GEOCHEMISTRY OF THE AMSAGA AREA ORTHOGNEISSES (ARCHEAN REGUIBAT RISE, MAURITANIA)

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ABSTRACT Geochemical data (major, trace) obtained on the orthogneisses which formed the basement of the Amsaga area (Archean Reguibat Rise, West African Craton) demonstrate: 1) that these gneisses define a calc-alkaline trend of trondhjemitic affinity; 2) the existence of at least two different types of migmatitic orthogneisses in the Amsaga; 3) a perturbation of composition of these orthogneisses during the Archean granulitic event and Proterozoic hydrothermal event (s) which affected the Amsaga.

Keywords: Major, Trace, REE, Archean Reguibat Rise, West African Craton.

Resumo GEOQUÍMICA DOS ORTHOGNAISSES DA REGIÃO DO AMSAGA (DORSAL REGUIBAT ARQUEANA; MAURITANIA). Dados geoquímicos (elementos maiores e traço) obtidos nos ortognaisses que formam o embasamento da região do Amsaga (Dorsal Reguibat, Craton do Oeste da África) mostram: 1) que os gnaisses formam um trend calcio-alcalino com afinidade trondhjemítica; 2) a presença de pelo menos dois tipos diferentes de ortognaisses migmatíticos naquela área; 3) perturbações da composição química destes gnaisses durante o metamorfismo granulítico arqueano e o metamorfismo hidrothermal proterozóico que afetaram a região do Amsaga.

Palavras-chaves : Maiores, Traço, REE, Dorsal Reguibat arqueana, Craton do Oeste da África.

INTRODUCTION The West African craton (Fig. I) is mainly composed of two shields, the Man Shield in the South and the Reguibat Rise in the North, separated by the sedimentary (Upper Proterozoic to Paleozoic) Taoudeni basin. These two shields are formed of both Archean and Proterozoic formations. The Archean part of these two domains, and in particular the Archean Reguibat Rise, have been only poorly studied. The present work represents the first geochemical study of the orthogneiss which forms the basement of the Archean Reguibat Rise. The studied area (the Amsaga area in the southwestern Reguibat Rise; Fig. 1) consists of a typical high grade terrain (Windley 1986) comprised of supracrustal series intruded by charnockitic bodies and migmatitic orthogneisses. These migmatitic orthogneisses exhibit field characteristics of archean TTG (eg. Arth & Hanson 1975). The present study aims to: 1) characterize the chemical composition of these migmatitic orthogneisses which where until now thought to be homogeneous based on field relationships (e.g. Barrère 1967, Auvray *et ai.* 1992a et b, Bronner 1992); 2) compare the chemical composition of the migmatitic orthogneisses and charnockite.

GEOLOGICAL SETTING The Amsaga area (Fig. 1) is mainly composed of major blocks separated by vertical mylonitic zones. The northern zone consists of supracrustal units (metapelites and metagraywackes) intruded by charnockitic bodies. The most important are the Snine Kembo and Bou Rhzama plutons. The central and eastern zones are formed of migmatitic orthogneisses overlain by volcano-sedimentary belts. The supracrustal series of the north are also exposed in the south-eastern part of the area, but are not associated with any charnockitic pluton in this sector.

The whole area suffered a high-grade (granulite and migmatite) metamorphism event following a clockwise P-T path from a peak located near 800±50 °C and 5 ± 1kb (Potrel 1994). The retrograde evolution began with a near isothermal decompression and stopped rapidly (~ 650-700 °C), but in lithologies located near the main shear zones, the granulitic paragenesis are replaced by low grade assemblages (Bt II ± Musc ± Ep ± Spn ± Zo ± Cal ± Chl). This low grade recrystallization grew statically and was not associated with a deformation event, so all the structures observed in the field could be linked to the granulitic event. Two syn-or late-tectonic but post-granulite plutons, the Touijenjert granite and the Iguilid gabbro, intruded the granulitic and migmatitic series at the end of the geological evolution. Both are affected by low grade recrystallization.

A sample of ortho-migmatitic gneiss has been dated by U-Pb SHRIMP and yielded an age of ca. 3.45 - 3.5 Ga. This age, in agreement with the Nd model age of the sample (3.64 Ga), marks the first crustal formation event documented in the area (Potrel *et al.* 1996). A second crust formation event had been dated at ca. 3.0 Ga by dating (U-Pb SHRIMP and Sm-Nd isochron) the charnockitic pluton of Snine Kembo (Potrel 1994, Potrel et al, submitted). The migmatitic orthogneisses studied in the present work are for the moment poorly dated. The only available age obtained on those gneisses is a single zircon evaporation date of 2836 ± 14 Ma (Potrel 1994). Furthermore, these gneisses exhibit a scattering in their Nd model ages (between ca. 2.8 and 3.2 Ga) and show rather parallel εNd versus time evolution lines which could indicate the presence of various magmatic bodies with various ages and/or sources (Potrel *et al.,* submitted). The two late-tectonic and post-granulite plutons were dated at ca. 2.7 Ga: the Touijenjert granite yielded a U-Pb SHRIMP age of 2726 ± 7 Ma and the Iguilid gabbro a Sm-Nd mineral isochron age of 2706 ± 54 Ma (Potrel 1994, Potrel *et al.,* submitted). This age, in agreement with a single zircon evaporation age of ca. 2.74 Ga obtained on the granulitic Guelb el Azib gabbro (Auvray *et al.* 1992a, Potrel 1994), is interpreted as the age of the granulite event. The Touijenjert granite yielded Nd model ages ranging between 3.1 and 3.2 Ga, so its emplacement marked the onset of crustal reworking in the area (Potrel 1994, Potrel *et al.,* submitted). No crustal formation event or magma emplacement younger than 2.7 Ga has been documented in the area, but resetting ages obtained in Rb-Sr system at ca 2.5 and 2.3 Ga indicate that the area was thermally affected during the Proterozoic evolution of the craton (Potrel 1994). This Proterozoic thermal event (s) is interpreted as having been responsible for the low grade recrystallizations observed in the samples.

