Mineral Res. Expl. Bull.. 113.65-71. 1991

DISTRIBUTION AND ORIGIN OF DETRITAL GOLD IN KAZIKKAYA (KAĞIZMAN-KARS) PLACERS

Necati TÜYSÜZ*

ABSTRACT. - Geologic, mineralogic and chemical studies indicate a considerable amount of detrital gold in Kağızman-Kazıkkaya placers. Gold values become of economic interest, especially along a 2 meter thick lowermost part of the placers. Amount of gold increases parallel to the heavy mineral content of the placers, reaching a maximum in 0.63 mm. - 0.315 mm. size fraction where heavy mineral content (3 %) shows a four-fold increment comparing to its average value in whole placers. Heavy mineral types identified in the placers are in well agreement with those of rocks exposed in the immediate vicinity. Chemical and physical nature of detrital gold is very similar to that of gold in quartz veins. Hence, the source of gold in the placers is mostly linked to quartz veins and less to the listwaenite and shear zones.

INTRODUCTION

The area of interest is situated between Komik mahallesi and Kazıkkaya village of Kağızman, Kars in the eastern Turkey (Fig. 1). The area is reached by following the paved road westwards from Kağızman for 38 km; then by a gravel road into the Ortakale river valley for about 15 km. after passing Çayarası village (Fig. 1), The roads accessible year round except under heavy winter conditions.

Gold exploration became very attractive in last few years following a boom in gold prices and introduction of low cost technology into the industry.

The Kağızman placers were exploited by Russians during the first World War. Molly (1955). based on the volume of pebble, cobble and bolder piles resulted from hydraulic washing, calculated a 150 kg. gold recovery by Russians in the area. Bergman (1988) and Haude (1989) delineated a 2 meter thick zone on the bedrock enriched with gold during the joint Turkish-German project studies. Haude furthermore reports a 0.9 gr/m^3 . Au grade with 700 000 m^3 . reserves for the 2 meter thick zone.

Pan prospection was first employed around the terrace edges along the contact of the placers with the bedrock during these studies. Gold distribution was rougly estimated in the field using a chart produced by Bergman (1988). Drilling, aditing, shafting and trenching were invoked in order to obtain data about gold and grain size distribution of the terraces. A truck mounted TH-60 rotary drill rig, refitted with dual wall drill pipe and using air injected down between the outer pipe and inner pipe of the dual drill system was employed for drilling. Gold content of the panned samples pooled in the field was found by amalgamation followed by ICP readings. Heavy minerals were first separated by Franz isodynamic separator and then were identified by polorizan microscope. In addition, samples collected from adits were concentrated by so called "Aufstrom" pipes after wet sieving into several size fractions. Heavy mineral contents of each fraction were recorded separately. Grains suspected to be any type of PGM (platinum group minerals) were analyzed by scanning electron microprobe.

GEOLOGY

Kağızman complex of Upper Cretaceous age crops extensively out in the catchment area of the placers (Çağlayan and Kral, 1980). Kağızman complex is composed of peridotite, serpentinite, gabbro, basalt and limestone blocks of various sizes in a pyroclastic and epiclastic matrix. Serpenlinites host listwaenite lenses and bands. Kağızman tonalite varying in composition from quartz diorite to tonalite intrudes the complex. Tuzluca formation of Oligocene-Miocene age comprising siltslone, sandstone and conglomerate intercalated with gypsum lenses rests disconformably on the complex. Quaternary is characterized by terrace and alluvial deposits. Ortakale valley seems to gain its present-day configuration through several terrace steps. Terraces occur between Komik mahallesi and Kazıkkaya villages where they reach 43.5 m. at most, presumably a paleo river channel, with an average of 25 m. Average length and width of the terraces in this area are about 2 km. and 0.5 km., respectively. They consits of different types of blocks ranging from several centimeters to about 2 m. in diameter with

