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GEOLOGY AND PETROCHEMISTRY OF THE QASH VOLCANICS, CENTRAL EASTERN DESERT, EGYPT

BY

Abd El Salam M. Abu El Ela

Department of Geology, Tanta University, Tanta

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ABSTRACT

The present work concerns the volcanic rocks around Wadi El-Qash which was previously mapped as Iron Bearing Horizon, Calc-Alkaline Volcanic Group, Natash Volcanics and as a new rock unit named the Qash Volcanics in the rock succession of the Precambrian rocks of the Eastern Desert of Egypt.

The studied Qash volcanics are presently found to comprise an association of basic to acidic lava flows together with their corresponding bedded pyroclastics. The lava flows comprise mainly andesites, quartz andesites, basaltic andesites, rhyodacites and rhyolites together with minor basalts and diabases and occasional dacites. Pyroclastics predominate and comprise essentially fine and coarse tuffs of basic to acidic composition and agglomerates. The volcanics and pyroclastics are unmetamorphosed but variably altered.

The geochemical data indicate that the intermediate and acidic Qash volcanics together with the diabases are calc-alkaline while the basalts are tholeiitic. The basalts, diabases and andesites were formed in a mature island arc with a thick continental crust (or active continental margin). The rhyodacites and rhyolites, on the other hand, originated as within plate lavas and probably rift-related.

The absence of metamorphism in the Qash volcanics, their relationships with the Hammamat molasse sediments (Igla Formation) as well as their chemical characteristics indicate that the studied Qash volcanics belong to the Dokhan Volcanics of the Eastern Desert of Egypt.

INTRODUCTION

El-Ramly and Akaad (1960) recognized three groups of volcanic rocks in the central Eastern Desert: a) Metavolcanic series, b) Old Volcanics (Dokhan type) and c) Alkaline Volcanic Suite.

The "Metavolcanics" are widely distributed and form extensive outcrops. They include variable proportions of metabasalts, meta-andesites, metadacites and less abundant metarhyodacites together with their equivalent metapyroclastics. They are closely associated with metasediments which together constitute the Abu Ziran Group (Akaad and Noweir, 1969, 1980). This volcanic association is refered to as "Younger Metavolcanics" formed in ensimatic island arcs (Stern, 1981) to differentiate it from the ophiolitic "Older Metavolcanics" consisting of pillowed and non-pillowed metabasalts. The "Younger Metavolcanics" are weakly metamorphosed, of calc-alkaline to tholeiitic nature and have been considered to represent an ensimatic island arc. Kroner (1985) obtained a Rb-Sr isochron age of 714 Ma for the "Younger Metavolcanics".

The "Dokhan Volcanics" are the oldest unmetamorphosed volcanics in the Eastern Desert (El-Ramly and Akaad, 1960). They occur below the regional unconformity at the base of the Hammamat Group and have contributed to the latter (Akaad and El-Ramly, 1958; Akaad and Noweir, 1969, 1980; Akaad, 1996) but younger than the Older Grey Granites (El-Ramly and Akaad, 1960; El-Ramly, 1972). They embrace a complex association of andesitic basalts, andesites, dacites, rhyodacites and rhyolites together with thick accumulations of corresponding pyroclastics, particularly andesitic of both massive and banded tuffs (Akaad and Noweir, 1978; Akaad, 1996). They are of calc-alkaline composition and may represent a well-developed island arc with a thick continental crust or an active continental margin (Basta et al., 1980; Gass, 1982; Furnes et al., 1985) or may erupted in a tectonic environment transitional toward a stable continental craton (Ressetar and Monrad, 1983). Stern et al. (1984) and Stern and Gottfried (1986) believe, however, that the bimodality of the Dokhan Volcanics is due to rifting. Radiometric ages from the Dokhan Volcanics range between 639 Ma and 581 Ma (Dixon et al., 1979; Stern and Hedge, 1985).

The " Alkaline Volcanics" represent the youngest rock unit in the central Eastern Desert where they form plugs, sheets and ring dikes cutting all the Proterozoic basement rocks of the Eastern Desert of Egypt (El-Ramly and Akaad, 1960). They are dominantly alkaline and comprise trachytes, bostonites, andesites and minor basalts and were considered to be related to the Natash Volcanics.

The Natash Volcanics (Barthaux, 1922) are essentially composed of mildly alkaline, intracontinental olivine basalts, mugearites, benmoreites and trachytes with less commonly basaltic andesites and calc-alkaline rhyodacites and rhyolites besides trachytic and rhyolitic tuffs (Hashad et al., 1982). Barthaux (op.cit.) assigned a late Cretaceous age on stratigraphic grounds for the Natash Volcanics which was confirmed by radiometric ages of 90-100 Ma (Hashad et al., op. cit.). El-Gaby et al., (1987) refered to the extension of these volcanics to Gabal Abraq in the south Eastern Desert.

