UR1983_21

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1983/21. Heavy minerals in Quaternary and Recent sands in Tasmania

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Abstract

Accurate assessment of the economic heavy mineral content of unconsolidated sands around the coast of Tasmania is affected by two factors, one peculiar to Tasmania in the high dolerite content of the hinterland, the other common to all beach sand operations in Australia, *i.e.* the variable colour of rutile. A magnetic separation procedure, following cradling in the field and sieving, with subsidiary use of heavy media (tetrabromoethane) allows an accurate measure of the ilmenite, zircon and rutile content. It enables the separation of pyroxene from the heavy mineral concentrate and facilitates optical counting of potentially economic samples.

A flow chart has been drawn up to assist in this process. This procedure should be applied to selected smaller samples from the current drilling programme for water in coastal sands. Results from drilling along the Southport Lagoon spit are included in this report.

INTRODUCTION

The normal complement of heavy minerals of economic importance in eastern Australian coastal sands is low, and was reported by Whitworth (1959) as around 0.01%. Around the eastern and southern Tasmanian coastline, the prevalence of dolerite in the hinterland results in a relatively high content of pyroxene (density $\sim$3400 kg/m^3) and a lesser amount of ilmenite (density $\sim$4800 kg/m^3) that tend to swamp other heavy minerals. For example, in the Southport Lagoon spit samples, brown pyroxene (pigeonite + augite) ranges from 0.9 to 4.3% and ilmenite from 0.2 to 0.9%. The generally drab pale brown appearance of some Tasmanian beach sands is largely a reflection of the pyroxene content, and to a lesser extent, due to blue-black ilmenite. Much higher contents of ilmenite are commonly found at the edges of lakes in dolerite bedrock in the Central Highlands.

Zircon, rutile and ilmenite are the three chief minerals sought in beach sand exploration. Since the closure of the Kibuka Mines operation on King Island in 1977, there has been no commercial Tasmanian production of these minerals; the Tioxide plant at Heybridge uses ilmenite from Western Australia for production of TiO_2. At present there is a world oversupply of both ilmenite and rutile and prices for these commodities are depressed. In addition, the mill at Heybridge uses the older sulphate process to produce about 45% of the Australian production of TiO_2 pigment. A more efficient chloride process developed by Du Pont now accounts for 30% of the world production and is able to use synthetic (and natural) rutile and 85% TiO_2 slag.

Prices for zircon have stabilised at around $A120/tonne for 65%$^+$ ZrO_2 with <0.05% Fe_2O_3. The use of zirconia based ceramics is increasing (*e.g.* PSZ programme, CSIRO Division of Materials Science) and as Australia is the major world supplier of zircon, it may be of future value to establish reserves of this mineral in Tasmania.

MINERALOGY OF BEACH SAND CONCENTRATES

Zircon occurs as both rounded grains and tetragonal bipyramidal prisms, either colourless or hyacinth coloured, having a brilliant lustre and often a golden yellow fluorescence under long wavelength U.V. light.

Rutile is variable in colour, ranging from deep yellow, through reddish brown to black, it generally has a dull surface and is well rounded.

Ilmenite is blue-black in colour, with a rounded, pitted surface, but a high lustre on basal surfaces.

Pyroxene occurs as translucent yellow to light brown broken prisms, of moderate rounding and suggestive of local derivation.

Trace constituents include magnetite (<1%), pale pink angular garnet; pale yellow, well rounded monazite; leucoxene with a range of colours, grey, yellow, brown and a smooth surface, and tourmaline, epidote and ?cassiterite.

SEPARATION PROCEDURE

The initial concentration of Southport Lagoon spit samples was carried out on an experimental basis by Mr D. Jennings who used a cradle designed for cassiterite extraction and, occasionally, a panning dish. This reduced the bulk of sample obtained by auger drilling from as much as 40 kg to concentrates of between 200 g and 5 kg. This initial concentration takes an excessive amount of time and may be unnecessary if a suite of accurately located samples of the order of 300-500 g are obtained from drilling. Large samples may be split to reduce the bulk for separation. The size ranges <125 μm, and >125 and <250 μm, are most useful for electromagnetic separation. It is essential to remove magnetite from each size fraction with a hand magnet before magnetic separation using the Cooke Isodynamic Separator is attempted. Removal of ilmenite at a minimum current setting (0.2A) is very efficient and allows recognition of dark coloured rutile with confidence. Pyroxene is removed at a setting of 0.5 to 0.7A and the essentially non-magnetic zircon + rutile concentrate is then treated with tetrabromoethane to remove quartz. The final concentrates are examined optically and percentages recorded. The mass of each fraction is recorded and the purity checked by inspection, under long wavelength U.V. light and, if necessary, by X-ray diffraction. A visual estimate of mineral percentages in the coarse +250 μm fraction is usually sufficient as there is little zircon + rutile in this fraction. A flow chart (fig. 1) is available for recording data and calculation of the mass% of heavy minerals.

CONCLUSIONS AND RESULTS

The results from Southport Lagoon spit are tabulated below.

Only one sample (No. 4) contains in excess of 1.5% economic heavy minerals (ilmenite + rutile + zircon), the remainder are of subeconomic grades, confirming the values obtained by a previous commercial investigation.

