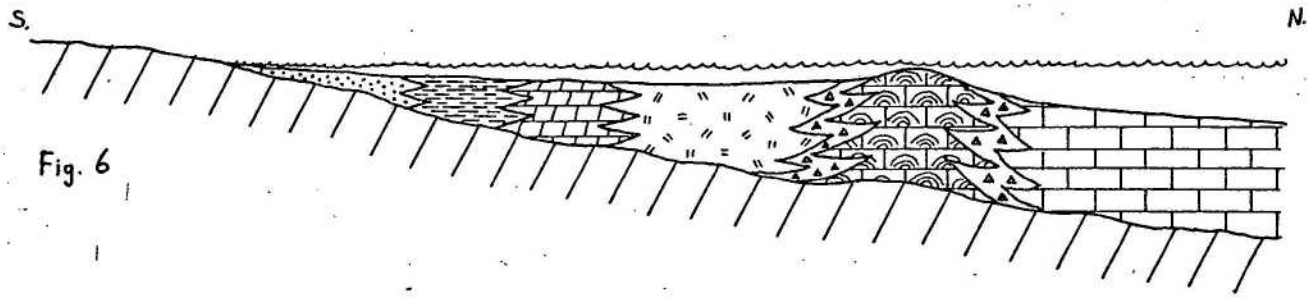

Fig. 6

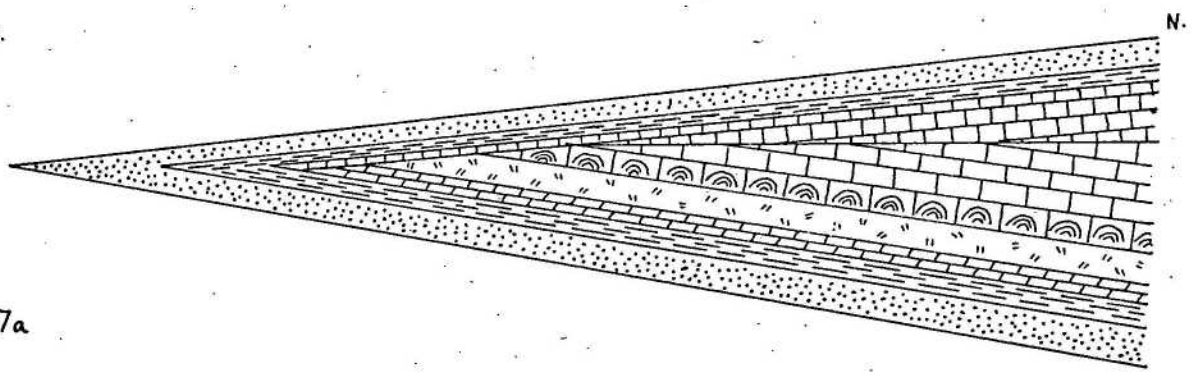

Fig. 7a

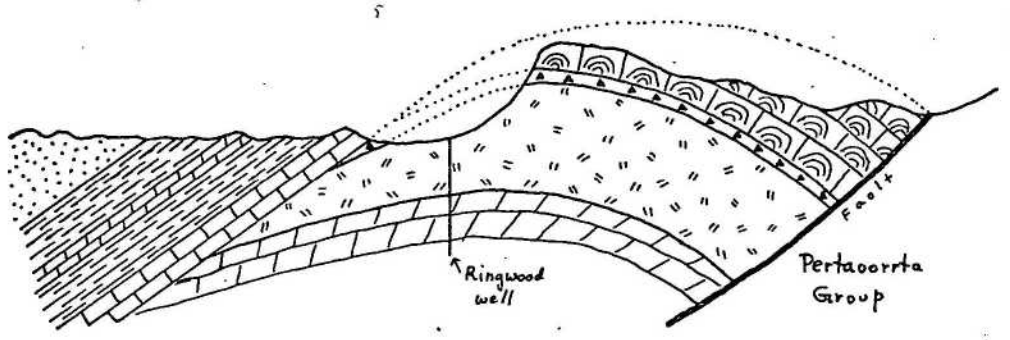

Fig. 7b

Lithologic Reference

Old land surface | Sandstone | Siltstone | Dolomite

Limestone | Algal limestone | Brecciated and contorted limestone | Evaporite

APPENDIX I

CUTTINGS DESCRIPTIONS

0' - 5'	Earthy gypsum, 95%; white to cream, fine-grained, porous to compact, hackly. Limestone, 2%; grey to red, fine-grained. Acicular gypsum, 1%; colourless cleavage fragments. Anhydrite, 1%; grey, fine-grained. Travertine, 1%; white to cream, fine-grained.
5' - 10'	Acicular gypsum, 92%; colourless to pale yellow, thin broken prisms. Earthy gypsum, 5%; cream to yellow, fine-grained. Limestone, 1%; yellow-brown, fine-grained. Anhydrite, 1%; pale grey, fine-grained, calcareous. Chert, 1%; grey to red.
10' - 15'	Gypsum or anhydrite, 50%; pale to dark grey, fine-grained, massive. Acicular gypsum, 40%; colourless to pale yellow, thin broken prisms. Anhydrite, 10%; pale grey, fine-grained, calcareous. Limestone, 1%; cream, fine-grained.
15' - 20'	Acicular gypsum, 50%; colourless broken prisms. Gypsum or anhydrite, 40%; white to cream, fine-grained, massive. Claystone, 6%; pale grey, calcareous. Shale, 3%; dark grey. Limestone, 1%; cream to white, fine-grained, massive.
20' - 25'	Gypsum or anhydrite, 60%; pale grey to white, fine-grained, massive. Acicular gypsum, 22%; colourless broken prisms. Shale, 17%; pale grey, calcareous (10%), dark grey non-calcareous (5%), black, pyritic (2%). Chert, 1%; dark brown Limestone, <1%; cream.
25' - 30'	Gypsum or anhydrite, 50%; pale grey to white, fine-grained, massive. Acicular gypsum, 40%; colourless broken prisms. Claystone, 5%; pale grey, calcareous. Dolomite, 5%; grey-brown.
30' - 35'	Acicular gypsum, 70%; colourless prisms. Gypsum or anhydrite, 25%; colourless, fine-grained, massive. Claystone, 3%; pale grey, calcareous. Anhydrite, 2%; dirty grey, massive.

35' - 40' Acicular gypsum, 50%; colourless broken prisms.
Gypsum or anhydrite, 45%; colourless to dirty grey, fine-grained, massive.
Shale, 5%; pale grey, calcareous.

40' - 45' Acicular gypsum, 35%; colourless prisms.
Gypsum or anhydrite, 35%; colourless, fine-grained, massive.
Shale, 30%; pale to dark grey, calcareous.

45' - 50' Acicular gypsum, 50%;colourless prisms
Gypsum or anhydrite, 44%;colourless, fine-grained, massive.
Shale or claystone, 5%; pale grey, calcareous.
Dolomite, 1%; grey-brown.

50' - 55' No sample available.

55' - 60' Acicular gypsum, 60%; colourless prisms.
Anhydrite, 30%; grey, calcareous.
Shale or claystone, 8%; pale grey calcareous.
Gypsum or anhydrite, 2%; white, massive.

60' - 65' Gypsum or anhydrite, 50%; colourless to pale grey, fine-grained, massive.
Acicular gypsum, 40%; colourless prisms.
Shale or claystone, 10%; pale grey, calcareous; black (<1%).

65' - 70' Gypsum or anhydrite, 53%; colourless, fine-grained,
Acicular gypsum, 30%; colourless prisms.
Claystone, 16%; pale grey, calcareous (8%); non-calcareous (7%); black (1%).
Dolomite, 1%; brown.

70' - 75' Gypsum or anhydrite, 52%; colourless, fine-grained, massive.
Acicular gypsum, 40%; colourless prisms.
Claystone, 8%; pale grey, calcareous (5%), non-calcareous (3%).

75' - 80' Gypsum or anhydrite, 59%; pale grey, fine-grained, massive.
Acicular gypsum, 20%; colourless prisms.
Claystone, 20%; pale grey, calcareous.
Anhydrite, 1%; dark grey, calcareous.

80' - 85' Gypsum or anhydrite, 70%; very pale grey, fine-grained, massive.
Acicular gypsum, 15%; colourless needles.
Claystone, 15%; pale blue-grey, calcareous.
Pyrite, <1%; minute pyritohedra.

85' - 95' Gypsum or anhydrite, 70%; pale grey, fine-grained, massive.
Claystone, 30%, pale grey, calcareous.

95' - 107' Gypsum or anhydrite, 70%; pale grey, fine-grained, massive.
Claystone, 30%; pale blue-grey, calcareous.

Continuous core from 107 feet to 830 feet.

830' - 835' 'Siltstone', 97%; pale grey to dark grey, fine-grained, massive to laminated, dolomitic.
Claystone, 2%; grey, calcareous.
Acicular gypsum, 1%; colourless prisms.

835' - 840' 'Siltstone',88%; grey, fine-grained, laminated, dolomitic.
Gypsum, 10%; white, fine-grained, massive.
Acicular gypsum, 2%; colourless needles.

840' - 845' 'Siltstone',90%; grey, fine-grained, laminated, dolomitic.
Gypsum, 7%; white, fine-grained, massive.
Claystone, 2%; grey calcareous.
Acicular gypsum, 1%; colourless prismatic needles.

845' - 850' 'Siltstone',94%; grey, fine-grained, laminated, dolomitic, pyritic.
Claystone, 5%; grey, calcareous.
Acicular gypsum, 1%; colourless needles.

850' - 852' 'Siltstone', 94%; grey, fine-grained, laminated, dolomitic.
Gypsum, 5%; white, fine-grained, massive.
Acicular gypsum, 1%; colourless needles.

APPENDIX II

CORE DESCRIPTIONS

Core No. 1.

Interval: 55' 0" - 58' 0" Cut: 3' Recovered: 3'

Description:

55' 0" - 55' 6" : Dark grey calcareous shale cut by ¼" veins of white medium-grained acicular gypsum.

55' 6" - 56' 3" : Breccia consisting of fragments of grey fine-grained laminated calcareous anhydrite in matrix of white medium to fine-grained gypsum.

56' 3" - 58' 0" : Partly bedded breccia of grey laminated calcareous anhydrite fragments in matrix of white fine to medium-grained gypsum. Some cross-cutting veins of white coarse-grained gypsum, partly acicular.

Core No. 2.

Interval: 107' 0" - 121' 2" Cut: 14' 2" Recovered: 14' 2"

Description:

107' 0" - 107' 6" : Breccia consisting of fragments of grey laminated partly calcareous anhydrite in matrix of white coarse-grained acicular gypsum.

107' 6" - 110' 4" : Coarse-grained acicular gypsum with ¼" interbeds, partly brecciated, of grey laminated anhydrite with euhedral interpenetrating pyritohedral twins of pyrite.

110' 4" - 111' 0" : Grey fine-grained gypsum with laminae of grey calcareous clay and anhydrite (some fragments). Cross-cutting veins of white coarse-grained gypsum.

111' 0" - 113' 4" : Grey acicular gypsum with disturbed interbeds of grey laminated anhydrite.

113' 4" - 114' 4" : Grey fine-grained laminated anhydrite cut by veins of acicular gypsum and pale grey calcareous clay.

114' 4" - 121' 2" : Grey medium to coarse-grained dirty gypsum containing fragments of interlaminated anhydrite and gypsum. Several inches of grey calcareous pyritic clay at 119' with included fragments of gypsum; stringers of clay elsewhere. A few cross-cutting veins of coarse-grained gypsum.

Core No. 3.

Interval: 122' 0" - 137' 0" Cut: 15' Recovered: 15'

Description:

122' 0" - 124' 6" : Medium to coarse-grained dirty gypsum containing disturbed fragments of grey calcareous anhydrite.

124' 6" - 125' 8" : Grey fine-grained laminated anhydrite with interbeds of soft grey calcareous claystone and veins of white coarse-grained gypsum.

125' 8" - 137' 0" : Grey medium to coarse-grained dirty gypsum with fragments of fine-grained anhydrite and laminae of calcareous clay. Several veins of white coarse-grained gypsum. Bottom 2' of anhydrite brecciated.

Core No. 4.

Interval: 139' 0" - 152' 0" Cut: 13' Recovered: 13'

Description:

139' 0" - 140' 0" : Fragments of grey calcareous anhydrite in matrix of white coarse-grained gypsum.

140' 0" - 141' 1" : Grey to white mottled gypsum, medium to coarse-grained, massive.

141' 1" - 145' 3" : Grey calcareous claystone, pyritic in places, with abundant veins and crystals of gypsum.

145' 3" - 146' 0" : Dirty grey coarse-grained clayey gypsum with some veins of white acicular gypsum.

146' 0" - 148' 0" : Grey calcareous claystone, gypsiferous, cut by thick vein of white acicular gypsum.

148' 0" - 148' 6" : Grey dirty coarse-grained gypsum.

148' 6" - 150' 9" : Grey fine to medium-grained gypsum containing convoluted fragments of soft grey calcareous claystone.

150' 9" - 152' 0" : Dirty medium to coarse-grained gypsum, nearly massive, some faint lamination.

Core No. 5.

Interval: 152' 0" - 166' 0" Cut: 14' Recovered: 14'

Description:

152' 0" - 152' 6" : Tough, medium to coarse-grained massive white gypsum, acicular in places.

152' 6" - 156' 0" : Grey medium-grained gypsum with laminae of grey anhydrite. Some angular fragments of dark grey shale at bottom.

156' 0" - 156'10" : Soft grey calcareous clay.

156'10" - 157' 7" : Grey medium-grained gypsum with thin laminae of anhydrite.

157' 7" - 158' 2" : Medium-grained gypsum, dirty.

158' 2" - 159' 8" : Grey calcareous shale with scattered gypsum crystals.

159' 8" - 160' 6" : Grey medium-grained gypsum with thin laminae of anhydrite

160' 6" - 161' 4" : Grey calcareous dirty anhydrite.
161' 4" - 164' 0" : Grey medium to coarse-grained gypsum with thin contorted laminae of shale.
164' 0" - 166' 0" : Grey to white medium to coarse-grained massive gypsum.

Core No. 6.

Interval: 170' 4" - 181'10" Cut: 11' 6" Recovered: 11' 6"

Description:

170' 4" - 170'10" : Grey calcareous claystone cut by thick uneven tabular masses of acicular gypsum.
170'10" - 174' 3" : Grey medium-grained massive gypsum with a few disturbed laminae of anhydrite.
174' 3" - 174'11" : Dark grey calcareous claystone with fragments of white coarse-grained gypsum.
174'11" - 177' 9" : Grey medium to coarse-grained massive gypsum with a few laminae of dark grey calcareous shale.
177' 9" - 178' 8" : Breccia of angular fragments of grey laminated calcareous claystone in matrix of white coarse-grained gypsum.
178' 8" - 181' 8" : Grey calcareous claystone with thin tabular masses of white medium-grained gypsum.
181' 8" - 181'10" : Pale grey medium to coarse-grained gypsum with contorted anhydrite laminae. Fragments derived from overlying claystone at top.

