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Titanium Analyses of Black Sands from Six Beaches, San Francisco and San Mateo Counties, California

by

Gretchen Luepke and Jerry J. Consul

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INTRODUCTION

Heavy minerals have been studied in beach sands on the coast south of San Francisco (Hutton, 1959), but the opaque minerals have received little attention. In particular, no detailed evaluation of Ti content has been conducted. In 1986, a newspaper reported that exceptionally high ilmenite concentrations, possibly of commercial grade, were being explored at Ocean Beach in San Francisco (Champion, 1986). We have analyzed the titanium content of black sands on this and several other nearby beaches in order to evaluate ilmenite concentrations.

METHODS

Black sands were collected from the following beaches (Figure 1): Ocean Beach, San Francisco; Daly City; Pillar Point, Half Moon Bay; Tunitas Creek; Whitehouse Creek; and Año Nuevo Creek. The samples were collected at the beach surface in the area of highest natural black sand concentration. This was done to ensure the highest possible concentration of ilmenite under natural conditions.

Samples (grain size range, 0.5-0.062 mm) were washed to remove sea salts, dried, and weighed, prior to removal of magnetite with a hand magnet. The magnetite fraction was weighed to determine its percentage in the sand concentrate. Microsplits of the magnetite fraction were made for each sample. A weighed split of the nonmagnetic fraction from each sample was passed through a Frantz isodynamic magnetic separator to remove all material in the 0-0.4 Ampere paramagnetic range, including ilmenite. Microsplits of this paramagnetic fraction were then made for each sample.

The titanium content in the magnetite and ilmenite-bearing microsplits was analyzed by induction coupled plasma optical emmision spectroscopy (ICP). The Ti percentages are minimum amounts, because not all of the material was dissolved in the standard mineral-acid-digestion solution (HCl + HNO_3 + HF + perchloric acid) during analysis. Total Ti (as TiO_2) was calculated for each sample, and results are given in Table 1.

RESULTS

The magnetite content of beach sands is relatively high near San Francisco and Daly City and markedly lower from Half Moon Bay to Año Nuevo Creek. Titanium in the magnetite fractions ranges between 1.5 and 6.3 percent. This could represent either the presence of titanomagnetite or magnetite-ilmenite intergrowths; the Ti in this form is currently economically unrecoverable (Force, 1976).

The percent of Ti in the ilmenite (0-0.4 Ampere) fraction ranges from 5.6 to 12.2. This fraction also contains noticeable amounts of garnet and hypersthene, although the amounts of these minerals are, from a visual estimate under a binocular microscope, probably less than 5 percent. The black sand at Pillar Point Beach near Half Moon Bay contains the least amount of garnet and hypersthene in the ilmenite fraction. Modal analyses were not made for this study but are planned for a future expanded study.

The beach of most interest in this study is Ocean Beach, where exceptionally high amounts of Ti were alleged to occur (Champion, 1986). Although the 0-0.4 Ampere fraction contains 10.5 percent Ti at this location, this fraction comprises only about 26 percent of the sample as a whole. This can be compared to values of 10.6 and 10.9 percent Ti from the beach at Whitehouse Creek, where percentages of the 0-0.4 Ampere fraction range from 40 to 50 percent of the whole sample, and about 12 percent Ti at Pillar Point, where the 0-0.4 Ampere fraction is nearly 60 percent. At present, the ilmenite fraction of a sample must be at least 54 percent TiO_2 in order to be considered saleable (Force, 1976).

The total percent of TiO_2 in these samples represents minimum amounts. Titanium is also present in the minerals sphene and rutile. Sphene has been found in most beach sands in the area (Hutton, 1959), but its titanium is not economically recoverable. Rutile is commonly present in the heavy-mineral fraction of beach sands in the area in amounts less than 1 percent (Hutton, 1959). The presence of these minerals in samples from this study were not evaluated.

CONCLUSIONS

A systematic coring program would be required to evaluate any economic heavy-mineral potential in the San Francisco peninsula offshore area. On the basis of the relatively high TiO_2 values obtained at

Pillar Point and Whitehouse Creek beaches, the possibility of similarly high values offshore cannot be discounted. This study does not appear to support the assertion that there are larger titanium resources on Ocean Beach itself.

