American Mineralogist, Volume 63, pages 1023–1052, 1978

Nomenclature of amphiboles

Compiled by BERNARD E. LEAKE

Department of Geology, University of Glasgow
Glasgow G12 8QQ, Scotland
for
SUBCOMMITTEE ON AMPHIBOLES, I.M.A.
Horace Winchell, Chairman, Subcommittee
Department of Geology and Geophysics, Yale University
New Haven, Connecticut 06520

Final report by the subcommittee on the Amphibole Group as approved by the International Mineralogical Association Commission on New Minerals and Mineral Names. The amphibole subcommittee was composed of H. Winchell, Chairman (U.S.A.), R. A. Binns (Australia), M. Fleischer (U.S.A.) later replaced by A. Kato (Japan), C. Guillemin (France) later replaced by G. Gottardi (Italy) and M. Fonteilles (France), E. Hilmy (Egypt), B. E. Leake (U.K.), K. J. Neuvonen (Finland), and L. van der Plas (Netherlands) later replaced by H. J. Kisch (Israel). All the reports were compiled by B. E. Leake.

This report is the fifth draft and could not have been compiled without the previous extensive work by R. Felix, L. van der Plas (The Netherlands), E. J. W. Whittaker (U.K.), R. A. Binns (Australia), K. J. Neuvonen (Finland), M. Ross, P. Robinson and H. Winchell (U.S.A.), together with many non-members of the subcommittee on amphiboles including E. K. Lazarenko (U.S.S.R.), I. V. Ginsburg (U.S.S.R.), V. A. Frank-Kamenetskii (U.S.S.R.), I. Kostov (Bulgaria), E. H. Nickel (Australia), M. Hey (U.K.), H. Micheelson (Denmark) and E. Wenk (Switzerland).

Contents

Errata

(1) In Fig. 1, the point labelled 0.67 Na_B along the left-hand back edge should be 1.34 Na_B.
(2) p. 1039, 3.3: $(OH)_2$ not $(OH)_7$
(3) p. 1045, 14.12: NaCaNa not $NaCaNa^4$
(4) p. 1040 6.4: Fe^2_3 not Fe_3
(5) p. 1040, 6.6: Fe^2_5 not Fe_5

0003-004X/78/1112-1023$02.00

1. General classification of the amphiboles

It is proposed that the classification of the amphiboles should be largely based on crystal chemistry, as the optical and other physical determinative properties such as X-ray powder diffraction cannot differentiate unambiguously between different members of the group. Of course the traditional and important distinction between orthorhombic and monoclinic members has been retained. When it is necessary to distinguish different polytypes or polymorphs further (e.g. with cummingtonite) this may be done by adding the space group symbol as a suffix.

The proposed nomenclature has successfully avoided introducing new names by the use of adjectival modifiers (e.g. titanian) and prefixes (e.g. ferro-) which cover specified elemental ranges and which, for simplicity, are hereafter both called prefixes. Accepted and widely used names have been chemically codified to agree, as far as is possible, with the consensus of present use. About 200 previously used amphibole names, mostly synonyms or obsolete or almost unused names, are recommended for formal extinction.

The classification is based on the chemical contents of a standard amphibole calculated to 24(O,OH,F,Cl), but it is recognised that where there is no determination of H_2O+ (e.g. electron microprobe analyses), or there is reason to suppose that the reported H_2O+ is erroneous, or where it is probable that unreported F or Cl may be substantial, then the basis of 23(O) should be used to calculate the cation contents of the standard formula. This formula unit contains eight tetrahedral sites and corresponds to the half unit cell for monoclinic amphiboles and to one quarter of the unit cell for orthorhombic amphiboles.

Throughout this report the standard amphibole formula is used with superscript arabic numerals (e.g. Fe^2) referring to charges; roman numerals (e.g. Al^{VI}) to co-ordination numbers and subscript numerals to numbers of atoms (e.g. Mg_3). General works dealing with the amphibole group include Deer et al. (1963), Ernst (1968) and the special papers of the Mineralogical Society of America (1969) and Great Britain (1968) which together provide a key to the voluminous literature.

The standard amphibole formula is taken to contain 8 tetrahedral sites and the general form of the standard formula is:

$$A_{0-1}\ B_2\ C_5^{VI}\ T_8^{IV}\ O_{22}(OH,F,Cl)_2$$

In the calculation of the standard amphibole formula the following procedure is recommended:

(1) If the water and halogen contents are well established, or if there is physical evidence that the amphibole is an oxy-amphibole, the formula should be calculated to 24(O,OH,F,Cl).

(2) If the water plus halogen content is uncertain the formula should be calculated on a water-free (and halogen-free) basis to 23(O) and 2(OH,F,Cl) assumed, unless this leads to an impossibility of satisfying any of the following criteria, in which case appropriate change in the assumed number of (OH+F+Cl) should be made.

(3) Sum T to 8.00 using Si, then Al, then Cr^3, then Fe^3, then Ti^4.

(4) Sum C to 5.00 using excess Al, Cr, Ti, Fe^3 from (3), then Mg, then Fe^2, and then Mn.

(5) Sum B to 2.00 using excess Fe^2, Mn, Mg from (4), then Ca, then Na.

(6) Excess Na from (5) is assigned to A, then all K. Total A should be between 0.00 and 1.00, inclusive.

These assignments normally correspond to the occupancies of the tetrahedral sites (T), the M1 + M2 + M3 sites (C), the M4 sites (B) and the A sites (A). Present knowledge of the distribution of ions is not sufficient to warrant making separate formal allocation to the three distinct sites that in total constitute the C position, nor does the available evidence suggest that calculation to a fixed number of cations is desirable.

When a standard amphibole formula has been determined in this way it is classified first into one of four principal amphibole groups on the basis of the numbers of atoms of $(Ca + Na)_B$ and Na_B. Within each of these groups it can then be named by reference to the appropriate two-dimensional diagram (Figs. 2-5) using the number of Si atoms and the ratio $Mg/(Mg + Fe^2)$. The name so found is the name of the defined end-member to which the formula most closely approximates. This name may be qualified by one or more prefixes according to definite rules to specify important (but relatively minor) departures from the end-member formula. The four principal amphibole groups are defined as:

(a) When $(Ca+Na)_B < 1.34$, then the amphibole is a member of the iron-magnesium-manganese amphibole group.

(b) When $(Ca+Na)_B \geq 1.34$ and $Na_B < 0.67$, then the amphibole is a member of the calcic amphibole group. Nearly all such natural amphiboles have $Ca_B > 1.34$.

(c) When $(Ca+Na)_B \geq 1.34$ and $0.67 \leq Na_B < 1.34$, then the amphibole is a member of the sodio-calcic amphibole group. Such natural amphiboles usually contain $0.67 < Ca_B < 1.34$.

(d) When $(Na)_B \geq 1.34$, then the amphibole is a member of the alkali amphibole group.

The principal reference axes chosen for the calcic, sodio-calcic and alkali amphibole groups are Na_B; $(Na+K)_A$; and (8-Si), as shown in Fig. 1 based on Smith's (1959) proposals. Other choices of axes are of course possible, and have been considered, but for various excellent reasons the present choice is recommended.

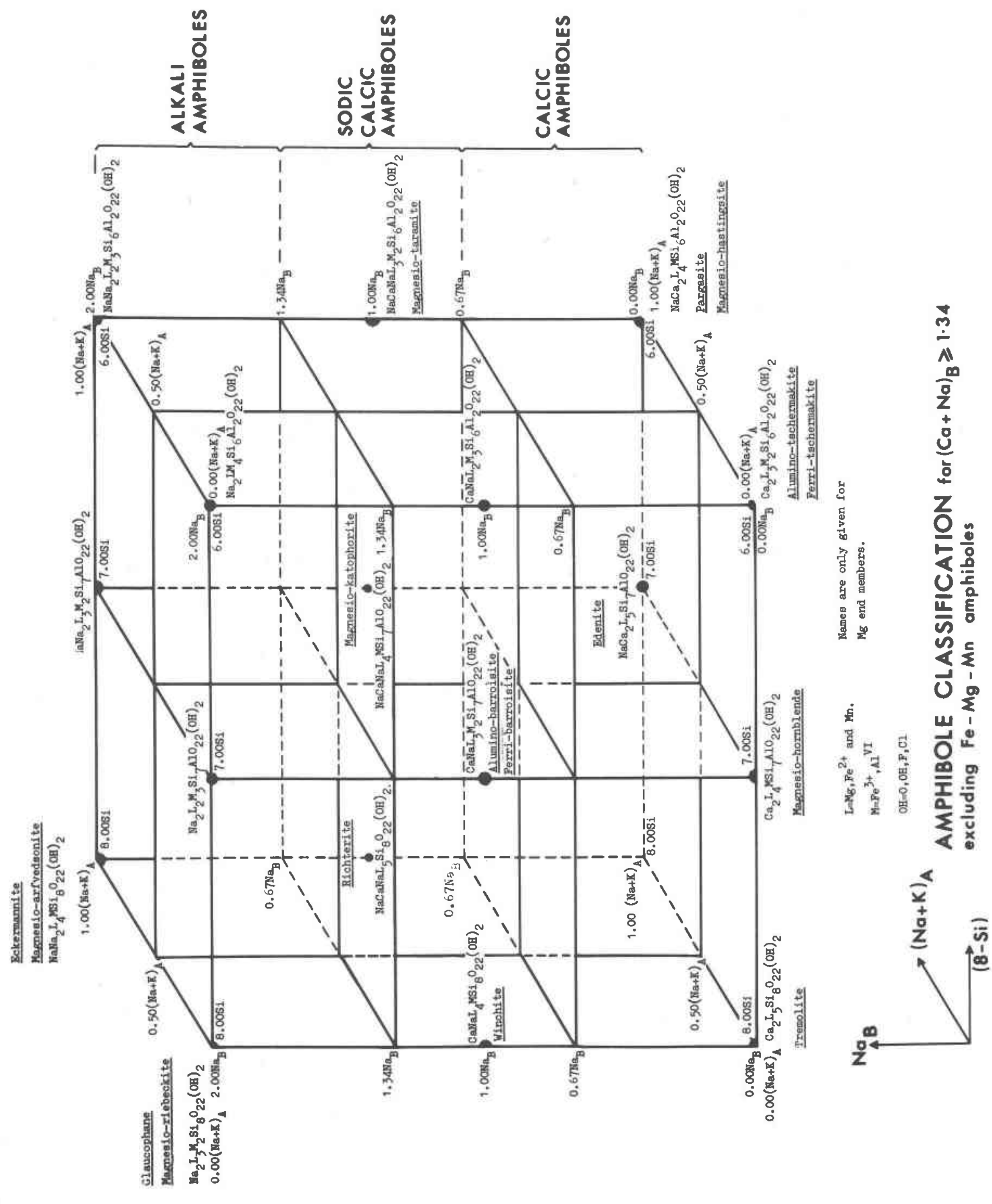
In general the scheme seeks to avoid primary divisions at integral contents of the standard formula so that analyses near to formalised end-, or integral members, whose names are defined, are grouped together, rather than split apart.

