Regional Geochemical Reconnaissance of Kirk Range-Lisungwe, Malawi

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Regional Geochemical Reconnaissance of Kirk Range-Lisungwe, Malawi

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Abstract

A regional geochemical drainage reconnaissance of Malawi covered the Kirk range-Lisungwe area, lying between latitudes 15°00′ and 15°20′ south and longitude 34°45′ and the western border of Malawi (34°35′) with Mozambique.

Paragneisses and schists of Basement Complex cover the greater part of the area. These are made up of semi-pelitic gneisses of medium grade, principally hornblende biotite gneisses and biotite gneisses, with smaller amounts of calc-silicate gneisses, quartzo-felspathic granulites and pelitic schists and gneisses. A few N-S dolerite dykes are the manifestations of Karroo System (Stromberg) vulcanicity. The Chilwa Alkaline Province is represented by carbonatite and agglomerate volcanic vents.

600 stream sediment samples were collected and analyzed for chromium, copper, nickel, and gold by the atomic absorption spectrophotometer. The results for copper and nickel were generally low, but the chromium and gold were of more interest and contoured geochemical maps for these elements were presented. Chromium was centred along Kapeni Stream, particularly on the northern side of Chimwadzulu Hill. The highest gold values were seen on and around south Chongwe Schist Formation.

Introduction

A. R. Andrew visited the Lisungwe Valley in 1906-7 and examined an occurrence which had previously been discovered by a private prospector near the confluence of the Mwendangombe Stream and the Lisungwe River. Although four tributaries of the Lisungwe were found to be auriferous, there is no payable vein in the locality.

In 1934 and 1935 the whole drainage basin of the Lisungwe was surveyed for gold by the Geological Survey Department. 4 different types of quartz-veins were found to contain gold. They are ; 1) Stringer types, 2) Pegmatitic quartz-veins, 3) Pyritiferous quartz-veins, and 4) Pyritifeous quartz-veins associated with fault-rock. The main source of gold showed up in the stringer types, and the richest were found to be the Little Chisumbwiti Stream, southern branch of Chitumbe Stream, but in the report Gillanders considered that they were probably worked out.

Regional geochemical drainage sampling in the search for gold has been carried out since 1993 as a program of one of the activities in the Geological Survey Department.

A base map was prepared at a scale of 1:50,000. The area covers about 660km^2, and stream sediment sampling was extended to the area, at an average density of about 1.2 samples per km^2. 600 samples were collected, and all samples were analyzed for

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gold, chromium, copper, and nickel. By the results, contoured geochemical maps for chromium and gold were produced. The purpose of the survey was to determine the source of chromium, copper, nickel, and particularly gold.

Location and Physiography

The area described in this report covers about 660km^2; it is approximately square in shape and lie between latitudes 15° 00′ and 15° 20′ south and longitude 34° 45′ east and the western border of Malawi (34° 35′) with Mozambique. It is situated in the Southern and Central Regions of Malawi about 40km north-west of Blantyre-Limbe (Fig. 1).

The area consists of the Kirk Plateau, the Border uplands, the Neno step, foothills zone, and the Shire Valley plain (Fig.2). Altitude in the area varies from about 370m to over 1800m. The ground gradually descends to the east from the border in a series of faults. In the Neno step, there are two step faults which are situated on the edge of the main Rift Valley.

The principal river is the Lisungwe River which starts from near Tsangano hill and flows eastwards up to the edge of the foothills zone. It is joined by the Likudzi Stream and lower down by the Mwendangombe Stream, and at last it drains into the Shire River.

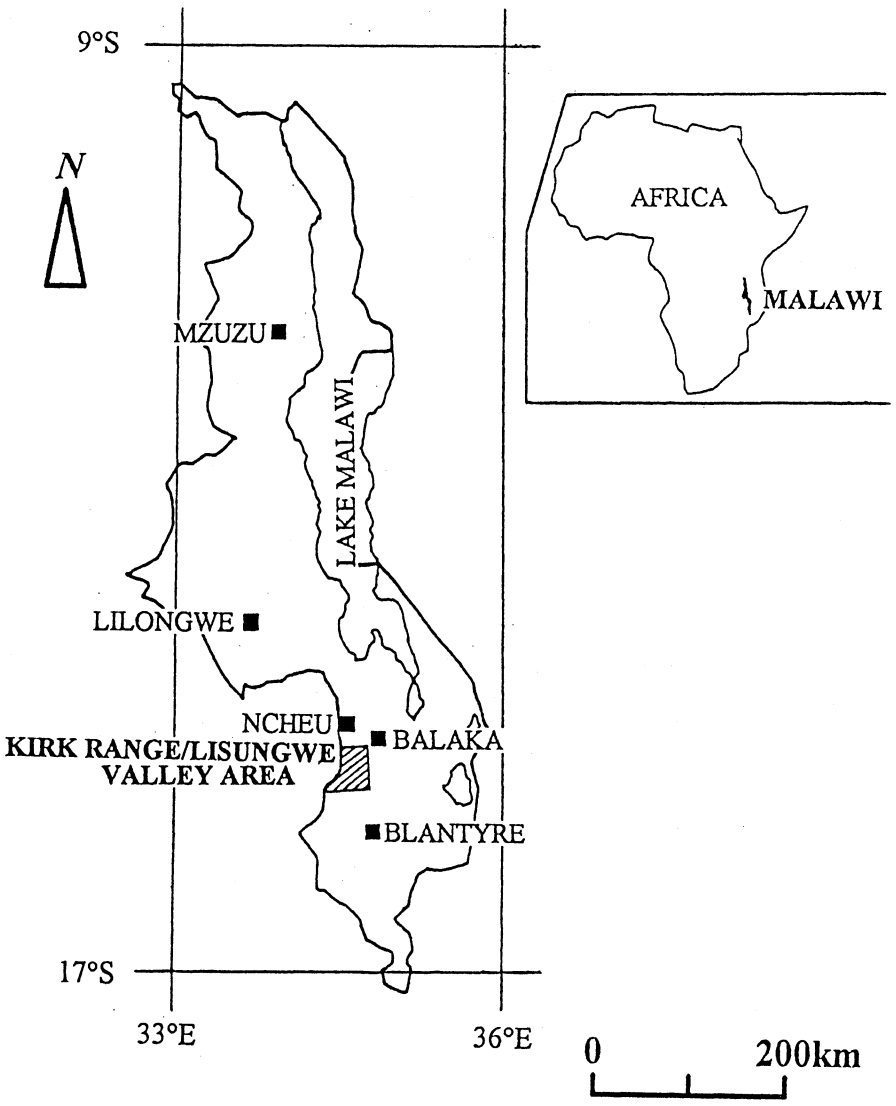

Fig. 1. Location map.