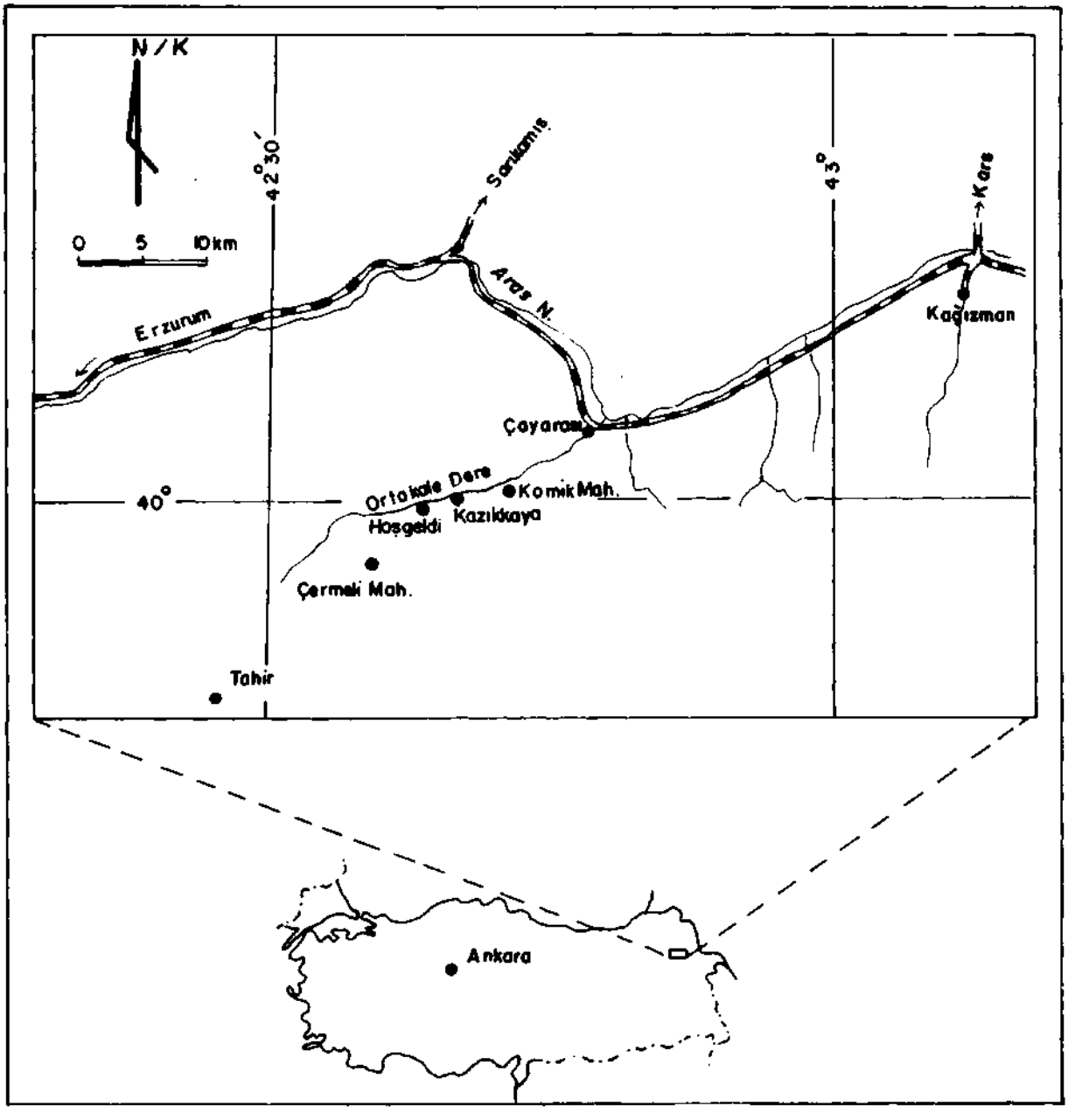

Fig. 1 - Location map.

sand fillings. Blocks are made up mainly of gabbro, serpetinite and basalt, and minor amounts of limestone. The terraces are very poorly sorted and unconsolidated, indicating no sign of bedding.

MINERALOGIC STUDIES

Grain size distribution

A variety of samples were collected from adits and shafts so as to examine grain size distributions (Fig. 2) of the placer. A sample taken from adit 2 represents an ungraded sediment (Haude, 1989; Fig. 3). Approximately 85 % of the sample consists of pebbles or rock fragments coarser than 2 mm. in size whereas only 5 % of it is finer than 2 mm. which con-

