Genesis of Gold Deposit in Um Trambishi Area, NE Atbara, Sudan

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Abstract

Um Trambishi area consists of volcano-sedimentary sequence intruded by syntectonic pluton of granitoids composition with marginal fissures injected by aplite, had been subjected to dynamic metamorphism and obliterated by recrystallization forming different rock units varying in composition, forming greenschist terrains. These are an assemblage of recrystalline schists, meta-acid, cataclastic tonalite, granodiorites, meta-andesite, chlorite schists, quartzite, marble, metabanded chert, together with two generations of unmineralized deformed and undeformed white quartz, which are oriented mainly in E-W and N-S direction following faults trend. The area is subjected to four deformational phases of brittle-ductile transition. The metamorphic grade is Green Schist Facies. The alteration around the endo-contact zone is characterized by minerals: albite, chlorite, epidote, sericite, carbonate and kaolin with anomalous Au=0.91ppm, Ag=1.75ppm, As=44.6XRF, Co=15.70XRF, V=65XRF, Ti=4796XRF, Cr=23XRF, Sr=269XRF, and base metals Pb=1.51ppm, Zn=22.02ppm and Cu=13.59ppm. The first phase of hydrothermal solution carrying gold is related to the magmatic high temperature associated with granitoid intrusions, deposited into the planar fabric S1 and has a characteristic signature of hypothermal processes. The second mode of occurrence is the regeneration of auriferous quartz stringers filling into the tectonic fissures trending 340° and oblique to S1 as a result of D3 (Kerf Shear Zone) and has a characteristic signature of mesothermal processes.

Keywords: Volcano-sedimentary sequence; Granitoids; Mineralization; Shear zone

1. Introduction

Um Trambishi Area is located in River Nile State, 14Km NE of Abidiya, bounded by latitudes 18°14'9" N (2016610 UTM) - 18°12'58" N (2012775 UTM) and longitudes 34° 4' 58"E (614500 UTM) - 34° 4' 10"E (613090 UTM) (Fig.No.1).

The geneses of gold deposits in UmTrambishi Area are related to the total geological environment. Tectonic and metallogeny provide a helpful scientific basis to define gold mineralization. The gold formed synchronously with the late stages of still ongoing regional deformation. The aim

is to use geological characteristics and geochemical signature of the trace elements within the alteration zone to identify the origin of the hydrothermal fluid carrying the gold.

2. Geological and Tectonic Setting

The area is a part of Arabian-Nubian Shield which consists of metavolcano-sedimentary rocks cut by syntectonic pluton of granitoid composition. This assemblage had been subjected to dynamic metamorphism and obliterated by recrystallization of rock forming units variable in composition forming greenschist terrains of metavolcanic-metasedimentary rocks.

Syntectonic granodiorites and tonalites intrude the metavolcanic-metasedimentary rocks with a marginal fissures injected by a meta-acid (aplite). This succession is corresponding to the mid Pan African

Trondhjemite- Tonalite - Granodioritic suite (Abdel Salamet al., 1998) which marks widespread emplacement of 690-720Ma intrusive rocks(Fig.No.2).

Four deformational phases can be recognized in the study area; the different phases(D1-D4) not necessary represent separated events but might be transitional and belong to one single deformational episode which is believed to be Kerf Shear Zone.

Two generations of unmineralized deformed and undeformed white quartz are oriented mainly in E-W and N-S direction following trend of faults.

Mineralized white quartz veinlets (Photo No.1) are associated with the emplacement of the granitoids intrusion while the mineralized white to faint grey quartz stringers trending 340° are related to shearing (Photo No.2).

Fig.No.1: Location map

Fig.No.2: Geological map of Um Trambishi Area

PhotoNo.2: Quartz veinlets and stringer

photo No.1: Quartz veinlets in tonalite; x25 in tonalite

3. Discussion

Geochemical Data and Direct Criteria

Sampling included used chip samples, systematic trench sampling and core samples.

Thirty two chip samples were collected from the quartz veins in the endo- exo-contact zone and other lithological units, 7817 channel samples across the strike of the alteration zone, were collected along the northern wall of the trench in success interval of approximately 1.0 m and 2,319 core samples of the drill ed boreholes core samples were collected from drilled boreholes. These samples passed systematic reduction of mass and grain size at the Laboratory of Exploration and Development Department of Rida Mining Company. Were reduced by crushing to minus 19 millimeters; the resultant was splitted until 200 gm weight. The 200 gm weighted

samples grinded to minus 80 micron which became portion for analytical procedures were to be analyzed for gold. The samples were decomposed by treatment with aqua regia ($3\text{HCl}:1\text{HNO}_3$). Gold is extracted from the solution into a solution of tricaprylyl methyl ammonium chloride (Aliquat 336) in di-isobutyl ketone (DIBK). The gold is determined by aspirating the organic phase in the Atomic Absorption Spectrometry (AAS) unit. Selected trench (TRT5, TRT5A and TRT13) samples within the oxidation zone and core (TDDH-1, 2, 3, 4, 7 and 9) samples of the intersected mineralization below the oxidation were passed through X-ray Fluorescence (XRF) for trace elements determination. The analytical results are displayed in Table No.1. The chloritization is probably linked with the hydrothermal solution with sericitization, silicification and

