U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Occurrence of platinum in a black sand from a beach deposit in San Mateo County, California

by

Gretchen Luepke and Norman M. Maher[1]

Open-File Report 91-308

[1]U.S. Geological Survey, Menlo Park, California

1991

Occurrence of platinum in a black sand from a beach deposit in San Mateo County, California

Gretchen Luepke and Norman M. Maher

Introduction

We identify and describe platinum grains found for the first time in a black-sand beach deposit near Green Oaks Creek, north of Point Año Nuevo on the north-central California coast (Fig. 1 and 2). The surficial geology around Point Año Nuevo consists of Quaternary dunes and marine terrace deposits cut into Santa Cruz Mudstone and Purisima, Monterey, and Vaqueros (?) formations (Brabb and others, 1977). A sea cliff exposure 2.2 km north of Point Año Nuevo,the Pliocene Purisima Formation lies unconformably on the Cretaceous Pigeon Point Formation (Clark, 1981). Headwaters of the creeks in this area lie in terrane dominated by the Santa Cruz Mudstone and Monterey Shale (Brabb and others, 1977; Clark, 1981).

Although hints of platinum occurrences in beach sands of San Mateo County exist in the literature, precise localities are rarely documented. Day and Richards (1906, p. 152) cite a single sample from "San Mateo County" as containing a trace of both gold and platinum. The only previous reference to a possible locality in this county is seen in the 8th annual report of the California State Mineralogist (Irelan, 1888a, p. 533), which mentioned gold (but not platinum) being found "on the coast near the Deniston Ranch, about 1 mile north of Amesport Landing." This locality is today known as Princeton Beach (Phyllis Crane, oral communication, 1990), between Pillar Point and the town of Half Moon Bay (Fig. 1). Whether this is the Day and Richards (1906) sample locality is uncertain, although significant black-sand concentrations are found here today.

Logan (1919, p. 41) states that beach sands have been worked for platinum extraction on a small scale on both San Mateo and Santa Cruz County coasts, with an intriguing footnote that "an enumeration [of platinum localities] would include practically every coastal county in the state." Davis (1955, p. 413) states only that "In 1952, 3 ozs. of gold, 1 oz. of silver, and a small quantity of platinum were produced from placers in the vicinity of Pescadero Beach by small-scale methods." Mertie's (1964, p. 92) listing of a San Mateo County locale for platinum is probably a quotation of the Day and Richards (1906) reference, because he does not include the Davis (1955) reference in his bibliography.

Reports of platinum are equally cryptic in Santa Cruz County, the coastline of which starts below Año Nuevo Creek (Fig. 1). Irelan (1888b, p. 556), in describing the presence of gold in beach sands in Santa Cruz County, states: "The sand also contains a small percentage of platinum." The only subsequent report to ever substantiate this (Boalich, 1918, p. 34) briefly reports platinum from a chromite beach-sand mining operation south of the

city of Santa Cruz, near Manresa Beach (not shown on Fig. 1). Hutton (1959), who identified several very rare minerals (e.g., diamond, galena, euxenite) in his detailed analyses of beach sands from Half Moon Bay to Monterey Bay, makes no mention of platinum.

Methods

The second author collected three beach sand samples in the back beach areas around Green Oaks, Whitehouse, and Año Nuevo Creeks. The samples were collected in the strongest natural concentrations of black sand near where the streams cross the beach. Each sample was washed, air-dried, and split into portions ranging from approximately 1.2 to 2.0 kg. Each portion was then dry-sieved into >0.5 mm, 0.25-0.50 mm, and <0.25 mm fractions.

Each size fraction was weighed and run separately through a "swirler" gold concentrator (Fig. 3). The "swirler" consists of a plastic bowl 28 cm in diameter and 8 cm deep with a 4.5 cm hollow cone rising from the center. A water inlet with a valve controls water flow. The stream of water entering the "swirler" at an angle creates a whirlpool that pushes the lighter grains up the center cone and into a bucket below. The heavier gold and platinum grains remain at the base of the cone.

The gold and platinum concentrate was then dried, weighed, and transferred to ceramic dishes for microscopic examination. A grain count determined the ratio of gold flakes to platinum grains. The Au:Pt ratios apply only to these samples and do not imply rigorous quantitative analysis of the entire deposit. All samples also contained grains of heavy minerals such as magnetite, garnet, pyroxene, and epidote.