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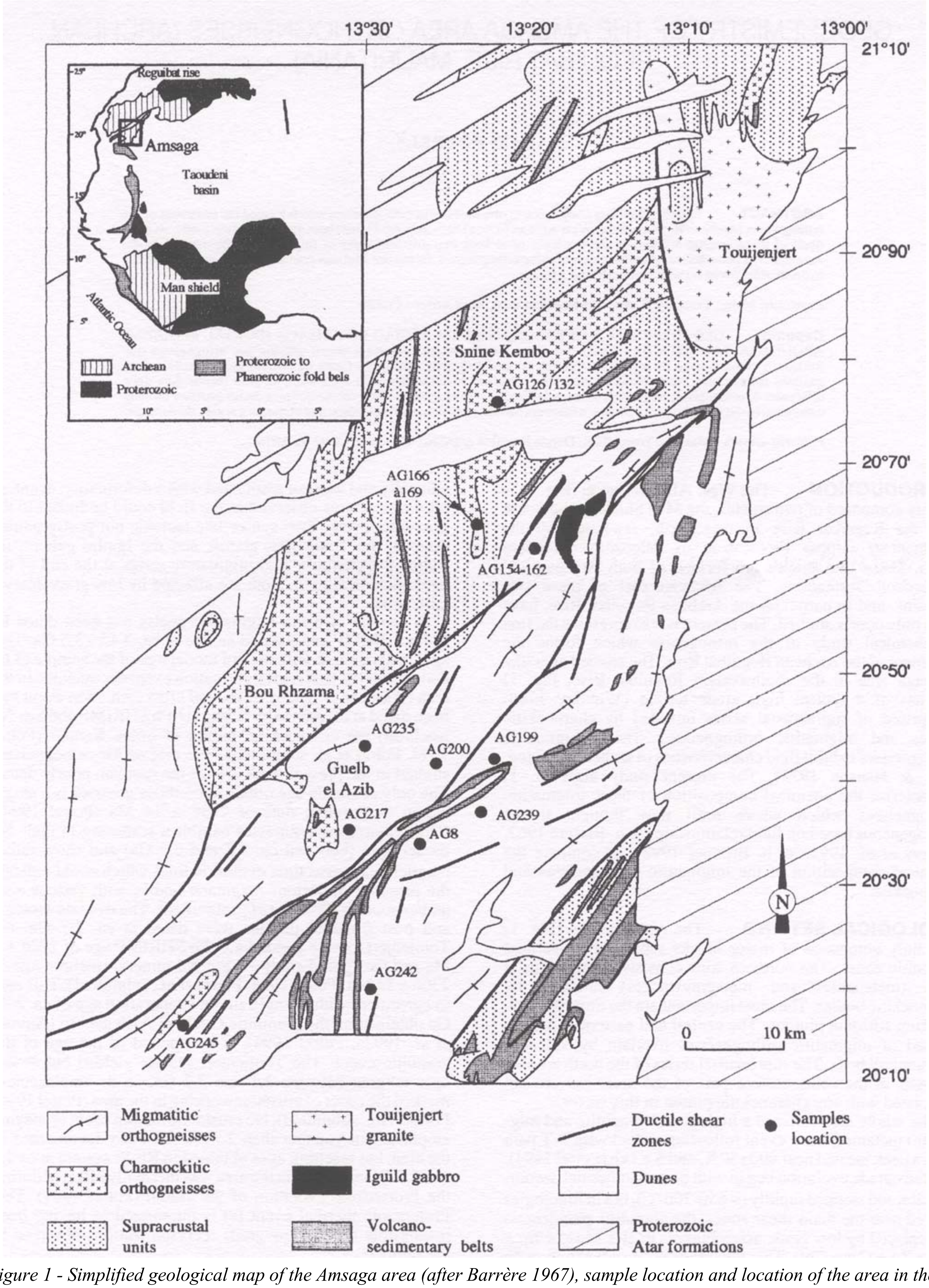

Figure 1 - Simplified geological map of the Amsaga area (after Barrère 1967), sample location and location of the area in the West African Craton.

Figura l - Mapa simplificado da região do Amsaga (modificado de Barrère 1967), localização das amostras e localização da região dentro do Craton do Oeste da África.

SAMPLES AND METHODOLOGY Ten samples of the charnockitic pluton of Snine Kembo and fourteen orthomigmatitic gneisses (location Fig. 1) have been studied. The paragenesis of the Snine Kembo massif is typical of granulite fades conditions (Qtz + PI + Kfs -t- B t + Opx ± Cpx). As this massif is located far from the mylonitic shear zones, the samples are not affected by the low grade recrystallization and the granulitic paragenesis is generally well preserved. The primary paragenesis of orthomigmatitic samples (Qtz + Pig + Kfs + Bt ± Hb) shows retrograde metamorphism such as breakdown to low grade phases: chlorite, calcite, prehnite, sericite, titanite, epidote (Fe-epidote, zoisite, clinozoisite). The most retrograde samples have not been reported here.