The form of the Mg to Fe ratio usually used is $Mg/(Fe^2+Mg)$. An increasing number of amphibole analyses are being obtained by microprobe analysis (over 85% of those reported in 1976) and these analyses usually do not report Fe_2O_3. There are various different possible procedures to partially alleviate the problems raised by such partial analyses but no one procedure is recommended though calculation on the basis of 23(O) and then adjustment of the total cations, excluding (Ca+Na+K), to 5 + 8 = 13, by varying the Fe^2/Fe^3, has much to recommend it.

Provision is made to denote by prefixes the presence of substantial substitution by elements that are not essential constituents of the end-members. Prefixes that are generally applicable are:-

chlor	when	Cl	$\geq$ 1.00 (about 4% Cl)
chromium	when	Cr	$\geq$ 1.00 (about 9% Cr_2O_3)
chromian	when	Cr	= 0.25-0.99 (about 2.3-9% Cr_2O_3)
ferri	when	Fe^3	$\geq$ 1.00 (about 9% Fe_2O_3) except in alkali amphiboles and hastingsite
ferrian	when	Fe^3	= 0.75-0.99 (about 6.8-9% Fe_2O_3) except in alkali amphiboles and hastingsite
fluor	when	F	$\geq$ 1.00 (about 2% F)
hydro	when	OH	$\geq$ 3.00 (about 3% H_2O)
lithian	when	Li	$\geq$ 0.25 (about 0.4% Li_2O) except in the alkali amphiboles when Li $\geq$ 0.50. Not used with holmquistite and clinoholmquistite.
manganese	when	Mn	$\geq$ 1.00 (about 10% MnO) except in end-members containing Mn
manganoan	when	Mn	= 0.25-0.99 (about 2.5-10% MnO) except in end-members containing Mn
oxy	when	OH+F+Cl	< 1.00. As many poor analyses have low recorded water and no F or Cl values, this prefix should be used with discretion.
plumbian	when	Pb	$\geq$ 0.08 (about 1.1% PbO)
potassium	when	K	$\geq$ 0.50 (about 2.7% K_2O)
potassian	when	K	= 0.25-0.49 (about 1.3-2.7% K_2O) except in the alkali amphiboles
subsilicic	when	Si	< 5.75

Fig. 1


ALKALI AMPHIBOLES
SODIC CALCIC AMPHIBOLES
CALCIC AMPHIBOLES
Glaucophane
Magnesio-riebeckite
$Na_2L_3M_2Si_8O_{22}(OH)_2$
0.00(Na+K)A 2.00NaB
Eckermannite
Magnesio-arfvedsonite
$NaNa_2L_4MSi_8O_{22}(OH)_2$
1.00(Na+K)A
0.50(Na+K)A
8.00Si
7.00Si
6.00Si
1.34NaB
1.00NaB
0.67NaB
0.00NaB
Richterite
$NaCaNaL_5Si_8O_{22}(OH)_2$
Winchite
$CaNaL_4MSi_8O_{22}(OH)_2$
Tremolite
$Ca_2L_5Si_8O_{22}(OH)_2$
Magnesio-hornblende
$Ca_2L_4MSi_7AlO_{22}(OH)_2$
Alumino-barroisite
Ferri-barroisite
$CaNaL_3M_2Si_7AlO_{22}(OH)_2$
Magnesio-katophorite
$NaCaNaL_4MSi_7AlO_{22}(OH)_2$
Edenite
$NaCa_2L_5Si_7AlO_{22}(OH)_2$
$NaNa_2L_3M_2Si_7AlO_{22}(OH)_2$
$Na_2L_3M_2Si_7AlO_{22}(OH)_2$
$Na_2L_4MSi_6Al_2O_{22}(OH)_2$
$CaNaL_3M_2Si_6Al_2O_{22}(OH)_2$
Alumino-tschermakite
Ferri-tschermakite
$Ca_2L_3M_2Si_6Al_2O_{22}(OH)_2$
Pargasite
Magnesio-hastingsite
$NaCa_2L_4MSi_6Al_2O_{22}(OH)_2$
Magnesio-taramite
$NaCaNaL_3M_2Si_6Al_2O_{22}(OH)_2$
$NaNa_2L_2M_3Si_6Al_2O_{22}(OH)_2$
Names are only given for Mg end members.
L=Mg, Fe2+ and Mn.
M=Fe3+, AlVI
OH=O,OH,F,Cl
NaB
(Na+K)A
(8-Si)
AMPHIBOLE CLASSIFICATION for (Ca+Na)B ≥ 1·34
excluding Fe-Mg-Mn amphiboles

titanium	when	Ti	$\geq$ 1.00 (about 10% TiO_2) except in kaersutite
titanian	when	Ti	= 0.25–0.99 (about 2.5–10% TiO_2) except in kaersutite
zinc	when	Zn	$\geq$ 1.00 (about 5% ZnO)
zincian	when	Zn	= 0.25–0.99 (about 1.2–5% ZnO)

A few prefixes (alumino, calcian, subcalcic, and sodian) have to be defined differently in the different principal amphibole groups, and their definitions are given in the appropriate places.

The proposals often do not involve uniform divisions at elegant and invariable mathematical points such as would clearly be proposed if usage could be ignored. On the contrary, the four separate amphibole-group schemes each endeavour to fit present usage and codify it. Consequently there are sometimes rather untidy aspects but this is preferable to schemes which cut across traditional and present usage. As there are already over 8000 published amphibole analyses it is important to provide for nearly every probable variation so as to avoid irregular proliferation of names and this is best prevented by providing ample scope for fairly detailed compositional indications.

Adjectival prefixes have been employed to keep the number of fundamental amphibole names to a minimum and to indicate specifically defined ranges of composition which seek to (1) avoid present and future haphazard and irregular naming, (2) enable between 15 and 20 variables to be conveyed in the name either explicitly or, more usually, implicitly (i.e., by the absence of a prefix), (3) give a non-specialist mineralogist or petrologist a name which in itself is meaningful (e.g. manganoan) even if the defined specific element-ranges covered by the adjectival prefixes are unknown. The absence of a prefix means that the element concerned is below, or occasionally above (e.g. with subsilicic and subcalcic), the limits prescribed for the use of the prefix, which in all instances has been defined after considering what is common and what is unusual and the limits defined endeavour to mark out the unusual from the common. Schaller's (1930) adjectives are used to indicate moderate enrichment of substituting elements.

The names proposed usually take into account and convey information about the following variables in the standard formula:-

$Si, Al^{IV}, (Ca+Na)_B, (Na+K)_A, Ca, Al^{VI}, Fe^3, Ti, F, Cl, K, Mn, Cr, Zn, Li, Pb, OH, O,$ and $Mg/(Mg+Fe^2)$

Prefixes magnesio-, ferro-, alumino-, and ferri- are often used with names that refer to part of a series. Alternate names are so widely used for the end or ends of some series that the alternative is sometimes preferable, such as tremolite instead of magnesio-actinolite and tschermakite as a synonym of alumino-tschermakite, particularly where two or more prefixes are otherwise required. If it is especially required to distinguish between pure theoretical end-members and natural compositions that will always only approach the theoretical end-member composition, then the prefix pure may (i.e. it is not obligatory) be used for the theoretical integral formula e.g. pure tremolite for $Ca_2\ Mg_5\ Si_8\ O_{22}\ (OH)_2$.

For amphiboles whose general nature only is known, (for instance, from optical properties without a chemical analysis) it may not be possible to allocate a precise name. It is then recommended that the assigned amphibole name be made into an adjective to be followed by the word amphibole. Thus, anthophyllitic amphibole, tremolitic amphibole, pargasitic amphibole, richteritic amphibole and glaucophanic amphibole. The familiar word hornblende can still be used where appropriate for calcic amphiboles, because hornblende is never used without an adjective in the precise nomenclature. The adoption of these recommendations will not only avoid confusion between precisely and loosely named amphiboles but will not inhibit the giving of loose names that is obviously often inevitable when only paragenesis and optical properties are available.

Several names have been used for various asbestiform amphiboles. In mineralogy, as distinct from commercial use, the precise mineral name according to this report should be used, followed by -asbestos; e.g. anthophyllite-asbestos, actinolite-asbestos. Where the nature of the mineral is uncertain or unknown, asbestos alone may be appropriate. Where the approximate nature of the mineral is known but not its precise composition, the recommendations made above should be followed but amphibole should be replaced by asbestos, e.g. anthophyllitic asbestos, actinolitic asbestos. For this purpose crocidolite may also be retained to cover alkali amphibole asbestos as a general name whereas, e.g. riebeckite-, or magnesio-riebeckite-asbestos should be used when the precise composition is known.

Finally, it has been much in mind that the amphiboles constitute an extremely complex group: while even more detailed subdivisions are possible, the proposals attempt to be as simple as is reasonable so that ordinary mineralogists and petrologists will be able to rapidly, uniquely and unambiguously name most amphibole analyses.

Each of the four principal amphibole groups is dealt with separately below. The above section was approved by 12 votes for and 1 against.

2. Fe-Mg-Mn Amphiboles

The group is defined so as to include possessing $(Ca+Na)_B < 1.34$ in the standard formula. The detailed classification is based on Fig. 2.

ORTHORHOMBIC FORMS

(1) Anthophyllite — $Na_x(Mg,Mn,Fe^2)_{7-y}Al_y(Al_{x+y}Si_{8-x-y})O_{22}(OH,F,Cl)_2$ where $x+y < 1.00$, otherwise the mineral is gedrite.

End Members

Magnesio-anthophyllite	$Mg_7Si_8O_{22}(OH)_2$
Ferro-anthophyllite	$Fe^2{}_7Si_8O_{22}(OH)_2$
Sodium anthophyllite	$Na(Mg,Fe^2)_7AlSi_7O_{22}(OH)_2$

Limits for use of end member names

Magnesio-anthophyllite	$Mg/(Fe^2+Mg) \geq 0.90$
Ferro-anthophyllite	$Fe^2/(Mg+Fe^2) \geq 0.90$
Sodium anthophyllite	$Na \geq 0.50$

Prefix for particular substitution (see also below)

Alumino-	when $Al^{VI} \geq 0.50$

(2) Gedrite — $Na_x(Mg,Mn,Fe^2)_{7-y}Al_y(Al_{x+y}Si_{8-x-y})O_{22}(OH,F,Cl)_2$ when $x+y \geq 1.00$, the distinction from anthophyllite being based on the total Al^{IV}, which exceeds 0.99 in gedrite.

