

Djalma Guimarães (1895-1973)

Engenheiro Civil, de Minas e Metalúrgico

Professor Djalma Guimarães em conferência na
Sociedade Mineira de Engenheiros (1934)

DJALMAITE, A NEW RADIO-ACTIVE MINERAL¹⁹⁴¹

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INTRODUCTION

While traveling through Conceição County, in the state of Minas Gerais, studying a pegmatite which is being mined for aquamarine and bismuth ore, Dr. Octavio Barbosa brought me a few specimens of miner-

mineral has sometimes been classified as betafite or microlite. A crystallographic study was made of the larger and more perfectly developed crystals.

CRYSTALLOGRAPHIC STUDY

This new mineral is found in forms showing a perfect octahedron, modified on each corner by four faces, which with the octahedron gives a total of 32 faces (See Fig. 3).

In order to calculate the indices of these faces we used their relative position with reference to the octahedron faces. Thus, the angle between the face in question (hkl) and that of the octahedron (111) was found to be $28^{\circ}23'$.

The measurement was made with a Babinet goniometer. As the crystal did not have perfectly plane faces, small pieces of cover glass were glued to the faces, in order to obtain good reflections. However, in spite of this procedure a high degree of accuracy was not attained.

In like manner the angle of the adjacent octahedron faces was meas-

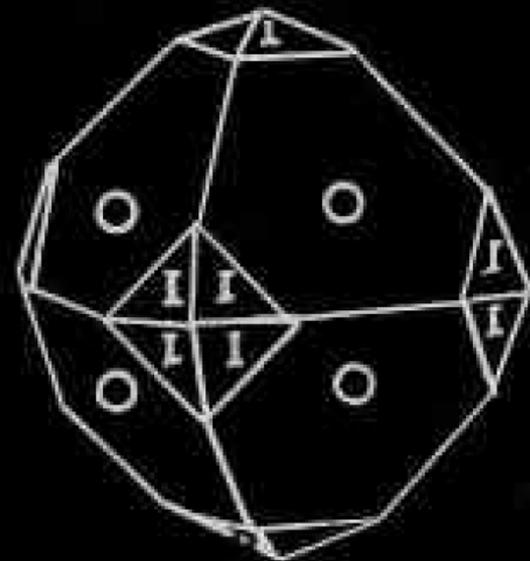


FIG. 3

REFRACTIVE INDEX

The index of refraction has been determined by the immersion method. The immersion medium used was Merwin's solution, and the refractive index was found to be 1.97.

CHEMICAL COMPOSITION

The chemical composition is as follows:

Ta ₂ O ₅	72.27
Nb ₂ O ₅	1.41
TiO ₂	2.54
SnO ₂	Trace
ZrO ₂	0.80
UO ₂	2.17
UO ₃	9.38
WO ₃	0.18
Bi ₂ O ₃	0.98
PbO	1.10
FeO	0.56
CaO	3.40
MgO	0.24
H ₂ O	4.62
	<hr/>
	99.65

Although it has not been possible to give an exact formula, on account of the alteration to a hydrate, the mineral is to be regarded as an uranium-bearing tantalate together with other bases and titanium in small amounts.*

PHYSICAL PROPERTIES

Color—04ie and 08ie of Ostwald scale.

Streak—04ge (light yellow) Ostwald scale.

Powder—04ge Ostwald scale.

Specific gravity—5.75–5.88.

Hardness—5.5.

Fracture—Irregular.

Cleavage—None.

System of symmetry—Isometric.

Habit—Octahedral.

Observed forms: icositetrahedron $i = (311)$ and octahedron $o = (111)$, the latter being dominant (Fig. 3).

OPTICAL PROPERTIES

In thin section the new mineral has the following properties:

Translucent, yellowish-brown, greasy luster, strongly refringent.

CHEMICAL COMPOSITION

A tantalate of uranium and other bases, with a small amount of titanium.

CONCLUSIONS

The physical properties of the mineral indicate that it is closely related to betafite and samirésite; it also resembles eschwegeite.

In the current literature no reference has been found for this mineral. As suggested by Dr. Octavio Barbosa, who furnished the specimens for the present study, we propose for the new mineral the name *Djalmaite*. It is a deserving tribute to Dr. Djalma Guimarães, the well known Brazilian mineralogist and petrologist.

ACKNOWLEDGMENTS

Thanks are due to both Drs. Octavio Barbosa and Viktor Leinz for their valuable suggestions, and to Dr. Emilio A. Teixeira for the translation of this note into English.

* Note by Dr. Harry Berman.

The best formula obtainable seems to be of the type $AB_3O_8(O, OH)$ with $A=U^4, U^6, Ca, Pb, Mg$; and $B=(Ta, Cb, Ti, Zr)$.

The analysis represents a composition distinct from any recorded mineral and is apparently a Ta, U-rich member of the betafite group. Other members are blomstrandine, the titanium-rich member, and samirésite, with much lead.

Classification and nomenclature of the pyrochlore group

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Abstract

The IMA Subcommittee on Nomenclature of the Pyrochlore Group recommends the following classification and nomenclature:

Group pyrochlore [$A_{2-m}B_2O_6(O,OH,F)_{1-n} \cdot pH_2O$]
Subgroups pyrochlore, microlite, betafite
Species pyrochlore, kalipyrochlore, bariopyrochlore, yttrropyrochlore, ceriopyrochlore, plumbopyrochlore, uranpyrochlore (pyrochlore subgroup); microlite, stannomicrolite, bariomicrolite, plumbomicrolite, bismuto-microlite, uranmicrolite (microlite subgroup); yttrobetafite, plumbobetafite, betafite (betafite subgroup).

Subgroups are divided according to *B*-atoms (Nb, Ta, Ti) and species according to *A*-atoms (K, Sn, Ba, REE, Pb, Bi, U). Forty-eight names related to the pyrochlore group should be dropped, and five type specimens should be reinvestigated.

Djalmaite (Guimarães, 1939) is a synonym for *uranmicrolite*. The name should be dropped.

THE PYROCHLORE SUPERGROUP OF MINERALS: NOMENCLATURE

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Oxiuranomicrolita

(“uranomicrolita”)

$U^{4+}Ta_2O_7$

37,93 % em massa de UO_2

62,07 % em massa de Ta_2O_5

Uranmicrolite

No samples described as uranmicrolite (“djalmaite” of Guimarães 1939) (*e.g.*, Baldwin 1989, Rub *et al.* 1998, Tindle & Breaks 1998, Novák & Černý 1998, Zhang *et al.* 2004, Breiter *et al.* 2007, van Lichtervelde *et al.* 2007, Uher *et al.* 2007) are rich enough in U to warrant a status as a separate species.

Nota previa sobre um mineral radio-activo

por DJALMA GUIMARÃES

1926

O mineral, assumpto desta nota previa, ocorre em um pegmatito ao lado do arraial de Divino no municipio de Ubá.

A geologia da zona já foi esboçada por mim no Boletim nº 13 do Serviço Geologico e Mineralogico do Brasil.

Este pegmatico é extremamente interessante pela associação dos mineraes Samarskita, Columbita, Monazita e o mineral que ora descrevo em massas crystallinas pesando dous ou mais kilogrammos.

Ha um verdadeiro crescimento paralelo dos crystaes, com disposição em leque (aggregados irradiantes).

A principio havia considerado o mineral como um producto de alteração da Samarskita, mas em vista de novas amostras gentilmente offerecidas pelo proprietario da jazida, o Sr. J. Castello Branco fui levado a um exame mais accu-

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ANEXO AL

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Ciencias Geológicas

Tomo I, n.º 5

ALGUNAS PROPOSICIONES

SOBRE

NOMENCLATURA MINERALOGICA

POR

GREGORIO GAGARIN Y JORGE R. CUOMO

Un mineral parecido a la ampangabeita, pero con una menor cantidad de bióxido de uranio y una mayor de bióxido de titanio, fué descrito por D. Guimarães (28). Se presenta en grupos paralelos o divergentes de cristales rómbicos. Dureza 5,5; peso específico 4,49. El color en las fracturas pardo de chocolate oscuro, o castaño claro. Procedencia: Divino de Ubá, Brasil. Se propone el nombre de *guimarãesita*.

NEW MINERAL NAMES

GREGORIO GAGARIN AND JORGE R. CUOMO, Algunas proposiciones sobre nomenclatura mineralógica: *Comun. Inst. Nacal. Invest. Cienc. Naturales, Museo Argentino Cienc. Naturales "Bernardino Rivadavia," Cienc. Geol.*, 1, No. 5, 21 pp. (1949).

The authors have set out to give names to all minerals which now lack them, but which are sufficiently well characterized, *in their opinion*, to merit naming. They also suggest new names for some minerals whose present names are not of the type they consider preferable. Some remarks are perhaps justified.

It seems to me that when a mineralogist describes a mineral, but considers that the description is insufficient to warrant giving the mineral a name, later workers should abide by his decision, except when additional data have been obtained on the mineral or on its analogues. Indiscriminate application of new names results only in burdening the literature.

New names have also been given by Gagarin and Cuomo to many materials previously named by others, simply because the old names did not agree with the authors' concepts of how minerals should be named. This is an indefensible practice.

It seems to me that mineralogists should not feel bound by any names proposed in this paper.

Specific remarks on the new names are given below.

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A SYSTEM OF CODIFICATION FOR UNNAMED MINERALS: REPORT OF THE SUBCOMMITTEE FOR UNNAMED MINERALS OF THE IMA COMMISSION ON NEW MINERALS, NOMENCLATURE AND CLASSIFICATION

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ABSTRACT

A system of codification that includes the year of publication and qualitative chemical composition has been developed for unnamed minerals reported in the literature. Such minerals are divided into two categories: those regarded as being "valid as unnamed minerals" (1363 in this listing) are those that do not correspond to existing species, have not been reported previously, and whose published descriptions enable them to be recognized if found elsewhere. Unnamed minerals regarded as being "invalid as unnamed minerals" (1460 in this listing) are those whose published descriptions are inadequate for their confident recognition if found elsewhere, or which correspond to existing mineral species or unnamed minerals published previously. Separate lists of unnamed minerals in the two categories, distinguished by different codings, are given as appendices.

Keywords: unnamed minerals, International Mineralogical Association, Commission on New Minerals, Nomenclature and Classification.

SOMMAIRE

Nous avons développé un système de codification des minéraux sans nom cités dans la littérature: il inclut l'année de la

CHARACTERIZATION OF UNNAMED MINERALS

Early literature included statements such as “*Unnamed: In parallel and divergent groups of orthorhombic crystals resembling eschynite in habit. Forms $\{100\}$, $\{010\}$ and $\{101\}$ with $(101) \wedge (\bar{1}01)$ about 75° . Fracture subconchoidal. $H=5.5$ $G=4.49$. Luster resinous. Color on fracture dark chocolate to clear maroon*” [quoted in Palache *et al.* (1944) from early twentieth century Brazilian literature]. Such descriptions may be useful in allowing later observers to locate the material that was being described in that particular sample, but it remains most unlikely that, on the basis of this description, the mineral will ever be matched with confidence to a mineral in another unrelated sample. Probably the most useful type of data for obtaining a

УДК 549.6

ГИМАРАЭСИТ – НОВЫЙ Zn-ДОМИНАНТНЫЙ МОНОКЛИННЫЙ МИНЕРАЛ ГРУППЫ РОШЕРИТА ИЗ ИТИНГИ (МИНАС ЖЕРАИС, БРАЗИЛИЯ)

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Новый моноклинный Zn-доминантный минерал группы рошерита гимараэсит¹, $\text{Ca}_2(\text{Zn}, \text{Mg}, \text{Fe})_5\text{Ve}_4(\text{PO}_4)_6(\text{OH})_4 \cdot 6\text{H}_2\text{O}$, найден в составе поздних прожилков в гранитном пегматите близ р. Пиауи (округ Итинга, Минас Жераис, Бразилия) в ассоциации с альбитом, микроклином, кварцем, опалом, эльбаитом, шерлом, лепидолитом, эосфоритом, мораэзитом, салеитом, занацциитом и Fe-доминантным минералом группы рошерита. Гимараэсит эпитактически нарастает на кристаллы других минералов группы рошерита, образуя на них периферические зоны шириной до 0.1 мм. Новый минерал прозрачный, его цвет светло-коричневый, черта белая, блеск стеклянный. Вычисленная плотность 2.963 г/см³. Гимараэсит под микроскопом бесцветный, оптически двуосный, отрицательный; $n_p = 1.596(2)$, $n_m = 1.600(2)$, $n_g = 1.602(2)$, $2V_{изм.} = 55-75$, $2V_{выч.} = 70$. Оптическая ось X совпадает с удлинением. Дисперсия не наблюдается. Химический состав (микронзонд, мас.%; пределы содержаний даны в скобках): CaO 9.72 (9.61–9.79); MgO 4.00 (3.61–4.74); MnO 2.18 (0.89–3.26); FeO 2.65 (1.40–4.45); ZnO 19.06 (16.33–20.50); Al₂O₃ 1.70 (1.53–1.92); VeO (вычислено) 8.975; P₂O₅ 38.20 (37.61–38.78); H₂O (вычислено по разности) 13.515, сумма 100.00. Эмпирическая формула, рассчитанная на шесть групп PO₄, имеет вид: $\text{Ca}_{1.93}(\text{Zn}_{2.61}\text{Mg}_{1.11}\text{Fe}_{0.41}^{2+}\text{Al}_{0.37}\text{Mn}_{0.34})_{\Sigma 4.84}\text{Ve}_{4.00}(\text{PO}_4)_{6.00}(\text{OH})_{3.90} \cdot 6.41\text{H}_2\text{O}$. Сильные линии дебаеграммы [d , Å (l , %)]

GUIMARÃESITE, A NEW Zn-DOMINANT MONOCLINIC ROSCHERITE-GROUP MINERAL FROM ITINGA, MINAS GERAIS, BRAZIL*

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Guimarãesite¹, Ca₂(Zn,Mg,Fe)₅Be₄(PO₄)₆(OH)₄·6H₂O, monoclinic, is a new member of the roscherite-group. It occurs as a late fracture-filling mineral in a phosphate-rich granite pegmatite near the Piauí river, Itinga county, Minas Gerais, Brazil. Associated minerals are: albite, microcline, quartz, elbaite, lepidolite, schorl, eosphorite, moraesite, saleeite, zanazziite, an iron-dominant roscherite-group mineral, opal. Guimarãesite forms peripheral zones (up to 0.1 mm thick) in crystals of roscherite-group minerals. The inner zones of the crystals are Mg-rich (and correspond to zanazziite) or Fe-rich (greifensteinite and/or ruifrancoite). Its colour is brown, the streak is white and the lustre is vitreous. Guimarãesite is transparent and non-fluorescent. Density (calc.) is 2.963 g/cm³. The mineral is biaxial (-), α 1.596(2), β 1.600(2), γ 1.602(2) (589 nm). 2V(obs.) 55-75°, 2V(calc.) 70°. The optical X axis coincides with the elongation direction, dispersion: none observed. It is colourless under the microscope. The chemical composition is (wt. %, ranges are indicated in brackets; EDS mode electron microprobe): CaO 9.72 (9.61-9.79); MgO 4.00 (3.61-4.74); MnO 2.18 (0.89-3.26); FeO 2.65 (1.40-4.45); ZnO 19.06 (16.33-20.50); Al₂O₃ 1.70 (1.53-1.92); BeO (calculated) 8.975; P₂O₅ 38.20 (37.61-37.78); H₂O (calculated by difference) 13.515, total 100.00. The empirical formula based on six (PO₄) groups per formula unit is Ca_{1.93}(Zn_{2.61}Mg_{1.11}Fe_{0.41}²⁺Al_{0.37}Mn_{0.34})_{Σ4.84}Be_{4.00}(PO₄)_{6.00}(OH)_{3.90}·6.41H₂O. The strongest reflections of the pow-



(1926). The new mineral has been approved by the CNMMN - IMA (vote 2006-028).

Holotype material is deposited under the number DR591 in the Museu de Geociências, Instituto de Geociências, Universidade de São Paulo, Rua do Lago, 562, 05508-080, São Paulo, SP, Brazil.

Occurrence, appearance and physical properties

The mineral occurs as a late fracture-filling mineral in a phosphate-rich granite pegmatite near the Piauí river, Itinga county, Minas Gerais, Brazil (16°36'47"S and 41°45'55"W),

Fig.1. Associated minerals are: albite, microcline, quartz, elbaite, lepidolite, schorl, eosphorite, moraesite, saleeite, zanazziite, an Fe-dominant roscherite-group mineral, opal.

Guimarãesite forms peripheral zones (up to 0.1 mm thick) in crystals of roscherite-group minerals. The inner zones of the crystals are Mg-rich (and correspond to zanazziite) or Fe-rich (greifensteinite and/or ruifrancoite?) (Figs. 2 and 3). Its colour is brown, the streak is white and the lustre is vitreous. Guimarãesite is transparent and non-fluorescent. Mohs hardness is probably about 4.5 by analogy with other roscherite-group minerals. The mineral is brittle. Density could not be measured

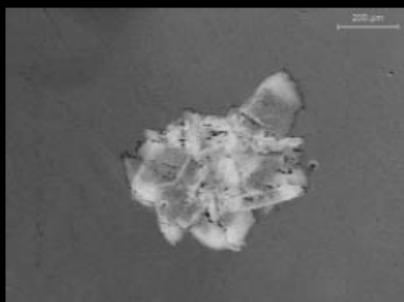
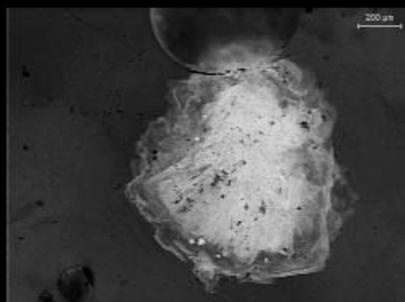


Fig. 2. Crystals of roscherite-group minerals with guimarãesite peripheral zones.

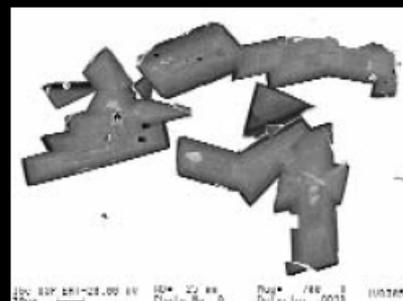
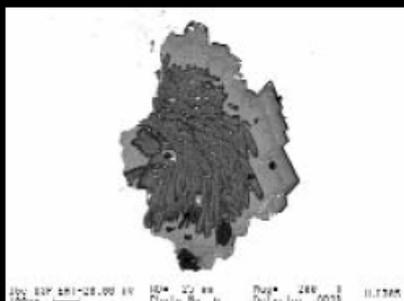
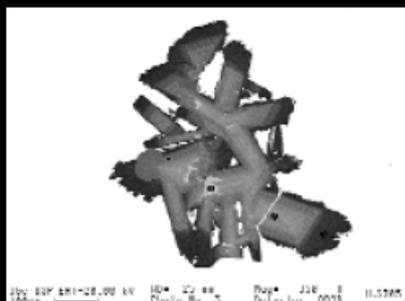


Fig. 3. Polished sections of aggregates of a roscherite-group mineral with guimarãesite peripheral zones. SEM-photos. The electron-microprobe analyses in the points 3 (on Fig. 3a), 6 (on Fig. 3b) and 4 (on Fig. 3c) correspond to guimarãesite.

Table 1. Chemical data for guimarãesite

Constituent	Wt.%,	Range	Probe Standard
CaO	9.72	9.61 – 9.79	Wollastonite
MgO	4.00	3.61 – 4.74	Diopside
MnO	2.18	0.89 – 3.26	MnTiO ₃
FeO	2.65	1.40 – 4.45	Fe
ZnO	19.06	16.33 – 20.50	Zn
Al ₂ O ₃	1.70	1.53 – 1.92	Al ₂ O ₃
P ₂ O ₅	38.20	37.61 – 38.78	LaPO ₄
BeO*	(8.975)		
H ₂ O*	(13.515)		
Total	(100.00)		

Notes: Calculated, see text

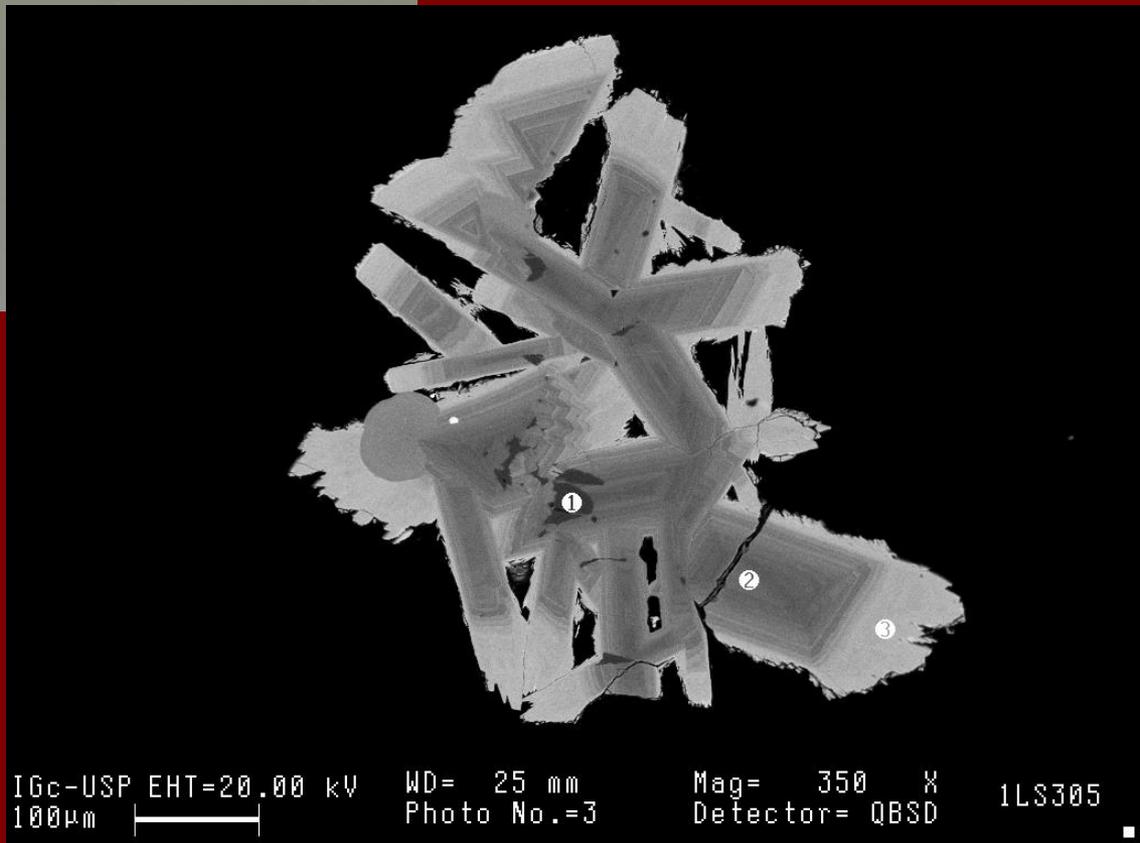
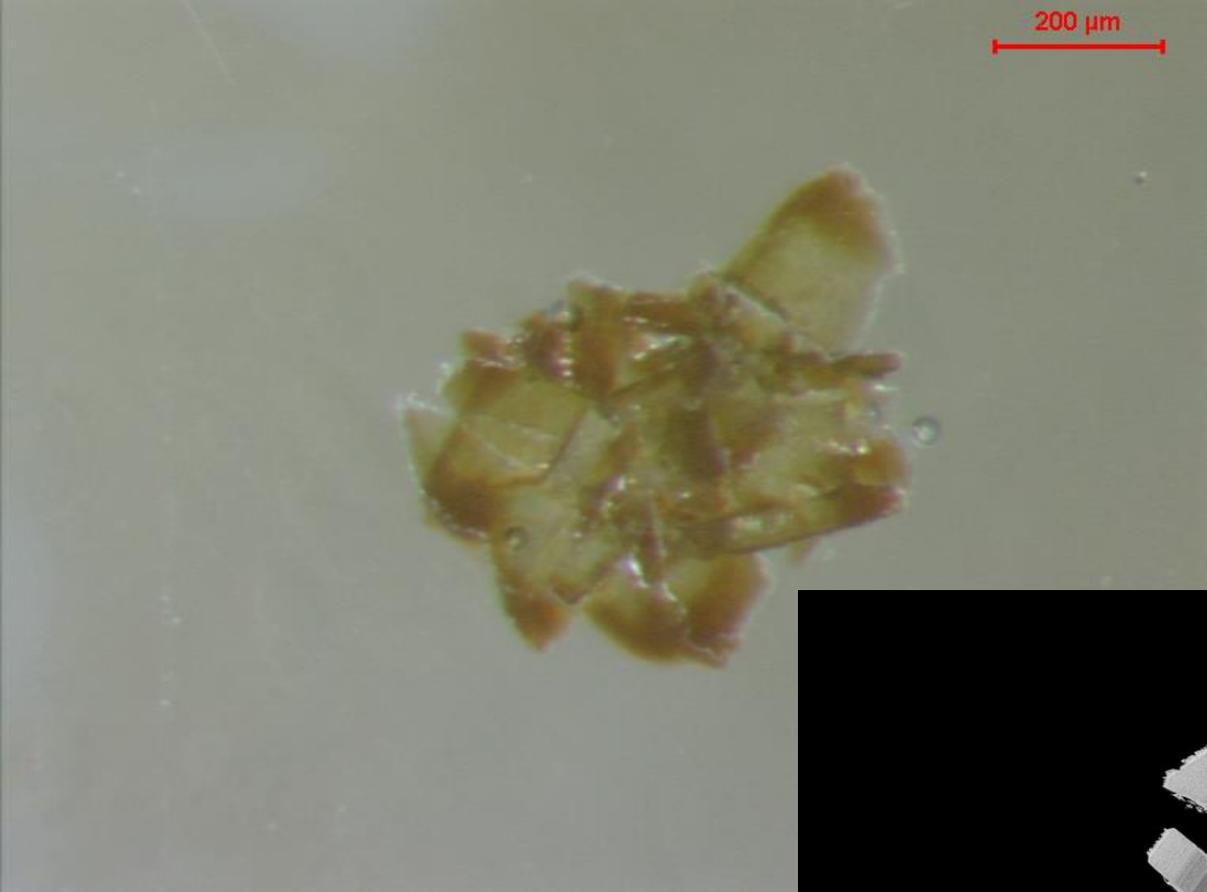
because of zonal grains. Density calculated with empirical formula is 2.963 g/cm³. By analogy with other roscherite-group minerals, guimarãesite should have perfect cleavage on {100} and good cleavage on {010}. Fracture is uneven. The crystals are not adequate for morphological observations. Forms are probably {100}, {001} and {010} (from prismatic habit). The crystals are tabular parallel to (100). Twinning was not observed.

Optical properties

Guimarãesite is biaxial, negative, α 1.596(2), β 1.600(2), γ 1.602(2); $2V_{\text{obs.}} = 55 - 75^\circ$, $2V_{\text{calc.}} = 70^\circ$. Orientation: the optical X axis coincides with the elongation direction; $Z \approx a$. The mineral shows direct extinction with respect to elongation direction. Dispersion is none observed. The mineral is none pleochroic

Table 2. X-ray powder-diffraction data for guimarãesite

$I_{\text{obs.}}$	$d_{\text{obs.}}$	$d_{\text{calc.}}$	hkl
90	9.48	9.50	110
10	7.93	7.96	200
100	5.98	5.92	020
20	5.30	5.29	111
80	4.82	4.84	310
30	4.41	4.41	021
60	3.358	3.345	-131
90	3.152	3.151	-202
70	3.052	3.046	-421
70	2.961	2.960	040
		2.957	202
70	2.841	2.838	-312
60	2.798	2.797	331
80	2.708	2.701	041
20	2.528	2.530	241
		2.528	-132
40	2.423	2.427	-422
		2.421	620
50	2.360	2.354	-512
60	2.272	2.274	-441
		2.268	531
70	2.223	2.227	332
		2.217	-151
60	2.161	2.162	350
		2.158	512, -242
10	2.093	2.092	242
50	2.036	2.039	-223
		3.033	-622, 351
50	1.995	1.999	900



NOMENCLATURA MINERALÓGICA

Daniel Atencio





AUTHENTIC REPLICAS



KRYPTONITE.

Jornada nas Estrelas – Star Trek



Figure 2. Leonard Nimoy (Mr. Spock) and William Shatner (Capt. Kirk) discussing the necklace of dilithium crystals. Photo copyright 1967 by Paramount Pictures, all rights reserved.



THE MINERALOGY OF STAR TREK

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While most mineralogy papers treat serious mineralogy, this paper will examine the mineralogy created for the imaginary universe of Star Trek in which many of us have grown up. It is meant for fun, but as Stephen Hawking wrote, “. . . today’s science fiction is often tomorrow’s science fact. The physics that underlies Star Trek is surely worth investigating. To confine our attention to terrestrial matters would limit the human spirit.” (Krauss, 1995).

Fictitious Minerals

Acetin

Occurs in swamp beds near Alixus community on an unidentified planet in the Delta quadrant. It is also the name for a real compound which is a mixture of acetic acid and glycerin. Episode: *Paradise* (DS9), 1994 [alternate spelling—Astatine?]

Antimonium

Undescribed mineral whose value greatly diminished after 2373. Because of the apparent important value ascribed to this mineral, it is clearly not antimony, which is a real mineral. Episode: *Business as Usual* (DS9), 1997

Argonite

Potentially hazardous substance. Episode: *Dr. Bashir, I Presume?* (DS9), 1997

Astatine

Although the name of a real element, one web-site reports this as the spelling for acetin. Episode: *Paradise* (DS9), 1994 [alternate spelling—Acetin]

Astiline

This ore can taint polyferranide, making it useless. Episode: *Tattoo* (VOY), 1995

Baakonite

A strong, reinforced metal used for traditional Klingon weaponry such as the bat'leth. Episode: *Blood Oath* (DS9), 1994

Bakrinium

Substance mined in the Gamma quadrant by a Vulcan geological survey team. Episode: *The Sword of Kahless* (DS9), 1995

Benomite, Bemonite

A metallic ore covering the surface of an M-class planet in the Delta quadrant. Episode: *Once Upon a Time* (VOY), 1998

ESTANDE
05

ESCOLA BÁSICA DE LINÓPOLIS
Grupo de Desenvolvimento
Profissional GDP 2008
Grupo 2

ATENCIÓDITA

Uma Escola de Linópolis

TEMA:

ATENCIÓDITA:

LIMA NOVA ESCOLA

DAS MINAS DE LINÓPOLIS.

ATENCIÓDITA

Atenciódita é a
única, rara
e exclusivamente
de Linópolis

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e exclusivamente
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UDC 549.753.1

THE ROSCHERITE GROUP AND ITS NEW REPRESENTATIVE MEMBER ATENCIOITE, $\text{Ca}_2\text{Fe}^{2+}\square\text{Mg}_2\text{Fe}_2^{2+}\text{Be}_4(\text{PO}_4)_6(\text{OH})_4\cdot 6\text{H}_2\text{O}$

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Crystal-chemical relationships between different roscherite-group minerals are discussed. General formula of monoclinic ($C2/c$) members of this group is $\text{Ca}_2D_2M_2\text{Be}_4(\text{PO}_4)_6(\text{OH})_4X_2\cdot 4\text{H}_2\text{O}$ where D and M are octahedral sites occupied by Mg, Mn^{2+} , Fe^{2+} , Fe^{3+} , Al and Zn; $X = \text{OH}$ or H_2O . The site D has a low occupancy (typically, from 1/3 to 1/2). In triclinic roscherite-group minerals above octahedral sites are subdivided into pairs of differently occupied sites; general formula of these minerals is $\text{Ca}_2D(1)D(2)M(1)_2M(2)_2\text{Be}_4(\text{PO}_4)_6(\text{OH})_4X_2\cdot 4\text{H}_2\text{O}$. A new mineral atencioite, triclinic member of the roscherite group, occurs in granite pegmatite at Linópolis, Divino das Laranjeiras, Minas Gerais, Brazil. It is associated with albite, quartz, lepidolite, beryl, muscovite, micas, monazite and ushkevite. The mineral



American Mineralogist, Volume 89, pages 721–724, 2004

Coutinhoite, a new thorium uranyl silicate hydrate, from Urucum mine, Galiléia, Minas Gerais, Brazil

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ABSTRACT

The new mineral coutinhoite, ideally $\text{Th}_x\text{Ba}_{1-2x}(\text{H}_2\text{O})_y(\text{UO}_2)_2\text{Si}_5\text{O}_{13}\cdot\text{H}_2\text{O}$, with $0 \leq x \leq 0.5$ and $0 \leq y \leq (2 + x)$, occurs as a secondary hydrothermal mineral in the Córrego do Urucum granitic pegmatite, Lavra Urucum, Galiléia Co., Minas Gerais, Brazil. Coutinhoite is intimately associated with weeksite, phosphuranylite, meta-uranocircite, and uranocircite on muscovite and microcline. The mineral forms irregular aggregates with very small curved scales, flaky crystals, up to 10 μm long and with a thickness up to about 0.5 μm . Coutinhoite is transparent to translucent and displays a waxy to silky luster; color and streak are yellow. It is non-fluorescent. The hardness is less than 2. It is brittle. Calculated density

Tecnologia :: Indústria Química

Duro na queda

Braskem produz resinas com nanotecnologia que resultam em plásticos mais resistentes

Marcos de Oliveira

Edição Impressa 132 - Fevereiro 2007

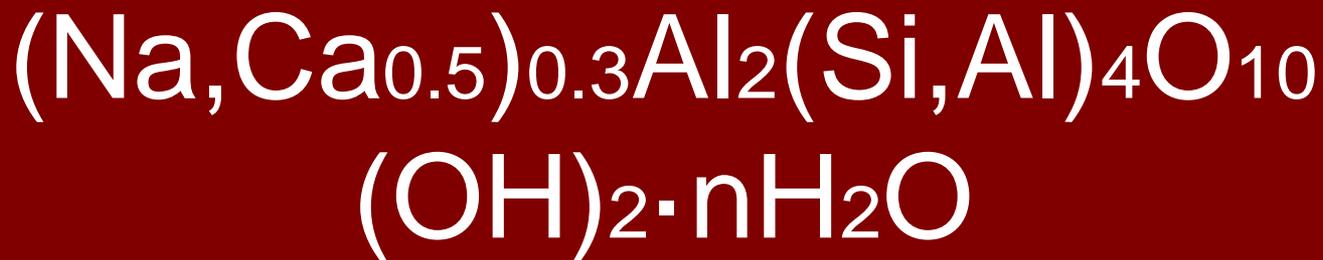
Um plástico mais rígido e resistente a impactos deverá estar em breve disponível para compor painéis e pára-choques de automóveis, gabinetes de aparelhos eletrônicos, embalagens e uma infinidade de utensílios domésticos.