Results

Platinum was identified with scanning electron microscopy, which showed the presence of iron within the platinum grains. No other platinum-group minerals were present. The gold and platinum occurred only in the <0.25 mm sand fraction. Platinum was found only in samples near Green Oaks Creek, while gold was found at all three sampling sites. The gold occurred as thin, irregular flakes; the platinum appeared as tiny rounded grains that looked like silvery beads. No crystal faces were present on any platinum grain. All platinum grains were slightly magnetic, in that the grains adhered to a metal probe when touched but did not jump toward the probe as did magnetite grains. Table 1 shows sample data and the proportion of gold to platinum in the samples examined.

Discussion

Platinum is usually associated with ultramafic rocks, specifically with chromiferous deposits. Hutton (1959) identifies chromite on most beaches between Half Moon Bay and Monterey Bay, but in spite of exceptionally detailed work he detected no platinum. He also did not find gold in beach deposits at Whitehouse or Año Nuevo Creek, while the present study did.

Hutton gives no data on initial sample size but platinum, like gold, is very prone to the particle sparsity effect (Clifton and others, 1969). Briefly stated, a sample must be of sufficient size to guarantee that rare minerals such as gold or platinum will be included; this usually means taking samples of a size on the order of kilograms rather than grams. The results of the present study are evidence that Hutton's samples, while adequate for routine heavy-mineral analysis, were not large enough to include either gold or platinum.

Small lode-gold occurrences, the most likely sources of gold in the beach sands, have been documented in the Santa Cruz Mountains (Irelan, 1888b). The platinum source is not so evident. Why the platinum occurs in the vicinity of Green Oaks Creek but not near Whitehouse or Año Nuevo creeks is not readily explainable either. No primary sources of platinum (Blair and others, 1977) or chromite (Carlson and others, 1985) presently exist in the drainages adjacent to San Mateo County beaches. Although sulfide mineralization occurs associated with pillow lavas in the Vaqueros (?) Formation on the south shore of Point Año Nuevo (Taylor, 1990), the mineralized sections have not been analyzed for platinum. The Pleistocene marine terraces and the marine sands of the Pliocene Purisima Formation also have never been examined for platinum, but ancient beach deposits within these formations could be possible secondary sources.

In addition to being rare, platinum has always been an elusive mineral to detect in black-sand concentrations. The first report on the minerals of California (Hanks, 1883-4, p. 310) states "The particles [of platinum] are so extremely fine that they can hardly be distinguished from the black sand which accompanies the gold." Murdoch and Webb (1948, p. 233) point out: "Native platinum is usually very impure. Occasionally it contains so much iron and other impurities as to be dark in color and not easily distinguished from grains of chromite with which it is very frequently associated." California platinum is commonly alloyed with iron (Mertie, 1964), so this characteristic no doubt contributed to its being missed in previous examinations.

One reason for lack of precise original documentation of platinum locations can be found from a quote from Hanks (1883-4, p. 310): "[miners decline] to save it [platinum] when informed that it can be sold for only two or three dollar per ounce." The most recent edition of the *Minerals of California* (Pemberton, 1983) eliminated all unsubstantiated references to platinum localities that had been carried in previous editions since the beginning. Platinum in California has invariably been a byproduct of placer gold mining (Clark, 1970), and no California beach sand has ever shown platinum in greater than trace amounts. The beach sand near Green Oaks Creek is no exception.

Conclusions

Platinum has been identified in beach sands near Green Oaks Creek in San Mateo County, California. This is the first description of a specific locality for platinum in beach sands in

this county, although the mineral's presence has been cryptically reported in California beach sands for over a century. The source, possibly a secondary one within the adjacent Quaternary marine terraces, cannot be positively determined. The mineral's extreme rarity at this locality renders it a mineralogical curiosity.

Acknowledgments

We thank Robert Oscarson for SEM work, and Gary Strachan, chief ranger at Año Nuevo State Reserve, for permission to collect samples within the reserve boundary. Phyllis Crane, of the Spanishtown Historical Society of Half Moon Bay, California, clarified questions concerning obsolete geographical names in the area.

References Cited

Blair, W.N., Page, N.J., and Johnson, M.G., 1977, Map and reported occurrences of platinum-group metals in the coterminous United States: U.S. Geol. Survey Miscellaneous Field Studies Map MF-861.

Boalich, E.S., 1918, Manganese and chromium (2nd edition): California State Mining Bureau Preliminary Report 3, 46 p.

Brabb, E.E., Clark, J.C., and Throckmorton, C.B., 1977, Measured sections of Paleogene rocks from the California Coast Ranges (for Field Conference on the Paleogene of California, sponsored by International Commission on Paleogene Stratigraphy): U.S. Geological Survey Open-File Report 77-714, 114 p.