Core No. 7.

Interval: 182' 0" - 197' 0" Cut: 15' Recovered: 15'

Description:

182' 0" - 182' 9" : Grey medium-grained massive gypsum with thin laminae of anhydrite, much contorted at bottom.
182' 9" - 183' 6" : Large angular fragments of grey laminated calcareous anhydrite in matrix of white coarse-grained gypsum. Black pyritic shale present in bottom 3".
183' 6" - 187' 6" : Grey medium to coarse-grained massive gypsum with thin contorted streaks and laminae of grey anhydrite. Fragments of anhydrite in lowest 6".
187' 6" - 192' 6" : Grey calcareous massive claystone containing angular fragments of white coarse-grained gypsum and grey fine-grained anhydrite. Some short uneven tabular masses of coarse-grained gypsum.
192' 6" - 196' 0" : Grey medium-grained massive gypsum with numerous uneven laminae of dark grey anhydrite. Two thin beds of grey calcareous clay in lower part, the upper one with gypsum fragments. Some cross-cutting veins of coarse-grained gypsum.
196' 0" - 197' 0" : Grey massive calcareous claystone with fragments of white gypsum and some cross-cutting gypsum veins.

Core No. 8.

Interval: 197' 0" - 212' 4" Cut: 15'4" Recovered: 15' 4"

Description:

197' 0" - 199' 6" : Grey medium to coarse-grained massive gypsum with thin laminae and a few fragments of grey laminated calcareous anhydrite.

199' 6" - 199' 8" : Grey calcareous claystone cut by $\frac{1}{4}$" tabular masses of white coarse-grained gypsum.

199' 8" - 200' 4" : Grey medium-grained laminated gypsum with a few streaks of calcareous anhydrite.

200' 4" - 200' 8" : Grey calcareous clay with a few fragments of tough grey laminated calcareous anhydrite. Apophyses of clay intrude underlying gypsum.

200' 8" - 201' 0" : Grey nearly massive gypsum vaguely laminated and brecciated, containing a few fragments of grey calcareous clay.

201' 0" - 209' 0" : Grey medium-grained gypsum, virtually massive, containing small streaks and fragments of grey anhydrite.

209' 0" - 209'10" : Mixed rock of pale grey medium-grained gypsum, dark grey calcareous claystone, and anhydrite, with cross-cutting veins of white coarse-grained gypsum.

209'10" - 210' 5" : Grey medium-grained gypsum with a few laminae of grey anhydrite.

210' 5" - 211' 9" : Grey calcareous claystone containing fragments and vein-like masses of white coarse-grained gypsum.

211' 9" - 212' 4" : Grey medium-grained poorly laminated gypsum.

Core No. 9.

Interval: 212' 4" - 226' 4" Cut: 14' Recovered: 14'

Description:

212' 4" - 213' 5" : Grey medium to coarse-grained gypsum with abundant contorted laminae of calcareous anhydrite.

213' 5" - 213' 9" : Pale grey calcareous claystone cut by anastomosing tabular masses $\frac{1}{2}$" thick of white coarse-grained gypsum.

213' 9" - 214' 0" : Interlaminated grey gypsum and calcareous anhydrite.

214' 0" - 215' 6" : Mixed rock consisting of abundant crowded fragments of gypsum in dark grey calcareous claystone.

215' 6" - 216' 3" : Large (4") fragments of gypsum in grey calcareous clay, with some veins of white gypsum.

216' 3" - 219' 0" : Mixed rock consisting of dirty grey gypsum with abundant fragments and laminae of dark grey anhydrite and with a few 1" beds of anhydrite crowded with gypsum fragments.

219' 0" - 220'10" : Grey medium-grained gypsum with large (6") pieces and smaller streaks of grey slightly calcareous anhydrite and claystone.

220'10" - 223'11" : Dark grey to black massive pyritic calcareous claystone, very tough, cut by $\frac{1}{8}$" veins of white coarse gypsum. Pyrite finely disseminated and abundant.

223'11" - 226' 4" : Interlaminated gypsum and anhydrite, the anhydrite laminae brecciated.

Core No. 10.

Interval: 230' 2" - 242' 0" Cut: 11'10" Recovered: 11'10"

Description:

230' 2" - 239'10" : Grey medium to coarse-grained massive gypsum, with some 6" fragments of laminated anhydrite and some streaks and small pieces of dark grey calcareous clay.

239'10" - 241' 2" : Dark grey calcareous claystone with fragments and veins of white coarse-grained gypsum and some fragments of medium-grained laminated gypsum.

241' 2" - 242' 0" : Fine to medium-grained laminated contorted gypsum with $\frac{1}{8}$" clots of grey calcareous clay.

Core No. 11.

Interval: 242' 0" - 256' 0" Cut: 14' 0" Recovered: 14' 0"

Description:

242' 0" - 242'10" : Grey medium-grained massive gypsum.

242'10" - 251' 7" : Interlaminated gypsum and calcareous anhydrite, in places brecciated. Top 12" consists of fragments of grey laminated anhydrite and coarse white gypsum in dark grey calcareous clay.

251' 7" - 253' 3" : Grey calcareous shale and claystone cut by veins of coarse white gypsum. Clay contains abundant interpenetrating pyritohedral twins of pyrite.

253' 3" - 254' 3" : Grey massive gypsum with a few contorted and broken laminae of calcareous anhydrite.

254' 3" - 255' 9" : Intermixed grey calcareous clay and tabular masses of white coarse-grained gypsum.

255' 9" - 256' 0" : Intermixed medium-grained gypsum and fine-grained anhydrite.

Core No. 12.

Interval: 256' 0" - 271' 0" Cut: 15' Recovered: 15'

Description:

256' 0" - 264' 0" : Interlaminated white medium to coarse-grained gypsum and grey fine-grained anhydrite. Contorted laminae of grey calcareous claystone in lower 4'.

264' 0" - 267' 6" : Mixed rock consisting of 1" pieces of calcareous claystone and fine-grained calcareous anhydrite in matrix of white coarse-grained gypsum.

267' 6" - 271' 0" : White to pale grey massive to laminated gypsum. Few inches of shale and calcareous anhydrite at 268' 3", and 4" of grey calcareous claystone and coarse white gypsum at 196' 6". Bottom 2" has large pieces of calcareous anhydrite and claystone in the gypsum.

Core No. 13.

Interval: 274' 0" - 285' 6" Cut: 11' 6" Recovered: 11' 6"

Description:

274' 0" - 278' 0" : Interbedded grey medium-grained anhydrite and white medium to coarse-grained gypsum, contorted. 1" vein of pure acicular gypsum at 274'. A few contorted streaks of calcareous clay.

278' 0" - 285' 6" : Breccia consisting of abundant fragments of tough grey slightly calcareous anhydrite in subordinate matrix of white coarse grained gypsum, plus fairly abundant streaks and wisps of calcareous clay. 1" vein of acicular gypsum at 282' 8".

Core No. 14.

Interval: 286' 6" - 300' 0" Cut: 13' 6" Recovered: 13' 6"

Description:

286' 0" - 298' 0" : Abundant pieces of pale grey slightly calcareous anhydrite in subordinate matrix of medium to coarse-grained gypsum with small streaks of calcareous claystone. Two cross-cutting 1" veins of acicular gypsum at 292' 0" and 294' 9".

298' 0" - 299' 0" : Abundant fragments of coarse white gypsum and a few of laminated anhydrite in matrix of calcareous claystone.

299' 0" - 300' 0" : Brecciated gypsum, grey to white, fine to medium-grained, laminated.

Core No. 15.

Interval: 300' 0" - 314'11" Cut: 14'11" Recovered: 14'11"

Description:

300' 0" - 302' 0" : Interbedded grey laminated anhydrite and medium to coarse-grained gypsum, with a few contorted laminae of calcareous claystone. Thick vein of acicular gypsum at 301'10".

302' 0" - 303' 9" : Irregularly interbedded grey calcareous clay and thick tabular masses of white coarse-grained gypsum.

303' 9" - 307'10" : Thinly interbedded fine-grained anhydrite and acicular coarse-grained gypsum. Bedding steep and regular.

307'10" - 308' 0" : Contorted interbedded gypsum and grey calcareous clay.

308' 0" - 309' 0" : Mottled mixture of white gypsum and grey anhydrite.

309' 0" - 314'11" : Thin-bedded grey fine-grained anhydrite and colourless coarse-grained gypsum. 8" of grey calcareous clay with tabular masses of coarse-grained gypsum at 311' 4".

Core No. 16

Interval: 317' 0" - 331' 6" Cut: 14' 6" Recovered: 14' 6"

317' 0" - 323' 0" : Laminated to thin-bedded grey fine-grained anhydrite and medium to coarse -grained gypsum. Locally contorted. Stringers of calcareous clay at 317' 3" and 320' 6".

323' 0" - 330' 0": Interbedded grey calcareous clay, anhydrite, and white coarse-grained gypsum.

330' 0" - 331' 6" : Slightly contorted grey laminated anhydrite and medium to coarse-grained gypsum.

Core No. 17

Interval: 331' 6" - 346' 6" Cut: 15' Recovered: 15'

Description:

331' 6" - 346' 6" : Interbedded grey laminated anhydrite and white medium to coarse-grained gypsum. A few laminae of calcareous clay, especially abundant from 332' to 334'. 4" vein of acicular gypsum at 338' 5", and thinner ones elsewhere with films of clay along their margins. Bedding contorted from 331' to 338', elsewhere regular.

Core No. 18

Interval: 346' 6" - 361' 6" Cut: 15' Recovered: 15'

Description:

346' 6" - 361' 6" : Interbedded and partly brecciated grey fine-grained laminated anhydrite and white medium to coarse-grained gypsum, with calcareous clay films and laminae. Cross-cutting veins of gypsum in uppermost 3'. Bedding contorted from 352' to 361', elsewhere regular. Few inches of calcareous clay at 360'.

Core No. 19

Interval: 361' 6" - 376' 6" Cut: 15' Recovered: 15'

Description:

361' 6" - 364' 0" : Grey dirty medium to coarse-grained gypsum, mostly massive, faintly contorted in a few places.

364' 0" - 367' 0" : Severely contorted interbedded grey laminated to thin-bedded anhydrite and white coarse-grained gypsum, with some calcareous clay.

367' 0" - 368' 0" : Mottled grey gypsum, nearly massive, with a few dark laminae of anhydrite.

368' 0" - 372' 6" : Contorted interbedded grey anhydrite, white medium to coarse-grained gypsum, and some films of grey clay. Cross-cutting vein of acicular gypsum at 372' 1".

372' 6" - 375' 0" : Mottled contorted anhydrite, grey and laminated, and gypsum, medium to coarse-grained.

375' 0" - 376' 6" : Interbedded severely contorted grey anhydrite (partly calcareous) and white coarse-grained gypsum.

Core No. 20

Interval: 376' 6" - 391' 0" Cut: 14' 6" Recovered: 14' 6"

Description:

Core very fractured when elevator plug failed and drill string dropped 75' to bottom of hole.

376' 6" - 384' 0" : Interbedded grey laminated fine-grained anhydrite and white, coarse-grained gypsum, with regular steep dip.

384' 0" - 391' 0" : Interbedded pale grey anhydrite, medium-grained massive gypsum, and white coarse-grained acicular gypsum, with rare streaks of grey calcareous clay.

Core No. 21

Interval: 391' 4" - 406' 0" Cut: 14' 8" Recovered: 14' 8"

Description:

391' 4" - 396' 0" : Mottled mixture of grey laminated anhydrite and white fine to medium-grained gypsum, with some grey calcareous clay. Bedding generally steep, contorted between 394' and 395'.

396' 0" - 400' 0" : Mottled mixture of grey anhydrite and white gypsum, generally massive, some lamination in places.

400' 0" - 406' 0" : Interbedded contorted grey laminated anhydrite white coarse-grained gypsum, and a few laminae of grey calcareous clay. Anhydrite commonly veined by the gypsum.

Core No. 22

Interval: 407' - 422' Cut: 15' Recovered: 15'

Description:

407' 0" - 416' 3" : Mottled to streaky grey fine-grained anhydrite and white fine-grained gypsum which contains numerous laminae of grey non-calcareous shale. Numerous cross-cutting veins up to 2" thick of pure white acicular gypsum.

416' 3" - 416' 8" : Contorted interbedded pale grey calcareous clay and white coarse-grained gypsum.

416' 8" - 422' 0" : Mottled and streaky grey anhydrite and white gypsum with shale laminae and specks of calcareous clay. Brecciated and contorted from 420' to 422'.

Core No. 23

Interval: 422' 0" - 437' 0" Cut: 15' Recovered: 15'

Description:

422' 0" - 425' 6" : Interbedded grey laminated fine-grained anhydrite and white medium-grained gypsum, with films of grey calcareous clay. Several cross-cutting veins (1") of coarse-grained acicular gypsum.

425' 6" - 426'10" : Contorted interbedded grey laminated to thin-bedded anhydrite, white gypsum, and pale grey calcareous clay.

426'10" - 436' 4" : Regularly interbedded grey anhydrite and white gypsum, with a few laminae of calcareous clay at 435'. Some anhydrite laminae brecciated. Numerous veins of acicular gypsum.

436' 4" - 437' 0" : Grey very fine-grained 'siltstone' cut by veins of white medium-grained gypsum. Some streaks of dark grey calcareous clay.

Core No. 24

Interval: 437' 0" - 452' 0" Cut: 15' Recovered: 6'

Description:

437' 0" - 438' 6" : Grey very fine-grained 'siltstone' cut by veins of white medium-grained gypsum. Some streaks of dark grey calcareous clay.

438' 6" - 439' 3" : Mottled mixture of grey anhydrite and white fine to medium-grained gypsum.

439' 3" - 442' 0" : Grey calcareous claystone with $\frac{1}{8}$" veins of gypsum.

442' 0" - 443' 0" : Grey laminated 'siltstone' very tough, brecciated in places.

443' 0" - 452' 0" : No recovery.

Core No. 25

Interval: 454' 0" - 465' 0" Cut: 11' Recovered: 11'

Description:

454' 0" - 457' 0" : Grey calcareous claystone with veins of white medium-grained gypsum.

457' 0" - 458' 0" : White coarse-grained gypsum with laminae of dark grey calcareous clay.

458' 0" - 462' 8" : Interbedded grey laminated anhydrite and white gypsum. Anhydrite laminae commonly broken, and brecciated from 459' to 460'.
462' 8" - 464' 0" : Interbedded grey calcareous clay and white coarse-grained acicular gypsum.
464' 0" - 465' 0" : Very tough laminated 'dolomitic siltstone'.

