Mineralogy of the fuchsites from Gattihosahalli, Chitradurga District

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Abstract. The fuchsites described here occur in the lower portions of a precambrian quartzite bed, which typically encloses small bands and lenses of barytes. Of the two fuchsites studied, one occurs in the main relatively fine grained quartzite and the other forming one of the small schistose segregations in the quartzite. While the commonly measured axial angles average 34° and 32° , small angles of 14° and 19° , which are possibly related to the formation of the mineral under high pressure, have been recorded in both the fuchsites. There is a close similarity in x-ray powder pattern between the two fuchsite samples studied and between these and muscovite. This observation is in accordance with the interpretation that fuchsites exhibit the same two layered mica structure as muscovite $2M_1$. Chemically the fuchsites of Gattihosahalli are closely similar to the one reported from Manitoba and the cell contents are comparable to di-octahedral micas of muscovite character with Cr substituting for octahedral Al. It is inferred that the fuchsites of Gattihosahalli are of sedimentary origin and the constituents required for their formation were all present in the shaly component of the sandstone or were partly or completely supplied by volcanic exhalations.

Keywords. Fuchsites; 2-layer mica structure; sedimentary; volcanic exhalation.

1. Introduction

The two fuchsite mica samples described here are from the attractively green coloured portions of the quartzite bed which encloses the recently discovered precambrian bedded barytes deposits of the area (Radhakrishna and Srinivasaiah 1974). The fuchsite quartzite forms the western or the lower portion of the bed (interestingly most of the barytes beds are also located in this portion), the bulk of which is buff white sericite-bearing quartzite. The fuchsite quartzite of the area is quarried at many places for ornamental stone and in several of these quarries the unmistakable inter-bedded sedimentary character of quartzite and baryte is exposed. The two samples used in this study are collected from the quarry on the southern slope of the low mound situated to the west of Gattihosahalli. The geological succession exposed in the mound is as shown in figure 1.

2. Petrography

Of the four samples collected for the present study, three represented the main fuchsite quartzite, which contains on an average 89 and 11 modal percents of quartz

Figure 1. Geological section across the small mound west of Gattihosahalli.

and fuchsite respectively. These are comparatively fine grained (the average fuchsite spangle in these is $0.7\text{mm} \times 0.5\text{mm}$), lighter green coloured and only moderately foliated. The fourth sample, designated here as fuchsite-quartz schist, is relatively coarse grained (the average size of fuchsite spangles is $1.2\text{mm} \times 0.05\text{mm}$), bright green coloured, strongly foliated and enriched (with an average of 23% modal fuchsite) in fuchsite. The fuchsite-quartz schist forms small segregation-like lenses and patches in the fuchsite quartzite.

In thin section, the rocks show abundant (an average of 89 and 76 modal percent quartz in the fuchsite quartzite and fuchsite-quartz schist respectively), interlocking anhedral grains of quartz, distinctly bluish green coloured scales and anhedral plates of fuchsite and sporadically distributed small shapeless grains of rutile. Blades of kyanite ($2v_x 85^\circ$) showing high relief occur in isolated lenses and patches only in the fuchsite-quartz schist specimen. Both quartz and fuchsite, although devoid of inclusions, always show undulose extinction, which is strongly marked in the former.

3. Optical characters

The important optical properties determined (see table 1) for the fuchsite of the quartzite and the schist show the following features.

(i) A significant variation in axial angle values (27° to 43° in quartzite and 29° to 36° in schist) and the presence of crystals with small axial angles (14° or less in quartzite; 24° , 19° or less in schist). The variation in axial angles is possibly related to the fluctuation in metamorphic conditions and the small angles are correlated with the formation of the mica under high pressure (the latter part of the interpretation is supported by the occurrence of kyanite) (see also Whitmore *et al* 1946).

Table 1. Optical properties of fuchsites.