Carlson, C.A., Wilson, S.A., Carlson, R.R., Bradley, L.A., Cornell, J., Gent, C.A., Goss, W.D., Groeneboer, H., Haffty, Joseph, Haubert, A.W., Love, A.H., McDale, J.M., Moore, R.F., Riley, L.D., Moring, B.C., Singer, D.A., and Page, N.G., 1985, Analyses for platinum group elements in samples from podiform chromite deposits, California and Oregon: U.S. Geological Survey Open-File Report 85-442, 15 p.

Clark, J.C., 1981, Stratigraphy, paleontology, and geology of the central Santa Cruz Mountains, California Coast Ranges: U.S. Geological Survey Professional Paper 1168, 51 p.

Clark, W.B., 1970, Platinum: California Division of Mines and Geology Mineral Information Service, v. 23, p. 115-122.

Clifton, H.E., Hunter, R.E., Swanson, F.J., & Phillips, R.L., 1969, Sample size and meaningful gold analysis: U.S. Geological Survey Professional Paper 625-C, 17 p.

Davis, F.F., 1955, Mines and mineral resources of San Mateo county, California: California Journal of Mines and Geology, v. 51, no. 4, p. 401-458.

Day, D.T. and Richards, R.H., 1906, Investigations of black sands from placer mines: U.S. Geological Survey Bulletin 285, p. 150-164.

Hanks, H.G., 1883-4, Catalog and description of the minerals of California as far as known, with special reference to those having an economic value: California Journal of Mines and Geology, v. 4, p. 63-397.

Hutton, C.O., 1959, Mineralogy of beach sands between Half Moon and Monterey bays, California: California Division of Mines Special Report 59, 32 p.

Irelan, W.E., Jr., 1888a, San Mateo County: California Journal of Mines and Geology, v. 8, p. 533-536.

Irelan, W.E., Jr., 1888b, Santa Cruz County: California Journal of Mines and Geology, v. 8, p. 550-556.

Logan, C.A., 1919, Platinum and allied metals in California: California Division of Mines and Geology Bulletin 85, 120 p.

Mertie, J.B., Jr., 1969, Economic geology of the platinum metals: U.S. Geological Survey Professional Paper 630, 120 p.

Murdoch, Joseph, and Webb, R.W., 1948, Minerals of California: California Division of Mines and Geology Bulletin 136. 402 p.

Pemberton, H.E., 1983, Minerals of California: Van Nostrand Reinhold Co., New York, 591 p.

Taylor, Eric, 1990, Syndepositional magmatism within the Vaqueros (?) Formation (Upper Oligocene-Lower Miocene) of Pescadero State Beach and Punta Año Nuevo, San Mateo County, California, *in* Garrison, R.E., Greene, H.G., Hicks, K.R., Weber, G.E., and Wright, T.E., eds., Geology and tectonics of the central California coast region, San Francisco to Monterey: SEPM Pacific Section Guidebook 67, p. 57-70.