Core No. 26

Interval: 465' 0" - 473' 0" Cut: 8' Recovered: 8'

Description:

465' 0 " - 467' 6" : Very tough grey laminated 'dolomitic siltstone', evenly bedded, with a few thin veins of medium-grained anhydrite. Some disseminated pyrite.
467' 6" - 468' 6" : Tough 'siltstone' cut by $\frac{1}{4}$" veins of white gypsum.
468' 6" - 471' 0" : Interbedded white medium to coarse-grained gypsum and grey fine-grained shaley anhydrite, non-calcareous except for a few darker calcareous laminae in places.
471' 0" - 473' 0" : Very tough 'dolomitic siltstone', pyritic in places, cut by thin ($\frac{1}{16}$") veins of gypsum.

Core No. 27

Interval: 473' 0" - 482' 0" Cut: 9' Recovered: 9'

Description:

473' 0" - 478' 3" : Tough 'dolomitic siltstone' cut by a few veins of white gypsum. Lowest 2' brecciated, with very subordinate matrix of white crystalline gypsum or anhydrite.
478' 3" - 482' 0" : Brecciated grey calcareous claystone with irregular concretions of gypsum.

Core No. 28

Interval: 483' 0" - 492' 0" Cut: 9' Recovered: 9'

Description:

483' 0" - 489' 0" : Tough 'dolomitic siltstone', very fine-grained, with faint contorted colour-lamination. 3" of white gypsum and calcareous clay at 483' 3".
489' 0" - 491' 0" : Interbedded grey laminated anhydrite and white medium-grained gypsum, with a few dark grey laminae of calcareous clay.
491' 0" - 492' 0" : Tough 'dolomitic siltstone' with a few laminae of calcareous claystone and cross-cutting veins of gypsum.

Core No. 29

Interval: 492' 0" - 506' 0" Cut: 14' Recovered: 14'

Description:

492' 0" - 496' 0" : Tough laminated 'dolomitic siltstone' with a few cross-cutting veins of white coarse-grained gypsum.

496' 0" - 497' 3" : Grey calcareous clay with tabular masses of white coarse-grained gypsum.

497' 3" - 500' 0" : Tough grey brecciated 'dolomitic siltstone' with very subordinate matrix of white to pale bluish-grey anhydrite; some finely disseminated pyrite present.

500' 0" - 502' 0" : Interlaminated and contorted grey calcareous clay and white medium-grained gypsum.

502' 0" - 506' 0" : Tough grey brecciated 'dolomitic siltstone', faintly convoluted in places, with very subordinate matrix of white to grey coarse-grained gypsum.

Core No. 30

Interval: 506' 0" - 512' 0" Cut: 6' Recovered: 6'

Description:

506' 0" - 507' 9" : Tough grey brecciated 'dolomitic siltstone',in places faintly convoluted, with very subordinate matrix of white to grey gypsum.

507' 9" - 510' 0" : Brecciated grey calcareous claystone with irregular concretions of gypsum.

510' 0" - 512' 0" : Tough grey laminated 'siltstone', partly brecciated, with enclosed irregular bodies of greyish-blue crystalline anhydrite; a complete shell of prismatic gypsum surrounds each anhydrite body, separating it from the 'siltstone'.

Core No. 31

Interval: 512' 0" - 527' 0" Cut: 15' Recovered: 13'

Description:

512' 0" - 514' 0" : No recovery.

514' 0" - 515' 0" : Interbedded pale grey calcareous claystone and thick tabular masses of prismatic gypsum; also present is some friable sandy substance, now saturated with oil from inside of core barrel.

515' 0" - 518' 6" : Interbedded grey fine-grained laminated anhydrite and white massive medium to coarse-grained gypsum which disrupts the bedding of the anhydrite. Grey calcareous clay with gypsum fragments from 515' 3" to 515' 9". Two veins of acicular gypsum.

518' 6" - 520' 0" : Interbedded contorted grey to white laminated anhydrite, coarse-grained acicular gypsum, and small amount of grey calcareous clay. Contortions are of large size.

520' 0" - 522' 6" : Interlayered mixture of grey laminated fine-grained anhydrite, medium-grained crystalline bluish speckled anhydrite, and coarse-grained acicular gypsum.

522' 6" - 523' 6" : Breccia of angular fragments of grey laminated anhydrite in matrix of coarse-grained acicular gypsum and calcareous grey clay. Contorted in places.

523' 6" - 527' 0" : Interbedded grey fine-grained laminated anhydrite, medium-grained speckled crystalline anhydrite, and coarse-grained acicular gypsum; some brecciation of laminated anhydrite at 525' 6".

Core No. 32

Interval: 527' 0" - 541' 7" Cut: 14' 7" Recovered: 14' 7"

527' 0" - 528' 6" : Breccia of fragments of grey gypsiferous shale in white coarse-grained gypsum, with a few streaks of grey calcareous clay; shale and gypsum interlaminated and contorted in a few places.

528' 6" - 535' 8" : Breccia of fragments of very tough grey-brown laminated 'dolomitic siltstone' in very subordinate matrix of white to pale blue coarse-grained crystalline anhydrite; lowermost 6" not brecciated. 1" vein of acicular gypsum at 532' 9".

535' 8" - 536' 4" : Grey calcareous clay with tabular masses of coarse-grained white gypsum.

536' 4" - 536' 9" : Very tough grey-brown very fine-grained 'dolomitic siltstone' with pyrite cubes. 1" vein of coarse-grained acicular gypsum at bottom of interval.

536' 9" - 537' 0" : Very friable grey calcareous clay and white gypsum.

537' 0" - 541' 7" : Interbedded grey shaley anhydrite and white medium to coarse-grained gypsum, with a few streaks of grey calcareous clay. Bedding steep, azimuth of dip changes every few feet.

Core No. 33

Interval: 541' 7" - 556' 0" Cut: 14' 5" Recovered: 10' + fragments

Description:

541' 7" - 545' 0" : Breccia of fragments of grey anhydrite in abundant matrix of white medium-grained gypsum.

545' 0" - 550' 4" : Interbedded grey laminated anhydrite and white thin-bedded medium-grained gypsum.

550' 4" - 554' 7" : Poor recovery; a few fragments of grey calcareous clay with $\frac{1}{4}$" veins of gypsum.

554' 7" - 556' 0" : Breccia of fragments of tough 'dolomitic siltstone' in very subordinate matrix of crystalline gypsum.

Core No. 34

Interval: 556' 0" - 571' 0" Cut: 15' Recovered: 10'

Description:

556' 0" - 556' 3" : Tough grey-brown 'dolomitic siltstone'.
556' 3" - 557' 6" : Crystalline anhydrite, medium-grained, bluish-grey with black specks, with some thin curved dark schlieren; measured specific gravity = 2.86. $\frac{1}{4}$" layers of coarse-grained prismatic gypsum between 'siltstone' and anhydrite.
557' 6" - 564'10" : Tough breccia of angular fragments of grey laminated 'dolomitic siltstone' in subordinate matrix of coarse-grained crystalline anhydrite.
564'10" - 571' 0" : Poor recovery; fragments of tough 'siltstone' and of tough 'siltstone'/anhydrite breccia; siltstone soft at bottom.

Core No. 35

Interval: 572' 0" - 582' 0" Cut: 10' Recovered: 10'

Description:

572' 0" - 573' 6" : Interlaminated and mixed dark grey anhydrite and white medium to coarse-grained gypsum; some streaks of calcareous shale.
573' 6" - 575' 0" : Contorted interlaminated mixture of grey shaley anhydrite, bluish-grey speckled crystalline anhydrite, and medium-grained gypsum.
575' 0" - 577' 9" : Grey calcareous claystone with tough irregular concretions of gypsum + clay.
577' 9" - 582' 0" : Very tough laminated 'siltstone', steeply dipping, some brecciation from 578' 6" to 579' 6"; some veins of white to pale blue anhydrite; 1" vein of acicular gypsum at 578' 4".

Core No. 36

Interval: 582' 0" - 596' 6" Cut: 14' 6" Recovered: 14'

Description:

582' 0" - 585' 7": Very tough 'siltstone' breccia with very subordinate poikilitic matrix of crystalline anhydrite; bedding of fragments steep to vertical. Measured specific gravity = 2.60.
585' 7" - 588' 9" : Intimately interlaminated and contorted mixture of grey laminated shaley pyritic anhydrite, medium-grained crystalline anhydrite, and subordinate $\frac{1}{4}$" laminae of gypsum; some streaks of calcareous pyritic clay.

588' 9" - 589' 3" : Tough grey 'siltstone' breccia with anhydrite veinlets.

589' 3" - 590' 9" : Contorted interlayered mixture of grey laminated shaley fine-grained anhydrite, medium-grained blue crystalline anhydrite, and gypsum; layers of soft coarse-grained prismatic gypsum along margins of crystalline anhydrite.

590' 9" - 591' 3" : Tough 'siltstone' breccia with soft gypsum veins.

591' 3" - 596' 6" : Interlayered mixture of grey shaley anhydrite, speckled bluish crystalline anhydrite, and abundant coarse-grained white gypsum. Several veins of coarse gypsum with margins of calcareous clay.

Core No. 37

Interval: 596' 6" - 611' 6" Cut: 15' Recovered: 15'

Description:

596' 6" - 600' 0" : Interbedded dark grey laminated shaley anhydrite and white medium-grained gypsum; some highly contorted cross-cutting veins of coarse-grained gypsum.

600' 0" - 602' 4" : Irregularly contorted intimately interlayered mixture of dark grey laminated shaley anhydrite, crystalline anhydrite, and gypsum.

602' 4" - 605' 0" : Interbedded and contorted grey laminated shaley anhydrite and white medium-grained gypsum.

605' 0" - 606' 6" : Grey non-calcareous shale with medium-grained white gypsum veins and some contorted cross-cutting veins of gypsum.

606' 6" - 611' 6" : Interbedded contorted grey laminated shaley anhydrite and white laminated to thin-bedded medium-grained gypsum, with some streaks of calcareous clay. Some contorted cross-cutting veins of white gypsum.

Core No. 38

Interval: 611' 6" - 615' 0" Cut: 3' 6" Recovered: 3' 6"

Description:

611' 6" - 612' 0" : Dark grey to black medium-grained anhydrite with several ½" megacrysts of (?) anhydrite.

612' 0" - 615' 0" : Very tough 'siltstone' breccia, grey-brown, cut by vertical veins of white to pale blue anhydrite.

Core No. 39

Interval: 615' 0" - 627' 0" Cut: 12' Recovered: 7'

Description:

615' 0" - 617' 0" : Breccia of tough grey very fine-grained 'dolomitic siltstone' with subordinate matrix of blue coarse-grained crystalline anhydrite; a few dark grey streaks of calcareous clay with abundant pyrite. Vein of acicular gypsum at 616' 6". Anhydrite matrix more abundant at bottom of interval.

617' 0" - 622' 0" : No recovery.

622' 0" - 625' 0" : Poor recovery; fragments of grey friable calcareous claystone with veins of acicular gypsum.

625' 0" - 626' 0" : Tough very fine-grained laminated 'dolomitic siltstone' with finely disseminated pyrite and a few streaks of dark grey clay, cut by veins of blue anhydrite.

626' 0" - 627' 0" : Fragments of grey calcareous claystone with gypsum veins.

Core No. 40

Interval: 627' 0" - 642' 0" Cut: 15' Recovered: 15'

Description:

627' 0" - 642' 0" : Contorted interbedded grey fine-grained laminated anhydrite, white medium-grained gypsum, and small amount of dark grey calcareous clay.

Core No. 41

Interval: 647' 0" - 662' 0" Cut: 15' Recovered: 15'

Description:

647' 0" - 648' 9" : Breccia of fragments of grey very fine-grained pyritic 'dolomitic siltstone' in very subordinate matrix of white coarse-grained anhydrite; at 647'10" core is cut by 1" vein composed of a central zone of blue anhydrite bordered on each side by layers of soft white prismatic gypsum.

648' 9" - 650' 0" : Grey calcareous clay with tabular masses 1" thick of white coarse-grained gypsum.

650' 0" - 650' 9" : Pale grey medium-grained crystalline anhydrite containing a few fragments of 'dolomitic siltstone'.

650' 9" - 652' 0" : Breccia of grey very fine-grained pyritic 'siltstone' fragments in very subordinate matrix of white medium-grained gypsum; some grey calcareous clay in gypsum matrix at top and bottom of interval.

652' 0" - 658' 0" : Thinly interbedded and contorted grey fine-grained laminated anhydrite, white medium-grained massive gypsum, and dark grey calcareous clay with large twinned crystals of pyrite.

658' 0" - 659' 3" : Pale grey medium-grained crystalline anhydrite; measured specific gravity = 2.73.

659' 3" - 662' 0" : Interbedded grey fine-grained anhydrite, white coarse-grained acicular gypsum, and small amount of grey calcareous clay; cross-cutting vein of acicular gypsum 4" thick at 660'2".

Core No. 42

Interval: 662' 0" - 677' 0" Cut: 15' Recovered: 15'

Description:

662' 0" - 666' 6" : Interbedded grey laminated fine-grained anhydrite, and thin-bedded white coarse-grained gypsum; bedding disturbed and interrupted, steepl.

666' 6" - 667' 0" : Tough grey very fine-grained 'siltstone' with veins 1" thick of acicular gypsum at each end of interval.

667' 0" - 669' 0" : Interlaminated grey fine-grained dirty anhydrite, coarse-grained gypsum, and streaks of grey calcareous clay at top and bottom; contorted.

669' 0" - 672' 9" : Breccia of tough grey very fine-grained laminated 'dolomitic siltstone' fragments in very subordinate matrix of coarse-grained anhydrite with minute pyrite grains.

672' 9" - 675' 0" : Contorted mixture of abundant large fragments of grey laminated very fine-grained 'siltstone' in matrix of blue crystalline anhydrite; layers of prismatic gypsum between 'siltstone' and anhydrite.

675' 0" - 677' 0" : Tough grey very fine-grained laminated 'dolomitic siltstone' partly brecciated by veins and pockets of white coarse-grained anhydrite.

Core No. 43.

Interval: 677' 0" - 691' 6" Cut: 14' 6" Recovered: 14' 6

Description:

677' 0" - 682' 9" : Brecciated grey 'dolomitic siltstone' with very subordinate veins of white coarse-grained anhydrite and a few $\frac{1}{4}$" veins of acicular gypsum.

682' 9" - 683' 6" : Fragments of grey calcareous clay with white coarse-grained prismatic gypsum.

683' 6" - 689' 0" : Partly bedded breccia of fragments of grey fine-grained laminated anhydrite in white medium-grained gypsum; some fragments of tough very fine-grained 'siltstone' in bottom 12".

689' 0" - 690' 0" : Large fragments of grey very fine-grained 'siltstone' in matrix of white coarse-grained gypsum.

690' 0" - 691' 6" : Fragments of grey calcareous clay with white coarse-grained gypsum.