The plagioclase microphenocrysts are highly altered to epidote, clinozoisite and calcite. Augite microphenocrysts are commonly fresh, but occasionaly marginally replaced by uralite. Olivine forms microphenocrysts commonly altered to antigorite and chlorite or to brown iddingsite.

Diabase consists of plagioclase laths bounding interstices filled with augite, chlorite, epidote, iron oxide, calcite and quartz. Some of the diabase specimens display a fine intergranular texture with a notable microporphyritic crystals of plagioclase, augite and occasionally olivine, others are coarser and show ophitic and subophitic textures. The plagioclase is moderately to highly altered, partly corroded by the other components and usually twinned according to the albite, carlsbad and carlsbad-albite laws; zoned crystals are also present . Augite is commonly fresh, but may show alteration to uralite. Olivine is occasionally present, typically as microphenocrysts partially to completely serpentinized.

Basaltic andesites are transitional between basalts and andesites. They are more siliceous than the basalts as judged by occasional presence of interstitial cryptocrystalline silica . They consist of augite and less commonly plagioclase microphenocrysts set in a fluidal or intergranular groundmass of microlitic plagioclase , granular augite, opaques and occasionally cryptocrystalline silica.

Andesites are commonly porphyritic and consist essentially of euhedral phenocrysts and microphenocrysts of plagioclase (An_{32-40}) and augite set in a felty to pilotaxitic groundmass formed of fine plagioclase laths with interstitial cryptocrystalline materials and specks of augite and iron oxides. Some specimens are composed of plagioclase and augite microphenocrysts embedded in a glass-rich base carrying microlitic plagioclase, augite and granular iron oxides. The plagioclase microphenocrysts are slightly to moderately altered to epidote, clinozoisite and calcite . Pyroxene is usually fresh but may show alteration to bastite , chlorite and calcite.

Quartz andesites consist essentially of microphenocrysts of altered plagioclase and augite set in a fine-grained groundmass composed of altered plagioclase laths, abundant intergranular quartz and specks of chlorite, epidote and iron oxide. Sometimes, they possess well-developed pilotaxitic texture.

Dacites are composed essentially of microphenocrysts of plagioclase (An_{28}) and quartz set in a felsitic groundmass formed of intimate mixture of quartz and feldspars together with chlorite, muscovite and opaques.

Rhyodacite is intermediate between rhyolite and dacite in all characteristics and composition. It consists mainly of microphenocrysts of orthoclase, quartz and plagioclase (An_{26}) set in a groundmass formed of microcrystalline quartz and feldspars together with epidote , sericite, carbonates and opaques.

Rhyolite consists of microphenocrysts of bipyramidal quartz and less commonly perthite set in a groundmass formed of microcrystalline to felsitic aggregates of quartz and feldspars, together with chlorite, epidote,calcite , sericite and opaques.

Basic coarse lithic crystal tuffs comprise coarse crystal ashes mainly of plagioclase, augite, chlorite and minor quartz together with sporadic coarse lithic fragments of basalts , glassy materials and minor felsites set in a microcrystalline tuffaceous matrix. The latter is composed mainly of microcrystalline volcanic dust containing small angular fragments of plagioclase, quartz and glassy materials together with chlorite flakes, iron oxide granules and carbonate patches.

Intermediate coarse lithic crystal tuffs are composed essentially of crystal and lithic ashes set in a microcrystalline tuffaceous matrix. The crystal ashes are generally more abundant than the lithic ashes. They are mostly angular to subangular and are represented mainly by plagioclase together with subordinate quartz and chlorite . The lithic ashes are represented mainly by andesite and subordinate felsite, dacite and glassy materials. The tuffaceous matrix is composed mainly of microcrystalline volcanic dust of plagioclase and subordinate quartz together with abundant chlorite flakes, iron oxide granules and carbonate patches.

Acidic fine and coarse crystal tuffs consist essentially of angular crystal ashes of quartz and plagioclase embedded in a tuffaceous microcrystalline matrix formed of quartz and feldspars with abundant scales of chlorite, iron oxides, epidote and irregular patches of calcite.

Laminated fine crystal tuffs are characterized by fairly distinct primary depositional lamination marked by a repeated alternation of fine and dust tuff laminae (0.1-0.8 cm thick). The fine tuff laminae are identical in composition to the acidic crystal tuffs. They consist essentially of quartz and plagioclase together with numerous irregular patches of calcite and epidote granules.

