

Q6. No. 1.

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PRELIMINARY REPORT ON
TASMANIAN
BEACH SANDS
Fraser Island Syndicate

Preliminary Report on Tasmanian Beach Sands, Fraser River, King Island.

H. W. Sarnell. 31/3/30.

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PRELIMINARY REPORT ON TASMANIAN BEACH SANDS.

A. W. Gammell 31-3-30

- References.
1. Letter from Department of Mines 771/29., enclosing letter from Development and Migration Commission of October 25/29.
 2. Letter from Mr. J. M. Bowling,
Secretary Fraser River Syndicate,
21 Tower Road, New Town, Tas. November 14/29.
 3. Reply to Mr. Bowling. November 28/29. expressing willingness to make a preliminary examination on the following conditions:-
 - (i) My report to be sent in the first instance to the S.A. Department of Mines.
 - (ii) The sample sent to be not less than 200 lb.
 - (iii) The Tasmanian Department of Mines to certify the sample as reasonably representative.
 - (iv) No charge to be made unless the deposit be profitably worked.
 4. Letter from Tasmanian Director of Mines. Dec. 6/29. stating that a fairly representative sample was being sent.
 5. Letter from Mr. Bowling. Dec. 7/29. entirely agreeing with conditions in 3.

Sample Received.

A bag weighing 93 lb.
A bag weighing 19 lb.

It will be noted that it has been agreed that not less than 200 lb. be sent. While this may seem a large sample there were good reasons for asking for so much:-

- (a) It was probable that the first step in treatment would be sizing or classifying into at least 3 grades.
- (b) In tabling some appreciable time is taken to stabilise conditions so that results are unsatisfactory unless enough material is available for runs of reasonable length.
- (c) In testing an ore it is rarely that one run is sufficient.
- (d) The sand was stated to contain 0.25% of cassiterite, i.e. if 100 lb. were divided into 3 equal parts each would contain about .08 lb. of cassiterite.
- (e) It is always desirable to put aside one half of the sample received so that when definite conclusions have been reached they can be checked by applying to an adequate amount of material what is believed to be the best scheme of treatment.

I am dwelling at length on this matter because while this is an unusual instance in that a definite minimum weight had been agreed upon, it is only one of a number of cases in which inadequate samples have been sent me. To a man taking a sample at a mine and then transporting it several hundred miles an extra fifty pounds often seems serious; but it should be considered how small is the labour expended by him compared with that of the experimenter and assayer. In this particular case unfortunately adverse conclusions were reached before the sample was consumed, but if the experimental work had given more favourable results it would probably have been necessary to have sent for a proper sample and to have duplicated a great deal of laborious work and expensive assaying.

Screen analysis of Sample.

| | | <u>Per Cent.</u> | <u>Cumulative per cent.</u> |
|----------|--------------|------------------|-----------------------------|
| | Plus 48 mesh | 7.8 | 7.8 |
| Minus 48 | " 65 " | 14.2 | 22.0 |
| " 65 | " 100 " | 41.0 | 63.0 |
| " 100 | " 150 " | 30.6 | 93.6 |
| " 150 | " 200 " | 5.8 | 99.4 |
| " 200 | | 0.6 | 100.0 |

Analysis by S.A. Government Assayer.Composition of Sand.

| | <u>Per Cent.</u> | |
|--------------------------------|------------------|--|
| H ₂ O | 1.04 | |
| SiO ₂ | 26.22 | |
| Al ₂ O ₃ | 12.48 | |
| Ironoxide | 12.71 | Calculated as Fe ₂ O ₃ though probably a considerable proportion is present as FeO. |
| TiO ₂ | 29.60 | |
| ZrO ₂ | 13.26 | |
| MnO | 0.93 | |
| CaO | 2.94 | |
| MgO | 0.60 | |
| SnO ₂ | not determined. | |
| Alkalies | not determined. | |
| | <u>99.78</u> | |

With this we may compare Mr. Bowling's analysis of "this or a similar sample".

| | <u>Per cent.</u> |
|-----------------|--|
| Silica | 6.00 |
| Zircon | 21.95 (which would correspond to ZrO ₂ 14.75% and SiO ₂ 7.20%) |
| Ferric Oxide | 25.50 |
| Ferrous Oxide | 6.45 |
| Manganous oxide | 2.32 |
| Lime | trace |
| Magnesia | 0.36 |
| Titanium Oxide | 39.00 |
| Tin Oxide | 0.25 |
| | <u>101.83</u> |

The letter from the Development and Migration Commission stated "These sands are said to have the following composition.

| | |
|-------------|--------------------|
| Ilmenite | 60 per cent. |
| Zircon | 10 " " |
| Quartz Sand | 30 " " |
| Tin Oxide | 4 lb. per cb. yd." |

Now pure Ilmenite contains only 52% of TiO₂ so that if 39% TiO₂ is present in the form of ilmenite there must be at least 75% of ilmenite, which added to 22% of Zircon gives 97% for these two minerals, which is very unlikely. The stated quantity of silica (6%) seems very low and suggests that the analysis may have been made on a naturally concentrated portion of the sand.

