# CONTENTS ENVELOPE 945

TENEMENT: S.M.L. 187

TENEMENT HOLDER: Geosurveys of Aus. Pty. Ltd.

003 ENV 945.

DEPOT AND LABORATORIES
57 TODVILLE STREET. WOODVILLE WEST • TELEPHONE 45 4624

geosurveys
OF AUSTRALIA PTY. LTD.
GEOLOGICAL AND GEOPHYSICAL CONSULTANTS AND CONTRACTORS
DA COSTA BUILDING. GRENFELL STREET. ADELAIDE. SOUTH AUSTRALIA 5000
TELEPHONE: 23 6116 · G.P.O. BOX 1479L · TELEGRAMS: "GEOSURVEYS" ADELAIDE



REPORT FOR SIX MONTHS ENDED 1ST OCTOBER 1968.

STANSBURY BRINES PROJECT

SPECIAL MINING LEASE NO. 187

During the period, a number of basic studies were undertaken in relation to this project. Cundill, Meyers & Associates Pty. Ltd. have provided preliminary reserve estimates and reservoir studies pertinent to exploitation of the Kulpara dolomite. Laboratory work has been carried out on artificial brine solutions approximating that of the natrual brines previously recovered in the Stansbury West No. 1 Well.

A preliminary Market Study was carried out by Messrs. R.C. Sprigg and D.R. Walter, indicating a potential for additional salt production in Australia, providing that a marketable product could be produced in close proximity to a modern deep-sea port. Information indicated that Japanese markets provided the principal potential outlet, but that with large developments coming into operation in Western Australia, considerable caution had to be exercised.

Preliminary studies by R.C. Sprigg drew attention to the general favourable situation of the Kulpara porous dolomite of Cambrian age in relation to the developing Port Giles. This area is also one of extensive salt lagoons where previously most of Australia's salt had been harvested. The area has the advantage of an indigenous population experienced in salt harvesting and it is a reservoir of summer labour. Recent rurual development also resulted in the construction of fresh water pipelines into the area from the River Murray, and the introduction of 3-phase power. Roads are excellent and a direct road exists between the Weavers Lagoon area and Port Giles.

Discussions were held with the Director of the Harbours Board (Mr. Sainsbury) and the Chief Engineer for Harbours (Mr. D. O'Malley).

...2

OUTSIDE CONSULTING.

Upon preliminary favourable consideration of the reports by Messrs. Sprigg and Walter, it was decided to engage the consulting and organising services of International Technical Services Ltd., the Battelle Memorial Institute of U.S.A. and The Australian Mineral Development Laboratories. Authority was given for the International Technical Services group to proceed with the first phase of a feasability study as to the availability of market for salt throughout the world. The preliminary report on this investigation has been received, and a copy of the conclusions are appended herewith. The report draws attention to the growing competition in the salt marketing field in Australia and the need to tie up markets in advance of field development. Production of the order of 250,000 to 500,000 tons annually is being considered.

Later during the period, authority was also given to International Technical Services to have The Australian Mineral Development Laboratories carry out laboratory tests for the production of salt from artificial brine solutions approximating the composition of the Stansbury Brines previously recovered from Drill Stem Tests in Stansbury West No. 1 Well. The preliminary tests have indicated that a 98% salt can be produced without serious contamination by other residual salts and that a 99% salt can be achieved only at the expense of loss of up to 40% or more of the product. These studies are continuing.

GENERAL.

A broad geological investigation of the area has been carried out by staff members of Geosurveys of Australia Pty. Ltd. and preliminary survey levelling has been carried out in the region of Weavers Lagoon, where deep drill holes are tentatively planned to exploit the sub-surface Kulpara dolomite reservoirs. Legal searches have been instituted through our Company Solicitors (Litchfield & Associates) to obtain surface rights to Weavers Lagoon and adjoining Crown Land.

Preliminary quotes have been called from leading Australian drilling companies for the contract drilling of one to three wells considered necessary to recover the necessary volumes of brine to meet the annual requirements of $\frac{1}{2}$ million tons of salt production annually.

12th November 1968.

R. C. Sprigg
Managing Director,
GEOSURVEYS OF AUSTRALIA PTY. LTD.

Appended:
Conclusions and Recommendations-
Cundill,Meyer & Associates Report.
Preliminary Conclusions -I.T.S. Report.
Salt Industry Feasibility Study -
AMDEL Report.

BEACH PETROLEUM N.L.

# INVESTIGATION OF THE DOLOMITE RESERVOIR OF THE LOWER CAMBRIAN PARARA-KULPARA SEQUENCE SOUTHERN YORKE PENINSULA

by

D. I. Rutledge

of

Cundill, Meyers & Associates Pty. Ltd.

## IV CONCLUSIONS AND RECOMMENDATIONS

The Unit 3B dolomite appears to occur in the subsurface over most of the eastern half of the southern Yorke Peninsula and probably thickens to the southeast offshore. Results from wells drilled to date indicate the presence of zones with good porosity and suggest zones of effective permeability are present within the dolomite reservoir, and also that individual zones appear to be connected vertically in the vicinity of each well.

The Stansbury West No. 1 well has the best reservoir development. It theoretically could supply brine at the required rate ($122.6 \times 10^6$ gallons per year) for a period of 4 years if the radius of influence of the well were 1000' and 24 years if the radius of influence of the well were 2500', and if permeability were reasonably continuous. The life of the well would be considerably extended if there was significant replenishment by sea or rain water although some eventual dilution could be expected in these cases.

Should reservoir permeability be restricted, it would probably not be possible to maintain the required production rate. Reservoir depletion would be associated with lower pressure and greater drawdown, and a larger number of more closely spaced wells would then be necessary to produce the same amount of brine.

Prediction of production rates and amounts given in this report can only be mostly hypothetical at this state and an extended testing programme for Stansbury West No. 1 is recommended to properly evaluate the Unit 3B reservoir potential. Measurements of porosity and permeability should be made on the existing Stansbury West No. 1 cores to allow comparison of porosity values with log calculations and to establish actual permeability values.

In conclusion, the Unit 3B dolomite appears to be continuous over a large area and to contain zones of good porosity and effective permeability although with an unknown degree of continuity. It should be theoretically possible to produce 365 million gallons of brine per year from 3 wells with 640 acre spacing providing permeability is consistently effective and continuous enough to allow rapid replenishment of the zones immediately adjacent to the wells.

CONYNGHAM ST. FREWVILLE SOUTH AUSTRALIA 5063 TELEPHONE 79 1662 TELEGRAMS 'AMDEL' ADELAIDE

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: IC 3/287/7
YOUR REFERENCE:

24 OCT AM 8

23rd October, 1968

The Manager,
International Technical Services Ltd,
202 East Terrace,
ADELAIDE, SA 5000

Attention: Mr D. Saunders

Dear Sir,

SALT INDUSTRY FEASIBILITY STUDY

The preliminary results of evaporation tests on synthetic brine are presented herewith.

Following discussions with Messrs R.C. Sprigg and D. Von Sanden at your office on 22nd July, 1968, the composition of brine from DST 5 (4720-4832 ft) was selected as typical of that likely to be available. The brine for evaporation tests was made up according to the analysis given for DST 5 (omitting lithium - 3 ppm). Forty litres of brine were prepared.

| Component | ppm |
|---|---|
| Cl | 98,300 |
| $SO_4$ | 1,187 |
| $HCO_3$ | 93 |
| Na | 62,100 |
| K | 828 |
| Ca | 1,178 |
| Mg | 190 |

| Assumed Composition | ppm |
|---|---|
| $CaHCO_3$ | 124 |
| $CaSO_4$ | 1,682 |
| $CaCl_2$ | 1,806 |
| $MgCl_2$ | 744 |
| NaCl | 157,926 |
| KCl | 1,579 |

The specific gravity of the brine was 1.113 at 20°C and the initial pH was 7.0.