Major and trace element contents (except Rare Earth Elements, REE) were analyzed by X-ray fluorescence. REE contents were determined in two ways: by ICPMS in the Department of Geology Southampton (U.K.) by J.A. Barrat (in that case U and Hf contents were also determined) and by isotopic dilution using a CAMECA TSN 206 single collector mass spectrometer in the University of Rennes.

RESULTS Major elements (Table 1) In a normative classification diagram (O'Connor 1965 modified by Barker 1979; Fig. 2a) samples define three distinct groups: the charnockites plot in the tonalite field and the ortho-migmatitic gneisses plot both in the trondjhemite (Tdj) and granodiorite groups. Two samples of migmatitic gneisses plot also in the tonalitic field, one close to the Tdj field. Here after the two main groups of trondhejemitic and granodioritic compositions will be distinguished in discution and figures. Show on the A/CNK versus SiO_2 diagram (Fig. 2b) all the analyzed samples plot along the calc-alkaline trend. The analyses scatter in the K-Na-Ca diagram (Barker and Arth 1976; Fig. 2c) but plot close to the trondjhemitic trend.

Traces elements (Table 2) In a Y versus Nb diagram (Pearce *et al.* 1984; Fig. 3), samples plot in the Arc and Syn-collision granite field. But it may be seen in this diagram that three samples (AG154, AG158 and AG161) have anomalous low Y contents (less than 1 ppm). In a Y+Nb versus Rb diagram (Pearce *et al.* 1984; Fig 4), all samples plot in the Island Arc granite field.

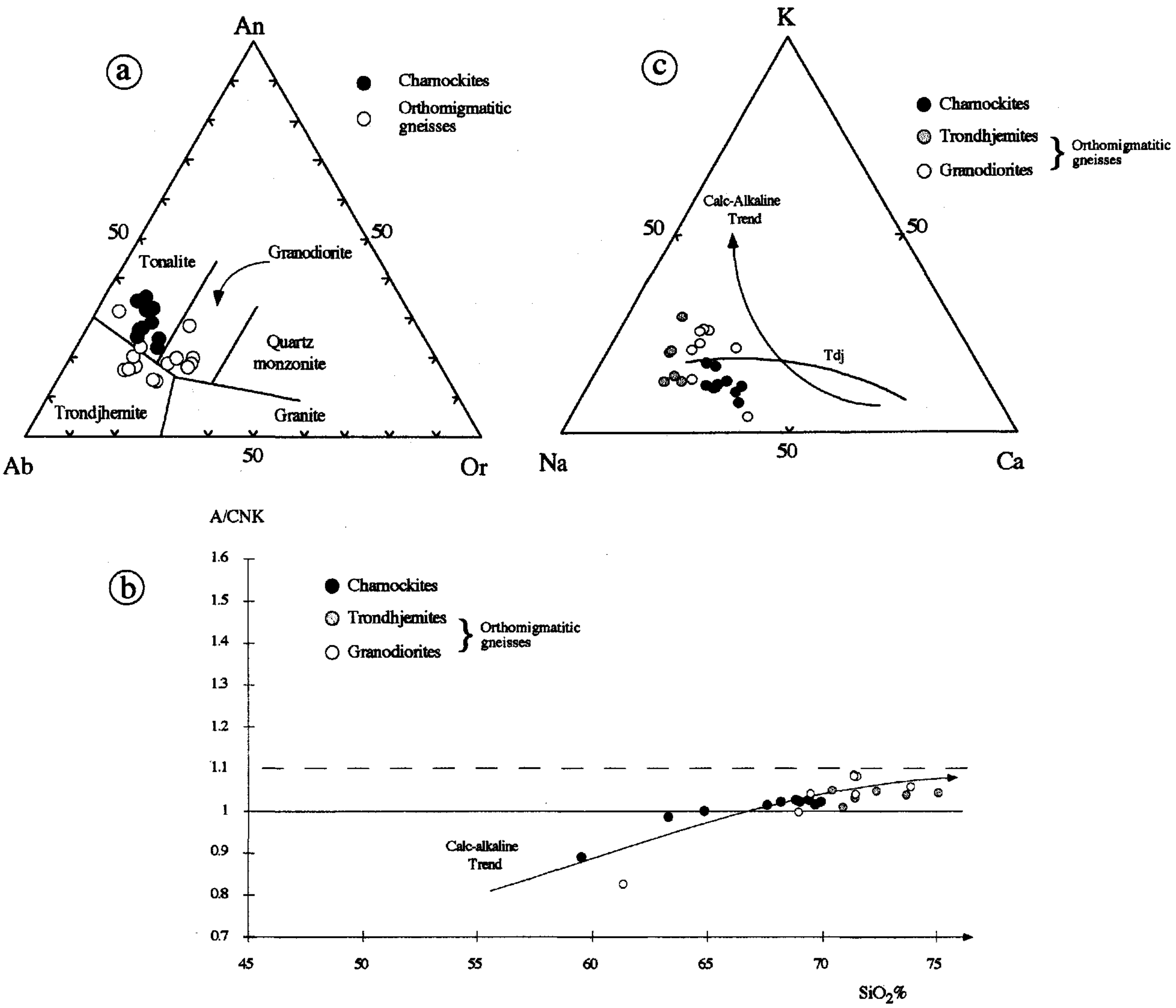

Figure 2 - (a) - Normative An-Ab-Or classification (O'Connor 1965 modified by Broker 1979) of the Amsaga ortho gneisses.(b) - A/CNK vs. SiO_2 diagram showing the calc-alkaline character of Amsaga orthogneisses. (c) -K-Na-Ca diagram showing the trondhjemitic affinity of the Amsaga calc-alkaline trend.
Figura 2 - (a) - Classificação normativa An-Ab-Or (O'Connor 1965, modificado por Barker 1979) dos ortognaisses de Amsaga. (b) - Diagrama A/CNK vs. SiO_2 monstrando o caráter calcio-alcalino dos ortognaisses de Amsaga. (c) -Diagrama K-Na-Ca monstrando a afinidade trondhjemítica do trend calcio-alcalino de Amsaga.