A argila utilizada é formada por minerais, chamados de **betonitas e montmorilonitas**, dispostos em camadas. No processo desenvolvido pelos pesquisadores da UFRGS e da empresa, as folhas empilhadas da argila se dispersam, com espessuras de 1 nanômetro, pelo polipropileno, se fixando nas moléculas da resina e formando um material chamado de nanocompósito. “O novo material melhora o produto final com 30% a mais de rigidez e quatro vezes mais resistência a impactos”, diz o gerente de nanotecnologia da Braskem, Manoel Lisboa da Silva Neto, que trabalha junto com um grupo de oito pesquisadores, sendo quatro doutores e quatro técnicos dedicados a essa área no Centro de Tecnologia e Inovação da empresa na cidade de Triunfo, próxima a Porto Alegre. Eles fazem parte de um grupo de 170 pessoas que atuam no mesmo centro.

Bentonita:

a) montmorillonita impura.

b) beidellita



Montmorillonita



Descoberto minério que converte luz solar, calor e movimento em eletricidade

Cientistas encontraram um material com propriedades para extrair energia de várias fontes ao mesmo tempo

Por **Giselle Hirata**

© 17 fev 2017, 19h39

As energia renováveis podem ganhar uma nova fonte. Cientistas da [Universidade de Oulu](#), na Finlândia, acabam de descobrir um mineral que é capaz de transformar luz solar, calor e energia cinética em eletricidade. E o mais impressionante: tudo ao mesmo tempo.

O material é um tipo de cristal, chamado de KBNNO, que pode ser um modo alternativo de carregar aparelhos eletrônicos, como celulares e laptops, e outros apetrechos high-tech – já que ele não teria energia o suficiente para abastecer uma casa inteira.

O elemento faz parte da família *perovskita* – minerais raros que são capazes de produzir energia a partir de algumas fontes: raios solares, temperatura e movimento. Esta é a primeira vez que os pesquisadores conseguem identificar um material que possa converter as três fontes simultaneamente.

De acordo com o estudo, publicado no jornal [Applied Physics Letters](#), o KBNNO é um material ferroelétrico com moléculas polares, que funcionam como as agulhas de uma bússola. Quando são estimuladas por algum fator físico, como a mudança de temperatura, por exemplo, elas acabam se desalinhando – o que desencadeia uma corrente elétrica.

O único empecilho dessa nova descoberta seria a eficácia da produção de energia, que é menor em comparação com os *perovskitas* especializados, como a de células solares – que já são usadas em tecnologias de captação de luz. Mais baratas, já bateram o recorde de

Free

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Ferroelectric, pyroelectric, and piezoelectric properties of a photovoltaic perovskite oxide

Yang Bai^{a)}, Tuomo Siponkoski, Jani Peräntie, Heli Jantunen, and Jari Juuti

[View Affiliations](#)

Citation: Appl. Phys. Lett. **110**, 063903 (2017); doi: <http://dx.doi.org/10.1063/1.4974735>



[Polarization](#) . [Ceramics](#) . [Vacancies](#) . [Pyroelectricity](#) . [Band gap](#)

ABSTRACT

A perovskite solid-solution, $(1-x)\text{KNbO}_3-x\text{BaNi}_{1/2}\text{Nb}_{1/2}\text{O}_{3-\delta}$ (KBNNO), has been found to exhibit tunable bandgaps in the visible light energy range, making it suitable for light absorption and

A importância dos minerais

Canadian Mineralogist
Vol. 31, pp. 253-296 (1993)

MINERALS, MINERALOGY AND MINERALOGISTS: PAST, PRESENT AND FUTURE*

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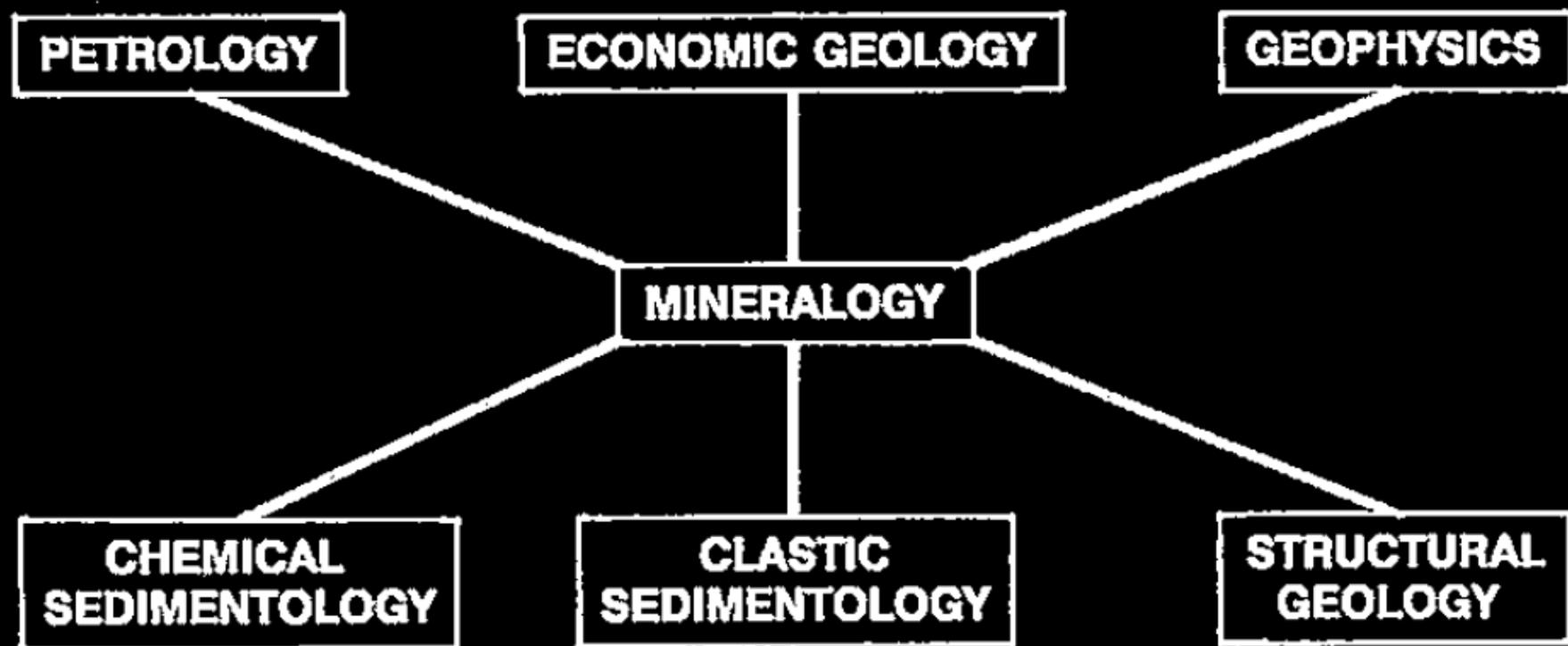


FIG. 1. The central role of Mineralogy in the Earth Sciences.

Minerals as advanced materials

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Key words minerals, advanced materials.

PACS 61.66.Fn, 81.05.Zx

A resume is given on relationships between minerals and materials. It is shown that Nature has many advantages over technology which can be profitably exploited for finding new materials with useful properties. However, Nature has also inherent limitations. Therefore, it seems advisable to use the knowledge of minerals as a treasure which can be tapped for getting inspired on the way to finding new materials. Several examples are given, including those of zorite/ETS-4/ETS-10, boracites, zircon, kesterite, a natural quasicrystal, opals, ultramarine and mayenite.

Dedicated to Prof. Wolfgang Neumann on the occasion of his 65th birthday

S. Krivovichev
(Ed.)

Minerals as Advanced Materials I

 Springer

MINERALS AS
ADVANCED
MATERIALS II



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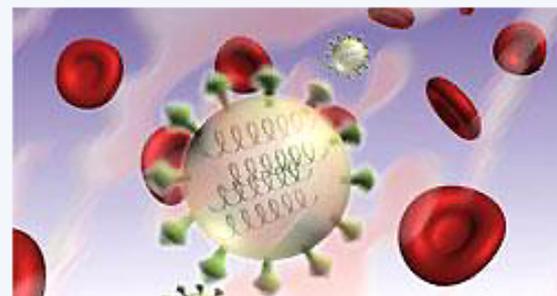
[Cientistas identificam novos genes associados ao câncer de mama.](#)

Pesquisa : Pesquisas Realizadas e em Andamento

Mineral recém-identificado poderá ajudar no combate à Aids

Tribuna da Imprensa online

Uma nova espécie mineral, a menezesita, foi identificada pelo professor Daniel Atencio, do Instituto de Geociências (IGc), da USP. Descoberta no Vale do Ribeira, é o primeiro heteropoliniobato - composto que contém agrupamentos de 12 octaedros de oxigênio cada qual com um íon de nióbio no centro - encontrado na natureza.



A substância poderá ser usada no controle de materiais radioativos e no tratamento da Aids. O mineral é classificado como heteropolimetalato - compostos que misturam metais e oxigênio. De cor avermelhada, a menezesita forma cristais dodecaédricos (com 12 lados).

Substâncias semelhantes - heteropolimetalatos - já haviam sido sintetizadas em laboratório. Diferentemente de outros heteropolimetalatos, os heteropoliniobatos são básicos em vez de ácidos, o que significa que podem sobreviver muito mais tempo e prosperar nos ambientes básicos de lixo radioativo ou neutros como o sangue. Quando estes compostos capturam um vírus na corrente sanguínea, ele não consegue mais entrar em uma célula para danificá-la.

Esses compostos também podem capturar elementos radioativos, como urânio e tório, removendo-os dos resíduos de instalações nucleares, através de separação de fase. Isso permitirá armazenamento mais fácil e seguro do lixo atômico.

Coletado no final da década de 1970, na cidade de Cajati (SP) em uma rocha denominada carbonatito, a menezesita foi encaminhada pelo engenheiro de minas Luiz Alberto Dias Menezes Filho para identificação somente em maio de 2003. O nome da substância homenageia seu descobridor. O estudo sobre o mineral está sendo preparado e será submetido ao periódico "American Mineralogist" para posterior publicação. (Agência SP Notícias)

08/08/05

Menezesite, the first natural heteropolyniobate, from Cajati, São Paulo, Brazil: Description and crystal structure

**DANIEL ATENCIO,^{1,*} JOSÉ M.V. COUTINHO,¹ ANTONIO C. DORIGUETTO,² YVONNE P. MASCARENHAS,³
JAVIER ELLENA,² AND VIVIANE C. FERRARI¹**

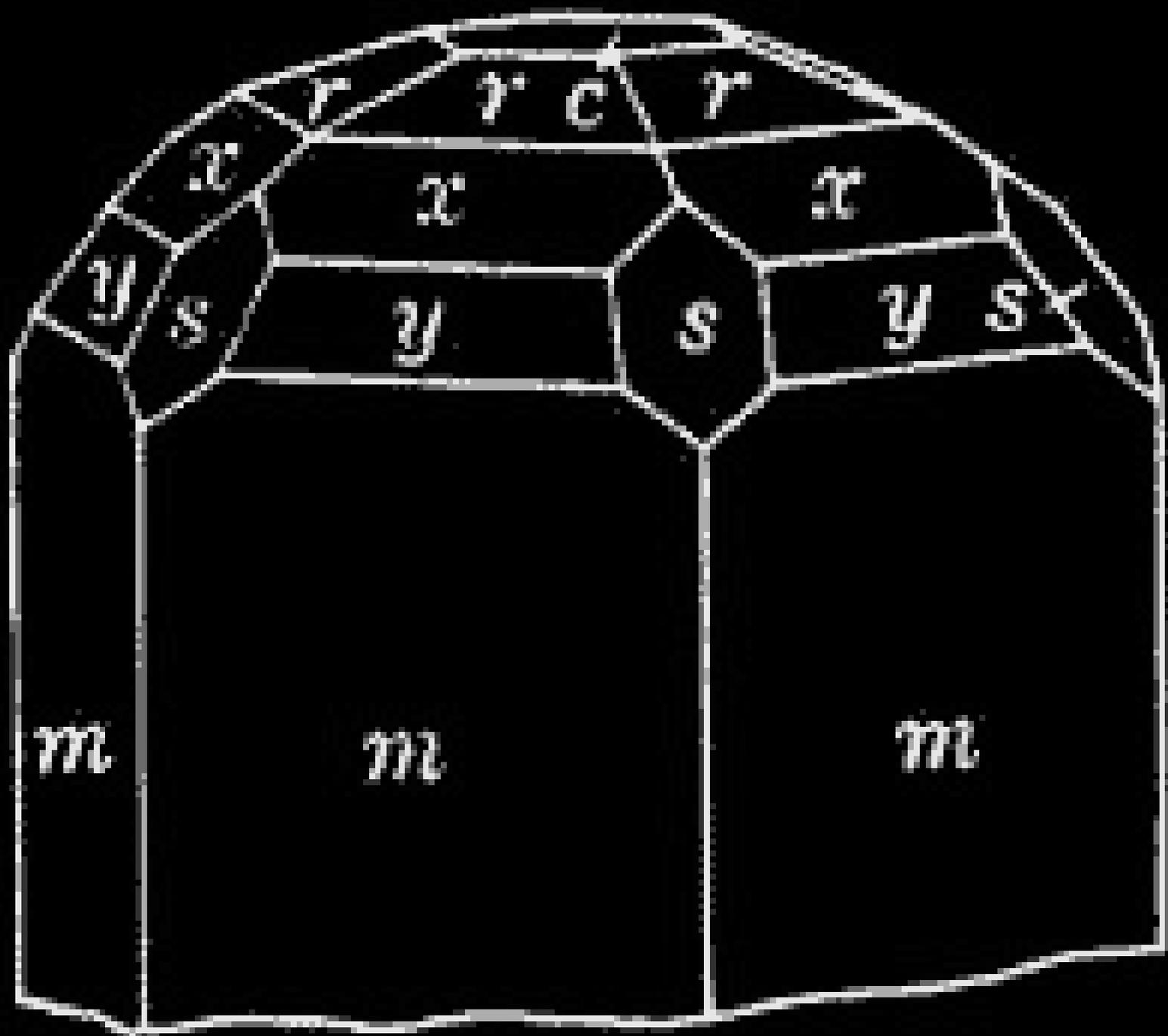
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ABSTRACT

Menezesite, ideally $\text{Ba}_2\text{MgZr}_4(\text{BaNb}_{12}\text{O}_{42}) \cdot 12\text{H}_2\text{O}$, occurs as a vug mineral in the contact zone between dolomite carbonatite and “jacupirangite” (=a pyroxenite) at the Jacupiranga mine, in Cajati county, São Paulo state, Brazil, associated with dolomite, calcite, magnetite, clinohumite, phlogopite, ancylite-(Ce), strontianite, pyrite, and tochilinite. This is also the type locality for quintinite-2H. The mineral forms rhombododecahedra up to 1 mm, isolated or in aggregates. Menezesite is transparent and displays a vitreous luster; it is reddish brown with a white streak. It is non-fluorescent. Mohs hardness is about 4. Calculated density derived from the empirical formula is 4.181 g/cm^3 . It is isotropic, $n_{\text{meas}} >$

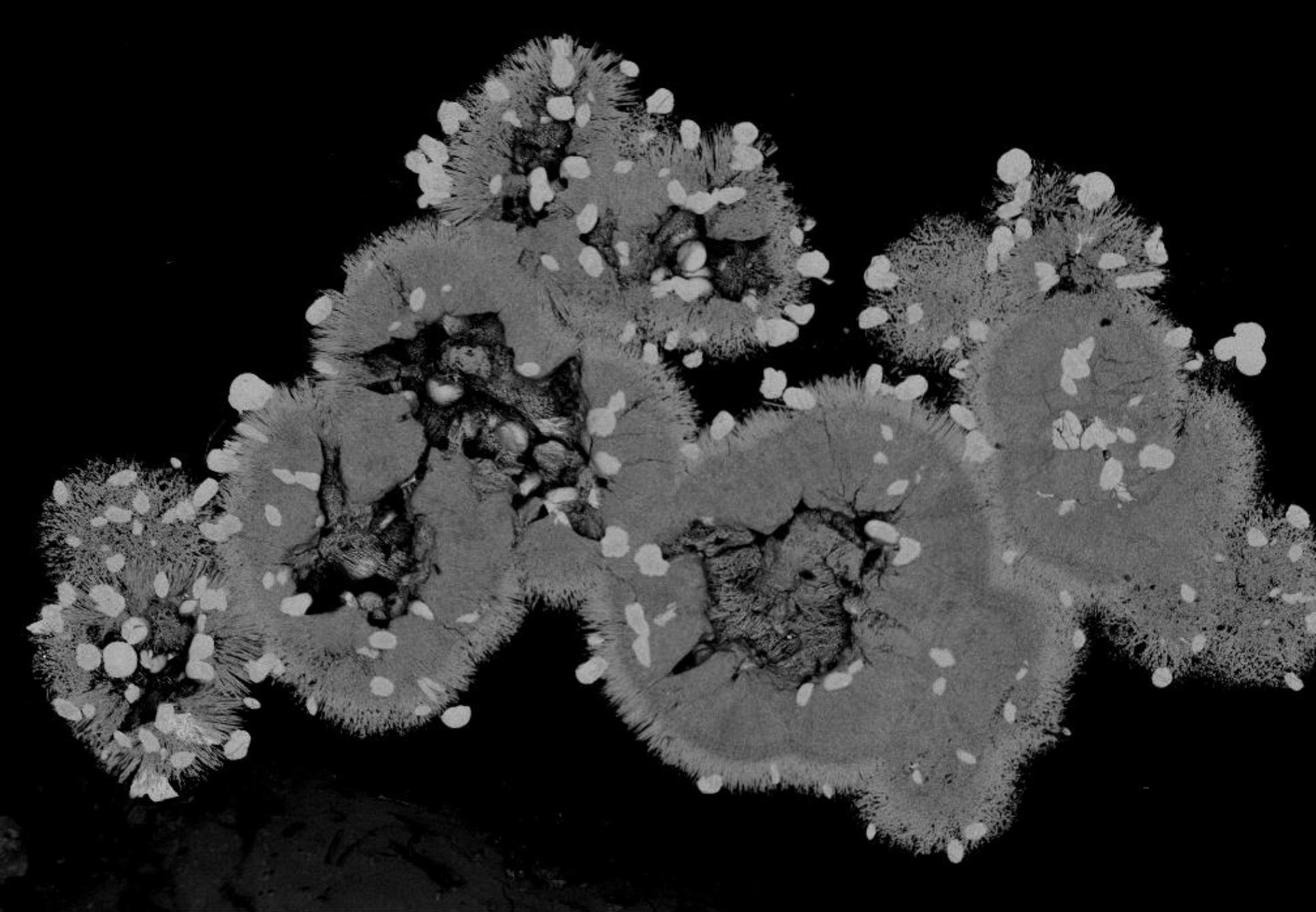




Malaquita

Hábito botrioidal





200µm
|-----|

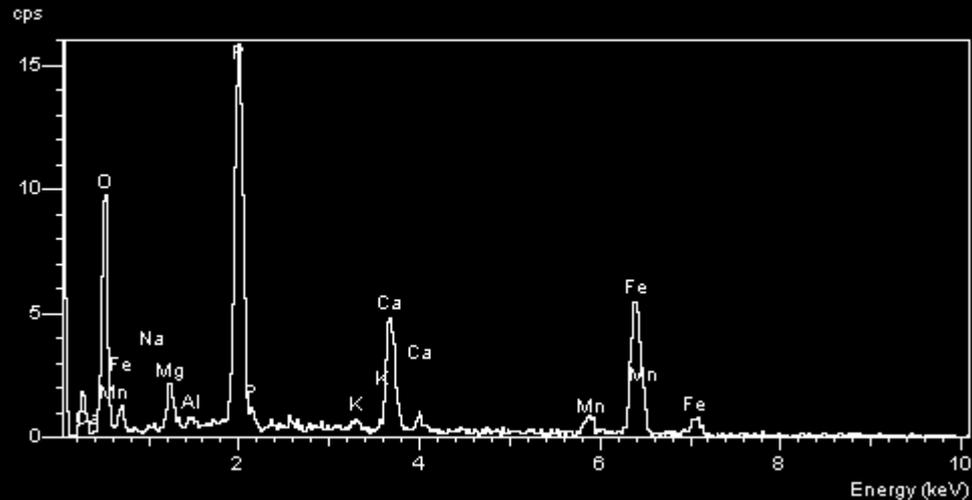
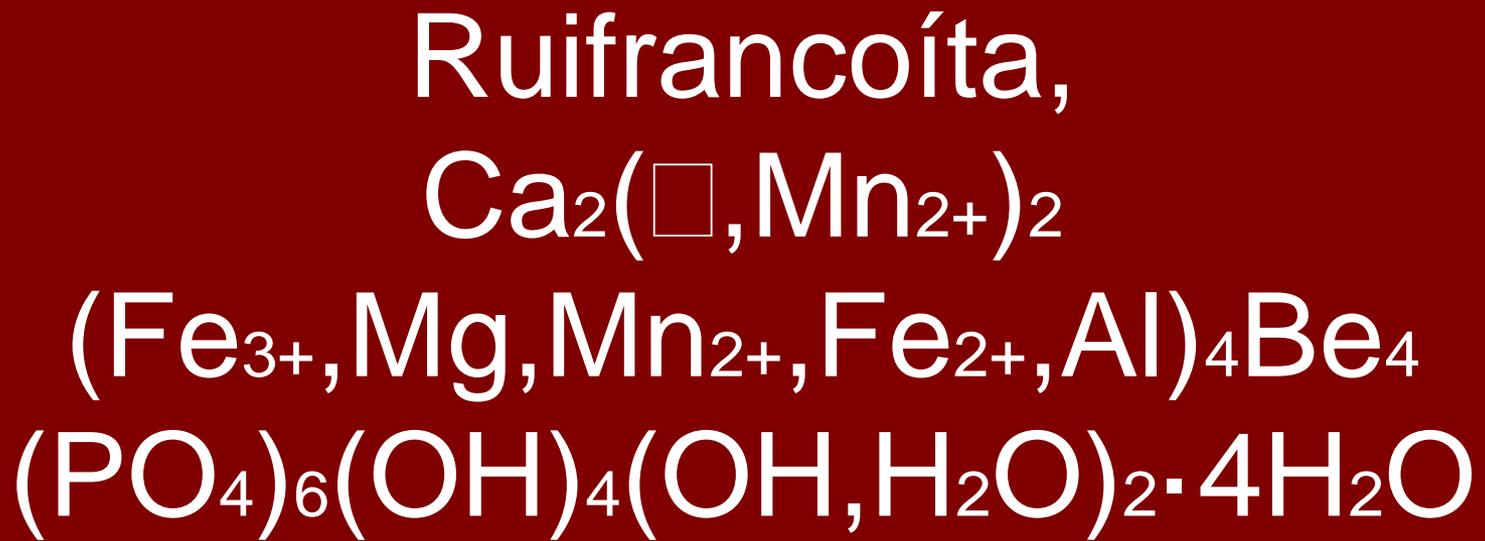
WD = 25 mm

Detector = QBSD
EHT = 20.00 kV

Mag = 50 X

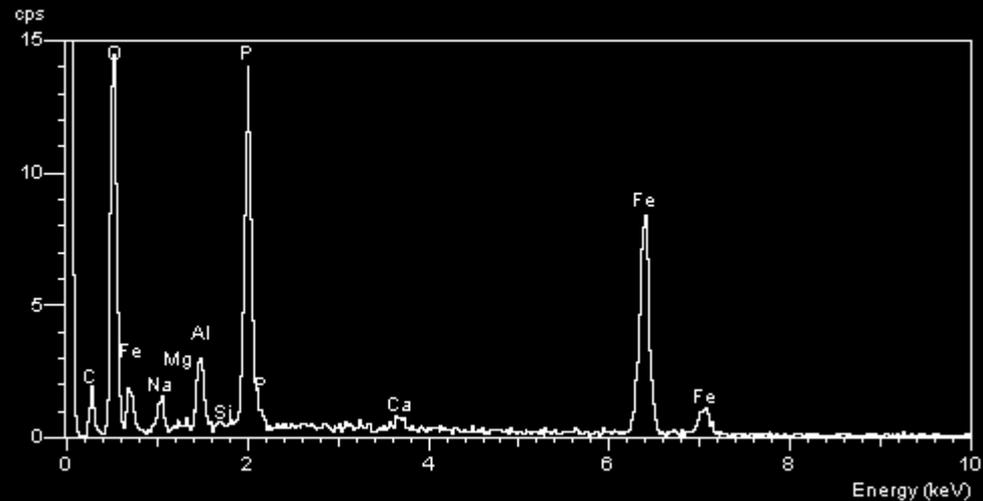
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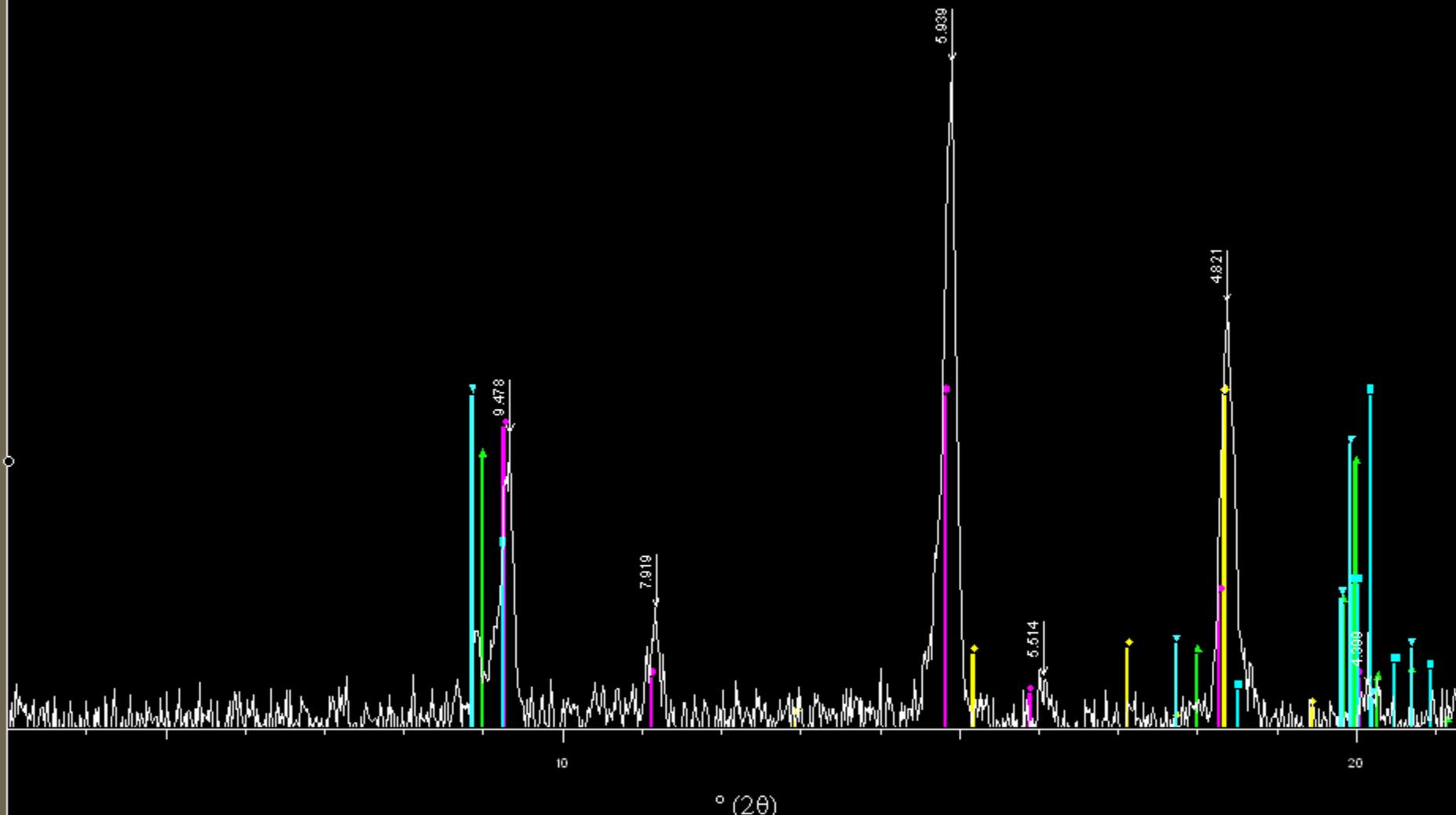
S1



Cyrilovita -

$\text{NaFe}_{3+3}[(\text{OH})_2|\text{PO}_4]_2 \cdot 2\text{H}_2\text{O}$





Site to - File: Site to.RAW - Type: 2 θ / θ locked - Start: 3.00 ° - End: 80.00 ° - Step: 0.02 ° - Step time: 5. s - Temp.: 25 °C (Room) - Time Started: 36 s - 2-Theta: 3.00 ° - Tilt: 1.50 ° - Phi: 0.00 ° - Ax1: 0.0 - Ax2: 0.0 - Ax3: 0.0
 85-1315 (C) - Cynilovite - NaFe₃(OH)₄(PO₄)₂(H₂O)₂ - Y: 50.00 % - d x by: 1. - WL: 1.54056 - Tetragonal - a 7.31300 - b 7.31300 - c 19.31500 - alpha 90.000 - beta 90.000 - gamma 90.000 - P 11212 (C2) - 4 - 1032.97
 11-0355 (I) - Roscherite-M - (Ca,Mn)₃Fe₃(PO₄)₃O₃H₃O₂ - Y: 50.00 % - d x by: 1. - WL: 1.54056 - Monoclinic - a 15.972 - b 11.934 - c 6.622 - alpha 90.000 - beta 95.25 - gamma 90.000 - Base-center - C2/c (15) - 4 - 1256.9
 85-2147 (C) - Mis covite 2M1 - (Na_{0.37}K_{0.60})(Al_{1.84}Ti_{0.02}Fe_{0.10}Mg_{0.06})(S_{0.03}A_{0.97})O₁₀(OH)₂ - Y: 50.00 % - d x by: 1. - WL: 1.54056 - Monoclinic - a 5.174 - b 8.975 - c 19.76999 - alpha 90.000 - beta 95.2 - gamma 90.000
 86-1386 (C) - Mis covite 2M1 - (K_{0.94}Al_{1.96})(AD_{0.95}SD_{0.05})O₁₀(OH)_{1.744}F_{0.256} - Y: 50.00 % - d x by: 1. - WL: 1.54056 - Monoclinic - a 5.18050 - b 8.99400 - c 20.08600 - alpha 90.000 - beta 95.740 - gamma 90.000 - Base-center
 82-2452 (C) - Mis covite 2M1 - (Na_{0.37}K_{0.60})(Al_{1.84}Ti_{0.02}Fe_{0.10}Mg_{0.06})(S_{0.03}A_{0.97})O₁₀(OH)₂ - Y: 50.00 % - d x by: 1. - WL: 1.54056 - Monoclinic - a 5.130 - b 8.886 - c 19.241 - alpha 90.000 - beta 95.5 - gamma 90.000

Glossary of Mineral Synonyms

Jeffrey de Fourestier



The Canadian
Mineralogist **2**
Special Publication

Glossary of OBSOLETE MINERAL NAMES



PETER BAYLISS

GLOSSARY
OF
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NAMES

Peter Bayliss

The Mineralogical Record Inc.