Two separate tests were conducted:

1. By direct evaporation almost to dryness.
2. By stagewise evaporation, collecting solid crystallized products at intervals.

The Tests are described below.

1. Direct Evaporation

A 500-ml portion of brine was evaporated under an infra-red lamp until almost dry. The salt/brine mixture was filtered under suction until the salt was as dry as possible. The salt was then washed on the filter with exactly 50 ml of saturated sodium chloride and again sucked dry. The amount of liquid "hold up" in the solid was determined by weighing the salt, drying at 100°C and re-weighing. The solid product, the initial filtrate (bitterns) and wash liquor were analysed separately and the distribution of the components was calculated after combining the results for the filtrate and wash.

Results

| | Distribution of Components, % | | | | | |
|---|---|---|---|---|---|---|
| | NaCl | KCl | $CaCl_2$ | $CaSO_4$ | $MgCl_2$ | $CaHCO_3$ |
| Solid product | 87 | 3 | 3 | 70 | 3 | 85 |
| Filtrate (bitterns) | 13 | 97 | 97 | 30 | 97 | 15 |

The total volume of bitterns was 40 ml including 5.5 ml of "Hold up" liquor.

Approximate composition of Solid Product:

| | % |
|---|---|
| NaCl | 99.0 |
| $CaSO_4$ | 0.7 |
| $CaHCO_3$ (as $CaCO_3$) | 0.1 |
| KCl | 0.03 |
| MgCl | 0.03 |
| $CaCl_2$ | 0.03 |

2. Stagewise Evaporation

Most of the brine (39 litres) was evaporated by infra-red heating under simulated natural conditions. An oscillating fan provided a constant air stream over the brine surface. The brine temperature reached 35 to 40°C during the day but was allowed to fall to approximately 20°C at night. Salt commenced to crystallize at a brine specific gravity of 1.210; the specific gravity then remained constant until approximately 80% of the salt had been crystallized, but then rose gradually to 1.220 after 94% had been crystallized.

Solid products were removed at intervals by filtration under suction and then washed by displacement with approximately 500 ml of water. The wash water was returned to the evaporation bath with the filtrate. The final product obtained at a brine specific gravity of 1.220 was not washed after filtration, but the "hold-up" volume was determined and an adjustment was made in the composition of the solid to allow for the bitterns remaining in it.

The solid products and bitterns were analysed to enable distribution of the components to be determined. Some difficulties were experienced in obtaining material balances for some of the components, but the figures given in Table 1 are regarded as reliable indications of the compositions of the various fractions. Some of the figures have been "rounded off" for the purpose of evaluating the results.

From the results of the two tests the conclusion is reached that a salt product containing 99% NaCl could be obtained only in the earlier stages of evaporation (up to 40% of the total NaCl), but that at least 80% of the NaCl could be obtained as a 98% product (assuming no contamination with foreign materials). Most of the bicarbonate and sulphate in the brine are precipitated during the middle stages of evaporation, so there is little likelihood of reducing the level of contamination by these components except by limiting the extent of evaporation. In the absence of any specification on product grade no further evaluation can be made at this stage.

Yours faithfully,

J.D. Hayton

J.D. Hayton
Assistant Officer in Charge,
Industrial Chemistry Section.

JDH:ss

TABLE 1: COMPOSITION OF SALT PRODUCTS

| Fraction | $NaCl$ | | $KCl$ | | $CaSO_4$ | | $MgCl_2$ | | $CaHCO_3$ | | $CaCl_2$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | dist. % | % | dist. % | % | dist. % | % | dist. % | % | dist. % | % | dist. % |
| 1 | 99.8 | 31 | <0.01 | 0.1 | <0.1 | 2.1 | <0.01 | 0.3 | 0.06 | 21 | <0.01 | 0.1 |
| 2 | 99.5 | 12 | <0.01 | 0.1 | 0.4 | 6.1 | <0.01 | 0.3 | 0.08 | 13 | <0.01 | 0.1 |
| 3 | 98.3 | 22 | 0.01 | 0.3 | 1.6 | 45.6 | 0.02 | 1.0 | 0.10 | 32 | 0.01 | 0.2 |
| 4 | 98.8 | 14 | 0.02 | 0.4 | 1.2 | 22.0 | 0.03 | 1.0 | 0.10 | 17 | 0.02 | 0.5 |
| 5 | 97.7 | 15 | 0.15 | 2.4 | 1.2 | 22.0 | 0.10 | 1.4 | 0.08 | 13 | 0.40 | 6.1 |
| Bittern | - | 6 | - | 96.7 | - | 2.2 | - | 96.0 | - | 4 | - | 93.0 |

INTERIM REPORT

on

# PHASE I - A STUDY OF THE FREE WORLD MARKETS FOR SALT

to

INTERNATIONAL TECHNICAL SERVICES LIMITED
(Geosurveys of Australia Pty. Ltd.)

October 2, 1968

by

M. G. Roth and R. W. Hale

BATTELLE MEMORIAL INSTITUTE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

INTERIM REPORT

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PHASE I - A STUDY OF THE FREE WORLD MARKETS FOR SALT

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## INTRODUCTION

Geosurveys of Australia Pty. Ltd. is considering the exploitation of a Yorke Peninsula brine discovery in the State of South Australia. Because of other extensive developments within the salt industry, particularly in Western Australia, Battelle was asked to conduct a study on the Free World Market for Salt.

This study consists of two phases. Phase I consists of a general identification of apparent markets by virtue of current size or growth potential. Phase II would be concerned with the determination of the probable penetration that could be achieved by a new producer on the Yorke Peninsula in the selected markets.

These preliminary conclusions have been requested by the Sponsor due to the time requirements. This interim report is based on research and analysis conducted only under Phase I of the study.

## PRELIMINARY CONCLUSIONS ON THE MARKET POTENTIAL FOR SALT

There has been considerable activity within Western Australia during the past two years to develop additional productive facilities for salt (NaCl). Successful operations will increase the production and supply of salt for domestic use and for export much above current levels. Since the Sponsor is anticipating the initiation of its own facilities in South Australia, there is concern about the ability of the market to absorb this great increase in supply.

While Australia's domestic consumption is expected to steadily increase, most of the new supply of salt probably will seek export markets, primarily in Japan. However, the Western Australian Government is concerned about the competition and price levels for established companies. Therefore, it is anticipated that only two or three of the six newly formed companies will be granted export licenses.

On the basis of an analysis of this increase in production and export supply of salt and the projected import requirements of Japan, it is expected that there will be a considerable excess available for export to that and other markets. While during 1969 and 1970 this surplus should not be excessive, between 1970 and 1980 much greater quantities will be involved. In addition, the potential for increased imports of salt into other countries in Asia and other nearby markets does not appear very promising. One exception may be Malaysia. While this country presently imports over 3,000 tons of salt annually from Austalia, there is a possibility of increasing the amount to 10,000-25,000 tons annually over the next few years. The only other markets that offer reasonable potentials are the United Kingdom, Canada, and Brazil. However, the shipping distances to these markets form a major deterrent.

Therefore, the feasibility of the Sponsor's establishing new production facilities in South Australia appears to hinge on the Japanese market. At this time there appears to be a reasonable chance for being able to supply that market even though large supplies are available from Western Australia. This conclusion is based on the internal competition between Japanese trading companies.