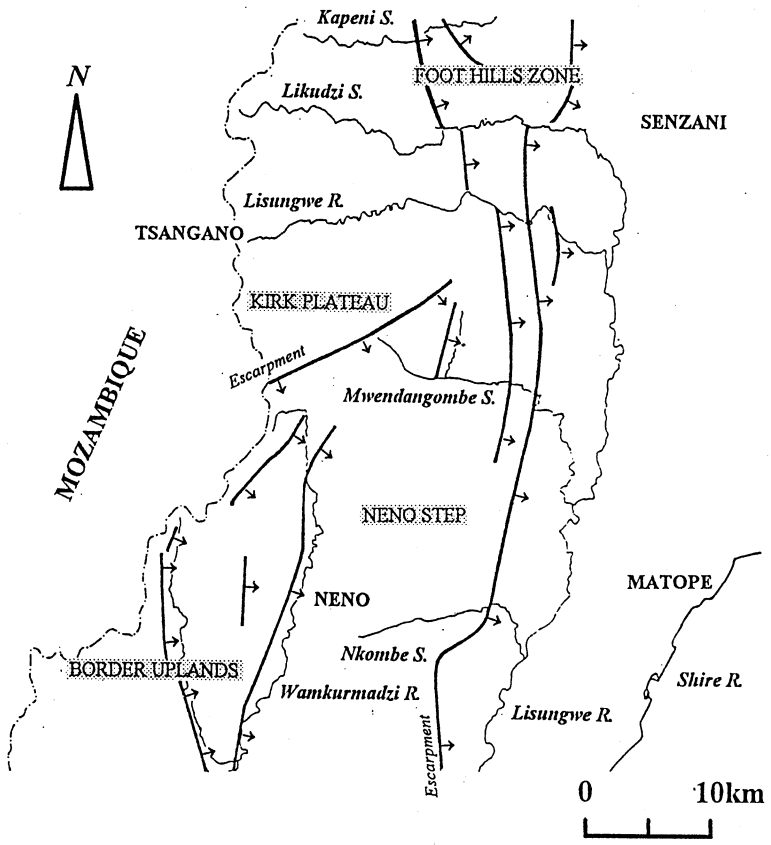

Fig. 2. Principal physiographic feature.

Geology

The area is roughly divided into 4 groups; Malawi Basement Complex, Stormberg Vulcanicity, Chilwa Alkaline Province, and Superficial Deposits (Chipili, 1989).

The oldest group is Malawi Basement Complex which mainly consists of hornblende-biotite-gneiss which covers the greater part of the area. Locally it contained a high proportion of epidote, biotite-gneisses, diopside-bearing gneisses, psammitic and pelitic gneisses. charnockitic gneisses, marbles and calc-silicate granulites. The age is precambrian.

Stormberg Vulcanicity's age is Lower Jurassic. It is comprised of a few north-trending dykes of ophitic quartz-dolerite and some thin basaltic veins which are ascribed to the Karroo System.

Chilwa Alkaline province has 6 veins with carbonatite and agglomerate. Those veins occur in the area along the main escarpment with the Rift Valley to the east, and they, as indicated by their geological position, are related to Rift Valley tectonics (Kaphwiyo and Lukhele, 1993). The age is from Upper Jurassic to Lower Cretaceous.

Superficial Deposits of Tertiary to Recent age represent weakly weathered ferruginous latosol associated with smaller amounts of grayish brown sandy loam in the Plateau and Upland area, and thick reddish brown sandy and gravelly colluvium in the Lower Lisungwe Valley.

There is no single Rift Valley fault but rather a series of N to NE-trending parallel step faults. Geological map of the area is shown in Fig. 3.

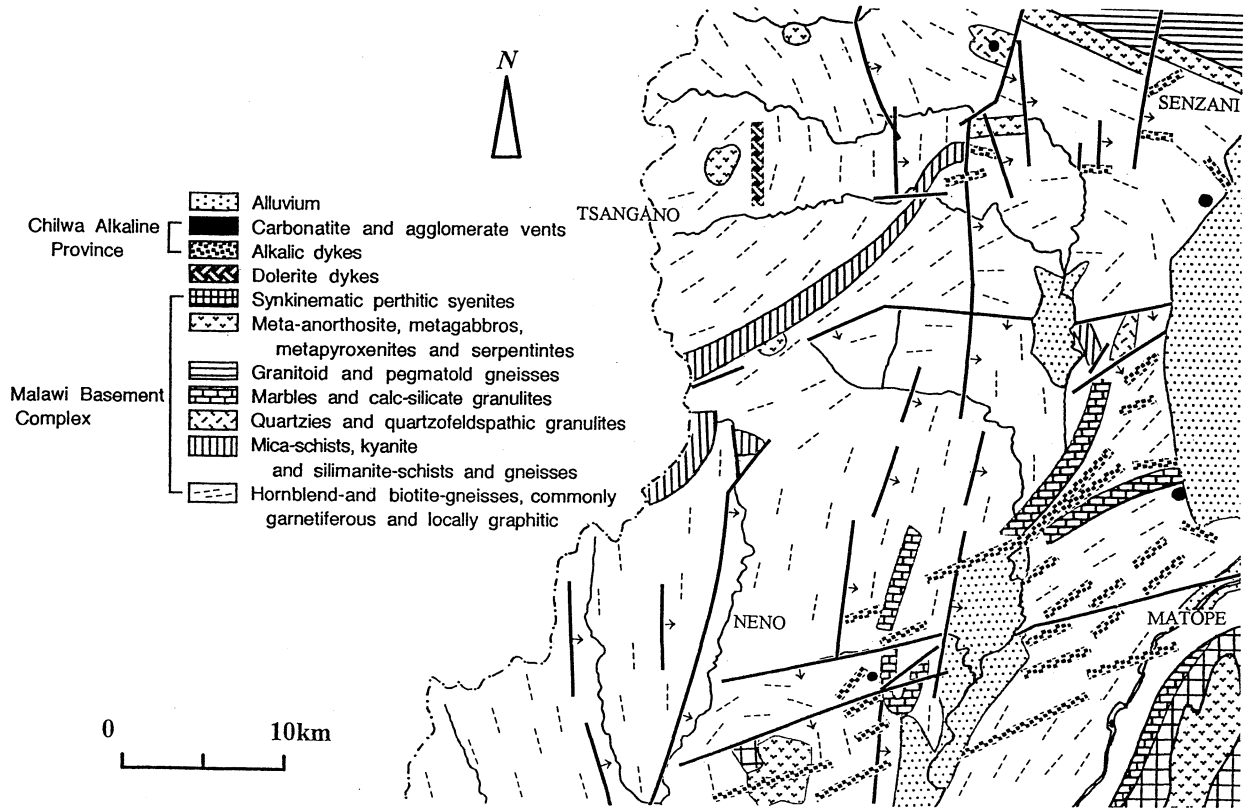

Fig. 3. Geological map.