Mass % of Heavy Mineral

Sample No.	IC	1B	1A	2	4	6
Magnetite	0.03	0.02	0.02	0.01	0.11	0.02
Ilmenite	0.51	0.90	0.43	0.18	0.42	0.22
Zircon	0.18	0.25	0.15	0.11	0.79	0.06
Rutile	0.20	0.10	0.15	0.04	0.73	0.06
Pyroxene	1.41	4.30	2.57	0.93	2.92	2.04
(Quartz)	(97.30)	(93.93)	(94.41)	(97.92)	(94.67)	(97.50)
Others*	0.02*	0.02*	0.04*	0.02*	0.31*	0.04*
Shell	0.35	0.48	2.23	0.89	0.05	0.06
	100.00	100.00	100.00	100.00	100.00	100.00
	*leucoxene garnet	*leucoxene garnet	*leuco-xene	*leuco-xene	*leuco-xene, garnet, tr. monazite	*leucoxene, garnet

The well rounded nature of some zircons and other heavy minerals confirm the suggestion of Whitworth (1959) that most zircon and rutile in the beach sands of eastern Australia is of second cycle derivation with a proximate source from Permian and Triassic sandstones but ultimately derived from Precambrian rocks. There is possibly some evidence for derivation of euhedral zircon and ?monazite from Devonian granites. Further sampling from the East Coast will confirm or deny this suggestion.

REFERENCE

WHITWORTH, H.F. 1959. The zircon-rutile deposits on the beaches of the east coast of Australia with special reference to their mode of occurrence and the origin of the minerals. *Tech.Rep.N.S.W.Dep.Mines* 4:7-60.

[17 June 1983]

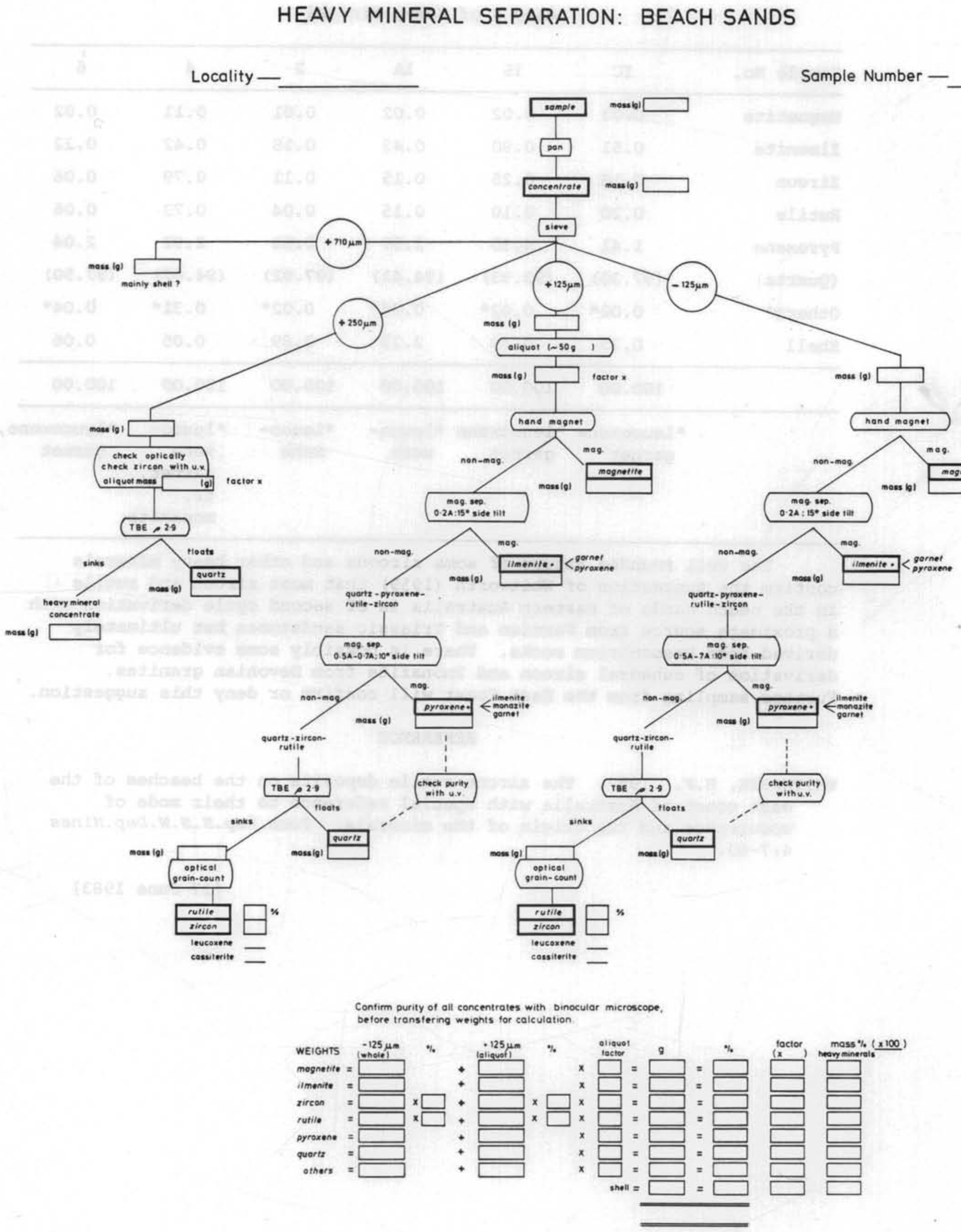

Figure 1. *Flow chart for the heavy mineral separation of beach sands.*