Most of the new companies in Western Australia are either joint ventures or have sales contracts with Japanese importers. Since three or four of these companies may not receive export licenses to supply the Japanese market, there appears to be an opportunity for a company in South Australia. Therefore, it is suggested that several Japanese trading firms be contacted for the purpose of determining interest in long-term contracts for the supply of salt. This should be done immediately, with emphasis on the potential lack of supply from established suppliers due to insufficient capacity and to political reasons, the competitiveness of salt shipped from South Australia with most of Japan's current suppliers, and the long-standing trade relationships between South Australia and Japan in salt.

## BASES FOR CONCLUSIONS

These conclusions are based on analysis and interpretation of the following information. Although considerable detail about the activities and needs of individual countries is lacking, the available information is believed sufficient for a preliminary evaluation.

## TREND OF THE AUSTRALIAN SALT INDUSTRY

While Australia's production of salt has grown over 20 percent during the past five years; in 1966 it still represented less than one percent of world production. As shown in Table 1, production of salt in Australia increased from 463,000 tons in 1960 to 644,500 tons in 1966. Imports of salt have been a minor and declining factor, with nearly all quantities originating in the United Kingdom. Exports have varied considerably from year to year, accounting for up to 20 percent of domestic production. Nearly all those shipments have been from South Australia to Japan and New Zealand, with small quantities to contiguous island economies. The inferred domestic consumption of salt in Australia has fluctuated between 1960 and 1966; however, there has been considerable growth during 1965 and 1966.

TABLE 1. AUSTRALIA SALT INDUSTRY
(Thousands of Tons)

| Year | Domestic Production | Exports | Imports | Inferred Domestic Consumption |
|---|---|---|---|---|
| 1966-1967* | 644.5 | 93.4 | 6.8 | 557.9 |
| 1965-66 | 654.2 | 113.5 | 6.8 | 547.5 |
| 1964-65 | 545.5 | 116.6 | 8.0 | 436.8 |
| 1963-64 | 581.5 | 119.9 | 5.8 | 467.4 |
| 1962-63 | 536.0 | 74.5 | 7.7 | 468.2 |
| 1961-62 | 508.7 | 59.6 | 11.8 | 460.9 |
| 1960-61 | 463.3 | 18.3 | 19.4 | 464.4 |

* Fiscal year July 1, 1966 to June 30, 1967

Source: Australian Department of Trade and Industry

During the past couple of years, there has been extensive interest in a developing salt industry in Western Australia. This has progressed to the point of the government granting reserves to newly formed companies and preliminary investment in and development of productive facilities. Included in this group of companies have been the following:

(1) Shark Bay Pty., Ltd., Shark Bay, W.A., owned by Adelaide Steamship Company Ltd. (60 percent) and Garrick Agnew Pty., Ltd. (40 percent). Contracted to sell to Mitsui Dussan Kaisha, Ltd., 1.6 million tons of salt over a seven-year period; first shipments made in 1968. The company plans to produce 500,000 tons annually of salt in 1969. Located near Useless Loop in Western Australia, the company has formed evaporating ponds by enclosing the inlet and built shiploading facilities on an off-shore island.

(2) Leslie Salt Company of San Francisco, California, U.S.A. Biggest solar salt producer in the U.S.A. has contracted with Leslie Ishirjama, Inc., of San Francisco to supply the Japanese market through Tashoku, Ltd. Expects to begin exporting 475,000 tons annually in 1969 and increase this to 1,000,000 tons annually by 1975 if demand warrants. Has leased 40,000 acres of tidal salt marsh 30 miles East of Port Hedland, W. A. Seawater is to be circulated through eight ponds and brine pumped into a canal to flow 18 miles to a crystallizer pond adjoining Port Hedland Township.

(3) Dampier Salt, Ltd. Owned by Comalco Industries Pty., Ltd. (50 percent), Marubeni Iida Co. Ltd. and Nissho Co. Ltd. of Japan (32 percent combined), British Tobacco Ltd. (14 percent), and C.M.L. Society Ltd. (4 percent). To start construction on a salt plant near port of Dampier. Plans to produce 650,000 tons annually by 1970.

(4) Texada Mines, Ltd., of Texada, B.C., Canada. Agreement with W.A. government for two-year research program on the feasibility of a potash facility on Lake McLeod. To extract economical volume of potash, the company anticipates a by-product of 3,000,000 tons of salt annually.

(5) Norseman Gold Mines N.L. (51 percent) and Sumitomio Shoji Kaisha Ltd. (49 percent). A joint venture for exporting salt obtained from Lake Lefroy near Norseman to Japan through Port of Esperance. Feasibility of the project depends on construction of a railway to Esperance and lowering of the freight rate by the government of Western Australia. Company anticipates shipping 200,000 tons of salt by 1969, increasing to 500,000 tons annually over the next 5-10 years.

(6) Exmouth Salt Co., of Exmouth Gulf, Western Australia. Owned by group of individuals from Perth with interest in acquiring a Japanese equity. Anticipate getting into production for export in 1970 with goal of 1,500,000 annually in subsequent years.

These very ambitious plans would increase the total volume of salt production by 1970 nearly 400 percent over current levels. This is based on Battelle's estimates of production from current facilities and the volume expected to be forthcoming from the new facilities by 1970.

POTENTIAL SALT PRODUCTION: 1970

| | Tons |
|---|---|
| Current Facilities | 700,000 |
| New Facilities | |
| Shark Bay Pty. Ltd. | 300,000 |
| Leslie Salt Co. | 500,000 |
| Dampier Salt, Ltd. | 100,000 |
| Texada Mines, Ltd. | 500,000 |
| Norseman Gold Mines N.L. | 500,000 |
| Exmouth Salt Co. | 100,000 |
| TOTAL PRODUCTION | 2,700,000 |

Source: Battelle estimates; Australian Mining Journal

Assuming a normal growth in domestic consumption to an estimated 600,000-630,000 tons in 1970, a little over 2,000,000 tons would be available for export.

However, it appears the total amount of new salt production will not actually reach 2,000,000 tons. Much depends on the awarding of export licenses to the new companies. Although the W. A. Government is believed to favor foreign capital participation, and most of the new companies have either Japanese or U.S. equity, it also is very much concerned about competition in terms of total supply

and price levels and the availability of markets. It is understood that only Shark Bay, which exported 120,000 tons during 1968, Leslie Salt, and Texada have prospects of getting export licenses. And these companies' exports have been limited, along with other stringent controls, by the W. A. Government.

This reduction in new productive capacity lowers the prospective volumes considerably during the next few years. A summary of the estimated production and quantities available for export between 1968 and 1980 are shown in Table 2.

It is believed production of salt in 1968 will be approximately 870,000 tons, imports should increase to around 10,000 tons, and domestic consumption will be about 594,000 tons. This leaves approximately 286,000 tons of salt to be exported. By 1969, production is expected to jump to 1,670,000 tons, and with normal growth in consumption, the amount for export should increase to 1,068,000 tons. Production is expected to reach 3,030,000 tons by 1975, with 2,320,000 tons available for export, and in 1980 production should increase to 3,330,000 tons and 2,600,000 tons would need to be exported.

## EXPORT POTENTIAL

The export markets for salt are very complex and illusive in nature. Nearly all countries produce some of their own salt. Even those that are net exporters may import varying amounts of their requirements. In some instances, countries with a considerable supply deficit also export to other countries. In other cases, some countries enjoy the advantage of being relatively near to large, fully industrialized markets and have developed long-standing trading relationships.