Tucson

First edition, 2000
Second edition, 2011

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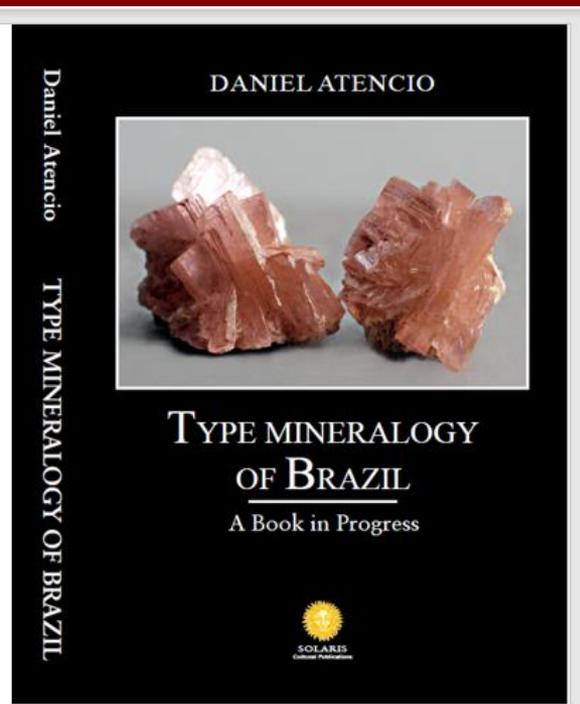
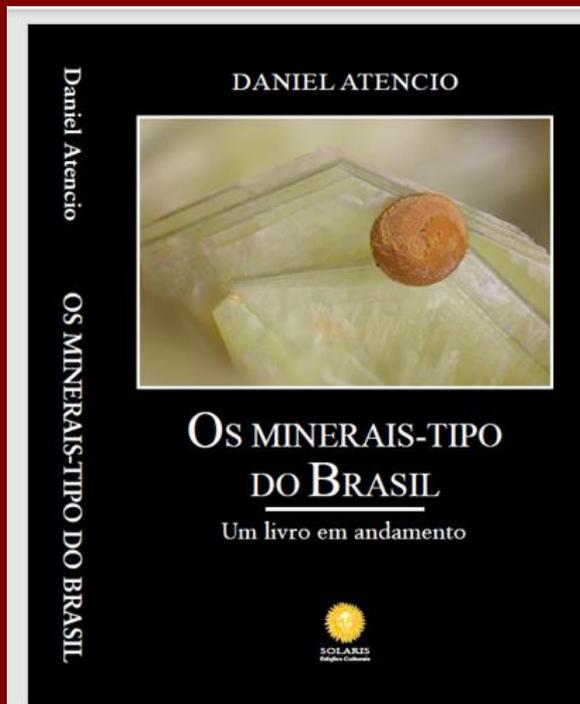
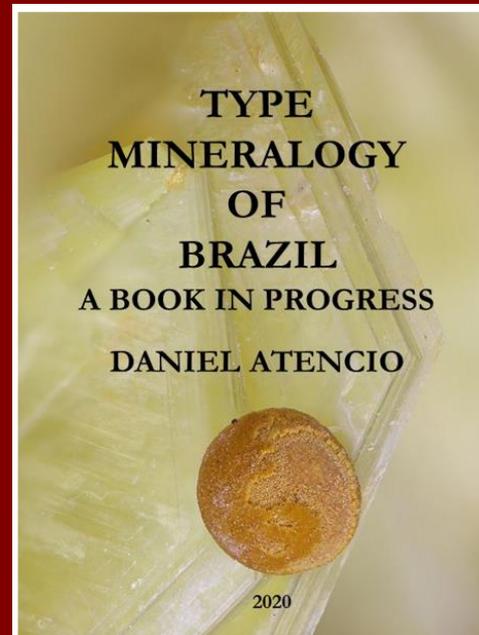
TYPE MINERALOGY OF BRAZIL

(Preliminary edition)

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International Mineralogical Association Commission on New Minerals, Nomenclature and Classification

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The **Commission on New Minerals, Nomenclature and Classification** (CNMNC) of the **International Mineralogical Association** (IMA) was formed in July 2006 by a merger between the **Commission on New Minerals and Mineral Names** (CNMMN) and the Commission on Classification of Minerals, at the request of both commissions. The Chairman has published a [paper](#) on this merger in Elements, Vol. 2, p. 388. The Commission on New Minerals and Mineral Names (CNMMN) was established in 1959 for the purpose of controlling the introduction of new minerals and mineral names, and of rationalising mineral nomenclature. Since that time, the work of the CNMMN has gained overwhelming support from the international mineralogical community. Please consult a [review](#) of the Commission activities. An official IMA-CNMMN list of Mineral Names can be accessed on the IMA list of minerals page of the web site.

The CNMNC consists of representatives appointed by national mineralogical bodies, and an executive committee consisting of chairman, two vice-chairmen and secretary, see the [list of current members](#).

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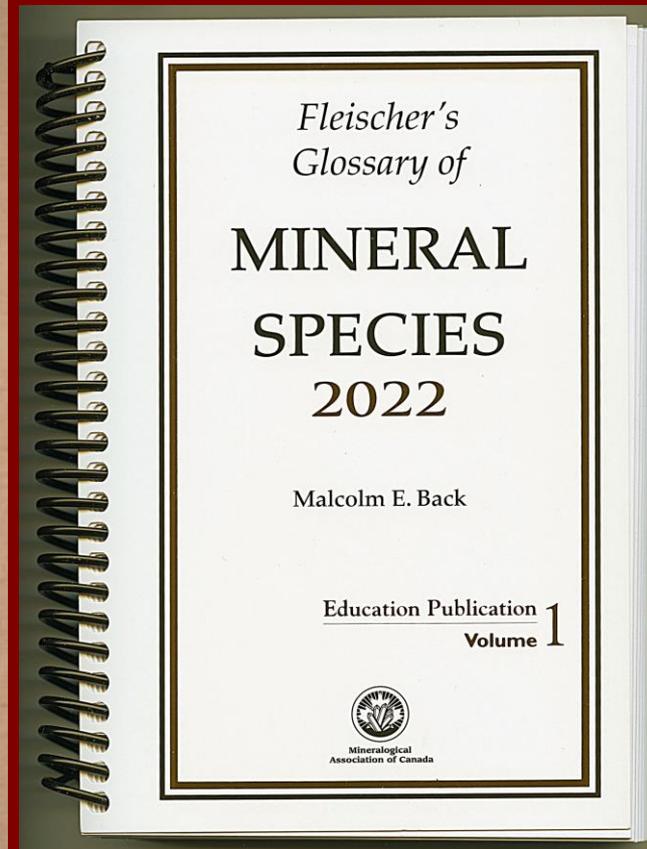
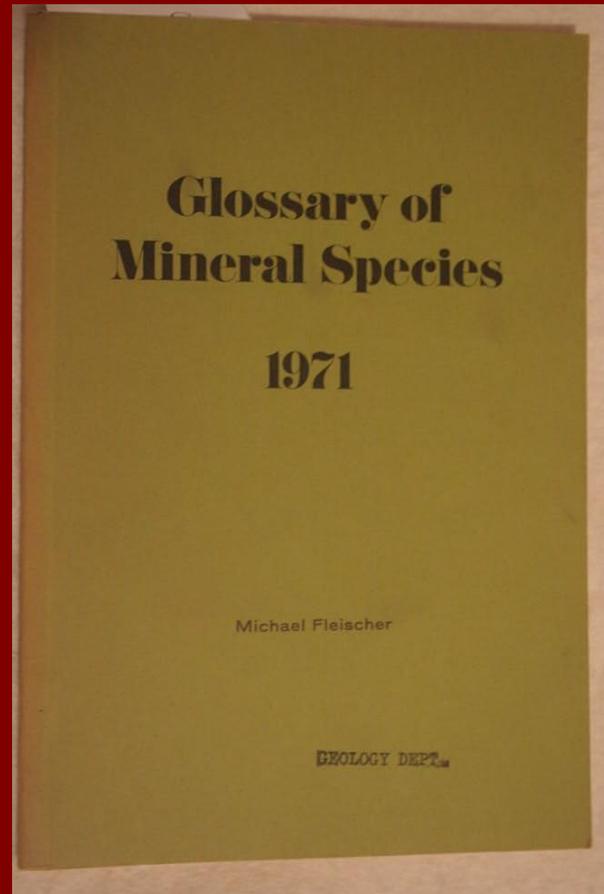


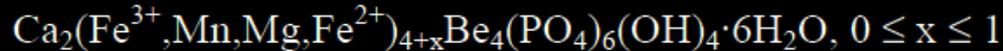
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Canadian Museum of Nature

P.O. Box 3443, Station D, Ottawa, Ontario K1P 6P4, Canada

Michael Fleischer



2005-061 RUIFRANCOITE

Monoclinic Space Group: *C2/c*

a 15.93(1) Å *b* 11.86(1) Å *c* 6.635(5) Å β 96(1)°

V 1247 Å³ *Z* = 2

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OCCURRENCE

The mineral occurs in a granite pegmatite at the Sapucaia (Proberil) mine, Sapucaia do Norte, Galiléia county, Minas Gerais, Brazil.

Ruifrancoite is associated with cyrilovite and meurigite on albite and muscovite.

Several other phosphates have been mentioned from this quarry: frondelite, faheyite, moraesite, barbosalite, tavorite, “manganoan lipscombite”, apatite, bermanite, childrenite, gordonite, heterosite, huréaulite, leucophosphite, phosphosiderite, montebrasite, “roscherite” (probably ruifrancoite), saleeite, strengite, variscite, vivianite, dufrenite, ferrisicklerite, lazulite, sabugalite, rockbridgeite, wardite, scorzalite, herderite, phosphuranylite, autunite, jahnsite, arrojadite, johnsomervilleite, augelite, berlinite, strunzite, robertsite, mitridatite, cacoxenite, beraunite, laueite, xenotime-(Y), monazite-(Ce), whiteite-(MnFeMg), a mineral similar to kidwellite (probably meurigite), a metamict phosphate, and

The Canadian Mineralogist
Vol. 40, pp. 1721-1735 (2002)

THE NAMING OF MINERAL SPECIES APPROVED BY THE COMMISSION ON NEW MINERALS AND MINERAL NAMES OF THE INTERNATIONAL MINERALOGICAL ASSOCIATION: A BRIEF HISTORY

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ABSTRACT

I present an overview of the origins and the history of the CNMMN, the naming of mineral species and the IMA system for numbering those new species. Where published, the equivalence between an IMA number and a name or composition is provided. I discuss the manner in which these IMA numbers came to be published, as they were originally confidential, and many still are. I highlight the role of various individuals in creating the system for naming mineral species as it exists today.

Keywords: Commission on New Minerals and Mineral Names, CNMMN, Committee on Nomenclature and Classification of Minerals, grandfather clause, history, IMA, IMA numbers, International Mineralogical Association, nomenclature.

SOMMAIRE

COMMISSION ON NEW MINERALS AND MINERAL NAMES

Appendix 3

GROWTH OF THE MINERAL KINGDOM CUMULATIVE

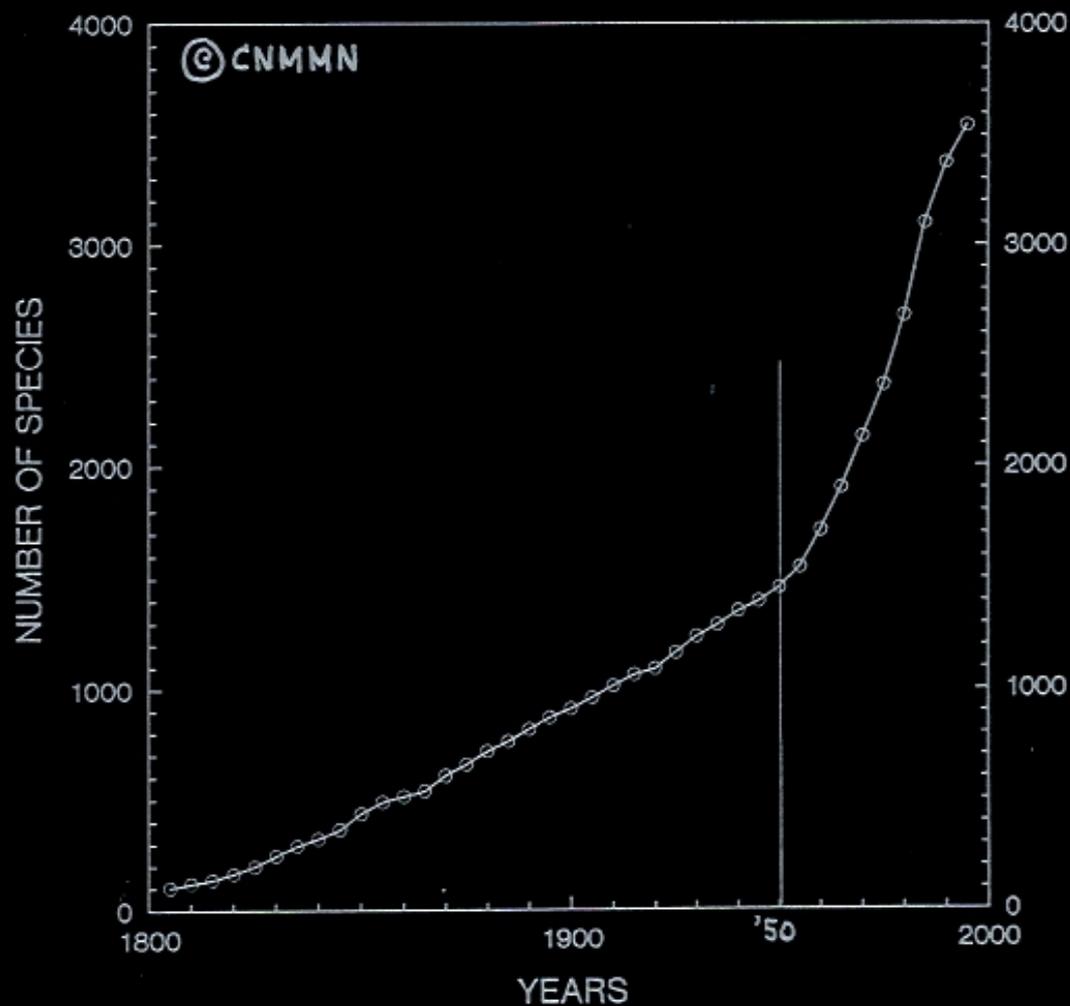


TABLE 1. NUMBER OF NEW MINERALS APPROVED BY IMA-CNMMN
IN THE PERIOD 1959-1979

List	Date prepared	No. of new minerals	No. of voting representatives ¹
1959	15 March 1961	36	6
1960	6 October 1961	25	9
1961	15 July 1963	29	10
1963	12 April 1965	49	13
1964	2 September 1967	33	10-16
1965	?	41	12-18
1966	June 1968	35	13-17
1967	June 1969	48	13-19
1968	29 August 1970	38	14-20
1969	(June 1972)	37	9-20
1970	(March 1973)	39	13-20
1972	17 September 1974	38	13-22
1975	?	48	13-21
1976	?	42	16-22
1977	?	55	14-21
1978	?	64	9-22
1979	?	70	14-20

¹ The number of voting members varied depending on the mineral.

The New IMA List of Minerals – A Work in Progress – Updated: January 2025

In the following pages of this document a comprehensive list of all valid mineral species is presented. The list is distributed (for terms and conditions see below) *via* the web site of the Commission on New Minerals, Nomenclature and Classification of the International Mineralogical Association, which is the organization in charge for approval of new minerals, and more in general for all issues related to the status of mineral species. The list, which will be updated on a regular basis, is intended as the primary and official source on minerals.

Explanation of column headings:

Name: it is the presently accepted mineral name (and in the table, minerals are sorted by name). Mineral names are common nouns, and thus have an initial capital letter only at the beginning of a sentence, or when they occur in an index or in a table, as in the current list

CNMMN/CNMNC approved formula: it is the chemical formula of the mineral.

IMA status: A = approved (it applies to minerals approved after the establishment of the IMA in 1958); G = grandfathered (it applies to minerals discovered before the birth of IMA, and generally considered as valid species); Rd = redefined (it applies to existing minerals which were redefined during the IMA era); Rn = renamed (it applies to existing minerals which were renamed during the IMA era); Q = questionable (it applies to poorly characterized minerals, whose validity could be doubtful).

IMA No. / Year: for approved minerals the IMA No. is given: it has the form XXXX-YYY, where XXXX is the year and YYY a sequential number; for grandfathered minerals the year of the original description is given. In some cases, typically for Rd and Rn minerals, the year may be followed by s.p. (special procedure): it refers to the year in which a specific action (redefinition and/or renaming) took place, and was approved by IMA. This may be related to the approval of a report by a dedicated subcommittee on a given group of minerals.

Country: it is the country in which the mineral was discovered for the first time (according to the national boundaries as of today).

First reference: it is the original reference for each mineral.

Second reference: it is the most recent or most complete reference for each mineral, possibly including a crystal structure study.

Caveat (IMPORTANT): the list includes selected information on the **6118** currently valid species; inevitably there will be mistakes in it. We will be grateful to all those who will point out errors of any kind, including typos. Please email your corrections to marco.pasero@unipi.it.

Acknowledgments: The following persons, listed in alphabetic order, gave their contribution to the building and the update of the IMA List of Minerals: Malcolm Back. Cristian Biadoni. William D. Birch. Michel Blondieau. Hans-Peter Boiar. Louis J. Cabri. Jerv Carter. Marco E. Ciriotti. Patricio Cuadra

Name	CNMMN/CNMNC approved formula	IMA Status	IMA No. / Year	Country	First reference	Second reference
Abellaite	NaPb ₂ (CO ₃) ₂ (OH)	A	2014-111	Spain	<i>European Journal of Mineralogy</i> 29 (2017), 915	
Abelsonite	NiC ₃₁ H ₃₂ N ₄	A	1975-013	USA	<i>American Mineralogist</i> 63 (1978), 930	<i>American Mineralogist</i> 102 (2017), 1129
Abenakiite-(Ce)	Na ₂₆ Ce ₆ (Si ₆ O ₁₈)(PO ₄) ₆ (CO ₃) ₆ (SO ₂)O	A	1991-054	Canada	<i>Canadian Mineralogist</i> 32 (1994), 843	
Abernathyite	K(UO ₂)(AsO ₄)·3H ₂ O	G	1956	USA	<i>American Mineralogist</i> 41 (1956), 82	<i>American Mineralogist</i> 49 (1964), 1578
Abhurite	Sn ²⁺ ₂₁ O ₈ (OH) ₁₄ Cl ₁₆	A	1983-061	Saudi Arabia	<i>Canadian Mineralogist</i> 23 (1985), 233	<i>Canadian Mineralogist</i> 41 (2003), 659
Abramovite	Pb ₂ SnInBiS ₇	A	2006-016	Russia	<i>Zapiski Rossiyskogo Mineralogicheskogo Obshchestva</i> 136(5) (2007), 45	
Abswurbachite	Cu ²⁺ Mn ³⁺ ₆ O ₈ (SiO ₄)	A	1990-007	Greece	<i>Neues Jahrbuch für Mineralogie Abhandlungen</i> 163 (1991), 117	
Abuie	CaAl ₂ (PO ₄) ₂ F ₂	A	2014-084	Japan	<i>Journal of Mineralogical and Petrological Sciences</i> 112 (2017), 109	
Acanthite	Ag ₂ S	G	1855	Czech Republic	<i>Annalen der Physik und Chemie</i> 95 (1855), 462	<i>Superlattices and Microstructures</i> 83 (2015), 35
Acetamide	CH ₃ CONH ₂	A	1974-039	Ukraine	<i>Zapiski Vsesoyuznogo Mineralogicheskogo Obshchestva</i> 104 (1975), 326	<i>Journal of Physical Chemistry</i> 96 (1992), 668
Achalaite	Fe ²⁺ TiNb ₂ O ₈	A	2013-103	Argentina	<i>Canadian Mineralogist</i> 54 (2016), 1043	
Achávalite	FeSe	Rn	1939	Argentina	<i>Boletín de la Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba</i> 2 (1939), 73	<i>Neues Jahrbuch für Mineralogie Monatshefte</i> (1972), 276
Achyrophanite	(K,Na) ₃ (Fe ³⁺ ,Ti,Al,Mg) ₅ O ₂ (AsO ₄) ₅	A	2018-011	Russia	CNMNC Newsletter 43 - <i>Mineralogical Magazine</i> 82 (2018), 779; <i>European Journal of Mineralogy</i> 30 (2018), 647	
Acmonidesite	(NH ₄ ,K,Pb,Na) ₉ Fe ²⁺ ₄ (SO ₄) ₅ Cl ₆	A	2013-068	Italy	<i>Mineralogical Magazine</i> 83 (2019), 137	
Actinolite	□Ca ₂ (Mg _{4.5-2.5} Fe ²⁺ _{0.5-2.5})Si ₈ O ₂₂ (OH) ₂	Rd	2012 s.p.	Germany / Austria	<i>Elements of Mineralogy</i> , 2nd ed., vol. 1. Elmsly, London (1794), 167	<i>American Mineralogist</i> 83 (1998), 458
Acuminite	SrAlF ₄ (OH)·H ₂ O	A	1986-038	Denmark (Greenland)	<i>Neues Jahrbuch für Mineralogie Monatshefte</i> (1987), 502	<i>Zeitschrift für Kristallographie</i> 194 (1991), 221
Adachiite	CaFe ²⁺ ₃ Al ₆ (Si ₆ AlO ₁₈)(BO ₃) ₃ (OH) ₃ (OH)	A	2012-101	Japan	<i>Journal of Mineralogical and Petrological Sciences</i> 109 (2014), 74	
Adamite	Zn ₂ (AsO ₄)(OH)	G	1866	Chile	<i>Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences</i> 62 (1866), 692	<i>Zeitschrift für Kristallographie</i> 238 (2023), 355
Adamsite-(Y)	NaY(CO ₃) ₂ ·6H ₂ O	A	1999-020	Canada	<i>Canadian Mineralogist</i> 38 (2000), 1457	
Adanite	Pb ₂ (Te ⁴⁺ O ₃)(SO ₄)	A	2019-088	USA	<i>Canadian Mineralogist</i> 58 (2020), 403	
Addischoffite	Ca ₂ Al ₆ Al ₆ O ₂₀	A	2015-006	Algeria (meteorite)	<i>American Mineralogist</i> 102 (2017), 1556	

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LIROCONITE
 (From The System of Mineralogy, Vol.II, p. 921)

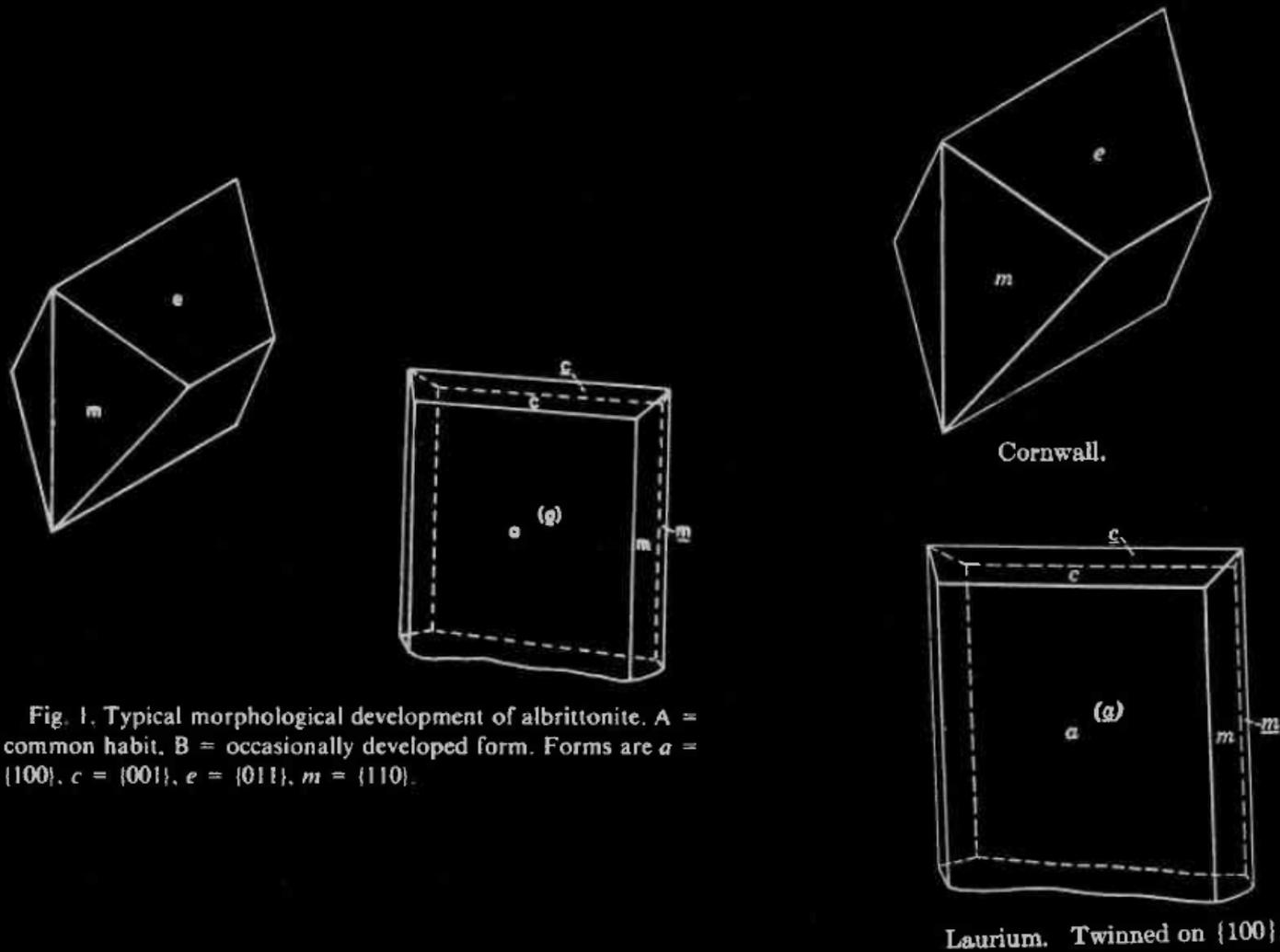


Fig. 1. Typical morphological development of albrittonite. A = common habit. B = occasionally developed form. Forms are $a = \{100\}$, $c = \{001\}$, $e = \{011\}$, $m = \{110\}$.

PARALAUIONITE

(From The System of Mineralogy, Vol.II, p. 65)

Fig. 1. Copy of Fig. 1 from Crook and Marcotty (1978), said to be "typical morphological development of albrittonite" (on the left), together with copies of figures (on the right) of crystals of liroconite and paralaurionite from Vol. II of *The System of Mineralogy*.

PINAKIOLITE

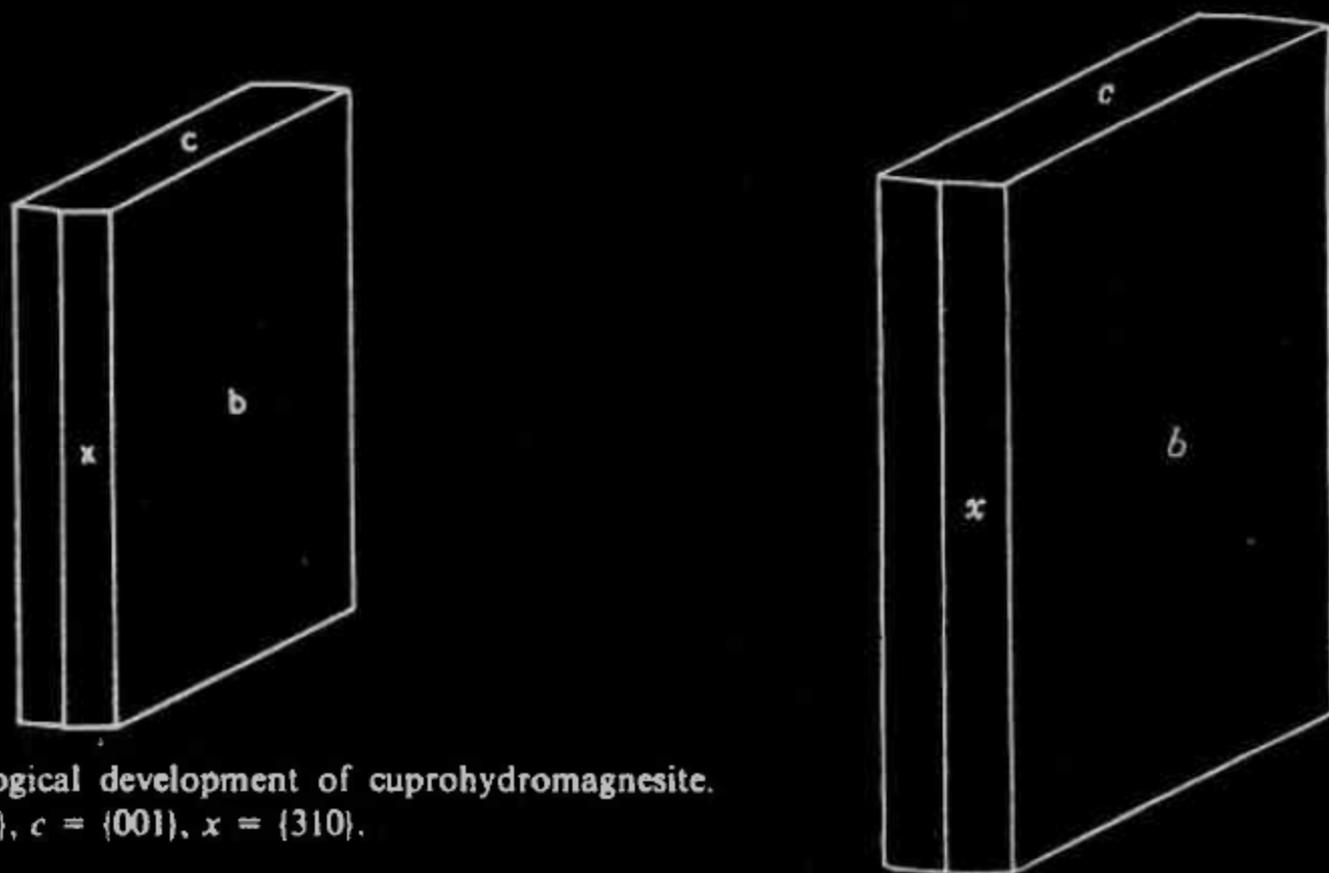


Fig. 1. Morphological development of cuprohydromagnesite.
Forms are $b = \{010\}$, $c = \{001\}$, $x = \{310\}$.

(From The System of Mineralogy,
Vol. II, p. 325)

American Mineralogist, Volume 67, pages 156–169, 1982

**New data on and discreditation of “texasite,” “albrittonite,” “cuproartinite,”
“cuprohydromagnesite,” and “yttromicrolite,” with corrected data on nickelbischofite,
rowlandite, and yttrocrasite**

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Abstract

THE IMA COMMISSION ON NEW MINERALS AND MINERAL NAMES: PROCEDURES AND GUIDELINES ON MINERAL NOMENCLATURE, 1998

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INTRODUCTION

The Commission on New Minerals and Mineral Names (hereafter abbreviated as CNMMN) of the International Mineralogical Association was established in 1959 for the purpose of controlling the introduction of new minerals and mineral names, and of rationalizing mineral nomenclature. Since that time, the work of CNMMN has gained overwhelming support from the international mineralogical community. The CNMMN consists of representatives appointed by national mineralogical bodies, and an executive committee

coherent guidelines that provide a reasonably consistent approach to the introduction of new minerals and the application of mineral nomenclature. The guidelines presented herein probably apply reasonably well to the great majority of cases, but inevitably situations arise that do not conform so readily. As is mentioned several times in the text, each case must be judged on its own merits.

