MINISTRY OF ENERGY AND MINERAL RESOURCES
Mineral Status and Future Opportunity

GOLD

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2014

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1. Introduction

The geochemical exploration undertaken in the Aqaba-Araba complexes (Precambrian) in southwestern part of Jordan had detailed by geochemical and mineral exploration. A joint, geochemical exploration project involving the NRA & BRGM has covered the whole of the southern Jordanian Panafrican basement, during the years 1992 - 1994. Systematic regional exploration, followed by semi-detailed and detailed prospecting to define the eight main geochemical anomalies areas that were been detected in the Aqaba-Araba basement (Final report/ NRA & BRGM project staff, 1994).

Enhanced gold concentration were detected at a number of localities, particularly in the felsic volcanic rocks of the Aheimir Suite in Wadi Abu khushyba, Wadi Hower and Wadi Sabra areas (Araba Complex), and in the metarhyolite rocks in Jebel al Mubarak and Enn El-Hasheem (Aqaba Complex), in extreme southern of Jordan near the Saudi Arabia border.

The metarhyolites, which hosted disseminated pyrite, were been initially examined in a joint project between NRA and United Nations development project and the Minerals Exploration Board of the Republic of Yemen in 1992.

Only the anomaly in Wadi Abu Khusheiba has been undergone to geochemical and minerals detailed studies, while the others anomalies still under geochemical examination to prove these anomalies.

This gold anomaly detected during the NRA/ BRGM collaborative project, ARAGEO 1, now referred to as the Wadi Abu Khusheiba gold occurrence, Nimry et al., (1995) investigated by the Geochemical Division of the NRA in 1994 and the first half of 1995.

Detailed geochemical and semi-detailed prospecting (soil, stream sediment and heavy mineral concentrates and rock chip samples) was been undertaken over the anomalies in Wadi Abu Khusheiba, Wadi Hower and Wadi Sabra. A limited number of Samples analyzed in the delineated areas, the results of which have detailed in Tables (1, 2 and 3); and depicted in Figures (5, 8 and 9). Visible gold has detected in a number of the heavy mineral concentrates in Wadi Abu Khusheiba and Wadi Sabra; latter on gold has detected in rock within a vein in Wadi Abu Khusheiba.

Table (1): Heavy mineral concentrates and sampling types in Wadi Abu Khushyba area.

(Refer to Figure 4 for sample localities).
H = heavy mineral concentrate from panned stream sediment sample.
HT = heavy mineral concentrate from wadi terrace.
HA = heavy mineral concentrate: 0.5 to 1 mm fraction.
HB = heavy mineral concentrate: <0.5 mm fraction.

Sample No.	Sample type	Au (ppm)	Sample No	Sample type	Au (ppm)
H17	H	5-8	H53	H	0.01
H18	H	0.010-0.140	H54	H	0.025
H19	H	0.020	H55	H	0.5
H20	H	3-5	H56	H	<0.010
H21	H	3-5	H57	H	0.110
H22	H	10	H58	H	0.025
H23	H	18	H59	H	0.015
H26	H	0.140	H60	H	0.025
H27	H	2-3	H61	H	0.170
H28	H	0.140	H62	H	0.230
H29	H	2-3	H63	H	0.130
H30	H	5-8	H64	H	0.500
H31	H	2-3	H65	H	0.400
H32	H	2-3	H66	H	<0.010
H33	H	0.140	H67	H	<0.010
H34	H	2-3	V1	H	<0.010
H35	H	2-3	V2	H	0.160
H36	H	0.300	V3	H	0.115
H37	H	0.180	V4	H	0.070
H38	H	0.030	HT1	HT	<0.010
H39	H	0.010	15040	H	<0.010
H40	H	0.035	15041	H	8
H41	H	0.010	15042	H	40
H42	H	0.27	15043	H	0.045
H43A	HA	0.170	15044	H	0.235
H43B	HB	<0.010	15045	H	<0.010
H44A	HA	7.27	15046	H	0.400
H44B	HB	0.34	15047	H	2
H45A	HA	0.030	15048	H	0.3
H45B	HB	0.020	15049	H	0.235
H46A	HA	0.010	15050	H	2
H46B	HB	<0.010	15051	H	0.006
H50	H	0.04	15052	H	2
H51	H	3.5	15053	H	<0.10
H52	H	0.02	15054	H	0.110

Table (2): Results of rock samples from Wadi Sabra (Major oxides).

Sample No.	SiO2 %	Al2O3 %	Fe2O3 %	CaO %	MgO %	MnO %	TiO2 %	K2O %
SB11	34	8.1	0.9	20.1	7.8	1.9	0.1	5.8
SB12	67.6	9.3	7.1	4	1.2	0.3	0.5	5.6
SB13	41.8	4.4	2.8	17.7	0.65	15	0.2	2.6
SB14	38.3	4.8	3.8	31.3	0.53	1.2	0.3	3.3
SB15	71.85	11.4	2.5	0.8	0.58	0.2	0.3	4.8
SB16	59.5	14.7	7.6	1.3	3	0.2	1	3
SB17	53.7	9.4	9.8	5.8	0.34	4	1.6	7.1
SB18	57.28	11.6	9.6	2.1	2.7	0.4	0.7	6.7
SB19	15.2	3.02	2.6	37.3	3.2	2.7	0.2	2
SB20	36.03	4.07	3.8	29.7	0.55	2	0.3	2.8
SB21	44.4	6	4.2	14.6	1.2	11	0.3	3.7
SB22	40.7	2.2	1.6	33.2	0.41	3.4	0.1	1.7
SB23	71.1	11.1	10	0.9	0.29	0.1	0.7	5.7
SB24	58.3	10.2	18.9	2.4	0.18	0.2	2.1	6.8
SB25	72.2	3.4	15.9	5.5	0.13	0.3	0.1	0.2
SB26	70.6	10.5	4.6	1.2	0.09	0.1	0.2	7
SB27	53.64	13.1	15.5	2.3	0.24	0.1	2.7	8.5
SB28	76.5	9.8	3.4	3.3	0.16	0.1	0.2	0.2
SB29	54.6	11.6	8.3	2.5	3	0.3	1.6	5.8
SB30	65.6	9.6	1.2	5.4	0.9	0.3	0.2	2.8
SB31	72.7	12.2	6.3	1.5	2.3	0.2	0.7	1.7
SB32	65.2	10.8	5.2	1.1	2	0.2	0.7	2.1
SB33	75.6	6.8	6.1	0.71	1.4	0.1	0.3	1.4
SB34	69.4	13.2	1.4	4.3	0.33	0.5	0.1	3
SB35	54.3	3.9	2.2	13.4	1.6	3.4	0.1	2.7
SB36	62.5	10.5	5	1.2	0.48	0.1	0.4	7.4
SB37	76.3	8.5	2.1	2.1	0.18	0	0.2	5.7
SB38	74.6	10.8	2.1	1.1	0.35	0	0.4	8.2

Table (3): Results of rock samples from Wadi Sabra (Trace elements).