Table 1 - Major element compositions for the Amsaga orthogneisses in wt %.
Tabela 1 - Composição química (elementos maiores) dos ortognaisses do Amsaga, % em peso.

	Nature	Samples	SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	LOI	Total
		AG154	70.42	16.17	2.02	0.02	0.59	2.83	5.23	1.54	0.26	0.06	0.74	99.88
		AG235	70.90	15.65	2.00	0.02	0.43	2.44	5.69	1.55	0.26	0.05	0.41	99.40
	Trondhjemites	AG162	71.37	15.45	2.17	0.03	0.42	2.52	5.24	1.68	0.23	0.08	0.53	99.72
		AG159	72.35	15.26	1.51	0.02	0.23	2.01	5.06	2.45	0.13	0.04	0.42	99.48
		AG158	73.65	14.58	1.36	0.01	0.15	1.92	4.91	2.27	0.11	0.03	0.31	99.30
Orthomigmatitic		AG161	75.10	14.67	0.38	0.01	0.04	1.72	4.46	3.35	0.03	0.01	0.25	100.02
gneisses		AG242	68.97	15.67	3.59	0.06	1.17	3.80	3.79	2.39	0.41	0.13	0.73	100.71
		AG239	71.39	14.29	3.35	0.04	0.62	2.29	4.10	2.12	0.29	0.08	0.64	99.21
	Granodiorites	AG200	71.41	14.52	2.77	0.03	0.58	2.25	3.90	2.65	0.26	0.09	0.82	99.28
		AG240	71.46	15.21	2.04	0.03	0.64	2.65	4.31	2.52	0.23	0.06	0.41	99.56
		AG199	71.52	14.27	3.37	0.02	0.74	2.41	3.64	2.62	0.28	0.07	0.54	99.48
		AG8	72.11	14.56	2.78	0.03	0.76	2.37	3.93	2.79	0.24	0.06	0.56	100.19
	Tonalites	AG245	69.52	15.28	3.04	0.05	0.86	2.99	4.66	1.46	0.35	0.10	0.79	99.10
		AG217	61.34	15.78	7.62	0.11	2.28	5.90	4.77	0.50	0.84	0.15	0.64	99.93
		AG125	69.08	15.53	3.8	0.05	1.2	4.21	3.91	1.06	0.4	0.13	0.38	99.75
		AG126	64.91	16.97	5.43	0.03	1.54	4.34	4.51	1.53	0.57	0.13	0.4	100.36
		AG127	67.64	16.93	3.34	0.06	0.98	4.09	4.69	1.41	0.39	0.1	0.22	99.85
Charnockites	*Tonalites*	AG128	63.3	17.54	5.51	0.08	1.79	5.12	4.58	0.88	0.62	0.14	0.24	99.80
		AG129	69.42	15.33	3.64	0.05	0.98	3.64	4.29	1.19	0.38	0.08	0.22	99.22
		AG132	59.55	17.29	7.46	0.1	2.98	6.17	4.32	1.04	0.67	0.13	-0.01	99.70
		AG167	68.18	16.48	3.25	0.06	1.02	3.71	4.79	1.39	0.29	0.08	0.3	99.55
		AG166	68.86	16.63	3.06	0.03	1.04	3.93	4.67	1.29	0.33	0.07	0.39	100.30
		AG168	69.97	15.6	2.66	0.04	0.9	3.22	4.44	1.96	0.32	0.06	0.65	99.82
		AG169	69.73	16.03	2.83	0.04	0.95	3.59	4.39	1.91	0.29	0.06	0.48	100.30

Reported in a spidergram normalized to the chondrites (Fig. 5) all the samples show a negative Ti anomaly. The charnockites are highly depleted in Th and U and have (to a lesser extent) a negative anomaly in Rb. They show a rather flat pattern in Sr and positives anomalies in Ba and Zr. They are depleted in Y. The Tdj have a negative Th anomaly and are highly depleted in Y. They have positive B a, K, Sr and Zr anomalies. The granodiorite patterns are more variable as samples AG 242 and the tonalite AG 217 have different patterns than the other ones. They all exhibit negative Sr and P anomalies and also a sligthly negative Nb anomaly (this is less visible for sample AG 242 as it is strongly depleted in U and K, but its Nb content is the same as the other samples). All but AG 242 have negative Ba and positive K, Th and U anomalies. They have also a positive Rb anomaly, except the tonalite AG 217 which has a strong negative anomaly.