PETROCHEMISTRY

Major and trace element analyses for 18 selected specimens of the Qash volcanics are given in Table 1. Averages of other arc andesites are given in Table 2 for comparison. The chemical analyses were carried out by atomic absorption and X-ray fluorescence techniques at the Central Laboratories of the Geological Survey of Egypt.

Table 1. Major and some trace element analyses of the Qash volcanics.

Rock name	Basalts		Diabases			Andesites								Rhyodacites		Rholites		
Serial No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Sample No.	51	25A	37C	61B	60	64A	52B	44A	11B	55B	55C	11A	56B	12F	47	17	27A	20B
SiO_2 wt%	48.04	47.87	51.91	52.30	54.97	56.77	58.88	58.73	56.86	57.84	57.78	58.87	59.65	69.82	70.96	74.16	76.37	77.33
TiO_2	0.48	1.50	1.48	1.22	0.94	0.86	0.73	0.76	0.94	0.78	0.87	0.92	0.84	0.63	0.43	0.05	0.04	0.06
Al_2O_3	13.58	13.49	14.35	14.09	14.62	15.40	15.87	15.52	16.12	15.95	15.69	15.73	14.68	14.38	11.24	14.29	13.63	13.22
$Fe_2O_3{}^*$	10.74	14.47	11.76	9.53	8.42	8.17	7.11	7.04	7.18	7.21	7.41	6.47	7.19	5.20	5.96	2.69	2.33	2.34
MnO	0.22	0.29	0.13	0.12	0.11	0.12	0.10	0.10	0.11	0.10	0.10	0.13	0.12	0.08	0.14	0.03	0.02	0.03
MgO	7.53	5.05	7.95	12.09	9.76	8.38	6.73	7.71	6.46	7.54	7.73	4.52	8.18	0.79	1.42	0.47	0.03	0.03
CaO	16.59	14.88	8.39	7.06	6.94	4.62	5.01	4.35	7.25	5.46	5.28	7.26	4.03	2.11	4.39	2.74	1.59	1.54
Na_2O	2.22	2.12	3.44	2.89	3.03	4.51	3.64	4.20	4.74	3.77	3.57	4.34	4.79	4.51	3.20	3.03	3.83	3.30
K_2O	0.19	0.26	0.31	0.51	1.04	0.97	1.75	1.43	0.21	1.24	1.37	1.66	0.39	2.41	2.19	2.54	2.15	2.15
P_2O_3	0.04	0.07	0.28	0.20	0.17	0.20	0.18	0.17	0.13	0.16	0.20	0.09	0.14	0.06	0.06	tr	tr	tr
Total	99.99	100	100	100	100	100	100	100.01	100	99.99	100	99.99	100.01	99.99	99.99	100	99.99	100
L.O.I.	9.84	7.98	9.83	8.43	3.40	6.00	8.50	6.14	2.86	3.17	2.80	3.54	3.54	5.19	3.18	3.82	3.69	1.28
Trace Elements																		
Zr ppm	70	80	180	122	118	280	198	190	98	250	270	112	290	530	594	68	39	113
Sr	114	135	142	162	332	111	462	303	130	500	315	266	118	40	58	48	38	50
Rb	18	18	19	23	40	75	133	92	30	118	95	60	68	118	97	124	74	88
Pb	21	37	22	18	26	15	19	24	32	27	17	14	28	9	9	17	21	18
Ba	87	169	133	186	138	121	187	191	101	132	161	164	173	116	72	68	39	113
Cu	73	90	44	50	84	72	124	75	110	100	88	107	119	168	194	136	127	164
Ni	73	166	76	126	102	84	64	75	70	64	61	55	104	6	25	20	25	22
Cr	306	485	266	337	304	216	155	219	189	187	152	158	282	61	67	46	40	48
Zn	159	220	191	210	160	166	168	182	180	140	194	173	122	208	183	157	299	217
Co	37	40	37	29	29	13	21	30	27	23	25	19	23	14	5	10	5	5
V	408	479	259	320	305	212	190	243	261	242	248	240	177	50	113	124	87	98
Ti	5032	8985	8865	7308	5631	5151	4373	4552	5631	4672	5211	5511	5032	3774	2576	300	240	359

- Total has been normalized to 100% anhydrous. All totals ranged between 98.49% and 100.53% prior to normalization.
- $Fe_2O_3{}^*$ = Total iron as Fe_2O_3, tr = traces