P2O5 ppm	Au mg/ton	Li ppm	Be ppm	V ppm	Cr ppm	Co ppm	Ni ppm	Cu ppm	Zn ppm	As ppm	Sr ppm	Y ppm	Nb ppm	Mo ppm	Ag ppm	Pb ppm	Zr ppm
413	10	8	1	102	8	2	26	9	19	103	136	4	0	0	0	0	389
1022	15	15	2	38	25	0	25	18	48	28	111	29	11	0	0	0	461
743	10	12	4	25	14	15	33	83	47	281	549	15	9	0	0	22	408
929	15	7	2	22	10	8	27	40	58	64	121	16	8	0	0	10	397
463	10	19	2	37	47	5	42	2111	113	31	126	25	9	0	0	0	476
2378	15	86	3	121	105	20	89	107	103	70	222	21	8	0	0	3	427
6296	10	7	8	121	39	28	250	155	124	140	184	49	33	4	0	149	514
1769	10	42	3	38	25	15	48	165	254	87	104	37	17	6	0	4	582
1320	10	3	2	51	46	40	88	192	53	122	267	13	12	0	1	30	639
1008	1	7	2	19	22	39	61	30	77	115	150	16	14	4	2	21	440
1061	20	7	4	22	17	42	86	36	30	291	242	20	17	20	2	23	420
425	5	10	2	18	31	52	93	20	14	154	259	16	18	10	3	16	392
1191	20	13	4	38	22	45	71	28	32	107	216	41	25	25	2	24	556
1255	1	8	4	87	27	58	84	15	62	112	330	42	43	34	2	119	627
848	20	28	10	112	43	58	97	40	42	133	133	23	21	44	7	83	211
324	0	19	5	25	21	2	42	15	53	15	79	39	24	0	0	0	407
1072	0	9	3	161	23	4	36	9	29	19	290	26	31	0	0	0	567
461	10	79	4	25	18	3	57	54	260	0	112	77	42	0	0	0	739
5474	260	63	4	49	15	0	3	45	455	84	116	36	15	0	0	6	302
438	20	15	2	42	22	0	7	1221	358	37	193	18	5	0	0	11	212
2085	40	85	2	96	79	7	46	91	138	64	233	21	3	0	0	0	160
1189	40	55	2	84	67	2	40	82	61	55	176	15	3	0	0	0	168
1108	95	37	1	59	51	0	21	306	66	211	171	7	1	0	0	0	128
1459	10	13	5	23	24	0	14	33	30	64	103	11	51	0	0	18	62
597	10	15	5	21	26	3	21	121	46	107	115	20	7	0	0	15	238
958	20	26	5	12	11	1	92	7	137	19	77	65	33	0	0	0	932
11189	20	21	4	10	16	8	97	7	41	25	154	41	23	3	0	0	630
706	30	17	5	14	14	14	44	8	68	30	95	61	40	5	0	0	903

2. Locations of the Deposits

2.1. Araba Complex

2.1.1. Wadi Abu Khusheiba

The deposit area in Abu Khusheiba situated 95 km north-northeast of Aqaba in South Jordan (Figure 1). The prospect located some 4km east of the Amman-Safi-Aqaba highway in Wadi Abu Kusheiba of Wadi Araba area.

The area is located at the following coordinates (UTM):

Abu Khushyba	**718000 – 723000 E**
	3347000 – 3352000 N

2.1.2. Wadi Hower

Wadi Hower area lies to the south of Wadi Abu Khushyba area, it is located at some 7- 8 km east of village Al-Risha in Amman– Safi- Aqaba highway through Wadi Hower in Wadi Araba. Access is by track road using 4-wheel drive vehicle.

The area is located at the following coordinates (UTM):

Wadi Hower	**720000 – 723000 E**
	3341000 – 3347000 N

2.1.3. Wadi Sabra

Wadi Sabra is situated about 90 km north-northeast of Aqaba in South Jordan. The area lies some 13-15 km east of the Amman- Safi – Aqaba highway, through Wadi Abu Khusheiba in Wadi Araba. It is located at the following coordinates (UTM):

Wadi Sabra	**727000 - 729300 E**
	3347000 - 3350000 N

2.2. Aqaba Complex

2.2.1. Jebel AL-Mubarak

Two areas were been detected as anomalies areas in Jebel El-Mubarak sheet; they are located in the southwestern part of Jordan, south east of Aqaba city at the following coordinates (UTM):

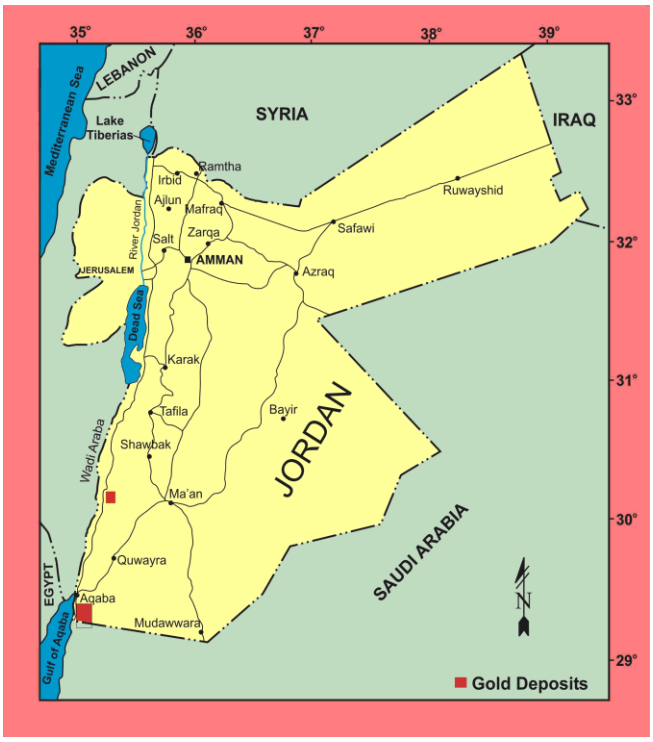
Jenub metamorphic	**699000 - 702000 E**
	3247000 - 325000 N

Hummrat granite	**716000 - 718000 E**
	3254000 - 3258000 N

2.2.2. Ein El-Hasheem

Anomaly area was been detected in Ein El-Hasheem sheet, within Jenub metamorphic that is located in the southwestern part of Jordan, south east of Aqaba city at the following coordinates (UTM):

Ein El-Hasheem	**724500 - 731000 E**
	3243000 - 3250500 N



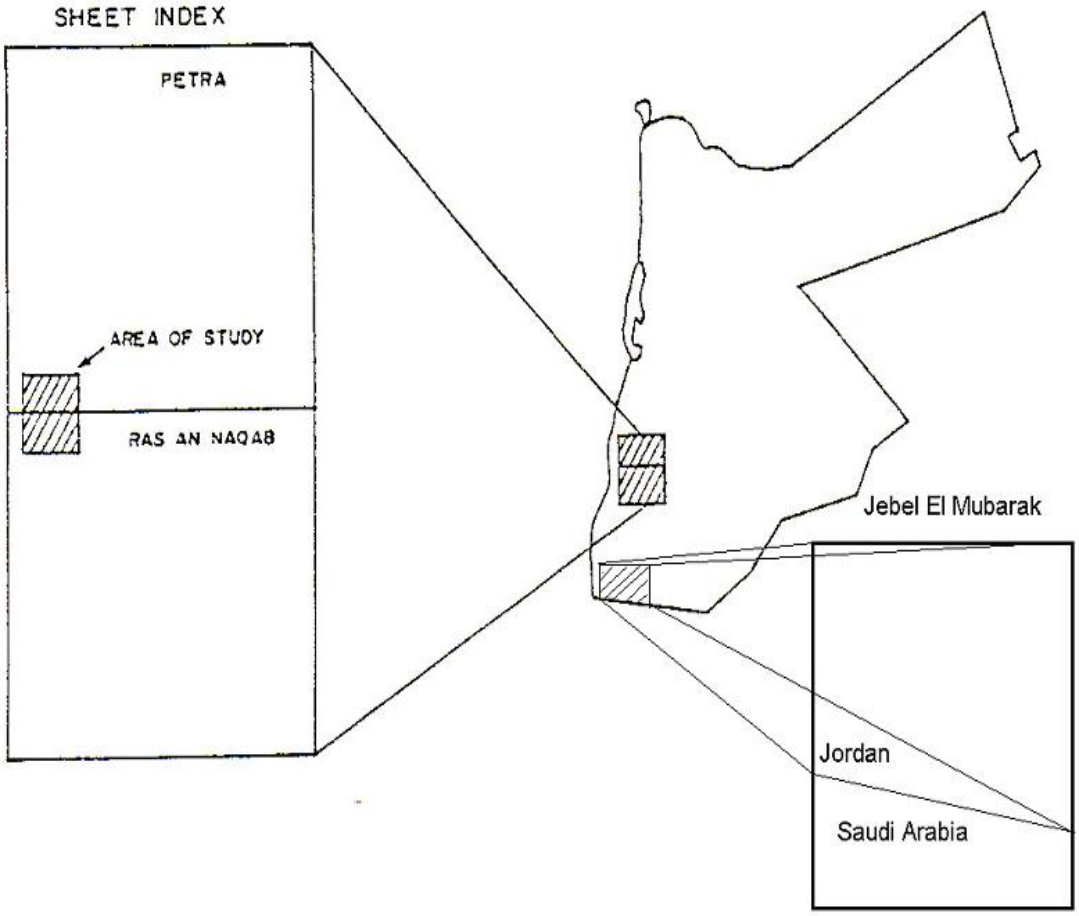


Figure (1): Location map of Gold anomalies.