REFERENCES

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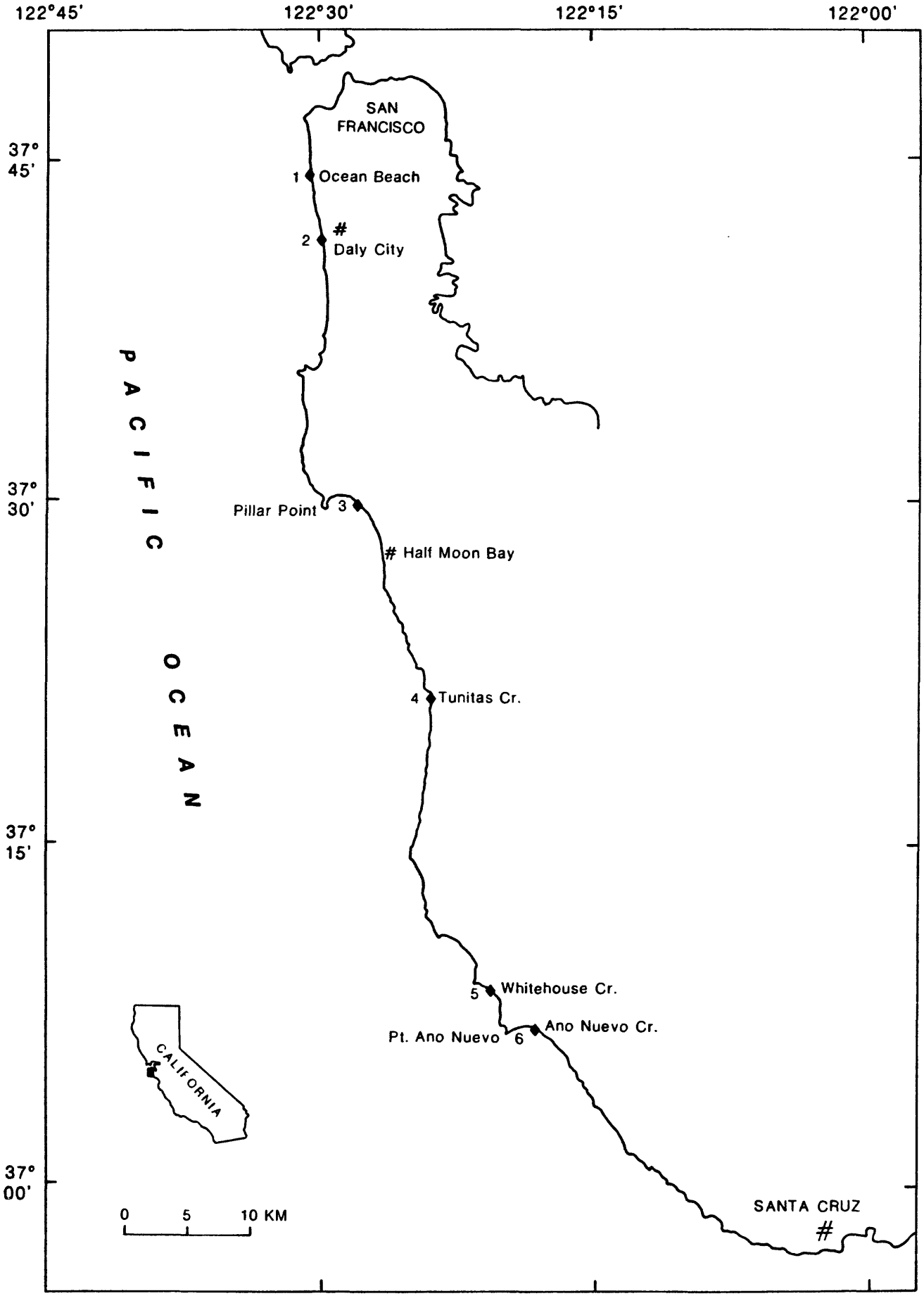

Figure 1. Index map of coastline from San Francisco to Santa Cruz, California, showing beach sample locations.

Table 1. Titanium values from beach sands between San Francisco and Point Ano Nuevo, California. Sample locations shown in Fig. 1. "% 0-0.4 Ampere" refers to that part of the sample which was separated in the 0-0.4 Ampere paramagnetic range of the Frantz isodynamic separator. "%Ti (mag)" and "%Ti (0-0.4 A)" refer to the values of elemental Ti in the magnetite and the 0-0.4 Ampere fractions, respectively.

Sample	Beach	% Magnetite	% 0-0.4A	%Ti (mag)	%Ti (0-0.4A)	Total $\%TiO_2$
1	Ocean Beach	55	26	2.8	10.5	7.1
2	Daly City	48	29	1.5	5.6	3.9
3	Pillar Point	14	58	6.3	12.2	13.3
4	Tunitas Cr.	15	37	3.7	10.1	7.2
5a	Whitehouse Cr.	13	41	3.9	10.9	8.3
5b	"	18	51	5.2	10.6	10.6
6	Ano Nuevo Cr.	13	42	5.5	8.7	7.3