Rutile may contain only TiO₂. Little however is to be gained by discussing the analysis submitted by Mr. Bowling; suffice to say it must have been made on a sample considerably different from that supplied although the samples may have appeared similar to the eye.

Partial description of certain minerals mentioned.

Ilmenite when pure TiO_2 52%
FeO 48%
sometimes with small amounts of Mg and Mn.
Density 4.5 to 5.0
Colour Iron Black.

Rutile TiO_2 .
Density 4.15 to 4.25
Colour red, reddish brown, black.

Zircon ZrO_2 67%
 SiO_2 33%
Density 4.68 to 4.70
Colour very varied.

Quartz Density 2.60 to 2.66.
Colour very varied.

Cassiterite Density 6.8 to 7.1.
Colour red, yellow, brown to black.

Garnet Double silicate with lime, magnesia, iron, manganese, alumina and chromium as bases.
Density 3.15 to 4.38
Colour very varied.

Staurolite Double silicate of iron and alumina, sometimes with magnesia or manganese.
Density 3.65 to 3.75
Colour brown, reddish or yellowish brown.

Discussion of analysis by S. A. Government Assayer.

ZrO_2 13.26% corresponds to Zircon 20%.
Iron oxide 12% cannot be united with titanium oxide 29% to form ilmenite. It is then probable that some of the titanium is present as rutile. Further some of the iron is likely to be associated with the alumina and silica. Viewed under a low power microscope it is plain that there are appreciable quantities of two minerals which are certainly not ilmenite, zircon, or quartz. These, I believe are garnet, a light-pink heavy variety and staurolite of a yellow-brown colour.

The 12% of alumina is typical of sands of this kind, is agreeable to the presence of garnet and staurolite and is much more to be expected than the absence of alumina noticeable in the other results.

Unfortunately the small sizes of the grains make it almost impracticable to isolate sufficient clean specimens for analysis, and garnet is a mineral of very varied composition.

Minerals present.

Microscopic examination is made difficult by the rounded form of the grains and particularly so by many grains being coated, either by iron oxide or by titanium oxide. The latter is suggested by an unsuccessful attempt to cause a visible change in colour of a sample by heating with hydrochloric acid.

It is possible to get a series of grains from a clear amber up to almost black so it is almost certain that an appreciable number of the dark grains are not ilmenite but coated silicate.

Some apparently black grains crushed on a glass slip showed that the coating was quite thin.

Separation by heavy density solutions is unsatisfactory as the "garnet" is a heavy variety, and, on account of the grains with varying amounts of coating there is a fairly continuous range of densities from the "staurolite" to the ilmenite. Probably most of the black mineral is ilmenite. The assay values and the fact that the grains vary considerably in magnetic attractability suggest an impure variety.

Rutile is visible as red grains, often with partial coats. We have then six minerals present in considerable quantities:- Ilmenite, rutile, zircon, quartz, garnet and staurolite.

There are small quantities of other minerals, such as cassiterite, tourmaline and spinel. Probably some monazite but not enough to be of any importance.

Concentration results.

Test on sand minus 20 plus 60 mesh.
Sand - 11.2% TiO₂

Wilfley table

| | |
|---------------------|---------------------|
| Heads 62% by wt. | Tails 38% by wt. |
|---------------------|---------------------|

Rapid Magnetic Separator

| | | |
|--|---|--------------|
| First heads 21% 17.2% TiO ₂ | Second heads 19% 16.6% TiO ₂ | Tails 22% |
|--|---|--------------|

This run, even before assays were available, suggested a number of difficulties. The composition given in the Development and Migration Commission's letter indicated the following treatment:-

Grading

Tabling

Small quantity of heads containing much of the tin and some ilmenite, the latter to be removed magnetically.

Middlings consisting of ilmenite and zircon, the ilmenite to be removed magnetically. Quartz tails.