3. Geological Setting

The basement rocks of southwest Jordan represents the northern extension of the Arabian-Nubian Shield (ANS), which separated by the Red Sea Rift zone. It is composed of plutonic igneous rocks with subordinate felsic and basic volcanics. The ANS is generally regarded as a series of Neoproterozoic intraoceanic island arcs and sialic microcontinents in which are incorporated a few slivers of oceanic lithosphere (ophiolites). Arc magmatism and Terrance accretion commenced 950 Ma with the new continental crust was been attached to the African craton during the panafrican orogeny. Extensional tectonism and granitic plutonism, followed by anorogenic magmatism, uplift and erosion between (~ 620 to ~ 540 Ma) marked the final stage of cratonisation.

The exposed basement rocks in Jordan comprise igneous and metamorphic Suites predominantly of late Proterozoic age, classified into two lithostratigraphical complexes. The Aqaba Complex (older) which is calc-alkaline plutonic igneous and metamorphic rocks ranging in age from 800 – 570 Ma. The geochemistry of the igneous rock derived from distinct via multiple batches melting from a relatively homogeneous source.

The Araba Complex (younger) comprises the Safi Group, Feinan Granitic Suite, Qirenifat Volcanic Suite and Ahayrnir Volcanic Suite (the youngest igneous rocks in the southwest Jordan (553 – 548 Ma). The later suite forms the host rocks that crossed by the mineralized zone.

The two complexes were been separated by a regional unconformity represented by the Saramuj Conglomerate Formation.

3.1. Geology of the Mineralized Zone and the Hosted Rocks in Wadi Abu Khushyba

3.1.1. Lithostratigraphy of the Hosted Rocks

The hosted rocks of the Au-bearing vein are agglomerates and rhyolites of the Ahaymir Volcanic Suite (late Proterozoic to early Cambrian), which includes four units (Barjous, 1995), in ascending order these are:

- **Qusayb Rhyolite:** It consists mainly of massive porphyritic to non-porphyritic rhyolite to micro-granite, which is the oldest eruption phase of the suite.

- **Musaymir Effusive:** It comprises rhyolitic tuff, ignimbrites, agglomerates, volcanic breccia and rhyolitic lava.

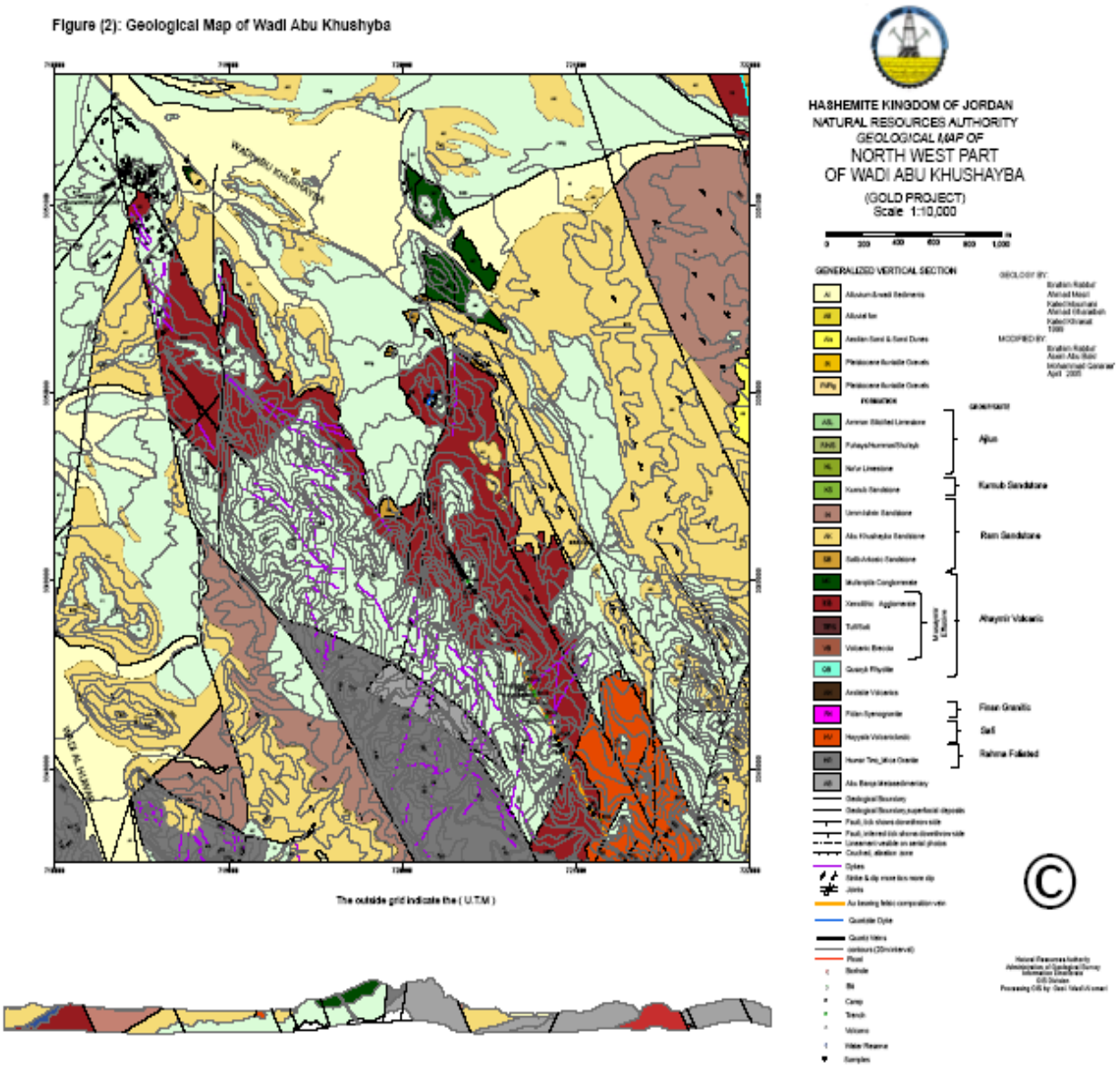
- **Mufarqad Conglomerate:** It consists mainly of conglomerates with constituents ranging from parts of the older Ahaymir units to granites and metamorphic rocks.

- **Al Bayda Quartz Porphyry:** It is the youngest phase of volcanism in the Ahaymir Suite (early Cambrian age). It consists mainly of quartz, feldspar rhyolite porphyry.

The Musaymir Effusive rocks in Wadi Abu Khushyba area, includes the Au-bearing vein, mainly consists of xenolithic agglomerate. The xenoliths comprise rhyolites, granites, granodiorite, tuff and metamorphic rocks. The sizes of the xenoliths vary from xenocrystals (less than 1cm) to boulders (up to 2 meter in diameter), derived from the adjacent and beneath the rocks exposed in the area. They are varying in age from the oldest rocks (Abu-Barqa Meta-sedimentary rocks) 800Ma in age to rocks of 540Ma age. Some layers of breccia intercalate the formation, green tuff and rhyolite flows. The youngest eruption phase occurred within the Musaymir volcanism is breccia and forms the uppermost 20m of the Unite. The Au-bearing vein covered by the volcanic breccia, particularly in the northern part of the area (Figure 2).

In the southern part of the mineralized zone, the Au- bearing vein is associated with Qusayb Rhyolite Unit. The rock is older than Musaymir Effusive Unit and composed of massive porphyritic brown-dark brown rhyolite. Field observations show that there is a sharp contact between the two units in the area situated at Longitude: 30º 14ó 51″ N, Latitude: 35º 17 ó75″ E.

