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Research Paper

Geochemistry of The Basement Gneissic Rocks Around Sumer-Umsning Area, Meghalaya India

Geology

KEYWORDS : Basement Gneisses, Sumer, Nayabunglow, Meghalaya

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ABSTRACT

The Basement Gneissic and Migmatitic Complex (BGMC) of the Assam Meghalaya craton studied in and around Sumer , Nayabunglow and Umsning areas of the Ribhoy Distrct of Meghalaya indicate that the quartzofeldspathic gneisses are the most abundant rock types. Besides the two verities of grey and pink gneisses, discontinuous but persistent bands of amphibolites and discontinuous quartz and aplitic veins also occur in the area. Microcline is less dominat in grey gneiss while it is dominant in pink gneiss apart from dominant phases of quartz, plagioclase and biotite. Hornblende, zircon apatite, magnetite and sphene occur as accessory phases in both verities. Modal composition of quartz varies between 31.5 to 35.3% in the gneisses. Geochemical analysis of the gneisses indicates that they are metaluminous to peraluminous granite of calc alkaline type with high Si and alk and low mg and c values. The gneisses might be the product of metamorphism of the siliceous shale under lower amphibolites facies condition.

Introduction

The Assam Meghalaya plateau (Sarma and Dey,1998) is the northeastern extension of the Indian peninsular shield **(**Pascoe, 1950**).** The Basement Gneissic and Migmatitic Complex (BGMC) of the Assam Meghalaya craton are studied at Zeropoint, Mawkhrong, Unsning and north of Nonghya of the Ribhoi District of Meghalaya (Fig.1).The sedimentary parentage of the gneisses in some parts of the Assam Meghalaya craton are reported by few workers (Mawsood et al, 1998). However few reports are available especially in regard to their petrogenesis and metamorphism. The quartzofeldspathic gneisses occurring in the present area can be divided in to two main types: (a) grey gneiss and (b) pink gneiss. Grey gneisses forms the greater part of the investigated area and the pink gneisses occur only in the northern part (Fig.2). Both varieties are traversed by pegmatitic, quartz and aplite veins. Discontinuous but persistent amphibolites bands are highly variable in their size and are parallel to the foliation in the quartzofeldspathic gneisses.

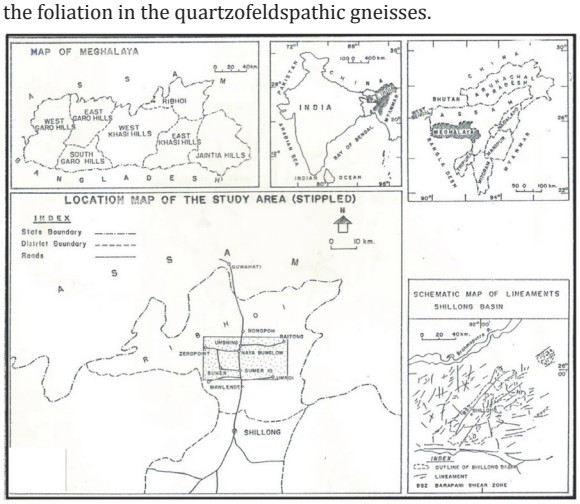

Fig.1. Position of Meghalaya and in NE India (shaded); location map of the study area (stippled) and Lineament map of shilling basin (schematic)

Petrography

Grey gneiss bears its character because of the higher percentage of biotite. These are generally well foliated with darker biotite rich layers and lighter quartzofeldpathic layers. The gneisses become migmatitic where quartz and feldspar minerals concentrated in lenses and bands giving the appearance of a mix rock.