Samples and Methods

The stream sediment samples were generally collected from depths of between 0.2 and 0.4m at about 1km intervals along all streams. At stream junctions, samples were collected above and below the bifurcation. The sample density was about 1.2 samples per km^2 on average. The number of samples was 600. After collection, the samples were dried and sieved through nylon cloth of approximately 80 mesh. All samples were analysed by atomic absorption spectrophotometer for chromium, copper, nickel and gold.

Geochemical results

The geochemical results for 4 elements are given in Table 1 and are summarized in Table 2.

The range of values for chromium, copper, nickel and gold were generally low, but at some points chromium and gold were of more interest. High values occurred in 2 areas (Fig. 4): one for chromium and the other for gold. Contoured geochemical maps for the elements are given in Fig. 5 and Fig. 6.

(1) Copper

Results for copper were of no interest. All values were below 100ppm. The highest copper value was 91.44ppm and is situated in Lisungwe River.

(2) Nickel

Nickel was centred in Kapeni Stream, but there were a few values in the range 30 to 410ppm which formed a small grouping on a part of area I (Fig. 5). The highest nickel value was 409.6ppm, but apart from it, the results do not seem very interesting.

(3) Chromium

There were 3 samples with chromium values greater than 1000ppm in Kapeni Stream (Fig. 5) and the highest value was 2107ppm. The highest chromium values (>1000ppm) are on the northern side of Chimwarzulu Hill and values of 400 to 999ppm

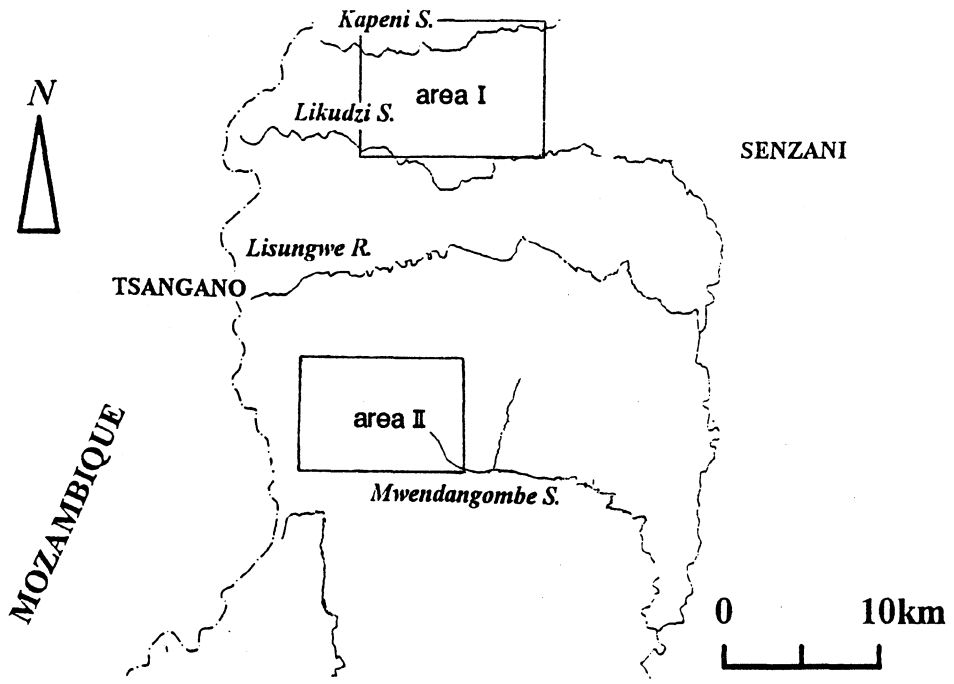

Fig. 4. Distribution of area I and area II.

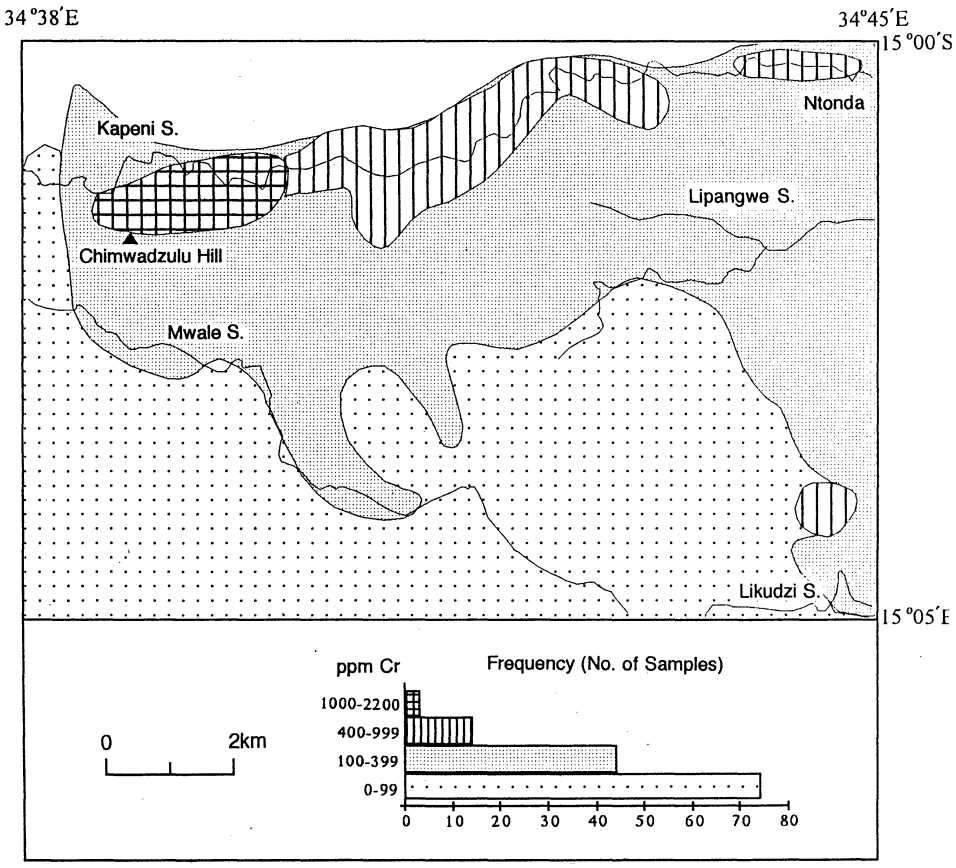

Fig. 5. Distribution of chromium in stream sediments from area I.