Table 2. Average chemical analyses of arc andesites

Serial No.	1	2	3	4
Sample No.	A	B	C	D
SiO_2%	58.17	58.70	59.57	59.02
TiO_2	0.84	0.88	0.70	0.73
Al_2O_3	15.62	17.24	17.22	17.65
Fe_2O_3	7.22*	3.31	-	7.15*
FeO	-	4.09	6.81^x	-
MnO	0.11	0.14	n.r.	0.14
MgO	7.16	3.37	3.40	3.45
CaO	5.41	6.88	7.01	7.61
Na_2O	4.19	3.53	3.68	3.13
K_2O	1.13	1.64	1.60	0.93
P_2O_5	0.16	0.21	n.r.	0.19
Total	100.01	99.99	99.99	100

A = Average of the studied andesites, B = Average arc andesites (Le Maitre, 1976), C = Calc-alkaline andesites from the Cascades (Condie, 1982), D = Average of arc andesites from south Sandwich arc (Luff, 1982).
x = Total Fe as FeO, * = Total Fe as Fe_2O_3, n.r. = not recorded

Chemical classification:

The analysed rocks are plotted on the Na_2O+K_2O versus SiO_2 classification diagram (Cox et al., 1979) for volcanic rocks (Fig.2) where :

(a) The 2 basalts plot within the field of subalkali basalts.

(b) The 3 diabases plot within the fields of subalkali basalts (no.3)and basalitic andesites (nos.4&5).

(c) The 8 andesites plot within the field of andesites.

(d) Only one rhyodacite plots within the field of rhyolite with the other just below that field .

(e) The 3 rhyolites are not represented because of their higher SiO_2 and lower K_2O contents.

(f) All plots fall below the dividing line suggested by Miyashiro (1978) to separate between alkalic (above) and subalkalic magma series (below).

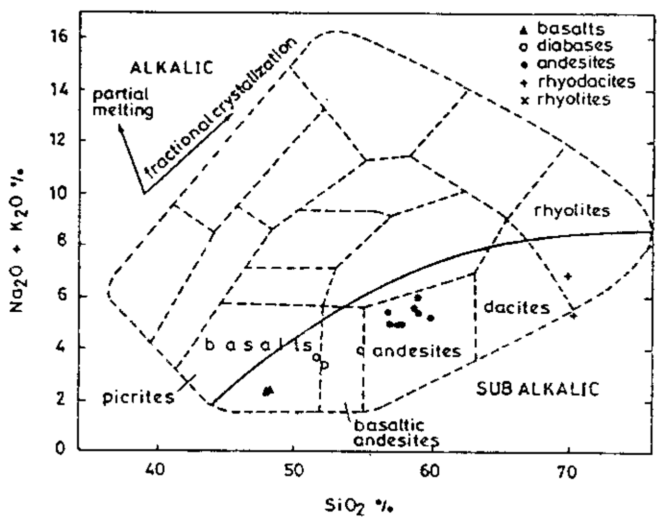

Fig. 2 $Na_2O + K_2O - SiO_2$ classification diagram *(Cox et al., 1979).*

The K_2O-SiO_2 diagram (Fig.3) shows the following :

(a) The basalts fall within the field of low-K basalt .

(b) The diabases fall within the fields of low-K basalt (nos. 3&4) and calc-alkaline basaltic andesite (no.5).

(c) The andesites are scattered within the fields of calc-alkaline andesite (nos. 7,8,10,11&12), calc - alkaline basaltic andesite (no.6), low-K andesite (no.13) and low-K basaltic andesite (no.9).

(d) The rhyodacites and rhyolites fall within the field of calc-alkaline rhyolite.

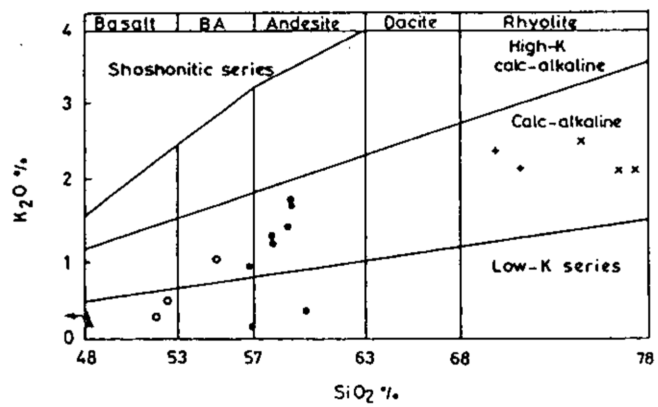

Fig. 3 K_2O-SiO_2 diagram *(Peccerillo and Taylor, 1976).* Symbols as in Figure 2.