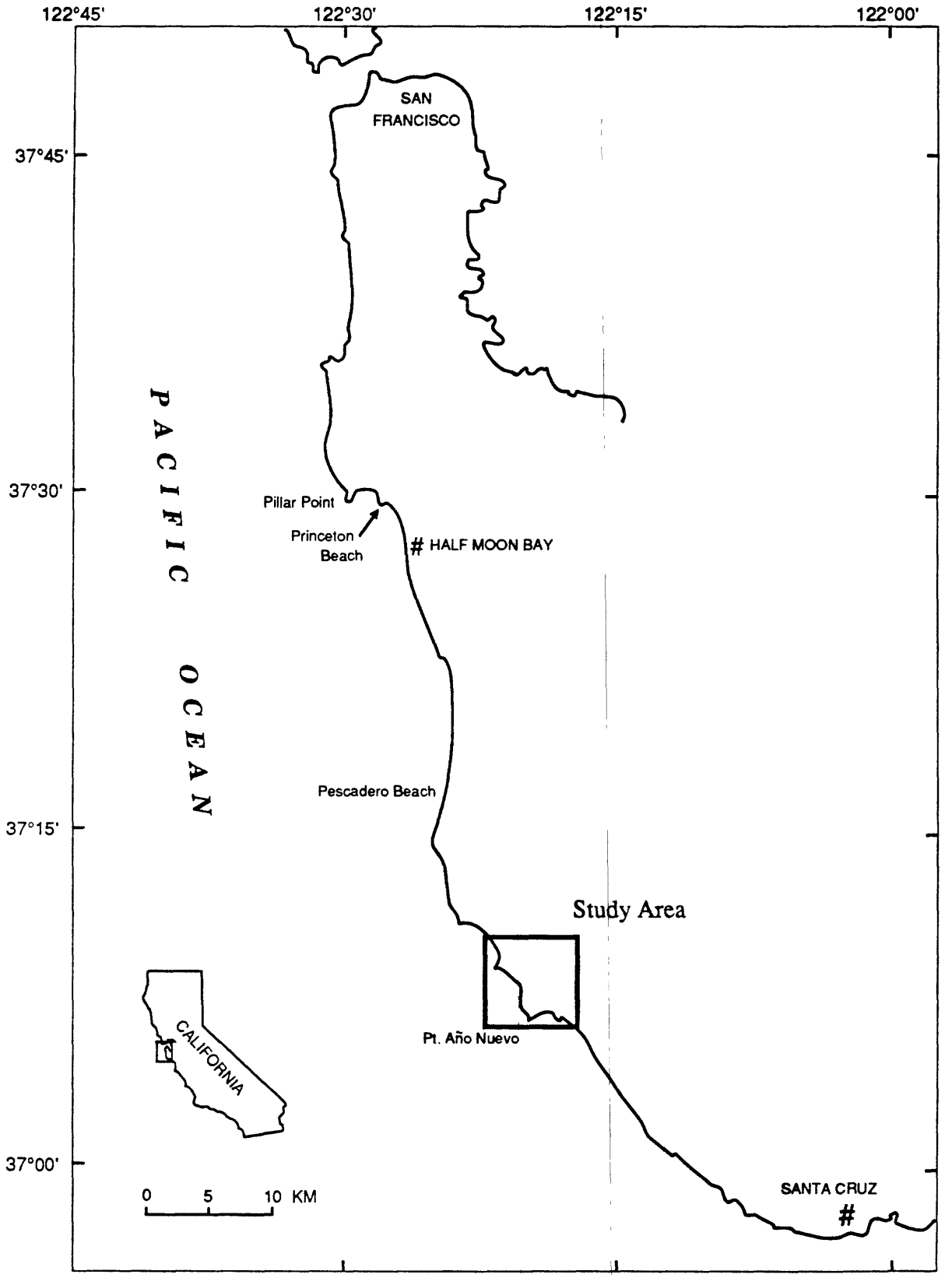

Figure 1. Index map showing location of study area. See Figure 2 for detail.