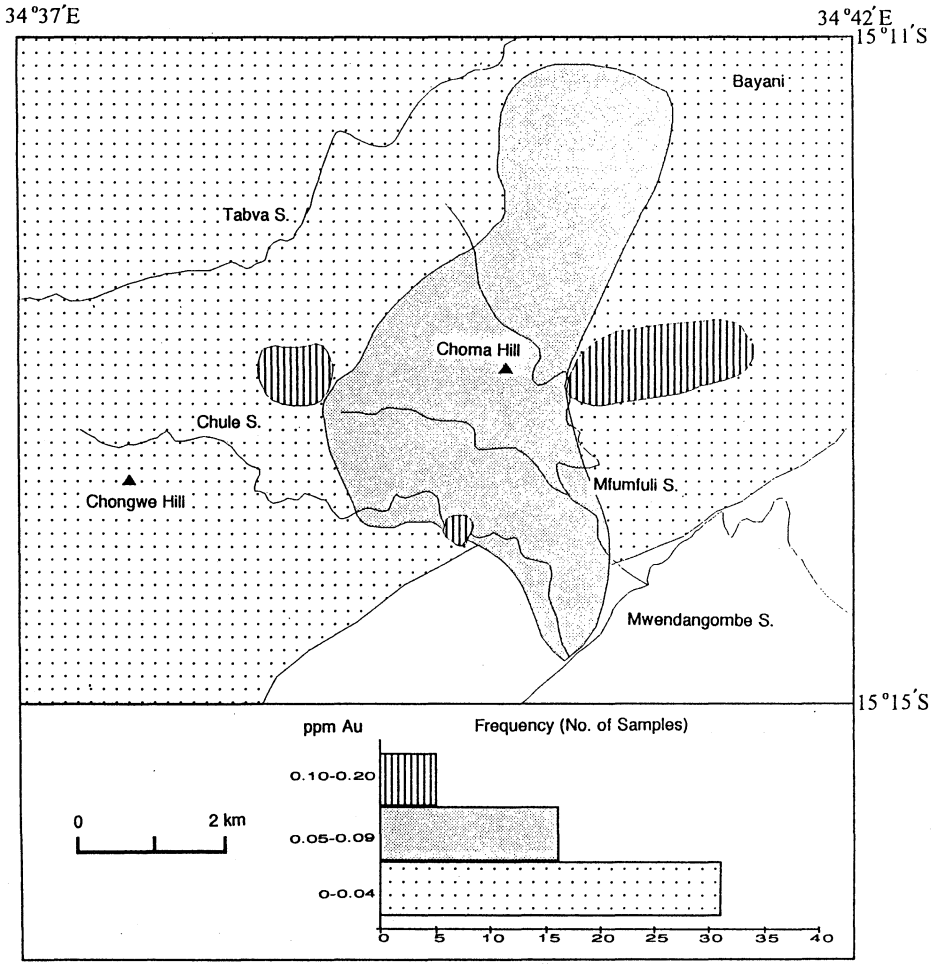

Fig. 6. Distribution of gold in stream sediments from area II.

chromium are centred along Kapeni Stream east of the highest chromium values. Chimwadzulu Hill, which consists of amphibolites, is roughly triangular in plan and is surrounded by paragneisses. On the hill the commonest variety is amphibolites consisting of short primatic crystals of black or very dark green hornblende varying in size from 1mm to as much as 10mm, and minute crimson garnets are also common. Hypersthene-amphibolites and porphyroblastic garneti-ferrous varieties are only found on the hill where the rocks are also rather more mafic than elsewhere. Traces of nickel and up to 0.2 percent chromium were found in almost all of the rock specimens from Chimwadzulu Hill (Bloomfield and Garson, 1965). On weathering the rocks produce a deep chocolate-brown soil well-developed around the base of the hill, and also, samples of chromium values greater than 1000ppm are that colour. There are some streams from Chimwadzulu Hill and they join the Kapeni Stream which flows eastwards. Chromium has come from Chimwadzulu Hill. Some parts were sedimented on the northern side of the hill and some carried eastwards. High values are related to Chimwadzulu Hill of amphibolites.

(4) Gold

Gold results are of most significance, and the geochemical map for gold in area II (Fig. 4) is shown in Fig. 6. Gold is centred in area II, and the highest gold value in the area is 0.11ppm. There are 5 samples with gold values greater than 0.1ppm; in Mfumfuli Stream, in Nyuzudzi Stream and three samples in Chule Stream. The highest gold values are seen in contact with the Chongwe Schist

Table1-a. Geochemical results

Sample No.	Au	Ni	Cu	Cr	Sample No.	Au	Ni	Cu	Cr
K1	0.03	22.53	14.10	451.92	k46	0.02	33.31	34.97	493.44
K2	-	41.72	24.20	27.75	k47	0.01	89.52	31.77	951.49
K3	-	41.01	19.02	592.89	k48	0.01	48.41	35.49	268.06
K4	0.01	49.07	34.51	231.56	k49	0.02	137.11	25.02	1420.90
K5	0.01	25.67	13.01	476.80	k50	0.02	409.60	27.68	2107.00
K6	0.01	12.26	18.11	74.65	k51	0.01	30.25	31.22	224.50
K7	0.04	28.53	17.03	280.57	k52	-	38.42	48.11	173.28
K8	-	32.86	23.13	318.26	k53	-	16.49	24.48	130.56
K9	0.01	23.54	10.15	498.10	k54	0.03	119.46	33.84	1007.40
K10	0.02	23.73	39.70	83.84	k55	0.02	22.43	35.02	120.02
K11	0.01	23.79	47.37	79.42	k56	0.02	8.40	12.52	80.70
K12	0.02	32.81	31.69	52.92	k57	0.03	9.66	15.24	62.81
K13	0.03	39.33	27.38	550.14	k58	0.02	17.91	18.79	89.48
K14	0.03	16.43	42.33	72.78	k59	-	7.43	12.35	46.21
K15	0.01	28.95	18.34	359.96	k61	-	4.29	8.94	47.73
K16	0.02	30.36	13.72	294.65	k62	0.04	6.54	11.53	40.17
K17	0.04	42.52	26.37	477.50	k64	0.01	9.57	18.85	61.04
K18	0.02	15.54	17.67	169.95	k65	0.01	13.19	24.37	98.38
K19	0.01	39.59	20.03	527.84	k66	0.01	7.58	11.04	36.20
K20	0.02	37.55	36.23	284.58	k67	0.02	29.14	31.48	209.69
K21	0.02	29.38	13.02	149.50	k68	0.01	12.55	21.57	115.85
K22	0.02	60.55	12.39	287.58	k69	0.02	13.57	31.33	96.93
K23	0.03	15.14	15.46	128.59	k70	0.01	18.17	33.27	109.58
K24	0.02	61.60	15.19	263.06	k71	0.01	5.52	21.14	27.64
K25	0.01	26.10	26.97	136.42	k72	0.01	21.74	15.70	164.49
K26	0.02	45.45	15.44	211.89	k73	0.40	67.45	45.94	322.00
K27	0.01	24.47	19.09	145.58	k74	-	12.63	21.64	84.63
K28	0.02	25.75	28.11	141.65	k75	0.01	68.70	20.64	721.17
K29	0.04	9.76	20.01	85.94	k76	-	10.58	23.15	62.70
K30	0.03	51.16	27.39	283.63	k77	0.01	14.09	25.98	81.50
K31	0.06	33.82	46.48	119.44	k78	0.02	4.78	15.25	30.94
K32	0.02	18.18	31.36	127.28	k79	0.01	9.66	25.04	116.18
K33	0.02	8.25	18.99	77.68	k80	0.01	27.95	17.61	292.17
K34	0.02	15.55	24.74	144.27	k81	0.03	12.36	29.64	84.21
K35	0.05	29.46	31.77	185.70	k82	0.03	8.34	27.01	77.78
K36	0.31	7.18	17.10	30.35	k83	-	6.29	20.60	77.24
K37	0.03	12.42	25.55	70.29	k84	0.02	11.54	26.27	81.75
K38	0.03	7.10	20.49	75.51	k85	-	15.50	31.91	103.87
K39	0.03	7.48	22.45	57.26	k86	0.04	6.45	30.88	61.42
K40	0.01	13.09	26.29	98.99	k87	-	5.12	23.19	62.14
K41	0.04	5.34	29.12	47.00	k88	-	7.58	31.78	67.03
K42	0.03	48.16	31.21	445.81	k89	-	9.30	66.74	34.46
K43	-	91.98	19.44	613.89	k90	0.02	8.23	49.89	23.87
K44	-	46.74	30.28	401.08	k91	0.02	9.02	66.74	39.40
K45	0.04	47.67	29.56	458.32	k92	-	8.58	55.06	15.82