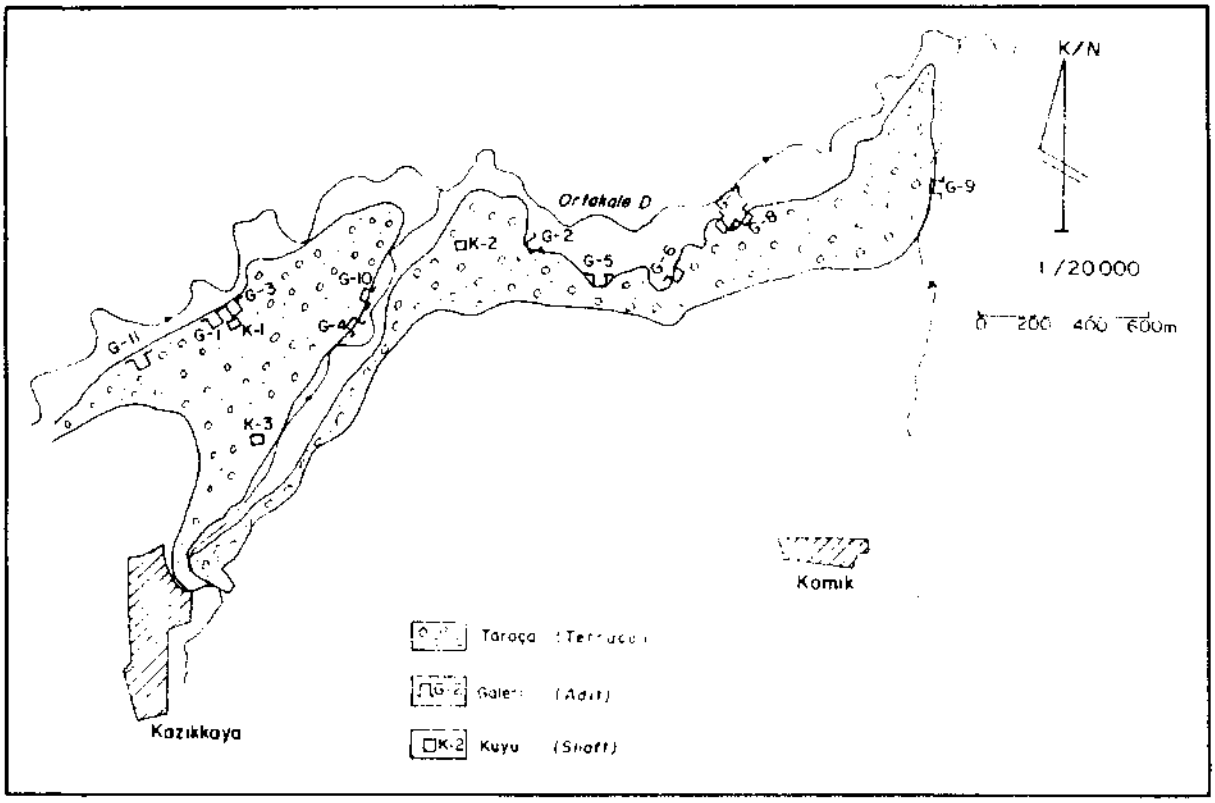

Fig. 2 - Map showing Kazikkaya (Kağızman-Kars) placers.