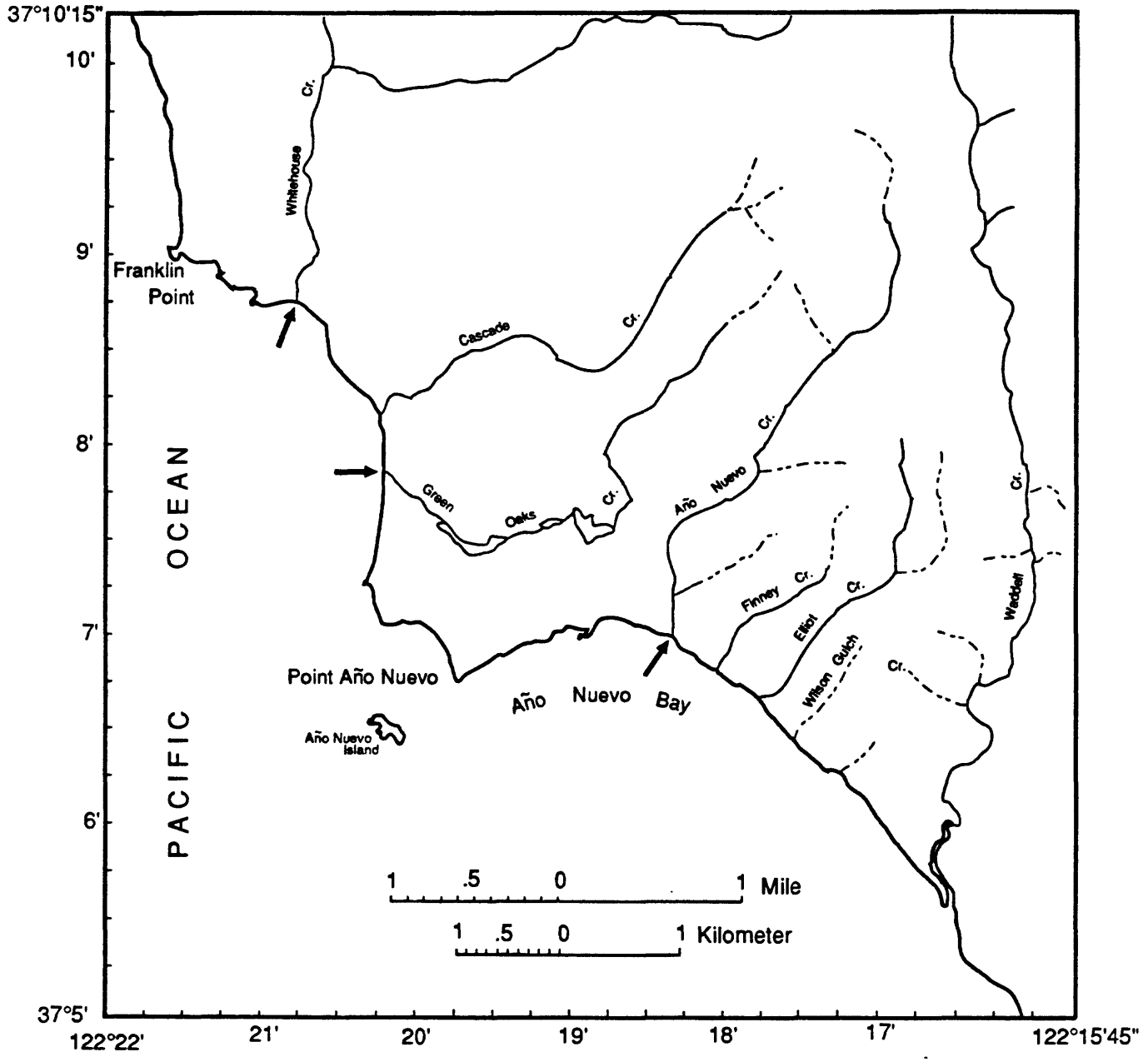

Figure 2. Detail of sampling area from Figure 1. Arrows show sample locations.

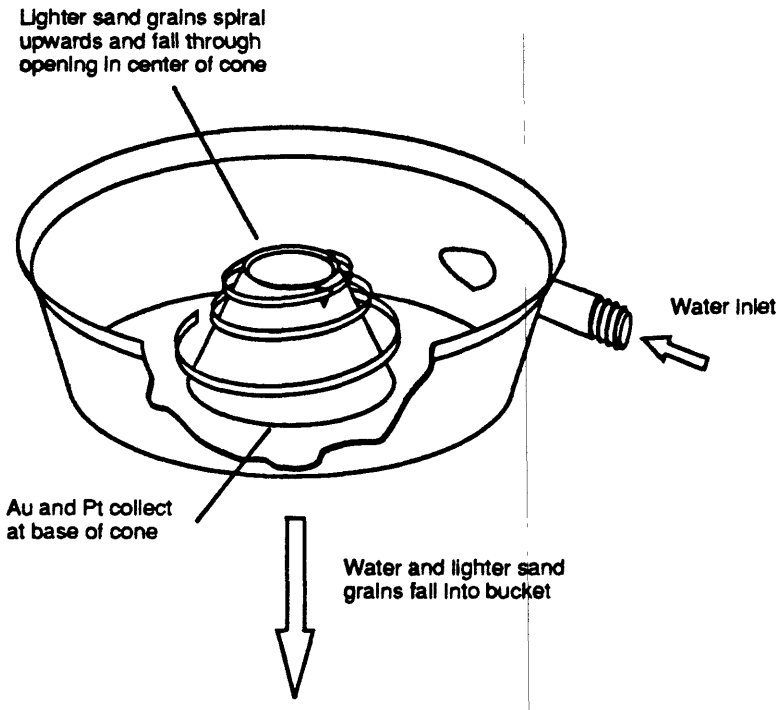

Figure 3. Diagram of "swirler" device used to concentrate gold and platinum.

Sample no.	weight of sample (g)	Au grain count	Pt grain count	Au:Pt ratio	Grains/kg of Sample Au	Pt
AN-1	1689	30	0	-----	18	-----
AN-2	1310	4	0	-----	3	-----
AN-3	1688	2	0	-----	1	-----
GO-1	1526	99	6	16:1	65	4
GO-2	1667	229	5	46:1	137	3
GO-3	1913	215	14	15:1	112	7
WH-1	1515	6	0	-----	4	-----
WH-2	1489	39	0	-----	26	-----
WH-3	1225	0	0	-----	-----	-----

Table 1. Concentrations of gold and platinum from Ano Nuevo (AN), Green Oaks (GO), and Whitehouse (WH) creeks, San Mateo County.