All values in ppm

Table1-b. Geochemical results

Sample No.	Au	Ni	Cu	Cr	Sample No.	Au	Ni	Cu	Cr
K93	-	7.78	57.84	27.25	K138	-	6.42	18.55	53.31
K94	-	7.52	55.76	19.49	K139	-	4.27	15.12	54.56
K95	0.01	7.62	41.89	15.03	K140	0.01	5.29	24.20	44.41
K96	0.01	5.87	36.11	34.32	K141	-	5.82	22.12	44.56
K97	-	6.00	26.35	14.41	K142	0.02	5.24	11.98	30.18
K98	-	6.14	28.10	36.82	K143	-	5.44	13.38	40.28
K99	-	7.63	30.17	25.37	K144	0.01	5.28	23.26	37.57
K100	-	5.95	31.41	19.67	K145	0.02	3.82	11.39	36.55
K101	-	11.12	43.38	100.38	K146	0.01	4.80	16.11	60.08
K102	-	6.66	23.98	20.20	K147	0.03	6.68	18.19	72.18
K103	-	6.87	25.72	21.26	K148	0.01	4.61	9.49	25.58
K104	-	8.10	29.36	69.21	K149	0.02	4.50	10.32	24.14
K105	-	7.23	31.44	63.16	K150	0.03	7.32	21.33	97.34
K106	0.01	7.50	31.25	66.14	K151	0.02	3.68	8.78	31.44
K107	0.01	5.33	15.42	54.75	K152	-	6.11	2.22	38.95
K108	-	7.98	21.83	72.93	K153	-	4.53	7.49	43.02
K109	-	7.64	21.14	74.82	K154	0.04	4.40	9.74	30.91
K110	0.01	5.45	29.72	36.18	K155	0.02	3.23	5.79	52.64
K111	0.01	6.67	22.93	56.14	K156	0.02	3.17	4.42	39.94
K112	0.03	5.54	17.13	38.87	K157	0.02	6.23	14.99	36.43
K113	0.02	10.85	25.76	86.67	K158	0.01	6.47	16.15	46.35
K114	0.03	7.69	22.80	72.19	K159	0.02	5.45	10.26	71.70
K115	0.03	6.09	21.87	56.27	K160	0.02	4.88	12.81	38.93
K116	-	9.53	27.62	102.38	K161	0.01	8.26	12.93	76.49
K117	0.01	10.24	29.85	95.41	K162	0.01	8.02	13.43	77.44
K118	0.03	11.23	40.83	57.32	K163	0.02	5.02	7.82	59.96
K119	-	9.31	35.63	67.78	K164	0.01	10.13	20.89	88.20
K120	0.02	8.94	45.61	53.95	K165	0.01	4.29	6.44	37.15
K121	-	10.71	46.91	100.53	K166	0.01	5.59	13.03	44.82
K122	-	14.24	39.87	103.02	K167	-	8.36	19.81	52.76
K123	-	9.02	50.84	59.34	K168	0.02	4.58	7.74	53.20
K124	-	10.08	37.70	115.67	K169	0.02	4.41	7.19	37.78
K125	0.01	5.45	12.17	63.08	K170	0.02	6.40	11.98	61.07
K126	0.01	15.09	33.75	107.15	K171	0.03	5.75	11.20	47.35
K127	0.01	11.44	32.18	107.51	K172	0.01	10.92	27.96	52.80
K128	-	18.19	29.22	90.54	K173	0.01	4.17	6.73	38.25
K129	0.01	19.82	46.03	75.15	K174	0.03	3.95	5.64	52.63
K130	-	15.57	30.36	96.67	K175	0.01	5.04	8.96	40.22
K131	0.01	35.88	41.61	178.87	K176	0.01	15.14	29.18	152.34
K132	0.01	21.11	45.78	116.96	K177	0.02	5.57	14.72	70.42
K133	-	14.81	29.44	57.47	K178	0.03	1.53	10.98	52.71
K134	0.03	26.54	42.45	112.31	K179	0.01	6.97	21.24	68.60
K135	-	10.41	30.81	84.58	K180	0.02	3.07	6.04	56.74
K136	0.03	5.94	12.26	52.46	K181	0.03	5.96	20.89	58.80
K137	-	6.03	19.56	48.10	K182	0.09	4.47	7.11	58.80