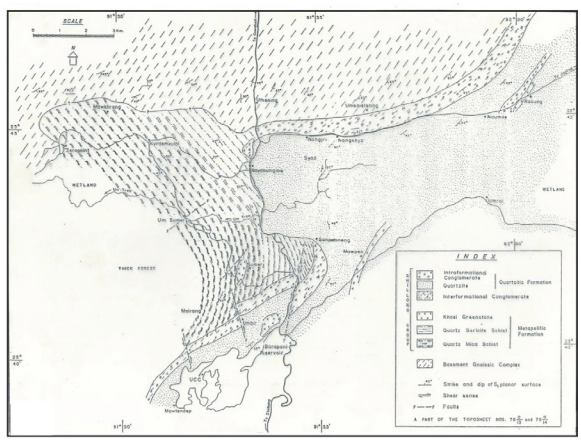

Fig.2. Geological map of the Sumer-Nayabunglow area of Meghalaya

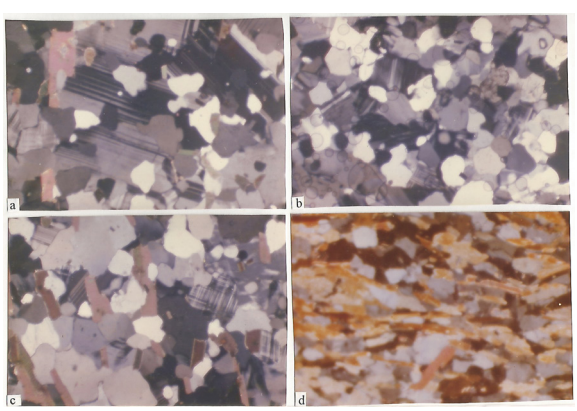

Fig.3a-d: well foliated quartzo feldspathic gneiss. Schistocity defined by mica layers indicate two foliations in a-d and third foliation is observed in d. Quartz of the later generation occur along the grain contacts of other minerals

Under microscope the quartz, plagioclase and or microcline, biotite, muscovite and chlorite are the dominant phases along with magnetite, sphene, zircon and apatite as accessories (Fig.3). Quartz occur as rounded to sub rounded grains along the grain boundaries of other minerals (Fig.4.1-4.4), while in some of the grains the sign of strain is visible with undulose extinction and strain lamalllae (Fig.4.2). Three generation of quartz are observed: the first generation occur as inclusions within the feldspars (Fig.4.2), the second generation occur as coarse minerals and forms the ground mass fabric while the third generation occurs as the coarse grains especially within the low pressure region of the rigid coarse grains. Along with the twined plagioclases untwined plagioclase grains are also

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seen (Fig.4.2). Biotite forms the dominant ferromagnesian phase and sercitisation of microcline is ubiquitous. Hornblende, plagioclase and biotites constitute the major mineral phases for amphibolites. The gneisses are well foliated. However when these are affected by shear zones the shear related fabrics are observed. The schistosity defined by the mica layers indicate at least three generations of deformation undergone by the gneisses. The modal percentage of quartz varies between 31.5 to 35.3%, the K-feldspar between 25.7 to 30.3%

Mineral Constituent	Zeropoint Grey Gneiss	Zero point Grey Gneiss	Unsning Grey Gneiss	Mawkhrong Pink Gneiss
Quartz	35.3	32	32.8	31.5
K-feldspar	25.7	29	28.9	30.3
Plagioclase	25.9	23	25.5	26.1
Biotite	10.6	13	10.2	8.5
Muscovite	0.5	1.4	1.1	1.2
Accessories	2	1.3	1.5	2.4

Table-1. Modal composition of the quartzo- feldspathic gneisses (vol %).

and the plagioclase feldspar between 23.1 to 26.1% (Table-1).

Geochemistry

Five samples without any chemical alteration are analyzed for major elements in the X-Ray Fluroscence of USIC Gauhati University.