End Members

Magnesio-gedrite	$Mg_5Al_2Si_6Al_2O_{22}(OH)_2$
Ferro-gedrite	$Fe^2_5Al_2Si_6Al_2O_{22}(OH)_2$
Sodium gedrite	$Na(Mg,Fe)_6AlSi_6Al_2O_{22}(OH)_2$

Limits for use of end member names

Magnesio-gedrite $Mg/(Fe^{2}+Mg) \geq 0.90$

Ferro-gedrite $Fe^{2}/(Mg+Fe^{2}) \geq 0.90$

Prefix for particular substitution

Sodium when $Na \geq 0.75$

(3) Holmquistite $Li_2(Mg,Fe^{2})_3(Fe^{3},Al)_2Si_8O_{22}(OH,F,Cl)_2$

It is critical that $Li \geq 1.00$ in structural formula (about 1.7% Li_2O).

End Members

Magnesio-holmquistite $Li_2Mg_3Al_2Si_8O_{22}(OH)_2$

Ferro-holmquistite $Li_2Fe_3Al_2Si_8O_{22}(OH)_2$

Limits of use of end member names

Magnesio-holmquistite $Mg/(Fe^{2}+Mg) \geq 0.90$

Ferro-holmquistite $Fe^{2}/(Mg+Fe^{2}) \geq 0.90$

MONOCLINIC FORMS

(1) Cummingtonite Series $(Mg,Fe^{2},Mn)_7\ Si_8O_{22}(OH)_2$

End Members

Magnesio-cummingtonite $Mg_7Si_8O_{22}(OH)_2$

Grunerite $Fe^{2}_7Si_8O_{22}(OH)_2$

Tirodite $Mn_2Mg_5Si_8O_{22}(OH)_2$

Dannemorite $Mn_2Fe_5Si_8O_{22}(OH)_2$

Limits of use of end member names

Magnesio-cummingtonite $Mg/(Fe^{2}+Mg) \geq 0.70$

Grunerite $Fe^{2}/(Mg+Fe^{2}) \geq 0.70$

Tirodite $Mn/(Mn+Mg+Fe) \geq 0.10$ and $Mg \geq Fe$

Dannemorite $Mn/(Mn+Fe+Mg) \geq 0.10$ and $Mg < Fe$

Prefix for particular substitution (see also below)

Sodian when $Na \geq 0.25$

(2) Clinoholmquistite $Li_2(Mg,Fe^{2},Mn)_3(Fe^{3},Al)_2Si_8O_{22}(OH,F,Cl)_2$

It is critical that $Li \geq 1.00$ (i.e. about 1.7% Li_2O)

End Members

Magnesio-clinoholmquistite $Li_2Mg_3Al_2Si_8O_{22}(OH)_2$

Ferro-clinoholmquistite $Li_2Fe_3Al_2Si_8O_{22}(OH)_2$

Limits for use of end member names

Magnesio-clinoholmquistite $Mg/(Fe^{2}+Mg) \geq 0.90$

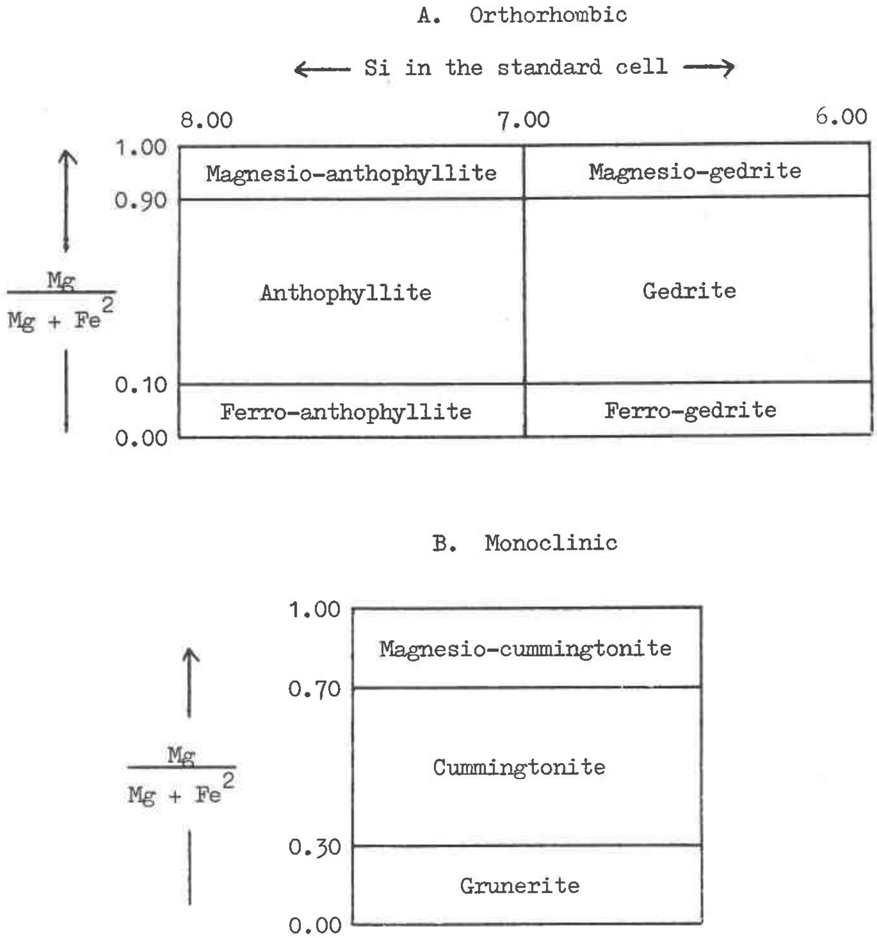
Ferro-clinoholmquistite $Fe^{2}/(Mg+Fe^{2}) \geq 0.90$

Special prefix for the whole Fe-Mg-Mn group of amphiboles

Calcian when $Ca \geq 0.50$ (about 3.5% CaO)

Fig. 2. IRON-MAGNESIUM-MANGANESE AMPHIBOLES

$Li < 1.00$; $(Ca+Na)_B < 1.34$



Nomenclature is given by reference to Fig. 2 or if $Li \geq 1.00$ to the above text, combined with the prefixes given for the whole amphibole group and those special to the Fe-Mg-Mn amphiboles.

The above section was approved by 11 votes for and 2 against.

3. Calcic Amphiboles

The group is defined as monoclinic amphiboles in which $(Ca+Na)_B \geq 1.34$ and $Na_B < 0.67$. Generally $Ca_B > 1.34$.

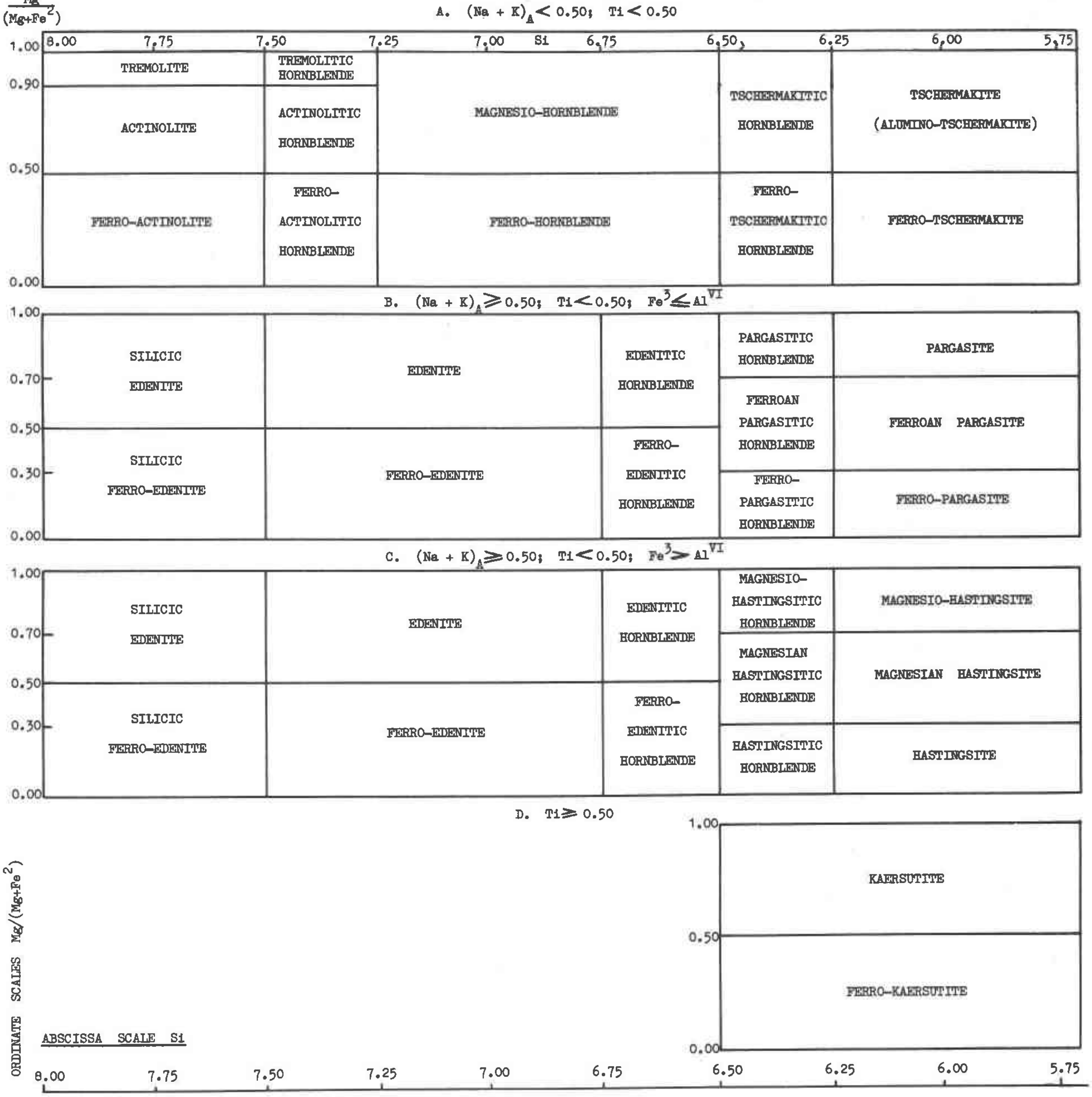
End Members

Tremolite	$Ca_2Mg_5Si_8O_{22}(OH)_2$
Ferro-actinolite	$Ca_2Fe^2_5Si_8O_{22}(OH)_2$
Edenite	$NaCa_2Mg_5Si_7AlO_{22}(OH)_2$
Ferro-edenite	$NaCa_2Fe^2_5Si_7AlO_{22}(OH)_2$
Pargasite	$NaCa_2Mg_4AlSi_6Al_2O_{22}(OH)_2$
Ferro-pargasite	$NaCa_2Fe^2_4AlSi_6Al_2O_{22}(OH)_2$
Hastingsite	$NaCa_2Fe^2_4Fe^3Si_6Al_2O_{22}(OH)_2$
Magnesio-hastingsite	$NaCa_2Mg_4Fe^3Si_6Al_2O_{22}(OH)_2$
Alumino-tschermakite	$Ca_2Mg_3Al_2Si_6Al_2O_{22}(OH)_2$
Ferro-alumino-tschermakite	$Ca_2Fe^2_3Al_2Si_6Al_2O_{22}(OH)_2$
Ferri-tschermakite	$Ca_2Mg_3Fe^3_2Si_6Al_2O_{22}(OH)_2$
Ferro-ferri-tschermakite	$Ca_2Fe^2_3Fe^3_2Si_6Al_2O_{22}(OH)_2$
Alumino-magnesio-hornblende	$Ca_2Mg_4AlSi_7AlO_{22}(OH)_2$
Alumino-ferro-hornblende	$Ca_2Fe^2_4AlSi_7AlO_{22}(OH)_2$
Kaersutite	$NaCa_2Mg_4TiSi_6Al_2(O+OH)_{24}$
Ferro-kaersutite	$NaCa_2Fe^2_4TiSi_6Al_2(O+OH)_{24}$

