

The Significance of the Tin and Chromium Content of the Heavy Fractions of Cornish Beach Sands

K. F. G. HOSKING, P. ONG AND M. S. KRISHNAN

SYNOPSIS

THE plus 2.8 specific gravity fractions from sand samples from 21 Cornish beaches have been analysed for tin and chromium by rapid colorimetric methods.

The results indicate that the heavy minerals on any given beach along this deeply indented coast have, in the absence of a "feeding river" been derived virtually entirely from the adjacent cliffs by weathering and, on occasion, by mining. When a river feeds the beach the heavy fraction may contain appreciable proportions of resistates derived from the catchment area, particularly if the latter happens to be one in which tin-mining has taken place.

From the point of view of the prospector, examination — particularly if the coast is of the Cornish type — of the heavy fractions of beaches by rapid analytical methods may often facilitate exploration, not only by revealing any potential which the beach deposits themselves may possess, but also by giving some indication of the potential of the cliffs and, when feeder rivers exist, of the land intersected by them.

The major object of the study which forms the basis of this paper was to determine to what extent determination of the concentration of certain selected elements, by rapid semi-quantitative colorimetric methods, in the plus 2.8 specific gravity fractions of sands derived from beaches along the deeply indented Cornish coast reflect the nature and general location of the source rocks. Clearly such a study could add something to the knowledge of the mechanism of beach development and, what is of much greater importance to the economic geologist, it might indicate a rapid means of learning something of the economic potential of beaches generally and the nature and location of the rocks from which their heavy fractions have been derived.

It was decided to analyse the heavy fractions rather than the complete sand samples as it was thought the results would be more revealing as they would be largely independent of local variations in the composition of samples from a given beach, and analysis would be facilitated because the elements to be determined would be largely confined to the denser mineral species.

During the investigation under review it was decided to determine tin and chromium. The choice of elements was determined by the thought that the tin content would probably indicate granitic and cassiterite lode sources whilst the chromium content would reveal ultrabasic and basic contributors.

Tin derived from the lodes and to some extent from the granitic rocks will report on the beaches as cassiterite, but that liberated from the rocks generally will be largely incorporated in the lattices of ferromagnesian and titanium species by virtue of the similarities between the ionic radii and charges of tin, and those of iron, magnesium and titanium. From the ultrabasic rocks chromium is mostly liberated as chromite and picotite. In the other igneous rocks the element occurs in the ferromagnesian minerals: these may be liberated, in part, in a fairly unaltered state (thus biotite may report in streams draining the granite because of rapid disintegration of the rock due to kaolinisation of the feldspars) or they may first be converted to clays: in the latter case the chromium reports in the hydrolysate fractions. Generally the more basic the igneous rock the greater its chromium content.

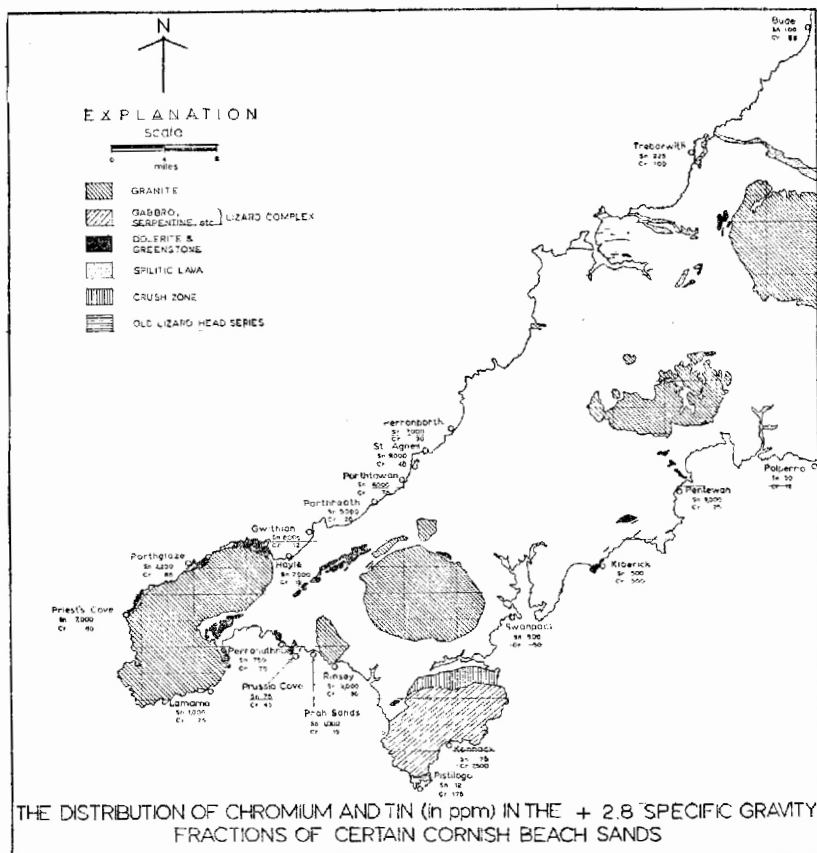
Analytical Methods.