Core No. 44

Interval: 691' 6" - 707' 0" Cut: 15' 6" Recovered: 8'

Description:

691' 6" - 699' 0" : No recovery.
699' 0" - 700' 0" : Fragments of grey calcareous clay with coarse-grained acicular gypsum.
700' 0" - 703' 9" : Interlayered grey laminated fine-grained 'siltstone' and coarse-grained bluish crystalline anhydrite with abundant disseminated pyrite, particularly at the margins of the anhydrite mass; 4" of grey calcareous clay with acicular gypsum at 702'.
703' 9" - 705' 9" : Friable grey calcareous claystone with some friable white acicular gypsum.
705' 9" - 707' 0" : Breccia of fragments of grey laminated fine-grained pyritic 'siltstone' and a few of dark grey calcareous clay in matrix of coarse-grained crystalline anhydrite. Clay fragments predominant from 706' 3" to 706' 9".

Core No. 45

Interval: 707' 0" - 722' 0" Cut: 15' Recovered: 12'

Description:

707' 0" - 710' 0" : Almost no recovery; six small pieces of grey calcareous clay with acicular gypsum.
710' 0" - 711' 0" : Interbedded and partly brecciated grey fine-grained laminated anhydrite in medium-grained white gypsum, with some laminae of grey calcareous clay.
711' 0" - 713' 0" : Fragmented grey calcareous claystone with white coarse-grained gypsum.
713' 0" - 715'10" : Massive grey 'dolomitic siltstone' with patches of coarse-grained blue crystalline anhydrite which contain small fragments of grey pyritic 'siltstone'; the massive siltstone has darker patches which are pyritic also.
715'10" - 717' 6" : Thin-bedded contorted mixture, pyritic in places, of grey calcareous clay, white coarse-grained acicular gypsum, and white medium-grained massive gypsum with lumps of fine-grained laminated anhydrite.
717' 6" - 721' 8" : Interbedded and brecciated dark grey laminated anhydrite, in places pyritic, in massive white medium-grained gypsum. Some streaks of dark grey calcareous clay, and some pieces of grey fine-grained anhydrite near bottom of interval.
721' 8" - 722' 0" : Black very finely pyritic calcareous claystone cut by veins of white gypsum, and also carrying irregular 'wisps' of white gypsum with abundant pyrite.

Core No. 46

Interval: 722' 0" - 737' 0" Cut: 15' Recovered: 12'

Description:

722' 0" - 725' 0" : No recovery.
725' 0" - 729' 6" : Partly bedded breccia of grey laminated clayey anhydrite, in places pyritic, in white medium-grained gypsum.
729' 6" - 730' 0" : Grey calcareous clay with colourless acicular gypsum.
730' 0" - 737' 0" : Bedded breccia of grey laminated fine-grained anhydrite with clay particles in matrix of white medium-grained gypsum.

Core No. 47

Interval: 737' 0" - 752' 0" Cut: 15' Recovered: 12' 6"

Description:

737' 0" - 739' 6": No recovery.
739' 6" - 750' 0" : Bedded breccia of anhydrite fragments, fine-grained and laminated, in white medium-grained gypsum matrix; some calcareous clay laminae.
750' 0" - 752' 0" : Grey medium-grained crystalline anhydrite; 1" of calcareous clay at top and bottom of interval. 2" vein of coarse-grained acicular gypsum from 750' 0" to 750' 2".

Core No. 48

Interval: 752' 0" - 759' 6" Cut: 7' 6" Recovered: 6' 6"

Description:

752' 0" - 753' 0" : No recovery.
753' 0" - 758' 0" : Brecciated 'siltstone', very tough, grey, and massive, with very subordinate matrix of medium-grained crystalline anhydrite; some pyrite in places. Lowermost 12" not brecciated, has moderate dip.
758' 0" - 758' 9" : Interbedded anhydrite and calcareous clay, with cross-cutting veins of acicular white gypsum.
758' 9" - 759' 3" : Pale grey crystalline anhydrite.
759' 3" - 759' 6" : Breccia of 'siltstone' with crystalline anhydrite matrix.

Core No. 49

Interval: 759' 6" - 767' 0" Cut: 7' 6" Recovered: 7'

Description:

759' 6" - 760' 0" : No recovery.
760' 0" - 763' 6" : Very tough brecciated grey laminated 'dolomitic siltstone' cut by ½" vein of bright blue anhydrite with a layer of white gypsum between the anhydrite and the 'siltstone'.
763' 6" - 764' 6" : Grey calcareous claystone with tabular bodies of white coarse-grained acicular gypsum.
764' 6" - 766' 9" : Medium-grained speckled crystalline anhydrite with a few laminae of grey 'siltstone'.
766' 9" - 767' 0" : Grey fine-grained 'siltstone' breccia with subordinate matrix of white anhydrite.

Core No. 50

Interval: 767' 0" - 778' 0" Cut: 11' Recovered: 9' 6"

Description:

767' 0" - 768' 6" : No recovery.
768' 6" - 776'10" : Disrupted beds of grey laminated fine-grained anhydrite in abundant white medium to coarse-grained gypsum; some streaks and laminae of grey pyritic calcareous clay.
776'10" - 778' 0" : Tough black pyritic 'dolomitic siltstone' cut by thin veinlets of anhydrite.

Core No. 51

Interval: 797' 0" - 802' 0" Cut: 5' Recovered: 5'

Description:

797' 0" - 799' 0" : Tough black laminated pyritic 'dolomitic siltstone' cut by veinlets of gypsum.
799' 0" - 800' 0" : Interlayered dark grey laminated 'siltstone' layers and medium-grained bluish crystalline anhydrite, with layers of prismatic gypsum between 'siltstone' and anhydrite.
800' 0" - 802' 0" : Contorted and brecciated tough laminated 'siltstone' with veinlets and pockets of grey crystalline anhydrite.

Core No. 52

Interval: 802' 0" - 816' 6" Cut: 14' 6" Recovered: 10' 6"

Description:

802' 0" - 806' 0" : No recovery.
806' 0" - 809' 0" : Tough grey-brown regularly laminated 'dolomitic siltstone', steeply dipping, with finely disseminated pyrite in places, cut by thin veins of white gypsum. Some films of grey clay at bottom of interval.
809' 0" - 814' 0" : Interlaminated dark grey 'siltstone', top 6" with calcareous clay, and pale grey to white medium-grained crystalline anhydrite which disrupts the bedding of the 'siltstone'. Veins of acicular gypsum at 812' 2"and 813' 9".
814' 0" - 816' 6" : Heterogeneous mixture of grey speckled crystalline anhydrite (major component), tough grey 'siltstone' for top and bottom few inches, some very friable coarse-grained acicular gypsum, and a few grey calcareous clay films.

Core No. 53

Interval: 816' 6" - 822' 6" Cut: 6' Recovered: 3'

Description:

816' 6" - 819' 6" : No recovery.
819' 6" - 822' 6" : Very fragmented grey calcareous claystone, lower part brecciated, with a few tabular masses of white gypsum.

Core No. 54

Interval: 822' 6" - 830' 0" Cut: 7' 6" Recovered: 6' 6"

Description:

822' 6" - 823' 6" : No recovery.
823' 6" - 830' 0" : Massive grey-brown very fine-grained 'siltstone' finely mottled with small streaks of white anhydrite, and cut by a few veinlets of white gypsum; finely disseminated pyrite abundant from 826' to 827'.

APPENDIX III

COMPARISON OF WELL LOGS WITH CORE LITHOLOGY

1. Spontaneous Potential

The spontaneous potential curve is fairly smooth throughout its length except for a sudden deflection of 100 millivolts between 420 and 430 feet. This is presumably caused by the abundant pyrite in the 'dolomitic siltstone' which forms so much of the core below 436 feet. The 100 millivolt change between 84 and 120 feet is presumably caused by the steel casing, which extends from 0 to 85 feet in the well.

2. Resistivity

The resistivity curve shows large and rapid variations throughout its length, and reflects quite faithfully the various lithologies in the core. In the upper part of the core, above 370 feet, the gypsum-anhydrite rock has a resistivity between 4,500 and 6,500 ohms M^2/M, in sharp contrast to the claystone beds, which have resistivities of only 100 to 200 ohms M^2/M. Between 370 and 430 feet the curve shows a steady decrease from 6,000 to 3,000 ohms M^2/M, which probably reflects the proximity of the mass of pyritic rocks in the lower part of the core. Below 430 feet, the resistivities of the gypsum-anhydrite rock, the crystalline anhydrite and the non-pyrite-bearing 'dolomitic siltstone' average between 2,000 and 3,000 ohms M^2/M, whereas the pyrite-bearing 'siltstone' and the claystone have resistivities between 20 and 200 ohms M^2/M. As in the spontaneous potential log, the rise in the curve from 84 to 120 feet is presumably an effect of the steel casing, though in this case there are low values opposite claystone beds superimposed on the general rising trend.

3. Acoustic Velocity

The travel time curve fluctuates regularly throughout most of its length, and there is good correlation with the lithology; low values (peaks to the right, corresponding to high velocity) occur opposite gypsum, anhydrite, and 'dolomitic siltstone', and high values (low velocity) are given by the claystone beds. From 250 to 430 feet there are only two claystone beds of appreciable thickness, and accordingly the curve shows a constant low value interrupted by sharp peaks opposite these claystones. Unlike the electrical curves, the travel time curve shows no fundamental change at the entry of the 'dolomitic siltstone'.

4. Gamma Ray

The gamma ray curve also reflects faithfully the claystone beds, with a high peak opposite each one, and correlates well with the travel time curve. The curve shows no fundamental change near 436 feet, indicating that the clay content of the 'dolomitic siltstone' is close to that of the overlying gypsum and anhydrite.

COMPOSITE WELL LOG

PLATE 1

OPERATOR: BUREAU OF MINERAL RESOURCES

WELL NAME AND NUMBER : ALICE SPRINGS (BMR) STRATIGRAPIC No 3 (RINGWOOD)

NORTHERN TERRITORY 1:250,000 SHEET ALICE SPRINGS SF 53-14 AMADEUS BASIN WELL STATUS: PLUGGED & ABANDONED

DRILLING DATA

LOCATION: Lat - 23° 53' S Long. 134° 53' E
ELEVATION: Ground level 1300' approx.
DATE SPUDDED: 24-7-68
DATE DRILLING STOPPED: 19-8-68
DATE RIG OFF 28-8-68
TOTAL DEPTH: driller 852'
welex 834', 816'
HOLE SIZE INS. FROM TO
7⅞" Surf. 85'
5½" 85' 300'
4¾" 300' T.D.
CASING:
ins WT GR DEPTH CMT. CMT'D TO
6 21lbs/ft w/bore 85' 15sx etc.
CEMENT PLUGS SURFACE
PERFORATIONS: NIL
DRILLED BY: BUREAU OF MINERAL RESOURCES
WELL HEAD FITTINGS: none
CEMENTED BY: driller
LOGGED BY: welex
DRILLING METHOD: air rotary
LITHOLOGY BY: A.J. Stewart
DRILLING DATA BY: J.M. Henry

LOG DATA

LOG TYPE	LATEROLOG	SPONTANEOS POT.	GAMMA RAY	ACOUSTIC VEL.
DATE	27-8-68	27-8-68	27-8-68	27-8-68
RUN NO.	-1-	-1-	-1-	-1-
DEPTH — DRILLER	852'	852'	852'	852'
DEPTH — WELEX	834'	834'	834'	834'
BTM. LOG INTER.	820'	804'	790'	809'
TOP LOG INTER	84'	84'	0'	84'
CASING DRILLER	6" at 85'	6" at 85'	6" at 85'	6" at 85'
CASING — WELEX	84'	84'	84'	84'
BIT SIZE	4¾"	4¾"	4¾"	4¾"
TYPE FLUID IN HOLE	SAT'D SALT WATER	SAT'D SALT WATER	SAT'D SALT WATER	SAT'D SALT WATER
DENS. | VISC	NA | NA	NA | NA	NA | NA	NA | NA
PH | FLUID LOSS	NA | NAml	NA | NAml	NA | NAml	NA | NAml
SOURCE OF SAMPLE	Pit	Pit	Pit	Pit
R_m at MEAS. TEMP.	0·19 at 60°F	0·19 at 60°F	0·19 at 60°F	0·19 at 60°F
R_{mf} at MEAS. TEMP	NA	NA	NA	NA
R_{me} at MEAS. TEMP	NA	NA	NA	NA
SOURCE R_{mf} R_{me}	NA | NA	NA | NA	NA | NA	NA | NA
R_m at BHT	NA	NA	NA	NA
TIME SINCE CIRC	3 HOURS	3 HOUR	3 HOURS	3 HOURS
MAX. REC. TEMP.	NA	NA	NA	NA
EQUIP | LOCATION	9343 | AS	9343 | AS	7343 | AS	7343 | AS
TOOL TYPE AND NO.	GUARD	GUARD	24A	24A
TOOL POSITION	FREE	FREE	FREE	FREE
RECORDED BY	PATTERSON			
WITNESSED BY	STEWART and REINE			

LITHOLOGICAL REFERENCE

Acicular gypsum — Massive gypsum — Fine-grained anhyarite — Crystalline anhydrite — Dolomitic siltstone — Calcareous claystone