Limits for use of end member names and nomenclature of the group

The nomenclature of the group is tabulated in Fig. 3. Assignment of the name is as follows: If $Ti \geq 0.50$ go to Fig. 3D; If $Ti < 0.50$ and $(Na+K)_A < 0.50$ go to Fig. 3A; If $Ti < 0.50$ and $(Na+K)_A \geq 0.50$, then go to Fig. 3B if $Fe^{3+} < Al^{VI}$ and to Fig. 3C if $Fe^3 \geq Al^{VI}$. Further subdivisions depend upon Si and $Mg/(Fe^2+Mg)$. These give the fundamental name of the particular amphibole. The final step is to scan the range of the elements dealt with by prefixes to finally obtain a name which implicitly or explicitly conveys an indication of the composition with respect to no less than 19 variables — Si, Al^{IV}, Al^{VI}, Fe^3, $(Na+K)_A$, Na_B, Ca, Ti, F, Cl, K, Na, Mn, Zn, Cr, Pb, OH, O and $Mg/(Fe^2+Mg)$. Although it would appear that very long and cumbersome names would be common, the reverse is true because the

Fig. 3 CALCIC AMPHIBOLES; $(Ca + Na)_B \geq 1.34$; $Na_B < 0.67$



prefixes are only used for unusual compositions and so over 80% of the available analyses in this group give names containing two or fewer adjectives, including adjectives which form part of the fundamental name.

Special prefixes for the calcic amphibole group

Alumino	when	Al^{VI}	≥ 1.00
Sodian	when	Na	≥ 1.00 (about 3.5% Na_2O)
Subcalcic	when	Ca	< 1.50 (about 9.5% CaO)

The compositions of the two tschermakite end-members, one with Al^{VI} and the other with Fe^3, can be clearly indicated and the prefixes ferri- or alumino- are in practice dropped for most, but not all, natural tschermakites because neither Fe^3 nor Al^{VI} reach or exceed 1.00. With tschermakite, tschermakitic hornblende, ferro-tschermakite and ferro-tschermakitic hornblende, alumino- and ferri- immediately precede the word tschermakite, e.g. ferro-alumino-tschermakite. Otherwise the order in which prefixes are used is not fixed. Neither ferri- nor ferrian should be used with hastingsite because hastingsite implies high Fe^{3+}.

The problem of what to call amphiboles that have Si and, or, $(Na+K)_A$ in excess of that contained in compositions between tremolite and edenite has not been satisfactorily resolved. Such amphiboles plot near the back left-hand bottom corner of Fig. 1 and have compositions that fall outside the theoretical range of possible substitutions. However, as some such compositions exist it is suggested that they be prefixed, silicic if Si exceeds 7.25 when $(Na+K)_A \geq 0.50$ but for the compositions involved in which $(Na+K)_A < 0.50$ no special name is proposed as these compositions are quite close to the names given in Fig. 3A.

This section was approved by 13 votes for and 0 against.

4. Sodic-calcic Amphiboles

This group is defined as monoclinic amphiboles in which $(Ca+Na)_B \geq 1.34$ and $0.67 < Na_B < 1.34$. Generally $0.67 < Ca_B < 1.34$.

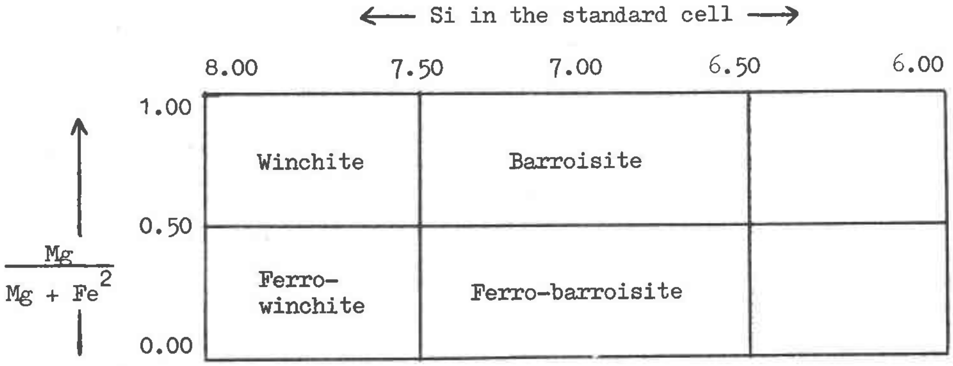
End Members

Richterite	$NaCaNaMg_5Si_8O_{22}(OH)_2$
Ferro-richterite	$NaCaNaFe^2_5Si_8O_{22}(OH)_2$
Ferri-winchite	$CaNaMg_4Fe^3Si_8O_{22}(OH)_2$
Alumino-winchite	$CaNaMg_4AlSi_8O_{22}(OH)_2$
Ferro-alumino-winchite	$CaNaFe^2_4AlSi_8O_{22}(OH)_2$
Ferro-ferri-winchite	$CaNaFe^2_4Fe^3Si_8O_{22}(OH)_2$
Alumino-barroisite	$CaNaMg_3Al_2Si_7AlO_{22}(OH)_2$
Ferro-alumino-barroisite	$CaNaFe^2_3Al_2Si_7AlO_{22}(OH)_2$
Ferri-barroisite	$CaNaMg_3Fe^3_2Si_7AlO_{22}(OH)_2$
Ferro-ferri-barroisite	$CaNaFe^2_3Fe^3_2Si_7AlO_{22}(OH)_2$
Magnesio-ferri-katophorite	$NaCaNaMg_4Fe^3Si_7AlO_{22}(OH)_2$
Magnesio-alumino-katophorite	$NaCaNaMg_4AlSi_7AlO_{22}(OH)_2$

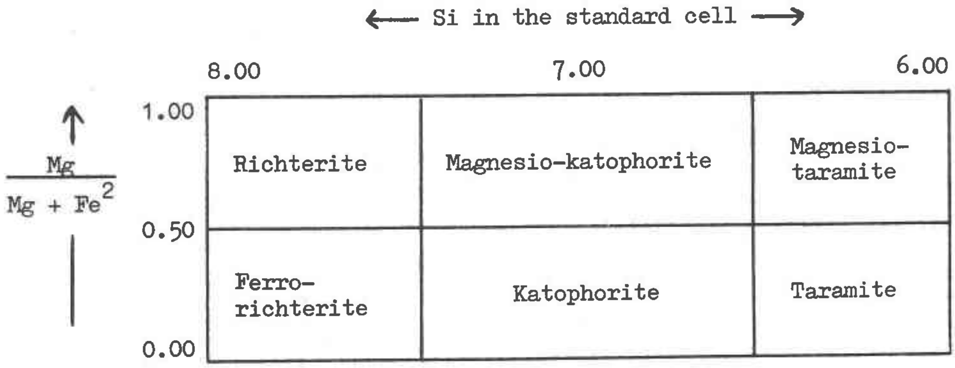
Fig. 4. SODIC - CALCIC AMPHIBOLES

$(Ca+Na)_B \geq 1.34$; Na_B between 0.67 and 1.34

A. $(Na+K)_A < 0.50$



B. $(Na+K)_A \geq 0.50$



Ferri-katophorite	$NaCaNaFe^{2}_{4}Fe^{3}Si_{7}AlO_{22}(OH)_{2}$
Alumino-katophorite	$NaCaNaFe^{2}_{4}AlSi_{7}AlO_{22}(OH)_{2}$
Ferri-taramite	$NaCaNaFe^{2}_{3}Fe^{3}_{2}Si_{6}Al_{2}O_{22}(OH)_{2}$
Magnesio-ferri-taramite	$NaCaNaMg_{3}Fe^{3}_{2}Si_{6}Al_{2}O_{22}(OH)_{2}$
Alumino-taramite	$NaCaNaFe^{2}_{3}Al_{2}Si_{6}Al_{2}O_{22}(OH)_{2}$
Magnesio-alumino-taramite	$NaCaNaMg_{3}Al_{2}Si_{6}Al_{2}O_{22}(OH)_{2}$

Limits for use of end member names and nomenclatures of the group

The nomenclature of the group is tabulated in Fig. 4. Assignment of the name is as follows: if $(Na+K)_A < 0.50$ go to Fig. 4A otherwise to Fig. 4B. Si, then the ratio $Mg/(Fe^2+Mg)$, and then the Al^{VI} and Fe^3 values decide the fundamental name of the amphibole. Analyses with $Al^{VI} \geq 1.00$ or $Fe^3 \geq 1.00$ have in the name alumino- or ferri- respectively. The final step is dealt with by considering the prefixes already given plus that given below which then gives a name which implicitly or explicitly conveys an indication of the composition with respect to 15 variables.

Special prefix for the sodic-calcic amphibole group

Alumino when $Al^{VI} \geq 1.00$

The words alumino- and ferri- immediately precede the fundamental amphibole name (i.e. the noun) otherwise the order in which the prefixes are used is not fixed.

This section was approved by 10 votes for, 2 against and 1 abstention.

5. Alkali Amphiboles

This group is defined as monoclinic amphiboles in which $Na_B \geq 1.34$.