The primary world import markets for salt consist of the regions of North America, Europe, and Asia. The amounts of imports used by these regions and the other major regions of the world are as follows:

WORLD IMPORTS OF SALT, 1965

| | Tons |
|---|---|
| Asia | 3,650,000 |
| Africa | 283,000 |
| Europe | 2,950,000 |
| South America | 298,000 |
| North and Central America | 2,620,000 |
| TOTAL | 9,801,000 |

Source: U.S. Bureau of Mines

Based on a total world production of approximately 119,500,000 tons of salt in 1965, the 9,801,000 tons of imports represents about 8.2 percent of the total supply. With the expanding need for salt by industrialized countries and the

TABLE 2. ESTIMATED AUSTRALIAN SALT PRODUCTION
1968-1980 (Tons)

| Company | Years | | | | |
|---|---|---|---|---|---|
| | 1968 | 1969 | 1970 | 1975 | 1980 |
| I.C.I.A.N.Z. | 550,000 | 600,000 | 650,000 | 1,000,000 | 1,250,000 |
| Shark Bay | 120,000 | 250,000 | 300,000 | 300,000 | 300,000 |
| Leslie Salt | -- | 400,000 | 500,000 | 1,000,000 | 1,000,000 |
| Texada Mines | 50,000 | 250,000 | 250,000 | 500,000 | 500,000 |
| B.H.P.-Whyalla | 50,000 | 60,000 | 80,000 | 80,000 | 80,000 |
| Others | 100,000 | 110,000 | 110,000 | 150,000 | 200,000 |
| Totals | 870,000 | 1,670,000 | 1,890,000 | 3,030,000 | 3,330,000 |
| Plus imports | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| Less inferred domestic consumption | 594,000 | 612,000 | 630,000 | 720,000 | 740,000 |
| Export supply | 286,000 | 1,068,000 | 1,270,000 | 2,320,000 | 2,600,000 |

Source: ITS and BMI estimates.

growth of developing countries, the trend of world imports of salt related to total production through 1980 is estimated to be as follows:

WORLD TREND OF SALT IMPORTS
(Tons)

| | Production | Exports | Percent |
|---|---|---|---|
| 1965 | 119,500,000 | 9,801,000 | 8.2 |
| 1970 | 126,000,000 | 11,350,000 | 9.0 |
| 1975 | 146,000,000 | 14,600,000 | 10.0 |
| 1980 | 175,000,000 | 17,500,000 | 10.0 |

Source: Battelle estimates; U.S. Bureau of Mines

Australia's estimated share of world imports related to the supply available for export would be as follows:

AUSTRALIA'S SHARE OF WORLD SALT IMPORTS
(Tons)

| | Total World Imports | Australia Exports | Percent |
|---|---|---|---|
| 1965 | 9,801.000 | 113,500 | 1.2 |
| 1970 | 11,350,000 | 1,270,000 | 11.2 |
| 1975 | 14,600,000 | 2,320,000 | 16.0 |
| 1980 | 17,500,000 | 2,600,000 | 14.8 |

Source: Battelle estimates

Salt, especially industrial and rock salt, is a very low-value commodity. Consequently, there are definite limitations on the distances it can economically be transported, although there are several instances in world trade where it is shipped thousands of miles. Therefore, the existence of large industrialized countries within acceptable shipping distances of the exporting countries is of primary importance. In this respect, Australia is at a disadvantage due to its distance from the major industrial areas of Europe and North America.

Table 3 indicates Australia's exports for 1966-67 by general types of salt, destinations, quantities and approximate values per ton. Although these data may differ from those of other sources, there is general agreement, and any discrepancies are probably due to the exclusion of some minor markets.

The most significant aspects of Australia's exports are that (1) the major portions of shipments are made to Japan, New Zealand and Malaysia, and (2) the prices for large quantities of refined salt range from $A 15.00 to $A21.00 per ton, while industrial salt ranges from $A 3.40 to $A 3.90 per ton.

TABLE 3. AUSTRALIAN SALT EXPORTS
1966-67 FISCAL YEAR

| Type of Salt | Destination | Tons | Approximate F.O.B. Value $A /Ton |
|---|---|---|---|
| Table salt (in packages not exceeding 14 lb. net weight) | N/A | 390 | 64.10 |
| Other table salt | New Zealand | 1,364 | 14.67 |
| | Other countries | 630 | 15.87 |
| Common salt, N.E.I. | Brunei | 500 | 34.00 |
| | Fiji | 897 | 15.60 |
| | Japan | 78,759 | 3.40 |
| | Malaysia | 3,325 | 3.90 |
| | New Zealand | 6,569 | 17.65 |
| | Other countries | 711 | 21.10 |
| TOTAL EXPORTS | | 93,145 | |

Source: Australian Department of Trade and Industry.

Another important factor is that well over 95 percent of Australia's exports up to 1966-67 originated from South Australia. Table 4 details the destinations, quantities, and approximate values of thos shipments. It will be noted that over 85 percent of South Australia's exports are to Japanese trading companies.

TABLE 4. SOUTH AUSTRALIAN SALT EXPORTS
1966-67 FISCAL YEAR

| Destination | Tons | Approximate Value/Ton |
|---|---|---|
| Fiji | 1,282 | 12.85 |
| Gilbert & Ellice Is. | 10 | 15.80 |
| Japan | 78,759 | 3.30 |
| Malaysia | 3,325 | 3.85 |
| New Caledonia | 13 | 22.15 |
| New Hebrides | 6 | 14.13 |
| New Zealand | 7,883 | 17.90 |
| Papua/New Guinea | 378 | 17.47 |
| Samoa (American) | 19 | 14.42 |
| Tonga | 42 | 15.09 |
| Western Samoa | 222 | 15.51 |
| TOTAL | 91,939 | |

Source: Australian Department of Trade and Industry.

It has been indicated that satisfactory buyer/seller relationships exist between South Australian companies and Japanese importers, quality of product is generally better than other sources, and the prices of the salt are competitive. Therefore, while Western Australia may offer some savings in freight to Japan over South Australia, the established and amiable relationships of the past should be of benefit to any new supplier from South Australia.

## JAPANESE IMPORT POTENTIAL

Traditionally, Japan has imported between 75 and 80 percent of its salt requirements. While Japan produces domestically for both consumer and industrial goods processing, a higher proportion of its salt imports are for industrial

products. This proportion is expected to increase in the future. Table 5 summarizes the distribution of Japanese salt imports for the period 1961-65.

TABLE 5. JAPANESE IMPORTS OF SALT, 1961-65
(Thousands of Tons)

| Year | Industrial | Food | Total |
|---|---|---|---|
| 1961 | 2,600 | 227 | 2,827 |
| 1962 | 2,700 | 201 | 2,901 |
| 1963 | 2,037 | 334 | 3,371 |
| 1964 | 3,663 | 344 | 4,007 |
| 1965 | 3,417 | 441 | 3,858 |

Source: Australian Department of Trade and Industry, Japan Desk, International Trade Relations Division

A more detailed picture of Japan's imports for 1967 by general type and point of origin is shown in Table 6.