CRITERIA FOR A NEW MINERAL SPECIES

General considerations

COMISSÃO DE NOVOS MINERAIS E NOMES DE MINERAIS DA IMA: PROCEDIMENTOS E DIRETRIZES SOBRE NOMENCLATURA MINERALÓGICA, 1998

ERNEST H. NICKEL* & JOEL D. GRICE**

Traduzido do original em inglês, *THE IMA COMMISSION ON NEW MINERALS AND MINERAL NAMES: PROCEDURES AND GUIDELINES ON MINERAL NOMENCLATURE*, 1998, com autorização da IMA, por

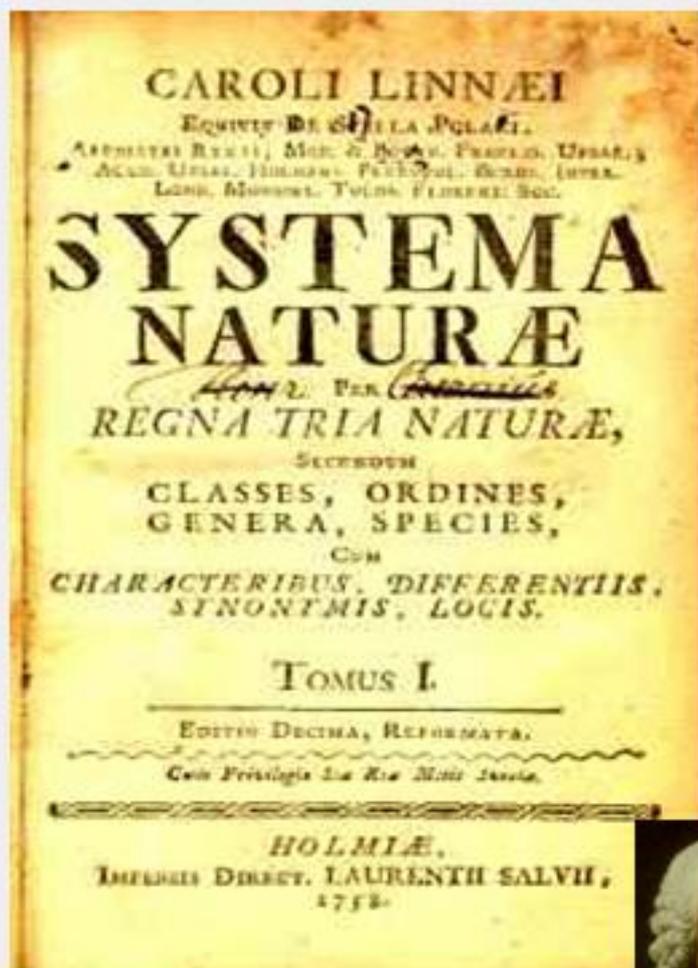
DANIEL ATENCIO***

INTRODUÇÃO A Comissão de Novos Minerais e Nomes de Minerais (CNMNM) da Associação Mineralógica Internacional (IMA) foi estabelecida em 1959, com o propósito de controlar a introdução de novos minerais e nomes de minerais, e de racionalizar a nomenclatura mineralógica. Desde aquela data, o trabalho da CNMNM ganhou apoio preponderante da comunidade mineralógica internacional. A CNMNM é constituída por representantes designados por associações mineralógicas nacionais, e um comitê executivo que consiste em presidente, vice-presidente e secretário. A lista dos membros atuais é fornecida no Apêndice I.

As atividades da CNMNM e suas diversas recomendações para nomenclatura mineralógica foram amplamente divulgadas em um número significativo de periódicos mineralógicos durante vários anos, e há uma clara necessidade de unir estas informações para prover um relatório atualizado sobre os procedimentos seguidos pela CNMNM, bem como fornecer diretrizes atualizadas em nomenclatura mineral.

Este artigo fornece um nome único. Critérios gerais para definir espécies minerais são fornecidos abaixo. Na prática, a maioria das espécies minerais se conforma a estes critérios, mas exceções e casos incertos surgirão inevitavelmente, e, em última instância, cada proposta para introduzir uma espécie mineral nova ou mudar a nomenclatura mineralógica deve ser considerada em seus próprios méritos.

O conceito de espécie mineral Uma espécie mineral é definida principalmente com base em sua composição química e suas propriedades cristalográficas, e estas devem ser, então, os fatores-chaves determinantes para a criação de uma espécie mineral nova e um nome mineralógico. Se for encontrado um mineral de composição e/ou propriedades cristalográficas substancialmente diferentes daquelas de qualquer espécie mineral existente, há uma possibilidade de que possa ser uma espécie nova. Uma diretriz geral para critérios composicionais é que pelo menos uma posição estrutural



Lineu e a sua obra



NOMENCLATURA regras básicas

- Regras de nomenclatura – tiveram origem nos trabalhos de Lineu e foram actualizadas pelas **Comissões Internacionais de Nomenclatura** – associações de taxonomistas que oficializam os nomes científicos dos seres vivos, que são os mesmos para todo o Mundo, de modo a facilitar a comunicação científica.

Qual é a importância de um nome?

Você já parou para pensar a razão de alguém dar um nome científico para um cachorro? Por que chamar a espécie do cão de *Canis familiaris*?

O *Canis familiaris* é chamado de cachorro em português, em inglês é *dog* e em francês é *chien*. Então, em cada lugar do mundo, o *Canis familiaris* tem um nome vulgar.

O nome científico é uma forma de se reconhecer uma espécie universalmente.

Regras de como se escreve o nome científico:

1. É geralmente binominal (composto de dois nomes – o primeiro indica o gênero e os dois juntos a espécie).
2. Deve ser escrita em itálico ou destacado do corpo do texto (sublinhado, por exemplo).
3. A primeira palavra é escrita com a inicial maiúscula.
4. Todas as outras letras do segundo nome são minúsculas.
5. Caso haja dois nomes científicos para a mesma espécie, vale o mais antigo.

Joséite

Kenngott (1853)

Bi₄TeS₂, trigonal

Other names: joseíta, joseite, josëite, tellure de bismuth, bornine, Bornit, tellure bismuthifère du Brésil, tellurure de bismuth du Brésil, Schwefelselen-tellurwismuth, Bismuthotellurites Brasiliensis, Tellurbismuth, Tellurwismuth, joséite-A, josëite-A, joseite-A, joseíta-A, telureto de bismuto do Brasil.

Occurrence. (1) In veins in limestone, associated with gold and “joseite-B”, at São José mine, near Mariana, Minas Gerais. (2) Intergrown with bismuth and “joseite-B”, at Glacier Gulch, Hudson Bay Mountain, near Smithers, British

QUINTA-FEIRA, 10 DE JUNHO DE 2010

Número de espécies no planeta é menor do que se pensava, diz estudo



Apenas 5,5 milhões de espécies existem atualmente na Terra, uma estimativa muito menor que os 30 milhões estimados anteriormente. É o que indica uma nova estimativa publicada na revista "American Naturalist".

HÁ LIMITES PARA O NÚMERO DE ESPÉCIES MINERAIS?

Data	Autor	Nº de espécies
1850	Dana	~ 250
1870	Dana	~ 600
1890	Dana	~ 800
1930	Dana-Ford	~ 1.100
1940	Strunz	~ 1.400
1970	Kostov	~2.000
1980	Fleischer	- 3.000

- ✳ Limites: físico-químicos (P, T, afinidades geoquímicas, disponibilidade e abundância dos elementos químicos);
- ✳ - analíticos;
- ✳ - definições adotadas.

2010 IMA ~4700

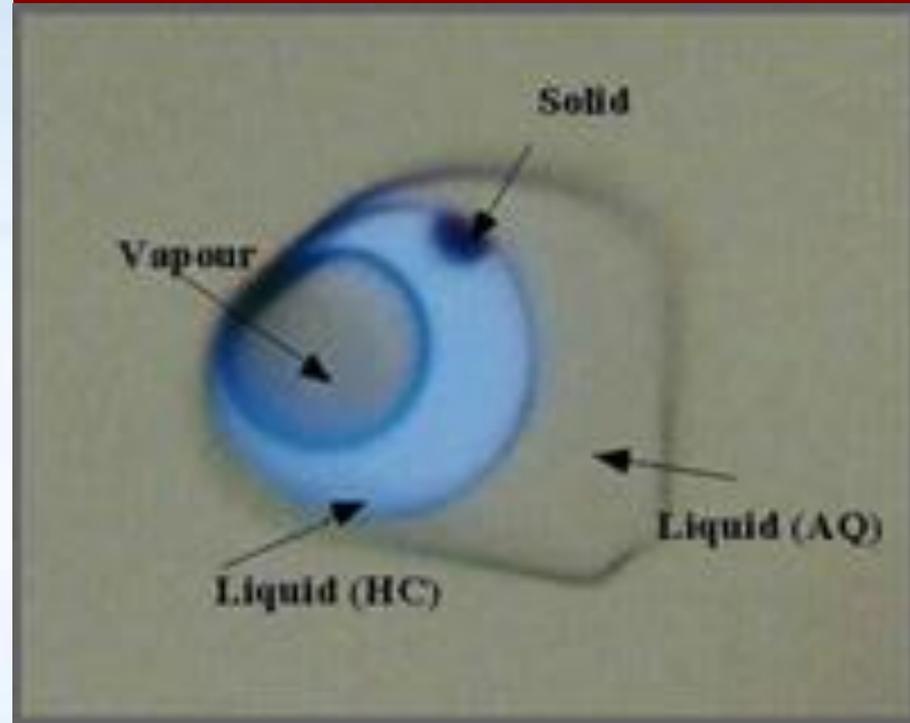
O conceito de espécie mineral (Nickel & Grice, 1998)

- sólido
- ocorre naturalmente
- formado através de processos geológicos
- na Terra ou em corpos extraterrestres
- com **composição química** e **propriedades cristalográficas** bem definidas
- merece um nome único.

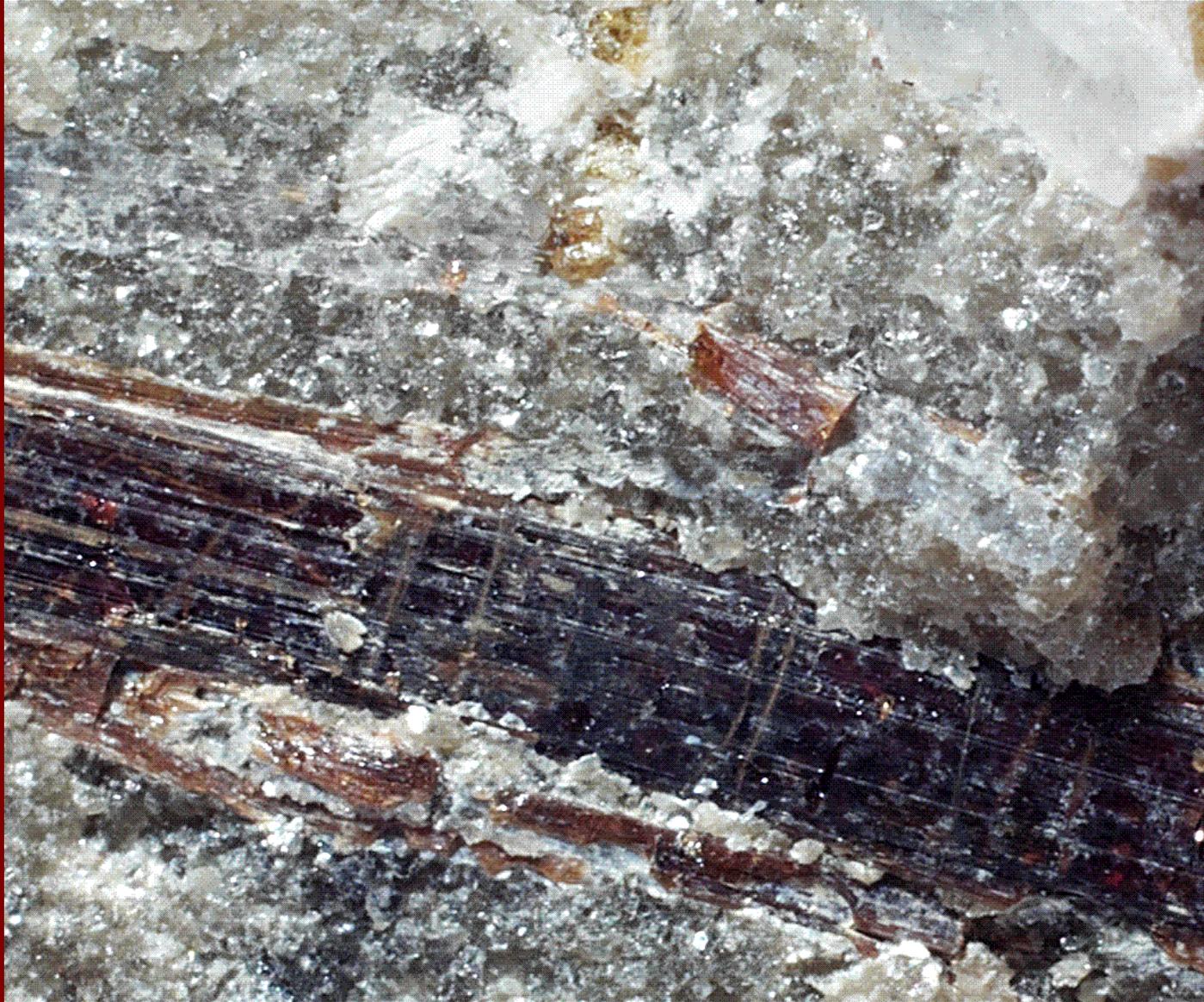
Sólido







Euxenita-(Y) - $Y(NbTi)O_6$
metamítico



Ocorre naturalmente

Substâncias formadas por intervenção humana











JAN 1981



OUTLOOKS IN EARTH AND PLANETARY MATERIALS

On the mineralogy of the “Anthropocene Epoch”

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ABSTRACT

The “Anthropocene Epoch” has been proposed as a new post-Holocene geological time interval—a period characterized by the pervasive impact of human activities on the geological record. Prior to the influence of human technologies, the diversity and distribution of minerals at or near Earth’s surface arose through physical, chemical, and/or biological processes. Since the advent of human mining and manufacturing, particularly since the industrial revolution of the mid-eighteenth century, mineral-like compounds have experienced a punctuation event in diversity and distribution owing to the pervasive impact of human activities. We catalog 208 mineral species approved by the International Mineralogical Association that occur principally or exclusively as a consequence of human processes. At least three types of human activities have affected the diversity and distribution of minerals and mineral-like compounds in ways that might be reflected in the worldwide stratigraphic record. The most obvious influence is the widespread occurrence of synthetic mineral-like compounds, some of which are manufactured directly for applications (e.g., YAG crystals for lasers; Portland cement) and others that arise indirectly (e.g., alteration of mine tunnel walls; weathering products of mine dumps and slag). A second human influence on the distribution of Earth’s near-surface minerals relates to large-scale



Laurionita - PbClOH



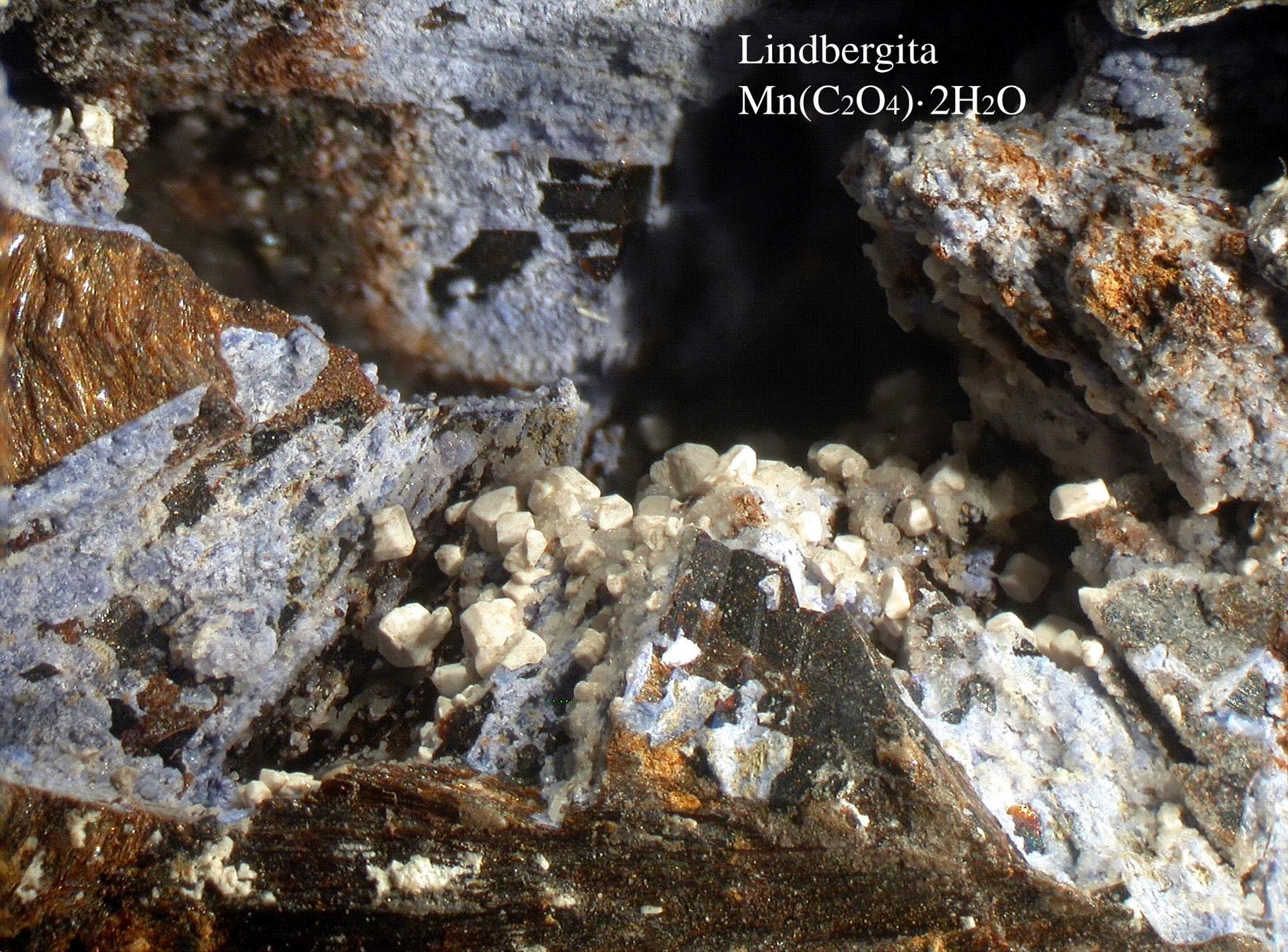


Processos geológicos



FOTO DE CÁLCULOS URINÁRIOS (Dr. Paulo Rocha)

Lindbergita
 $\text{Mn}(\text{C}_2\text{O}_4) \cdot 2\text{H}_2\text{O}$



Lindbergite, a new Mn oxalate dihydrate from Boca Rica mine, Galiléia, Minas Gerais, Brazil, and other occurrences

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ABSTRACT

The new mineral lindbergite, $\text{Mn}(\text{C}_2\text{O}_4) \cdot 2\text{H}_2\text{O}$, is a secondary mineral in the Lavra da Boca Rica granite pegmatite, Sapucaia do Norte, Galiléia Co., Minas Gerais, Brazil. It occurs as: (1) white short prismatic crystals 0.1 to 0.3 mm in length, interpreted as pseudomorphs after the orthorhombic trihydrate, with faces of $\{100\}$, $\{hk0\}$, $\{010\}$, and $\{0kl\}$ forms, rounded edges, and twinning on (010); and (2) grayish-white aggregates in 0.1 mm thick translucent crusts made up of interlocking irregularly contoured platelets up to 0.03 mm in length. Lindbergite is transparent, has a white streak,

Na Terra ou em corpos
extraterrestres



meteoritos



Composição química: Fórmula

TABLE 3. EARLY CHEMICAL MINERALOGISTS AND THEIR OFFSPRING

Kronstedt	1722-1765	Cronstedtite
Bergman	1735-1784	Torbernite
Berzelius	1779-1848	Berzeliite
Vauquelin	1763-1820	Vauquelinite
Gadolin	1760-1852	Gadolinite
Tennant	1761-1817	Tennanite
Wollaston	1766-1826	Wollastonite
Stromeyer	1778-1835	Stromeyerite
Arfvedson	1792-1841	Arfvedsonite
Rose	1795-1864	Roselite

SOLID SOLUTIONS IN MINERAL NOMENCLATURE

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INTRODUCTION

Guidelines for mineral nomenclature recommended by the Commission on New Minerals and Mineral Names (CNMMN) of the International Mineralogical Association were summarized by Nickel & Mandarino (1987-1989) and published in most of the international mineralogical journals. One aspect of mineral nomenclature not covered in the guidelines is the question of how members of

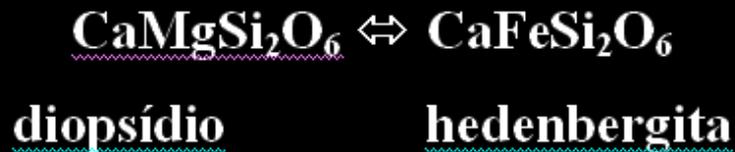
structural order, solid solutions with structural order, and partial solid-solutions. Mineral nomenclature in each of these categories is discussed below.

COMPLETE SOLID-SOLUTIONS WITHOUT STRUCTURAL ORDER

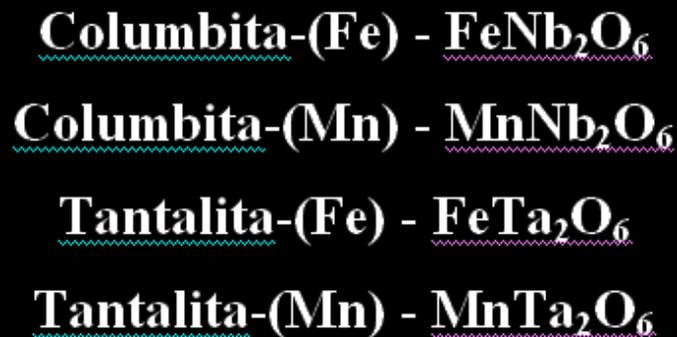
For purposes of nomenclature, a complete solid-solution series without structural order of the

1) Regra do constituinte dominante

Substituições homovalentes em uma única posição estrutural

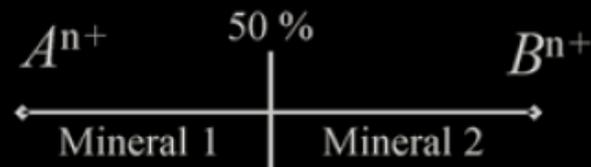


Substituições homovalentes independentes em diversas posições estruturais



HOMOVALENT SUBSTITUTIONS

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« 33.3 % marks »

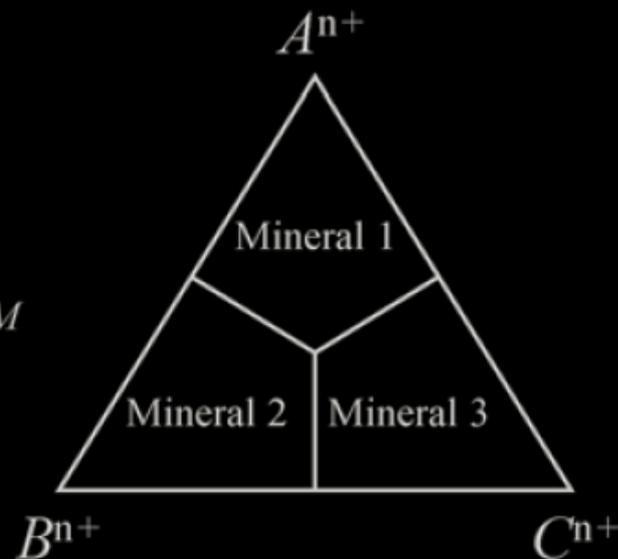


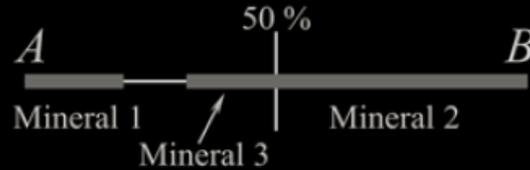
FIG. 1. Diagrammatic representations of homovalent substitutions. a. Complete binary solid-solution series. b. Complete ternary solid-solution series.

BINARY PARTIAL SOLID SOLUTIONS

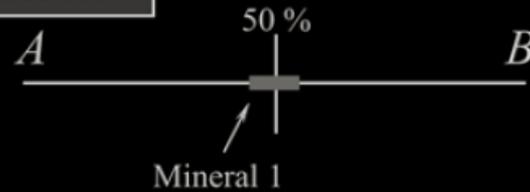
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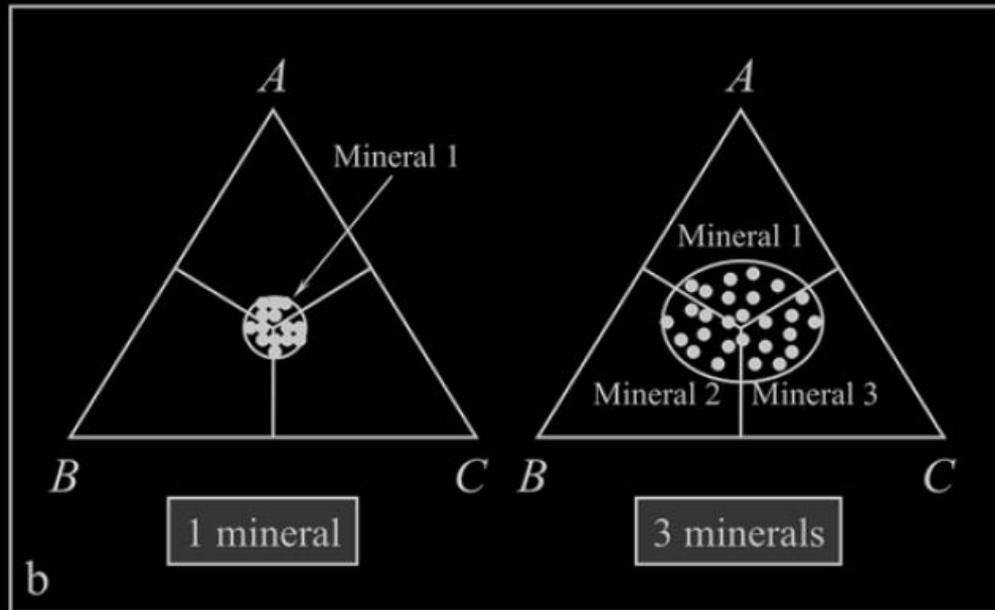
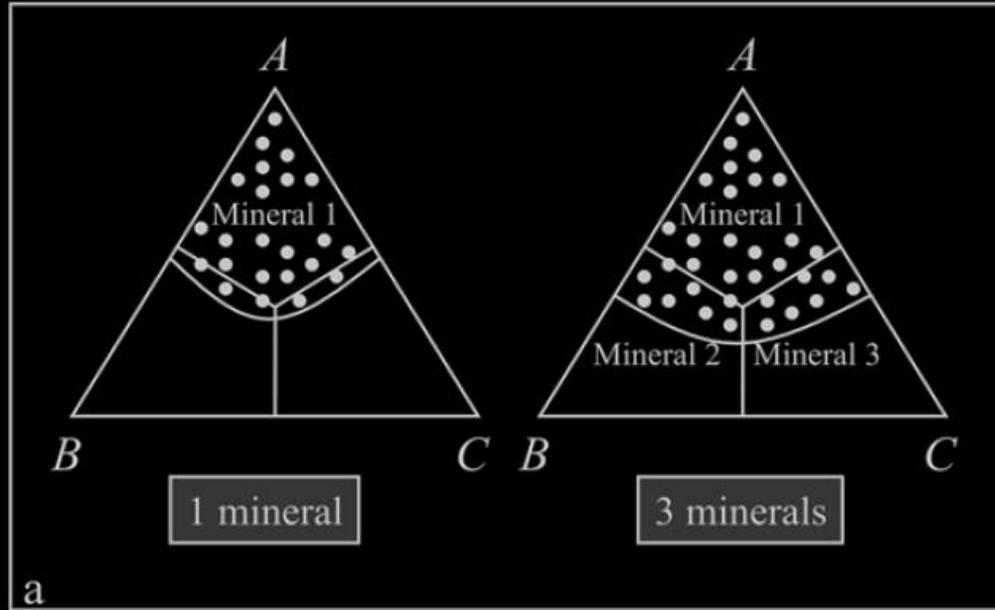


« 50 % mark »



FIG. 4. Diagrammatic representations of partial binary solid-solution series. a. Series with a miscibility gap. b. Series with a miscibility gap, but with one member encompassing the midpoint. c. Series with members limited around the midpoint.

TERNARY PARTIAL SOLID SOLUTIONS



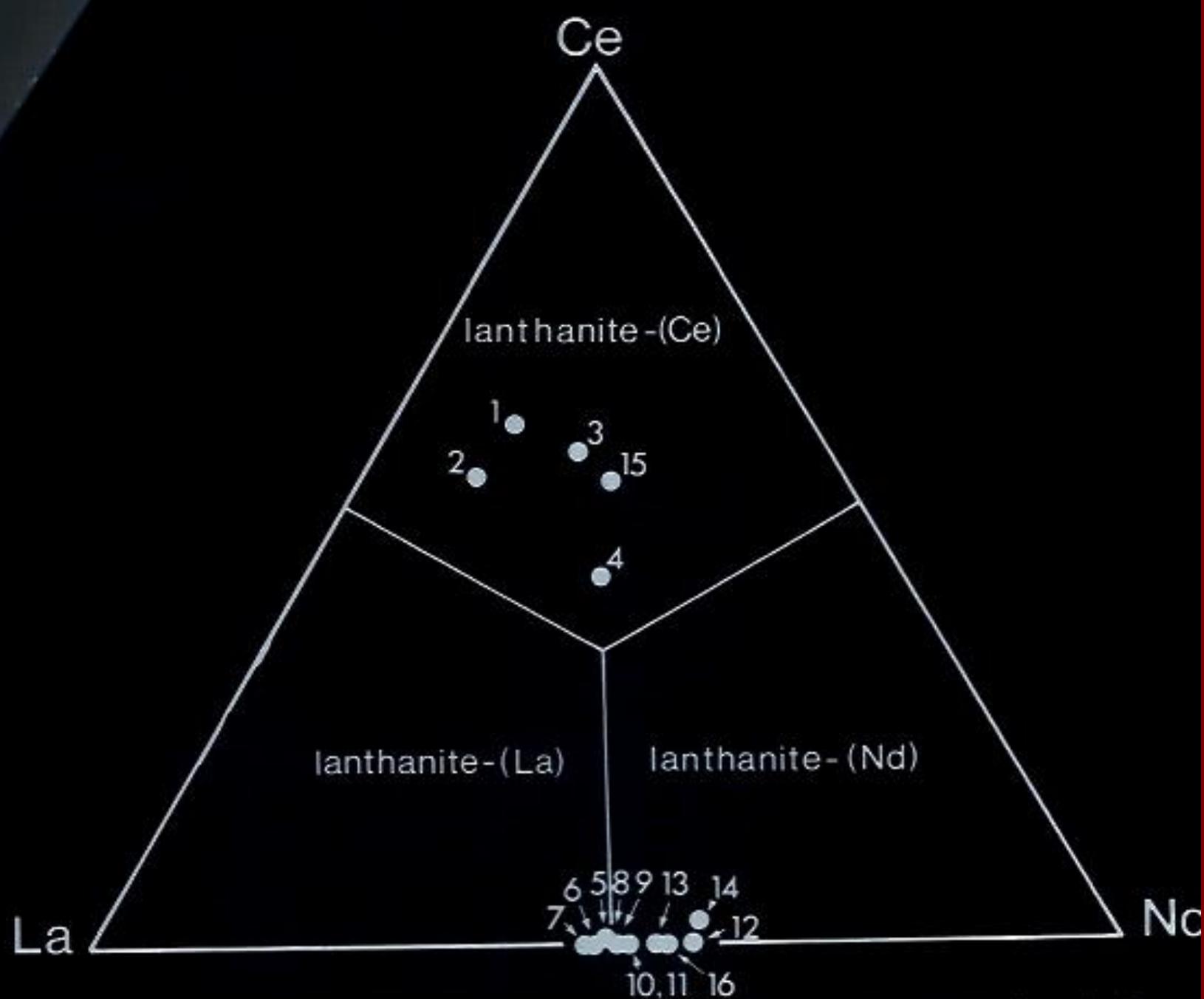
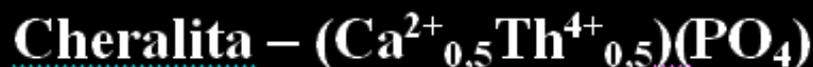


FIG. 1. La-Nd-Ce atomic proportions for lanthanite-group minerals. Sample numbers are those given in Table 1.