Qash andesites compared with arc andesites :

The studied andesites, which dominate within the Qash volcanics, are compared with other arc andesites (Table 2). The average of the studied andesites is similar in SiO_2, TiO_2, FeO*, MnO, Na_2O and K_2O contents to the averages of arc andesites in general (Le Maitre, 1976) and to that from the Cascade Range (Condie, 1982) and from the South Sandwich arc (Luff, 1982) but is higher in MgO content and lower in Al_2O_3 and CaO contents than the compared averages of arc andesites.

Geochemical characters

The contents of major and some trace elements are plotted versus Larsen's differentiation index (Fig .4). The variation diagrams depict the presence of a distinct compositional gap at 59.65 -69.82 SiO_2% i.e. between the basalts, diabases and andesites, on the one hand, and rhyodacites and rhyolites on the other (Table 1 and Figure 4). Also, a break in the variation trends of Al_2O_3, Na_2O and Rb is obvious between the two volcanic subgroups. Besides, the rhyodacites and rhyolites are so low in Na_2O and K_2O to be derived from andesites by differentiation.

The presence of a compositional gap and the break in variation trends of some major and trace elements between the two volcanic subgroups may indicate that the rhyodacites and rhyolites have evolved from a separate magma. Such features have been observed in the Dokhan Volcanics of Wadi Queh area (El-Gaby et al., 1989).

Magma type and tectonic implications

The studied Qash volcanics fall in the subalkaline field on the alkali-silica variation diagram (Fig.5). On the AFM diagram (Fig .6) , the diabases, andesites, rhyodacites and rhyolites lie in the calc-alkaline field whereas the basalts are of tholeiitic affinity. The studied diabases and andesites exhibit calc-alkaline affinity on the FeO* / MgO versus SiO_2 diagram (Fig.7) and follow the trend of the Marianas calc-alkaline series whereas the basalts show tholeiitic affinity. According to Miyashiro (1974) , the tholeiitic magma series is characterized by marked enrichment in FeO* and TiO2 with increasing fractionation , in marked contrast to the calc-alkaline series in which these oxides decrease steadily with increasing fractionation . The studied volcanics are plotted on FeO* and TiO_2 versus FeO* / MgO diagram (Fig.8) where basalts show a tendency towards Fe- and