Ca — calcareous Py — pyritic

BIT TYPES AND REMARKS	SPONTANEOUS POTENTIAL Millivolts	% CORES RECOVERY	DEPTH in feet	DETAILED LITHOLOGY	RESISTIVITY Ohms M^2/M	GAMMA RAY API units	TRAVEL TIME Microseconds/foot T3 R_1, 3 R_2	DESCRIPTIVE LITHOLOGY
1 7⅞" HAWTHORN	6" W.S. Ctg		50		0 500 | 0 5000 5000 10,000	0 100	40 140	White to cream earthy gypsum
2 3 15/16" COREHEAD (Reamed to 7⅞")								Colourless prisms of gypsum (~45%); fragments of pale grey f.gr massive gypsum and/or anhydrite (~45%); pale grey Ca claystone (~10%), probably interbedded and fragmented.
3 7⅞" W.S.C								Anhydrite fragments in m.gr gypsum.
4 5½" W.R.C			100					Colourless prisms of gypsum (~35%), fragments of grey f.gr massive gypsum and/or anhydrite (~55%); pale grey Ca claystone (~10%)
R.R.2 3 15/16" COREHEAD TRIEFUS TUNGSTEN		2 3 4 5	150	Py Py Py				Fragments of pale grey f.gr massive gypsum or anhydrite (~70%), pale grey Ca claystone (~30%)
Reamed to 5½" R.R.4								Grey M-C.gr. gypsum containing streaks, films, laminae and fragments of grey laminated anhydrite.
R.R.4 - 5½" W.R.C								Grey Ca claystone with pyrite and gypsum crystals
R.R.2 3 15/16" COREHEAD TRIEFUS TUNGSTEN		6 7 8 9	200	Py Py				Grey M-C.gr. gypsum with films and laminae of annydrite and claystone interbeds.
Reamed to 5½" R.R.4								Grey M-C.gr gypsum with films, laminae and fragments of grey laminated annydrite; Ca claystone interbeds have gypsum masses
R.R.4 - 5½" W.R.C								
R.R.2 3 15/16" COREHEAD TRIEFUS		10 11 12	250	Py Py				
Reamed to 5½" R.R.4								
R.R.4 - 5½" W.R.C								
5 Reamed to 4¾" Hughes		13 14 15	300					Fragments of grey f.gr laminated anhydrite surrounded by colourless M-C.gr gypsum; Ca claystone interbeds have masses of acicular gypsum. Cross-cutting veins of acicular gypsum.
R.R.2 3 15/16" COREHEAD TRIEFUS TUNGSTEN		16 17 18 19	350					
R.R.5 Reamed to 4¾" 6 3 15/16" COREHEAD TRIEFUS		20						
R.R.5 Reamed to 4¾" R.R.6 3 15/16" COREHEAD TRIEFUS		21	400					
R.R.6 3 15/16" COREHEAD TUNGSTEN TRIEFUS		22 23 24	450					Uppermost occurrence of 'dolomitic siltstone'
R.R.5 Reamed to 4¾" 7 3 15/16" DIAMOND COREHEAD (DIABORT)		25 26 27 28 29 30	500	Py Py Py				'Dolomitic siltstone'
								Dolomitic siltstone' with small interval of gypsum and anhydrite
								Uppermost occurrence of crystalline anhydrite
R.R.5 Reamed to 4¾" 8 3 15/16" COREHEAD TRIEFUS TUNGSTEN		31 32 33 34	550	Py				Interlayered mixture of 'siltstone', acicular gypsum and crystalline anhydrite
								Large fragments of anhydrite, partly bedded in m.gr. gypsum
4¾" R.R.5 drill								Brecciated 'siltstone' with lens of crystalline anhydrite
R.R.5 Reamed to 4¾" R.R.7 3 15/16" DIAMOND COREHEAD (DIABORT)		35 36 37 38	600	Py Py				Contorted, interlayered mixture of f.gr. anhydrite, acicular gypsum and crystalline anhydrite
R.R.5 Reamed to 4¾" R.R.8 3 15/16" COREHEAD TRIEFUS		39 40	650	Py				Contorted, interbedded fragments of anhydrite in gypsum.
R.R.5 4¾" drill								
R.R.5 Reamed to 4¾" R.R.8 3 15/16" COREHEAD		41 42		Py Py				Interlayered anhydrite and gypsum with two intervals of crystalline annydrite
								Brecciated 'siltstone' with some contorted crystalline anhydrite
R.R.5 Reamed to 4¾" R.R.7 3 15/16" DIAMOND COREHEAD (DIABORT)		43 44 45 46	700	Py Py Py Py				'Siltstone' with crystalline anhydrite in places
R.R.5 Reamed to 4¾" 9 3 15/16" COREHEAD TRIEFUS TUNGSTEN		47	750	Py				Partly bedded, partly brecciated anhydrite in gypsum, with crystalline anhydrite at top and bottom of interval
R.R.7 3 15/16" DIAMOND COREHEAD (DIABORT)		48 49 50		Py Py				Brecciated 'siltstone'
10 4¾" HUGHES								Anhydrite fragments in gypsum
RR9 3 15/16" Triefus RR10 Reamed to 4¾" R.R.7 3 15/16" DIAMOND COREHEAD		51 52 53	800	Py Py				Brecciated 'siltstone' with some crystalline anhydrite
R.R.10 4¾" HUGHES		54	850	Py				Dolomitic siltstone' (~92% gypsum (~6%), claystone (~2%), organic matter

852' - Total depth

To accompany Record 1969/7

F53/A14/104

DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1969/7

(Supplement)

AMENDMENTS TO RECORD 1969/7, 'COMPLETION REPORT, BMR ALICE SPRINGS NO. 3 (RINGWOOD)'

by

A.J. Stewart

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by

A.J. Stewart

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INTRODUCTION

BMR Alice Springs No. 3 was drilled into a gypsum outcrop in the Bitter Springs Formation of the Amadeus Basin, in the southern part of the Northern Territory. The author was well-site geologist during the drilling, and on the basis of normal field examination of the core and cuttings, supplemented by X-ray examination of nine selected core samples, prepared a completion report on the results of the drilling (Stewart, 1969). Some years later, the opportunity arose to make a detailed petrographic and geochemical study of the evaporite core and cuttings. The results of that study, to be presented elsewhere (Stewart, in prep.) have revealed a number of errors in the geological descriptions in the completion report, and the necessary corrections follow.

CORRECTIONS TO RECORD 1969/7

'Summary'

Paragraph 3: delete line 3 and first word of line 4, and replace with 'gypsum and anhydrite with abundant fragments of gypsiferous dolomite and interbeds of soft, friable dolutite.'

line 5: delete 'dolomitic siltstone', and replace with 'very tough dolomite'.

'Logging and Testing - Cores'

Table I, page 6, core No. 53: delete 802' and replace with 816'6".

delete 816'6" and replace with 822'6".

'Summary of Regional Geology'

Page 9, paragraph 2, line 2: delete "' dolomitic siltstone' and claystone" and replace with 'and several varieties of dolomite,'.

Page 10, paragraph 1, line 9: delete 'anhydrite' and replace with 'dolomite'.

'Lithological Description of Core'

1. Pages 11-16 throughout:

Delete 'laminated anhydrite' and replace with 'gypsiferous dolomite'.

Delete 'calcareous claystone', 'claystone', or 'clay' and replace with 'friable dolutite'.

Delete "'dolomitic siltstone'", or "'siltstone'" and replace with 'bituminous dolomite.'

In addition, make the following corrections:

2. Page 11, last paragraph: delete all, and replace with 'The lithology of the Ringwood core is a heterogeneous mixture of five main rock-types: gypsum, anhydrite, bituminous dolomite, gypsiferous dolomite, and dolutite.'

3. Page 12, paragraph 2, line 1: delete 'three' and replace with 'two'; delete last word.

lines 2-5: delete all.

line 6: delete 'the core descriptions'; delete 'second' and replace with 'first'.

line 9: delete 'third' and replace with 'second'.

line 10: delete all after parentheses.

line 11: delete first five words.

4. Page 13, Table II, Sample 4: delete 'Laminated anhydrite'.

5. Page 13, paragraph 2: insert at beginning 'Three varieties of dolomite are present in the core.'

6. Page 14: after paragraph 2, insert

'<u>Gypsiferous Dolomite</u>

The third variety of dolomite is a grey fine-grained laminated rock, generally with small white spots of gypsum; it forms large fragments in the massive gypsum.'

7. Page 14, paragraph 3, <u>0-107 feet</u>, line 3: delete 'or anhydrite'.

line 5: delete 'or anhydrite'.

8. Page 14, paragraph 4, <u>107-250 feet</u>, line 4: delete 'anhydrite' and replace with 'gypsiferous dolomite'.

line 6:
delete 'anhydrite' and replace with 'dolomite'!

line 8:
delete 'anhydrite' and replace with 'dolomite'.

line 13:
delete 'shaley anhydrite' and replace with 'dolomite'.

9. Page 15, paragraph 1, 250-436 feet, line 3: delete last word 'anhydrite' and replace with 'dolomite'.

10. Page 15, paragraph 2, 436-852 feet, line 2: delete 'anhydrite' and replace with 'dolomite'.

11. Page 16, paragraph 3: delete all.

Table III: delete all.

12. Page 16a, delete all.

'Discussion and Conclusions'

13. Pages 17-21: delete all; this section will be superseded by Stewart (in prep.).

'Appendix I' - Cuttings Descriptions

Delete all 'or anhydrite'.

Delete all 'Anhydrite' and replace with 'Dolomite'.

Delete all 'Shale', and replace with 'Dolomite'.

Delete all 'Claystone' and replace with 'Dolutite'.

Delete all 'Siltstone' and replace with 'Bituminous dolomite'.

Delete all 'calcareous'.

Appendix II - Core Descriptions

Delete all of pages 27-46, and replace with the following:

Core No. 1.

Interval: 55' 0" - 58' 0" Cut: 3' Recovered: 3'

Description:

55' 0" - 55' 6"	: Dark grey dolomite cut by ¼" veins of white medium-grained acicular gypsum.
55' 6" - 56' 3"	: Breccia consisting of fragments of grey fine-grained laminated gypsiferous dolomite in matrix of white medium to fine-grained gypsum.
56' 3" - 58' 0"	: Partly bedded breccia of grey laminated gypsiferous dolomite fragments in matrix of white fine to medium-grained gypsum. Some cross-cutting veins of white coarse-grained gypsum, partly acicular.

Core No. 2.

Interval: 107' 0" - 121' 2" Cut: 14' 2" Recovered: 14' 2"

Description:

107' 0" - 107' 6"	: Breccia consisting of fragments of grey laminated partly gypsiferous dolomite in matrix of white coarse-grained acicular gypsum.
107' 6" - 110' 4"	: Coarse-grained acicular gypsum with ¼" interbeds, partly brecciated, of grey gypsiferous dolomite with euhedral interpenetrating pyritohedral twins of pyrite.
110' 4" - 111' 0"	Grey fine-grained gypsum with laminae of grey friable dolutite and gypsiferous dolomite (some fragments). Cross-cutting veins of white coarse-grained gypsum.
111' 0" - 113' 4"	: Grey acicular gypsum with disturbed interbeds of grey gypsiferous dolomite.
113' 4" - 114' 4"	: Grey fine-grained laminated anhydrite cut by veins of acicular gypsum and pale grey friable dolutite.
114' 4" - 121' 2"	: Grey medium to coarse-grained impure gypsum containing fragments of interlaminated gypsiferous dolomite and gypsum. Several inches of grey pyritic dolutite at 119' with included fragments of gypsum; stringers of dolutite elsewhere. A few cross-cutting veins of coarse-grained gypsum.

Core No. 3.

Interval: 122' 0" - 137' 0" Cut: Recovered: 15'

Description:

122' 0" - 124' 6" : Medium to coarse-grained dirty gypsum containing disturbed fragments of grey gypsiferous dolomite.
124' 6" - 125' 8" : Grey fine-grained gypsiferous dolomite with interbeds of soft grey dolutite and veins of white coarse-grained gypsum.
125' 8" - 137' 0" : Grey medium to coarse-grained impure gypsum with fragments of fine-grained dolomite and laminae of dolutite. Several veins of white coarse-grained gypsum. Bottom 2' of dolomite brecciated.

Core No. 4.

Interval: 139' 0" - 152' 0" Cut: 13' Recovered: 13'

Description:

139' 0" - 140' 0" : Fragments of grey gypsiferous dolomite in matrix of white coarse-grained gypsum.
140' 0" - 141' 1" : Grey to white mottled gypsum, medium to coarse-grained massive.
141' 1" - 145' 3" : Grey friable dolutite, pyritic in places, with abundant veins and crystals of gypsum.
145' 3" - 146' 0" : Impure grey coarse-grained dolutitic gypsum with some veins of white acicular gypsum.
146' 0" - 148' 0" : Grey friable dolutite, gypsiferous, cut by thick vein of white acicular gypsum.
148' 0" - 148' 6" : Grey impure coarse-grained gypsum.
148' 6" - 150' 9" : Grey fine to medium-grained gypsum containing convoluted fragments of soft grey friable dolutite.
150' 9" - 152' 0" : Impure medium to coarse-grained gypsum, nearly massive, some faint lamination.

Core No. 5.

Interval: 152' 0" - 166' 0" Cut: 14' Recovered: 14'

Description:

152' 0" - 152' 6" : Tough, medium to coarse-grained massive white gypsum, acicular in places.
152' 6" - 156' 0" : Grey medium-grained gypsum with laminae of grey dolomite. Some angular fragments of dark grey dolomite at bottom.

156' 0" - 156'10" : Soft grey friable dolutite.
156'10" - 157' 7" : Grey medium-grained gypsum with thin laminae of dolomite.
157' 7" - 158' 2" : Medium-grained gypsum, impure.
158' 2" - 159' 8" : Grey dolomite with scattered gypsum crystals.
159' 8" - 160' 6" : Grey medium-grained gypsum with thin laminae of dolomite.
160' 6" - 161' 4" : Grey gypsiferous impure dolomite.
161' 4" - 164' 0" : Grey medium to coarse-grained gypsum with thin contorted laminae of dolomite.
164' 0" - 166' 0" : Grey to white medium to coarse-grained massive gypsum.

Core No. 6.

Interval: 170' 4" - 181'10" Cut: 11' 6" Recovered: 11' 6"

Description:

170' 4" - 170'10" : Grey friable dolutite cut by thick uneven tabular masses of acicular gypsum.
170'10" - 174' 3" : Grey medium-grained massive gypsum with a few disturbed laminae of dolomite.
174' 3" - 174'11" : Dark grey friable dolutite with fragments of white coarse-grained gypsum.
174'11" - 177' 9" : Grey medium to coarse-grained massive gypsum with a few laminae of dark grey dolomite.
177' 9" - 178' 8" : Breccia of angular fragments of grey laminated friable dolutite in matrix of white coarse-grained gypsum.
178' 8" - 181' 8" : Grey friable dolutite with thin tabular masses of white medium-grained gypsum.
181' 8" - 181'10" : Pale grey medium to coarse-grained gypsum with contorted dolomite laminae. Fragments derived from overlying dolutite at top.

Core No. 7.

Interval: 182' 0" - 197' 0" Cut: 15' Recovered: 15'

Description:

182' 0" - 182' 9" : Grey medium-grained massive gypsum with thin laminae of dolomite, much contorted at bottom.
182' 9" - 183' 6" : Large angular fragments of grey laminated gypsiferous dolomite in matrix of white coarse-grained gypsum. Black pyritic dolomite present in bottom 3".

183' 6" - 187' 6" : Grey medium to coarse-grained massive gypsum with thin contorted streaks and laminae of grey dolomite. Fragments of dolomite in lowest 6".

187' 6" - 192' 6" : Grey friable massive dolutite containing angular fragments of white coarse-grained gypsum and grey fine-grained dolomite. Some short uneven tabular masses of coarse-grained gypsum.

192' 6" - 196' 0" : Grey medium-grained massive gypsum with numerous uneven laminae of dark grey dolomite. Two thin beds of grey dolutite in lower part, the upper one with gypsum fragments. Some cross-cutting veins of coarse-grained gypsum.

196' 0" - 197' 0" : Grey massive friable dolutite with fragments of white gypsum and some cross-cutting gypsum veins.

Core No. 8.

Interval: 197' 0" - 212' 4" Cut: 15'4" Recovered: 15'4"

Description:

197' 9" - 199' 6" : Grey medium to coarse-grained massive gypsum with thin laminae and a few fragments of grey laminated gypsiferous dolomite.