Figure (2): Geological Map of Wadi Abu Khushyba



3.1.2. Geology of the Gold Bearing Vein

The Au-bearing vein is located in Wadi Abu Khushyba area in southwestern part of Jordan forms a linear zone (up to 700m) in length. The width of the mineralized zone varies from 0.4m up to 10m. It is trending NW-SE and the dip varies from 38° to 52° in small part of the mineralized zone; 200m horizontal distance (table 1). It pinches out in the southern part due to the faulting and the heavy dykes in the area ((Rabba, and Qararaa, M., 2002).

The Au- bearing vein is much thinner in the Qusayb Rhyolite unit than in the agglomerates of Musaymir Effusive unit. It occurs as thin quartz veins (1-2 cm) and veinlets in the Qusayb Rhyolite; this may be due to the difference in hardness between the two rock types (Rabba, and Qararaa, 2002).

Rabaa and Qararaa mentioned in their last study of the area that Au-bearing vein consists of different rock types, due to four different eruption events that took place locally along the mineralized zone. The main and earlier one is the aplite alkali granite (eruption phase No.1), followed and invaded by a dark brown cryptocrystalline siliceous rock (eruption phase No. 2), succeeded by eruption phase No. 3, which consists of light green to brownish green, and light pink of cryptocrystalline felsic rock named quartz rich felsite (Fig. 3).

The last eruption phase No 4 consists of iron rich carbonates, which invaded and cross cut the rocks of the other eruptions.

Four phases of different mineralogical compositions associated with hydrothermal solutions have been invaded the weakness zone, which affected the area, in ascending order (Rabba, and Qararaa, 2002).

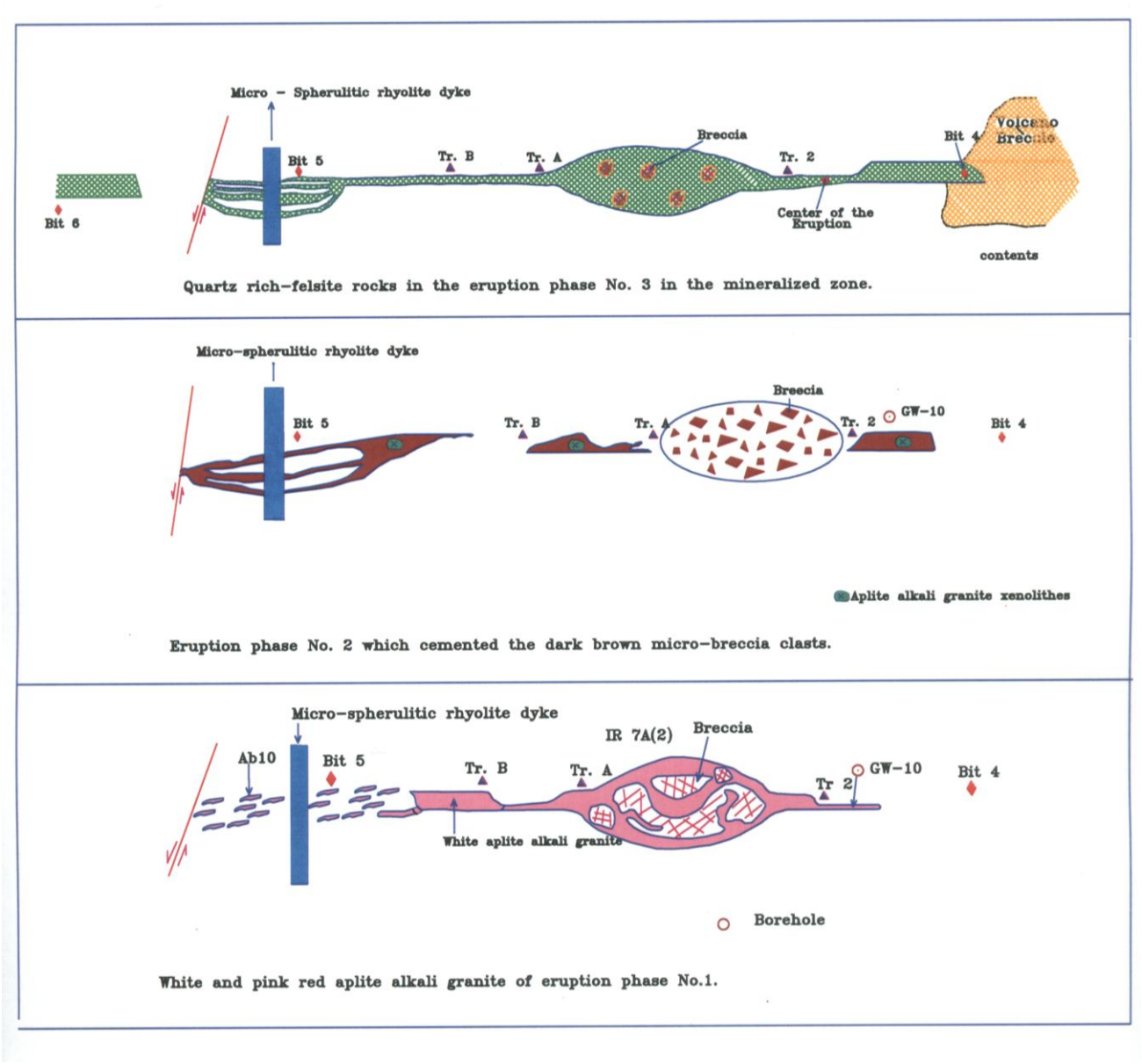


Figure (3): Minerological and mineralization of the gold bearing vein in Wadi Abu Khushyba.

4. Properties of the Deposits

4.1. General Properties of Gold

- Pure gold (Au) is quite soft and readily scratched with a knife (2.5 – 3) Mohs scale. It is highly ductile and malleable and can beat to a leaf so thin that it transmits greenish – blue rays.

- The property allows gold to be used as foil .Gold remarkable stability , the un changeability of its color, its resistance to the action of atmospheric moisture and all strong chemicals have won for it wide application in jewelry , density to the chemical industry and soon.

- Gold usually occurs as grain, scales or nuggets. Some times in dendritic form or as alloy with silver (electrum). It is seldom in cubic, octahedral or dodecahedral.

- Gold occurs mostly in natural alloys with other metals, usually with silver and copper. Gold deposits divided in to two classes: lodes and placers.

- All primary (lode) gold deposits formed during the last stages of the chilling of the magma.

- Gold in nature found as usually as disseminated grains in quartz veins with pyrite and other sulphides, or as rounded grains, flakes or nuggets in placer deposits and in streams and rivers.

- Gold often panned from such deposits by taking advantage of its high density to wash away the lighter sediments from a pan or sluice.

4.2. Properties of the Deposits (Wadi Abu Khushyba and Wadi Sabra)

Abu Kusheiba gold occurrence sited within quartz porphyry and quartz feldspar porphyry volcanic rocks of the Aheimir Volcanic Suites of Wadi Araba complex. The gold mineralization hosted in an intensely silicified linear zone up to 1m in width. Hydrothermal breccias commonly developed in the marginal zone in which recognizable rhyolite fragments encased in siliceous matrix. The gold rock was been identified as epithermal precious metal deposition and hosted by aplite granite with felsic composition vein (Bullen, et. al., 1996). As a result, visible gold was been detected in a number of the heavy mineral concentrates and in chip samples. In a number of the heavy mineral concentrates up to 40g/t values up to 15g/t of gold were been obtained from the vein and the highly silicified weathered rock in alteration zones.

In sabra visible gold was been detected in a number of the heavy mineral concentrates, gold was found as small nuggets with long diameters of up to 1 mm (average 0.25 to 0.75 mm (Figure 4).