Substituições heterovalentes acopladas em uma única posição estrutural



Substituições heterovalentes acopladas em duas posições estruturais



Substituições heterovalentes – homovalentes acopladas

Albita $\text{NaAlSi}_3\text{O}_8$

Substituições heterovalentes:

$(\text{Na}_{0,6}\text{Ca}_{0,4})\text{Al}_{1,4}\text{Si}_{2,6}\text{O}_8$: albita.



$(\text{Na}_{0,35}\text{K}_{0,25}\text{Ca}_{0,4})\text{Al}_{1,4}\text{Si}_{2,6}\text{O}_8$

Regra do constituinte dominante: anortita.

Fórmula ideal do membro final: $\text{CaAlSi}_3\text{O}_8$,

(não balanceada!)

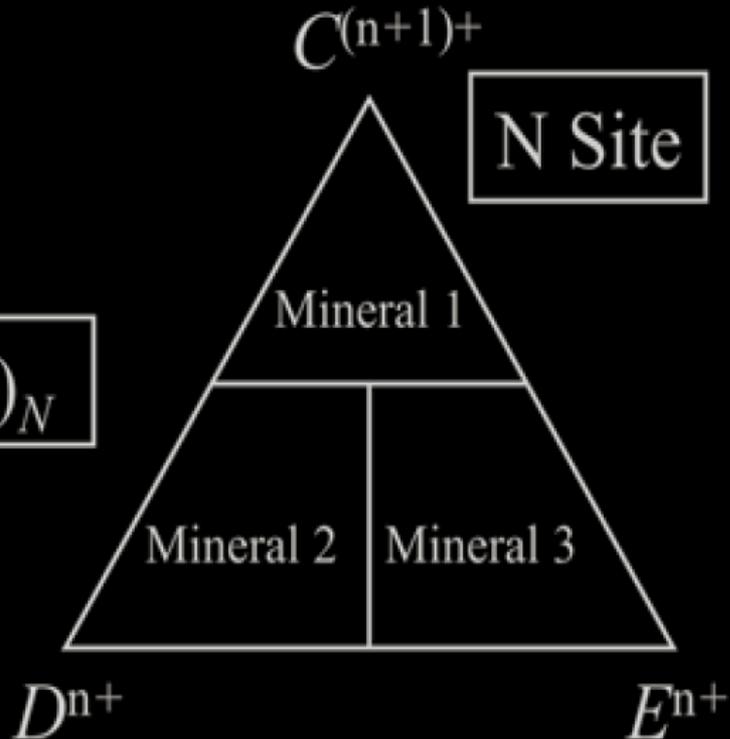
Regra da valência dominante: albita $\text{NaAlSi}_3\text{O}_8$

(cátions monovalentes são dominantes)

2) Regra da valência dominante

« Dominant valency rule »

b



THE USE OF END-MEMBER CHARGE-ARRANGEMENTS IN DEFINING NEW MINERAL SPECIES AND HETEROVALENT SUBSTITUTIONS IN COMPLEX MINERALS*

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ABSTRACT

The characteristics of an end-member formula are defined as follows: (1) the chemical formula must be fixed; no variable chemical components are possible; (2) the end-member formula must be compatible with the crystal structure of the mineral (or putative mineral); (3) the chemical composition at each site in the crystal structure must be fixed; an end-member formula may have two types of cation or anion (in a fixed ratio) at *one* site in the structure if required for electroneutrality; two cations or anions at more than one site are not allowed. Combining these characteristics of end-member formulae with aspects of their crystal structures can lead to unambiguous definition of end-member compositions of complex minerals, and can give considerable insight into coupled heterovalent substitutions. Several examples are given. The end-member formula of the tourmaline-group mineral povondraite was originally written as $\text{Na Fe}^{3+}_3 \text{Fe}^{3+}_6 (\text{Si}_5 \text{O}_{18}) (\text{BO}_3)_3 (\text{O}, \text{OH})_4$, whereas the correct end-member formula is $\text{Na Fe}^{3+}_3 (\text{Fe}^{3+}_4 \text{Mg}_2) (\text{Si}_6 \text{O}_{18}) (\text{BO}_3)_3 (\text{OH})_3 \text{O}$. The yttrium-rich milarite described by Černý *et al.* (1991) is shown to be a new mineral of the milarite group, with the end-member formula $\text{K} (\text{CaY}) [\text{Be}_3 (\text{Si}_{12} \text{O}_{30})]$. There are seven accredited ^[4](Li,Zn)-bearing minerals of the milarite group, and there has been some ambiguity over the end-member compositions of darapiosite, dusmatovite and sogdianite; end-member formulae for these minerals are unambiguously defined with the approach used here. The complex Be-bearing borosilicate mineral hyalotekite has been somewhat elusive with regard to unambiguous definition of its solid-solution behavior. The ideal formula of Christy *et al.* (1998) can be resolved into two distinct end-member formulae: (1) $\text{Ba}_4 \text{Ca}_2 \text{Si}_8 (\text{BeB}) (\text{Si})_2 \text{O}_{28} \text{F}$, and (2) $\text{Ba}_4 \text{Ca}_2 \text{Si}_8 (\text{B}_2) (\text{SiB}) \text{O}_{28} \text{F}$; note that one end-member has essential Be and the other end-member does not. Thus the competing views on whether hyalotekite is a Be mineral or not are both correct, and there are two distinct minerals buried in the chemical compositional data for hyalotekite. "Makarochkinite" is a non-accredited phase described by Yakubovich *et al.* (1990) that has been identified as identical to høgtuvaite by Grauch *et al.* (1994). Application of the approach developed here shows that, according to the published chemical data, "makarochkinite" and høgtuvaite have distinct end-member formulae, $\text{Ca}_2 (\text{Fe}^{2+}_4 \text{Fe}^{3+} \text{Ti}) (\text{Si}_4 \text{Be Al}) \text{O}_{20}$ and $\text{Ca}_2 (\text{Fe}^{2+}_4 \text{Fe}^{3+}_2) (\text{Si}_5 \text{Be}) \text{O}_{20}$, respectively. These examples show that the very simple approach developed here, using the characteristics of an end-member formula with aspects of the crystal structure, can simply and easily resolve many quite complicated problems in mineral chemistry.

Estrutura Cristalina



Kepler

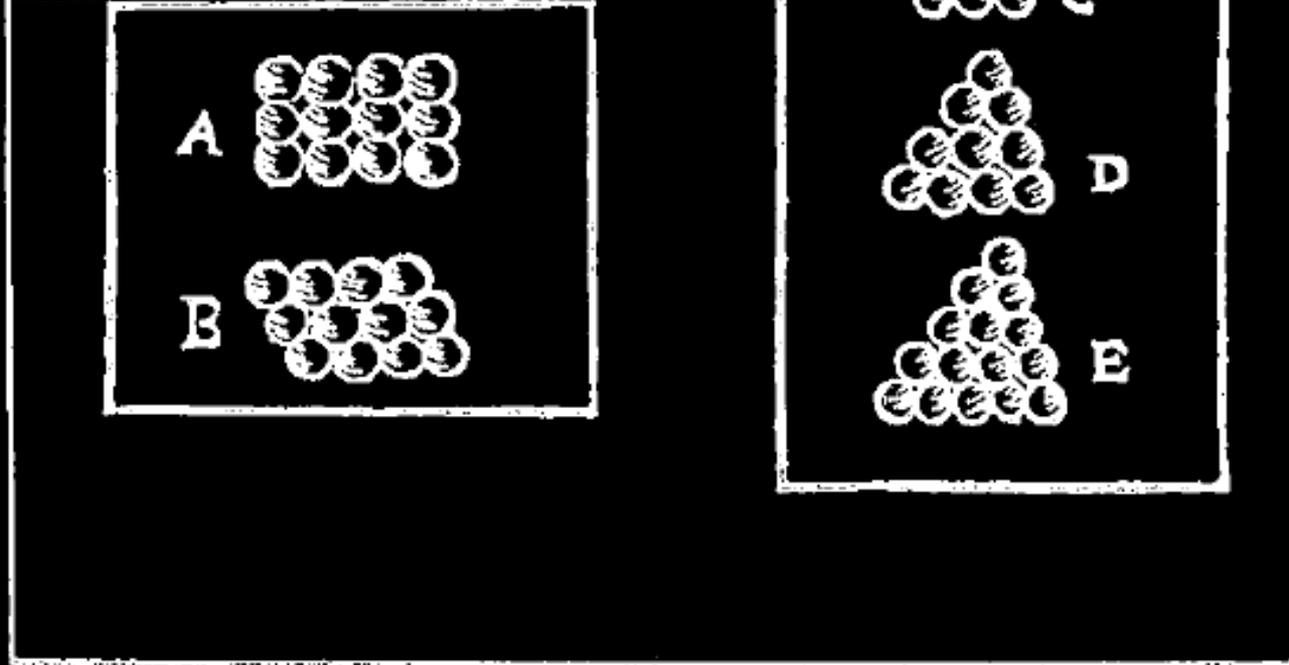
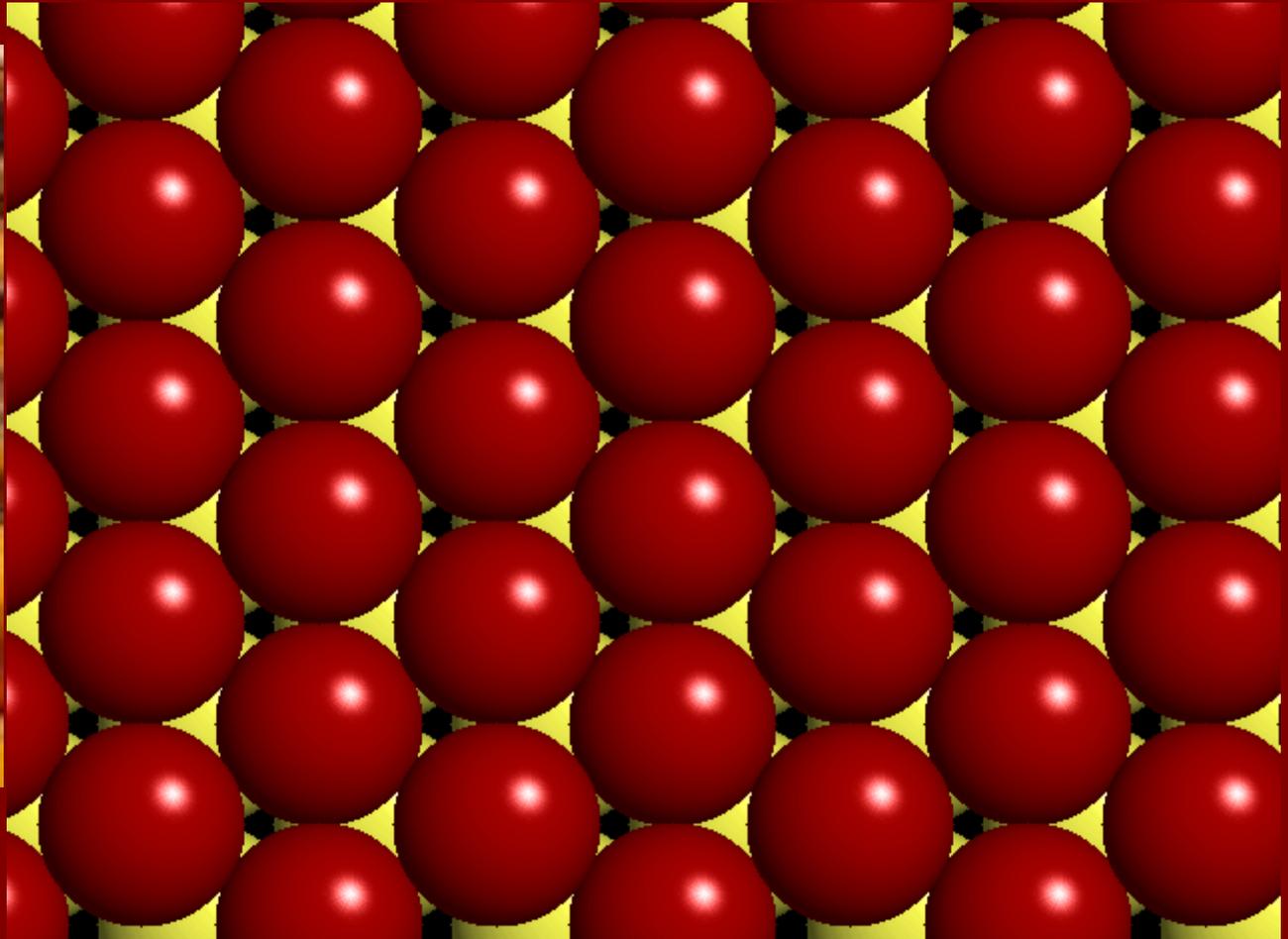


FIG. 6. The formation of snow crystals *via* close-packing of "snow atoms"; after Kepler in 1611.

Empacotamento Compacto



Nicholas Steno (1669):

Lei da Constância dos Ângulos Interfaciais

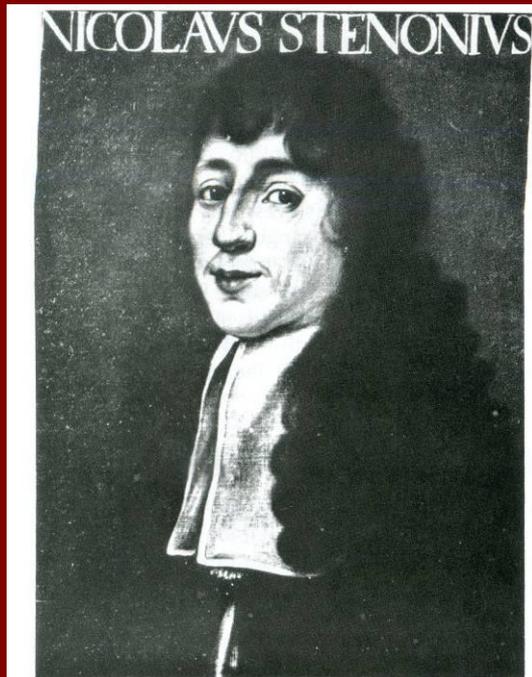
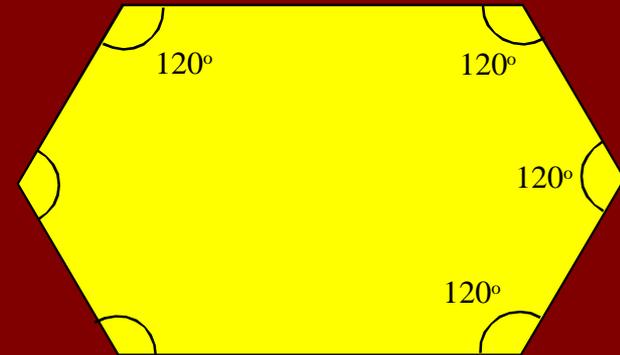
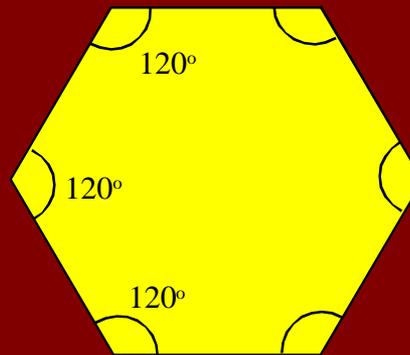
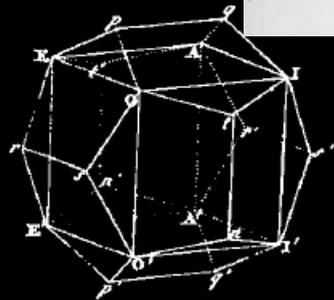
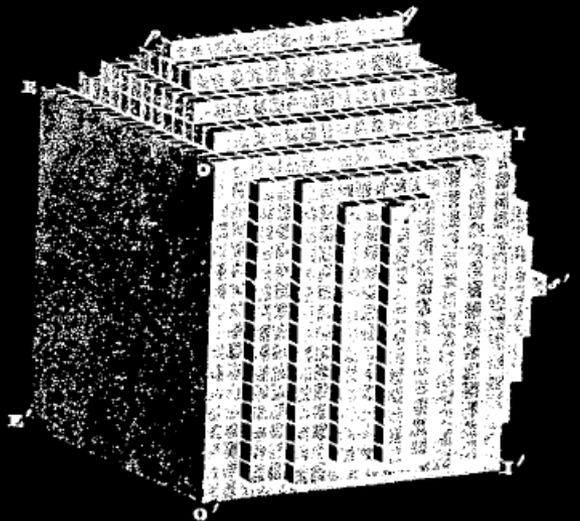
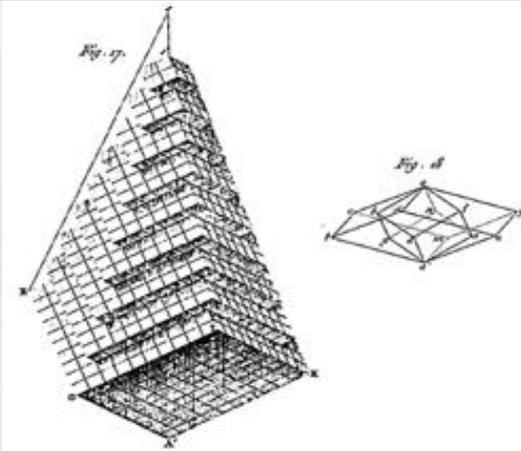
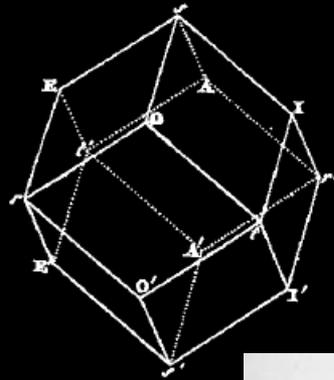
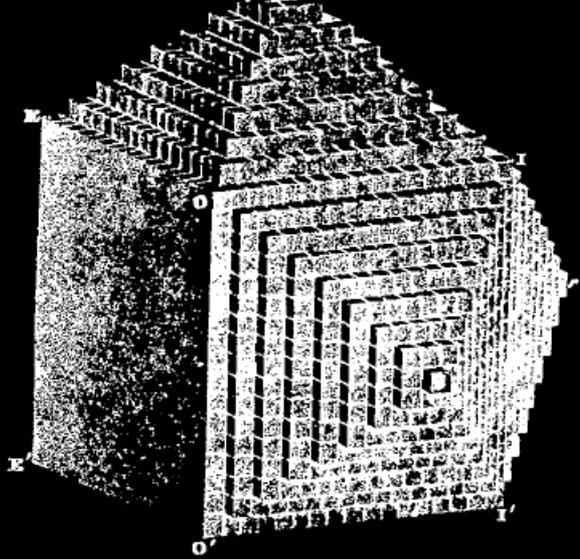


FIG. 1.4. Portrait of Niels Stensen (Latinized to Nicolaus Steno). Steno was born in Copenhagen, Denmark, in 1638 and died in 1686. (From Scherz, G., *Steno, Geological Papers*. Odense University Press, 1969.)





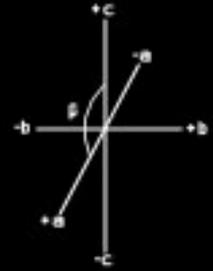
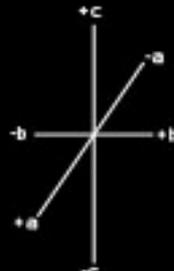
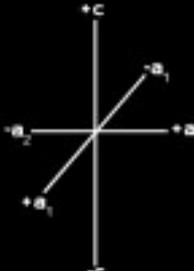
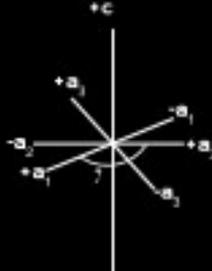
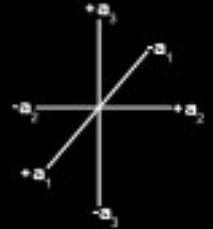
Haüy

FIG. 7. Different crystal forms derived from the stacking of identical "blocks"; after René-Just Haüy, 1743–1822.



Christian Samuel Weiss (1810 - 1856)

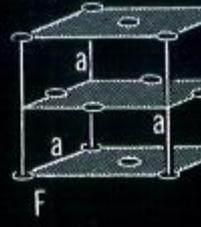
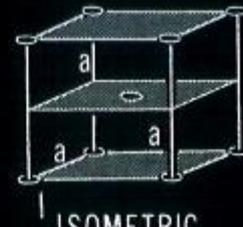
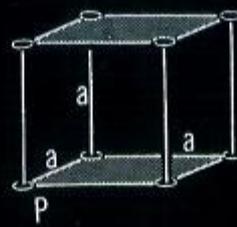
Crystallographic Axes

<p>Triclinic System</p>  <p>$a \neq b \neq c \quad \alpha \neq \beta \neq \gamma$</p>	<p>Monoclinic System</p>  <p>$a \neq b \neq c \quad \alpha = \gamma = 90^\circ, \beta > 90^\circ$</p>	<p>Orthorhombic System</p>  <p>$a \neq b \neq c \quad \alpha = \beta = \gamma = 90^\circ$</p>
<p>Tetragonal System</p>  <p>$a_1 = a_2 \neq c \quad \alpha = \beta = \gamma = 90^\circ$</p>	<p>Hexagonal System</p>  <p>$a_1 = a_2 = a_3 \neq c \quad \alpha = \beta = 90^\circ, \gamma = 120^\circ$</p>	<p>Isometric System</p>  <p>$a_1 = a_2 = a_3 \quad \alpha = \beta = \gamma = 90^\circ$</p>

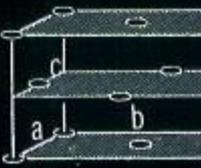
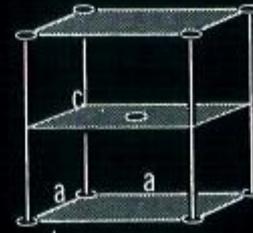
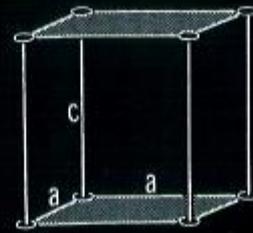
Sistema Cristalino	Classe Cristalina	Grau de Simetria	Nome da Classe
Triclínico	1	Sem simetria	Pedial
	$\bar{1}$	i	Pinacoidal
Monoclínico	2	1E2	Esfenoédrica
	m	1m	Domática
	2/m	1E2, 1m, i	Prismática
Ortorrômbico	222	3E2	Biesfenoédrica-rômbica
	mm2	1E2, 2m	Piramidal rômbica
	2/m2/m2/m	3E2, 3m, i	Bipiramidal rômbica
Tetragonal	4	1E4	Piramidal tetragonal
	$\bar{4}$	1E $\bar{4}$	Biesfenoédrica tetragonal
	4/m	1E4, 1m, i	Bipiramidal tetragonal
	422	1E4, 4E2	Trapezoédrica tetragonal
	4mm	1E4, 4m	Piramidal ditetragonal
	$\bar{4}2m$	1E $\bar{4}$, 2E2, 2m	Escalenoédrica tetragonal
	4/m2/m2/m	1E4, 4E2, 5m, i	Bipiramidal ditetragonal
Trigonal	3	1E3	Piramidal trigonal
	$\bar{3}$	1E $\bar{3}$	Romboédrica
	32	1E3, 3E2	Trapezoédrica trigonal
	3m	1E3, 3m	Piramidal ditrigonal
	$\bar{3}2/m$	1E $\bar{3}$, 3E2, 3m, i	Escalenoédrica hexagonal
Hexagonal	6	1E6	Piramidal hexagonal
	$\bar{6}$	1E $\bar{6}$	Bipiramidal trigonal
	6/m	1E6, 1m, i	Bipiramidal hexagonal
	622	1E6, 6E2	Trapezoédrica hexagonal
	6mm	1E6, 6m	Piramidal dihexagonal
	$\bar{6}m2$	1E $\bar{6}$, 3E2, 3m	Bipiramidal ditrigonal
Isométrico (Cúbico)	6/m2/m2/m	1E6, 6E2, 7m, i	Bipiramidal dihexagonal
	23	4E3, 3E2	Tetartoédrica
	2/m $\bar{3}$	4E $\bar{3}$, 3E2, 3m, i	Diploédrica
	432	4E3, 3E4, 6E2	Giroédrica
	$\bar{4}3m$	4E3, 3E $\bar{4}$, 6m	Hexatetraédrica
4/m $\bar{3}2/m$	4E $\bar{3}$, 3E4, 6E2, 9m, i	Hexaoctaédrica	



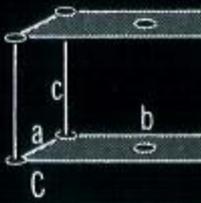
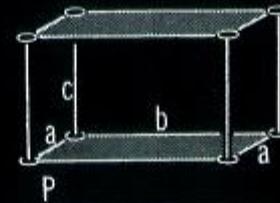
AUGUSTE BRAVAIS



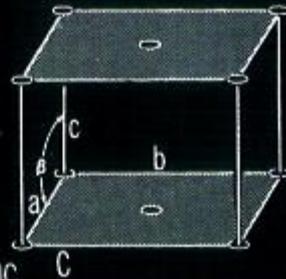
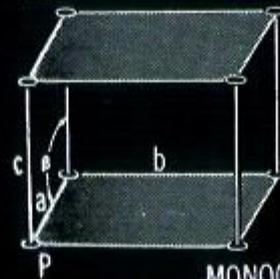
ISOMETRIC



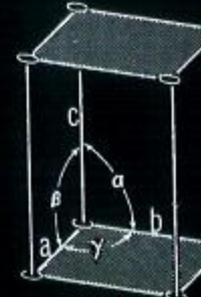
TETRAGONAL



ORTHORHOMBIC



MONOCLINIC



TRICLINIC



P

R

TABLE 12.3 The 230 Space Groups, and the 32 Crystal Classes (Point Groups). The Space Group Symbols Are, in General, Unabbreviated.

Crystal Class	Space Group
1	$P1$
$\bar{1}$	$P\bar{1}$
2	$P2, P2_1, C2$
m	Pm, Pc, Cm, Cc
$2/m$	$P2/m, P2_1/m, C2/m, P2/c, P2_1/c, C2/c$
222	$P222, P22_1, P2_12_12, P2_12_12_1, C222, C22_1, F222, I222, I2_12_12_1$
$mm2$	$Pmm2, Pmc2_1, Pcc2, Pma2, Pca2_1, Pnc2, Pmn2_1, Pba2, Pna2_1, Pnn2, Cmm2, Cmc2_1, Ccc2, Amm2, Abm2, Ama2, Aba2, Fmmc, Fdd2, Imm2, Iba2, Ima2$
$2/m2/m2/m$	$P2/m2/m2/m, P2/n2/n2/n, P2/c2/c2/m, P2/b2/a2/n, P2_1/m2/m2/a, P2/n2/n2/a, P2/m2/n2/a, P2_1/c2/c2/a, P2_1/b2_1/a2/m, P2_1/c2_1/c2/n, P2/b2_1/c2/m, P2_1/n2_1/n2/m, P2_1/m2_1/m2/n, P2_1/b2/c2_1/n, P2_1/b2_1/c2_1/a, P2_1/n2_1/m2_1/a, C2/m2/c2/m, C2/m2/c2_1/a, C2/m2/m2/m, C2/c2/c2/m, C2/m2/m2/a, C2/c2/c2/a, F2/m2/m2/m, F2/d2/d2/d, I2/m2/m2/m, I2/b2/a2/m, I2/b2/c2/a, I2/m2/m2/a,$
4	$P4, P4_1, P4_2, P4_3, I4, I4_1$
$\bar{4}$	$P\bar{4}, I\bar{4}$
$4/m$	$P4/m, P4_2/m, P4/n, P4_2/n, I4/m, I4_1/a$
422	$P422, P4_22, P4_122, P4_22_1, P4_122, P4_22_1, P4_322, P4_22_1, I422, I4_122$
$4mm$	$P4mm, P4bm, P4_2cm, P4_2nm, P4cc, P4nc, P4_1mc, P4_1bc, I4mm, I4cm, I4_1md, I4_1cd$
$42m$	$P42m, P42c, P4_2m, P4_2c, P4m2, P4c2, P4b2, P4n2, I4m2, I4c2, I42m, I42d$
$4/m2/m2/m$	$P4/m2/m2/m, P4/m2/c2/c, P4/n2/n2/c, P4/m2_1/b2/m, P4/m2_1/n2/c, P4/n2_1/m2/m, P4/n2_1/c2/c, P4_1/m2/m2/c, P4_2/m2/c2/m, P4_2/n2/b2/c, P4_2/n2/n2/m, P4_2/m2_1/b2/c, P4_2/m2_1/n2/m, P4_1/n2_1/m2/c, P4_2/n2_1/c2/m, I4/m2/m2/m, I4/m2/c2/m, I4_1/a2/m2/d, I4_1/a2/c2/d$
3	$P3, P3_1, P3_2, R3$
$\bar{3}$	$P\bar{3}, R\bar{3}$
32	$P312, P321, P3_112, P3_121, P3_212, P3_211, R32$
$3m$	$P\bar{3}m1, P\bar{3}1m, P\bar{3}c1, P\bar{3}1c, R\bar{3}m, R\bar{3}c$
$\bar{3}2/m$	$P31m, P31c, P3m1, P3c1, R3m, R3c$
6	$P6, P6_1, P6_2, P6_3, P6_4, P6_5, P6_6$
$\bar{6}$	$P\bar{6}$
$6/m$	$P6/m, P6_3/m$
622	$P622, P6_122, P6_222, P6_322, P6_422, P6_522$
$6mm$	$P6mm, P6cc, P6_3cm, P6_3mc$
$\bar{6}m2$	$P\bar{6}m2, P\bar{6}c2, P\bar{6}2m, P\bar{6}2c$
$6/m2/m2/m$	$P6/m2/m2/m, P6/m2/c2/c, P6_3/m2/c2/m, P6_2/m2/m2/c$
23	$P23, F23, I23, P2_13, I2_13$
$2/m\bar{3}$	$P2/m\bar{3}, P2/n\bar{3}, F2/m\bar{3}, F2/d\bar{3}, I2/m\bar{3}, P2_1/a\bar{3}, I2_1/a\bar{3}$
432	$P432, P4_232, F432, F4_132, I432, P4_332, P4_132, I4_332$
$\bar{4}3m$	$P\bar{4}3m, F\bar{4}3m, I\bar{4}3m, P\bar{4}3n, F\bar{4}3c, I\bar{4}3d$
$4/m\bar{3}2/m$	$P4/m\bar{3}2/m, P4/n\bar{3}2/n, P4_2/m\bar{3}2/n, P4_2/n\bar{3}2/m, F4/m\bar{3}2/m, F4/m\bar{3}2/c, P4_1/d\bar{3}2/m, F4_1/d\bar{3}2/c, I4/m\bar{3}2/m, I4_1/a\bar{3}2/d$

Fedorov, Schoenflies, Barlow (1880-1890)

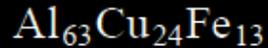
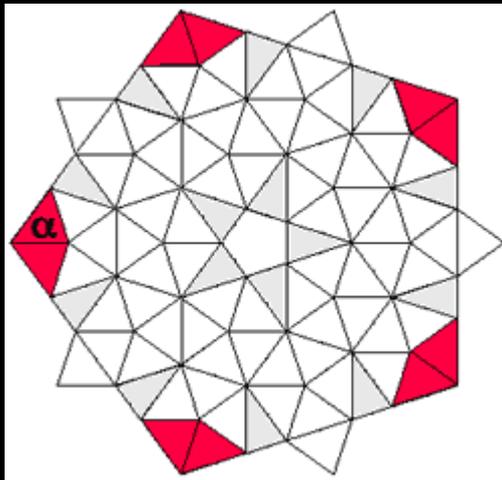
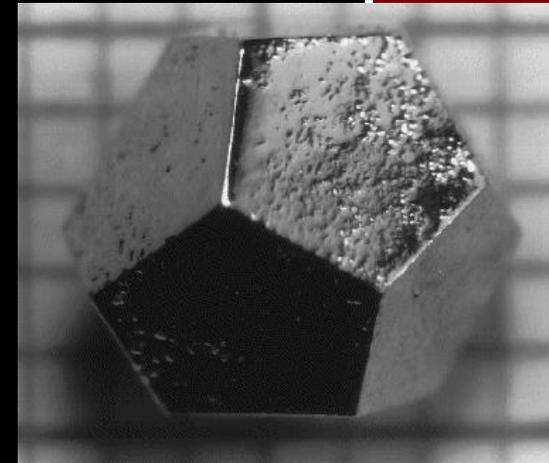
2010-042 ICOSAHEDRITEIcosahedral Space group: $Fm\bar{3}\bar{5}$ a_{6D} 12.64 Å (six-dimensional notation; Steurer and Deloudi, 2009)It is not possible to give three-dimensional unit cell values and Z for this mineral.Luca Bindi^{1*}, Paul J. Steinhardt², Nan Yao³ and Peter J. Lu⁴

Table 2. X-ray powder-diffraction data for icosahedrite. The pattern was indexed on the basis of six integer indices as conventionally used with quasicrystals (Bancel, 1991; Lu, 2000; Lu *et al.*, 2001).