199' 6" - 199' 8" : Grey friable dolutite cut by ¼" tabular masses of white coarse-grained gypsum.

199' 8" - 200' 4" : Grey medium-grained laminated gypsum with a few streaks of gypsiferous dolomite.

200' 4" - 200' 8" : Grey friable dolutite with a few fragments of tough grey laminated gypsiferous dolomite. Apophyses of dolutite intrude underlying gypsum.

200' 8" - 201' 0" : Grey nearly massive gypsum vaguely laminated and brecciated, containing a few fragments of grey friable dolutite.

201' 0" - 209' 0" : Grey medium-grained gypsum, virtually massive, containing small streaks and fragments of grey dolomite.

209' 0" - 209'10" : Mixed rock of pale grey medium-grained gypsum, dark grey friable dolutite, and gypsiferous dolomite, with cross-cutting veins of white coarse-grained gypsum.

209'10" - 210' 5" : Grey medium-grained gypsum with a few laminae of grey anhydrite dolomite.

210' 5" - 211' 9" : Grey friable dolutite containing fragments and vein-like masses of white coarse-grained gypsum.

211' 9" - 212' 4" : Grey medium-grained poorly laminated gypsum.

Core No. 9.

Interval: 212' 4" - 226' 4" Cut: 14' Recovered: 14'

Description:

212' 4" - 213' 5" : Grey medium to coarse-grained gypsum with abundant contorted laminae of gypsiferous dolomite.

213' 5" - 213' 9" : Pale grey friable dolutite cut by anastomosing tabular masses ½" thick of white coarse-grained gypsum.

213' 9" - 214' 0" : Interlaminated grey gypsum and gypsiferous dolomite.

214' 0" - 215' 6" : Mixed rock consisting of abundant crowded fragments of gypsum in dark grey friable dolutite.

215' 6" - 216' 3" : Large (4") fragments of gypsum in grey friable dolutite, with some veins of white gypsum.

216' 3" - 219' 0" : Mixed rock consisting of impure grey gypsum with abundant fragments and laminae of dark grey dolomite and with a few 1" beds of dolomite crowded with gypsum fragments.

219' 0" - 220'10" : Grey medium-grained gypsum with large (6") pieces and smaller streaks of grey gypsiferous dolomite and dolutite.

220'10" - 223'11" : Dark grey to black massive pyritic bituminous dolomite, very tough, cut by 1/8" veins of white coarse gypsum. Pyrite finely disseminated and abundant.

223'11" - 226' 4" : Interlaminated gypsum and dolomite, the dolomite laminae brecciated.

Core No. 10.

Interval: 230' 2" - 242' 0" Cut: 11'10" Recovered: 11'10"

Description:

230' 2" - 239'10" : Grey medium to coarse-grained gypsum, with some 6" fragments of gypsiferous dolomite and some streaks and small pieces of dark grey friable dolutite.

239'10" - 241' 2" : Dark grey friable dolutite with fragments and veins of white coarse-grained gypsum and some fragments of medium-grained laminated gypsum.

241' 2" - 242' 0" : Fine to medium-grained laminated contorted gypsum with 1/8" clots of grey dolutite.

Core No. 11.

Interval: 242' 0" - 256' 0" Cut: 14' 0" Recovered: 14' 0"

Description:

242' 0" - 242'10" : Grey medium-grained massive gypsum.
242'10" - 251' 7" : Interlaminated gypsum and gypsiferous dolomite, in places brecciated. Top 12" consists of fragments of grey gypsiferous dolomite and coarse white gypsum in dark grey dolutite.
251' 7" - 253' 3" : Grey dolutite and friable dolutite cut by veins of coarse white gypsum. Dolutite contains abundant interpenetrating pyritohedral twins of pyrite.
253' 3" - 254' 3" : Grey massive gypsum with a few contorted and broken laminae of gypsiferous dolomite.
254' 3" - 255' 9" : Intermixed grey friable dolutite and tabular masses of white coarse-grained gypsum.
255' 9" - 256' 0" : Intermixed medium-grained gypsum and fine-grained gypsiferous dolomite.

Core No. 12.

Interval: 256' 0" - 271' 0" Cut: 15' Recovered: 15'

Description:

256' 0" - 264' 0" : Interlaminated white medium to coarse-grained gypsum and grey fine-grained dolomite. Contorted laminae of grey friable dolutite in lower 4'.
264' 0" - 276' 6" : Mixed rock consisting of 1" pieces of friable dolutite and fine-grained gypsiferous dolomite in matrix of white coarse-grained gypsum.
267' 6" - 271' 0" : White to pale grey massive to laminated gypsum. Few inches of dolutite and gypsiferous dolomite at 268' 3", and 4" of grey friable dolutite and coarse white gypsum at 196' 6". Bottom 2" has large pieces of gypsiferous dolomite and dolutite in the gypsum.

Core No. 13.

Interval: 274' 0" - 285' 6" Cut: 11' 6" Recovered: 11' 6"

Description:

274' 0" - 278' 0" : Interbedded grey medium-grained gypsiferous dolomite and white medium to coarse-grained gypsum, contorted. 1" vein of pure acicular gypsum at 274'. A few contorted streaks of friable dolutite.

278' 0" - 285' 6" : Breccia consisting of abundant fragments of tough grey gypsiferous dolomite in subordinate matrix of white coarse grained gypsum, plus fairly abundant streaks and wisps of friable dolutite. 1" vein of acicular gypsum at 282' 8".

Core No. 14.

Interval: 286' 6" - 300' 0" Cut: 13' 6" Recovered: 13' 6"

Description:

286' 0" - 298' 0" : Abundant pieces of pale grey gypsiferous dolomite anhydrite in subordinate matrix of medium to coarse-grained gypsum with small streaks of friable dolutite. Two cross-cutting 1" veins of acicular gypsum at 292' 0" and 294' 9".

298' 0" - 299' 0" : Abundant fragments of coarse white gypsum and a few of gypsiferous dolomite in matrix of friable dolutite.

299' 0" - 300' 0" : Brecciated gypsum, grey to white, fine to medium-grained, laminated.

Core No. 15.

Interval: 300' 0" - 314'11" Cut: 14'11" Recovered: 14'11"

Description:

300' 0" - 302' 0" : Interbedded grey gypsiferous dolomite and medium to coarse-grained gypsum, with a few contorted laminae of friable dolutite. Thick vein of acicular gypsum at 301'10".

302' 0" - 303' 9" : Irregularly interbedded grey friable dolutite and thick tabular masses of white coarse-grained gypsum.

303' 9" - 307'10" : Thinly interbedded fine-grained dolomite and acicular coarse-grained gypsum. Bedding steep and regular

307'10" - 308' 0" : Contorted interbedded gypsum and grey friable dolutite.
308' 0" - 309' 0" : Mottled mixture of white gypsum and grey dolomite.
309' 0" - 314'11" : Thin-bedded grey fine-grained dolomite and colourless coarse-grained gypsum. 8" of grey friable dolutite with tabular masses of coarse-grained gypsum at 311' 4".

Core No. 16.

Interval: 371' 0" - 331' 6" Cut: 14' 6" Recovered: 14' 6"

Description:

371' 0" - 323' 0" : Laminated to thin-bedded grey fine-grained dolomite and medium to coarse-grained gypsum. Locally contorted. Stringers of friable dolutite at 317' 3" and 320' 6".
323' 0" - 330' 0" : Interbedded grey friable dolutite, dolomite, and white coarse-grained gypsum.
330' 0" - 331' 6" : Slightly contorted grey gypsiferous dolomite and medium to coarse-grained gypsum.

Core No. 17.

Interval: 331' 6" - 346' 6" Cut: 15' Recovered: 15'

Description:

331' 6" - 346' 6" : Interbedded grey gypsiferous dolomite and white medium to coarse-grained gypsum. A few laminae of friable dolutite, especially abundant from 332' to 334'. 4" vein of acicular gypsum at 338' 5", and thinner ones elsewhere with films of dolutite along their margins. Bedding contorted from 331' to 338', elsewhere regular.

Core No. 18.

Interval: 346' 6" - 361' 6" Cut: 15' Recovered: 15'

Description:

346' 6" - 361' 6" : Interbedded and partly brecciated grey fine-grained gypsiferous dolomite and white medium to coarse-grained gypsum, with friable dolutite films and laminae. Cross-cutting veins of gypsum in upper-most 3'. Bedding contorted from 352' to 361', elsewhere regular. Few inches of friable dolutite at 360'.

Core No. 19.

Interval: 361' 6" - 376' 6" Cut: 15' Recovered: 15'

Description:

361' 6" - 364' 0" : Grey dirty medium to coarse-grained gypsum, mostly massive, faintly contorted in a few places.

364' 0" - 367' 0" : Severely contorted interbedded grey laminated to thin-bedded dolomite and white coarse-grained gypsum, with some friable dolutite.

367' 0" - 368' 0" : Mottled grey gypsum, nearly massive, with a few dark laminae of dolomite.

368' 0" - 372' 6" : Contorted interbedded grey gypsiferous dolomite, white medium to coarse-grained gypsum, and some films of grey dolutite. Cross-cutting vein of acicular gypsum at 372' 1".

372' 6" - 375' 0" : Mottled contorted gypsiferous dolomite, grey and laminated, and gypsum, medium to coarse-grained.

375' 0" - 376' 6" : Interbedded severely contorted grey gypsiferous dolomite and white coarse-grained gypsum.

Core No. 20.

Interval: 376' 6" - 391' 0" Cut: 14'6" Recovered: 14' 6"

Description:

Core very fractured when elevator plug failed and drill string dropped 75' to bottom of hole.

376' 6" - 384' 0" : Interbedded grey laminated fine-grained gypsiferous dolomite and white, coarse-grained gypsum, with regular steep dip.

384' 0" - 391' 0" : Interbedded pale grey gypsiferous dolomite, medium-grained massive gypsum, and white coarse-grained acicular gypsum, with rare streaks of grey friable dolutite.

Core No. 21.

Interval: 391' 4" - 406' 0" Cut: 14' 8" Recovered: 14' 8"

Description:

391' 4" - 396' 0" : Mottled mixture of grey gypsiferous dolomite and white fine to medium-grained gypsum, with some grey friable dolutite. Bedding generally steep, contorted between 394' and 395'.

396' 0" - 400' 0" : Mottled mixture of grey dolomite and white gypsum, generally massive, some lamination in places.

400' 0" - 406' 0" : Interbedded contorted grey gypsiferous dolomite white coarse-grained gypsum, and a few laminae of grey friable dolutite. Dolomite commonly veined by the gypsum.

Core No. 22.

Interval: 407' - 422' Cut: 15' Recovered: 15'

Description:

407' 0" - 416' 3" : Mottled to streaky grey fine-grained gypsiferous dolomite and white fine-grained gypsum which contains numerous laminae of grey dolutite. Numerous cross-cutting veins up to 2" thick of pure white acicular gypsum.

416' 3" - 416' 8" : Contorted interbedded pale grey friable dolutite and white coarse-grained gypsum.

416' 8" - 422' 0" : Mottled and streaky grey gypsiferous dolomite and white gypsum with dolomite laminae and specks of friable dolutite. Brecciated and contorted from 420' to 422'.

Core No. 23.

Interval: 422' 0" - 437' 0" Cut: 15' Recovered: 15'

Description:

422' 0" - 425' 6" : Interbedded grey laminated fine-grained gypsiferous dolomite and white medium-grained gypsum, with films of grey friable dolutite. Several cross-cutting veins (1") of coarse-grained acicular gypsum.

425' 6" - 426'10" : Contorted interbedded grey laminated to thin-bedded gypsiferous dolomite, white gypsum, and pale grey friable dolutite.

426'10" - 436' 4" : Regularly interbedded grey gypsiferous dolomite and white gypsum, with a few laminae of friable dolutite at 435'. Some dolomite laminae brecciated. Numerous veins of acicular gypsum.

436' 4" - 437' 0" : Grey very fine-grained bituminous dolomite cut by veins of white medium-grained gypsum. Some streaks of dark grey friable dolutite.

Core No. 24.

Interval: 437' 0" - 452' 0" Cut: 15' Recovered: 6'

Description:

437' 0" - 438' 6" : Grey very fine-grained bituminous dolomite cut by veins of white medium-grained gypsum. Some streaks of dark grey friable dolutite.
438' 6" - 439' 3" : Mottled mixture of grey gypsiferous dolomite and white fine to medium-grained gypsum.
439' 3" - 442' 0" : Grey friable dolutite with 1/8" veins of gypsum.
442' 0" - 443' 0" : Grey laminated bituminous dolomite very tough, brecciated in places.
443' 0" - 452' 0" : No recovery.

Core No. 25.

Interval: 454' 0" - 465' 0" Cut: 11' Recovered: 11'

Description:

454' 0" - 457' 0" : Grey friable dolutite with veins of white medium-grained gypsum.
457' 0" - 458' 0" : White coarse-grained gypsum with laminae of dark grey friable dolutite.
458' 0" - 462' 8" : Interbedded grey gypsiferous dolomite and white gypsum. Dolomite laminae commonly broken, and brecciated from 459' to 460'.
462' 8" - 464' 0" : Interbedded grey friable dolutite and white coarse-grained acicular gypsum.
464' 0" - 465' 0" : Very tough laminated bituminous dolomite.

Core No. 26.

Interval: 465' 0" - 473' 0" Cut: 8' Recovered: 8'

Description:

465' 0" - 467' 6" : Very tough grey laminated bituminous dolomite, evely bedded, evenly bedded, with a few thin veins of medium-grained anhydrite. Some disseminated pyrite.
467' 6" - 468' 6" : Tough bituminous dolomite cut by ¼" veins of white gypsum.
468' 6" - 471' 0" : Interbedded white medium to coarse-grained gypsum and grey fine-grained gypsiferous dolomite.
471' 0" - 473' 0" : Very tough bituminous dolomite, pyritic in places, cut by thin (1/16") veins of gypsum.

Core No. 27.

Interval: 473' 0" - 482' 0" Cut: 9' Recovered: 9'

Description:

473' 0" - 478' 3" : Tough bituminous dolomite cut by a few veins of white gypsum. Lowest 2' brecciated, with very subordinate matrix of white crystalline gypsum or anhydrite.

478' 3" - 482' 0" : Brecciated grey friable dolutite with irregular concentrations concretions of gypsum.

Core No. 28.

Interval: 483' 0" - 492' 0" Cut: 9' Recovered: 9'

Description:

483' 0" - 489' 0" : Tough bituminous dolomite, very fine-grained, with faint contorted colour-lamination. 3" of white gypsum and friable dolutite at 483' 3".

489' 0" - 491' 0" : Interbedded grey gypsiferous dolomite and white medium-grained gypsum, with a few dark grey laminae of friable dolutite.

491' 0" - 492' 0" : Tough bituminous dolomite with a few laminae of friable dolutite and cross-cutting veins of gypsum.