	Fuchsite from quartzite	Fuchsite from schist
$2V_x$	32°, 34°, 31°, 27°, 43°, 30°, 30° (Average 34°) Also 14°	32°, 28°, 32°, 35°, 32° 36°, 32°, 32°, 29°, 31° 31°, (Average 32°) Also 24° and 19°
γ	1.6008	1.6102
β	1.5980	1.6070
α	1.5688	1.5747
$(\gamma - \alpha)$	0.032	0.0355

Pleochrism: X=Light emerald green; Y=green; Z=emerald green

(ii) The higher refractive index and birefringence of the schist fuchsite, with lower Cr content, than the quartzite fuchsite, with higher Cr content. This observation is apparently contrary to what has been reported by Whitmore *et al* (1946) and Deer *et al* (1962).

4. X-ray study

The x-ray powder data (table 2, figures 2 and 3) obtained separately for the fuchsite of quartzite and schist of the area reveals a close similarity not only between these two samples but also between these and the muscovite described by Hendricks and Jefferson (1939) (see table 2, No. 1). The latter part of the observation is in accordance with the opinion of Whitmore *et al* (1946) that fuchsites exhibit the same two-layer mica structure as that characteristic of muscovite $2M_1$.

5. Chemistry

Chemically the fuchsite of quartzite (No. 1) differs from that of schist (No. 2) in containing more of Al_2O_3 and Cr_2O_3 and less of SiO_2 and K_2O (table 3). A somewhat higher soda content of both the analysed fuchsite is a distinctive feature. Otherwise, the two analysed fuchsite are similar to each other; their compositions are well within the range recorded for the mineral by different workers (Whitmore *et al* 1946; Deer *et al* 1962; Sadashivaiah and Karisiddaiah 1976), and are akin to the one reported from Manitoba (table 3, No. 3). The minor difference in composition between the analysed samples of Gattihosahalli is believed to be inherent, related to the inhomogeneity in the compositions of the sedimentary rock (argillaceous sandstone) from which they are derived. The cell contents calculated on the basis of 24 (O, OH) are in accordance with the classification of the fuchsites as di-octahedral micas (Deer *et al* 1962), closely similar to muscovite, with Cr presumably replacing octahedral Al of muscovite.

Table 2. X-ray powder data of fuchsites

1			2		3	
<i>I</i>	<i>hkl</i>	<i>d</i> Å	<i>I</i>	<i>d</i> Å	<i>I</i>	<i>d</i> Å
95	002	9.95	82	9.880	73	9.935
—	—	—	—	—	4	5.478
30	004	4.97	50	4.963	88	4.966
20	110	4.47	3	4.475	3	4.452
4	110	4.30	4	4.264	6	4.246
4	022	4.11	—	—	1	4.080
6	112	3.95	—	—	1	3.974
14	113	3.88	3	3.875	3	3.870
18	023	3.73	4	3.720	4	3.714
—	—	—	3	3.656	7	3.662
20	114	3.48	14	3.466	17	3.465
25	024	3.34	—	—	—	—
100	006	3.32	92	3.312	86	3.330
30	114	3.19	8	3.190	6	3.195
2	115	3.12	—	—	—	—
35	025	2.987	10	2.981	11	2.984
25	115	2.859	9	2.851	7	2.851
20	116	2.789	6	2.782	6	2.781
16	131	2.596	—	—	—	—
55	202	2.566	10	2.561	6	2.561
8	008	2.505	—	—	—	—
14	132	2.491	24	2.481	35	2.483
8	133	2.465	—	—	—	—
8	202	2.450	—	—	3	2.456
10	204	2.398	3	2.399	—	—
25	133	2.384	—	—	2	2.383
10	134	2.254	—	—	—	—
—	—	—	2	2.851	2	2.280
4	135	2.236	2	2.247	2	2.235
8	221, 204	2.208	3	2.195	2	2.202
4	223	2.189	—	—	—	—
16	208	2.49	—	—	—	—
20	135	2.132	6	2.128	3	2.127
4	223	2.070	4	2.095	—	—
6	044	2.053	8	2.045	—	—
45	00, 10	1.993	100	1.985	100	1.986
10	224, 045	1.972	—	—	—	—
6	206	1.951	—	—	—	—
4	228	1.941	—	—	—	—
2	208	1.894	—	—	—	—
4	046	1.871	—	—	—	—
4	—	1.822	4	1.785	5	1.8200
4	228	1.746	3	1.727	2	1.726
—	—	—	4	1.673	—	—
—	—	—	9	1.656	7	1.658
—	—	—	5	1.641	6	1.645
—	—	—	2	1.553	—	—
—	—	—	3	1.540	3	1.543
—	—	—	5	1.518	5	1.520
—	—	—	4	1.505	3	1.496
—	—	—	3	1.447	4	1.450