As the entire area has undergone a granulitic facies metamorphism, the depletion in K, Rb, Th and U in the charnockites and Tdj could be linked to this event (Tarney & Windley 1977, Weaver *et al.* 1978), but the K/Rb ratios of the samples, if they are high (between 334 and 1167 for the charnockite and 376 and 846 for the Tdj; Tab. 2), remain lower than the classical ratios of depleted granulites (1000; Heier 1973). The Rb/Sr ratios of the samples (Tab. 2) reflect the different behavior of these two elements in the distinct groups, with a low ratio for the charnockites and Tdj (between 0.03 and 0.18 and 0.06 and 0.1 respectively) and a higher one for the granodiorites (between 0.22 and 1.42). Sample AG 217 has a Rb/Sr ratio of 0.03, which reflects its depletion in Rb.

Rare Earth elements. The three groups of rock separated by major element contents also shown distinct REE patterns and contents (Fig. 6; Tab. 2). The Tdj show highly fractionated patterns ($[La/Yb]_N$ between 37.04 and 67.61) with positive or no Eu anomalies (Eu/Eu* between 1 and 2.02). Furthermore, their REE contents are low (ΣREE between ≈ 40 and 65). The charnockites exhibit more variable REE patterns, less fractionated than those of the Tdj ($[La/Yb]_N$ between 8.99 and 27.37) with also a slightly positive or no Eu anomaly (Eu/Eu* between 0.9 and 1.2). Their total REE contents overlap with the range of concentration of the Tdj samples (∑REE between ≈ 54 and 91). The granodiorites show the most distinct patterns, with a rather flat fractionation ([La/Yb]N between 12.73 and 25.27), a negative Eu anomaly (Eu/Eu* between 0.62 and 0.85) and a higher total REE content (EREE between ≈119 and 156). Sample AG 217 of tonalitic composition shows REE content and pattern closer to that of the granodiorites, with a rather flat pattern ([La/Yb]N of 6.64), a slightly negative Eu anomaly (Eu/Eu*= 0.92) and a total REE content of 100. Furthermore, the REE contents and negative Eu anomaly of the granodiorites and samples AG 217 appears to accompany increasing SiO_2.

INTERPRETATION The major element content of the Amsaga orthogneisses indicate clearly the presence of three petrologic groups in the area: charnockites of tonalitic composition and migmatitic orthogneisses of Tdj and granodioritic compositions (Fig. 2a). Variation diagrams indicate that the Amsaga orhtogneisses belong to a calc-alkaline trend with trondjemitic affinity (Fig. 2b and c). This is in agreement with the island arc granite nature of the samples (Fig. 3 and 4). This kind of composition is particularly common in Archean granitoids (eg. Collerson & Bridgwater 1979, Tarney *et al.* 1979, Windley 1986).

The trace element compositions of the gneisses are more perturbed due to the effect of the metamorphism and magmatic differentiation. Their negative Ti anomaly and the positive Ba and Sr anomalies of the charnockites and Tdj are in agreement with the Island Arc nature of the magma (eg. Gill 1981, Thompson *et al.* 1984). The fact that the granodiorites exhibit negative anomalies in Ba, Sr and P can be linked to fractiona-

Table 2 - Trace element compositions for the Amsaga orthogneisses, in ppm.
*Note: For REE contents: # signify isotopic dilution method; * signify ICP-MS analyses.*
Tabela 2 - Composição química (elementos traço) dos ortognaisses do Amsaga em ppm.
Nota: Para as REE: # significa análise por diluição isotópica; * significa análise por ICP-MS.

	Nature	Samples	Pb	Sr	Rb	Ba	Zr	Th	Nb	Y	U	Hf	K/Rb	Rb/Sr
Migmatitic Gneisses	*Trondhjemites*	AG154	8	518	33	985	121	2	6	<1	-	-	555	0.06
		AG235	5	499	49	621	134	4	9	2	-	-	376	0.10
		AG162	10	545	30	1026	158	4	6	2	-	-	667	0.06
		AG159	11	343	35	1324	95	<1	5	4	-	-	776	0.10
		AG158	11	438	38	1351	106	3	4	<1	-	-	768	0.09
		AG161	11	453	47	1353	46	<1	4	<1	-	-	846	0.10
	Granodiorites	AG242	7	342	77	1015	139	5	9	14	0.58	2.52	371	0.23
		AG239	32	114	162	610	165	38	10	15	-	-	159	1.42
		AG200	28	176	111	853	169	34	9	15	-	-	290	0.63
		AG240	8	309	69	875	97	8	6	3	-	-	437	0.22
		AG199	38	125	129	650	165	35	10	16	-	-	246	1.03
		AG8	31	150	148	749	155	36	9	11	10	5.08	226	0.99
	Tonalites	AG245	14	249	61	334	151	10	8	8	2.86	3.45	289	0.24
		AG217	6	281	8	195	140	5	9	20	-	-	751	0.03
Charnockites	*Tonalites*	AG125	3	248	24	644	163	< 1	6	5	-	-	532	0.10
		AG126	6	260	35	705	154	< 1	11	11	0.19	0.86	520	0.13
		AG127	6	323	26	704	138	< 1	7	6	-	-	645	0.08
		AG128	6	300	9	322	179	< 1	9	8	0.27	2.28	1167	0.03
		AG129	6	236	43	606	143	3	8	8	0.73	2.53	334	0.18
		AG132	4	268	17	467	100	< 1	10	12	-	-	729	0.06
		AG167	6	367	26	643	125	< 1	6	4	-	-	638	0.07
		AG166	9	331	23	581	126	< 1	6	2	0.40	1.83	665	0.07
		AG168	7	264	26	940	136	< 1	6	4	-	-	902	0.10
		AG169	8	306	32	914	130	< 1	7	4	-	-	710	0.10