Core No. 29.

Interval: 492' 0" - 506' 0" Cut: 14' Recovered: 14'

Description:

492' 0" - 496' 0" : Tough laminated bituminous dolomite with a few cross-cutting veins of white coarse-grained gypsum.

496' 0" - 497' 3" : Grey friable dolutite with tabular masses of white coarse-grained gypsum.

497' 3" - 500' 0" : Tough grey brecciated bituminous dolomite with very subordinate matrix of white to pale bluish-grey anhydrite; some finely disseminated pyrite present.

500' 0" - 502' 0" : Interlaminated and contorted grey friable dolutite and white medium-grained gypsum.

502' 0" - 506' 0" : Tough grey brecciated bituminous dolomite faintly convoluted in places, with very subordinate matrix of white to grey coarse-grained gypsum.

Core No. 30.

Interval: 506' 0" - 512' 0" Cut: 6' Recovered: 6'

Description:

506' 0" - 507' 9" : Tough grey brecciated bituminous dolomite, in places faintly convoluted, with very subordinate matrix of white to grey gypsum.

507' 9" - 510' 0" : Breciated grey friable dolutite with irregular concretions of gypsum.

510' 0" - 512' 0" : Tough grey laminated bituminous dolomite, partly brecciated, with enclosed irregular bodies of greyish-blue crystalline anhydrite; a complete shell of prismatic gypsum surrounds each anhydrite body, separating it from the dolomite.

Core No. 31.

Interval: 512' 0" - 527' 0" Cut: 15' Recovered: 13'

Description :

512' 0" - 514' 0" : No recovery.

514' 0" - 515' 0" : Interbedded pale grey friable dolutite and thick tabular masses of prismatic gypsum; also present is some friable sandy substance*, now saturated with oil from inside of core barrel.

515' 0" - 518' 6" : Interbedded grey fine-grained gypsiferous dolomite and white massive medium to coarse-grained gypsum which disrupts the bedding of the dolomite. Grey friable dolutite with gypsum fragments from 515' 3" to 515' 9". Two veins of acicular gypsum.

518' 6" - 520' 0" : Interbedded contorted grey to white laminated gypsiferous dolomite, coarse-grained acicular gypsiferous dolomit gypsum, and small amount of grey friable dolutite. Contortions are of large size.

520' 0" - 522' 6" : Interlayered mixture of grey laminated fine-grained gypsiferous dolomite, medium-grained crystalline bluish speckled anhydrite, and coarse-grained acicular gypsum.

523' 6" - 527' 0" : Breccia of angular fragments of grey laminated gypsiferous dolomite in matrix of coarse-grained acicular gypsum and friable grey dolutite. Contorted in places.

* Analysis by X-ray diffraction found gypsum, dolomite, quartz, chlorite, mica (G. Berryman, analyst, BMR).

523' 6" - 527' 0" : Interbedded grey fine-grained gypsiferous dolomite, medium-grained speckled crystalline anhydrite, and coarse-grained acicular gypsum; some brecciation of gypsiferous dolomite at 525' 6".

Core No. 32.

Interval: 527' 0" - 541' 7" Cut: 14' 7" Recovered: 14' 7"

Description:

527' 0" - 528' 6" : Breccia of fragments of grey gypsiferous dolomite in white coarse-grained gypsum, with a few streaks of grey friable dolutite; dolomite and gypsum interlaminated and contorted in a few places.

528' 6" - 535' 8" : Breccia of fragments of very tough grey-brown laminated bituminous dolomite in very subordinate matrix of white to pale blue coarse-grained crystalline anhydrite; lowermost 6" not brecciated. 1" vein of acicular gypsum at 532' 9".

535' 8" - 536' 4" : Grey friable dolutite with tabular masses of coarse-grained white gypsum.

536' 4" - 536' 9" : Very tough grey-brown very fine-grained bituminous dolomite with pyrite cubes. 1" vein of coarse-grained acicular gypsum at bottom of interval.

536' 9" - 537' 0" : Very friable grey friable dolutite and white gypsum.

537' 0" - 541' 7" : Interbedded grey gypsiferous dolomite and white medium to coarse-grained gypsum, with a few streaks of grey friable dolutite. Bedding steep, azimuth of dip changes every few feet.

Core No. 33.

Interval: 541' 7" - 556' 0" Cut: 14' 5" Recovered: 10' + fragments

Description:

541' 7" - 545' 0" : Breccia of fragments of grey dolomite in abundant matrix of white medium-grained gypsum.

545' 0" - 550' 4" : Interbedded grey gypsiferous dolomite and white thin-bedded medium-grained gypsum.

550' 4" - 554' 7" : Poor recovery; a few fragments of grey friable dolutite clay with ¼" veins of gypsum.

554' 7" - 556' 0" : Breccia of fragments of tough bituminous dolomite in very subordinate matrix of crystalline gypsum.

Core No. 34.

Interval: 556' 0" - 571' 0" Cut: 15' Recovered: 10'

Description:

556' 0" - 556' 3" : Tough grey-brown bituminous dolomite.
556' 3" - 557' 6" : Crystalline anhydrite, medium-grained, bluish-grey with black specks, with some thin curved dark schlieren; measured specific gravity = 2.86. ¼" layers of coarse-grained prismatic gypsum between bituminous dolomite and anhydrite.
557' 6" - 564'10" : Tough breccia of angular fragments of grey laminated bituminous dolomite in subordinate matrix of coarse-grained crystalline anhydrite.
564'10" - 571' 0" : Poor recovery; fragments of tough bituminous dolomite and of bituminous dolomite/anhydrite breccia; dolomite soft at bottom.

Core No. 35

Interval: 572' 0" - 582' 0" Cut: 10' Recovered: 10'

Description:

572' 0" - 573' 6" : Interlaminated and mixed dark grey gypsiferous dolomite and white medium to coarse-grained gypsum; some streaks of dolutite.
573' 6" - 575' 0" : Contorted interlaminated mixture of grey gypsiferous dolomite, bluish-grey speckled crystalline anhydrite, and medium-grained gypsum.
575' 0" - 577' 9" : Grey friable dolutite with tough irregular concretions of gypsum + dolutite.
577' 9" - 582' 0" : Very tough laminated bituminous dolomite steeply dipping, some brecciation from 578' 6" to 579' 6"; some veins of white to pale blue anhydrite; 1" vein of acicular gypsum at 578' 4".

Core No. 36.

Interval: 582' 0" - 596' 6" Cut: 14'6" Recovered: 14'

Description:

582' 0" - 585' 7" : Very tough bituminous dolomite breccia with very subordinate poikilitic matrix of crystalline anhydrite; bedding of fragments steep to vertical. Measured specific gravity = 2.60.

585' 7" - 588' 9" : Intimately interlaminated and contorted mixture of grey gypsiferous pyritic dolomite, medium-grained crystalline anhydrite, and subordinate ¼" laminae of gypsum; some streaks of friable pyritic dolutite.

588' 9" - 589' 3" : Tough grey bituminous dolomite breccia with anhydrite veinlets.

589' 3" - 590' 9" : Contorted interlayered mixture of grey laminated gypsiferous fine-grained dolomite, medium-grained blue crystalline anhydrite, and gypsum; layers of soft coarse-grained prismatic gypsum along margins of crystalline anhydrite.

590' 9" - 591' 3" : Tough bituminous dolomite breccia with soft gypsum veins.

591' 3" - 596' 6" : Interlayered mixture of grey gypsiferous dolomite, speckled bluish crystalline anhydrite, and abundant coarse-grained white gypsum. Several veins of coarse gypsum with margins of friable dolutite.

Core No. 37.

Interval: 596' 6" - 611' 6" Cut: 15' Recovered: 15'

Description:

596' 6" - 600' 0" : Interbedded dark grey laminated gypsiferous dolomite and white medium-grained gypsum; some highly contorted cross-cutting veins of coarse-grained gypsum.

600' 0" - 602' 4" : Irregularly contorted intimately interlayered mixture of dark grey laminated gypsiferous dolomite, crystalline anhydrite, and gypsum.

602' 4" - 605' 0" : Interbedded and contorted grey laminated gypsiferous dolomite and white medium-grained gypsum.

605' 0" - 606' 6" : Grey dolomite with medium-grained white gypsum veins and some contorted cross-cutting veins of gypsum.

606' 6" - 611' 6" : Interbedded contorted grey laminated gypsiferous dolomite and white laminated to thin-bedded medium-grained gypsum, with some streaks of friable dolutite. Some contorted cross-cutting veins of white gypsum.

Core No. 38.

Interval: 611' 6" - 615' 0" Cut: 3' 6" Recovered: 3' 6"

Description:

611' 6" - 612' 0" : Dark grey to black medium-grained anhydrite with several ½" megacrysts of dolomite.

612' 0" - 615' 0" : Very tough bituminous dolomite breccia, grey-brown, cut by vertical veins of white to pale blue anhydrite.

Core No. 39.

Interval: 615' 0" - 627' 0" Cut: 12' Recovered: 7'

Description:

615' 0" - 617' 0" : Breccia of tough grey very fine-grained bituminous dolomite with subordinate matrix of blue coarse-grained crystalline anhydrite; a few dark grey streaks of friable dolutite with abundant pyrite. Vein of acicular gypsum at 616' 6". Anhydrite matrix more abundant at bottom of interval.

617' 0" - 622' 0" : No recovery.

622' 0" - 625' 0" : Poor recovery; fragments of grey friable dolutite with veins of acicular gypsum.

625' 0" - 626' 0" : Tough very fine-grained laminated bituminous dolomite with finely disseminated pyrite and a few streaks of dark grey dolutite, cut by veins of blue anhydrite.

626' 0" - 627' 0" : Fragments of grey friable dolutite with gypsum veins.

Core No. 40.

Interval: 627' 0" - 642' 0" Cut: 15' Recovered: 15'

Description:

627' 0" - 642' 0" : Contorted interbedded grey fine-grained gypsiferous dolomite, white medium-grained gypsum, and small amount of dark grey friable dolutite.

Core No. 41.

Interval: 647' 0" - 662' 0" Cut: 15' Recovered: 15'

Description:

647' 0" - 648' 9" : Breccia of fragments of grey very fine-grained pyritic bituminous dolomite in very subordinate matrix of white coarse-grained anhydrite; at 647'10" core is cut by 1" vein composed of a central zone of blue anhydrite bordered on each side by layers of soft white prismatic gypsum.

648' 9" - 650' 0" : Grey friable dolutite with tabular masses 1" thick of white coarse-grained gypsum.

650' 0" - 650' 9" : Pale grey medium-grained crystalline anhydrite containing a few fragments of bituminous dolomite.

650' 9" - 652' 0" : Breccia of grey very fine-grained pyritic bituminous dolomite fragments in very subordinate matrix of white medium-grained gypsum; some grey friable dolutite in gypsum matrix at top and bottom of interval.

652' 0" - 658' 0" : Thinly interbedded and contorted grey fine-grained gypsiferous dolomite, white medium-grained massive gypsum, and dark grey friable dolutite with large twinned crystals of pyrite.

658' 0" - 659' 3" : Pale grey medium-grained crystalline anhydrite; measured specific gravity = 2.73.

659' 3" - 662' 0" : Interbedded grey fine-grained gypsiferous dolomite, white coarse-grained acicular gypsum, and small amount of grey friable dolutite; cross-cutting vein of acicular gypsum 4" thick at 660' 2".

Core No. 42.

Interval: 662' 0" - 677' 0" Cut: 15' Recovered: 15'

Description:

662' 0" - 666' 6" : Interbedded grey laminated fine-grained gypsiferous dolomite, and thin-bedded white coarse-grained gypsum; bedding disturbed and interrupted, steep.

666' 6" - 667' 0" : Tough grey very fine-grained bituminous dolomite with veins 1" thick of acicular gypsum at each end of interval.

667' 0" - 669' 0" : Interlaminated grey fine-grained impure gypsiferous dolomite coarse-grained gypsum, and streaks of grey friable dolutite at top and bottom; contorted.

669' 0" - 672' 9" : Breccia of tough grey very fine-grained laminated bituminous dolomite fragments in very subordinate matrix of coarse-grained anhydrite with minute pyrite grains.

672' 9" - 675' 0" : Contorted mixture of abundant large fragments of grey laminated very fine-grained bituminous dolomite in matrix of blue crystalline anhydrite; layers of prismatic gypsum between dolomite and anhydrite.

675' 0" - 677' 0" : Tough grey very fine-grained laminated bituminous dolomite partly brecciated by veins and pockets of white coarse-grained anhydrite.

Core No. 43.

Interval: 677' 0" - 691' 6" Cut: 14' 6" Recovered: 14' 6"

Description:

677' 0" - 682' 9" : Brecciated grey bituminous dolomite with very subordinate veins of white coarse-grained anhydrite and a few ¼" veins of acicular gypsum.

682' 9" - 683' 6" : Fragments of grey friable dolutite with white coarse-grained prismatic gypsum.

683' 6" - 689' 0" : Partly bedded breccia of fragments of grey fine-grained gypsiferous dolomite in white medium-grained gypsum; some fragments of tough very fine-grained bituminous dolomite in bottom 12".

689' 0" - 690' 0" : Large fragments of grey very fine-grained bituminous dolomite in matrix of white coarse-grained gypsum.

690' 0" - 691' 6" : Fragments of grey friable dolutite with white coarse-grained gypsum.

Core No. 44.

Interval: 691' 6" - 707' 0" Cut: 15' 6" Recovered: 8'

Description:

691' 6" - 699' 0" : No recovery.

699' 0" - 700' 0" : Fragments of grey friable dolutite with coarse-grained acicular gypsum.

700' 0" - 703' 9" : Interlayered grey laminated fine-grained bituminous dolomite and coarse-grained bluish crystalline anhydrite with abundant disseminated pyrite, particularly at the margins of the anhydrite mass; 4" of grey friable dolutite with acicular gypsum at 702'.

703' 9" - 705' 9" : Friable grey dolutite with some friable white acicular gypsum.

705' 9" - 707' 0" : Breccia of fragments of grey laminated fine-grained pyritic bituminous dolomite and a few of dark grey friable dolutite in matrix of coarse-grained crystalline anhydrite. Dolutite fragments predominant from 706' 3" to 706' 9".

Core No. 45.

Interval: 707' 0" - 722' 0" Cut: 15' Recovered: 12'

Description:

707' 0" - 710' 0" : Almost no recovery; sic small pieces of grey friable dolutite with acicular gypsum.

710' 0" - 711' 0" : Interbedded and partly brecciated grey fine-grained gypsiferous dolomite in medium-grained white gypsum, with some laminae of grey friable dolutite.

711' 0" - 713' 0" : Fragmented grey friable dolutite with white coarse-grained gypsum.

713' 0" - 715'10" : Massive grey bituminous dolomite with patches of coarse-grained blue crystalline anhydrite which contain small fragments of grey pyritic bituminous dolomite; the massive dolomite has darker patches which are pyritic also.