1. Muscovite—2M₁. Reproduced from ASTM card 6-0263: CuK α radiation Ni filter.

2 & 3. Fuchsites from Gattihosahalli;

(2) from the quartzite and (3) from schist (see under table 3 for further details); CuK α Radiation, Ni filter, 30 KVP, 15 mA and chart speed 10 mm/min.

Table 3. Chemical analysis of fuchsites.

	1		2		3	
SiO ₂	43.94		45.55		45.97	
Al ₂ O ₃	34.58		32.73		31.67	
TiO ₂	0.24		0.29			
Cr ₂ O ₃	3.90		3.14		4.81	
Fe ₂ O ₃	1.18		1.18		2.56	
FeO	0.19		0.19		0.53	
MnO	0.07		0.08		—	
MgO	1.90		2.04		0.31	
CaO	0.56		0.34		0.15	
Na ₂ O	1.88		1.87		1.03	
K ₂ O	7.44		9.12		9.07	
H ₂ O ⁺	3.73		3.67		3.48	
H ₂ O ⁻	0.00		0.04		0.51	
Total	99.61		100.24		100.09	
Number of ions on the basis of 24 O, OH.						
	1		2		3	
Si	5.924	8.00	6.143	8.00	6.268	8.00
Al	2.076		1.857		1.732	
Al	3.420		3.347		3.360	
Ti	0.024		0.029			
Cr	0.416		0.334		0.518	
Fe ⁺³	0.120	4.39	0.120	4.27	0.262	4.26
Fe ⁺²	0.021		0.021		0.061	
Mn	0.008		0.009			
Mg	0.382		0.410		0.063	
Ca	0.081		0.049		0.022	
Na	0.491	1.85	0.489	2.11	0.272	1.87
K	1.280		1.569		1.578	
OH	3.354	3.35	3.301	3.30	3.166	3.17

1 and 2 from Gattihosahalli, (1) from the typical fuchsite quartzite, and (2) from one of the small schistose segregations in quartzite. Analysis: R J Vaidya and N M Udayashankar.
 3. Fuchsite from Pointe de Bois. Analysis: D R E Whitmore (Whitmore *et al* 1946).

6. Comments on the genesis and conclusions

The observations such as: (i) the occurrence in a bedded sequence of sedimentary rocks, (ii) close association with barytes of sedimentary origin, (iii) lack of evidence of hydrothermal activity and metasomatism; (iv) nonexistence of undoubted granitic or other intrusive bodies in close association; (v) evidence of explosive volcanic activity (Sadashivaiah 1964); (vi) laminated/foliated character and simple mineralogy of the fuchsite bearing rocks and presence in them of sedimentary minerals such as kyanite, epidote and pyrite; (vii) absence of evidence of replacement relationship of fuchsite, are all suggestive of sedimentary origin of fuchsite-bearing rocks. The

Figures 2 and 3. Powder x-ray diffraction patterns of fuchsites from quartzite and schist respectively.

components required for the formation of fuchsite were all either present in the sediment itself, possibly in the hydrolizate/shaly matter of the sandstone or those were partly or completely supplied to the rock by the volcanic exhalation which appear to have played an important role in the formation of the intimately associated baryte beds. As postulated by Anhaeusser (1976) the interbedded quartzite barite association perhaps represents terminal phase of a volcanic cycle. That relatively high pressure operated during the metamorphism of sediments, which have given rise to fuchsite-bearing rocks, is particularly indicated by the occurrence of kyanite and by the marked undulose extinction of quartz and fuchsite.

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