	Nature	Samples	La	Ce	Nd	Sm	Eu	Gd	Dy	Er	Yb	Lu	La/Y	SREE	Eu/E
Migmatitic Gneisses	*Trondhjemites*	AG235#	12.34	28.21	9.66	1.58	0.46	1.27	0.87	0.32	0.22	-	33.99	54.93	1.00
		AG162#	18.43	31.60	10.64	1.61	0.58	0.96	0.63	0.33	0.18	-	62.05	64.96	1.44
		AG158#	10.65	20.01	6.34	1.01	0.51	0.60	0.32	0.14	0.11	0.02	58.68	39.71	2.02
	Granodiorites	AG242*	29.11	52.42	21.52	4.57	1.17	3.98	3.02	1.59	1.51	0.24	11.68	119.13	0.85
		AG199#	33.15	59.01	19.84	3.29	0.65	3.04	2.51	1.35	1.21	0.19	16.60	124.24	0.63
		AG8*	42.48	72.77	25.25	4.68	0.90	4.24	2.67	1.40	1.11	0.16	23.19	155.66	0.62
	Tonalites	AG245*	30.63	55.44	21.16	4.19	0.79	3.45	2.07	1.31	1.00	0.18	18.56	120.22	0.64
		AG217#	21.22	44.35	17.72	3.74	1.12	3.80	3.69	2.19	2.11	0.33	6.10	100.27	0.92
Charnockites	*Tonalites*	AG126*	20.35	37.69	17.89	4.17	1.13	3.58	2.56	1.5	1.43	0.2	8.62	90.54	0.90
		AG128*	14.7	28.12	13.99	3.45	1.14	3.09	2.12	1.26	1.08	0.17	8.25	69.12	1.08
		AG129*	20.93	36.06	14.74	3.05	1.08	2.54	1.8	1.09	1.03	0.2	12.32	82.52	1.20
		AG167#	14.07	24.63	9.69	1.852	0.547	1.557	1.065	0.489	0.375	0.058	22.72	54.34	1.00
		AG166*	21.14	36.88	14.02	2.51	0.82	1.76	1.02	0.61	0.51	0.09	25.12	79.36	1.20

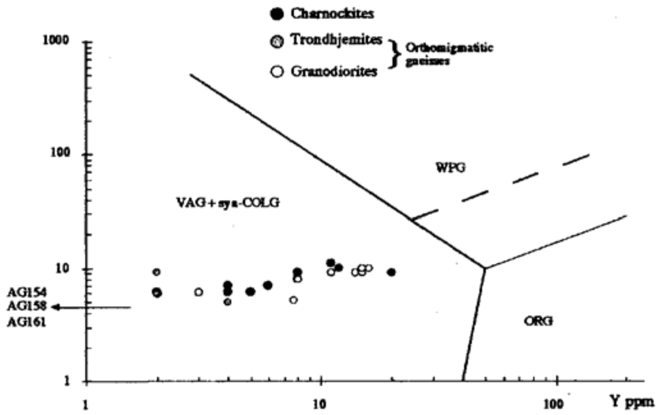

Figure 3 - Chemical composition of the Amsaga orthogneisses plotted in a geotectonic Y vs. Nb diagram (Pearce etal. 1984).
Figura 3 - Composição química dos ortognaisses de Amsaga reportada num diagrama geotectônico Y vs. Nb (Pearce *et al.* 1984).

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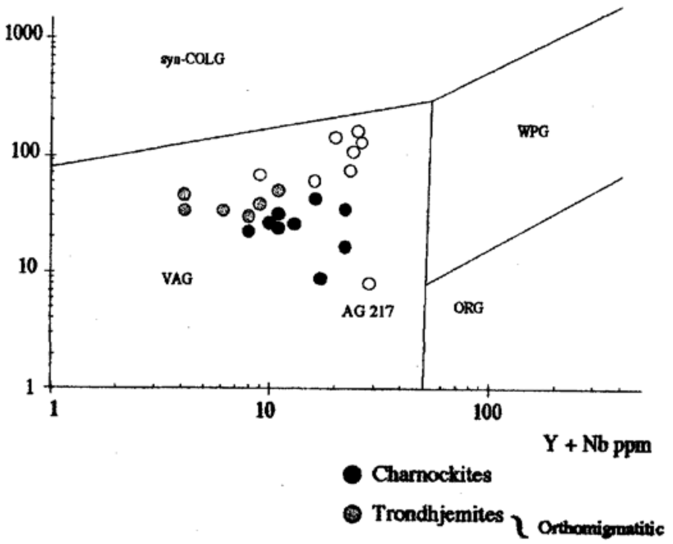

Figure 4 - Chemical composition of the Amsaga orthogneisses plotted in a geotectonic Y+Nb vs. Rb diagram (Pearce et al. 1984).
Figura *4* - Composição química dos ortognaisses de Amsaga reportada num diagrama geotectônico Y+Nb vs. Rb (Pearce *et al.* 1984).

tion of plagioclase and apatite during the differentiation processes. This is in agreement with their increasing in REE contents and Eu negative anomaly with increasing of SÍÜ2. This differentiation process does not seem to exist in the Charnockites and Tdj. The other anomalies observed in the spidergrams could be linked to the metamorphic processes. At least two kinds of metamorphic processes have been documented in the area: the first is the granulitic event which affected the entire area and the second is hydrothermal meta-