All values in ppm

Table1-c. Geochemical results

Sample No.	Au	Ni	Cu	Cr	Sample No.	Au	Ni	Cu	Cr
K183	0.02	5.51	15.17	56.11	K228	0.05	7.71	28.49	88.68
K184	0.02	4.29	9.26	57.06	K229	0.03	15.60	40.58	76.39
K185	0.03	3.52	6.81	59.51	K230	0.03	13.08	52.48	98.55
K186	0.02	2.75	4.87	46.63	K231	0.02	8.65	37.22	71.64
K187	0.02	6.28	17.48	71.84	K232	0.03	16.91	91.44	114.07
K188	0.03	6.92	31.97	78.88	K233	0.01	13.23	45.12	84.38
K189	0.02	5.66	25.71	59.83	K234	0.03	5.08	14.94	42.49
K190	0.02	5.26	17.07	89.00	K235	0.02	7.70	36.27	65.63
K191	0.02	5.26	14.77	101.65	K236	0.03	5.90	24.51	36.04
K192	0.01	5.43	15.98	61.09	K237	0.04	6.16	31.68	62.49
K193	0.02	4.32	10.49	98.96	K238	0.04	6.34	18.94	55.41
K194	0.02	2.86	6.11	85.68	K239	0.02	8.00	25.38	74.15
K195	-	4.67	15.62	72.40	K240	0.03	11.81	36.08	95.68
K196	0.02	3.14	7.05	40.07	K241	0.01	15.99	51.25	94.69
K197	0.01	4.12	16.23	53.74	K242	0.10	14.99	26.21	52.52
K198	0.02	3.56	8.90	36.67	K243	-	12.03	32.20	45.21
K199	0.02	5.54	10.03	45.84	K244	0.01	10.22	30.63	57.69
K200	0.01	7.94	9.74	50.26	K245	0.02	8.38	38.54	54.85
K201	0.01	4.53	5.28	38.09	K246	0.01	8.15	28.52	49.00
K202	0.04	9.09	13.80	44.57	K247	0.02	6.00	16.16	43.82
K203	0.01	10.55	28.39	120.19	K248	-	5.46	12.24	49.99
K204	0.02	7.08	17.39	70.90	K249	-	9.65	45.95	82.80
K205	0.02	8.20	26.01	78.62	K250	-	10.27	27.50	59.31
K206	0.01	24.09	37.89	165.04	K251	-	6.35	15.89	27.59
K207	0.01	5.81	22.96	44.07	K252	0.01	5.19	11.94	47.57
K208	0.01	9.62	37.79	73.19	K253	-	7.66	17.14	34.70
K209	0.01	6.30	41.81	56.99	K254	-	4.92	12.06	44.62
K210	0.02	4.28	14.45	36.85	K255	-	6.43	20.91	47.91
K211	0.03	6.83	36.99	41.07	K256	-	5.63	14.12	38.23
K212	0.04	4.56	7.05	35.69	K257	-	4.00	8.40	27.21
K213	0.03	8.67	16.23	65.61	K258	-	7.94	14.94	28.87
K214	0.07	20.15	8.90	115.75	K259	-	7.97	15.97	38.71
K215	0.05	12.14	10.03	64.57	K260	-	7.14	15.60	31.53
K216	0.04	11.18	9.74	60.63	K261	0.02	6.01	11.46	26.94
K217	0.01	16.22	5.28	74.04	K262	0.01	8.67	14.64	26.58
K218	0.04	6.14	13.80	51.11	K263	0.03	10.50	19.78	27.69
K219	0.05	18.83	28.39	112.36	K264	-	21.06	15.60	57.46
K220	0.05	5.17	17.39	42.76	K265	0.01	8.97	18.48	71.13
K221	0.03	11.85	26.01	77.47	K266	-	5.59	10.84	412.78
K222	0.03	8.03	37.89	62.77	K267	0.01	8.44	31.76	134.85
K223	0.05	7.28	22.69	62.94	K268	-	4.74	12.59	92.35
K224	0.03	7.63	22.56	54.60	K269	0.01	22.64	39.04	214.49
K225	0.08	5.04	14.08	41.24	K270	0.01	18.76	32.26	130.15
K226	0.06	5.14	15.40	76.03	K271	-	17.71	42.31	67.71
K227	0.05	9.07	48.37	106.80	K272	0.02	6.46	15.69	318.87

All values in ppm

Table1-d. Geochemical results

Sample No.	Au	Ni	Cu	Cr	Sample No.	Au	Ni	Cu	Cr
K273	0.03	7.62	25.17	454.34	K319	-	7.60	15.72	35.65
K274	0.03	9.22	24.93	156.76	K320	0.02	8.24	15.72	23.03
K275	0.01	7.37	30.46	444.91	K321	-	3.41	31.11	23.59
K276	-	7.93	24.50	41.37	K322	0.02	19.51	16.55	58.49
K277	-	15.05	20.91	39.37	K323	-	4.20	16.68	30.60
K278	-	7.90	17.26	484.59	K324	-	14.61	16.43	34.44
K279	0.01	5.80	13.48	591.62	K325	0.01	3.04	13.83	45.45
K280	0.01	14.07	31.50	47.89	K326	-	3.20	18.45	57.95
K281	0.02	6.46	14.55	571.82	K327	0.01	12.22	37.95	43.96
K282	0.01	15.25	33.89	55.44	K329	-	16.26	32.73	44.96
K283	-	14.02	31.02	51.71	K330	-	5.41	13.13	43.13
K284	0.01	12.15	21.53	42.66	K331	-	13.09	44.27	65.84
K285	0.02	8.76	21.77	528.76	K332	-	16.35	48.82	1.61
K286	-	4.93	7.84	425.03	K333	-	8.60	24.72	33.25
K287	-	6.59	8.76	567.49	K334	-	7.40	19.21	35.50
K288	0.02	6.06	25.51	170.50	K335	0.01	5.92	13.58	31.50
K289	-	8.02	14.15	138.61	K336	-	22.93	22.14	41.22
K290	0.01	9.74	26.78	196.76	K337	0.01	9.72	23.98	28.35
K291	0.02	6.55	18.70	590.13	K338	-	5.93	11.39	63.74
K292	0.01	6.85	12.33	107.09	K339	-	7.86	14.97	35.32
K293	-	6.28	25.68	209.73	K340	0.01	6.83	10.72	92.32
K294	0.04	7.66	29.22	148.01	K341	0.01	7.37	20.90	34.52
K295	-	7.65	19.76	290.76	K342	-	10.93	17.28	26.10
K296	0.01	8.58	18.66	191.39	K343	-	6.28	19.84	33.60
K297	0.01	9.42	44.05	151.93	K344	-	6.92	16.01	54.90
K298	-	9.75	28.89	567.24	K345	-	42.24	17.43	21.92
K299	0.02	5.29	10.04	99.36	K346	-	5.15	28.13	18.70
K300	-	8.60	18.89	145.92	K347	-	4.18	11.87	28.12
K301	-	8.22	31.21	119.70	K348	-	5.14	22.28	68.07
K302	-	15.36	17.48	55.27	K349	0.02	7.16	16.13	37.48
K303	0.01	3.76	8.27	64.53	K350	-	3.92	15.35	39.19
K304	-	5.28	10.84	97.55	K351	0.01	9.65	29.96	72.82
K305	0.01	22.76	22.01	187.82	K352	-	15.15	31.43	49.94
K306	-	9.55	37.55	304.71	K353	-	14.18	39.00	63.88
K307	-	7.50	21.34	265.52	K354	-	14.17	35.72	35.60
K308	0.01	7.88	15.79	164.51	K355	0.03	14.28	31.27	58.26
K309	-	6.80	15.17	46.45	K356	0.02	15.70	33.84	75.82
K310	-	9.27	22.05	129.82	K357	0.01	19.12	35.40	100.02
K311	-	9.24	23.65	146.34	K358	0.02	12.50	28.24	39.23
K312	0.05	14.87	40.18	51.22	K359	-	12.34	25.49	59.47
K314	-	7.87	16.12	44.14	K360	-	7.40	23.28	42.84
K315	0.01	9.45	12.53	17.32	K361	0.03	19.68	41.03	58.45
K316	0.01	8.87	25.40	28.63	K362	-	10.40	29.34	45.29
K317	-	6.28	23.43	24.68	K363	0.04	11.93	34.09	39.03
K318	0.08	11.17	19.94	39.88	K364	-	12.41	29.85	70.81