I	d_{meas}	d_{calc}	$hklmno$
2	8.94	8.9443	200000
5	5.53	5.5216	11 $\bar{1}\bar{1}$ 11
20	3.75	3.7450	200022
25	3.41	3.4100	31 $\bar{1}\bar{1}$ 11
20	3.24	3.2444	220022
5	2.799	2.7962	31 $\bar{1}\bar{1}$ 31
10	2.451	2.4522	420022
5	2.350	2.3505	31 $\bar{1}\bar{1}$ 33
90	2.108	2.1082	42 $\bar{2}\bar{2}$ 22
100	2.006	2.0048	4 $\bar{2}$ 0042
5	1.728	1.7283	53 $\bar{1}\bar{2}$ 33
15	1.452	1.4528	62 $\bar{2}$ 044
5	1.418	1.4176	62 $\bar{2}\bar{2}$ 44
30	1.238	1.2390	60 $\bar{4}$ 064



LETTER

Icosahedrite, $\text{Al}_{63}\text{Cu}_{24}\text{Fe}_{13}$, the first natural quasicrystal

LUCA BINDI,^{1,2,*} PAUL J. STEINHARDT,^{3,4} NAN YAO,⁵ AND PETER J. LU⁶

¹Museo di Storia Naturale, Sezione di Mineralogia, Università di Firenze, Via La Pira 4, I-50121 Firenze, Italy

²CNR-Istituto di Geoscienze e Georisorse, Sezione di Firenze, Via La Pira 4, I-50121 Firenze, Italy

³Princeton Center for Theoretical Science, Princeton University, Princeton, New Jersey 08544, U.S.A.

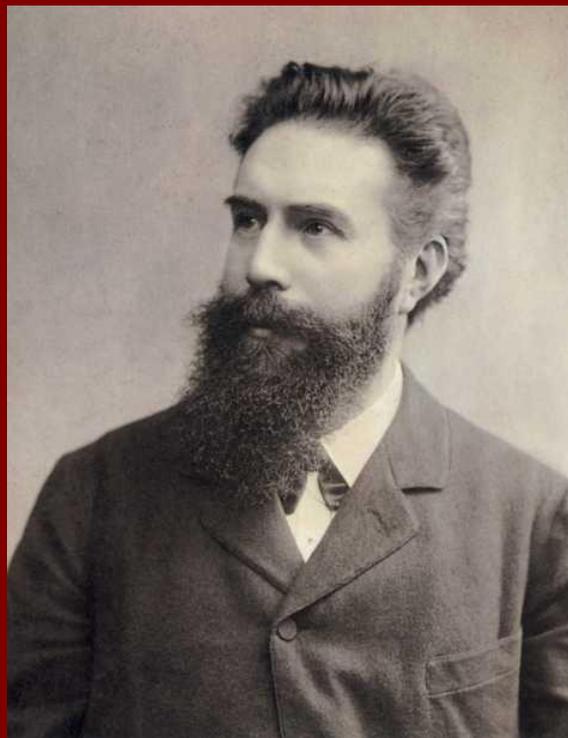
⁴Joseph Henry Laboratories, Department of Physics, Princeton University, Princeton, New Jersey 08544, U.S.A.

⁵Princeton Institute for the Science and Technology of Materials, Princeton University, New Jersey 08544, U.S.A.

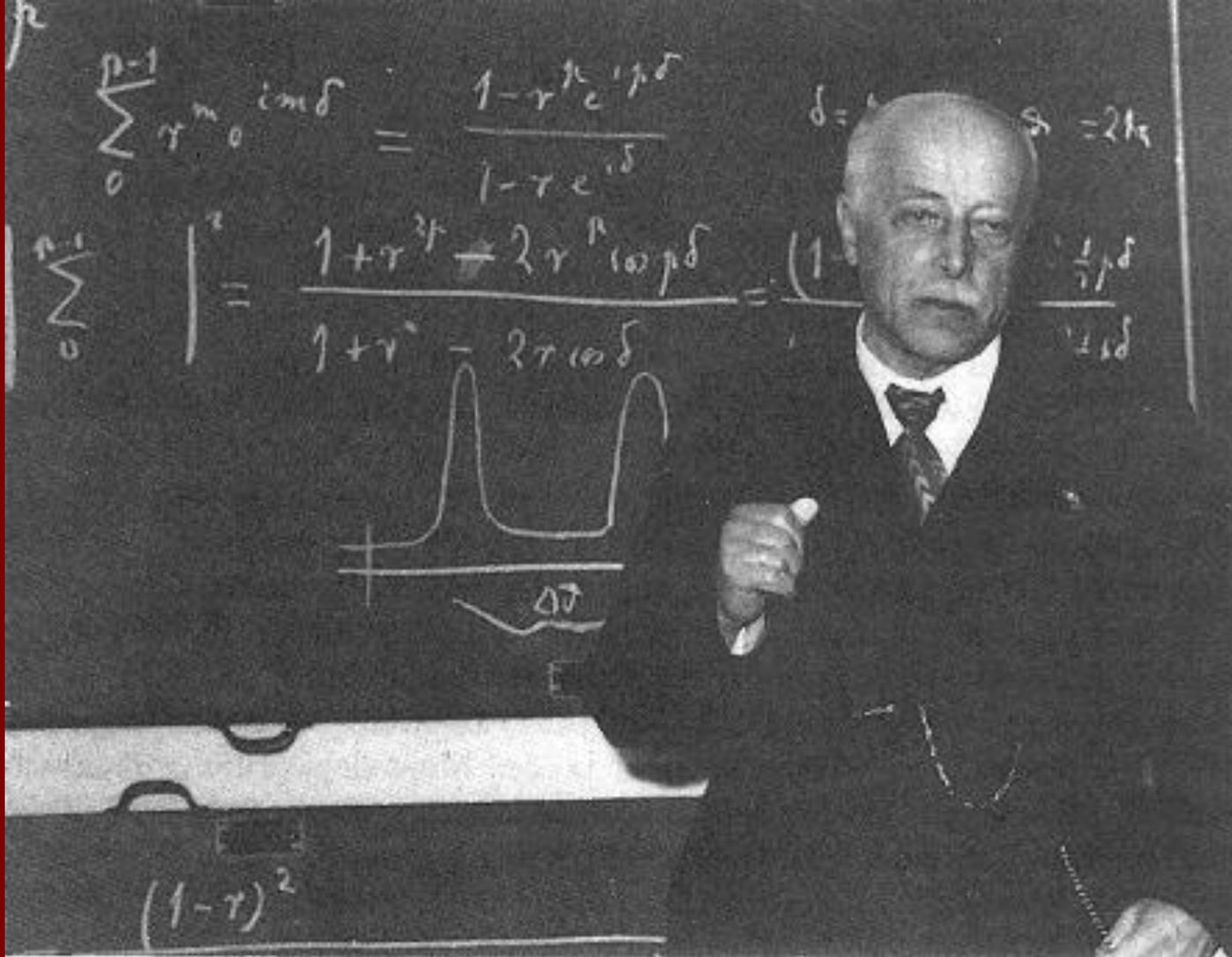
⁶Department of Physics and SEAS, Harvard University, Cambridge, Massachusetts 02138, U.S.A.

ABSTRACT

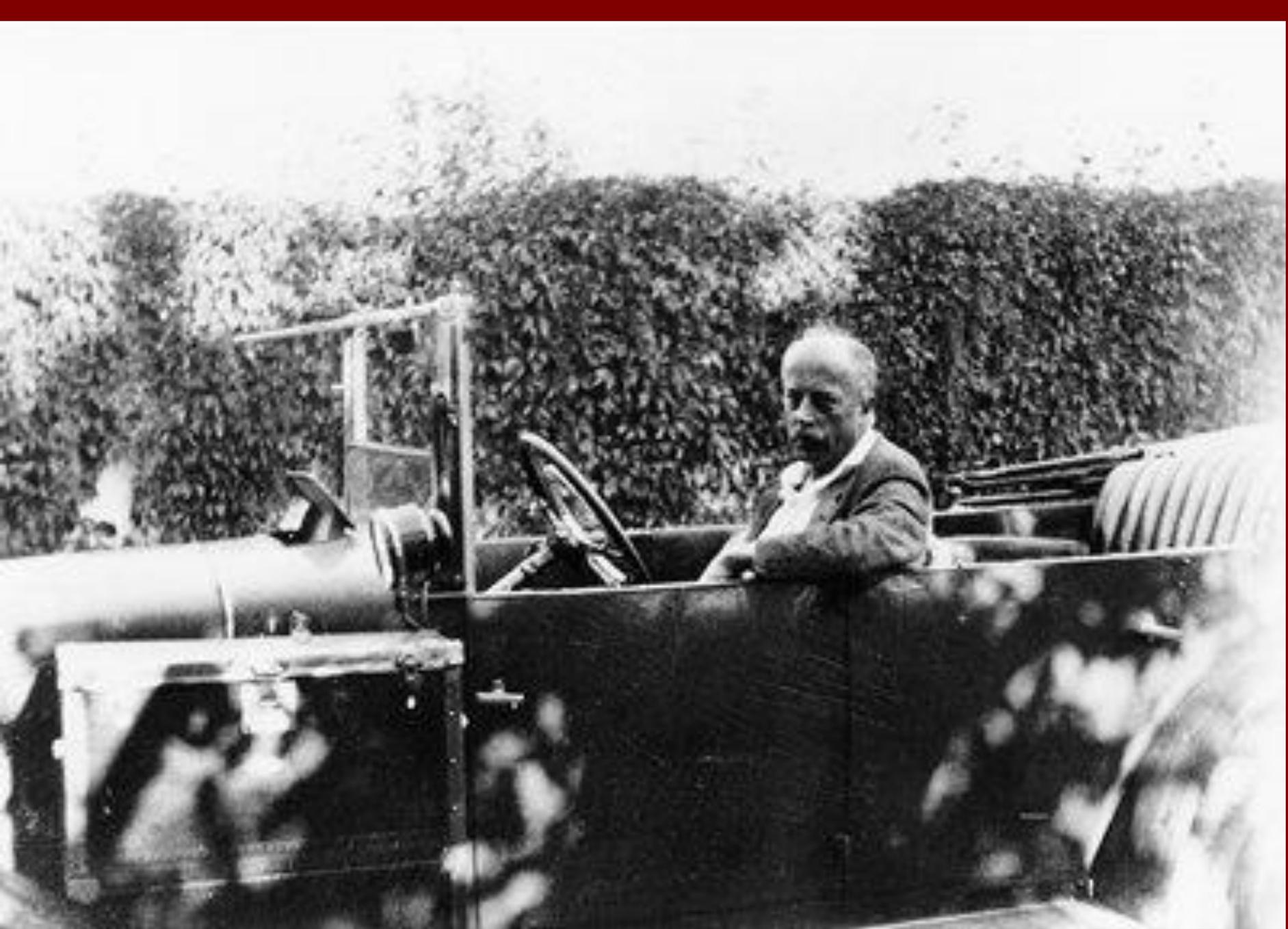
Icosahedrite, ideally $\text{Al}_{63}\text{Cu}_{24}\text{Fe}_{13}$, is a new mineral from the Khatyrka River, southeastern Chukhotka, Russia. It occurs as dark gray-black anhedral to subhedral grains up to 100 μm across, closely associated with spinel, diopside, forsterite, nepheline, sodalite, corundum, stishovite, khatyrkite, cupalite, and an unnamed phase of composition AlCuFe . Icosahedrite is opaque with a metallic luster, possesses a gray streak, and is brittle with an uneven fracture. The density could not be determined. For quasicrystals, by definition, the structure is not reducible to a single three-dimensional unit cell, so neither cell parameters nor Z can be given. In plane-polarized incident light, icosahedrite exhibits neither bireflectance nor pleochroism. Between crossed polars, it is isotropic. Reflectance percent-



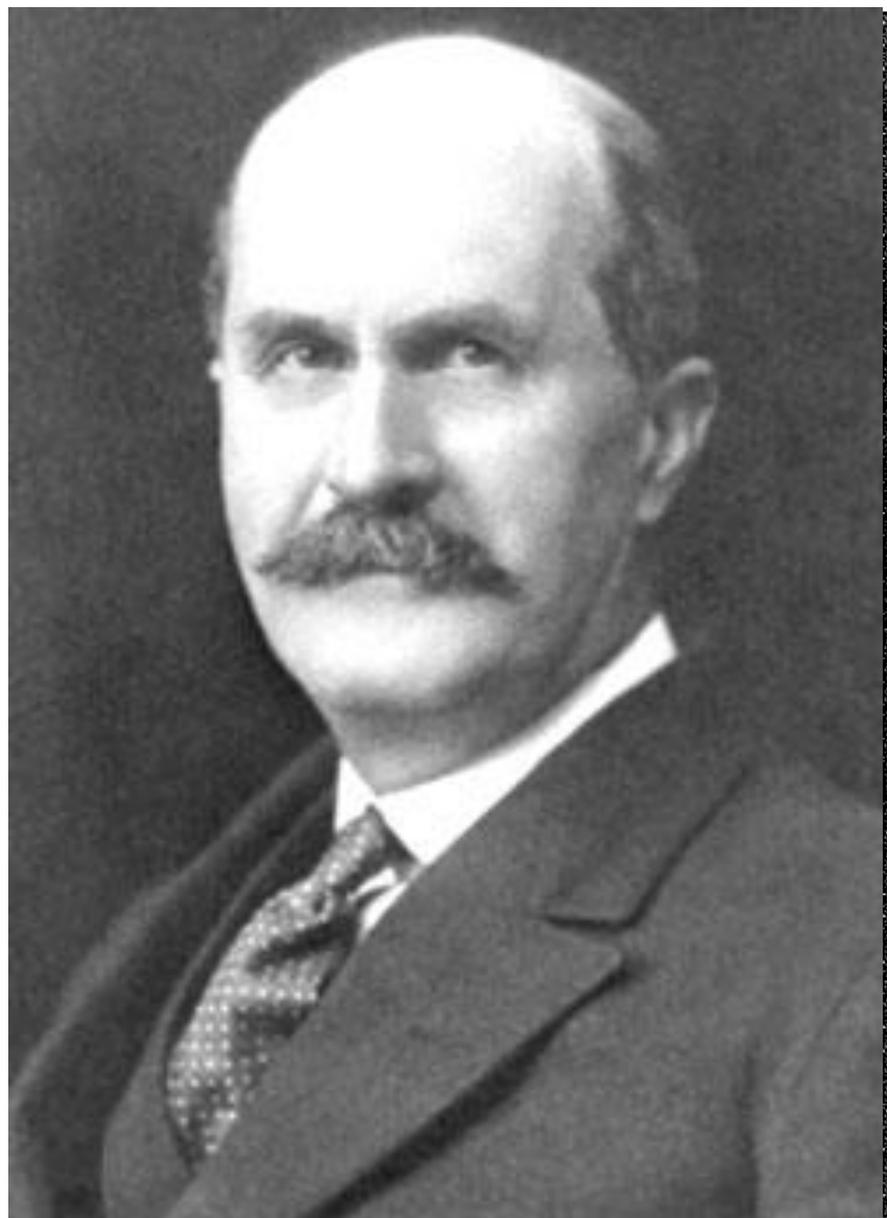
1895 – Röntgen –
descoberta dos raios X



1912 – von Laue – interação
raios X - cristais







ATOMIC STRUCTURE OF MINERALS

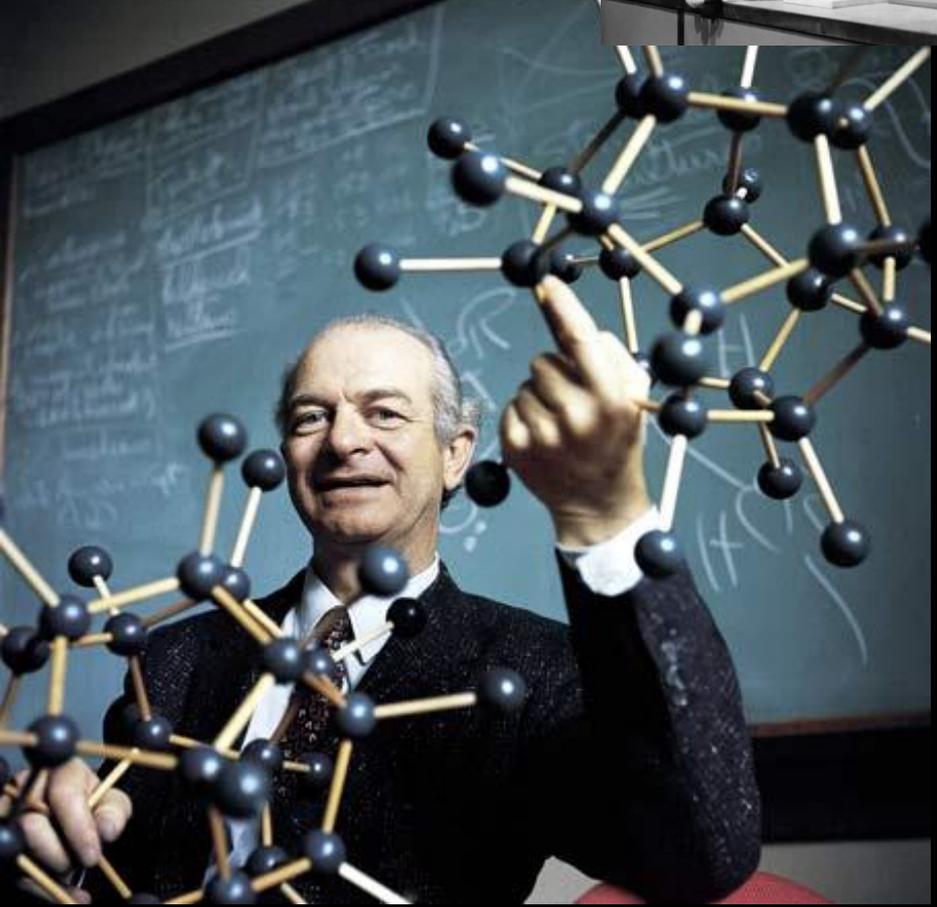
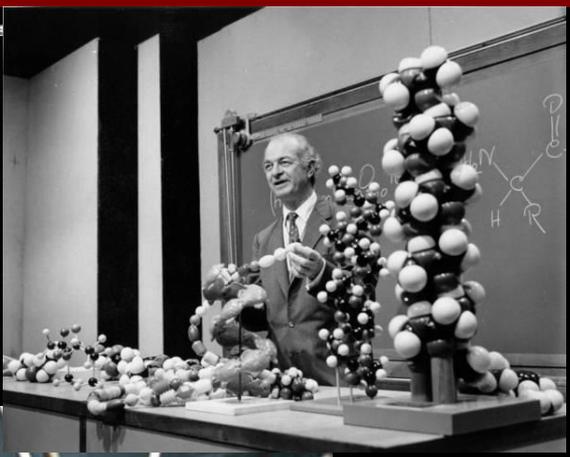
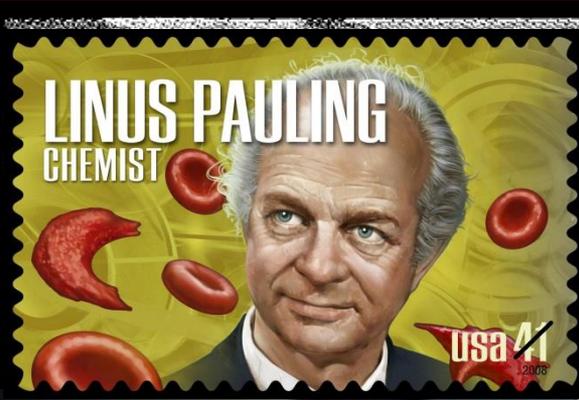
BY

W. L. BRAGG

*Langworthy Professor of Physics in
The Victoria University of Manchester*



FIG. 10. left: W.L. Bragg; right: frontispiece of *The Atomic Structure of Minerals* (Bragg 1937).



THE PRINCIPLES DETERMINING THE STRUCTURE OF COMPLEX IONIC CRYSTALS

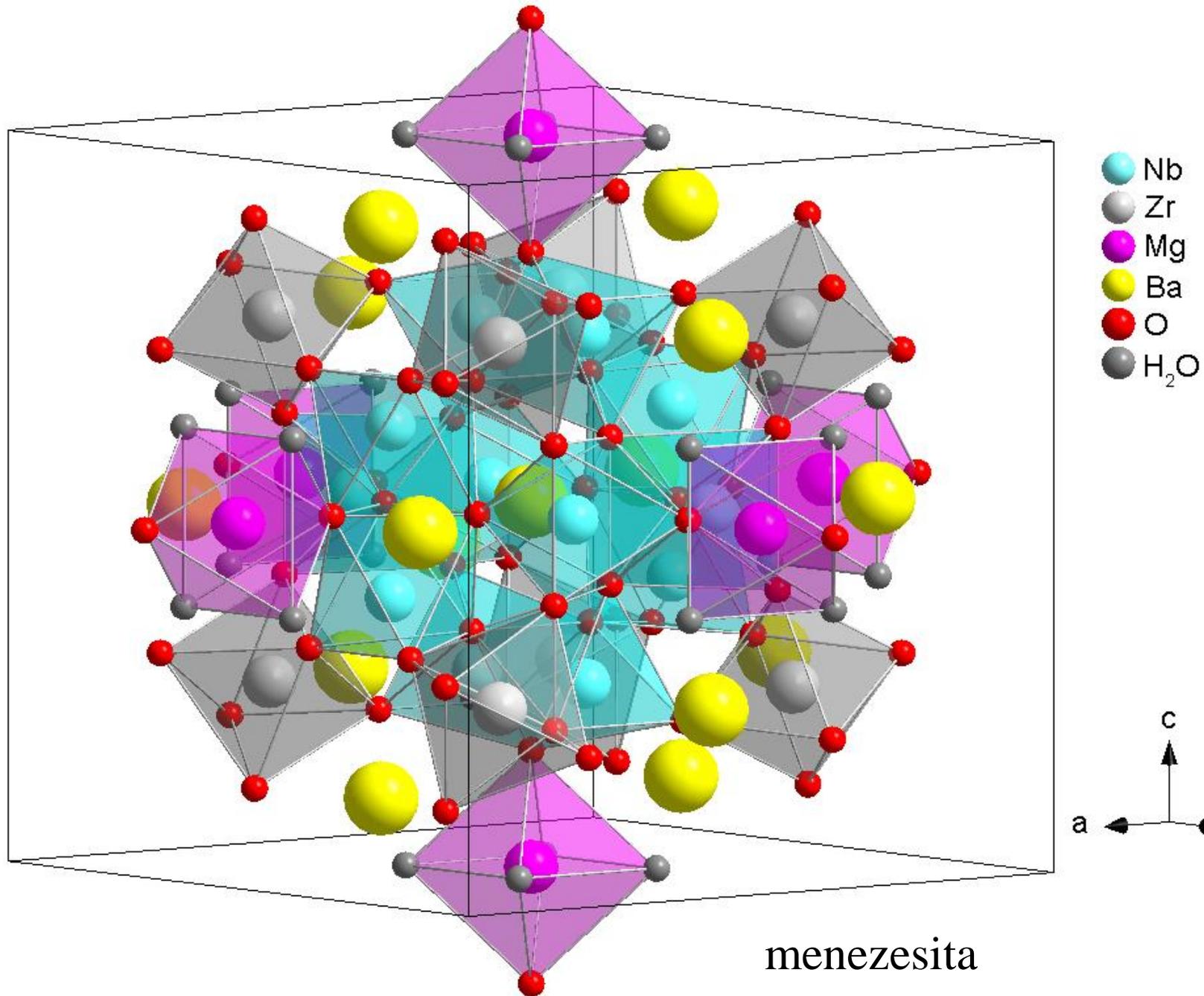
BY LINUS PAULING

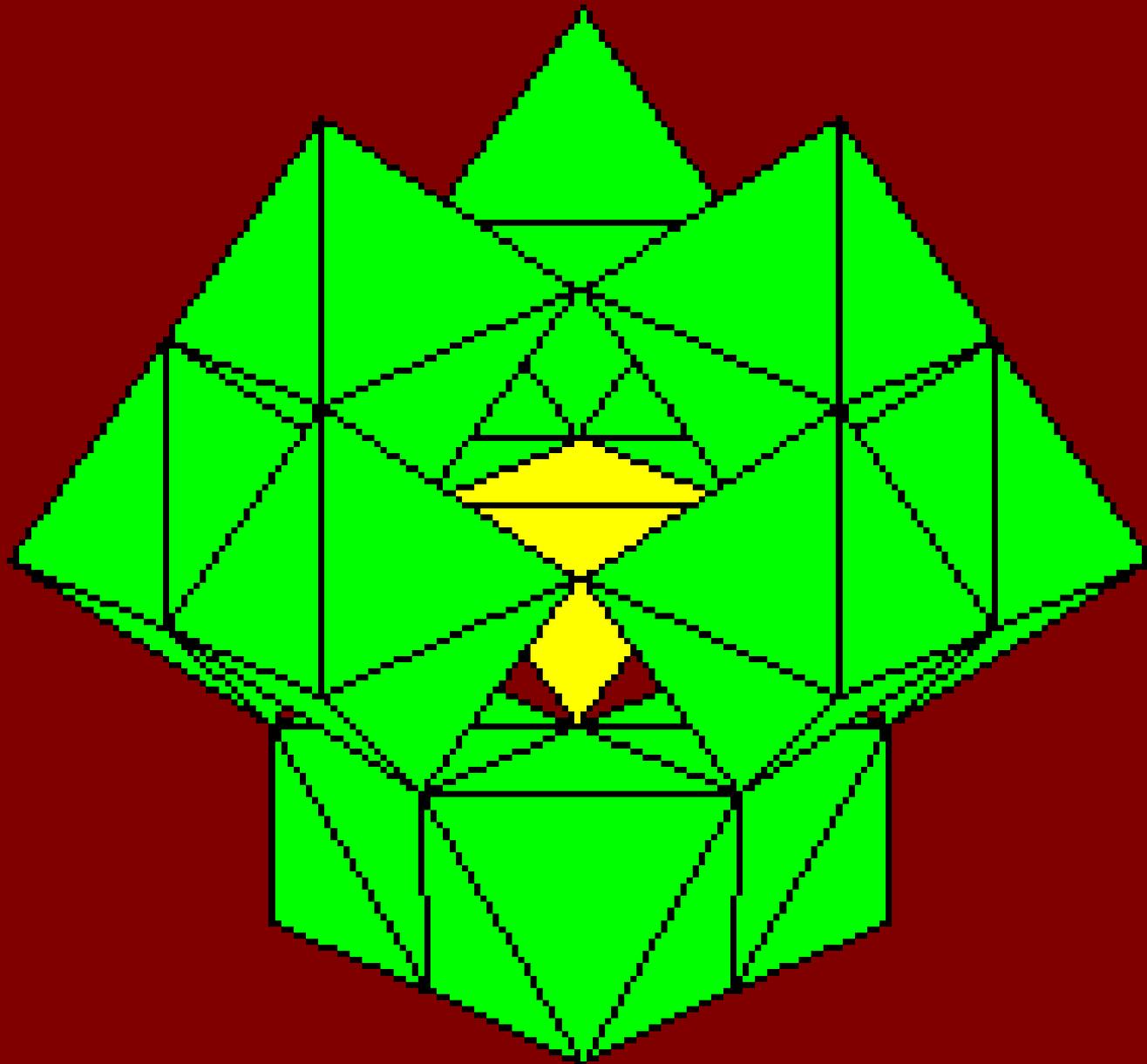
RECEIVED SEPTEMBER 5, 1928

PUBLISHED APRIL 5, 1929

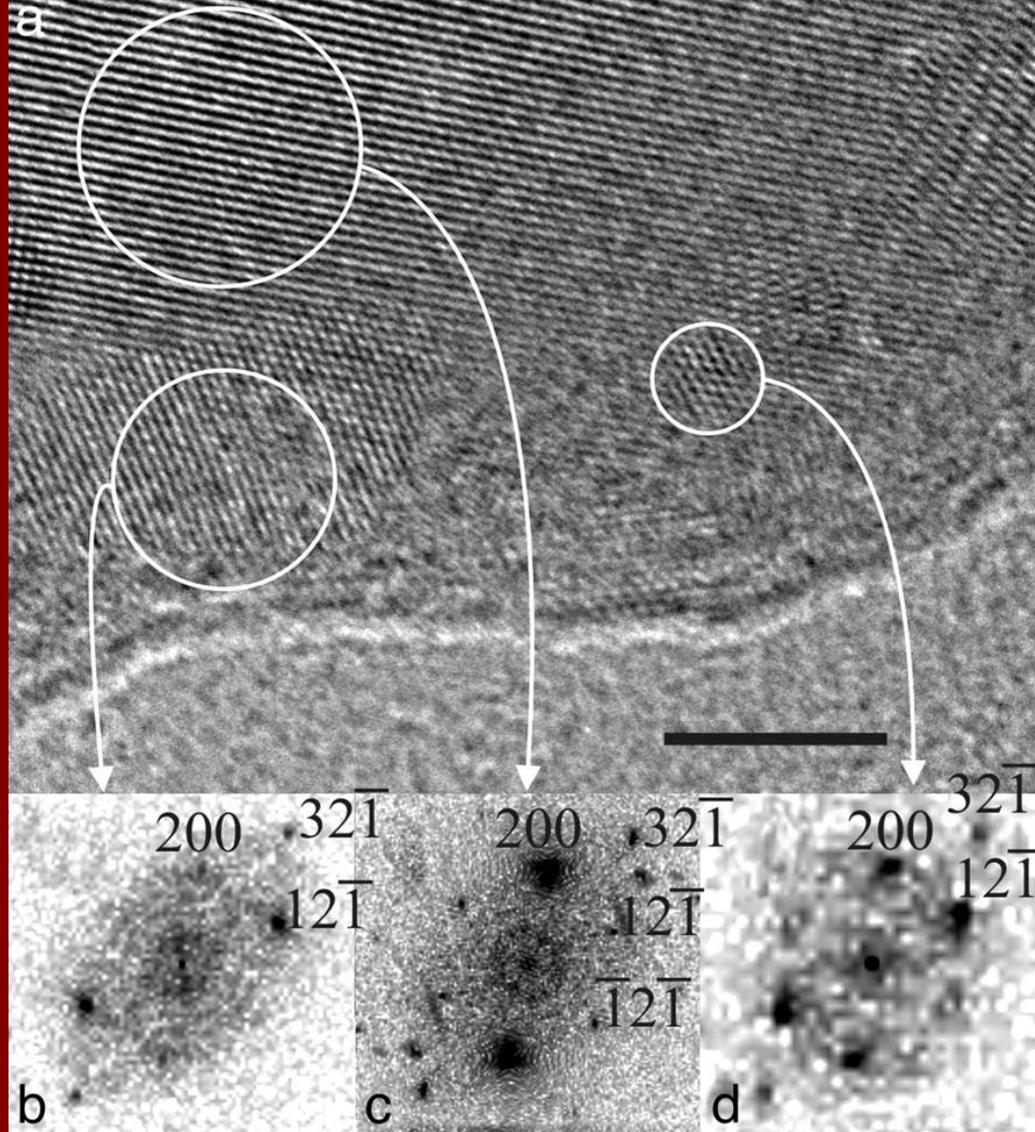
1. **The Relative Stability of Alternative Structures of Ionic Crystals.**—The elucidation of the factors determining the relative stability of alternative crystalline structures of a substance would be of the greatest significance in the development of the theory of the solid state. Why, for example, do some of the alkali halides crystallize with the sodium chloride structure and some with the cesium chloride structure? Why does titanium dioxide under different conditions assume the different structures of rutile, brookite and anatase? Why does aluminum fluosilicate, $\text{Al}_2\text{SiO}_4\text{F}_2$, crystallize with the structure of topaz and not with some other structure? These questions are answered formally by the statement that in each case the structure with the minimum free energy is stable. This answer, however, is not satisfying; what is desired in our atomistic and quantum theoretical era is the explanation of this minimum free energy in terms of atoms or ions and their properties.

FIG. 11. left: Linus Pauling; right: the beginning of Linus Pauling's classic paper on "Pauling's rules" (Pauling 1929).





menezesita



HRTEM study of beam-damaged nacre platelets. (a) HRTEM micrograph of a selected surface area of the single crystalline aragonite platelets after irradiation. (Scale bar: 5 nm.) (b and d) Power spectra of the crystallized ACC layer. (c) Power spectrum of the core of the platelet. The crystal is oriented along the $[012]$ direction.