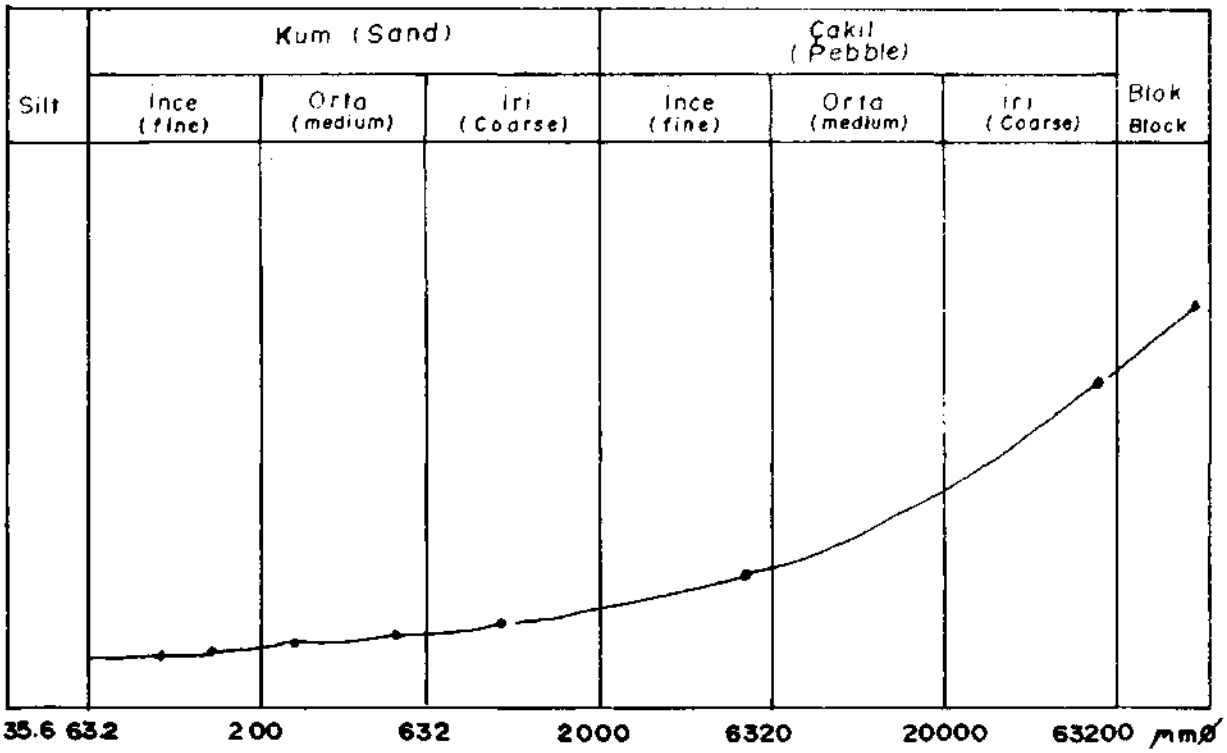

Fig. 3 - Grain size distribution of a sample from adit 2.

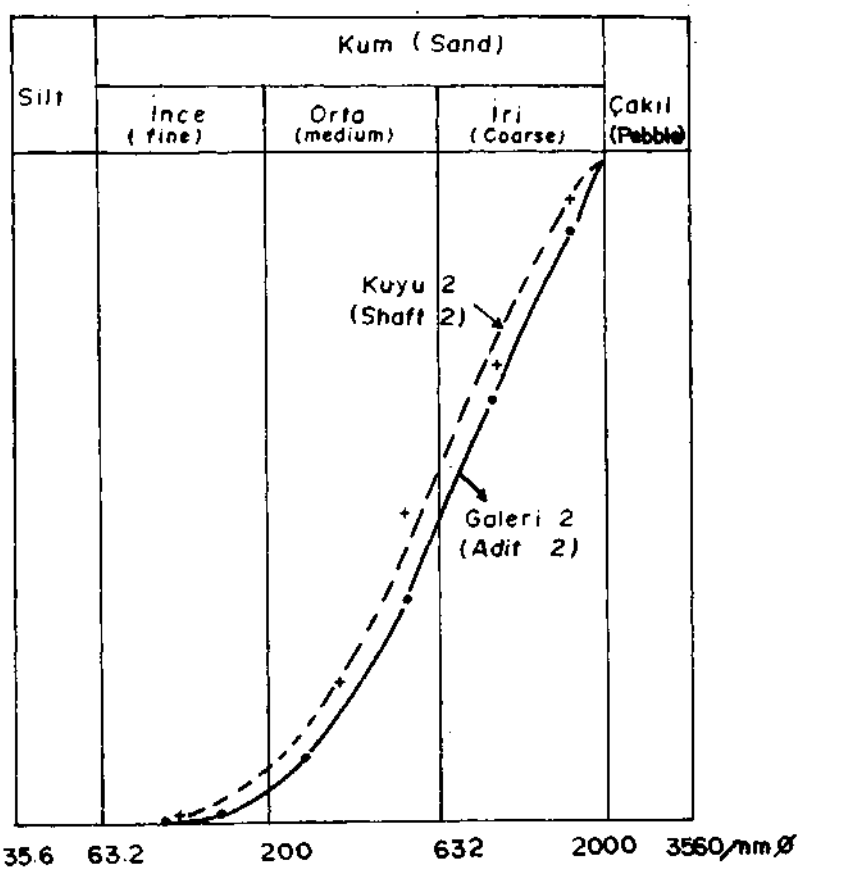

Fig. 4 - Grain size comparisons of sample from adit 2 with that of shaft 2 (between 2.0-0.1 mm.).

tains gold. The samples taken from shaft 2 is composed of 80 % pebble size and 17.6 % sand size material. Figure 4 illustrates that both samples are dominated by medium and coarse size sands.