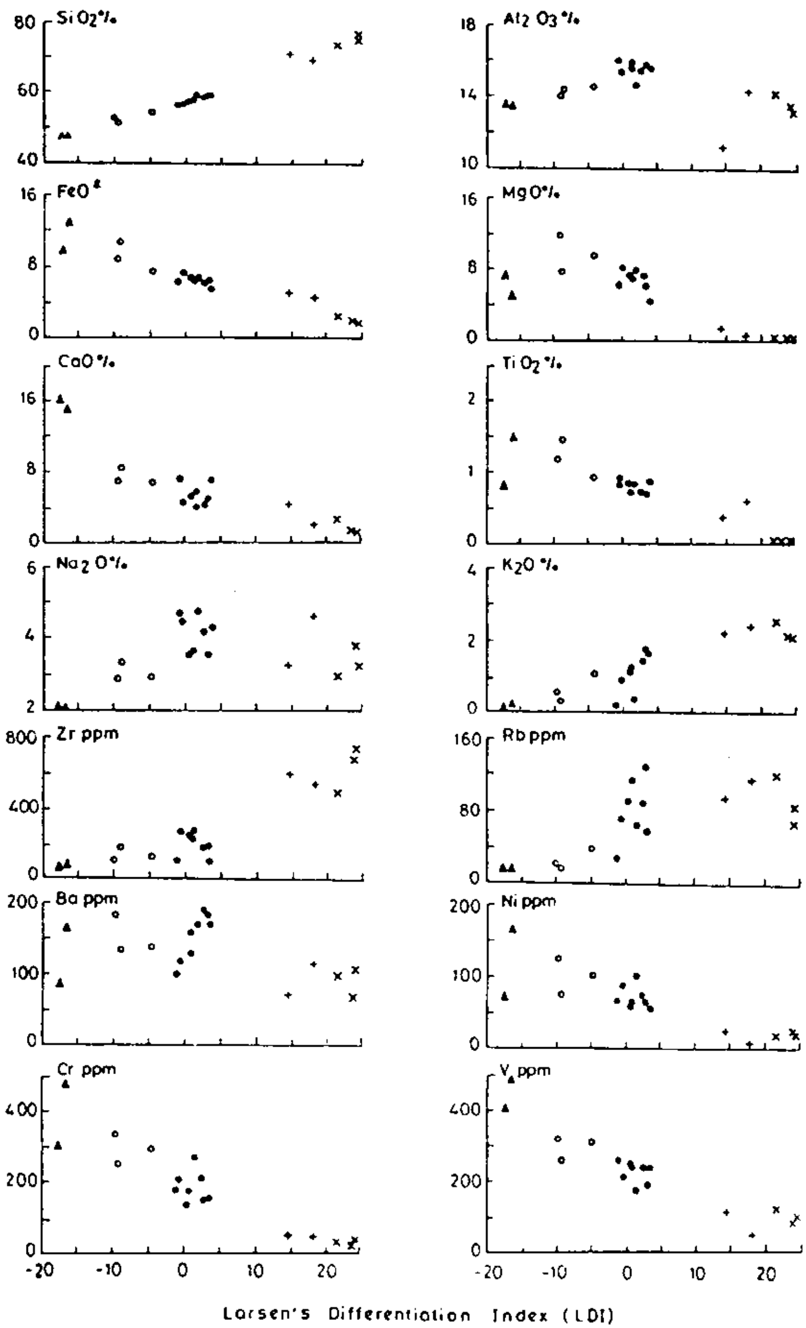

Fig. 4 Variation diagrams of some major oxides and trace elements versus Larsen's Differentiation Index. Symbols as in Figure 2..

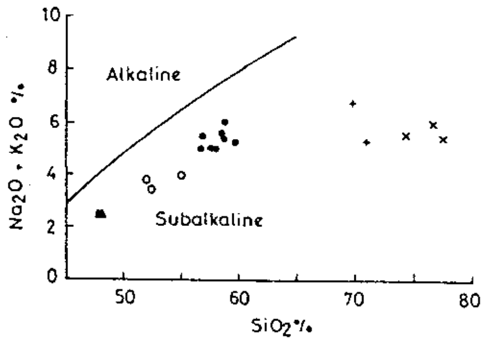

Fig. 5 Alkali-silica variation diagram *(Irvine and Baragar, 1971).*
Symbols as in Figure 2.

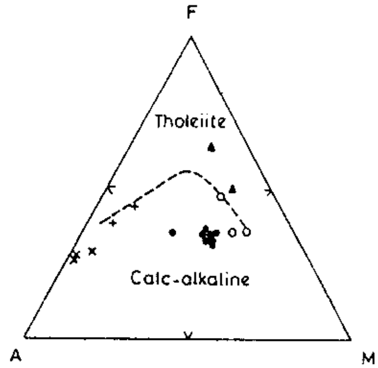

Fig. 6 AFM diagram *(Irvine and Baragar, 1971).*
Symbols as in Figure 2.

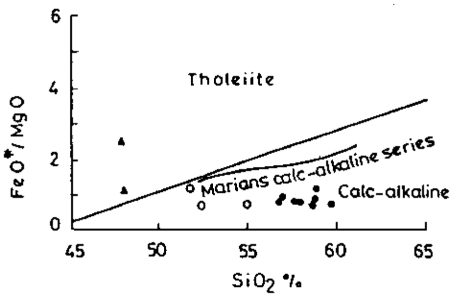

Fig. 7 FeO*/MgO- SiO_2 diagram from Wilson (1989).
Marianas calc-alkaline series after Meijer and Reagan (1981)
Symbols as in Figure 2.

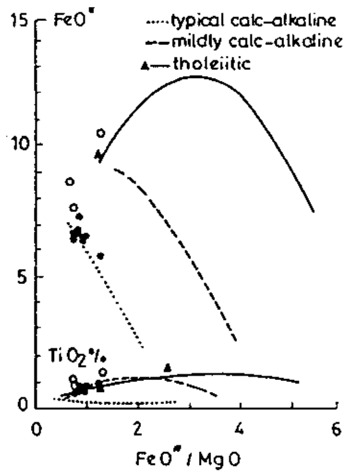

Fig. 8 FeO* and TiO_2 versus FeO*/MgO diagram (Miyashiro, 1974).
Symbols as in Figure 2.

Ti- enrichment with slight increase in FeO* / MgO suggesting a tholeiitic composition, whereas the diabases (with one exception) and andesites show Fe and Ti depletion with advancing fractionation suggesting a calc-alkaline affinity.

Calc-alkaline volcanics constitute 89% among the Qash volcanics. According to Miyashiro (1974) , the proportion of calc-alkaline series rocks tend to increase with the development of a continental-type crust beneath the volcanic arc. They constitute < 40% in the arcs of small volcanic islands having an oceanic-type crust, 40 to 80% in the arcs of larger islands having a continental type crust and 80 to 100% in the Cascades and Central Andes on continental margins with thick continental crust.

