Subcalcic ferroaugite from Mount Arthur, East Griqualand.

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Nomenclature.—In recent years the clinopyroxenes of the system clinoenstatite–diopside–hedenbergite–clinoferrosilite have received a great deal of attention. As research in this field advanced, the need for a balanced and generally acceptable subdivision of the system has made itself increasingly felt. Hess (1941) proposed a classification for these clinopyroxenes, which was subsequently extended by Benson (1944). The present author adopts the main scheme of Benson's classification, but suggests the following minor modifications (fig. 1):

(i) The addition of a new subdivision 'ferrohedenbergite' to counterbalance the endiopside field and to accommodate the end-members of the normal magmatic clinopyroxene series.

(ii) The boundary line between the salite to intermediate pigeonite fields and the ferrosalite to ferropigeonite fields to be drawn as the perpendicular bisector of the En–Fs line.

(iii) The division line between magnesian- and intermediate pigeonite has been moved slightly towards the En–Wo line.

(iv) Benson suggests the lines 2V 45° and 2V 30° as boundaries between (*a*) the augites and ferroaugites, (*b*) their subcalcic equivalents, and (*c*) the pigeonites. The position of these two lines was taken from Tomita's diagram for 2V (1934). In his work on the Karroo dolerites the present author found many discrepancies in the application of Tomita's curves. Hence it is considered likely that the exact position of the lines 2V 45° and 2V 30° will be altered as more data become available.

Benson's suggestion to express compositions of all rock-forming minerals in terms of molecular percentages (1944, p. 76) is welcomed by the author. Thus all compositions of clinopyroxenes in this paper are given as molecular percentages.

Chemical Data.—The analysis of the subcalcic ferroaugite, the calculated atomic ratios to 6(O,OH) atoms, and the estimated formulae are presented in table I, together with the analysis, norm, and mode of the dolerite-pegmatite from which the pyroxene was obtained. The rock contains tabular plagioclase (An_{46}), euhedral, brown subcalcic ferroaugite, and a dark mesostasis, while titanomagnetite and ovoid patches of chalcedony occur in minor quantities (Poldervaart, 1946).

TABLE I. Chemical analyses. (Analyst, W. H. Herdsman.)

Subcalcic ferroaugite from dolerite-pegmatite of Mount Arthur, East Griqualand.

	Analysis.	100%.		Atomic ratios.	No. mols. on basis 6(O,OH).		
SiO_2	49·57	49·67	$Si^{\cdot\cdot\cdot\cdot}$	0·828	1·936		1·993 (Si + 0·057 Al)
TiO_2	0·78	0·78	$Al^{\cdot\cdot\cdot}$	0·028	0·066	0·057 / 0·009	
Al_2O_3	1·36	1·36	$Fe^{\cdot\cdot\cdot}$	0·018	0·042		
Fe_2O_3	1·38	1·38	$Fe^{\cdot\cdot}$	0·305	0·714		
FeO	21·92	21·96	$Mg^{\cdot\cdot}$	0·251	0·587		1·992 (0·009 Al to Mn)
MnO	0·45	0·45	$Ca^{\cdot\cdot}$	0·257	0·601		
MgO	10·03	10·05	$Ti^{\cdot\cdot\cdot\cdot}$	0·010	0·023		
CaO	14·32	14·35	$Mn^{\cdot\cdot}$	0·007	0·016		
Na_2O	trace	100·00	O''	2·565			
K_2O	trace						
H_2O+	0·44						
H_2O-	0·04						
P_2O_5	trace						
Total	100·29						

Formula: $(Mg,Fe^{\cdot\cdot\cdot},Fe^{\cdot\cdot},Ca,Ti,Mn,Al)_2[(Si,Al)_2O_6]$
$Wo_{31\cdot6}En_{30\cdot9}Fs_{37\cdot5}$

Colour, brown; sp. gr. 3·47, α 1·712, γ 1·733, 2V 43°, $\gamma : c = 44°$.

Dolerite-pegmatite of Mount Arthur, East Griqualand.

Analysis.		Norm.		Mode.	
SiO_2	52·52	Qu	13·0	plagioclase	21·5
TiO_2	2·56	Or	7·8	pyroxene	25·9
Al_2O_3	11·26	Ab	14·2	iron-ore	15·5
Fe_2O_3	2·88	An	19·5	mesostasis	36·0
FeO	14·22	Di Wo	6·5	chalcedony	1·1
MnO	0·41	Di En	1·7		100·0
MgO	2·57	Di Fs	5·2		
CaO	7·22	Hy En	4·7		
Na_2O	1·65	Hy Fs	14·9		
K_2O	1·34	Il	5·0		
H_2O+	1·48	Mt	4·2		
H_2O-	1·37	Ap	0·3		
P_2O_5	0·23	H_2O	2·9		
Total	99·71	Total	99·9		

As in most pyroxenes, part of the $Al^{\cdot\cdot\cdot}$ replaces $Si^{\cdot\cdot\cdot\cdot}$ in the crystal structure. The analysis is fairly low in sesquioxides and hence the composition may be expressed in terms of Wo, En, and Fs.