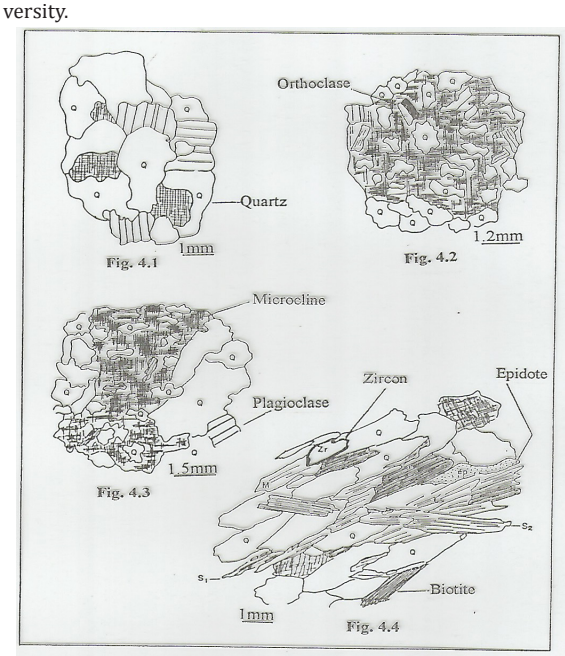

Fig.4.1-4.3. Grain contact of quartz and other minerals are straight to cerated.4.4. Two generations of foliations defined by mica (S_1 and S_2) are shown

It has been observed that SiO_2 varies between 72.34 to 74.27 wt percent. The gneisses are depleted in CaO, MgO and TiO_2. Normative Or varies between 23.52 to 30.74%, Ab from 26.02 to 33.27% and An from 2.97 to 6.81 %.(Table 2). In the Harkar variation diagram (Fig.4.5a to 4.5i) the K_2O show a gradual increase and Decrease of Al2O3 with the increase of silica. The anlysed samples plotted in the field of granite in the Ab-An-Or diagram (O'connor, 1965) (Fig.4.6). The gneisses define a calc alkaline trend when plotted in the AFM diagram of Kuno (1968) (Fig.4.7). The gneisses plot in the granite-adamallite field in the K_2O vs Na_2O diagram (Fig.4.9). The binary diagram of Mol. Al_2O_3/K_2O+ Na2O+ Cao) vs. Mol. Al_2O_3/k_2O+Na_2O (Fig.4.10) indicate that most of the plots fall between metaluminous to peraluminous field ranging from 0.91 to 1.06.

In the ternary plot of Al_2O_3-CaO-MgO+FeO (Rao et al, 1974), the gneisses fall in the field of siliceous shale (orthoquartzite) and in the transitional zone between siliceous shale and pelites (Fig.4.8). The acidic nature of the gneisses also indicated by their high Si and alk content and low mg and c values. Plots of c versus mg and al-alk versus c are consistent with the involvement of acidic magma in the formation of these rocks. In Fig. 4.11b i.e. c vs.al-alk, the plots cluster around Or-Ab-An mix trend while in Fig.4.11a, plots fall below the igneous trend.

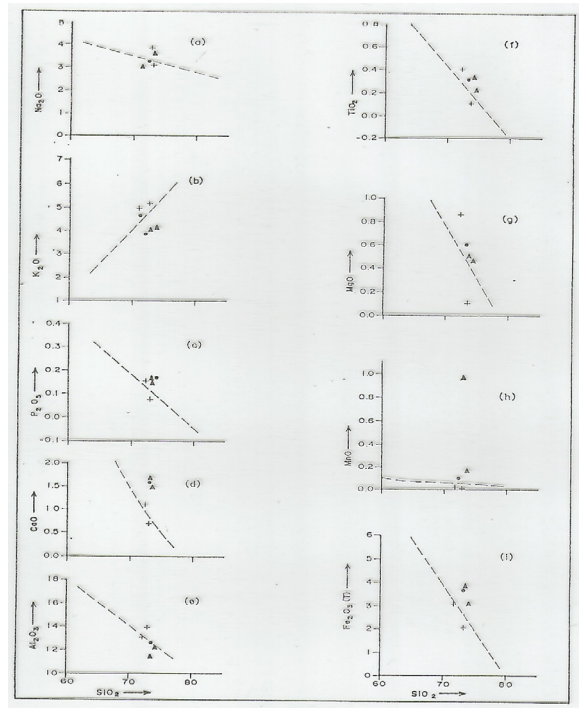

Fig.4.5 a-i. Bivariate plots of different oxides vs SiO_2. Increase in K_2O with SiO_2 is clearly observed

Discussion and conclusions

From the field, petrographic and geochemical analysis it appears that the gneisses of the present area forms from a crustal source, and more specifically from a sedimentary parentage. A decline in quartz, and both micas with a corresponding increase in plagioclase, relict flacks of biotite as inclusions in plagioclase, increase in size of k-feldspar from metaelites to gneisses, predominance of cross hatching in k-feldspar, muscovite over biotite and sub rounded zircons, abundant inclusions of quartz and mica, indicate the operation one or more of the petrogenetic mechanisms during the formation these rocks. Field and petrographic data indicate involvement of metasomatism in the transformation of country rocks.