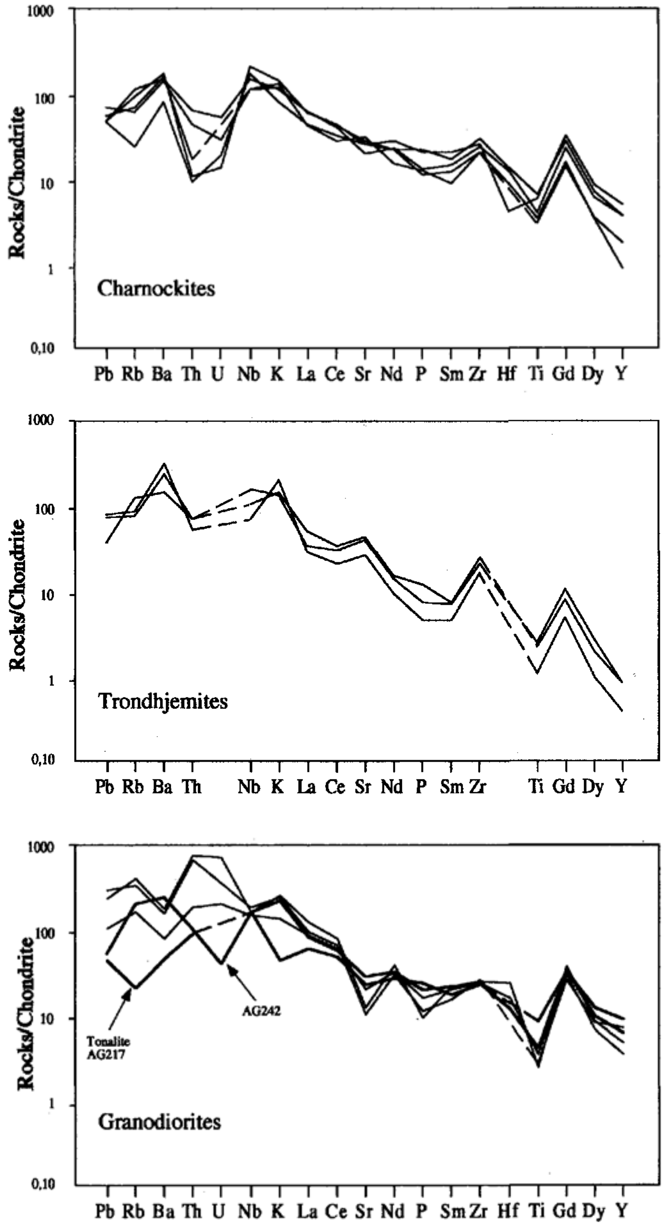

Figure 5 - Spidergrams of the Amsaga orthogneisses normalized against chondrites (Sun 1982; except Gd and Dy: Nakamura 1974, andtif, Wood et al 1979).
Figura 5 - Spidergramas dos ortognaisses do Amsaga normalizados ao condrito (Sun 1982; para o Gd e Dy: Nakamura 1974 e para o Hf: wood *et al.* 1979).

morphism, essentially observed along the vertical mylonite zones. The latter seems to have affected the migmatitic orthogneisses but not the charnockitic body of S nine Kembo (Potrel 1994). The depletion in Rb, K and essentially Th and U of the charnockite and Tdj might be due to the granulitic event, as this behavior is common in high grade terrains (eg. Tarney & Windley 1977, Weaver *et al.* 1978). The fact that the K/Rb ratios of the samples remain lower than the classical depleted granulite ratio could be due to a similar depletion in K and Rb, or by a renewal of the initial ratio during retrograde processes (Moorlock *et al.* 1972, Drury 1973, 1974). The