TABLE 6. JAPANESE IMPORTS OF SALT, 1967

| Type | Source | Tons |
|---|---|---|
| Common salt (put up for resale) | West Germany | 1 |
| Common salt N.E.S. | Mexico | 2,011,055 |
| | Mainland China | 1,083,539 |
| | Taiwan | 5,513 |
| | Indonesia | 18,891 |
| | India | 391,564 |
| | Pakistan | 95,979 |
| | Aden | 51,291 |
| | Yemen | 112,439 |
| | Spain | 34,467 |
| | USSR | 5,445 |
| | Romania | 25,823 |
| | Turkey | 7,497 |
| | USA | 481,796 |
| | Venezuela | 53,168 |

TABLE 6. (Continued)

| Type | Source | Tons |
|---|---|---|
| | Chile | 170,520 |
| | Tunisia | 35,875 |
| | United Arab Republic | 56,850 |
| | Ethiopia | 169,649 |
| | Australia | 74,649 |
| TOTAL | | 4,886,010 |

Source: Japanese Trade Statistics.

While the Japanese Industrial Structure Research Council had forecast 4,350,000 tons of salt imports for 1967, the actual figure was 4,886,000. Therefore, the Council's forecasts through 1970 have been adjusted as shown in Table 7. Additional estimates have been included for 1975 and 1980.

TABLE 7. FORECASTS FOR JAPANESE SALT IMPORTS 1968-80

| Year | Tons |
|---|---|
| 1968 | 5,170,000 |
| 1969 | 5,440,000 |
| 1970 | 5,780,000 |
| 1975 | 6,230,000 |
| 1980 | 6,800,000 |

Source: Battelle estimates; Japanese Industrial Structure Research Council (M.I.T.I.)

Therefore, we come to a major point in the evaluation. Australia, up to now, has been exporting its excess supply of salt to Asian countries and contiguous islands. Japan, being the most industrialized country in this part of the world, has absorbed the major portion of these exports. The feasibility of initiating a new salt production unit in South Australia hinges on the demand/supply picture for Japan and other possible outlets in Asia plus any other countries

offering sufficient demand and for which South Australian producers can satisfactorily compete. An important element in this evaluation is the new supply that is expected to become available from Western Australia and other exporting areas.

Table 8 is a summary analysis of what the supply/demand relationship is projected to be through 1980 for Japan. While these figures indicate a surplus of supply, only two of the new companies are believed to have definite commitments of their production either through joint ownership or sale contracts with Japanese firms. Despite the fact that the production of these two firms along with I.C.I.A.N.Z. shipments (less domestic consumption increase) exceeds Japan's forecast requirements in 1969 by approximately 150,000 tons, with the small increase in those companies anticipated production during 1970, and possibly for the next couple of years, there will be a near parity during that period between the supply under contract and Japan's forecast requirements. In addition, the internal competition between Japanese trading companies must be considered. It is understood individual importing companies are assigned quotas by the Japanese Monopoly Corporation based on that organization's estimate of the demand requirements. Two companies, Marubeni Iida Co. Ltd. and Sumitomo Shoji Kaisha Ltd., have joint equity positions with Dampier Salt, Ltd., and Norseman Gold Mines N.L. Since it is believed neither of these companies will obtain export licenses from the W. A. Government, it is assumed these two Japanese import houses have quotas which they will be unable to fill except from either another Australian source or some other foreign source.

TABLE 8. JAPANESE SUPPLY/DEMAND FOR SALT, 1968-80
(Tons)

| Year | Forecast Demand | Basic Supply (1967) | Forecast New Australian Supply* | Surplus Australian Supply |
|---|---|---|---|---|
| 1968 | 5,170,000 | 4,886,000 | 320,000 | 36,000 |
| 1969 | 5,440,000 | 4,886,000 | 1,102,000 | 548,000 |
| 1970 | 5,780,000 | 4,886,000 | 1,304,000 | 410,000 |
| * | | | | |
| 1975 | 6,230,000 | 4,886,000 | 2,354,000 | 1,010,000 |
| 1980 | 6,800,000 | 4,886,000 | 2,634,000 | 720,000 |

* Consider increase in domestic consumption.

Source: Battelle estimates; Japanese M.I.T.I.

Related to these deficiencies is the relative instability and lack of capacity of some of Japan's regular sources of salt supply. An example of this problem that occurred in previous years is when the stocks of Egyptian salt "ran out" after supplying 60,000 tons to the Japanese Monopoly Corporation. Similarly,

salt available from Taiwan was limited to 350,000 tons, which apparently was less than the volume originally anticipated.

Another tentative limitation to Japan fulfilling its salt requirements involves political factors. While Communist China was the second largest supplier to Japan in 1967, it is close to Japan, and its salt is very cheap, the possibility of this source of supply being cut off would be critical to Japan. In a similar vein, supplies from such countries as Aden, Yemen, and Rumania must be open to question.

On the other hand, with the development of Western Australian salt facilities, certain reaction can be expected from current suppliers to Japan. It has been indicated that Mexico, Japan's largest supplier, plans to increase its capacity. In addition, although Japanese experts have predicted Australian salt could be landed in Japan for less than from Mexico, that country can be expected to compete vigorously from the standpoint of price, since its product, although of somewhat lower quality, is essentially the same as that from Australia.

Therefore, although there appears to be an excess of supply, an opportunity may exist for additional companies to contract for export to Japan. This suggests that a potential new supplier should contact the two trading companies mentioned above and other importers also, in an effort to obtain a contract for sales. Due to the relative importance of the Japanese market, initial investment might be tied to the signing of a long-term contract to supply that market.

## OTHER MARKET POTENTIALS

Because of the nebulous Japanese market potential, it is essential that Australian salt producers consider other outlets for their product. As a Japanese importing representative stated, "This business will become highly competitive and some companies will be seriously disappointed if they are depending only on the Japanese market. They could lose money."

Therefore, information has been obtained on the salt industries and consumption of most countries of the world. The usefulness of much of this information is limited, however, because of the relative value of salt and the high transportation costs. While there are isolated instances of long-distance shipping of salt, normally this involves refined salt shipped in less than bulk quantities and in packages. As a consequence, Australian producers must be primarily interested in other countries within reasonable shipping distances.

Table 9 describes the production, imports, exports, and apparent consumption of salt for selected countries that appear to offer some possibilities as markets for Australian salt. In each instance, the information on the sources of imports that is available is included.

Referring to the Asian countries, during 1964 India had the highest apparent consumption with 5,368,000 tons. However, this country is a major producer and also exported 283,000 tons during 1964. Since India imports relatively little salt and is an undeveloped economy, there seems to be little market potential for Australian salt.

TABLE 9. TRADE AND CONSUMPTION OF SALT IN SELECTED COUNTRIES
(Thousands of Metric Tons)