End Members

Glaucophane	$Na_{2}Mg_{3}Al_{2}Si_{8}O_{22}(OH)_{2}$
Ferro-glaucophane	$Na_{2}Fe^{2}_{3}Al_{2}Si_{8}O_{22}(OH)_{2}$
Magnesio-riebeckite	$Na_{2}Mg_{3}Fe^{3}_{2}Si_{8}O_{22}(OH)_{2}$
Riebeckite	$Na_{2}Fe^{2}_{3}Fe^{3}_{2}Si_{8}O_{22}(OH)_{2}$
Eckermannite	$NaNa_{2}Mg_{4}AlSi_{8}O_{22}(OH)_{2}$
Ferro-eckermannite	$NaNa_{2}Fe^{2}_{4}AlSi_{8}O_{22}(OH)_{2}$
Magnesio-arfvedsonite	$NaNa_{2}Mg_{4}Fe^{3}Si_{8}O_{22}(OH)_{2}$
Arfvedsonite	$NaNa_{2}Fe^{2}_{4}Fe^{3}Si_{8}O_{22}(OH)_{2}$
Kozulite	$NaNa_{2}Mn_{4}(Fe^{3},Al)Si_{8}O_{22}(OH)_{2}$

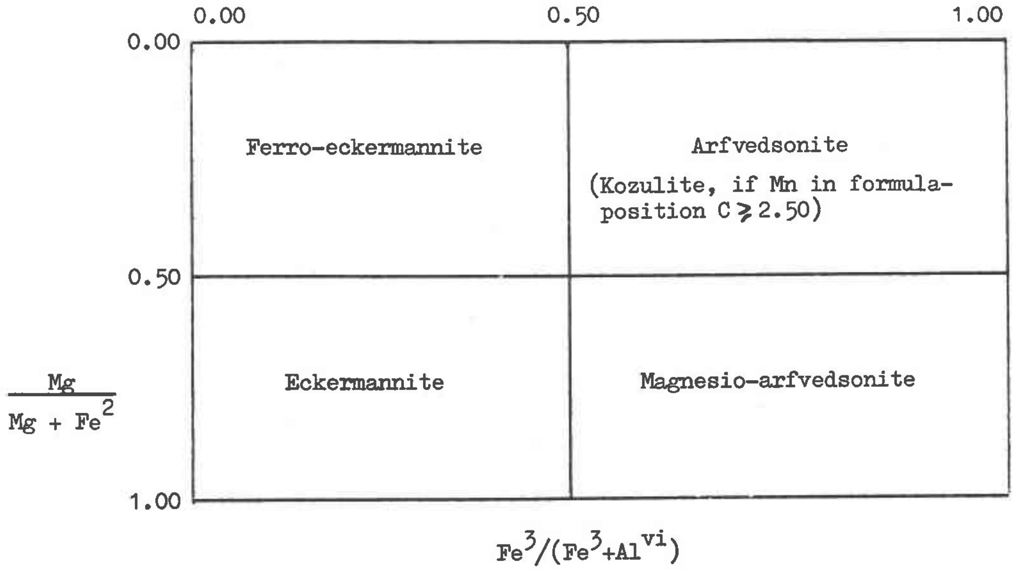
Limits for use of end member names

The nomenclature of the group is tabulated in Fig. 5. Three factors decide which fundamental name applies; the $(Na+K)_A$ values (Fig. 5A or 5B) then the ratio

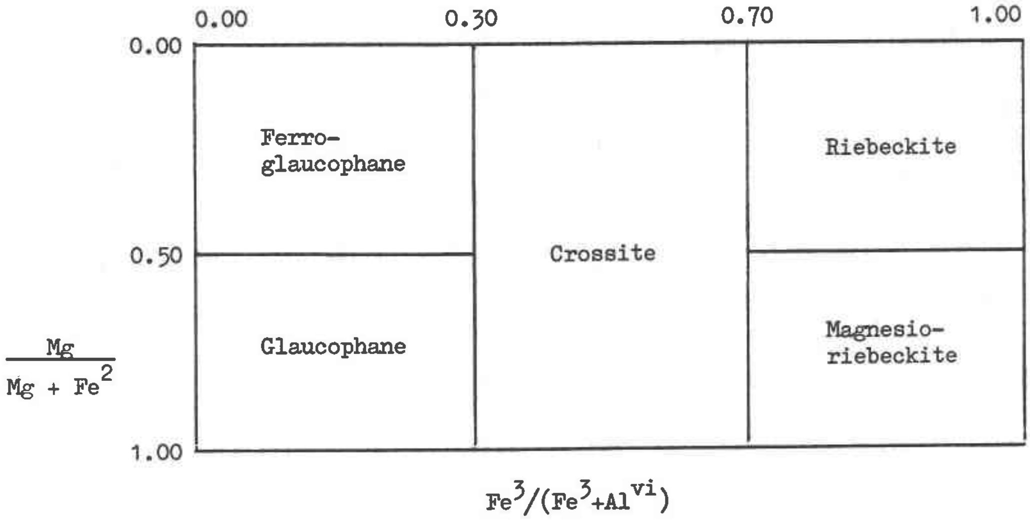
Fig. 5. ALKALI AMPHIBOLES

$Na_B \geq 1.34$

A. $(Na+K)_A \geq 0.50$



B. $(Na+K)_A < 0.50$



$Fe^3/(Fe^3+Al^{VI})$ and thirdly the ratio $Mg/(Fe^2+Mg)$. The final step is dealt with by the prefixes already given together with those given below and 16 variables are implicitly or explicitly conveyed by the name -- Si, Ca, Ti, F, Cl, K, Li, Mn, Zn, Cr, OH, O, $Fe^3/(Fe^3+Al^{VI})$, Pb, $Fe^2/(Fe^2+Mg)$ and $(Na+K)_A$. Kozulite is newly described (Nambu et al., 1969).

Special prefixes for the alkali amphibole group

Calcian	when	Ca ≥ 0.50 (about 3% CaO)
Lithian	when	Li ≥ 0.50 (about 1.0% Li_2O)

The optical variations in this group are so complex and so irregularly related to composition that no formal recommendations regarding them are made at this time. The optical orientations may be indicated conveniently and precisely following Borg's (1967) method by prefixing the symbol G, C, O or R for the four different orientations if it is required to emphasize this aspect.

This section was approved by 12 votes for, 0 against and 1 abstention.

References

BORG, I. Y. 1967. Optical properties and cell parameters in the Glaucophane-Riebeckite series. Contrib. Mineral. and Petrol. 15, p.67.

DEER, W. A., HOWIE, R. A. and ZUSSMAN, J. 1963. Rock-forming minerals. Vol. 2, Longmans, Green, London.

ERNST, W. G. 1968. Amphiboles. Springer-Verlag, New York. Mineralogical Society of America, 1969. Pyroxenes and amphiboles: crystal chemistry and phase petrology. Mineralogical Society of America, Special Paper No. 2.

Mineralogical Society of Great Britain, 1968. Amphiboles and pyroxenes.

SCHALLER, W. T. 1930. Adjectival ending of chemical elements used as modifiers to mineral names. Amer. Mineral. 15, p.566.

SMITH, J. V. 1959. Graphical representation of amphibole compositions. Amer. Mineral. 44, p.437.

NAMBU, M., TANIDA, K. and KITAMURA, T. 1969. Kozulite, a new alkali amphibole from Tanohata Mine, Iwate Prefecture, Japan. J. Jap. Ass. Mineral., Petrol., Econ. Geol. 62, 311-328. Abst., Amer. Mineral. 55, p.1815.

6. Formal Resolutions adopting the Proposed Amphibole Nomenclature

Throughout, roman superscripts refer to co-ordination numbers and arabic superscripts to charges.

1. For the purposes of the following resolutions the standard amphibole formula is taken to contain 8 tetrahedral sites and the general form of the standard formula is:

$$A_{0-1}\ B_2\ C_5^{VI}\ T_8^{IV}\ O_{22}(OH,F,Cl)_2$$

In the calculation of the standard amphibole formula the following procedure is recommended:

(1) If the water and halogen contents are well established, or if there is physical evidence that the amphibole is an oxy-amphibole, the formula should be calculated to 24(O,OH,F,Cl)

(2) If the water plus halogen content is uncertain the formula should be calculated on a water-free (and halogen-free) basis to 23(O) and 2(OH,F.Cl) assumed.

(3) Sum T to 8.00 using Si, then Al, then Cr^3, then Fe^3, then Ti^4.

(4) Sum C to 5.00 using excess Al, Cr, Ti, Fe^3 from (2), then Mg, then Fe^2, and then Mn.

(5) Sum B to 2.00 using excess Fe^2, Mn, Mg from (3), then Ca, then Na.

(6) Excess Na from (5) is assigned to A, then all K. Total A should be between 0.00 and 1.00, inclusive.

2. The iron-magnesium-manganese amphiboles are amphiboles defined by possessing $(Ca+Na)_B < 1.34$ in the standard formula.

3. The formalised end-member formulae for the orthorhombic members are as follows.

3.1	Magnesio-anthophyllite	$Mg_7Si_8O_{22}(OH)_2$
3.2	Ferro-anthophyllite	$Fe^2_7Si_8O_{22}(OH)_2$
3.3	Sodium anthophyllite	$Na(Mg,Fe^2)_7Si_7Al(OH)_7$
3.4	Magnesio-gedrite	$Mg_5Al_2Si_6Al_2O_{22}(OH)_2$
3.5	Ferro-gedrite	$Fe^2_5Al_2Si_6Al_2O_{22}(OH)_2$
3.6	Sodium gedrite	$Na(Mg,Fe^2)_6AlSi_6Al_2O_{22}(OH)_2$
3.7	Magnesio-holmquistite	$Li_2Mg_3Al_2Si_8O_{22}(OH)_2$
3.8	Ferro-holmquistite	$Li_2Fe^2_3Al_2Si_8O_{22}(OH)_2$

4.1 Magnesio-anthophyllite is to be used for orthorhombic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li < 1.00$; $Si \geq 7.00$; $Mg/(Mg+Fe^2) \geq 0.90$.

4.2 Anthophyllite is to be used for orthorhombic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li < 1.00$; $Si \geq 7.00$; $Mg/(Mg+Fe^2)$ between 0.10 and 0.89 inclusive.

4.3 Ferro-anthophyllite is to be used for orthorhombic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li < 1.00$; $Si \geq 7.00$; $Mg/(Mg+Fe^2) < 0.10$.

4.4 Magnesio-gedrite is to be used for orthorhombic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li < 1.00$; $Si < 7.00$; $Mg/(Mg+Fe^2) \geq 0.90$.

4.5 Gedrite is to be used for orthorhombic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li < 1.00$; $Si < 7.00$; $Mg/(Mg+Fe^2)$ between 0.10 and 0.89 inclusive.

4.6 Ferro-gedrite is to be used for orthorhombic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li < 1.00$; $Si < 7.00$; $Mg/(Mg+Fe^2) < 0.10$.

4.7 Magnesio-holmquistite is to be used for orthorhombic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li \geq 1.00$; $Mg/(Mg+Fe^2) \geq 0.90$.