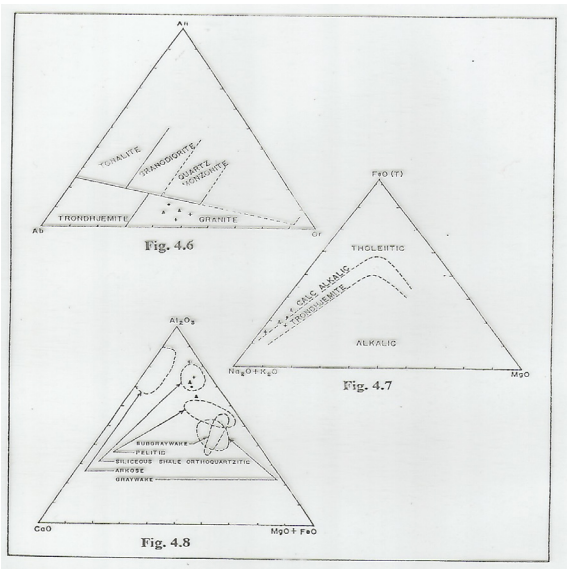

Fig.4.6.Normative Ab-Or-An diagram indicates gneisses fall in the granite field.4.AFM plots show gneisses o the calc-alkaline nature.4.8. In the ACF plot the politic source is documented.

The granitisation takes place through active participation of fluid diffusion in rocks. According to Muecke and Clarke (1981) such rocks in part are the result of interaction between te late stage magmas and subsolidus rocks and hydrothermal fluids. Geochemical data supports granitisation as the cause of formation of the gneisses. Considering the gneisses of metaluminous to peraluminous type, Clark 1981, linked te peraluminous granites genetically to metapelitic source rock. The transformation of pelitic rocks by potash metasomatism is indicated by enrichment of K_2O (especially in the pink gneisses), negative correlation beween SiO_2 and CaO (Fig.4.5a to i), prgresive decrease in Al_2O_3, Na_2O, MgO and Fe_2O_3 and increase in K_2O/Na_2O ratios (Table-2). The decrease in TiO_2, Fe_2O_3 and MgO and increase in siO2 may also be correlated to he fractionation of plagioclase and biotite. (Phillips et al, 1981).

Therefore, metamorphism of the politic source for the formation of the gneisses can be justified by the major element geocochemistry of the gneisses.

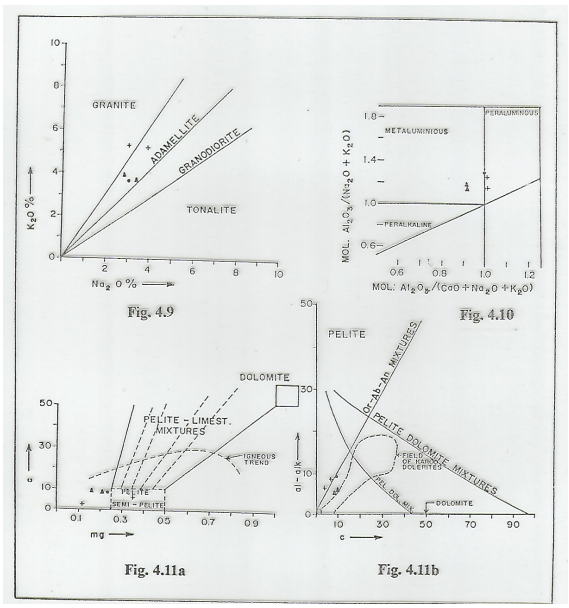

Fig.4.9.K_2O vs Na_2O plot show gneisses are of adamellite to granitic composition. A/CNK plots show mealuminos to peraluminous nature 4.10 of the gneisses 4.11a - 4.11b: c vs mg and al-alk vs c plots indicate politic to semipelitic composition of the precursor for the gneisses.