| Country | Average Annual Production, 1964-66 | Range of Imports, 1963-65 | Range of Exports, 1963-65 | Apparent Consumption, 1965 | Sources of Imports |
|---|---|---|---|---|---|
| Asia | | | | | |
| Aden | 75.4 | -- | 65-70 | 7.5 | -- |
| Afghanistan | 33.7 | -- | -- | 33.7 | -- |
| Burma | 129.7 | -- | -- | 129.7 | -- |
| Cambodia | 59.0 (1964) | -- | -- | N/A | -- |
| Ceylon | 64.7 | 33-40 | -- | 118.0 | All from India |
| Hong Kong | -- | 32-35 | -- | 32.0 | China (25), Thailand (3) |
| India | 4,953.0 | 3.6 (1964) | 195-283 (63 & 64) | 5,368 (1964) | Pakistan (3.6) |
| Indonesia | 250 (1965-66) | -- | -- | 253.0 | -- |
| Iraq | 49.0 | -- | -- | 60 | -- |
| Iran | 257.0 | -- | 2.5-3.4 (63 & 64) | 225 | -- |
| Israel | 47.7 | -- | -- | 55 | -- |
| Jordan | 17.7 | -- | 1.3-6.1 | 14 | -- |
| Korea, Republic of | 482.7 (varies) | -- | -- | 669 | -- |
| Kuwait | 8.0 (1965) | 1.135 (1965) | -- | 9.1 (1965) | Iran (.7), U.K. (.2) W. Germany (1) |
| Laos | 3.4 | 4-1.0 | -- | 3.0 | Thailand (.4) |
| Lebanon | 23.0 | 1.1-1.5 (63-64) | Neg. | 24 | Egypt (1.1) W. Germany (.3) |
| Malaysia (Singapore & Brunei) | -- | 83.1-87.5 (63-64) | -- | 80-85 | Thailand (67.1) |
| Pakistan | 467.7 | 2.0-2.6 (63-64) | -- | 495 | -- |
| Philippines | 138.0 (varies) | -- | -- | 225 | -- |
| Ryukyu Is. | 4.3 | -- | -- | 3 | -- |
| Saudi Arabia | 5.0 | -- | -- | 5 | -- |
| Syria | 19.0 | 15.6-23.5 | -- | 36.6 | Egypt (9.0), Jordan (5.9) |
| Taiwan | 524 | -- | 283-399 | 258 | -- |
| Thailand | 193 | -- | 82-140 | 106 | -- |
| S. Vietnam | 158 | -- | -- | 175 | -- |
| Yemen | 78 (1963-66) | -- | 35-100 | Neg. | -- |
| Other Areas | | | | | |
| United Kingdom | 7,034 | 38-180 | 363-405 | 6,655.0 | W. Germany (35) Poland (10) Tunisia (60) |
| Canada | 3,899 | 222.5-400.6 | 656.5-906.5 | 3,653.1 | US (166.9) Mexico (172.4) Spain (31.3) |
| Brazil | 1,089 | 12-250.0 | .03 | 1,450.0 | W. Germany (78.6) US (35.6) Tunisia (30.2) |

Source: U.S. Bureau of Mines

Most other countries of Asia with substantial requirements also appear to fill their needs through internal production. One exception is Ceylon which, although it produces 60,000 tons internally, also imports 30,000-40,000 tons, all of which originates in India. Another exception is Hong Kong, which must import all its salt requirements of 30,000-35,000 tons annually. Most of its imports come from Communist China and Thailand. The last exception is the area including Malaysia, Singapore and Brunei (combined in this data), which must import 83,000-87,000 tons each year. Australian producers already supply over 3,000 tons to this area, and most of the balance is imported from Thailand. However, due to the nearness of this market, the previous selling relationship, and the steady development of the area, especially Malaysia, there appears to be a possibility of exporting 10,000-25,000 additional tons annually to this area.

The only other countries that appear to offer significant exporting opportunities are quite distant. They include the United Kingdom, Canada, and Brazil. The only reasons they are included here are their quantities of imports and, for U.K. and Canada, the tariff advantages offered to Australian companies. Also in each instance, some of those countries' imports have been shipped considerable distances from Mexico, Tunisia, and Spain.

In summary, the market potential, outside of Japan, is relatively limited. While an Australian salt producer may make some penetration of those markets, most of them produce considerable internal quantities, additional sources of supply have been established, and those economies are mostly under-developed and the rate of growth is very slow.

INTERIM REPORT

on

PHASE I - A STUDY OF THE FREE WORLD MARKETS FOR SALT

to

INTERNATIONAL TECHNICAL SERVICES LIMITED
(Geosurveys of Australia Pty. Ltd.)

from

Roth + Hale
M.E. Roth & R.W. Hale

BATTELLE MEMORIAL INSTITUTE
Columbus Laboratories

October 2, 1968

## INTRODUCTION

Geosurveys of Australia Pty. Ltd. is considering the exploitation of a Yorke Peninsula brine discovery in the State of South Australia. Because of other extensive developments within the salt industry, particularly in Western Australia, Battelle was asked to conduct a study on the Free World Market for Salt.

This study consists of two phases. Phase I consists of a general identification of apparent markets by virtue of current size or growth potential. Phase II would be concerned with the determination of the probable penetration that could be achieved by a new producer on the Yorke Peninsula in the selected markets.

These preliminary conclusions have been requested by the Sponsor due to the time requirements. This interim report is based on research and analysis conducted only under Phase I of the study.

## PRELIMINARY CONCLUSIONS ON THE MARKET POTENTIAL FOR SALT

There has been considerable activity within Western Australia during the past two years to develop additional productive facilities for salt (NaCl). Successful operations will increase the production and supply of salt for domestic use and for export much above current levels. Since the Sponsor is anticipating the initiation of its own facilities in South Australia, there is concern about the ability of the market to absorb this great increase in supply.

While Australia's domestic consumption is expected to steadily increase, most of the new supply of salt probably will seek export markets, primarily in Japan. However, the Western Australian Government is concerned about the competition and price levels for established companies. Therefore, it is anticipated that only two or three of the six newly formed companies will be granted export licenses.

On the basis of an analysis of this increase in production and export supply of salt and the projected import requirements of Japan, it is expected that there will be a considerable excess available for export to that and other markets. While during 1969 and 1970 this surplus should not be excessive, between 1970 and 1980 much greater quantities will be involved. In addition, the potential for increased imports of salt into other countries in Asia and other nearby markets does not appear very promising. One exception may be Malaysia. While this country presently imports over 3,000 tons of salt annually from Austalia, there is a possibility of increasing the amount to 10,000-25,000 tons annually over the next few years. The only other markets that offer reasonable potentials are the United Kingdom, Canada, and Brazil. However, the shipping distances to these markets form a major deterrent.

Therefore, the feasibility of the Sponsor's establishing new production facilities in South Australia appears to hinge on the Japanese market. At this time there appears to be a reasonable chance for being able to supply that market even though large supplies are available from Western Australia. This conclusion is based on the internal competition between Japanese trading companies.

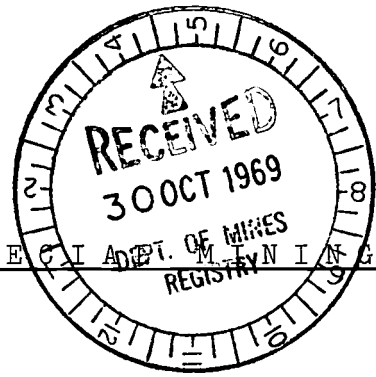
Most of the new companies in Western Australia are either joint ventures or have sales contracts with Japanese importers. Since three or four of these companies may not receive export licenses to supply the Japanese market, there appears to be an opportunity for a company in South Australia. Therefore, it is suggested that several Japanese trading firms be contacted for the purpose of determining interest in long-term contracts for the supply of salt. This should be done immediately, with emphasis on the potential lack of supply from established suppliers due to insufficient capacity and to political reasons, the competitiveness of salt shipped from South Australia with most of Japan's current suppliers, and the long-standing trade relationships between South Australia and Japan in salt.

## BASES FOR CONCLUSIONS

These conclusions are based on analysis and interpretation of the following information. Although considerable detail about the activities and needs of individual countries is lacking, the available information is believed sufficient for a preliminary evaluation.

## TREND OF THE AUSTRALIAN SALT INDUSTRY

While Australia's production of salt has grown over 20 percent during the past five years; in 1966 it still represented less than one percent of world production. As shown in Table 1, production of salt in Australia increased from 463,000 tons in 1960 to 644,500 tons in 1966. Imports of salt have been a minor and declining factor, with nearly all quantities originating in the United Kingdom. Exports have varied considerably from year to year, accounting for up to 20 percent of domestic production. Nearly all those shipments have been from South Australia to Japan and New Zealand, with small quantities to contiguous island economies. The inferred domestic consumption of salt in Australia has fluctuated between 1960 and 1966; however, there has been considerable growth during 1965 and 1966.