Heavy mineral distribution

Heavy mineral content of the placer, about 3 %, shows an increase towards the bottom, parallel to gold content. However, heavy mineral content of the lowermost zone, 2 meters in thickness, reaches 13 % (Table 1).

Table 1- Grain size distributions and heavy mineral contents of shaft 2 and adit 2

Sample from shaft 2		*Sample from adit 2*	
Grain size (mm.)	*Heavy mineral (%)*	*Grain size (mm.)*	*Heavy mineral (%)*
1.6 - 1.0	7.5	1.60 - 0.95	0.3
1.0 - 0.63	6.6	0.95 - 0.5	7.7
0.63 - 0.315	12.4	0.5 - 0.25	12.9
0.315 - 0.2	2.2	0.25 - 0.147	4.5
0.2 - 0.1	1.7	-	-

In addition, heavy minerals are largely concentrated within 0.63 mm.-0.315 mm. size fraction (Table 1).

Heavy mineral types

An unprocessed sample taken from the placers was first sieved through 630 mm- 200 mm, 200 mm - 63 mm, and 63 mm and approximately 200 grains of each fraction was counted. The result is illustrated in Table 2.

Table 2- Mineral distribution of placers

	Grain size		
Mineral	*630-200 μm (%)*	*200-63 μm (%)*	*63 μm< (%)*
Opaque	40	25	20
Chromite	.1	-	1
Pyroxene	8	15	3
Amphibole	10	10	8
Calcite	2	2	Trace
Zircon	-	0.5	1
Turmaline	-	Trace	0.5
Rutile	-	Trace	0.5
Garnet	3	2	1
Epidote	15	20	20
Quartz+Feldspar	20	25	45

Besides, some concentrations were prepared to search for PG (platinum group) minerals. Those grains which were suspected to be any type of platinum group minerals were assayed by scanning electron microprobe. The results showed several combinations of Cr, Fe, Cu, Ni, Si, S, Ti, Pb, and Sn for these grains. Based on these combinations, some grains could be chromite, ilmenite, and awaruite but some remains very difficult to identify. Weisser (1988) determined some grains as some types of PGMs comprising a solid solution of Pt and Fe, osmiridium and rutheniridium. Some of these grains contain rounded gold inclusions.

Table 3 - Heavy mineral and gold distribution in the lowermost 60 cm. of shaft 2

Grain size (mm.)	*Heavy mineral content (%)*	*Number of gold grains*
> 1.6	2.5	2
1.6-1.0	13.3	8
1.0-0.63	0.7	5
0.63-0.315	19.4	9
0.315-0.2	2.9	-
0.2-0.1	1.3	-
< 0.1	6.4	-

Origin of gold

Quartz veins, trending NE-SW and NW-SE and varying in thickness from mm. to 4-5 m., occur in the drainage area. Some gold grains can be seen by naked eye in these quartz veins. Electron microprobe analyses of 5 grains, each with 3 readings, from the quartz veins are given in Table 4 (Weisser, 1988).

Table 4 - Electron microprobe analyses of gold grains in a quartz vein

		Elements %											
Sample	*Analyse*	*Au*	*Ag*	*Fe*	*Hg*	*Cu*	*S*	*Bi*	*Sb*	*Te*	*As*	*Se*	*Total*
	1	91.84	7.22	0.11	-	0.09	0.05	0.27	-	-	-	0.01	99.60
1	2	91.83	7.13	0.62	0.17	0.15	0.03	0.08	-	-	-	-	100.02
	3	91.95	7.02	0.19	0.09	0.07	0.04	-	0.01	0.01	-	0.01	99.40
	4	83.69	15.9	0.08	-	0.02	0.03	0.32	0.01	0.03	-	-	100.07
2	5	90.67	7.56	0.06	0.15	0.05	0.03	0.31	-	0.03	-	-	98.87
	6	91.58	7.37	0.12	0.08	0.08	0.03	0.31	-	-	0.01	-	99.58
	7	92.14	6.84	0.01	-	0.04	0.03	0.03	-	-	-	-	99.08
3	8	91.38	6.76	0.37	0.14	0.29	0.08	0.01	0.04	0.03	-	-	99.11
	9	91.39	7.02	0.52	0.08	0.44	0.10	0.15	-	-	-	-	99.71
	10	91.66	6.99	0.05	0.13	0.13	0.04	0.09	-	-	-	-	99.10
4	11	92.06	6.65	0.26	0.09	0.73	0.05	-	0.02	0.04	-	-	99.90
	12	91.43	6.95	0.28		0.25	0.05	-	-	0.01	0.01	-	98.99
	13	92.36	6.98	0.08	0.07	0.10	0.04	0.15	0.03	-	-	-	99.81
5	14	92.52	6.82	0.22	0.03	0.16	0.04	0.13	0.01	0.02	-	-	99.94
	15	91.93	7.03	0.28	0.13	0.47	0.06	-	0.02	-	-	-	99.91