When the sand was put on the table it was soon found to be impossible to see at what points the various products should be cut off and that dark particles would come into the tailing. Consequently only two products were made and the heads put on the magnetic separator. Here it was found that the most magnetic portion was distinctly pinkish in bulk, and examination showed that it contained more pink grains than black grains. In some of these pink grains inclusions were seen and while their nature was not determined it seems possible that they were magnetite. The Rapid Magnetic Separator can easily be used to make a large number of products by retreatment with varying spacings and field strengths. In this way the first heads were graded into

- (i) A very small quantity of rough material, probably haematite.
- (ii) Ilmenite.
- (iii) "Garnet".
- (iv) "Garnet" with black mineral.

By eye these first heads appeared to contain about 45% of black mineral, so, assuming this to contain all the 17% of TiO_2 , these black grains would assay about 40% TiO_2 which indicates a somewhat impure ilmenite.

The second heads however present a difficulty for they appeared to contain about 60% of black mineral which would then contain not more than 25% TiO_2 and could not be rutile. However they appeared also to contain about 30% "staurolite" the remainder being chiefly "garnet". Probably the black grains were partly ilmenite and partly coated "staurolite", with perhaps some rutile.

Test on minus 60 plus 100 mesh.

Sand. This not only constituted 62% of the total by weight but assayed 36.0% TiO_2 . The sand was put over the magnetic separator yielding:-

| First Heads | Second Heads | Tails |
|---------------|---------------|---------------|
| 28.4% by wt. | 21.6% by wt. | 50.0% by wt. |
| 34.4% TiO_2 | 43.2% TiO_2 | 33.6% TiO_2 |

The first heads were estimated by eye to contain 30% "Garnet" so that the black mineral might contain 50% TiO_2 . The second heads were estimated to contain 10% "staurolite" so that the black mineral would appear to have the same composition as that in the first heads.

The non-magnetic portion was relatively light in colour and although it contained many dark grains it was obvious that 33% of TiO_2 could not be there as ilmenite. The red grains present are believed to be rutile, and as many of them had partial dark coats it is probable that most of the wholly dark grains were coated rutile. The total proportion of red and black grains seemed about sufficient to account for the 33% of TiO_2 supposing both colours to be rutile.

Assaying of products.

The sands are very resistant to decomposition so that the titanium assay is laborious. The zirconium assay is much more so and the skill required makes zirconium assays very expensive.

Possible Commercial Products.

1. Ilmenite. Even if containing 50% TiO_2 the profit in shipping from Australia is small.
2. Rutile. Marketed concentrates usually contain about 95% TiO_2 . Spurr and Wormser "Marketing of Metals and Minerals" p. 568 state that the American Rutile Co. producing Rutile 95% TiO_2 and Ilmenite 52% TiO_2 have a very large deposit and the output of their plant is governed only by the market.
3. Zircon. The market is very small but seems to be steadily growing. In 1928 400 tons of zirconium ore were imported into U.S.A. Ladoo "Non-metallic Minerals" p. 659 states:- "The second most important source of zircon is found in the monazite deposits of Travancore, India. In the recovery of monazite large quantities of zircon are saved, though but little success has been had in marketing it." Particular attention is drawn to the last clause. To be merchantable zircon concentrated would probably need to contain at least 55% zirconium oxide, i.e. over 80% zircon.

4. Cassiterite.

Conclusions.

1. The presence of other heavy magnetic minerals will make it difficult to prepare a high-grade ilmenite. The market for low-grade ilmenite is so limited that probably even the low price is largely nominal.
2. The presence of other heavy feebly-magnetic or non-magnetic minerals will make it difficult to prepare a high-grade zircon. Even if it could be prepared the demand is so limited that it would be hard to displace present producers, especially as it is believed that some of them have large reserves of high-grade material.
It would be foolish to begin producing this material without an assured market.
3. The sample supplied was insufficient for experimental work on tin recovery. The quantity of tin present was not determined.
4. It is understood that the sample supplied was a composite one from borings made by the Tasmanian Department of Mines but that no more of this material is available.
Should it be decided to make a thorough examination of these sands the borings should be forwarded separately to the experimenter, together with a statement of what tonnage each sample represents.
5. I do not regard the sample submitted as sufficiently encouraging to warrant the cost of a thorough examination.

31.3.30.

(Sgd.) H. W. GARNELL.

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Copies.

1. To file.
2. To file.
3. To Dept. of Mines.
4. To Dept. of Mines for transmission to Development & Migration Commission.
5. To Dept. of Mines for transmission to Tasmanian Director of Mines.
6. To Dept. of Mines for transmission to Tas. Director of Mines for Fraser River Syndicate.

31.3.30.