# SPECIAL MINING LEASE NO. 187 -

## SOUTHERN YORKE PENINSULA

## REPORT FOR PERIOD ENDED

## SEPTEMBER 30th, 1969

by

GEOSURVEYS OF AUSTRALIA PTY. LTD.

# SPECIAL MINING LEASE NO. 187

Feasibility and related field and laboratory investigations carried out on this area relate closely to parallel studies in progress in the adjoining Peesey Swamp area.

Principal field work entailed drilling of shallow Quaternary aquifers in southeastern Peesey Swamp, also geological and geomorphological inspection of numerous salina lakes and salt pans, and topographic surveys in relation to Lake Fowler and drainage lines into eastern Peesey Swamp.

Detailed drill logs for the foregoing (Peesey Swamp and Bull's Lagoon) shallow holes are appended. Neither holes fully penetrated the Permian sedimentary section, and only the latter hole intersected a Permian brine aquifer.

Brine aquifers of the shallow Peesey Swamp association extend on to S.M.L. 187 (from S.M.L. 299) and the relevant data in relation to geomorphology, hydrology and salinity are summarised in reports prepared for S.M.L. 299, all of which will be supplied separately in relation to that tenement.

Considerable effort was concentrated on defining westerly extensions to possible brine carrying Cambrian dolomites in the area west of Yorketown. The limestones proved not to be present (except as Permian erratics) in the Peninsula Oil Syndicate Bore on Peesey Swamp, but are anticipated to extend westwards at least to a prominent N.E.-S.W. magnetic lineament lying west of Yorketown. In discussion with geophysical consultant, Mr. D. Drayton, agreement was general with the company geophysicists (Dr. W. Stackler and Mr. A. Yakunin) and geologists Mr. R.C. Sprigg and Mr. R.A. Laws) that a reinterpretation of aeromagnetic data interpolated against gravity Bouguer information could lead to better prediction of shallowing Cambrian brine aquifers in this direction.

With this in mind, support was accorded more detailed geophysical effort in this south-westerly area in progress Cambrian oil exploration,

and such surveys have been planned to commence in November 1969.

Additional study of the Cambrian dolomite porosity-permeability was carried out by Mr. R.A. Laws, and this will be extended by deep testing currently recommended in petroleum exploration drilling by Beach Petroleum No Liability in this area. Wells in the Lake Fowler-Yorketown vicinity would be of great value in exploring such potential in this area of greater concentration of surficial salt pans, suitable for an evaporative salt industry. These investigations are being extended by review studies of pre-existing electric logs and formation test data in relation to all of southern Yorke Peninsula.

Considerable interest has been focussed on Lake Fowler as a final evaporative pan, and extensive studies are in progress in relation to such development.

Costing for a railways line from Peesey through this area has been undertaken and reported on by the South Australian Railways. Also facilities at Port Giles for stacking and loading of salt produced within the present area and the adjacent Peesey Swamp have been the subject of serious investigation. All of these investigations are being drawn together as part of an extensive feasibility study involving salt production from Peesey Swamp across to Lake Fowler.

Reg. C. Sprigg,
MANAGING DIRECTOR.

Enclosures attached.

APPENDIX

PROJECT: Southern Yorke Peninsula Salt (S.M.L. 187).

DRILL HOLE NO.: PDH 1.

LOCATION: Southeast side of Peesey Swamp, on roadside near Southwest corner of P T 57, Hd. of Moorowie, Co. Ferguson, S.A.

LATITUDE: S 35° 04' 42"

LONGITUDE: E 137° 31' 15"

Collar elevation approximately 25 feet A.S.L.

Drill - Mayhew rotary, Geosurveys unit No. 215 using Skidmore $4\frac{3}{4}$ inch drag bit.

Driller: Ted Quarry.

Assistant: J. Davis.

On Site Geologist: J. E. Johnson.

Drilling commenced at 1200 hours, April 10th, 1969.

Drilling completed at 1430 hours, April 11th, 1969.

Depth 230 feet. Hole plugged and marked with dropper.

No casing left in hole.

* * *

In mousehole drilled alongside PDH 1 water was struck in a Pleistocene shell bed, at a depth of 4 feet. Water level is static 3 feet below collar.

On the afternoon of April 11th, 1969, small auxiliary pump took $2\frac{1}{2}$ hours to pump a measured 400 gallons out of mousehole, during which time water level was reduced from 3 feet to 7 feet 9 inches below collar, with slow return to static level.

Water sample obtained by bailing from a depth of 6 feet on morning of April 11th, had a specific gravity of 1.045 at a temperature of 20.08°C, indicative of a brine containing 6.6% dissolved salt.

* * *

Detailed Field Sample Log

| | |
|---|---|
| 0 - 10 feet | Cutting of hard calcrete, equal 50% of sample, rest is white clay with about 10% of quartz sand, and rare shell fragments. Sand fraction is medium grained and sub-angular (60% of quartz is clear, 30% is limonite stained and 10% cloudy). Very rarely quartz grains are frosted.<br><br>Slow drilling from 0 to 5 feet, equal to shelly calcrete outcropping at drill collar. Fast drilling from 5 to 10 feet, equal to pale grey sand clay. |
| 10 - 15 feet | Cuttings consist of 50% lumps of grey plastic clay, 30% quartz sand as above, and 20% contaminating calcrete chips. |
| 15 - 20 feet | Stiff plastic grey clay with light brown mottling. Contains about 10% quartz sand in medium grained, clear sub-angular to well rounded, frosted grains. Rare chips of contaminating calcrete. |
| 20 to 35 feet | Sample as before. |
| 35 - 40 feet | Grey plastic clay with about 10% quartz sand as above. Rare chips of calcrete. |
| 40 - 45 feet | Dark grey plastic clay with about 5% of fine quartz sand. Rare chips calcrete. Sand grains frosted, sub-angular to well rounded, mostly clear, but rarely limonite stained. Drilled hole losing water, although return water thick with suspended clay. |
| 45 - 85 feet | Sample same as before. |
| 85 - 90 feet | Sample as above plus rare, well rounded grains of pink garnet. |
| 90 - 115 feet | Sample same as before. |
| 115 - 120 feet | Dark grey, plastic clay, with 10 - 12% fine quartz sand as before. Rare garnet grains. At 117 feet an angular fragment of black chert, 1 cm. across. Return water dense with suspended clays. |
| 120 - 125 feet | Grey plastic clay 85% grey micaceous siltstone 10%. Well rounded, clear, frosted quartz sand grains 5%. |
| 125 - 135 feet | Sample same as before. |

135 - 140 feet Grey plastic clay 80%, grey siltstone 15%; rounded to sub-angular clear frosted quartz grains 5%. Few flakes of biotite, rare grains of pink garent. One composite grain of pyrite and siltstone noted.

140 - 180 feet Sample as above, but without pyrite.

180 - 185 feet Dark grey plastic clay 90%, grey siltstone 5%. Well rounded to sub-rounded. Clear, frosted quartz grains 5%. Rare biotite flakes.

185 - 230 feet Sample as above.

E N D O F H O L E

Summary Log.

0 - 5 feet Shelly, calcreted limestone of Pleistocene Glanville Formation.

5 - 230 feet Grey Permian clays and clay shales with little sand.