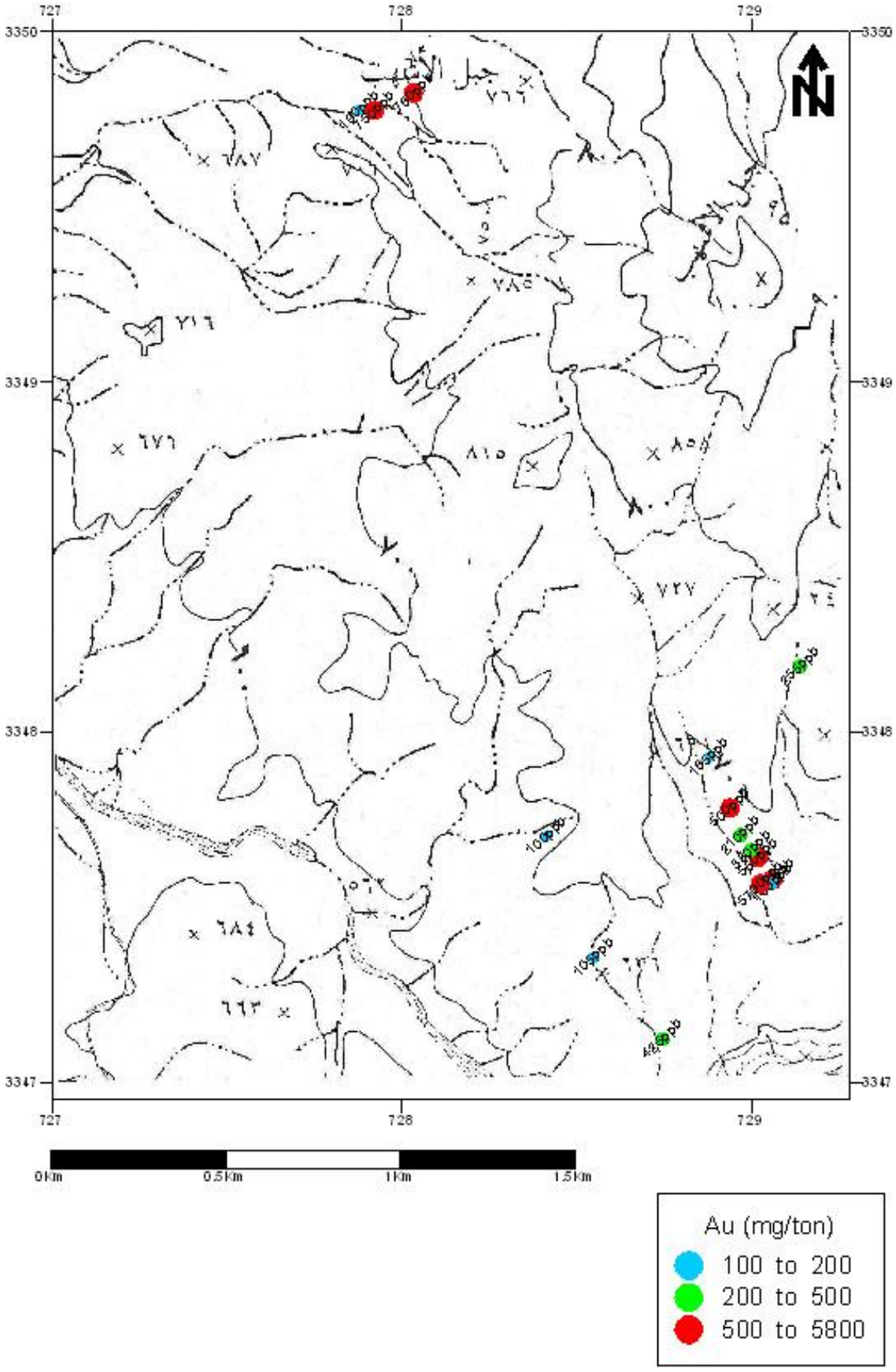


Figure (4): Au from Heavy Minerals concentrates Wadi Sabra area.

5. Previous Works

Otto Gold (1964) produced a geological map at scale of 1:100,000 covering Wadi Abu Khushyba area, which is including the copper mineralization to different formations, during the years 1966, 1967, 1973 and 1977. The Natural Resources Authority (NRA) with assistance of BGR and BRGM carried out the prospecting for the copper mineralization. The NRA and RBGM carried out several studies on the study area by geochemical and mineral exploration on Aqaba and Araba complexes–final report (NRA & BRGM project staff, 1994) "the Southern Jordanian Panafrican Basement during 1992 –1994". ARGEO1, gold anomaly detected during the NRA &BRGM collaborative project (Nimery et al, 1995). Detailed geochemical prospecting was been done in the area (Bullen, et al., 1995, Bullen, et al., 1996 and Nimery, et al., 1998).

Four geological map sheets were been published for the investigated area these are:

- Geology of Jordan Sheet by Bender (1974) at scale 1:100,000.
- Gharandal sheet by Bender (1974) at scale 1:100,000.
- Ras En Naqab Sheet by Geological Mapping Division/ NRA at scale 1:50000.
- Petra Wadi Lahyana sheet (Barjous, 1995) by Geological Mapping Division/ NRA at scale 1:5000.

which covers the northern part of the study area where Ras En Naqab sheet covers part of the study area (Rabba and Ibrahim, in progress) and two geological map in different scale for the Wadi Abu Khushyba area during the gold exploration at scale1:10000 (Rabba, et. al., 1999) and at scale 1:2500 (Barjous and Rabba, 2000).

Detailed geophysical prospecting using horizontal–loop electromagnetic (HLEM), magnetic gravity and induced polarization were carried out by Geophysical Division (AL-Zoubi, et al., 1999) and detailed mineral Exploration activities applying digging pits, open trenches and drilling boreholes were also conducted by Exploration Studies Division, on the study area: (Dana, et al., 2001).

5.1. Background

Due to surface sampling results of the preliminary work carried out by NRA and the detailed prospecting conducted in wadi Abu Khushyba area within one month (1999) are:

5.1.1. Geochemical Prospecting

Between 1992 and 1994, Natural Resources Authority (NRA) and BRGM carried out a regional geochemical prospecting on the complexes of Aqaba and Araba. This phase emphasized gold anomalies in the basement, particularly in the felsic rocks of Aheimir in the area of Wadi Abu Khushyba and other areas. During this phase, the grade of concentrates gave results that do not exceed 0.4 g/t Au (Figures 5, 6, 7, 8 and 9).