The plus 2.8 specific gravity fraction of each sample was obtained in the usual manner by the use of bromoform and was then reduced to an impalpable powder. The tin was determined by the gallein/methylene blue method (Stanton and McDonald, 1961-62) and the chromium by the chromate/diphenylcarbazide technique (Wood and Stanton, 1956-57). These simple, semi-quantitative methods, which were designed for applied geochemical studies, enable 70-100 determinations for either metal, to be made per 8-hour man/day.

Discussion of Results. (See map.)

Examination of the results permits the following conclusions to be drawn:

1. The tin and chromium content of any given beach is determined fundamentally by the composition of the backing cliffs and that of the country intersected by any feeder rivers. Should a feeder river occur which receives tailings from a tin field the concentration of tin in the heavy fraction of the beach may be very high (of the order of 5,000, or more parts per million) and be due almost entirely to material added by the river. There is no indication that a given beach is receiving heavy minerals from adjacent beaches. If lateral migration of the heavy minerals were important, a comparatively high concentration of chromium would be expected in the Pistil Ogo material, not the 175 p.p.m. which, in fact, occurs.



2. Broadly speaking, if the beach is not fed by rivers the tin content of the heavy beach fraction will be at a maximum when the backing cliffs contain tin bearing lodes (as at Priest's Cove). In such instances the rocks of the cliffs will either be granite (entirely, or in part), or slates and dolerites within the aureole of thermal metamorphism. When the cliffs are granitic but lacking in lodes, the heavy fraction of the beach will still contain c. 1,000 p.p.m. tin due to the presence of cassiterite derived from minute veinlets, etc., and of tin bearing silicates — particularly biotite. When the cliffs consist of barren, non-granitic rocks, etc., the tin content is usually not greater than 100 p.p.m.

As might be expected the chromium content of the heavy fraction is greatest when the beach is backed by ultrabasic rocks (as at Kennack and in the Nare Point/Kiberick area). It reaches values of 75-100 p.p.m. when greenstones have contributed appreciably, but is of the order of 30-40 p.p.m. when the cliffs and immediate hinterland are composed essentially of slates.

General Conclusions.

It is concluded that the study suggest that during a regional geological reconnaissance survey of a little explored, coastal fringed area, determination of "key" elements in the heavy fractions of samples from the various beaches by rapid colorimetric or instrument methods, might not only pin-point any beaches with a possible economic potential but might also indicate which cliffs, and which feeder river systems should receive priority during the search for ore.

REFERENCES

- STANTON, R. E. AND McDONALD, A. J. Field determination of tin in geochemical soil and stream sediment surveys. Trans. Inst. Min. Metall. Lond. LXXI, 27-29, 1961-62.
- WOOD, G. A. AND STANTON, R. E. A rapid method for the determination of chromium in soils for use in geochemical prospecting. Trans. Inst. Min. Metall. Lond. 66, 321-340, 1956-57.

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Calcium Phosphate crystals in phosphatic limestone.

Locality : Tafelburg, Curacao.

Donated by : D. Brinkworth. (Trevarrick Hall, St. Austell.)

Xenolith surrounded by chalcopyrite, pyrrhotite and pentlandite.

Also contains magnetite.

Locality : 500' Level ; Hardy Mine, Falconbridge Nickel Mines Ltd.

Donated by : S. H. Alder.

Tourmaline Pegmatite.

Locality : Horse Point, St. Agnes Island, Scilly Isles.

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Pure Tin Candle from smelting furnace.

Donated by : Makeri Smelter, Nigeria.