4.8 Ferro-holmquistite is to be used for orthorhombic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li \geq 1.00$; $Mg/(Mg+Fe^2) < 0.10$.

4.9 Holmquistite is to be used for orthorhombic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li \geq 1.00$; $Mg/(Mg+Fe^2)$ between 0.10 and 0.89 inclusive.

5.1 The prefix sodium is to be used within the orthorhombic amphibole group for amphiboles with $Na \geq 0.50$ in the standard formula.

5.2 The prefix alumino- is to be used within the anthophyllite subgroup for amphiboles with $Al^{VI} \geq 0.50$ in the standard formula.

6. The formalised end-member formulae for the monoclinic members are as follows:

6.1	Magnesio-cummingtonite	$Mg_7Si_8O_{22}(OH)_2$
6.2	Grunerite	$Fe^2_7Si_8O_{22}(OH)_2$
6.3	Magnesio-clinoholmquistite	$Li_2Mg_3Al_2Si_8O_{22}(OH)_2$
6.4	Ferro-clinoholmquistite	$Li_2Fe_3Al_2Si_8O_{22}(OH)_2$
6.5	Tirodite	$Mn_2Mg_5Si_8O_{22}(OH)_2$
6.6	Dannemorite	$Mn_2Fe_5Si_8O_{22}(OH)_2$

7.1 Magnesio-cummingtonite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li < 1.00$; $Mn < 0.50$; $Mg/(Mg+Fe^2) \geq 0.70$.

7.2 Cummingtonite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li < 1.00$; $Mn < 0.50$; $Mg/(Mg+Fe^2)$ between 0.30 and 0.69 inclusive.

7.3 Grunerite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li < 1.00$; $Mn < 0.50$; $Mg/(Mg+Fe^2) < 0.30$.

7.4 Magnesio-clinoholmquistite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B < 1.34$; $Li \geq 1.00$; $Mg/(Mg+Fe^2) \geq 0.90$.

7.5 Ferro-clinoholmquistite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$$(Ca+Na)_B < 1.34; \quad Li \geq 1.00; \quad Mg/(Mg+Fe^{2}) < 0.10.$$

7.6 Clino-holmquistite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$$(Ca+Na)_B < 1.34; \quad Li \geq 1.00; \quad Mg/(Mg+Fe^{2}) \text{ between 0.10 and 0.89 inclusive.}$$

7.7 Tirodite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$$(Ca+Na)_B < 1.34; \quad Li < 1.00; \quad Mn \geq 0.50; \quad Mg/(Mg+Fe^{2}) < 0.50.$$

7.8 Dannemorite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$$(Ca+Na)_B < 1.34; \quad Li < 1.00; \quad Mn \geq 0.50; \quad Mg/(Mg+Fe^{2}) \geq 0.50.$$

8.1 The prefix sodian is to be used within the monoclinic iron-magnesium-manganese amphiboles when $Na \geq 0.25$ in the standard formula.

8.2 The prefix calcian is to be used within the iron-magnesium-manganese amphiboles when $Ca \geq 0.50$ in the standard formula.

9. The calcic amphiboles are monoclinic amphiboles in which the standard formula contains $(Ca+Na)_B \geq 1.34$ and $Na_B < 0.67$. Usually $Ca_B \geq 1.34$.

10. The formalised end-member formulae are as follows:

10.1	Tremolite	$Ca_2Mg_5Si_8O_{22}(OH)_2$
10.2	Ferro-actinolite	$Ca_2Fe^{2}_5Si_8O_{22}(OH)_2$
10.3	Edenite	$NaCa_2Mg_5Si_7AlO_{22}(OH)_2$
10.4	Ferro-edenite	$NaCa_2Fe^{2}_5Si_7AlO_{22}(OH)_2$
10.5	Pargasite	$NaCa_2Mg_4AlSi_6Al_2O_{22}(OH)_2$
10.6	Ferro-pargasite	$NaCa_2Fe^{2}_4AlSi_6Al_2O_{22}(OH)_2$
10.7	Hastingsite	$NaCa_2Fe^{2}_4Fe^{3}Si_6Al_2O_{22}(OH)_2$
10.8	Magnesio-hastingsite	$NaCa_2Mg_4Fe^{3}Si_6Al_2O_{22}(OH)_2$
10.9	Tschermakite (Alumino-tschermakite)	$Ca_2Mg_3Al_2Si_6Al_2O_{22}(OH)_2$
10.10	Ferro-alumino-tschermakite	$Ca_2Fe^{2}_3Al_2Si_6Al_2O_{22}(OH)_2$
10.11	Ferri-tschermakite	$Ca_2Mg_3Fe^{3}_2Si_6Al_2O_{22}(OH)_2$
10.12	Ferro-ferri-tschermakite	$Ca_2Fe^{2}_3Fe^{3}_2Si_6Al_2O_{22}(OH)_2$
10.13	Magnesio-hornblende	$Ca_2Mg_4AlSi_7AlO_{22}(OH)_2$
10.14	Ferro-hornblende	$Ca_2Fe^{2}_4AlSi_7AlO_{22}(OH)_2$

10.15 Kaersutite $NaCa_2Mg_4TiSi_6Al_2(O+OH)_{24}$

10.16 Ferro-kaersutite $NaCa_2Fe_4TiSi_6Al_2(O+OH)_{24}$

11.1 Tremolite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A < 0.50$; $Si \geq 7.50$; $Mg/(Mg+Fe^2) \geq 0.90$.

11.2 Actinolite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A < 0.50$; $Si \geq 7.50$; $Mg/(Mg+Fe^2)$ between 0.50 and 0.89 inclusive.

11.3 Ferro-actinolite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A < 0.50$; $Si \geq 7.50$; $Mg/(Mg+Fe^2) < 0.50$.

11.4 Tremolitic hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A < 0.50$; $Mg/(Mg+Fe^2) \geq 0.90$; Si between 7.25 and 7.49 inclusive.

11.5 Actinolitic hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A < 0.50$; $Mg/(Mg+Fe^2)$ between 0.50 and 0.89 inclusive and Si between 7.25 and 7.49 inclusive.

11.6 Ferro-actinolitic hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A < 0.50$; $Mg/(Mg+Fe^2) < 0.50$; Si between 7.25 and 7.49 inclusive.

11.7 Magnesio-hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A < 0.50$; $Mg/(Mg+Fe^2) \geq 0.50$; Si between 6.50 and 7.24 inclusive.

11.8 Ferro-hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A < 0.50$; $Mg/(Mg+Fe^2) < 0.50$; Si between 6.50 and 7.24 inclusive.

11.9 Tschermakitic hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A < 0.50$; $Mg/(Mg+Fe^2) \geq 0.50$; Si between 6.25 and 6.49 inclusive; $Ti < 0.50$.

11.10 Ferro-tschermakitic hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A < 0.50$; $Mg/(Mg+Fe^2) < 0.50$; Si between 6.25 and 6.49 inclusive; $Ti < 0.50$.

11.11 Tschermakite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A < 0.50$; $Mg/(Mg+Fe^2) \geq 0.50$; $Si < 6.25$; $Ti < 0.50$.

11.12 Ferro-tschermakite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A < 0.50$; $Mg/(Mg+Fe^2) < 0.50$; $Si < 6.25$; $Ti < 0.50$.

11.13 Edenite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2) \geq 0.50$; Si between 6.75 and 7.25 inclusive.

11.14 Ferro-edenite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2) < 0.50$; Si between 6.75 and 7.25 inclusive.

11.15 Edenitic hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2) \geq 0.50$; Si between 6.50 and 6.74 inclusive.

11.16 Ferro-edenitic hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2) < 0.50$; Si between 6.50 and 6.74 inclusive.

11.17 Pargasitic hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2) \geq 0.70$; Si between 6.25 and 6.49 inclusive; $Ti < 0.50$; $Fe^{3+} \leq Al^{VI}$.

11.18 Ferroan pargasitic hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B > 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2)$ between 0.30 and 0.69 inclusive; Si between 6.25 and 6.49 inclusive; $Ti < 0.50$; $Fe^3 \leq Al^{VI}$.

11.19 Pargasite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2) \geq 0.70$; $Si < 6.25$; $Ti < 0.50$; $Fe^3 \leq Al^{VI}$.

11.20 Ferroan Pargasite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2)$ between 0.30 and 0.69 inclusive; $Si < 6.25$; $Ti < 0.50$; $Fe^3 \leq Al^{VI}$.

11.21 Ferro-pargasite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2) < 0.30$; $Si < 6.25$; $Ti < 0.50$; $Fe^3 \leq Al^{VI}$.

11.22 Magnesio-hastingsitic hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2) \geq 0.70$; Si between 6.25 and 6.49 inclusive; $Ti < 0.50$; $Fe^3 > Al^{VI}$.

11.23 Magnesian hastingsitic hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2)$ between 0.30 and 0.69 inclusive; Si between 6.25 and 6.49 inclusive; $Ti < 0.50$; $Fe^3 > Al^{VI}$.

11.24 Hastingsitic hornblende is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2) < 0.30$; Si between 6.25 and 6.49 inclusive; $Ti < 0.50$; $Fe^3 > Al^{VI}$.

11.25 Magnesio-hastingsite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2) \geq 0.70$; $Si < 6.25$; $Ti < 0.50$; $Fe^3 > Al^{VI}$.

11.26 Magnesian hastingsite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2)$ between 0.30 and 0.69 inclusive; $Si < 6.25$; $Ti < 0.50$; $Fe^3 > Al^{VI}$.

11.27 Hastingsite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $(Na+K)_A \geq 0.50$; $Mg/(Mg+Fe^2) < 0.30$; $Si < 6.25$; $Ti < 0.50$; $Fe^{3+} > Al^{VI}$.

11.28 Kaersutite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $Mg/(Mg+Fe^2) \geq 0.50$; $Si < 6.50$; $Ti \geq 0.50$.

11.29 Ferro-kaersutite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; $Na_B < 0.67$; $Mg/(Mg+Fe^2) < 0.50$; $Si < 6.50$; $Ti \geq 0.50$.

12.1 The prefix subcalcic is to be used within the calcic amphibole group for amphiboles with $Ca < 1.50$ in the standard formula.

12.2 The prefix alumino- is to be used within the calcic amphibole group for amphiboles with Al in six fold co-ordination ≥ 1.00 in the standard formula.

12.3 The prefix sodian is to be used within the calcic amphibole group for amphiboles with $Na \geq 1.00$ in the standard formula.

12.4 The prefix silicic is to be used within the calcic amphibole group for amphiboles with $Si > 7.25$ when $(Na+K)_A \geq 0.50$.

13. The sodic-calcic amphiboles are monoclinic amphiboles in which $(Ca+Na)_B \geq 1.34$ and Na_B is between 0.67 and 1.33 inclusive.