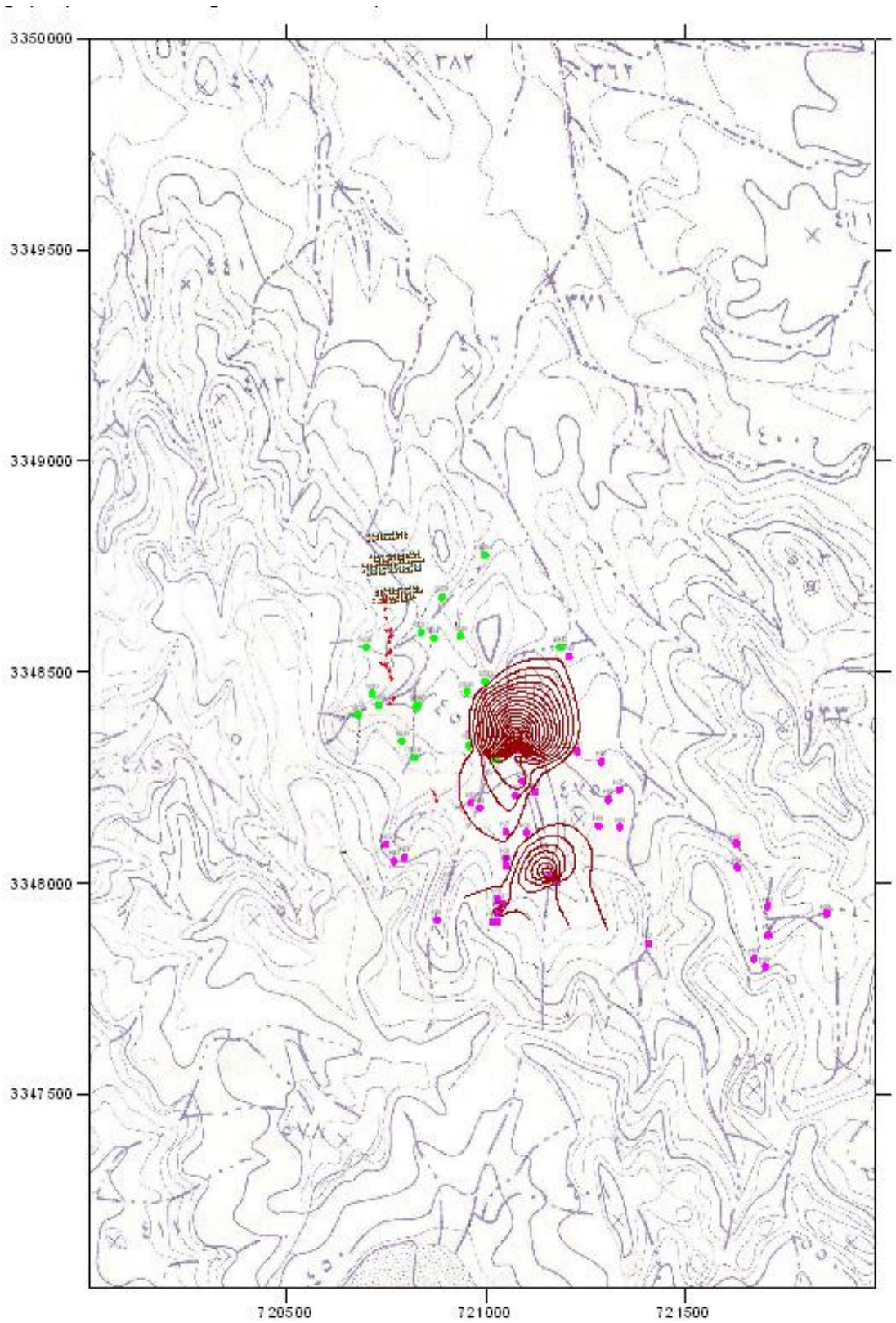


Figure (5): Stages of follow-up of the BRGM anomalies in Wadi Abu Khushyba.

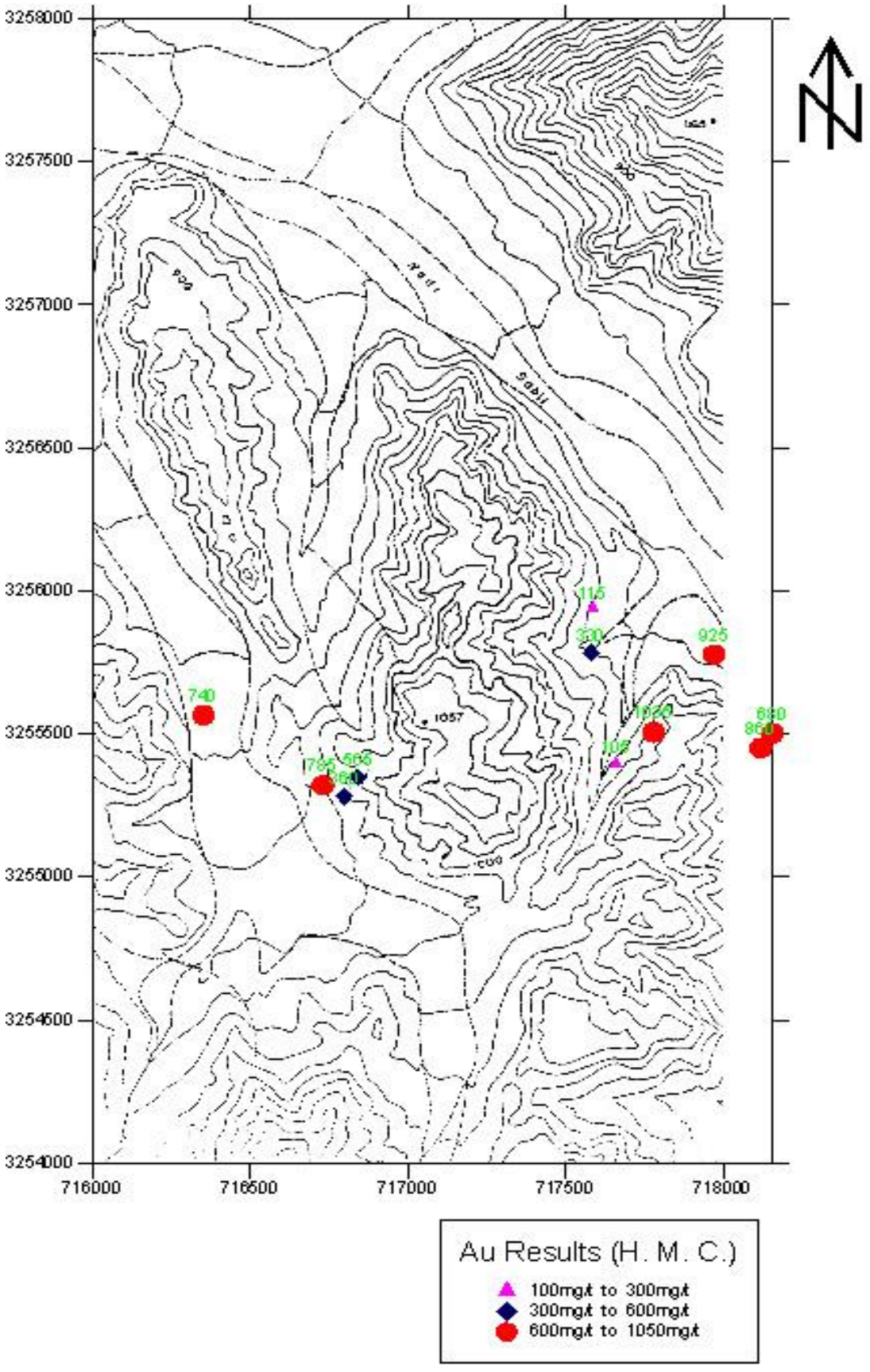


Figure (6): Follow-up of the BRGM anomaly in Jebel Al-Mubark.