715'10" - 717' 6" : Thin-bedded contorted mixture, pyritic in places, of grey friable dolutite, white coarse-grained acicular gypsum, and white medium-grained massive gypsum with lumps of fine-grained gypsiferous dolomite.

717' 6" - 721' 8" : Interbedded and brecciated dark grey gypsiferous dolomite, in places pyritic, in massive white medium-grained gypsum. Some streaks of dark grey friable dolutite, and some pieces of grey gypsiferous dolomite near bottom of interval.

721' 8" - 722' 0" : Black very finely pyritic friable dolutite cut by veins of white gypsum, and also carrying irregular 'wisps' of white gypsum with abundant pyrite.

Core No. 46.

Interval: 722' 0" - 737' 0" Cut: 15' Recovered: 12'

Description:

722' 0" - 725' 0" : No recovery.
725' 0" - 729' 6" : Partly bedded breccia of grey laminated gypsiferous dolomite, in places pyritic, in white medium-grained gypsum.
729' 6" - 730' 0" : Grey friable dolutite with colourless acicular gypsum.
730' 0" - 737' 0" : Bedded breccia of grey laminated fine-grained gypsiferous dolomite with dolutite particles in matrix of white medium-grained gypsum.

Core No. 47.

Interval: 737' 0" - 752' 0" Cut: 15' Recovered: 12' 6"

Description:

737' 0" - 739' 6" : No recovery.
739' 6" - 750' 0" : Bedded breccia of dolomite fragments, fine-grained and laminated, in white medium-grained gypsum matrix; some friable dolutite laminae.
750' 0" - 752' 0" : Grey medium-grained crystalline anhydrite; 1" of friable dolutite at top and bottom of interval. 2" vein of coarse-grained acicular gypsum from 750' 0" to 750' 2".

Core No. 48.

Interval: 752' 0" - 759' 6" Cut: 7' 6" Recovered: 6' 6"

Description:

752' 0" - 753' 0" : No recovery.
753' 0" - 758' 0" : Brecciated bituminous dolomite, very tough, grey, and massive, with very subordinate matrix of medium-grained crystalline anhydrite; some pyrite in places. Lowermost 12" not brecciated, has moderate dip.
758' 0" - 758' 9" : Interbedded gypsiferous dolomite and friable dolutite, with cross-cutting veins of acicular white gypsum.
758' 9" - 759' 3" : Pale grey crystalline anhydrite.
759' 3" - 759' 6" : Breccia of bituminous dolomite with crystalline anhydrite matrix.

Core No. 49.

Interval: 759' 6" - 767' 0" Cut: 7' 6" Recovered: 7'

Description:

759' 6" - 760' 0" : No recovery.
760' 0" - 763' 6" : Very tough brecciated grey laminated bituminous dolomite cut by ½" vein of bright blue anhydrite with a layer of white gypsum between the anhydrite and the dolomite.
763' 6" - 764' 6" : Grey friable dolutite with tabular bodies of white coarse-grained acicular gypsum.
764' 6" - 766' 9" : Medium-grained speckled crystalline anhydrite with a few laminae of grey bituminous dolomite.
766' 9" - 767' 0" : Grey fine-grained bituminous dolomite breccia with subordinate matrix of white anhydrite.

Core No. 50.

Interval: 767' 0" - 778' 0" Cut: 11' Recovered: 9' 6"

Description:

767' 0" - 768' 6" : No recovery.
768' 6" - 776'10" : Disrupted beds of grey laminated gypsiferous dolomite in abudant white medium to coarse-grained gypsum; some streaks and laminae of grey pyritic friable dolutite.
776'10" - 778' 0" : Tough black pyritic bituminous dolomite cut by thin veinlets of anhydrite.

Core No. 51.

Interval: 797' 0" - 802' 0" Cut: 5' Recovered: 5'

Description:

797' 0" - 799' 0" : Tough black laminated pyritic bituminous dolomite cut by veinlets of gypsum.
799' 0" - 800' 0" : Interlayered dark grey laminated bituminous dolomite layers and medium-grained bluish crystalline anhydrite, with layers of prismatic gypsum between dolomite and anhydrite.
800' 0" - 802' 0" : Contorted and brecciated tough laminated bituminous dolomite with veinlets and pockets of grey crystalline anhydrite.

Core No. 52.

Interval: 802' 0" - 816' 6" Cut: 14'6" Recovered: 10' 6"

Description:

802' 0" - 806' 0" : No recovery.
806' 0" - 809' 0" : Tough grey-brown regularly laminated bituminous dolomite, steeply dipping, with finely disseminated pyrite in places, cut by thin veins of white gypsum. Some films of grey dolutite at bottom of interval.
809' 0" - 814' 0" : Interlaminated dark grey bituminous dolomite, top 6" with friable dolutite, and pale grey to white medium-grained crystalline anhydrite which disrupts the bedding of the dolomite. Veins of acicular gypsum at 812' 2" and 813' 9".
814' 0" - 816' 6" : Heterogeneous mixture of grey speckled crystalline anhydrite (major component), tough grey bituminous dolomite for top and bottom few inches, some very friable coarse-grained acicular gypsum, and a few grey friable dolutite films.

Core No. 53.

Interval: 816' 6" - 822' 6" Cut: 6' Recovered: 3'

Description:

816' 6" - 819' 6" : No recovery.
819' 6" - 822' 6" : Very fragmented grey friable dolutite, lower part brecciated, with a few tabular masses of white gypsum.

Core No. 54.

Interval: 822' 6" - 830' 0" Cut: 7' 6" Recovered: 6' 6"

Description:

822' 6" - 823' 6" : No recovery.
823' 6" - 830' 0" : Massive grey-brown very fine-grained bituminous dolomite finely mottled with small streaks of white anhydrite, and cut by a few veinlets of white gypsum; finely disseminated pyrite abundant from 826' to 827'.

'Appendix III - Comparison of Well Logs with Core Lithology'

1. Make changes listed under Item 1 of 'Lithological Description of Core', throughout.

In addition, make the following corrections,

2. Paragraph 2, line 4: delete 'anhydrite' and replace with 'dolomite'.

line 9: delete 'anhydrite' and replace with 'dolomite'.

3. Paragraph 3, line 4: delete 'anhydrite' and replace with 'gypsiferous dolomite'.

4. Paragraph 4, line 5: delete 'anhydrite' and replace with 'dolomite'.

'Plate I - Composite Well Log'

Remove and destroy and replace with Plate 1 of this Supplement.

REFERENCES

STEWART, A.J., 1969 - Completion report, BMR Alice Springs No. 3 (Ringwood). Bur. Miner. Resour. Aust. Rec. 1969/7 (unpubl.).

STEWART, A.J., in prep. - Petrographic and geochemical study of the Ringwood evaporite deposit. Bur. Miner. Resour. Aust.

COMPOSITE WELL LOG

PLATE 1

OPERATOR: BUREAU OF MINERAL RESOURCES

WELL NAME AND NUMBER: BMR ALICE SPRINGS No.3

NORTHERN TERRITORY 1:250,000 SHEET ALICE SPRINGS SF 53-14. AMADEUS BASIN. WELL STATUS: PLUGGED & ABANDONED

DRILLING DATA

LOCATION: Lat. 23° 53'S Long. 134° 53'E

ELEVATION: Ground level 1300' (396m) approx.

DATE SPUDDED: 24-7-68

DATE DRILLING STOPPED: 19-8-68

DATE RIG OFF: 28-8-68

TOTAL DEPTH: driller 852' (259·65m)

welex 834', 816' (254·16m, 248·68m)

HOLE SIZE: INS(mm) FROM TO

7⅞" (187) Sfc. 85' (25·90m)

5½" (140) 85' 300' (91·44m)

4¾" (121) 300' T.D.

CASING:

IN(mm) WT. GR. DEPTH CMT. CMT'D TO

6(152) 21lbs/ft (17·8kg/m w/bore 85' (25·90m) 5sx sfc.

CEMENT PLUGS: SURFACE

PERFORATIONS: NIL

DRILLED BY: BUREAU OF MINERAL RESOURCES

WELL HEAD FITTINGS: none

CEMENTED BY: driller

LOGGED BY: welex

DRILLING METHOD: air rotary

LITHOLOGY BY: A.J. Stewart

DRILLING DATA BY: J.M. Henry

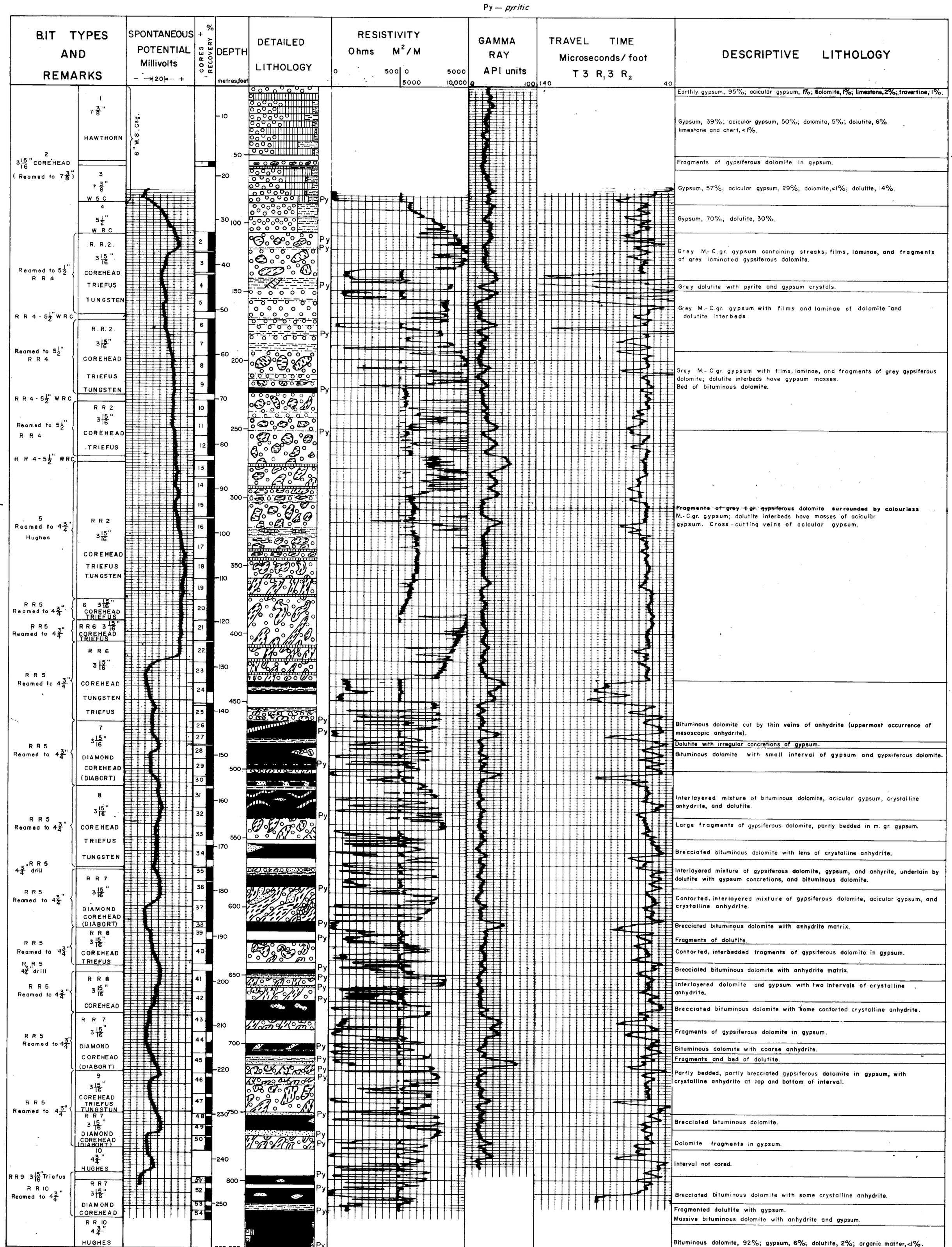
LOG DATA

LOG TYPE	LATEROLOG	SPONTANEOUS POTENTIAL	GAMMA RAY	ACOUSTIC VELOCITY
DATE	27·8·68	27·8·68	27·8·68	27·8·68
RUN NO.	-1-	-1-	-1-	-1-
DEPTH — DRILLER	852' (259·65m)	852' (259·65m)	852' (259·65m)	852' (259·65m)
DEPTH — WELEX	834' (254·16m)	834' (254·16m)	834' (254·16m)	834' (254·16m)
BTM. LOG INTER.	820' (249·90m)	804' (245·02m)	790' (240·83m)	809' (246·54m)
TOP LOG INTER.	84' (25·60m)	84' (25·60m)	0' (0m)	84' (25·60m)
CASING DRILLER	6"(152mm) at 85'(25·90m)	6"(152mm) at 85'(25·90m)	6"(152mm) at 85'(25·90m)	6"(152mm) at 85'(25·90m)
CASING — WELEX	84' (25·60m)	84' (25·60m)	84' (25·60)	84' (25·60m)
BIT SIZE	4¾" (121mm)	4¾" (121mm)	4¾" (121mm)	4¾" (121mm)
TYPE FLUID IN HOLE	SAT'D SALT WATER	SAT'D SALT WATER	SAT'D SALT WATER	SAT'D SALT WATER
DENS. | VISC.	NA | NA	NA | NA	NA | NA	NA | NA
pH | FLUID LOSS	NA | NA ml	NA | NAml	NA | NAml	NA | NAml
SOURCE OF SAMPLE	Pit	Pit	Pit	Pit
R_m at MEAS. TEMP.	0·19 at 60°F (15·6°C)	0·19 at 60°F (15·6°C)	0·19 at 60°F (15·6°C)	0·19 at 60°F (15·6°C)
R_{mf} at MEAS. TEMP.	NA	NA	NA	NA
R_{me} at MEAS. TEMP.	NA	NA	NA	NA
SOURCE R_{mf} R_{me}	NA | NA	NA | NA	NA | NA	NA | NA
R_m at BHT	NA	NA	NA	NA
TIME SINCE CIRC.	3 HOURS	3 HOURS	3 HOURS	3 HOURS
MAX. REC. TEMP.	NA	NA	NA	NA
EQUIP. | LOCATION	9343 | AS	9343 | AS	7343 | AS	7343 | AS
TOOL TYPE AND NO.	GUARD	GUARD	24A	24A
TOOL POSITION	FREE	FREE	FREE	FREE
RECORDED BY	PATTERSON			
WITNESSED BY	STEWART and REINE			

LITHOLOGICAL REFERENCE

Acicular gypsum — Massive gypsum — Gypsiferous dolomite — Crystalline anhydrite — Bituminous dolomite — Friable dolutite

Py — pyritic



To accompany Record 1969/7
(Supplement)

F 53/A14/104