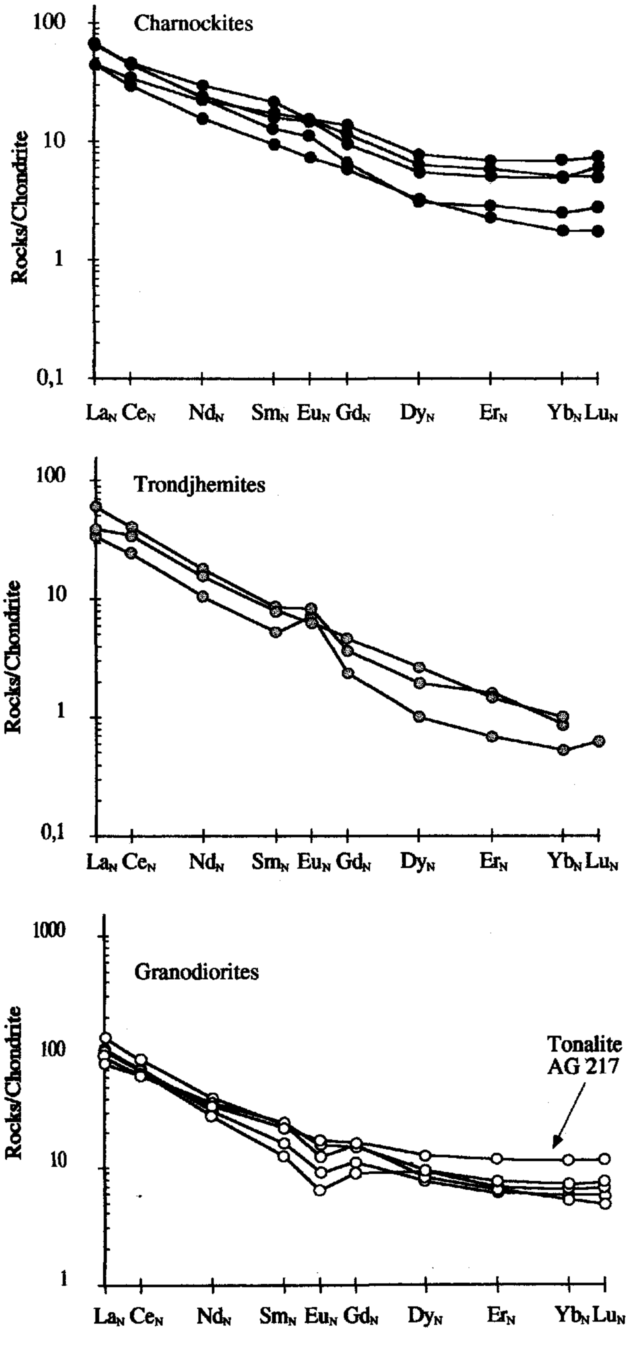

Figure 6 - Rare Earth element patterns of the Amsaga orthogneisses (chondritic normalisation of Taylor & Gorton 1977).

Figura 6 - Padrões de Terras Raras dos ortognaisses do Amsaga (normalizados ao condrito segundo Taylor e Gorton 1997).

strong depletion in Y observed in the charnockite and Tdj samples (and particularly in the Tdj with some Y contents lower than 1 ppm) remains ambiguous as this element is generally thought to be immobile during metamorphism (eg. Rollingson 1993). The more or less developed depletion in Rb, K, Th and U observed in samples AG 217 and AG 242 could also be explained by the granulite facies metamorphism. The enrichment in Rb and Th and U observed in the others granodiorites is more ambiguous: this could be due to the Island Arc nature of the samples as these magmas are generaly enriched in these elements (eg. Gill 1981, Thomson *et al.* 1984) or possibly to the metamorphic processes. In this case two hypothesis are proposed: either the granodiorites formed a sink during the granulite metamorphism and hence display anomalies opposite to those observed in the charnockite and Tdj, nor their composition was more affected by the hydrothermal metamorphism. The crystallization during these low grade processes of white micas and secondary biotites could explain the enrichment in Rb and Th could be concentrated in secondary epidote and titanite. The depletion in Sr could result in this case both from the fractional crystallization processes and from the breakdown of plagioclase to form sericite.

The REE pattern of these gneisses (Fig. 6) confirm the presence of the three petrologic groups observed in the normative An-Ab-Or diagram (Fig. 2a). The Tdj show a typical Archean TTG pattern with high (La/Yb)n ratio and positive Eu anomalies (eg. Condie 1981, Martin 1986, Condie 1992). The charnockite patterns are less characteristic but exhibit also the Archean TTG features. On the other hand, the granodiorite and the tonalitic sample AG 217 REE patterns are closer to the post-archean TTG, as they are less fractionated and exhibit significant negative Eu anomalies (eg. Condie 1992), even if they are clearly older than 2.7 Ga, as they are intruded by the Guelb el Azib and Iguilid gabbros (Auvray *et al.* 1992a, Potrel 1994, Potrel *et al.*, submitted). The highly fractionated REE patterns of Archean TTG are interpreted as resulting from the presence of garnet and/or amphibole remaining in the residual solid after melting and segregation of these magmas (eg. Barker & Arth 1976, Martin 1987, Drummond & Defant 1990). Hence this feature is directly linked to the magmatic source of these gneisses and was not a result of fractional crystallization processes. Also, we could conclude that the differences observed in the REE patterns of the Amsaga orthogneisses indicate different sources, at least for the charnockite and Tdj on one side and granodiorites on the other side. This conclusion is in agreement with the scattering in the Nd model ages of these gneisses and their fairly parallel εNd versus time evolution lines (Potrel 1994, Potrel *et al.,* submitted).

CONCLUSION This work represents the first geochemical data obtained from the Archean basement of the Reguibat Rise. These preliminary results do not allow proposal of detailed geodynamical and petrological model for this zone for the moment. Some features could nevertheless be distinguished. The Amsaga orthogneisses define a classical Archean calc-alkaline trend of trondjhemitic affinity and the primary composition of the magmas is in agreement with their Island Arc nature. The charnockites and Tdj chemical compositions indicate a depletion in K, Rb, Th and U, probably linked to the high grade event. The REE patterns of the migmatitic orthogneisses indicate that they were derived from at least two distinct sources and are not homogeneous as was considered in previous studies (e.g. Barrère 1967, Auvray *et al.* 1992a et b, Bronner 1992). Further studies are required to establish the exact nature of these different magmas. Furthermore, the superposition of granulitic and hydrothermal events caused a strong perturbation of the primary composition of the samples and a detailed study is necessary to evaluate the precise mode of this chemical disturbance.

Acknowledgements Field expenses were supported by French-Mauritanian cooperation grant (IRIM). I would like to thank M. Lê Coz-Bouhnik, N. Morin, O. Hénin, J. Cornichet and J. Mace for their help in X-ray fluorescence and isotopic dilution analyses. I thank J.A. Barrat for the ICP-MS analyses. I thank Prof. T. Liverton and two anonymous reviewers for constructive criticism of the manuscript.

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MANUSCRITO A924
Recebido em 01 de julho de 1997
Revisão do autor em 01 de setembro de 1997
Revisão aceita em 03 de setembro de 1997