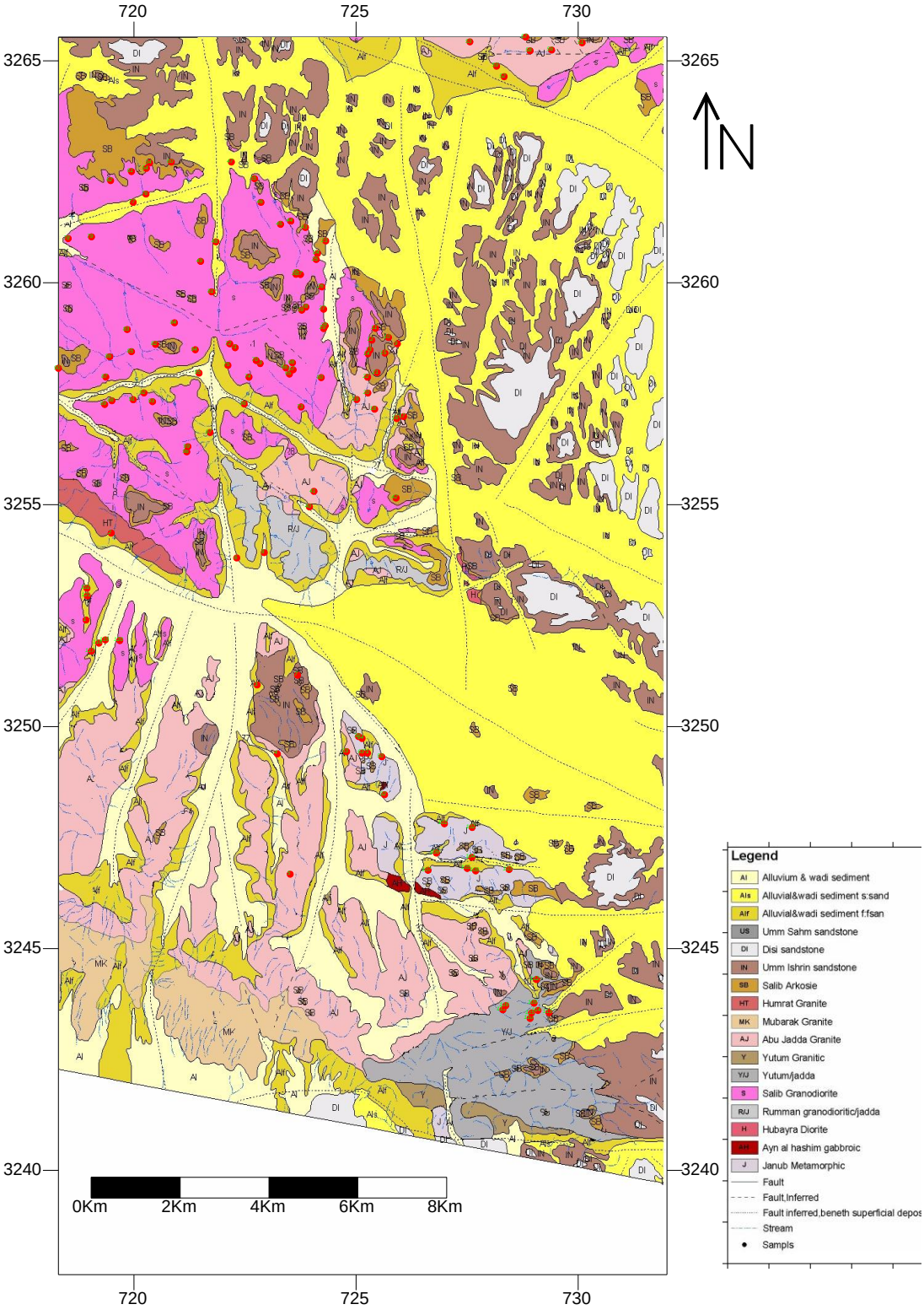


Figure (7): Follow up of the BRGM anomaly in Ein El–Hasheem.

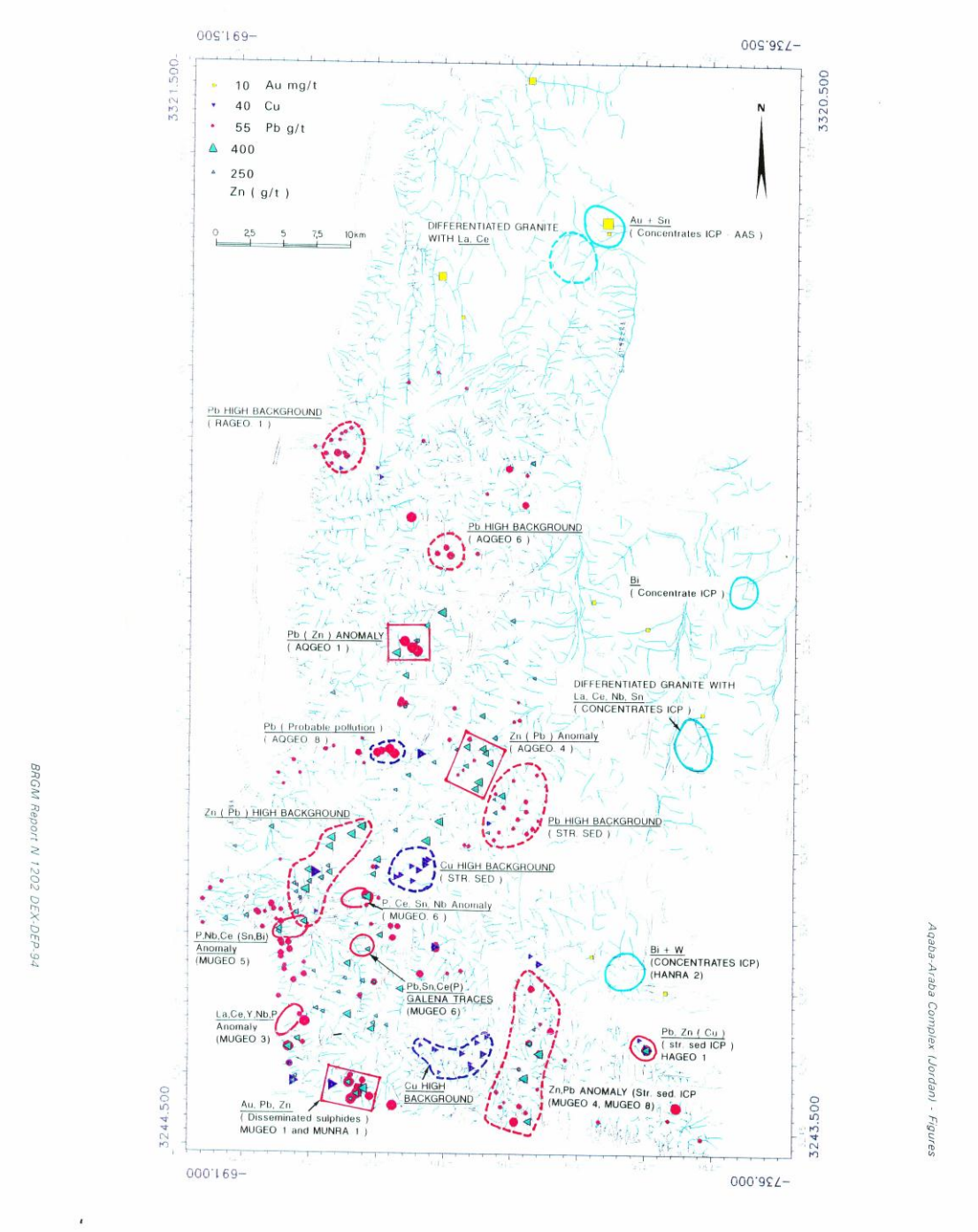


Figure (8): Aqaba basement: synthesis map Main Geochemical anomalies and high background.

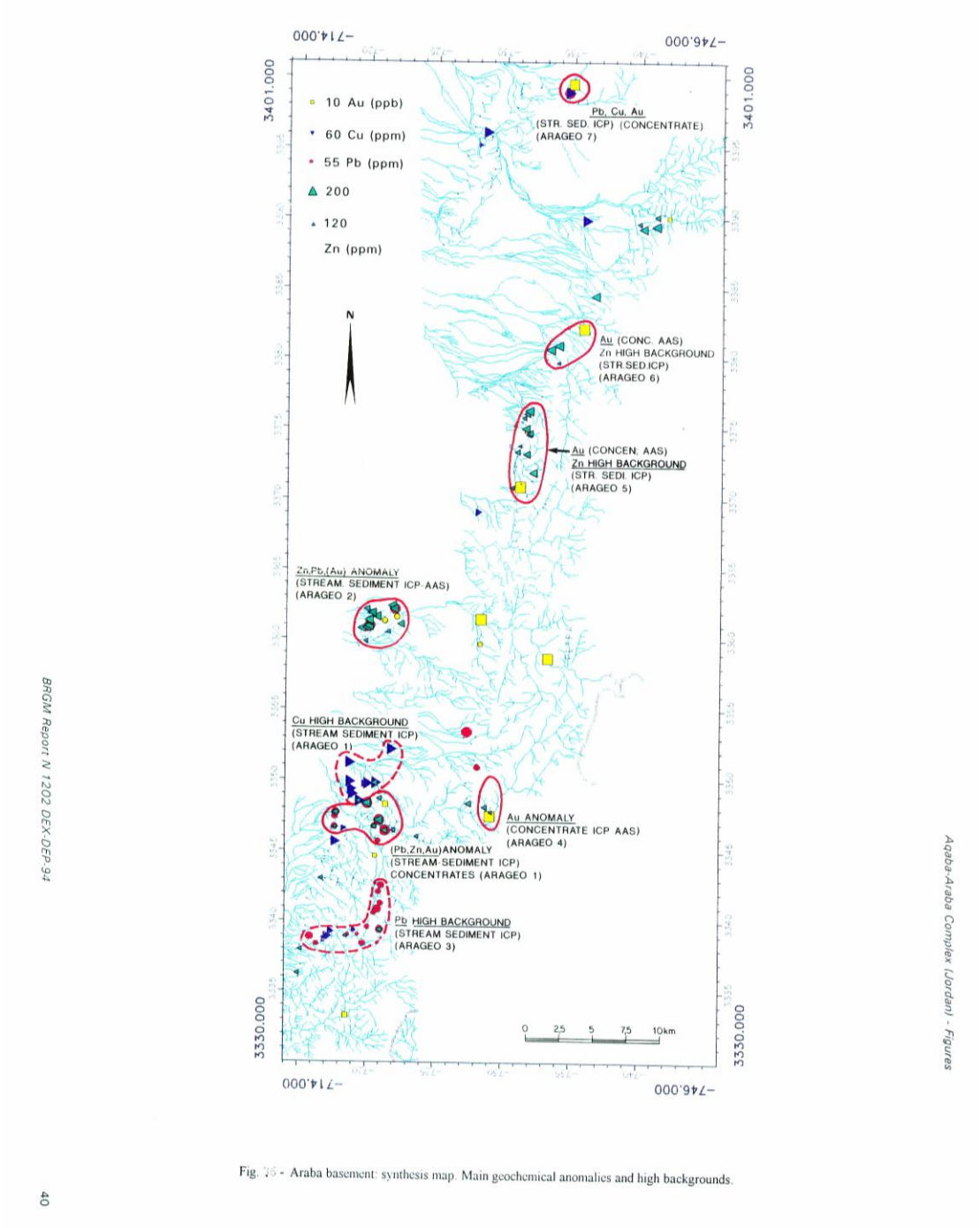


Fig. 16 - Araba basement: synthesis map. Main geochemical anomalies and high backgrounds.