Gold content of these grains range from 83.69 % to 92.52 % with an average of 91.23 %. Ag values vary between 6.65 % and 7.56 %, except a point reading of 15.89 %, with an average of 7.02 %, indicating rather low values. Hence, gold in the quartz veins appears to have high fineness expressed as [(Au/Au+Ag)1000 of 923]. Besides, Cu and Fe occur at the equal amounts. S, As, and Te yield very low values. Low Ag values indicate a secondary precipitation for gold below the water table (Mann, 1984; Webster and Mann, 1984). Very low Te values provide evidence for oxidation (Antweiller and Campbell, 1982). In addittion, low Ag, high Cu, Bi and Pb values indicate high temparature formation conditions for primary gold deposition (Antweiller and Campbell, 1977).

Electron microprobe assays carried out on placer gold grains indicate similar range of fineness (900-950) to that of vein gold (Bergman, 1988). Besides, gold redeposited below the water table shows secondary growth. Therefore, gold in the placers was largely derived from quartz veins, less from listwaenites and shear zones.

CONCLUSIONS

Drilling, aditing, shafting and trenching carried out on placers revealed considerable amount of reserves and delimited the lowermost section, approximately 2 m. thick, of placers to be of economic interest. Gold content increases parallel to heavy mineral content, especially in 0.63 mm.-0.315 mm. size fraction. Heavy minerals identified in the placers correlate well with these in surrounding rocks. Gold in placers show same size and fineness as gold in quartz veins. In addition, some gold was derived from listwaenites and shear zones. Density of sampling is not sufficient due to unsuccessful sampling by drilling. Thus, Any drilling method successfully applied to similar type of placers should be sought and be applied to the area of interest for more representative sampling.

ACKNOWLEDGEMENT

This study was generally realized within the framework of Turkish-German joint project. Grain size analyses were carried out by the author in Germany, the graphics were prepared by Dr. H. Haude. The author is thankful to all who put their great contributions on this paper.

Manuscript received October 3, 1991

REFERENCES

Antweiller, J.C. and Campbell, W.L., 1977, Application of gold compositional data to mineral exploration in the United States: J. Geoch. Explor., v.8, p. 17-29.

———and————1982, Implications of the compositions of lode and placer gold: T.G. Theodore et al. (Eds.), Geology and gold mineralization of the Gold Basin- Lost Basin mining districts Mohave country, Arizona, U.S.G.S. Prof. Pap., 1361, p. 245-264.

Bergman, H.B., 1988, Gold/PGM placer prospecting and exploration in the Kazıkkaya area, Eastern Anatolia, Turkey, Archives, no. 102096, 60 p. (unpublished), BGR-Hannover.

Çağlayan, A. and Kral, K., 1980, Ağrı-Taşlıçay ve Kars-Kağızman civarının jeolojisi: MTA Rep. 6785 (unpublished), Ankara.

Haude, H., 1989, Exploration von seifengold in Terrassen schotien hei Kazıkkaya, provinz Kars, Türkei: Archives no. 105867, 72 p. (unpublished), BGR-Hannover.

Mann, A.W., 1984, Mobility of gold and silver in lateritic weathering profiles: some observations from western Australia: Econ. Geol., v.79, p.38-49.

Molly, E.W., 1955, Zaraphane-Kazıkkaya altın prospeksiyon raporu: MTA Rep. 2334 (unpublished), Ankara.

Webster, J.G. and Mann, A.W., 1984, The influence of climate, gcomorphology, and primary geology on the supergene migration of gold and silver: J. Geoch. Expl., v. 22, p. 21 -42.

Weisser, T., 1988, Erzmikroskopische und mikroanalytischc untcrsuchungen von Au-und PGM-Kömem aus dem Ortakale Dere, provinz Kars, Türkei: Archives no. 40066, 7 p. (unpublished), BGR-Hannover.