probalization (albite, chlorite, epidote, sericite and carbonate). Kaolinization is found within the alteration zone as a process of oxidation (supergene enrichment) indicating high sulphidation. Giles (1972) and Schilling (1972), explain that, the content or ratio of elements in minerals can also be used to identify types of ores. In low and high sulphidation state, generally the ratio Ag/Au reach 0.2 to 2.0 (John, 2001), relating this to the data obtained, the ratio of Ag/Au is 2.83 with a chemical signature of Au, Ag, As, Co, V, Ti, Cr, Sr, base metals Pb, Zn and Cu. Thus, the hydrothermal solution may take place after the

crystallization of felsic dyke and have a characteristic signature of hypothermal, mesothermal successive stages of hydrothermal processes. The first mode of occurrence (hypothermal) is related to the granitoids intrusion (BadrelDin Khalil, 1973) while the second mode of occurrence (mesothermal) is related to Keraf Shear Zone (KSZ), have no link to magmatism as a carrier phase, generating hydrothermal white to faint grey quartz stringers, filled into the tectonic fissures trending N to NNW, forming a network of stringer lodes (shear zone hosted gold).

Table No.1: Analysis of trace elements

ID	Sample	Au	Ag	Fe	Cu	Zn	Pb	As	Ti	V	Cr	Co	Zr	Th	Sr
	ID	ppm	ppm	%	ppm	ppm	ppm	ppm	XRF	XRF	XRF	XRF	XRF	XRF	XRF
TRT5	42082	0.23	-	3.86	14.68	14.57	1.36	5.93	2213	46	65	9.9	144	8	137
TRT5	42088	0.01	-	7.02	11.96	20.16	2.37	13.13	4821	89	96	18.4	269	—	219
TRT13	24236	0.26	-	8.25	15.76	20.47	—	3.64	5154	97	81	16	264	8	138
TRT5A	42002	1.62	-	5.33	—	20.78	1.53	10.76	2984	71	51	10.3	116	8	169
TDDH-01	72490	0.91	1.75	9.21	13.59	22.02	1.51	18.9	8160	98	—	24.00	230	8	277
TDDH-03	71999	11.69	—	7.91	12.5	22.64	—	19.1	4796	65	23	15.70	277	11	269
TDDH-05	67874	11.90	—	7.49	7.611	22.64	—	—	48038	—	64	17.50	201	8	287
TDDH-07	67872	0.26	—	8.18	16.31	22.64	1.73	—	4593	70	45	14.00	223	9	342
TDDH-09	67875	4.28	—	5.74	13.05	21.40	—	2.79	44339	—	86	19.20	211	—	269
TDDH-02	72491	0.59	1.67	5.41	14.68	17.05	-	5.80	3939	67	—	14	203	—	256
TDDH-04	72000	—	—	5.20	13.59	17.05	-	3.56	41379	—	47	14	234	9	296

4. Conclusions

The study area lies within the Arabian-Nubian Shield, corresponding to the mid Pan African Trondhjemite-Tonalite-Granodiorite Suite. The granitoidal magma, probably assimilated magmatic source, derived from the subduction slab from melting of the lower part of the sediments,

contains anomalous Cr and V. The metasedimentary rock consisting of various types of schistose rocks, representing the older sequence in the area had been extruded by andesite with pillow lava. This indicates the subaqueous extrusion. Four deformational phases can be recognized in

the study area, generally of brittle-ductile regime (D1-D4). D1 is characterized by F1 of regional extent, associated with the emplacement of granitoids magma and characterized by auriferous white quartz veinlets. D2-D4 might represent a single deformation event and might be transitional known as Keraf Shear Zone (KSZ). This deformation took place between 640 and 580Ma. This indicates that the granitoids pluton is older and the first separated hydrothermal solution took place prior to KSZ. The hydrothermal solution was separated at or after the crystallization of the granitoids magma; this is indicated by the injection of pegmatite stringers recorded in many exploration trenches and the aplite dyke along the marginal fissures of tonalite. The foliation planes S1, were filled by hydrothermal quartz veinlets forming a stockwork deposit, with no sharp boundaries and can be mapped by sampling data based on anomalous gold content. The alteration zone at the contact of tonalite with metavolcano-sedimentary sequence, suggest a direct relation between tonalite and mineralization. The anomalous content of the elements Au, Ag, Zn, Pb, Cu and chlorite alteration indicates low sulphidation, related to the magmatic heat associated with granitoids intrusion.

5. Recommendations

The endo-contact zone is of regional extent and can be traced in both north and south directions, folded at the southern exploratory (Um Trambishi) while the other limb is exposed at areas west of the River Nile. Geochemical samples across the endo-contact zone are recommended to locate anomalies along the whole of the prospected extension.

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