All values in ppm

Table1-e. Geochemical results

Sample No.	Au	Ni	Cu	Cr	Sample No.	Au	Ni	Cu	Cr
K365	0.03	12.87	33.15	67.62	K410	0.03	17.83	35.85	59.30
K366	0.02	9.57	23.34	56.86	K411	0.01	26.53	47.58	79.10
K367	0.02	12.30	28.03	58.72	K412	0.02	32.37	49.02	85.48
K368	0.01	14.00	33.81	53.30	K413	-	35.81	37.94	119.21
K369	0.02	9.95	23.58	38.34	K414	0.02	30.35	43.23	153.05
K370	-	13.36	34.20	40.44	K415	0.01	20.71	42.99	103.46
K371	0.02	14.02	22.81	63.74	K416	0.01	12.96	33.91	69.40
K372	0.01	8.11	21.63	29.40	K417	0.02	31.70	45.98	102.04
K373	0.03	10.08	34.29	32.66	K418	-	30.48	49.73	170.36
K374	-	23.96	39.61	115.86	K419	-	27.41	34.17	172.76
K375	0.01	9.00	36.50	47.18	K420	0.01	32.27	41.60	184.30
K376	0.02	13.32	45.32	82.94	K421	0.06	11.04	33.07	67.62
K377	0.01	6.50	19.24	27.27	K422	0.02	18.88	37.39	104.34
K378	0.02	14.38	29.38	45.16	K423	0.02	16.89	35.98	27.42
K379	0.01	24.71	34.98	52.59	K424	-	14.94	37.08	16.26
K380	0.01	6.84	24.83	48.81	K425	0.01	23.32	39.09	152.47
K381	0.02	6.60	11.91	21.72	K426	0.03	26.50	40.40	131.38
K382	0.02	27.63	36.80	99.94	K428	0.10	15.37	42.04	154.89
K383	0.03	14.68	22.16	55.03	K429	0.02	27.75	43.06	168.24
K384	-	10.30	17.24	72.65	K430	0.02	34.83	51.71	152.68
K385	0.01	13.87	23.54	87.50	K431	0.02	28.03	44.34	134.23
K386	-	8.93	23.31	56.05	K432	0.01	25.86	35.21	108.38
K387	0.02	14.40	26.55	59.39	K433	0.01	31.68	56.49	116.84
K388	0.01	24.43	43.35	68.56	K434	0.02	34.09	48.86	99.19
K389	-	13.79	18.09	41.22	K435	0.02	30.69	68.33	118.95
K390	-	13.75	24.24	61.05	K436	-	25.02	53.32	59.19
K391	-	-	15.00	64.22	K437	0.01	9.42	33.26	32.91
K392	-	9.83	13.82	49.18	K438	0.01	5.81	15.21	57.72
K393	-	9.81	20.57	69.89	K439	-	9.23	22.82	59.28
K394	-	17.54	25.82	88.84	K440	0.01	8.66	18.16	32.45
K395	-	27.61	29.58	71.06	K441	0.01	10.24	48.11	83.21
K396	0.01	13.31	38.73	55.05	K442	0.05	14.08	39.38	91.18
K397	-	19.99	43.46	95.52	K450	-	8.93	18.32	57.14
K398	-	24.89	40.82	84.33	K451	0.03	8.38	21.35	59.44
K399	-	1.46	11.84	31.65	K452	0.02	9.46	20.43	56.81
K400	-	13.95	27.33	76.99	K453	0.06	7.99	29.25	91.31
K401	-	21.91	43.98	111.23	K454	0.03	25.12	53.10	143.49
K402	-	13.13	37.77	67.31	K455	-	10.19	22.48	79.20
K403	-	13.99	29.62	63.43	K456	-	5.80	16.74	67.71
K404	0.02	11.35	46.52	44.32	K457	-	6.99	23.94	79.65
K405	0.02	16.86	44.13	50.81	K458	-	8.73	19.76	59.58
K406	0.01	23.12	50.69	48.06	K459	0.02	12.19	22.42	69.91
K407	0.01	16.60	40.03	57.05	K460	-	13.58	30.06	53.66
K408	0.03	17.82	49.07	88.80	K461	-	11.86	28.96	58.59
K409	0.01	20.53	41.69	102.87	K463	-	11.59	30.11	95.07