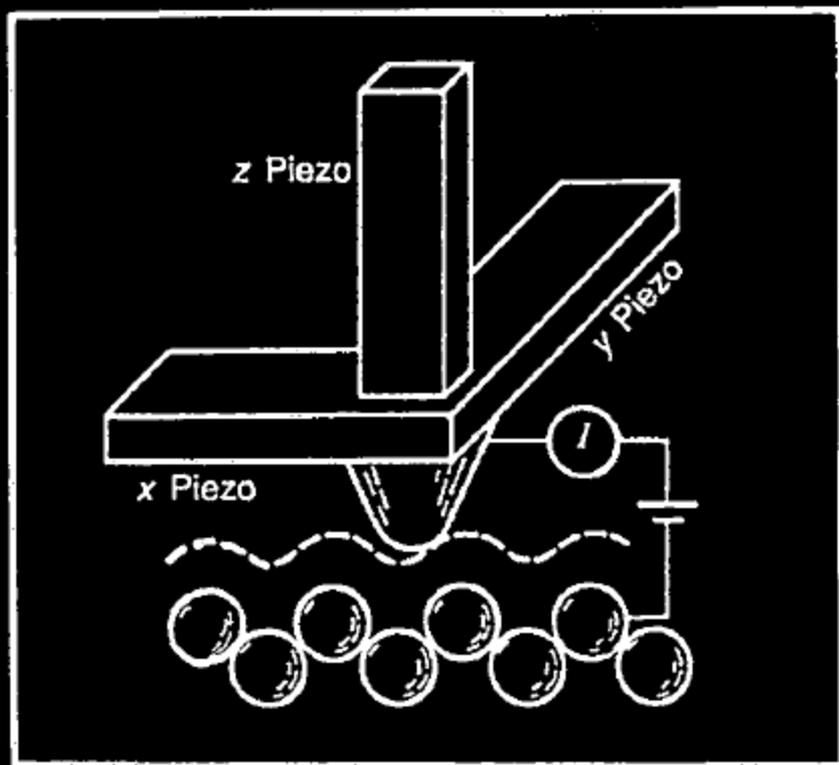
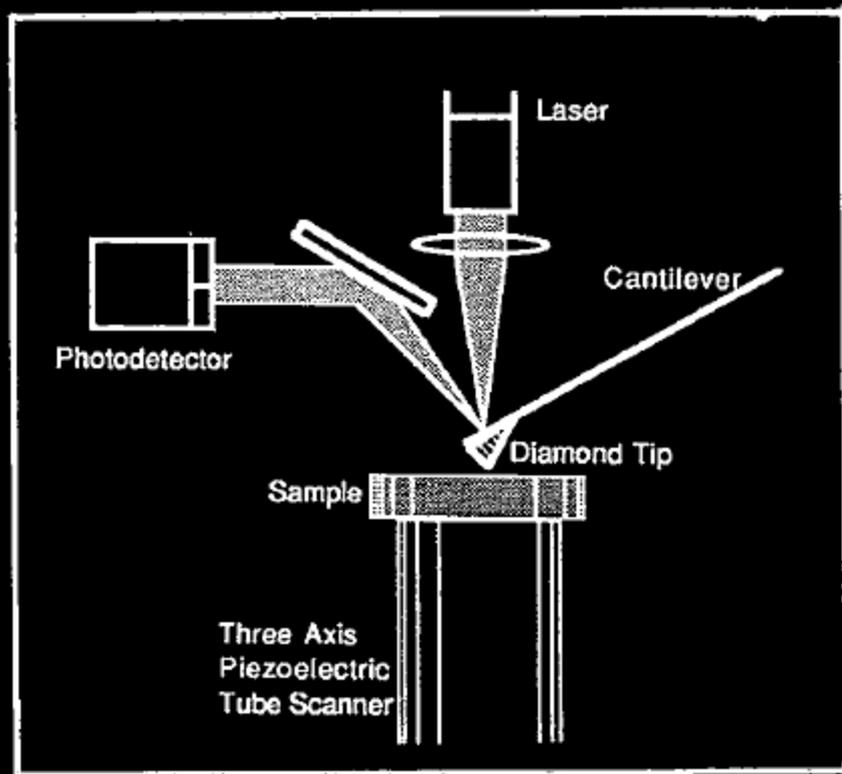
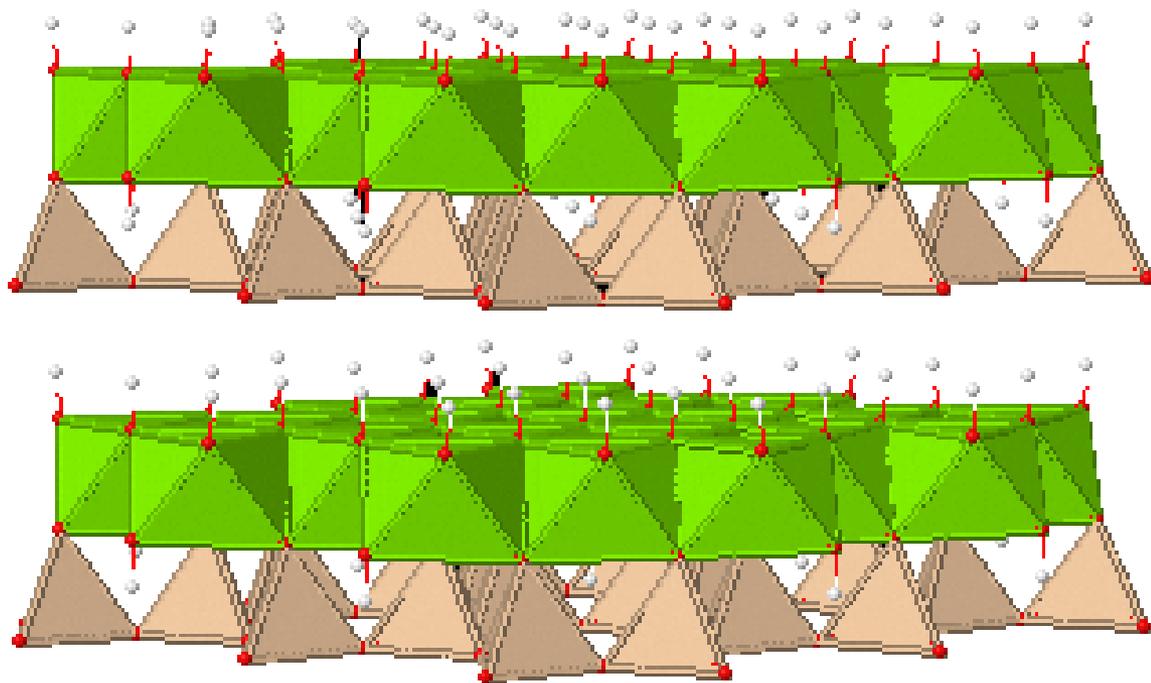
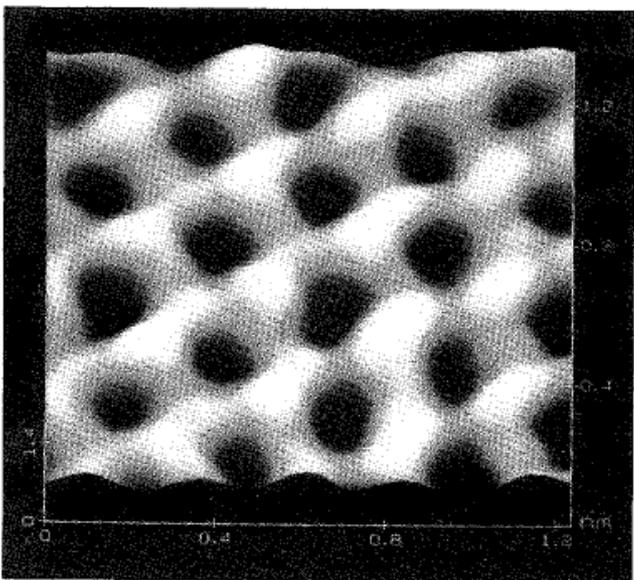
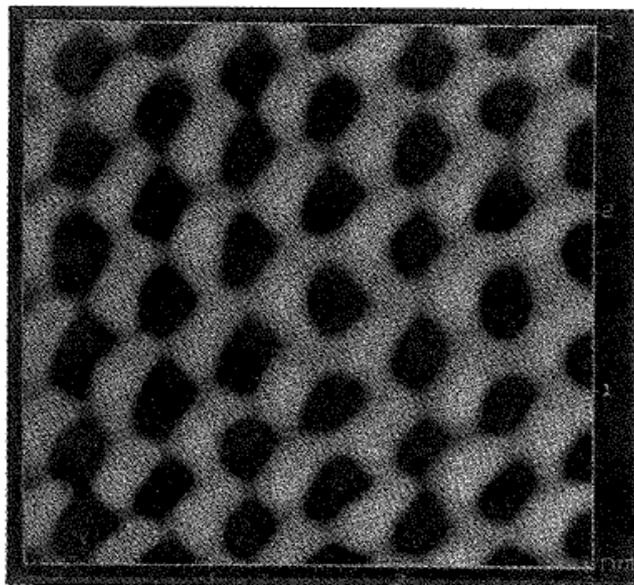
(a)**STM****SCANNING TUNNELLING MICROSCOPY****(b)****AFM****ATOMIC FORCE MICROSCOPY**

FIG. 32. Surface microscopies. a) Scanning tunnelling microscopy, in which an atomically sharp conducting voltage-biased tip interacts with the surface of conducting and semiconducting minerals to produce atomic (or near-atomic) resolution images of the surface. b) Atomic force microscopy, in which a sharp tip senses differences in the “Born” repulsion between the atoms of the tip and the surface, producing an atomic scale “topographic map” of the mineral surface.



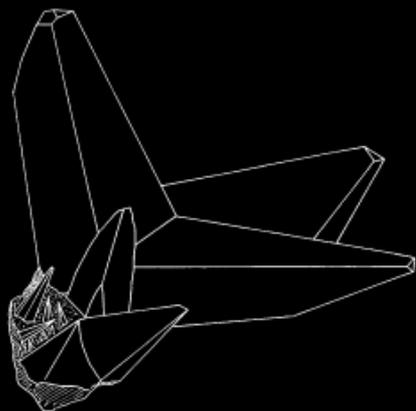
Lizardite, $\text{Mg}_3(\text{OH})_4[\text{Si}_2\text{O}_5]$

FIG. 33. Atomic resolution images of the {001} surface in lizardite. Top: the silicate sheet, showing the hexagonal rings of (SiO_4) tetrahedra. Bottom: the hydroxyl groups of the octahedral sheet, with the underlying Mg atoms visible; from Wicks *et al.* (1992).

Nomes

TABLE I. EARLY WRITINGS ON MINERALS

~1100 B.C.	India	<i>Vedas</i>
~700 B.C.	China	Compilations of minerals
~300 B.C.	India	Descriptions of minerals
384-322 B.C.	Greece	Aristotle - <i>Meteorologica</i>
370-287 B.C.	Greece	Theophrastus - <i>On Stones</i>
23-79 A.D.	Rome	Pliny - <i>Historia Naturalis</i>
8th century	Persia	Jabir ibn Hayyan
9th century	Arabia	Al Khindi
980-1037 A.D.	Persia	Avicenna ibn Sina
1540 A.D.	Italy	Biringuccio - <i>Pirotecniã</i>
1556 A.D.	Germany	Agricola - <i>De Re Metallica</i>



CALCITE

方解石

(fang jie shi)

fang = quadrilateral, square; jie = to divide or break up; shi = rock, stone
Calcite is, therefore, a stone that breaks into quadrilateral pieces. A "quadrilateral" is a solid that has four sides.

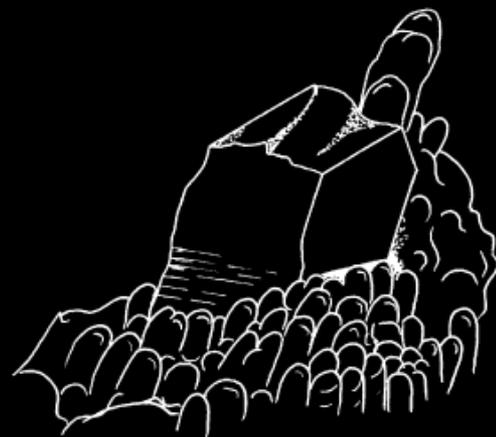


AZURITE

蓝铜矿

(la tong kuang)

la = blue; tong = copper; kuang = ore

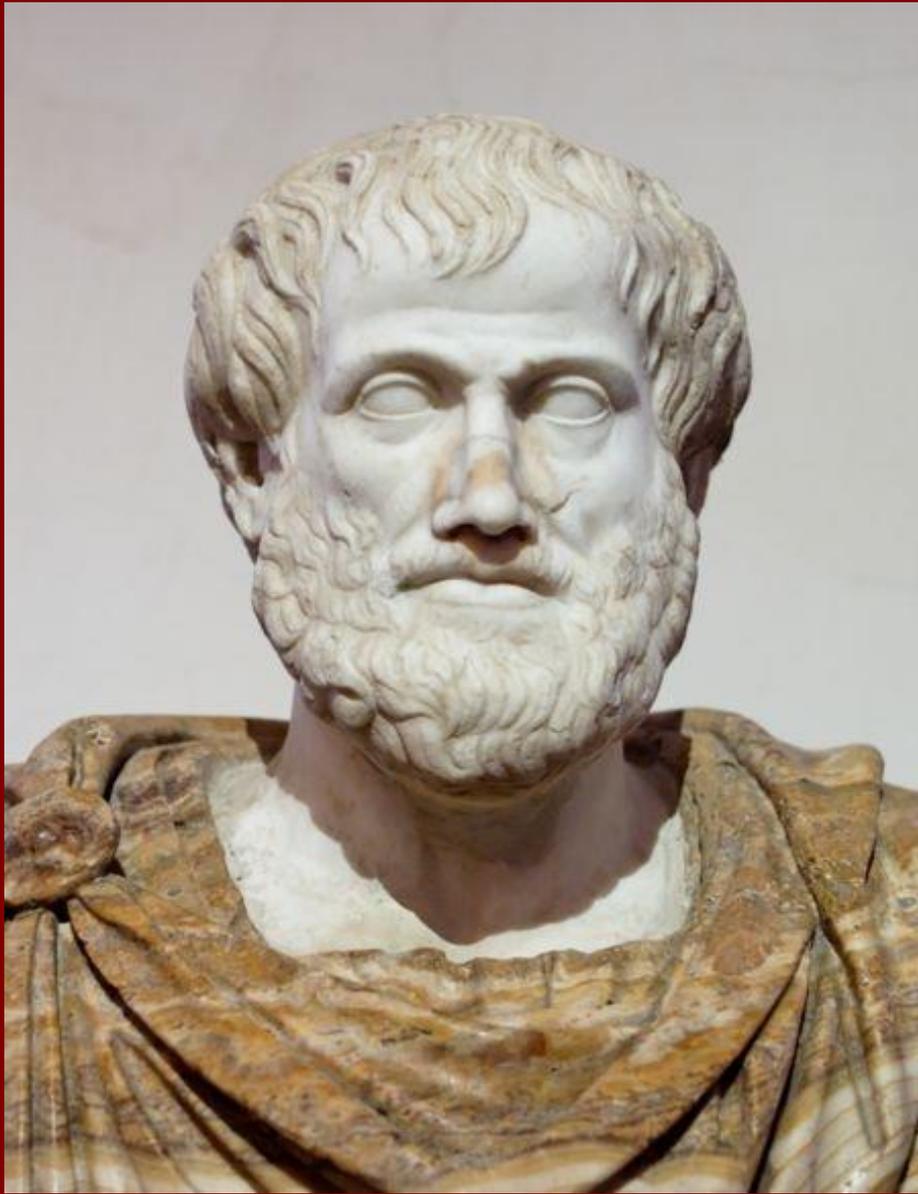


MALACHITE

石绿

(shi lu)

shi = stone, rock; lu = green



ARISTÓTELES
384-322 B.C.

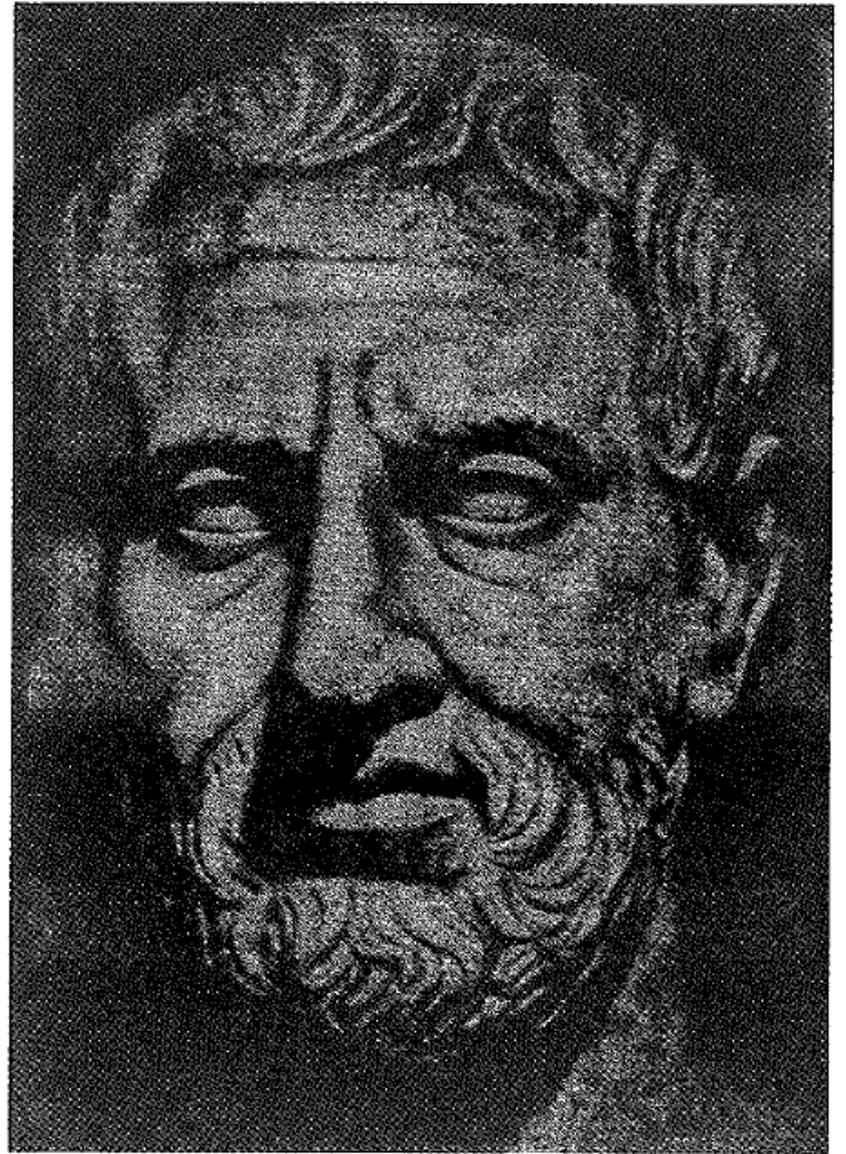


FIG. 4. Theophrastus (370–287 B.C.), author of “History of Stones”.

HISTORIA NATURAL DE GAYO PLINIO SEGUNDO.

Traducida por el Licenciado Gasparino de Herrera, Médico de la
Magistral, y Familiar del Ilustre Oficio de la Inspección.

*Y ampliada por el mismo con Eflectos, y Aclaraciones, en que declara
lo oscuro, y dudoso, y añade lo no sabido hasta este tiempo.*

DEDICADA

Al Católico Rey de las Españas don FELIPE Quarto nuestro Señor;

TOMO SEGUNDO.



Año

1629

*Imprata dove la fiore, sul vostro realito ordini
Per vostro allumino a Dio nostro, alla fiore.*

CON PRIVILEGIO.

EN MADRID, Por Juan Gomez, d. c.



Avicenna (*Αβιτζιανός*, *Avitzianós*),
(c. 980 - 1037)

GEORGII AGRICOLAE

DE RE METALLICA LIBRI XII QVI

bus Officia, Instrumenta, Machinae, ac omnia denique ad Metallum tam spectantia, non modo luculentissime describuntur, sed & per effigies, suis locis insertas, adiunctis Latinis, Germanicisque appellationibus ita ob oculos ponuntur, ut clarius tradi non possint.

E I V S D E M

DE ANIMANTIBVS SYSTERRANEIS Liber, ab Autore recognitus: cum Indicibus diversis, quae quid in opere tractatum est, pulchre demonstrantibus.



BASILEAE M D LVI

Cum Privilegio Imperatoris in annos v.
& Galliarum Regis ad Sexennium.



FIG. 5. Illustrations from *De Re Metallica* by Georgius Agricola; left: frontispiece; right: mining in the fifteenth century.

Origem dos nomes de minerais

- 1- Personalidade: menezesita, coutinhoíta, ruifrancoíta.
- 2- Propriedade física ou morfológica: astrocianita-(Ce) (rosetas azuis).
- 3- Composição química: tantalita, umohoíta (U, Mo, H, O).
- 4- Localidade: brazilianita, minasgeraisita-(Y), brumadoíta.
- 5- Prefixos e sufixos: clinocalcomenita, pseudomalaquita, lantanita-(La).

Prefixos X sufixos

Nomes alternativos para minerais do grupo do pirocloro

1. pirocloro-(NaF)
2. fluorpirocloro-(Na)
3. natropirocloro-(F)
4. fluornatropirocloro
5. natrofluorpirocloro

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vol. 39, no. 2 (March–April 2008)
www.MineralogicalRecord.com

TIDYING UP MINERAL NAMES: AN IMA-CNMNC SCHEME FOR SUFFIXES, HYPHENS AND DIACRITICAL MARKS

Ernst A.J. Burke

Chairman, Commission on New Minerals, Nomenclature and Classification (CNMNC)
of the International Mineralogical Association (IMA)

Department of Petrology, Faculty of Earth and Life Sciences, Vrije Universiteit
De Boelelaan 1085, NL-1081 HV Amsterdam, Netherlands

Mineral names which do not conform to the current nomenclature guidelines of the Commission on New Minerals, Nomenclature and Classification have to be corrected, and in the future a suffix-based nomenclature is to be used for new mineral names.

Encyclopedia of Mineral Names



William H. Blackburn
William H. Dennen



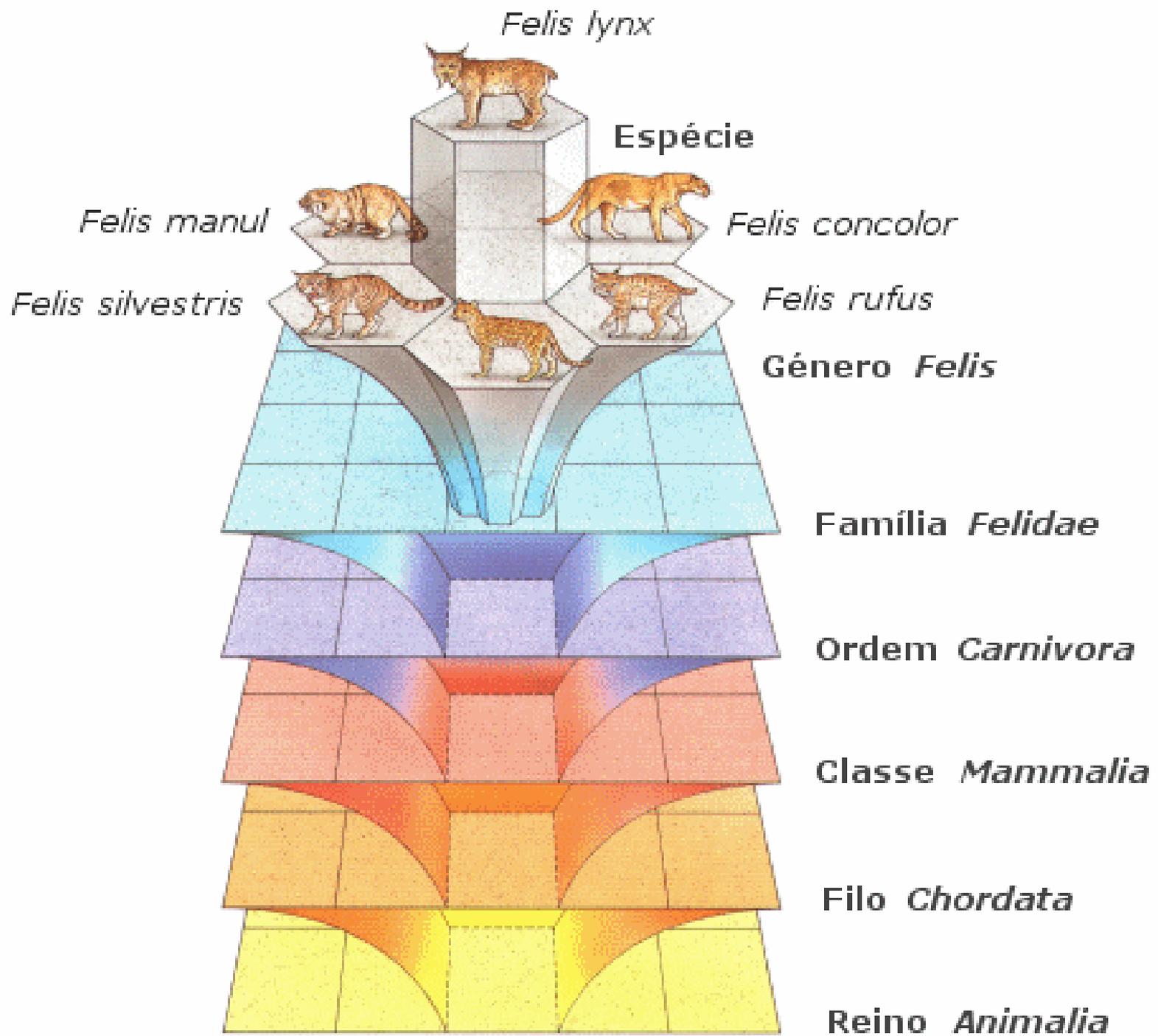
The Canadian Mineralogist **1**
Special Publication

Los Nombres de los Minerales

José Luis Zamora Rubio

Datos biográficos





The standardisation of mineral group hierarchies: application to recent nomenclature proposals

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Commission on New Minerals, Nomenclature and Classification, of the International Mineralogical Association
(IMA–CNMNC), Secretary

*Corresponding author, e-mail: smills@eos.ubc.ca

² Laboratoire de Minéralogie et de Cristallographie, B-18, Université de Liège, 4000 Liège, Belgium
IMA–CNMNC, Vice-Chairman

³ CSIRO, Private Bag 5, Wembley, Western Australia 6913, Australia

⁴ Dipartimento di Scienze Mineralogiche e Petrologiche, Università di Torino, Via Valperga Caluso 35,
10125, Torino, Italy

Abstract: A simplified definition of a mineral group is given on the basis of structural and compositional aspects. Then a hierarchical scheme for group nomenclature and mineral classification is introduced and applied to recent nomenclature proposals. A new procedure has been put in place in order to facilitate the future proposal and naming of new mineral groups within

Hierarquia mineralógica:

1. Classe
2. Subclasse
3. Família
4. Supergrupo
5. Grupo
6. Subgrupo ou Série
7. Espécie



Variedades

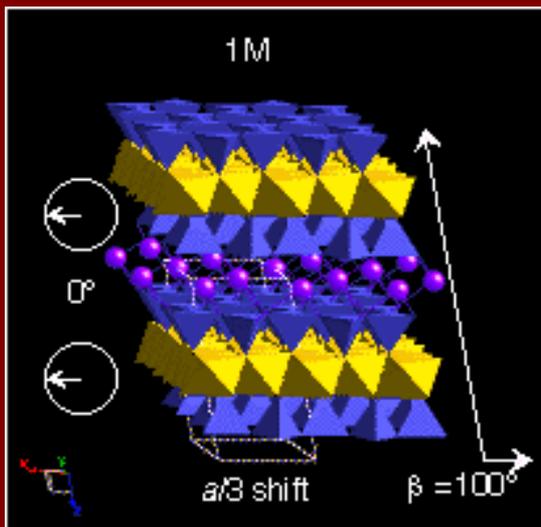
marmatita X
ferroesfalerita X
Fe-esfalerita X

esfalerita rica em Fe

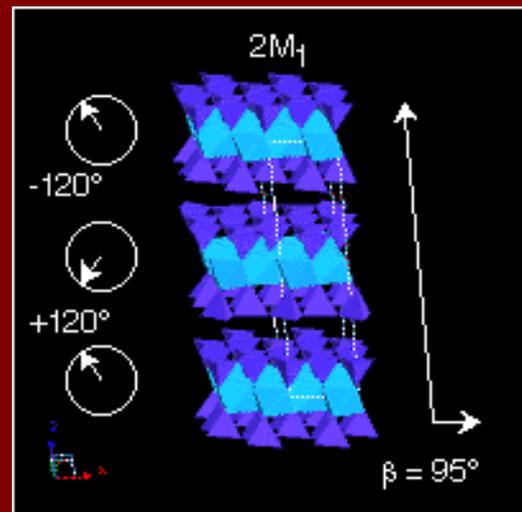
© 2002 Thames Valley Minerals

Fórmula: $(\text{Zn}, \text{Fe})\text{S}$

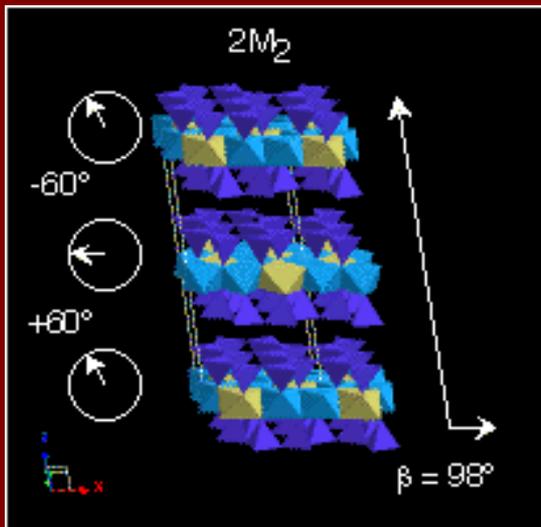
Politipos



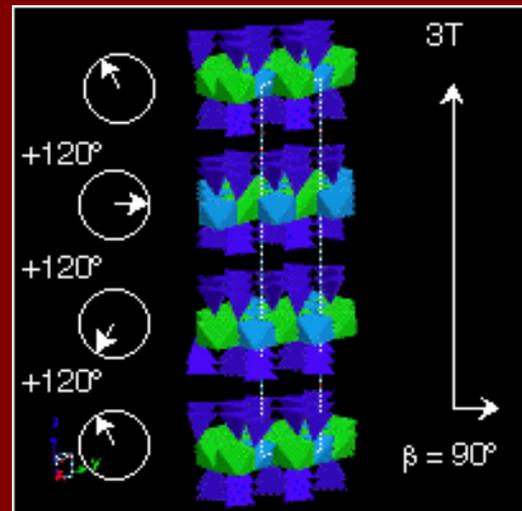
Muscovita-1M



Muscovita-2M₁



Muscovita-2M₂



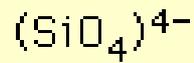
Muscovita-3T

12 CLASSES MINERAIS

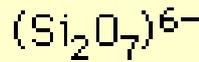
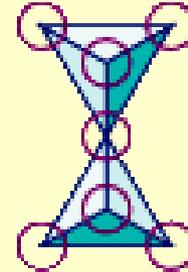
- Elementos nativos
- Sulfetos
- Sulfossais
- Óxidos
- Halóides
- Carbonatos
- Nitratos
- Boratos
- Fosfatos
- Sulfatos
- Tungstatos
- Silicatos

Subclasses

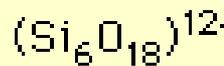
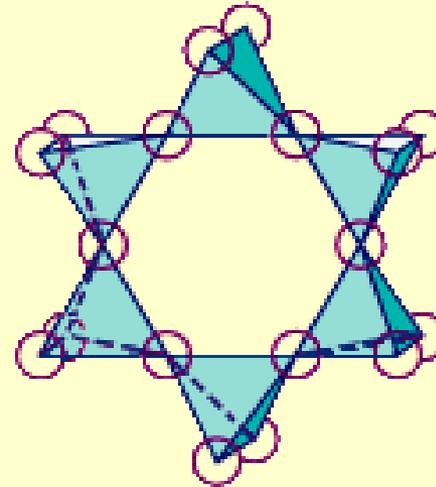
Nesosilicates



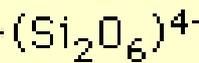
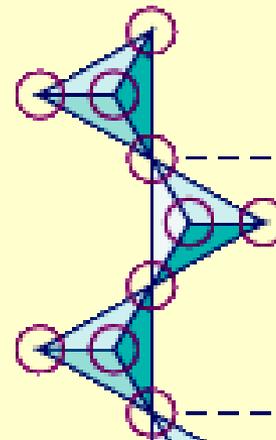
Sorosilicates



Cyclosilicates



Inosilicates
(single chain)

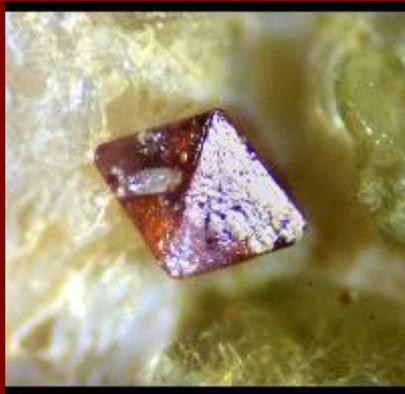


Famílias

- 2 ou + grupos e/ou supergrupos:
 - Zeólitas
 - Feldspatóides

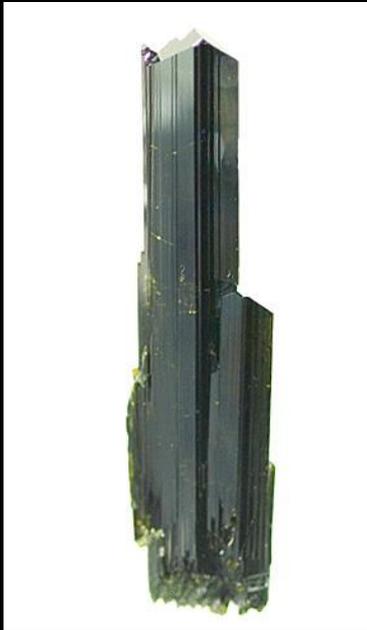
Supergrupos

2 ou + grupos com mesma estrutura:



Pirocloro
Epídoto

Table 1c. Group nomenclature for the epidote supergroup.