Figure (9): Araba basement: synthesis map Main Geochemical anomalies and high background.

5.1.1.1. Detailed Geochemical Prospecting

Detailed geochemical prospecting was been carried out in the area of interest and the felsic- vein within contains gold and gold nuggets and the adjacent altered rocks by using rock geochemistry and heavy mineral geochemistry methods.

This stage proceeded between 1994 and 1997 on the zone of the gold anomalies and showed concentrations of gold in the area of Abu Khushyba, reaching 40 g/t in the heavy mineral concentrates. Visible gold also detected in heavy minerals.

With the aim of seeking the source of the anomalies highlighted in the sector of Abu khushyba the samples are taken from all the structures which can be mineralized.

The rock samples have taken in an aplite dyke shows grade of gold up to 5 g/t.

Based on the work a zone of interest was been delimited on 1.7 Km^2 in the area of Abu Khushyba.

Between 1999 and 2000, detailed works are concentrated on the zone of Wadi Abu Khushyba in order to delimit the distribution of gold mineralization. Detailed works completed in the sector of Abu Khushyba gave results that reach 50 g/t Au in some samples. The extension of the aplitic vein is about 700 m, with thickness of 0.5 to 1m. The mineralized zone with significant grade does not exceed 100 m in extension.

It proved that gold bearing mineralization is carried by a felsic dyke oriented NW-SE, with thickness varying between 0.5 and 1m, and an extension of 700m. The grade can reach 50 g/t Au in some samples (Table 4).

Table (4): Major element concentrations of samples taken from alteration zone XIV.

Sample No.	Au (ppb)	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	CaO (%)	MgO (%)	MnO (%)	TiO_2 (%)	K_2O (%)	P_2O_5 (%)
F1	2000	76068	6.48	2.288	0.98	0.46	0.04	0.28	4.27	0.12
F2	5000	73.45	8.73	2.52	1.20	0.63	0.08	0.33	5.52	0.13
F3	1600	76.48	8.11	3.14	0.85	0.67	0.06	0.46	4.53	0.17
F4	2100	80.25	7.16	2.23	0.84	0.38	0.04	0.22	4.82	0.11
F5	1100	75.69	8.49	2.31	0.99	0.58	0.05	0.28	5.61	0.11
F6	1200	83.14	8.03	2.56	1.16	0.55	0.60	0.29	5.11	0.11
F7	1200	Nd	7.94	2.81	1.20	0.59	0.06	0.33	5.21	0.15
F8	500	77.49	10.76	1.73	0.73	0.40	0.04	0.19	8.03	0.08
F9	1600	80.79	10.87	3.83	0.91	0.99	0.08	0.62	5.83	0.22
F10	1000	Nd	7.05	3.10	0.67	0.85	0.06	0.47	4.16	0.18
F11	400	80.37	14.37	2.83	0.83	0.58	0.02	0.93	8.17	0.13
F12	400	81.22	11.20	5.28	2.32	0.30	0.03	0.68	6.16	0.17

5.2. Other Detailed Prospecting

Various completed works are as follows:

5.2.1. Geological Mapping

The report concerning the geology of wadi Abu Khusheiba area with an accompanying map (1:10,000), described a variety of igneous rocks and the faults, which are the most important structural elements.

5.2.2. Remote Sensing Applications

By using TM data (scale 1: 50000) to determine the rock types, the alteration zones in the area and to correlate the initial geochemical maps with the results of remote sensing analysis data.

5.2.3. Exploration Works

Many exploration activities carried out by the exploration Division in the NRA in wadi Abu Khusheiba that was including as fellows (Table 5):

PITS

Five pits were been dug at suitable locations depending upon the strike of the felsic vein in order to determine the gold distribution with the horizontal and distribution of gold. Systematic channel samples collected during and after the digging.

Trenches

Two trenches were been excavated by a privet sector under the supervision of NRA; they were located in the northern mineralized zone (II). One of them (A) crossed the highest portion of the mineralized zone while the other was dug in the lowest part of it.

One of them (Trench A) is 50 m long and 5.5 m wide. It was dug in five levels of elevation along the trench and the elevations between the lowest level and the upper most one is 27.5m.Its crossed the highest portion of the mineralized zone while the other (Trench B): it was dug in two directions; west (B1) and south (B2) the lowest part of it.

Boreholes

10 boreholes .were drilled by NRA in the Abu Khushyba area. Six of them (2, 3, 4, 6, 7 and 8) were drilled out of the project area due to the Geophysical prospecting recommendations and the surface geochemical results. The others (1, 5, 9 & 10) were drilled within the (1.375 km²) area, two boreholes are shallow (up to 20 m in depth) and the third (BH 9) is 117.5 m in depth and (BH 10) 38.5m in depth.

From all the exploration activities as mention before, these results of gold from all activities occur in the area in the table as fellow:

Table (5): Types of exploration in Wadi Abu Khushyba.

Type of exploration	**Au %**
Pits	
Pit No.1	
47: channel samples.	ranged from 10 to 1030 mg/t.
23: rock samples.	up to 5000 mg/t.
Pit No.2	
26: channel sample.	from 15 to 980 mg/t
55: rock samples.	At least five samples give more than 50mg/t.
Pit No. 3	
8: chip samples.	from 160 to 4010 mg/t.
2: vein samples.	up to 1739 mg/t.
Pit No. 4	
45: rock samples.	from 10 to 20,000 mg/t.
Pit No. 5	
5: rock samples	from 10 to 1560 mg/t.
Trenches	
Trench (A)	
18: rock samples.	From 55 to 18910 mg/t.
21: channel sample.	from 10 to 4020 mg/t.
Trench (B)	
B1: 7 rock samples.	From 28 – 4190 mg/t.
14 channel samples.	From 26 up to 198 mg/t.
B2: 2 rock samples.	10- 80 mg/t.
19 channel samples.	10- 350 mg/t.
Boreholes	
BH No. 1	
7 core samples.	from 10 to 110 mg/t.
BH No .5	
18 core samples.	from 10– 180 mg/t.
BH No .9	
247 core samples.	from < 10– 20 mg/t(on sample reached up to 40 mg/t).
BH No .10	(2) samples <10, mg/t and (3) samples ranged 110-120 125 mg/t.
5 core samples.	
	10- 100 mg/t.
Surface Samples	
	One sample reached up to 3000mg/t.
20 rock samples.	

5.2.4. Geophysical Prospecting

In 1999, detailed horizontal- loop electromagnetic (HLEM), magnetic, gravity, and induced polarization methods were been applied in the area. The results of the potential field methods out-lined an intense positive and negative anomaly trending NW– SE.

6. Investment Opportunities

The mineral is open for investment and mining/exploration companies invited based on detailed exploration, evaluation and exploitation.

Further works is still required in Wadi Abu Khushyba and other prospect areas to ascertain the true surface extent of the gold anomalies and the distribution of gold in width and depth.

Memorandum of Understanding (MOU) and/ or concessions are based on negotiation with MEMR under a Mineral Concession Agreement standard or Production Sharing Agreement.

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