

a basis of 24 (O, OH) this corresponds to Si 7.74, Al^{iv} 0.26, Al^{vi} 0.12, Ti 0.03, Fe³⁺ 1.65, Fe²⁺ 1.34, Mg 2.22, Mn 0.08, Na 1.36, K 0.10, Ca 0.46, OH 1.16; ΣY 5.44, ΣX 1.92. This composition is very near that of a magnesioriebeckite from Glen Lui, Aberdeenshire, described by McLachlan (1951), but the latter differs in having $2V_{\alpha}$ 50° and $\alpha:[001]$ 14°. The optical data, together with the ratios $100\text{Fe}^{3+}/(\text{Fe}^{3+} + \text{Al} + \text{Ti}) = 90.8$ and $100\text{Fe}^{2+}/(\text{Fe}^{2+} + \text{Mg} + \text{Mn}) = 36.7$, show that the mineral is a magnesioriebeckite.

The consistent presence of this mineral in almost all the rock types, including aplites, pegmatites, zirconiferous syenites, garnetiferous syenites, and carbonatites, of this region deserves an explanation. It may be surmised that the crystallization of the amphibole was retarded because the enrichment of Na and K in the magma would have increased its solubility, giving preference to the formation of alkali feldspars and feldspathoids; however, owing to the relative impoverishment of the magma in alumina feldspathoids were not formed (unpublished partial chemical analyses by R. Ramasamy of the host rocks show alkali:alumina ratios in wt. % ranging from 0.75 in a zircon syenite and a thorite syenite to 1.17 in a syenite pegmatite). This facilitated the accumulation of the amphibole in the residual liquid, and it was subsequently injected into all the earlier rocks as both crystals and veins.

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MINERALOGICAL MAGAZINE, SEPTEMBER 1971, VOL. 38, PP. 377-379

Ferroan sahlite from the Eastern Ghats, Andhra Pradesh, India

THE first discovery of metasomatic ferroan sahlite in the Eastern Ghats has been made at the contact of calc granulites with intrusive granite near Maruturu, 2 km north of Anakapalle (Long. 83° 1' 6" E; Lat. 17° 44' 18" N.) and Garividi (Long. 83° 32' 28" E.; Lat. 18° 16' 38" N.). Calc granulites are part of the khondalite suite

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of para-gneisses, which are often intruded by pink granites and then the sahlite in the calc granulite is converted into ferroan sahlite at the contact. A zone of ferroan sahlite and sphene extends for 6 inches to 2 feet on both sides of intrusive tongues of pink microcline granite in the calc granulites. Xenoliths of calc granulite striking roughly parallel to the walls of the granite have prominent ferroan sahlite and sphene development while the outer margin of the granite has scattered coarse-grained ferroan sahlite and sphene.

TABLE I. *Chemical, optical, and X-ray analyses of clinopyroxenes* (Anal. K.S.R.Rao)