All values in ppm

Table1-f. Geochemical results

Sample No.	Au	Ni	Cu	Cr	Sample No.	Au	Ni	Cu	Cr
K464	-	25.42	46.13	130.63	K541	-	32.64	34.08	172.23
K465	-	23.99	48.02	153.44	K543	-	29.05	41.42	172.48
K466	-	29.35	65.59	148.21	K544	-	27.85	40.51	270.46
K467	0.05	31.50	56.61	183.88	K546	-	23.37	46.02	82.61
K468	-	31.34	48.04	244.86	K547	0.01	29.29	43.93	133.55
K469	-	31.37	48.59	247.12	K548	0.01	24.05	56.00	96.71
K470	0.01	27.49	54.10	166.20	K549	0.03	27.21	36.82	89.11
K471	-	32.54	49.34	214.18	K550	-	18.23	46.51	97.60
K472	0.03	28.84	49.73	188.65	K551	0.01	20.04	45.55	61.80
K473	0.04	24.59	45.09	172.29	K552	0.02	19.31	47.98	54.55
K474	-	17.17	33.63	157.93	K553	-	9.95	26.59	71.47
K475	-	18.56	45.33	130.83	K554	-	10.80	28.56	47.47
K476	-	16.90	42.17	96.26	K555	-	21.96	30.50	105.12
K477	-	29.82	41.41	213.12	K556	-	20.58	27.14	105.09
K478	-	30.82	52.30	103.75	K557	-	11.23	26.66	42.07
K479	0.03	22.64	39.96	171.26	K558	-	11.16	33.09	52.14
K480	0.02	27.72	40.41	120.09	K559	-	15.67	34.78	101.93
K481	-	39.27	60.90	113.75	K560	-	11.76	18.11	62.80
K482	0.06	23.27	43.20	105.66	K561	-	8.17	14.42	47.87
K483	0.08	33.28	45.67	195.35	K562	-	10.86	17.32	48.97
K484	0.08	19.41	41.59	123.17	K563	-	8.30	24.00	35.69
K485	0.06	28.98	43.60	130.12	K564	-	11.70	31.25	37.54
K486	0.11	25.71	46.61	113.95	K565	-	11.68	30.11	47.00
K515	0.05	15.56	23.45	100.84	K566	-	12.02	25.90	65.30
K516	0.07	16.63	19.66	120.78	K567	-	11.80	25.41	49.18
K517	0.03	20.96	35.17	124.42	K568	-	7.54	22.91	42.28
K518	0.10	18.25	30.01	177.91	K569	-	24.28	38.98	33.89
K519	0.05	25.42	37.16	251.96	K570	-	13.53	30.76	114.22
K520	0.06	31.79	37.14	169.82	K571	-	20.12	34.78	65.98
K521	0.03	32.26	38.95	165.75	K572	-	6.61	18.98	91.10
K522	0.08	17.73	26.50	164.44	K573	-	11.33	22.66	32.72
K523	-	8.40	11.82	79.49	K574	-	10.04	26.61	38.13
K524	0.06	12.56	22.02	78.84	K575	-	11.03	21.12	30.31
K529	0.10	26.19	33.51	131.63	K576	-	13.49	25.60	36.06
K530	0.07	20.45	51.36	149.18	K577	-	22.80	27.63	69.59
K531	0.05	15.04	35.78	81.83	K578	-	9.74	18.54	61.35
K532	0.03	22.77	27.97	159.95	K579	-	12.98	21.82	45.00
K533	-	25.18	35.44	135.51	K580	-	19.09	26.86	32.40
K534	0.09	28.73	33.47	200.90	K581	-	14.51	19.74	36.04
K535	0.10	24.01	31.91	134.28	K582	-	24.69	38.61	70.11
K536	0.10	25.21	28.76	146.71	K583	-	13.16	7.02	39.96
K537	-	20.91	30.80	122.84	K584	-	12.45	8.31	31.30
K538	-	26.02	22.10	162.99	K585	-	8.24	10.59	25.57
K539	-	26.53	33.62	190.26	K586	0.02	11.13	13.18	39.02
K540	-	27.38	32.53	214.61	K587	-	13.70	11.13	39.78

All values in ppm

Table1-g. Geochemical results

Sample No.	Au	Ni	Cu	Cr
K588	0.01	4.90	13.37	34.59
K591	-	11.64	13.69	10.47
K592	-	5.52	11.61	29.06
K602	-	10.41	20.69	27.60
K603	-	7.61	16.87	11.35
K609	0.01	10.30	10.77	17.87
K610	-	10.74	13.48	19.87
K611	-	11.50	12.52	28.27
K612	-	10.24	11.45	73.54
K613	-	5.90	10.53	29.00
K614	-	6.73	8.59	60.89
K615	-	11.63	10.85	32.67
K616	-	7.53	9.55	38.93
K617	-	5.85	9.52	43.18
K618	-	8.24	8.38	48.75
K619	-	14.15	15.38	23.88
K620	-	10.05	11.40	108.88
K621	-	10.22	8.60	33.56
K622	-	12.05	11.60	105.69
K623	-	10.05	10.78	-
K624	-	4.85	8.48	5.92
K625	-	5.22	5.88	103.34
K626	-	6.26	6.83	19.36
K627	-	6.62	8.05	130.12
K628	0.01	11.19	21.10	38.46
K629	-	7.83	17.74	45.22
K630	-	14.71	19.76	31.65
K631	-	11.13	19.69	56.11
K632	-	18.08	28.04	17.76
K633	0.02	12.02	17.28	44.26
K646	-	19.73	42.04	139.69
K647	-	22.87	22.05	36.49
K648	-	19.27	24.21	14.45
K649	-	22.85	27.69	268.08
K650	-	17.22	20.21	33.31
K662	-	9.02	19.88	12.48
K663	-	14.30	19.37	159.34
K664	-	11.71	16.73	84.28
K665	-	12.38	14.11	169.23
K666	-	5.07	10.16	21.46
K667	-	15.22	21.46	54.39
K668	-	12.19	19.41	43.82
K669	0.02	26.01	33.98	86.77
K670	0.01	4.49	11.31	45.41
K671	-	7.56	11.58	106.57
K672	-	8.62	16.34	96.53
K673	-	12.65	19.80	94.99
K674	-	7.80	13.91	80.63
K675	0.25	12.25	23.69	89.44
K676	-	7.75	12.81	78.78
K679	-	5.61	15.33	51.33
K680	0.18	5.61	10.02	57.05
K681	-	7.05	11.40	60.56
K682	-	10.97	13.72	68.44
K683	-	3.90	7.16	44.01
K684	-	8.20	8.36	51.27
K685	-	4.05	6.65	57.36
K686	-	4.37	7.04	57.67
K687	-	3.64	6.77	61.18
K688	-	8.94	12.28	104.90

All values in ppm

Table 2. Summary of geochemical results

	Mean	Maximum
Gold	0.02	0.40
Nickel	15.17	409.60
Copper	25.81	91.44
Chromium	108.28	2107.00

All values in ppm.

Formation which is the largest and most persistent schist horizon in the survey area. It can be traced from the Mozambican border, across Chongwe Hill and the northern side of Choma Hill to the Namiso Fault near Ntonda road. Around Chongwe and Choma Hill the rocks are kyanite-bearing graphitic muscovite-schists. Traced north-eastwards the amount of kyanite decreases and graphite increases. Kyanite is usually strongly corroded and intergrown with quartz which forms vents in some places. The streams come from the Chongwe Schist Formation in the area of high gold values. Gold may be associated with the formation and with quartz vents in particular.

Conclusions

Levinson (1974) showed some elements in average abundance in soil; chromium from 5 to 1000ppm, copper from 2 to 1000ppm, nickel from 5 to 500ppm and gold none. According to these results, in the area the levels of copper and nickel in stream sediment samples are low, but chromium and gold are of more interest. The highest chromium values (>1000ppm) occurred on the northern side of Chimwadzulu Hill which consists of amphibolites, and also the highest nickel value (409.6ppm) was situated in the same area. Chromium is related to the hill. The chromium content of any concentrate that could be benificiated for commercial use is too low to be useful. Gold is centred on and around the Chongwe Schist Formation. There were 5 samples over 0.1ppm which was associated with quartz vents in the formation, but the vents are small in size and continuation is limited. It is difficult to search for greater gold values.

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