Miyashiro(1975) and Miyashiro and Shido (1975) proposed plotting Ni, Ba and Cr against FeO* / MgO to differentiate between abyssal tholeiites and volcanics from island arcs and active continental margins (Figs. 9-11). The Ni versus FeO* /MgO diagram (Fig.9) shows that two analyses (one basalt and one diabase) plot within the field of abyssal tholeiite whereas the remaining diabases and andesites plot within the field of volcanic rocks of island arcs and active continental margins. All plots fall within the field of volcanic rocks from island arcs on the Ba versus FeO*/MgO diagram (Fig.10). On the Cr versus FeO* / MgO diagram (Fig.11), 2 diabases and one basalt fall within the field of abyssal tholeiite whereas the remaining diabase and andesites fall within the field of volcanic rocks of island arcs and active continental margins. Jakes and Gill (1970), Jakes and White (1969 and 1972) and Gill (1970) argued for considering the abyssal tholeiites associated with calc-alkaline volcanics as island arc tholeiites. The studied rhyodacites and rhyolites are not represented on the Ni, Ba and Cr versus FeO* /MgO diagrams because of their high FeO*/MgO ratio. On the Ti-Zr diagram (Fig.12), the studied basalts fall within the area common to both MORB and arc

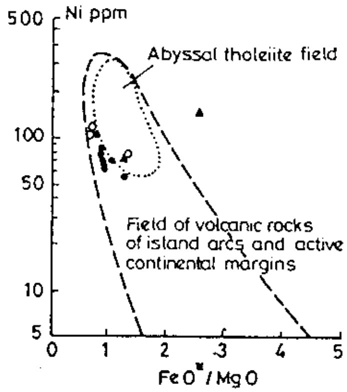

Fig. 9 Ni - FeO*/MgO diagram (Miyashiro, 1975). Symbols as in Figure 2.

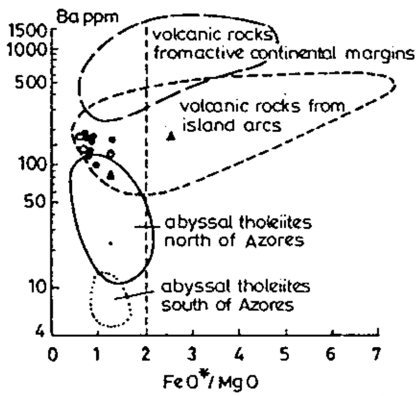

Fig. 10 Ba - FeO*/MgO diagram (Miyashiro, 1975). Symbols as in Figure 2.

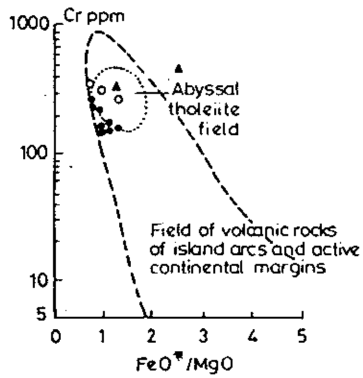

Fig. 11 Cr - FeO*/MgO diagram (Miyashiro and Shido, 1975). Symbols as in Figure 2.

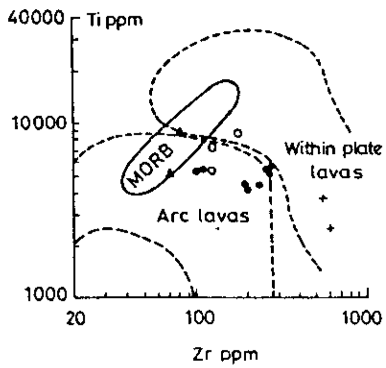

Fig. 12 Ti - Zr diagram (Pearce et al., 1981). Symbols as in Figure 2.

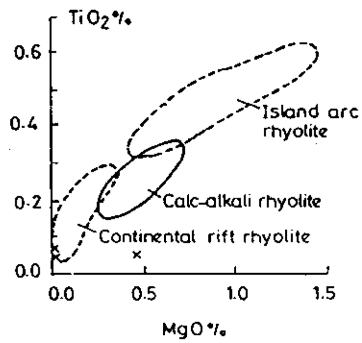

Fig.13 TiO_2 - MgO diagram (Condie and Shadel, 1984). Symbols as in Figure 2.

lavas, 2 out of 3 diabases fall within the field of arc lavas with the remaining analysis lying within the field of within plate lavas. The studied andesites fall within the field of arc lavas whereas the rhyodacites fall within the field of within plate lavas. The rhyolites are not represented because of their low TiO_2 contents. On the TiO_2 versus MgO diagram (Condie and Shadel, 1984) (Fig.13) the studied rhyolites fall within or near the field of continental rift rhyolites.