Fig. 2 shows clinopyroxenes of similar compositions, plotted against

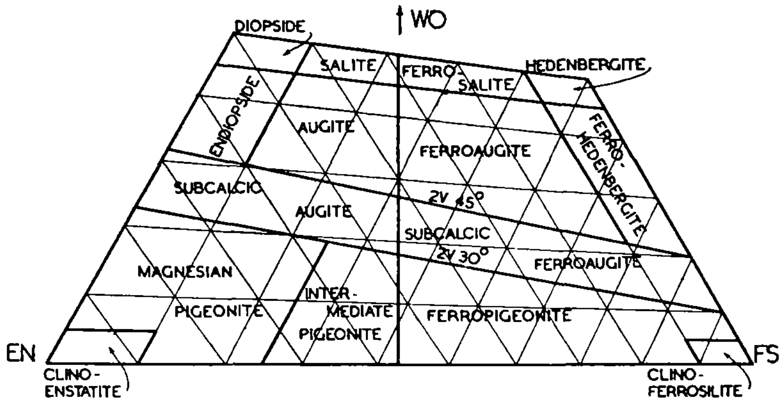

Fig. 1. Nomenclature of the clinopyroxenes of the system En–Di–He–Fs.

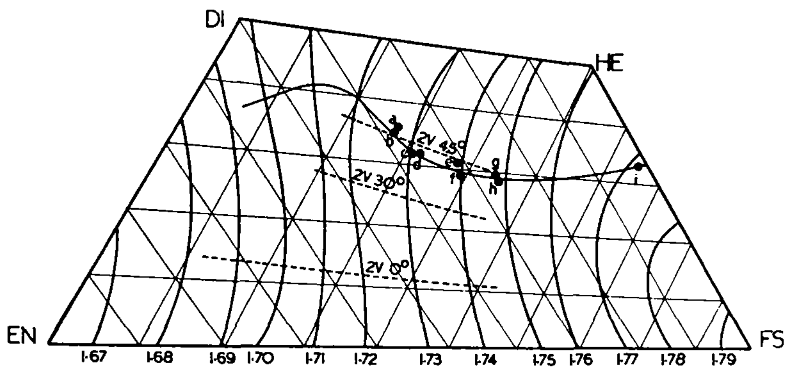

Fig. 2. Plot of refractive index γ and chemical analyses of clinopyroxenes. *a*, Tyne Head (Teall, 1884); *b*, Whin Sill (Teall, 1884); *c*, Skaergaard (Wager and Deer, 1939); *d*, Finland (Wahl, 1906); *e*, Mount Arthur (new analysis); *f*, Volhynia (Lebedev, 1936); *g*, Rocky Hill (Phillips, 1899); *h*, Skaergaard (Wager and Deer, 1939); *i*, Skaergaard (Wager and Deer, 1939).

the γ-curves drawn by Deer and Wager (1938, p. 20, fig. 2) and the course of crystallization of clinopyroxenes according to Hess (1941, p. 585, fig. 10), while the provisional positions of the lines 2V 45°, 30°, and 0° are also indicated.

In table II compositions of the analysed subcalcic ferroaugite are given, as deduced from the optical properties, using the diagrams of Deer and Wager (1938) and Tomita (1934).

TABLE II. Composition of subcalcic ferroaugite.

	Calculated from Chemical analyses.	Deduced from γ index and course of crystallization.	Deduced from γ and α indices.	Deduced from γ and 2V	Deduced from γ and γ:c.	Deduced from 2V and γ:c.
Wo	31·6	30	22	23	19	22
En	30·9	33	39	38	39	28
Fs	37·5	37	39	39	42	50

It appears most accurate to find the composition from the intersection of Deer and Wager's γ-curves with the course of crystallization as given by Hess. The unreliability of the values for 2V and γ:c as a standard for correlation is also clearly demonstrated.

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Abstract.—A new analysis of a subcalcic ferroaugite is given. The calculated composition is compared with compositions deduced from the optical properties according to various methods. Slight modifications to Benson's nomenclature of the clinopyroxenes are suggested.

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