14. The formalised end member formulae are as follows:

14.1	Alumino-winchite	$CaNaMg_{4}AlSi_{8}O_{22}(OH)_{2}$
14.2	Ferro-alumino-winchite	$CaNaFe^{2}_{4}AlSi_{8}O_{22}(OH)_{2}$
14.3	Ferri-winchite	$CaNaMg_{4}Fe^{3}Si_{8}O_{22}(OH)_{2}$
14.4	Ferro-ferri-winchite	$CaNaFe^{2}_{4}Fe^{3}Si_{8}O_{22}(OH)_{2}$
14.5	Alumino-barroisite	$CaNaMg_{3}Al_{2}Si_{7}AlO_{22}(OH)_{2}$
14.6	Ferro-alumino-barroisite	$CaNaFe^{2}_{3}Al_{2}Si_{7}AlO_{22}(OH)_{2}$
14.7	Ferri-barroisite	$CaNaMg_{3}Fe^{3}_{2}Si_{7}AlO_{22}(OH)_{2}$
14.8	Ferro-ferri-barroisite	$CaNaFe^{2}_{3}Fe^{3}_{2}Si_{7}AlO_{22}(OH)_{2}$
14.9	Richterite	$NaCaNaMg_{5}Si_{8}O_{22}(OH)_{2}$
14.10	Ferro-richterite	$NaCaNaFe^{2}_{5}Si_{8}O_{22}(OH)_{2}$
14.11	Magnesio-ferri-katophorite	$NaCaNaMg_{4}Fe^{3}Si_{7}AlO_{22}(OH)_{2}$
14.12	Magnesio-alumino-katophorite	$NaCaNa^{4}Mg_{4}AlSi_{7}AlO_{22}(OH)_{2}$
14.13	Alumino-katophorite	$NaCaNaFe^{2}_{4}AlSi_{7}AlO_{22}(OH)_{2}$
14.14	Ferri-katophorite	$NaCaNaFe^{2}_{4}Fe^{3}Si_{7}AlO_{22}(OH)_{2}$
14.15	Ferri-taramite	$NaCaNaFe^{2}_{3}Fe^{3}_{2}Si_{6}Al_{2}O_{22}(OH)_{2}$
14.16	Magnesio-ferri-taramite	$NaCaNaMg_{3}Fe^{3}_{2}Si_{6}Al_{2}O_{22}(OH)_{2}$
14.17	Alumino-taramite	$NaCaNaFe^{2}_{3}Al_{2}Si_{6}Al_{2}O_{22}(OH)_{2}$
14.18	Magnesio-alumino-taramite	$NaCaNaMg_{3}Al_{2}Si_{6}Al_{2}O_{22}(OH)_{2}$

15.1 Winchite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; Na_B between 0.67 and 1.33 inclusive; $(Na+K)_A < 0.50$; $Si \geq 7.50$; $Mg/(Mg+Fe^{2}) \geq 0.50$.

15.2 Ferro-winchite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; Na_B between 0.67 and 1.33 inclusive; $(Na+K)_A < 0.50$; $Si \geq 7.50$; $Mg/(Mg+Fe^{2}) < 0.50$.

15.3 Barroisite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; Na_B between 0.67 and 1.33 inclusive; $(Na+K)_A < 0.50$; $Si < 7.50$; $Mg/(Mg+Fe^{2}) \geq 0.50$.

15.4 Ferro-barroisite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; Na_B between 0.67 and 1.33 inclusive; $(Na+K)_A < 0.50$; $Si < 7.50$; $Mg/(Mg+Fe^{2}) < 0.50$.

15.5 Richterite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; Na_B between 0.67 and 1.33 inclusive; $(Na+K)_A \geq 0.50$; $Si \geq 7.50$; $Mg/(Mg+Fe^{2}) \geq 0.50$.

15.6 Ferro-richterite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; Na_B between 0.67 and 1.33 inclusive; $(Na+K)_A \geq 0.50$; $Si \geq 7.50$; $Mg/(Mg+Fe^{2}) < 0.50$.

15.7 Magnesio-katophorite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; Na_B between 0.67 and 1.33 inclusive; $(Na+K)_A \geq 0.50$; Si between 6.50 and 7.49 inclusive; $Mg/(Mg+Fe^{2}) \geq 0.50$.

15.8 Katophorite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; Na_B between 0.67 and 1.33 inclusive; $(Na+K)_A \geq 0.50$; Si between 6.50 and 7.49 inclusive; $Mg/(Mg+Fe^{2}) < 0.50$.

15.9 Magnesio-taramite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; Na_B between 0.67 and 1.33 inclusive; $(Na+K)_A \geq 0.50$; $Si < 6.50$; $Mg/(Mg+Fe^{2}) \geq 0.50$.

15.10 Taramite is to be used for monoclinic amphiboles chemically defined with respect to the standard formula as follows:

$(Ca+Na)_B \geq 1.34$; Na_B between 0.67 and 1.33 inclusive; $(Na+K)_A \geq 0.50$; $Si < 6.50$; $Mg/(Mg+Fe^{2}) < 0.50$.

16. The prefix alumino- is to be used within the soda calcic amphibole group when Al in six fold co-ordination ≥ 1.00 in the standard formula.

17. The alkali amphiboles are monoclinic amphiboles in which $Na_B \geq 1.34$.

18. The formalised end member formulae are as follows:

18.1	Glaucophane	$Na_2Mg_3Al_2Si_8O_{22}(OH)_2$
18.2	Ferro-glaucophane	$Na_2Fe^{2}_3Al_2Si_8O_{22}(OH)_2$

18.3 Magnesio-riebeckite $Na_2Mg_3Fe^3_2Si_8O_{22}(OH)_2$

18.4 Riebeckite $Na_2Fe^2_3Fe^3_2Si_8O_{22}(OH)_2$

18.5 Eckermannite $NaNa_2Mg_4AlSi_8O_{22}(OH)_2$

18.6 Ferro-eckermannite $NaNa_2Fe^2_4AlSi_8O_{22}(OH)_2$

18.7 Magnesio-arfvedsonite $NaNa_2Mg_4Fe^3Si_8O_{22}(OH)_2$

18.8 Arfvedsonite $NaNa_2Fe^2_4Fe^3Si_8O_{22}(OH)_2$

18.9 Kozulite $NaNa_2Mn_4Fe^3Si_8O_{22}(OH)_2$

19.1 Glaucophane is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$Na_B \geq 1.34$; $(Na+K)_A < 0.50$; $Fe^2/(Fe^2+Mg) < 0.50$; $Fe^3/(Fe^3+Al^{VI}) < 0.30$.

19.2 Ferro-glaucophane is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$Na_B \geq 1.34$; $(Na+K)_A < 0.50$; $Fe^2/(Fe^2+Mg) \geq 0.50$; $Fe^3/(Fe^3+Al^{VI}) < 0.30$.

19.3 Crossite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$Na_B \geq 1.34$; $(Na+K)_A < 0.50$; $Fe^3/(Fe^3+Al^{VI})$ between 0.30 and 0.69 inclusive.

19.4 Magnesio-riebeckite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$Na_B \geq 1.34$; $(Na+K)_A < 0.50$; $Fe^2/(Fe^2+Mg) < 0.50$; $Fe^3/(Fe^3+Al^{VI}) \geq 0.70$.

19.5 Riebeckite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$Na_B \geq 1.34$; $(Na+K)_A < 0.50$; $Fe^2/(Fe^2+Mg) \geq 0.50$; $Fe^3/(Fe^3+Al^{VI}) \geq 0.70$.

19.6 Eckermannite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$Na_B \geq 1.34$; $(Na+K)_A \geq 0.50$; $Fe^2/(Fe^2+Mg) < 0.50$; $Fe^3/(Fe^3+Al^{VI}) < 0.50$.

19.7 Ferro-eckermannite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$Na_B \geq 1.34$; $(Na+K)_A \geq 0.50$; $Fe^2/(Fe^2+Mg) \geq 0.50$; $Fe^3/(Fe^3+Al^{VI}) < 0.50$.

19.8 Magnesio-arfvedsonite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$Na_B \geq 1.34$; $(Na+K)_A \geq 0.50$; $Fe^2/(Fe^2+Mg) < 0.50$; $Fe^3/(Fe^3+Al^{VI}) \geq 0.50$.

19.9 Arfvedsonite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$Na_B \geq 1.34$; $(Na+K)_A \geq 0.50$; $Fe^2/(Fe^2+Mg) \geq 0.50$; $Fe^3/(Fe^3+Al^{VI}) \geq 0.50$; $Mn_C < 2.50$.

19.10 Kozulite is to be used for amphiboles chemically defined with respect to the standard formula as follows:

$Na_B \geq 1.34$; $(Na+K)_A \geq 0.50$; $Mn^2/(Mg+Fe^2+Mn^2) > 0.33$; $Fe^3/(Al^{VI}+Fe^3) \geq 0.50$; $Mn_C \geq 2.50$.

20.1 The prefix calcian is to be used within the alkali amphibole group for amphiboles with $Ca \geq 0.50$ in the standard formula.

20.2 The prefix lithian is to be used within the alkali amphibole group for amphiboles with $Li \geq 0.50$ in the standard formula.

21. The following are specified prefixes for the whole amphibole group in terms of contents in the standard formula.

21.1	chlor	when	Cl	$\geq$ 1.00
21.2	chromium	when	Cr	$\geq$ 1.00
21.3	chromian	when	Cr	= 0.25-0.99
21.4	ferri	when	Fe^3	$\geq$ 1.00 except in alkali amphiboles and hastingsite
21.5	ferrian	when	Fe^3	= 0.75-0.99 except in alkali amphiboles and hastingsite
21.6	fluor	when	F	$\geq$ 1.00
21.7	hydro	when	OH	$\geq$ 3.00
21.8	lithian	when	Li	$\geq$ 0.25 except in alkali amphiboles when lithian is used when $Li \geq 0.50$. Not used with holmquistite and clinoholmquistite.
21.9	manganese	when	Mn	$\geq$ 1.00 except in end-members containing Mn
21.10	manganoan	when	Mn	= 0.25-0.99 except in end-members containing Mn
21.11	oxy	when	(OH+F+Cl)	is confirmed as < 1.00
21.12	plumbian	when	Pb	$\geq$ 0.08
21.13	potassium	when	K	$\geq$ 0.50
21.14	potassian	when	K	= 0.25-0.49
21.15	subsilicic	when	Si	< 5.75
21.16	titanium	when	Ti	$\geq$ 1.00 except in kaersutite
21.17	titanian	when	Ti	= 0.25-0.99 except in kaersutite
21.18	zinc	when	Zn	$\geq$ 1.00
21.19	zincian	when	Zn	= 0.25-0.99

22. Physically identified amphiboles should be named according to the nearest identifiable end-member which should be made into an adjective to be followed by the word amphibole.