* * *

PROJECT: Southern Yorke Peninsula Salt (S.M.L. 187)

DRILL HOLE NO.: Bull's Lagoon No. 1.

LOCATION: On northeastern shore of Bull's Lagoon, alongside old bore and well with cement cylinder collar. West side of section 194, Hd. of Dalrymple, Co. Ferguson, S.A.

LATITUDE: S 34° 56' 00".

LONGITUDE: E 137° 41' 40".

Collar elevation approximately 160 feet A.S.L.

Drill - Mayhew rotary. Geosurveys unit No. 215, using Skidmore $4\frac{3}{4}$ inch drag bit.

Driller: Ted Quarry.

Assistant: J. Davis

On Site Geologist: J.E. Johnson.

Drilling commenced at 1400 hours, April 17th, 1969.

Drilling completed at 1215 hours, April 18th, 1969.

Depth 230 feet. Hole left open. No casing left in hole.

* * *

During progress of drilling, circulation water from adjacent well was always very dense with suspended clays.

On morning of April 18th, water level stood 1 foot below collar, equivalent to level of lagoon floor. On completion of bore, hole was air pumped for 1½ hours to purge sand, mud and drilling brine and on completion of purging, air pumped for 1 hour at rate of 550 g.p.h. over V-notch choke. On completion of pump, test water level rapidly made up to 4 feet below collar, but on afternoon of April 21st, bore had turned artesian and was flowing weakly over collar from sand cut at 220 feet. Bore was still flowing at end of August 1969.

Hydrometer tests show that water from surface seepage near bore contains 1.4% salts, stagnant brine from well, used as drilling fluid, contains 25.9% salts and water from bore at completion of pump test, contains 4.7% salts.

Detailed field sample log.

| | |
|---|---|
| 0 - 10 feet | Pale yellow-grey clay with 5% fine quartz sand, mostly clear, grains well rounded to partly rounded, finely frosted. Rare grains of garnet, flakes of biotite and chips of rock stained yellow and brown by limonite. Sand passes through 25 mesh screen and is retained on 52 mesh. |
| 10 - 15 feet | Light grey clay with about 5% of chips of grey shale and 5% of quartz and grains which are clear, frosted, well rounded to sub-rounded and pass through 25 mesh screen although retained on 52 mesh. |
| 15 - 20 feet | Sample as above. |
| 20 - 30 feet | Sample as above, but clay is tough and silty. |
| 30 - 35 feet | Chips of soft, grey clay-shale with about 5% of very fine quartz sand, grains clear, frosted, round to sub-rounded. Rare grains of pink garnet and flakes of biotite. |
| 35 - 75 feet | Sample as above. |
| 75 - 130 feet | Sample as above, plus few fine chips of pyrite. |
| 130 - 135 feet | Light grey clay with 50% fine quartz sand which passes through 25 mesh screen but is retained on 52 mesh. |

Quartz grains clear, frosted, well rounded to sub-rounded. Rare flakes of biotite, opaque grains and pyrite chips. Few black carbonaceous (lignitic) fragments.

135 - 140 feet — Sample as above but clay 75% of sample and fine quartz sand as above 25%. Rare biotite, opaques and pyrite. Many small chipped grains of pink garnet.

140 - 155 feet — Sample as above.

155 - 160 feet — Sample as above plus few % of coarse quartz grit grains and a few chips of black hornfels.

160 - 220 feet — Sample as above.

220 - 225 feet — Buff grey clay 30% coarse and fine quartz sand 70%. Quartz sand grains clear, frosted, well rounded to sub-rounded. Few garnets, biotite flakes and pyrite chips. Many rock chips, mainly hornfels and greywacke.

225 - 230 feet — Sample as above.

E N D O F H O L E

Summary Geologic Log

0 - 1 foot — Black soil

1 - 130 feet — Grey Permian clay shale with little sand.

130 - 135 feet — Fine Permian sand well sorted. Trace of pyrite and lignite.

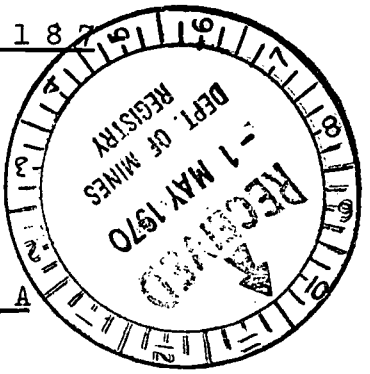
135 - 220 feet — Grey Permian clay shale, little sand.

220 - 230 feet — Poorly sorted Permian sand with small pebbles and trace of pyrite.

END OF HOLE

* * *

# SPECIAL MINING LEASE NO. 187




## SOUTHERN YORKE PENINSULA

## REPORT FOR PERIOD ENDED

## MARCH 31st, 1970

by

GEOSURVEYS OF AUSTRALIA PTY. LTD.

# SPECIAL MINING LEASE NO. 187

During the period covered by this report, the field engineering experiments and office-based feasibility studies (by staff and consultants) continued at an accelerated pace, in regard to the Southern Yorke Peninsula salt project, in its totality.

As usual, field engineering operations were, perforce, concentrated and intensified upon the primary producing area of Peesey Swamp itself (S.M.L.299). These operations are, in part, carried out on S.M.L.187 as it includes the eastern lobe of Peesey Swamp proper.

Practical engineering and economics force initial work to be concentrated on Peesey, where some of the initial cash outlay can be recovered with minimum delay, but the salt potential production of Southern Yorke Peninsula involves a master plan in which the two S.M.L.'s are complimentary, and Geosurveys' staff have never lost sight of the long term production of salt from deep lower Cambrian brine aquifers, using the solid bottomed Lake Fowler as an evaporating and harvesting area.

The area of S.M.L. 187 is coincident with part of O.E.L. 24, and it was the intersection of high grade Cambrian brines in deep hydrocarbon exploration wells which initially stimulated interest in salt production, bearing in mind the particularly favourable environment which involves proximity of salt source, to large harvesting area to deep sea port.

Hydrocarbon exploration of the Cambrian sequences on O.E.L. 24 is therefore inextricably connected with the presence of brines in the same Cambrian sequence.

This exploration, over the past six months, has involved the shooting of approximately 100 miles of seismic reflection profile, magnetic readings being taken synchronously, and required eight field working weeks by the seismic crew. Results of this survey are currently being assessed, and hopefully will lead to the drilling later in 1970 of one or more wells within the Yorketown vicinity within S.M.L.187. In the expected event of intersection of brine bearing limestone intervals, production testing and sampling will be proposed.

A geological reconnaissance survey also was carried out by staff geologists A. T. von Sanden and H. Simpson and student geologist S. Giles. This survey concentrated on Middle Cambrian strata mapped just south of Minlaton on the Maitland 1 : 250,000 geological sheet. Outcrop in this area proved to be extremely poor and no information relevant to structures below the sub-surface Minlaton conglomerate could be derived from surface exposures.

Examination of lower Cambrian outcrops near Ardrossan also failed to yield further relevant data. A large number of samples were collected during this reconnaissance survey and petrological preparation and description are proceeding.

Liaison has been maintained, by occasional consultations, with officers of the Palaeontological Section of the Department of Mines, particularly Mr. J. M. Lindsay, regarding Tertiary to Recent stratigraphy of Southern Yorke Peninsula. Although this project is of no immediate

economic importance, it is continued as opportunity permits, as it is thought that the unusual distribution of Tertiary and Recent marine limestones may be reflecting reactivated basement structures, and not simple enstatic emergence.

D. H. A. von Sanden,
OPERATIONS MANAGER.

JEJ;hjr