DISCUSSION AND CONCLUSION

The Qash volcanics comprise an association of basic to acidic lava flows together with thick accumulations of corresponding bedded pyroclastics. The lava flows include mainly andesites, quartz andesites, basaltic andesites, rhyodacites and rhyolites together with minor basalts and diabases and occasional dacites. The pyroclastics vary from coarse agglomerates down to basic and acidic coarse tuffs and laminated fine tuffs. The volcanics and pyroclastics are unmetamorphosed but variably altered.

Field relations indicate that the studied Qash volcanics are certainly older than the Hammamat sediments which lie unconformably above the volcanics from the northeast.

The geochemical data indicate that the studied basalts are tholeiitic whereas the diabases, andesites, rhyodacites and rhyolites are of calc-alkaline affinity (Figs.5-8). The percentage of calc-alkaline rocks in the studied volcanics (about 89%) corresponds to that of the Cascades and Central Andes suggesting an active continental margin tectonic environment or an island arc with a thick continental-type crust for the development of the studied volcanics. This conclusion is also corroborated by different discrimination diagrams (Figs 9-12) . However, the rhyodacites are similar to within plate lavas (Fig.12) whereas the rhyolites are akin to continental rift rhyolites (Fig.13). The chemical gap between the basic-intermediate and acidic volcanics as well as the difference in their tectonic environments makes the existence of two different magmas or magma history eminently possible. However, Stern and Gottfried (1986) interpreted the intermediate and acidic Dokhan Volcanics (separated by a chemical gap at 65-70% SiO_2) as bimodal and indicative of rift environment.

The question arises whether (1) the Qash volcanics originated in a mature island arc with a thick continental crust (or active continental margin) or (2) they originated in a rift environment ?. Thorpe et al., (1982) and Condie and Shadel (1984) reported that bimodal volcanics characterize some continental margin arcs . Strong (1977), Gill and Stork (1979), Donnelly and Rogers (1980) and Sivell and Waterhouse (1988) reported that bimodal volcanics characterize some oceanic island arcs. It is therefore possible that the acidic volcanics were formed later in rift zones on the mature island arc or active continental margin. The basalts, diabases and andesites evolved during the island arc or active continental margin tectonic phase whereas the rhyodacites and rhyolites erupted during the rifting phase.

The conclusion is finally reached that the Qash volcanics are lithostratigraphically and petrochemically akin to the "Dokhan Volcanics " of the Eastern Desert of Egypt.

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جيولوجية وبتروكيميائية بركانيات القش بوسط الصحراء الشرقية ، مصر

عبد السلام محمد رشاد أبو العلا

قسم الجيولوجيا - كلية العلوم - جامعة طنطا

تضمن البحث ولأول مرة دراسات حقلية وبتروجرافية وبتروكيميائية تفصيلية على بركانيات القش بوسط الصحراء الشرقية لمصر والتي تقع على بعد حوالي ١٨ كيلومتر جنوب منجم دهب الفواخير.

أوضحت الدراسة الحقلية أن بركانيات القش أقدم في التتابع الاستراتجرافي الصخري من رواسب الحمامات حيث تعلوها بعدم توافق.

أظهرت الدراسة البتروجرافية أن بركانيات القش لم تعاني من التحول وأن كانت قد تعرضت للتحلل بدرجات مختلفة وهي تتكون أساسا من صخور الإنديزايت والكوارتز أنديزايت والبازلت أنديزيت والرايوداسيت والريولايت بالإضافة إلى البازلت والدايابيز والداسيت . وتمثل الصخور الفتاتية البركانية جزءا هاما في صخور بركانيات القش وتشمل أساسا صخور التوفا والأجلوميرات.

بنيت الدراسة البتروكيميائية على نتائج تحليل عدد ١٨ عينة صخرية للأنواع المختلفة من بركانيات القش بالنسبة للعناصر الشائعة وبعض العناصر الشحيحة حيث أثبتت هذه الدراسة أن صخور الدايابيز والأنديزايت والرايوداسيت والرايولايت ذات طبيعة كلس قلوية في حين أن صخور البازلت ذات طبيعة ثيولينية وقد تكونت صخور البازلت والدايابيز والأنديزايت في بيئة أقواس جزر ناضجة ذات قشرة قارية سميكة أو على حافة قارية نشطة في حين أن صخور الرايوداسيت والرايولايت تكونتا داخل الألواح . كما ظهر أيضا وجود فاصل في التركيب بين هاتين المجموعتين من الصخور مما يؤكد اشتقاقها من نوعين مختلفين من الصهير.

وقد خلص البحث إلى أن صخور "بركانيات القش" تنتمي صخريا وبتروكيميائيا إلى صخور "بركانيات الدخان".