Table: **Major element data for the quartzofeldpathic gneisses (wt%)**

Major oxides Wt %	SP/8 Zero Point	SP/9 1km west of zeropoint	SP/18A 0.5km north of Nongkhya	SP/19 Mawkhrong	SP/20 ZeroPoint
SiO2	74..27	73.68	73.38	72.34	73.18
TiO2	0.22	0.31	0.32	0.42	0.11
Al2O3	12.23	11.55	12.76	13.52	14
Fe2O3	0.54	0.53	0.82	0.66	0.55
FeO	2.65	3.39	2.9	2.6	2.06
MnO	0.17	0.99	0.1	0.02	0.02
MgO	0.47	0.51	0.61	0.87	0.17
CaO	1.48	1.66	1.6	1.12	0.7
Na2O	3.69	3.08	3.36	3.1	3.93
K2O	4.14	4.23	3.98	5.2	5.19
P2O5	0.15	0.16	0.17	0.16	0.08
Total	100.01	99.99	100.01	100.01	100
A/CNK	0.92	0.91	1.01	1.06	1.05
K2O/Na2O	1.12	1.37	1.18	1.67	1.32
CIPW Norm					
Quartz	33.92	36.04	34.74	29.52	27.47
Corrundum	0	0	0.43	1.14	0.83
Orthoclase	24.45	25.03	23.52	30.74	0.83
Albite	31.23	26.02	28.45	26.26	33.27
Anorthite	4.58	5.19	6.81	4.49	2.97
Diopside	1.29	1.55	0	0	0
Hypersthene	0.56	0.56	1.51	5.72	3.61
Magnetite	0	2.31	0	0.96	0.8
Hematite	3.19	2.32	3.72	0	0
Ilmenite	0.37	0.59	0.2	0.79	0.21
Sphene	0.07	0	0	0	0
Rutile	0	0	0.22	0	0
Apatite	0.36	0.39	0.41	0.39	0.19
Niggli values					
Si	406.44	389.3	391.24	381.49	399.48
al	39.44	36.01	40.09	41.44	45.03
fm	17.86	24.51	19.87	19.44	12.01
c	8.68	9.41	9.14	6.24	4.09
alk	34.02	30.07	30.9	32.88	38.87
r	0.91	1.23	1.28	1.64	0.45
p	0.35	0.36	0.38	0.35	0.18
mg	0.21	0.16	0.24	0.35	0.12

Table 2: Major oxide wt. pc., CIPW norm and Niggli values of selected sample of gneisses

REFERENCE

Mawsood, Md., Sarma, K.P. and Medhi, J. 1998. Geochemistry of amphibolites and related rocks from Deoduar-Ganesh Mandir area of North Guwahati, Kamrup district, Assam, Journal of Geoscience, 24, 31-67. Clarke, D.B. 1981. The mineralogy of Peraluminous granites: A Review, Contr. Min. & Petrl.,10, 3-17 Phillips G.N., Wall, V.J. and Clements, J.D. 1981. Petrology of the Starthbogie batholith: a cordierite bearing granite, Canadian Mineralogist, 19, 47-63 O'Connor, J.T. 1965 A classification of quartz rich igneous rocks, based on feldspar ratio. U.S. Geol. Surv. prof. Paper, 525, 79-84 Kuno, H. 1968. Differentiation of basaltic magmas: The Poldervart Treaties on rocks of basaltic composition (eds. Hessan, H.H. and Poldervart, A.), Inter. Sci. Publishers, pp.632-688 Sarma, K.P. and Dey, T.1998. structural evolution of boudins of the Precambrian rocks of tatimara-Narengi area, Kamrup District, Assam, Journal of Geoscience,2, 43-50 Pascoe, E.H.1950. A manual of Geology of India and Burma, Misc. Pub. Geo.Surv. Ind.1, 3rd Ed.