22.1 Hornblende is to be used for calcic amphiboles identified solely or largely by their physical properties and not confidently identifiable as near to an end-member.

Each part of the above section 6 was voted on separately and received at least 10, and usually 12 or 13 affirmative votes (out of 13) except for sections 11 and 19 which received 9 for, 2 against and 2 abstentions.

7. Amphibole Names Recommended for Extinction

It is agreed that the following amphibole names be formally abandoned.

Abkhazite	=	tremolite
Abriachanite	=	riebeckite
Achromaite	=	hornblende
Actynolin	=	actinolite
Actynolite	=	actinolite
Actinote	=	actinolite
Aktinolitischer tschermakite	=	magnesio- or ferro- hornblende
Alkali-femaghastingsite	=	sodian potassian magnesian hastingsite
Alkali-ferrohastingsite	=	sodian potassian hastingsite
Alkali-hastingsite	=	sodian potassian (hastingsite to magnesio-hastingsite)
Amiant(h)	=	asbestos
Amianthoide	=	asbestos
Amianthinite	=	asbestos
Amianthus	=	asbestos
Amosite	=	asbestiform grunerite or anthophyllite pre 1948
Amphibole-anthophyllite	=	cummingtonite
Amphibolite	=	hornblende
Anophorite	=	titanian calcian magnesio-arfvedsonite
Anthogrammatite	=	anthophyllite
Anthogrammite	=	anthophyllite
Antholite	=	anthophyllite and cummingtonite
Antholith	=	anthophyllite
Anthophylline	=	anthophyllite
Anthophyllite rayonné	=	anthophyllite
Antiglaucophane	=	glaucophane or crossite
Arfwedsonite	=	arfvedsonite
Asbeferrite	=	asbestos
Asbestinite	=	asbestos
Asbestoide	=	asbestos
Asbestus	=	asbestos
Astochite	=	manganoan richterite
Astorit(e)	=	richterite
Bababudanite	=	magnesio-riebeckite
Barkevicite, Barkevikite	=	(sometimes sodian) ferroan or ferro-pargasitic hornblende, but has been used for other compositions and has never been chemically defined
Basaltic hornblende	=	an oxyhornblende, often ferri- or ferrian titanian (magnesio or magnesian hastingsite)
Basaltine	=	oxyhornblende + augite
Bedenite	=	ferrian actinolitic hornblende
Bergamaskite	=	hastingsite
Bergamaschite	=	hastingsite
Bergflachs	=	asbestos
Bergfleisch	=	asbestos
Berghaar	=	asbestos
Berghaut	=	asbestos
Bergholz	=	asbestos
Bergkork	=	asbestos
Bergpapier	=	asbestos
Bergwolle	=	asbestos
Bidalotite	=	gedrite
Borgniezite	=	sodium amphibole
Breadalbanite	=	hornblende
Byssolite	=	asbestos
Calamite	=	tremolite

Carinthine	=	hornblende, often pargasitic hornblende
Carystine	=	asbestos
Cataphorite = kataphorite	=	katophorite
Catophorite	=	katophorite
Cataforite	=	katophorite
Chernyshevite	=	sodium amphibole
Chiklite	=	manganoan ferri-ferro-richterite
Chrome-tremolite	=	tremolite or actinolite
Clino-anthophyllite	=	magnesio-cummingtonite
Clinokupfferite	=	cummingtonite
Crocidolite	=	asbestiform riebeckite
Daschkesanit	=	chlor potassian hastingsite
Dashke(s)sanite	=	chlor potassian hastingsite
Diastatite	=	hornblende
Eckrite	=	winchite
Eisenrichterite	=	ferro-richterite
Fasciculite	=	hornblende
Femaghastingsite	=	magnesian hastingsite
Feranthophyllite	=	ferro-anthophyllite
Ferrian pargasite	=	sodian manganoan magnesio-hastingsite
Ferri- edenite	=	ferro-edenite
Ferriglaucophane	=	magnesio-riebeckite
Ferrihedrite	=	ferri-gedrite
Ferririchterite	=	manganoan magnesio-arfvedsonite
Ferri-tremolite	=	ferri-ferro-actinolite
Ferrohastingsite	=	hastingsite
Ferro-tremolite	=	ferro-actinolite
Gamsigradite	=	manganoan (magnesio-hornblende or edenite)
Gastaldite	=	glaucophane
Girnarite	=	subsilicic titanian sodian magnesian hastingsite
Grammatite	=	tremolite
Grammatit-strahlstein	=	tremolite
Griqualandite	=	crocidolite
Grünerite	=	grunerite
Heikolite	=	crossite
Heikkolite	=	crossite
Heterotype	=	amphibole and pyroxene
Hexabolit	=	oxyhornblende
Hexagonite	=	manganoan tremolite
Hillängsite	=	dannemorite
Hoepfnerite	=	tremolite
Holzasbest	=	asbestos
Hudsonite	=	hastingsite
Imerinite	=	magnesio-arfvedsonite
Iron-anthophyllite	=	ferro-anthophyllite
Iron-hornblende	=	oxy-manganoan potassian ferrian ferro-hornblende
Iron-richterite	=	ferro-richterite
Isabellite	=	richterite
Juddite	=	manganoan magnesio-arfvedsonite
Kalamite	=	tremolite
Kalio-magnesio-katophorite	=	titanian potassian richterite
Karinthin	=	hornblende, often pargasitic hornblende
Kidney stone	=	actinolite
Kievite	=	cummingtonite
Kirwanite	=	impure altered amphibole
Kokscharowit	=	edenitic amphibole
Kokscharovite	=	edenitic amphibole
Krokidolite	=	crocidolite
Krokydolith	=	crocidolite
Kupfferite (Allen & Clement)	=	magnesio-anthophyllite

Kupfferite (Hermann)	=	chromian anthophyllite
Kupfferite (Koksharov)	=	chromian anthophyllitic amphibole
Kymatine	=	asbestos
Labrador hornblende	=	orthopyroxene
Lamprobolite	=	oxyhornblende
Laneite	=	ferroan or ferro-pargasitic hornblende
Linosite	=	ferri or ferrian oxy kaersutite
Lithionglaukophan	=	holmquistite
Lithium-amphibole	=	lithian amphibole, holmquistite and clino-holmquistite
Maganthophyllite	=	magnesio-anthophyllite
Magnesia-arfvedsonite	=	magnesio-arfvedsonite
Magnesian glaucophane	=	glaucophane
Magnophorite	=	titanian potassian richterite
Magnesium anthophyllite	=	magnesio-anthophyllite
Mangan-actinolite	=	mangananoan actinolite
Mangan amphibole	=	rhodonite (not an amphibole)
Mangan crocidolite	=	manganoan riebeckite
Mangan krokidolith	=	manganoan riebeckite
Mangano-anthophyllite	=	tirodite
Mangan-tremolite	=	manganoan tremolite
Manganuralite	=	manganoan magnesio-arfvedsonite
Marmairolite	=	manganoan richterite
Mboziite	=	potassian taramite
Mountain wood	=	asbestos
Montasite	=	asbestiform grunerite
Natrongrammatit	=	richterite
Natronrichterite	=	manganoan richterite
Naurodite	=	alkali amphibole
Nephrite	=	actinolite
Noralite	=	ferro-hornblende
Nordenskiöldite	=	tremolite
Orniblende	=	hornblende
Orthoriebeckite	=	riebeckite
Osannite	=	riebeckite
Philipstadite	=	ferrian ferro-hornblende
Picroamosite	=	ferrian anthophyllite
Pilite	=	actinolite pseudomorph
Pseudoglaucophane	=	glaucophane or crossite
Prismatic schillerspar	=	anthophyllite
Raphilite	=	tremolite
Rezhikite	=	magnesio-riebeckite or magnesio-arfvedsonite
Rhodusite	=	magnesio-riebeckite
Rimpylite	=	hornblende
Sebesite	=	tremolite
Silbölite	=	actinolite
Sillbölite	=	actinolite
Silfbergite	=	dannemorite
Simpsonite	=	titanian potassian richterite
Smaragdite	=	actinolite or hornblende
Smaragditic grammatite	=	tremolite
Smaragditic tschermakite	=	tschermakite or tschermakitic hornblende
Soda asbestos	=	magnesio-arfvedsonite
Soda hornblende	=	arfvedsonite
Soda richterite	=	manganoan richterite
Soda tremolite	=	richterite
Soretite	=	magnesian hastingsite
Speziatite	=	hornblende
Strahlstein	=	actinolite
Strelite	=	actinolite or anthophyllite

Subglaucophane	=	crossite
Svidneite	=	oxy magnesio-riebeckite
Syntagmatite (Troger 1952)	=	titanian hastingsite
Szechenyiite	=	richterite
Szechonyit	=	richterite
Ternovskite	=	magnesio-riebeckite
Thalackerite	=	anthophyllite
Tibergite	=	manganoan sodian magnesio-hastingsite
Titanhornblende	=	aenigmatite
Tonerdehaltiger strahlstein	=	tremolite
Torendrikite	=	magnesio-riebeckite
Tremolite-glaucophane	=	richterite
Tschernischewit	=	sodium amphibole
Uralite	=	actinolite pseudomorph
Valleite	=	calcian manganoan anthophyllite
Waldheimite	=	richterite
Wallerian	=	hornblende
Weinschenkite	=	ferri-magnesio-hornblende or magnesio-hastingsite
Zillerite	=	actinolite
Zillerthite	=	actinolite
Zinc-manganese-cummingtonite	=	zinc tirodite

M. H. Hey (1962) and appendix 1963), Index to mineral species and varieties arranged chemically should be consulted for further details of the above names.

This section was approved by 13 votes for, 0 against.

The compiler particularly draws the attention of mineralogists to the abandonment of barkevikite, basaltic hornblende, carinthine, ferrohastingsite, grammatite, karinthine, kataphorite and mboziite, as these names are more commonly used than the remainder.

The compiler comments that the main practical difficulty in naming amphiboles by the agreed procedure is that the ratio $Mg/(Mg+Fe^2)$ cannot be accurately obtained from electron microprobe analysis. Agreement to use $Mg/(Mg+Fe^2+Fe^3)$ could not be obtained and so it will be essential to examine critically the procedure adopted to calculate Fe^2 and Fe^3 when only the total Fe has been determined. Different procedures could give different names to same chemical analysis. In addition, in view of the very large number of incorrectly calculated standard amphibole formulae in the literature, authors are urged to always calculate these carefully, never to avoid checking that the positive and negative charges balance and that the determined oxides have been precisely transcribed -- a common error in computer-calculated results. The whole procedure including outputting the full name will be most conveniently dealt with by one computer programme.