	1	2	3	4	5		1	2	3	4	5
SiO ₂	52.26	50.84	48.14	47.91	47.04	<i>Optical Properties</i>					
TiO ₂	0.18	0.12	0.35	0.31	0.35	2V _y	59°	60°	62°	60°-63°	65°
Al ₂ O ₃	1.72	2.19	5.41	5.21	6.68	γ:[001]	38°-41°	44°	43°-48°	42°-48°	48°-51°
Fe ₂ O ₃	1.02	1.58	4.25	3.27	3.11	α	1.687	1.691	1.703	1.720	1.721
FeO	5.74	8.93	6.54	12.44	12.46	β	1.697	1.698	1.718	1.728	1.730
MnO	0.25	0.37	0.56	0.41	0.58	γ	1.712	1.715	1.729	1.744	1.745
MgO	14.94	12.07	11.07	7.86	7.89	α	—	—	Light green	Green	Green
CaO	23.03	22.49	23.42	22.04	21.86	β	—	—	Light green	Yellowish green	Yellowish green
Na ₂ O	0.35	0.46	0.14	0.35	0.22	γ	—	—	Green	Bluish green	Dark green
K ₂ O	0.12	0.21	0.09	0.02	0.08	<i>Cell Parameters</i>					
Cr ₂ O ₃	0.02	0.01	0.02	0.03	0.02	a	9.747 Å	9.751	9.749	9.750	9.752
H ₂ O ⁺	0.34	0.29	0.18	0.18	0.18	b	8.945 Å	8.938	8.886	8.904	8.884
H ₂ O ⁻	0.08	0.16	0.09	0.08	0.12	c	5.260 Å	5.265	5.283	5.279	5.289
Total	100.05	99.72	100.26	100.11	100.59	β	74° 10'	74° 03'	74°	74° 01'	73° 55'
						a sin β	9.383	9.374	9.371	9.371	9.369
<i>Number of ions on the basis of six oxygen atoms</i>											
Si	1.945	1.931	1.820	1.846	1.806						
Al ^{iv}	0.055	0.069	0.180	0.154	0.194						
Al ^{vi}	0.026	0.031	0.061	0.082	0.108						
Ti	0.004	0.002	0.010	0.009	0.010						
Fe ³⁺	0.029	0.045	0.120	0.097	0.090						
Fe ²⁺	0.179	0.282	0.207	0.402	0.400						
Mn	0.008	0.011	0.018	0.014	0.018						
Mg	0.828	0.686	0.620	0.451	0.451						
Ca	0.918	0.913	0.949	0.909	0.898						
Na	0.025	0.032	0.009	0.028	0.016						
K	0.004	0.009	0.004	—	0.005						
Z	2.000	2.000	2.000	2.000	2.000						
WXY	2.021	2.011	1.998	1.992	1.996						
Ca At. %	46.80	47.10	49.60	48.50	48.35						
Mg At. %	42.20	35.40	32.40	24.10	24.27						
Fe At. %	11.00	17.50	18.00	27.40	27.37						

Five pure pyroxenes have been analysed (table I); two are sahlites from calc granulites, two are ferroan sahlites from granite-calc-granulite contacts, and one sahlite is from calc granulite 2 feet away from a granite contact. The increase in refractive indices from sahlite to ferroan sahlite reflects the replacement of Mg by Fe²⁺ as is well known in the diopside-hedenbergite series (Deer *et al.*, 1963). Although the cell parameters are not highly accurate because internal standards were not used, the results agree with Lewis's (1967) conclusions that *b* and *a sin β* decrease and *c* increases linearly as Si is replaced by Al^{iv} in natural aluminous clinopyroxenes.

The ferroan sahlite has been formed by metasomatic recrystallization of the sahlite due to addition of iron, titanium, and aluminium from the granite magma, which probably crystallized at 700–750 °C based on Winkler's (1965) results and the Q, Or, Ab (40:34:26) values of the granite. The fact that pegmatite-calc-granulite contacts near Garividi have the assemblage epidote-actinolite-sphene suggests that the pyroxenes form under lower P_{H₂O} and higher temperatures than the hydrous assemblage mentioned.

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Surface structures of Pamir quartz

THE author has been concerned with the production of quartz from the Pamirs for some years, and has examined several thousand crystals (Vadilo, 1947). The only forms developed are $r\{10\bar{1}1\}$, $z\{01\bar{1}1\}$, $m\{10\bar{1}0\}$, $s\{11\bar{2}1\}$, and $x\{51\bar{6}1\}$ (fig. 1). The bounding facets of steps or horizontal striations on the m faces, often regarded as definite acute rhombohedra r_a and z_a , are rather to be considered vicinal facets, making no definite angle with m , but lying anywhere between m and r or z ; the triangular growth pyramids typical of z and r faces are never observed on such vicinals.

Growth pyramids on r (fig. 2, a) and on z (fig. 2, b) have triangular outlines, the base being a triangle with curved sides, with the least curved side parallel to the edge $[rm]$ or $[zm]$; for pyramids on r the base is an equilateral triangle, for those on z an isosceles one. Growth pyramids are often situated along cracks and grow over them (fig. 2, e). Some such pyramids are formed as the result of the attachment of small (<1 mm) crystals to the large one; the small crystal converts to a growth pyramid. Pyramids overlapping a twin boundary present a combination of the typical forms seen on r and z faces (fig. 2, e). Elevated growth forms also occur consisting of numerous minute, closely-packed growth pyramids (fig. 2, f). Minute growth pyramids may also be