Epidote supergroup³		
Epidote group	Allanite group	Dollaseite group
Clinozoisite	Allanite-(Ce)	Dollaseite-(Ce)
Epidote	Allanite-(La)	Khristovite-(Ce)
Epidote-(Pb)	Allanite-(Y)	
Mukhinite	Dissakisite-(Ce)	
Clinozoisite-(Sr)	Dissakisite-(La)	
Piemontite	Ferriallanite-(Ce)	
Piemontite-(Sr)	Manganiandrosite-(Ce)	
Manganipiemontite-(Sr)	Manganiandrosite-(La)	
	Vanadoandrosite-(Ce)	

³ Reference: Armbruster *et al.* (2006).

Grupo de Minerais

- *Um grupo de minerais consiste de dois ou mais minerais com a mesma ou essencialmente a mesma estrutura e compostos por elementos químicos similares.*

Mills et al. (2009)

IMA reports for mineral systematics

The IMA-CNMMN has published over the past years in several mineralogical journals many official reports which contain the rules and regulations about all aspects of the mineral systematics, including: Definition of a mineral; Definitions of type mineral specimens; Discreditation of mineral species; End-member formula; Guidelines for polymorphs and polysomes; Mineral symbols; Names, prefixes and suffixes, and adjectival modifiers; Procedures and guidelines on mineral nomenclature; Solid solutions in mineral nomenclature.

These reports are available in the following papers:

- 1987 – [Formal definitions of type mineral specimen.](#) (Dunn and Mandarino)
- 1987 – [Procedures involving the IMA Commission on New Minerals and Mineral Names and guidelines on mineral nomenclature.](#) (Nickel and Mandarino)
- 1989 – [Protocols for scientists on the deposition of investigated mineral specimens.](#) (Dunn)
- 1990 – [The discreditation of mineral species.](#) (Dunn)
- 1992 – [Solid solutions in mineral nomenclature.](#) (Nickel)
- 1993 – [Standardization of polytype suffixes.](#) (Nickel)
- 1995 – [The definition of a mineral.](#) (Nickel)
- 1995 – [Mineral names applied to synthetic substances.](#) (Nickel)
- 1998 – [The IMA Commission on New Minerals and Mineral Names: procedures and guidelines on mineral nomenclature, 1998.](#) (Nickel and Grice)
- 2002 – [The use of end-member charge-arrangements in defining new mineral species and heterovalent substitutions in complex minerals.](#) (Hawthorne)
- 2005 – [The use of chemical-element adjectival modifiers in mineral nomenclature.](#) (Bayliss et al.)
- 2008 – [The IMA-CNMMN dominant-constituent rule revisited and extended.](#) (Hatert and Burke)

Recent IMA-CNMNC Reports on Nomenclature and Classification of Mineral Groups and Supergroups Approved (from 2010, based on CNMNC Newsletters)

- July 2024: **Nolanite supergroup**

Bosi, F., Hatert, F., Pasero, M., Mills, S.J. (2024): CNMNC Newsletter 80. *European Journal of Mineralogy*, 36, 599-604.

- July 2024: **Kröhnkite supergroup**

Bosi, F., Hatert, F., Pasero, M., Mills, S.J. (2024): CNMNC Newsletter 80. *European Journal of Mineralogy*, 36, 599-604.

- February 2024: **Ancylite supergroup**

Bosi, F., Hatert, F., Pasero, M., Mills, S.J. (2024): CNMNC Newsletter 78. *European Journal of Mineralogy*, 36, 361-367.

- July 2023: **Dongchuanite group**

Bosi, F., Hatert, F., Pasero, M., Mills, S.J. (2023): CNMNC Newsletter 74. *European Journal of Mineralogy*, 35, 659-664.

- June 2023: **Paulkerrite group**

Grey, I.E., Boer, S., MacRae, C.M., Wilson, N.C., Mumme, W.G., Bosi, F. (2023) Crystal-chemistry of type paulkerrite and establishment of the paulkerrite group nomenclature. *European Journal of Mineralogy*, 35, 909-919.

- May 2023: **Cerite group**

Bosi, F., Hatert, F., Pasero, M., Mills, S.J. (2023): CNMNC Newsletter 73. *European Journal of Mineralogy*, 35, 397-402.

- April 2023: **Minium group**

Bosi, F., Hatert, F., Pasero, M., Mills, S.J. (2023): CNMNC Newsletter 73. *European Journal of Mineralogy*, 35, 397-402.

Nomenclatura
de
minerais formadores de
rocha
e
outros minerais comuns



Quartzo SiO_2

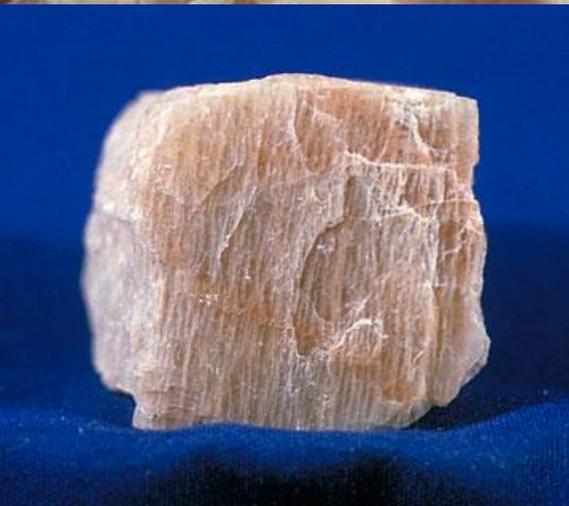


Berlinita	AlPO_4
Alarsita	AlAsO_4
Rodolicoíta	$\text{Fe}^{3+}\text{PO}_4$

Berlinite : AlPO_4 , Burangaite : $\text{NaFe}^{2+}\text{Al}_5(\text{PO}_4)_4(\text{OH})_6 \cdot 2\text{H}_2\text{O}$

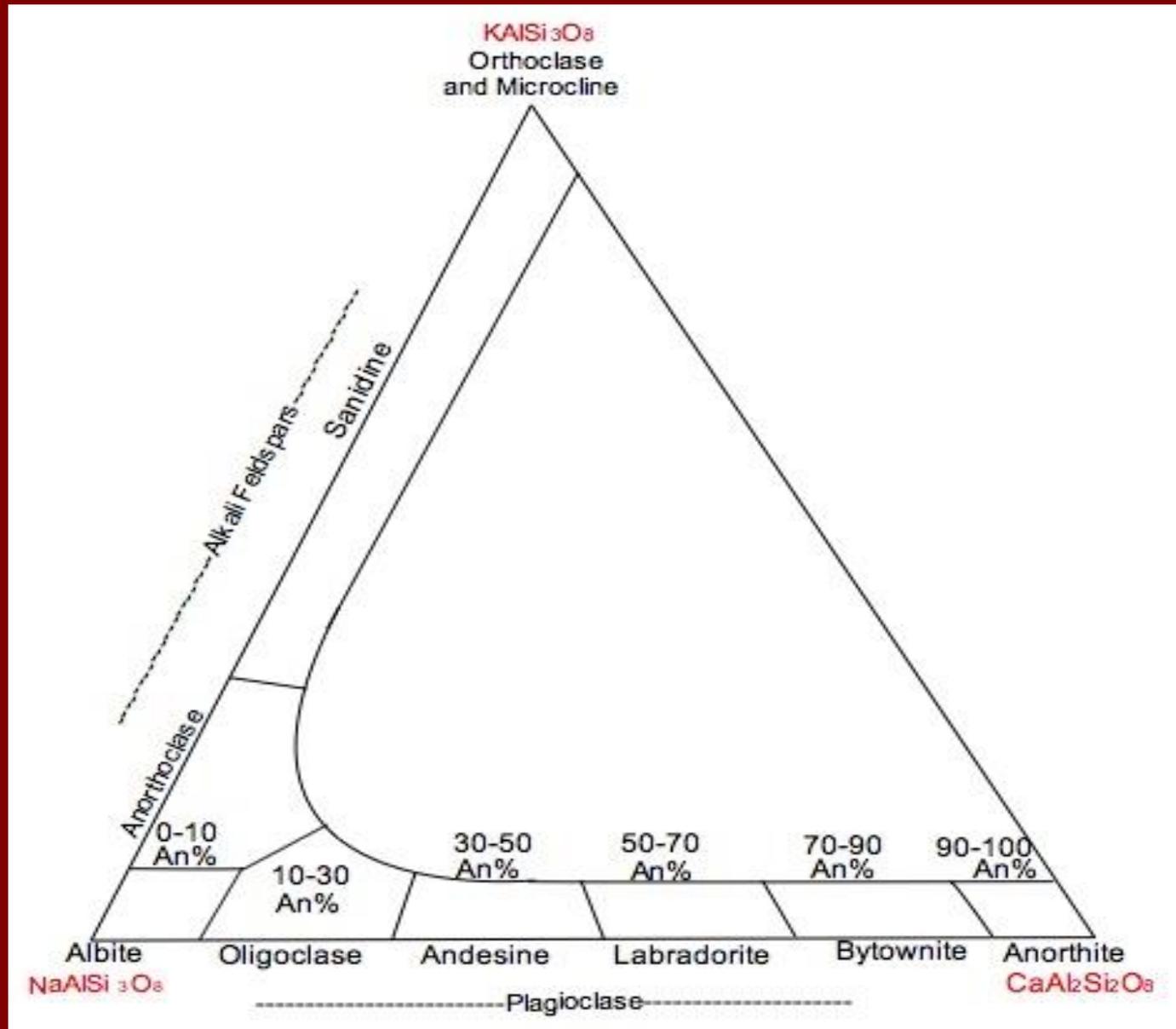
Hålsjöberg, Torsby, Värmland, Sweden





Feldspato

Grupo dos Feldspatos



HOMOVALENT SUBSTITUTIONS

« 50 % mark »



« 33.3 % marks »

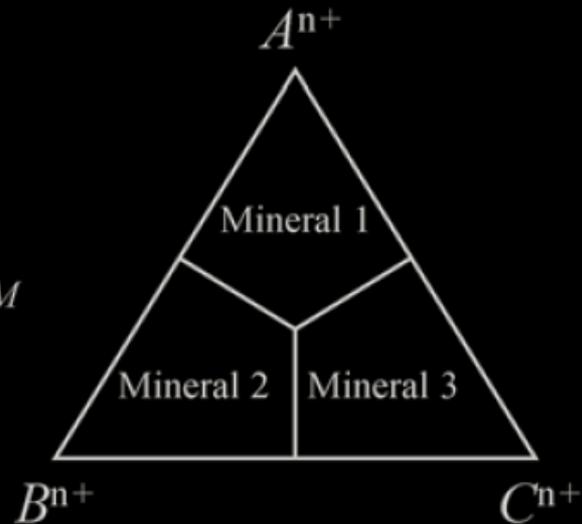


FIG. 1. Diagrammatic representations of homovalent substitutions. a. Complete binary solid-solution series. b. Complete ternary solid-solution series.

Kyanoxalite	$\text{Na}_7(\text{Al}_{5.6}\text{Si}_{6.7}\text{O}_{24})(\text{C}_2\text{O}_4)_{0.5-1.0}\cdot 5\text{H}_2\text{O}$	A	2008-041	Russia	<i>Zapiski Rossiyskogo Mineralogicheskogo Obshchestva</i> 138(6) (2009), 18
Kyawthuite	$\text{Bi}^{3+}\text{Sb}^{5+}\text{O}_4$	A	2015-078	Myanmar	<i>CNMNC Newsletter 28 - Mineralogical Magazine</i> 79 (2015), 1859
Kyrgyzstanite	$\text{ZnAl}_4(\text{SO}_4)(\text{OH})_{12}\cdot 3\text{H}_2\text{O}$	A	2004-024	Kyrgyzstan	<i>New Data on Minerals</i> 40 (2005), 23
Kyzylkumite	$\text{Ti}_2\text{V}^{3+}\text{O}_5(\text{OH})$	A	1980-081	Uzbekistan	<i>Zapiski Vsesoyuznogo Mineralogicheskogo Obshchestva</i> 110 (1981), 607
Laachite	$(\text{Ca},\text{Mn})_2\text{Zr}_2\text{Nb}_2\text{TiFeO}_{14}$	A	2012-100	Germany	<i>European Journal of Mineralogy</i> 26 (2014), 103
Labuntsovite-Fe	$\text{Na}_4\text{K}_4\text{Fe}^{2+}_2\text{Ti}_8\text{O}_4(\text{Si}_4\text{O}_{12})_4(\text{OH})_4\cdot 10-12\text{H}_2\text{O}$	A	1998-051a	Russia	<i>Zapiski Vserossiyskogo Mineralogicheskogo Obshchestva</i> 130(4) (2001), 36
Labuntsovite-Mg	$\text{Na}_4\text{K}_4\text{Mg}_2\text{Ti}_8\text{O}_4(\text{Si}_4\text{O}_{12})_4(\text{OH})_4\cdot 10-12\text{H}_2\text{O}$	A	1998-050a	Russia	<i>Zapiski Vserossiyskogo Mineralogicheskogo Obshchestva</i> 130(4) (2001), 36
Labuntsovite-Mn	$\text{Na}_4\text{K}_4\text{Mn}^{2+}_2\text{Ti}_8\text{O}_4(\text{Si}_4\text{O}_{12})_4(\text{OH})_4\cdot 10-12\text{H}_2\text{O}$	Rn	2000 s.p.	Russia	<i>Doklady Akademii Nauk SSSR</i> 101 (1955), 1113
Labyrinthite	$(\text{Na},\text{K},\text{Sr})_{35}\text{Ca}_{12}\text{Fe}_3\text{Zr}_6\text{TiSi}_{51}\text{O}_{144}(\text{O},\text{OH},\text{H}_2\text{O})_9\text{Cl}_3$	A	2002-065	Russia	<i>Zapiski Rossiyskogo Mineralogicheskogo Obshchestva</i> 135(2) (2006), 38
Lacroixite	$\text{NaAl}(\text{PO}_4)\text{F}$	G	1914	Germany	<i>Bulletin de la Société Française de Minéralogie</i> 37 (1914), 157
Laffittite	AgHgAsS_3	A	1973-031	France	<i>Bulletin de la Société Française de Minéralogie et de Cristallographie</i> 97 (1974), 48
Laflammeite	$\text{Pd}_3\text{Pb}_2\text{S}_2$	A	2000-014	Finland	<i>Canadian Mineralogist</i> 40 (2002), 671
Laforêtite	AgInS_2	A	1995-006	France	<i>European Journal of Mineralogy</i> 11 (1999), 891
Lafossaite	TlCl	A	2003-032	Italy	<i>Mineralogical Record</i> 37 (2006), 165

Substituições heterovalentes – homovalentes acopladas

Albita $\text{NaAlSi}_3\text{O}_8$

Substituições heterovalentes:

$(\text{Na}_{0,6}\text{Ca}_{0,4})\text{Al}_{1,4}\text{Si}_{2,6}\text{O}_8$: albita.



$(\text{Na}_{0,35}\text{K}_{0,25}\text{Ca}_{0,4})\text{Al}_{1,4}\text{Si}_{2,6}\text{O}_8$

Regra do constituinte dominante: anortita.

Fórmula ideal do membro final: $\text{CaAlSi}_3\text{O}_8$,

(não balanceada!)

Regra da valência dominante: albita $\text{NaAlSi}_3\text{O}_8$

(cátions monovalentes são dominantes)

flogopita



NOMENCLATURE OF THE MICAS

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DIOCTAHEDRAL

muscovite	$\text{K Al}_2\text{□ AlSi}_3\text{ O}_{10}(\text{OH})_2$
$^{\text{IV}}\text{Si}: 3.0 - 3.1$	$^{\text{VI}}\text{Al}: 1.9 - 2.0$ $\text{K}: 0.7 - 1.0$ ($I \geq 0.85$)
$^{\text{VI}}\text{R}^{2+}/(^{\text{VI}}\text{R}^{2+} + ^{\text{VI}}\text{R}^{3+}) < 0.25$	$^{\text{VI}}\text{Al}/(^{\text{VI}}\text{Al} + ^{\text{VI}}\text{Fe}^{3+}): 0.5 - 1.0$
aluminoceladonite	$\text{K Al}(\text{Mg}, \text{Fe}^{2+})\text{□ Si}_4\text{ O}_{10}(\text{OH})_2$
$^{\text{VI}}\text{R}^{2+}/(^{\text{VI}}\text{R}^{2+} + ^{\text{VI}}\text{R}^{3+}) \geq 0.25$	$^{\text{VI}}\text{Al}/(^{\text{VI}}\text{Al} + ^{\text{VI}}\text{Fe}^{3+}): 0.5 - 1.0$
$\text{Mg}/(\text{Mg} + ^{\text{VI}}\text{Fe}^{2+}) > 0.5$	
ferro-aluminoceladonite	$\text{K Al}(\text{Fe}^{2+}, \text{Mg})\text{□ Si}_4\text{ O}_{10}(\text{OH})_2$
$^{\text{VI}}\text{Al}/(^{\text{VI}}\text{Al} + ^{\text{VI}}\text{Fe}^{3+}): 0.5 - 1.0$	$\text{Mg}/(\text{Mg} + ^{\text{VI}}\text{Fe}^{2+}) \leq 0.5$
celadonite	$\text{K Fe}^{3+}(\text{Mg}, \text{Fe}^{2+})\text{□ Si}_4\text{ O}_{10}(\text{OH})_2$
$^{\text{VI}}\text{R}^{2+}/(^{\text{VI}}\text{R}^{2+} + ^{\text{VI}}\text{R}^{3+}) \geq 0.25$	$^{\text{VI}}\text{Al}/(^{\text{VI}}\text{Al} + ^{\text{VI}}\text{Fe}^{3+}) < 0.5$
$\text{Mg}/(\text{Mg} + ^{\text{VI}}\text{Fe}^{2+}) > 0.5$	
ferroceladonite	$\text{K Fe}^{3+}(\text{Fe}^{2+}, \text{Mg})\text{□ Si}_4\text{ O}_{10}(\text{OH})_2$
$^{\text{VI}}\text{Al}/(^{\text{VI}}\text{Al} + ^{\text{VI}}\text{Fe}^{3+}) < 0.5$	$\text{Mg}/(\text{Mg} + ^{\text{VI}}\text{Fe}^{2+}) \leq 0.5$
roscoelite	$\text{K V}_2\text{□ AlSi}_3\text{ O}_{10}(\text{OH})_2$
chromphyllite	$\text{K Cr}_2\text{□ AlSi}_3\text{ O}_{10}(\text{OH})_2$
boromuscovite	$\text{K Al}_2\text{□ BSi}_3\text{ O}_{10}(\text{OH})_2$
paragonite	$\text{Na Al}_2\text{□ AlSi}_3\text{ O}_{10}(\text{OH})_2$
$\text{K} < 0.15$	$\text{Ca} < 0.11$
nanpingite	$\text{Cs Al}_2\text{□ AlSi}_3\text{ O}_{10}(\text{OH})_2$
tobelite	$(\text{NH}_4)\text{Al}_2\text{□ AlSi}_3\text{ O}_{10}(\text{OH})_2$

TRIOCTAHEDRAL

annite	$\text{K Fe}^{2+}_3 \text{ AlSi}_3 \text{ O}_{10} (\text{OH})_2$
phlogopite	$\text{K Mg}_3 \text{ AlSi}_3 \text{ O}_{10} (\text{OH})_2$
siderophyllite	$\text{K Fe}^{2+}_2 \text{ Al Al}_2 \text{ Si}_2 \text{ O}_{10} (\text{OH})_2$
eastonite	$\text{K Mg}_2 \text{ Al Al}_2 \text{ Si}_2 \text{ O}_{10} (\text{OH})_2$
hendricksite	$\text{K Zn}_3 \text{ AlSi}_3 \text{ O}_{10} (\text{OH})_2$
$\text{Zn} > 1.5$	
montdorite*	$\text{KFe}^{2+}_{1.5} \text{Mn}^{2+}_{0.5} \text{Mg}_{0.5} \square_{0.5} \text{ Si}_4 \text{ O}_{10} \text{ F}_2$
tainiolite	$\text{K LiMg}_2 \text{ Si}_4 \text{ O}_{10} \text{ F}_2$
polyolithionite	$\text{K Li}_2 \text{ Al Si}_4 \text{ O}_{10} \text{ F}_2$
trilithionite*	$\text{K Li}_{1.5} \text{ Al}_{1.5} \text{ AlSi}_3 \text{ O}_{10} \text{ F}_2$
masutomilite	$\text{K LiAlMn}^{2+} \text{ AlSi}_3 \text{ O}_{10} \text{ F}_2$
$\text{Mn}^{2+}: 1.0 - 0.5$	$\text{Li}: 1.0 - 1.5$
$\text{Si}: 3.0 - 3.5$	$^{\text{IV}}\text{Al}: 1.0 - 0.5$
norrishite	$\text{K LiMn}^{3+}_2 \text{ Si}_4 \text{ O}_{12}$
tetra-ferri-annite	$\text{K Fe}^{2+}_3 \text{ Fe}^{3+} \text{ Si}_3 \text{ O}_{10} (\text{OH})_2$
tetra-ferriphlogopite	$\text{K Mg}_3 \text{ Fe}^{3+} \text{ Si}_3 \text{ O}_{10} (\text{OH})_2$
aspidolite	$\text{Na Mg}_3 \text{ AlSi}_3 \text{ O}_{10} (\text{OH})_2$
preiswerkite	$\text{Na Mg}_2 \text{ Al Al}_2 \text{ Si}_2 \text{ O}_{10} (\text{OH})_2$
ephesite	$\text{Na LiAl}_2 \text{ Al}_2 \text{ Si}_2 \text{ O}_{10} (\text{OH})_2$

TABLE 4. SERIES NAMES USED IN MICA NOMENCLATURE

biotite	trioctahedral micas between, or close to, the annite – phlogopite and siderophyllite – eastonite joins; dark micas without lithium
glauconite	dioctahedral interlayer-deficient micas with composition defined in Table 3
illite	dioctahedral interlayer-deficient micas with composition defined in Table 3
lepidolite	trioctahedral micas on, or close to, the trilithionite – polyolithionite join; light micas with substantial lithium
phengite	potassic dioctahedral micas between, or close to, the joins muscovite – aluminoceladonite and muscovite – celadonite
zinnwaldite	trioctahedral micas on, or close to, the siderophyllite – polyolithionite join; dark micas containing lithium

True and brittle micas: composition and solid-solution series

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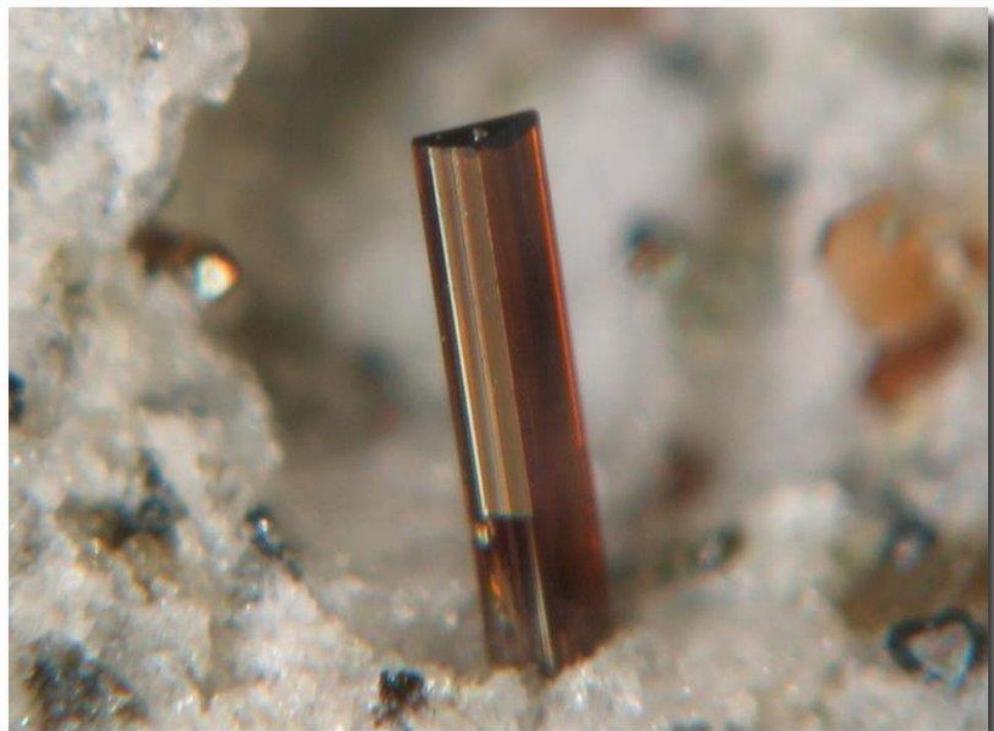
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ABSTRACT

Micas incorporate a wide variety of elements in their crystal structures. Elements occurring in significant concentrations in micas include: Si, ^{IV}Al, ^{IV}Fe³⁺, B and Be in the tetrahedral sheet; Ti, ^{VI}Al, ^{VI}Fe³⁺, Mn³⁺, Cr, V, Fe²⁺, Mn²⁺, Mg and Li in the octahedral sheet; K, Na, Rb, Cs, NH₄, Ca and Ba in the interlayer; and O, OH, F, Cl and S as anions. Extensive substitutions within these groups of elements form compositionally varied micas as members of different solid-solution series. The most common true K micas (94% of almost 6750 mica analyses) belong to three dominant solid-solution



PIROXÊNIOS

NOMENCLATURE OF PYROXENES

SUBCOMMITTEE ON PYROXENES*

COMMISSION ON NEW MINERALS AND MINERAL NAMES
INTERNATIONAL MINERALOGICAL ASSOCIATION

NOBUO MORIMOTO, *Chairman*

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ABSTRACT

This is the final report on the nomenclature of pyroxenes by the Subcommittee on Pyroxenes established by the Commission on New Minerals and Mineral Names of the International Mineralogical Association. The recommendations of the Subcommittee as put forward in this report have been formally accepted by the Commission. Accepted

ou de plusieurs éléments. Cent-cinq noms utilisés antérieurement sont abandonnés formellement.

(Traduit par la Rédaction)

Mots-clés: pyroxène, nomenclature, Association Internationale de Minéralogie, rapport final.

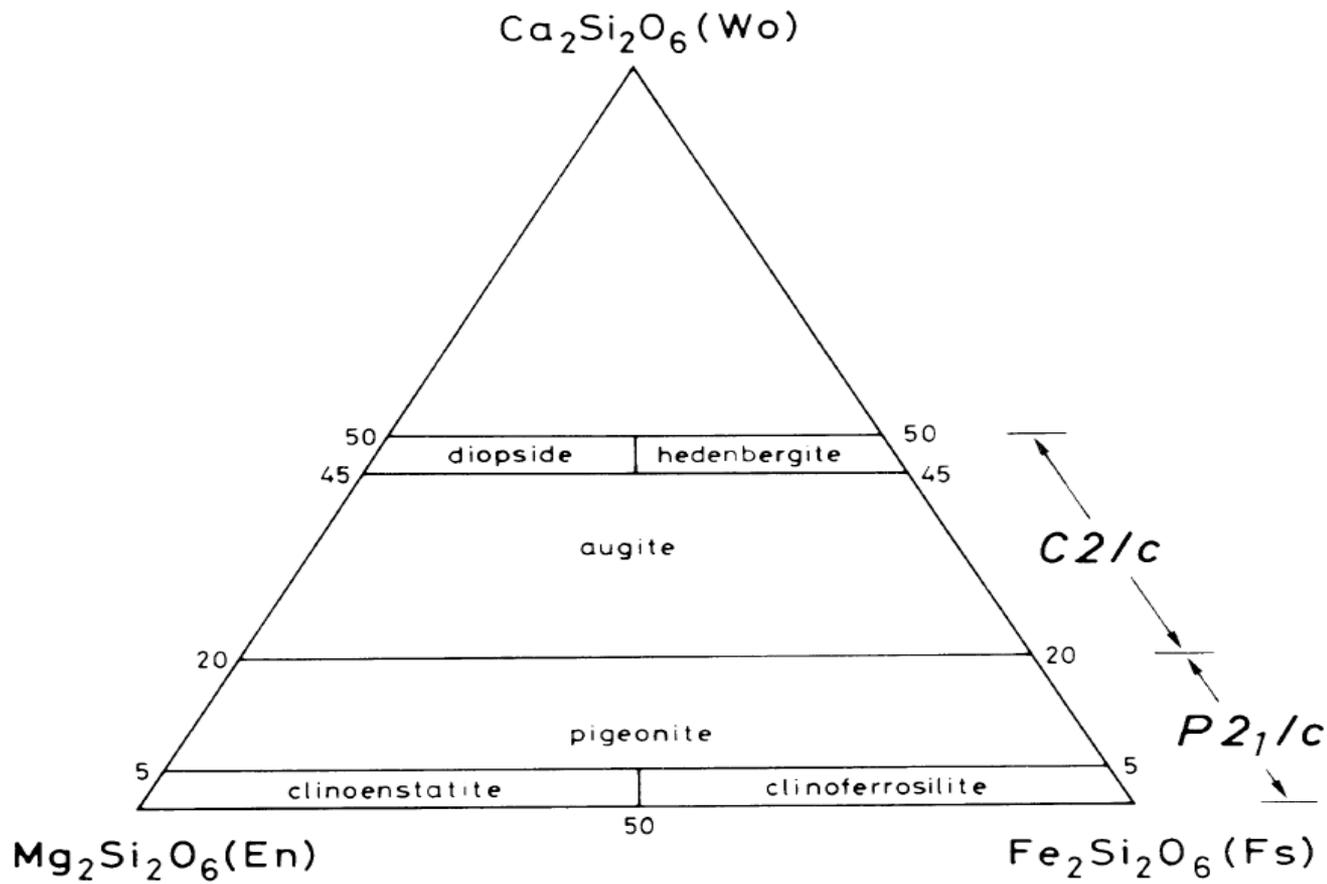


FIG. 4. Composition range of the Ca-Mg-Fe clinopyroxenes, with accepted names.

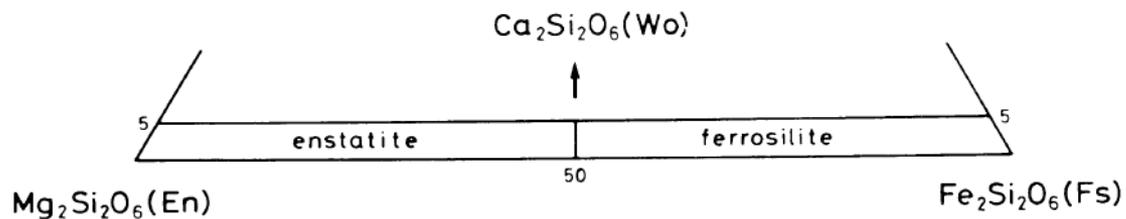


FIG. 5. Composition ranges of orthopyroxenes, with accepted names.

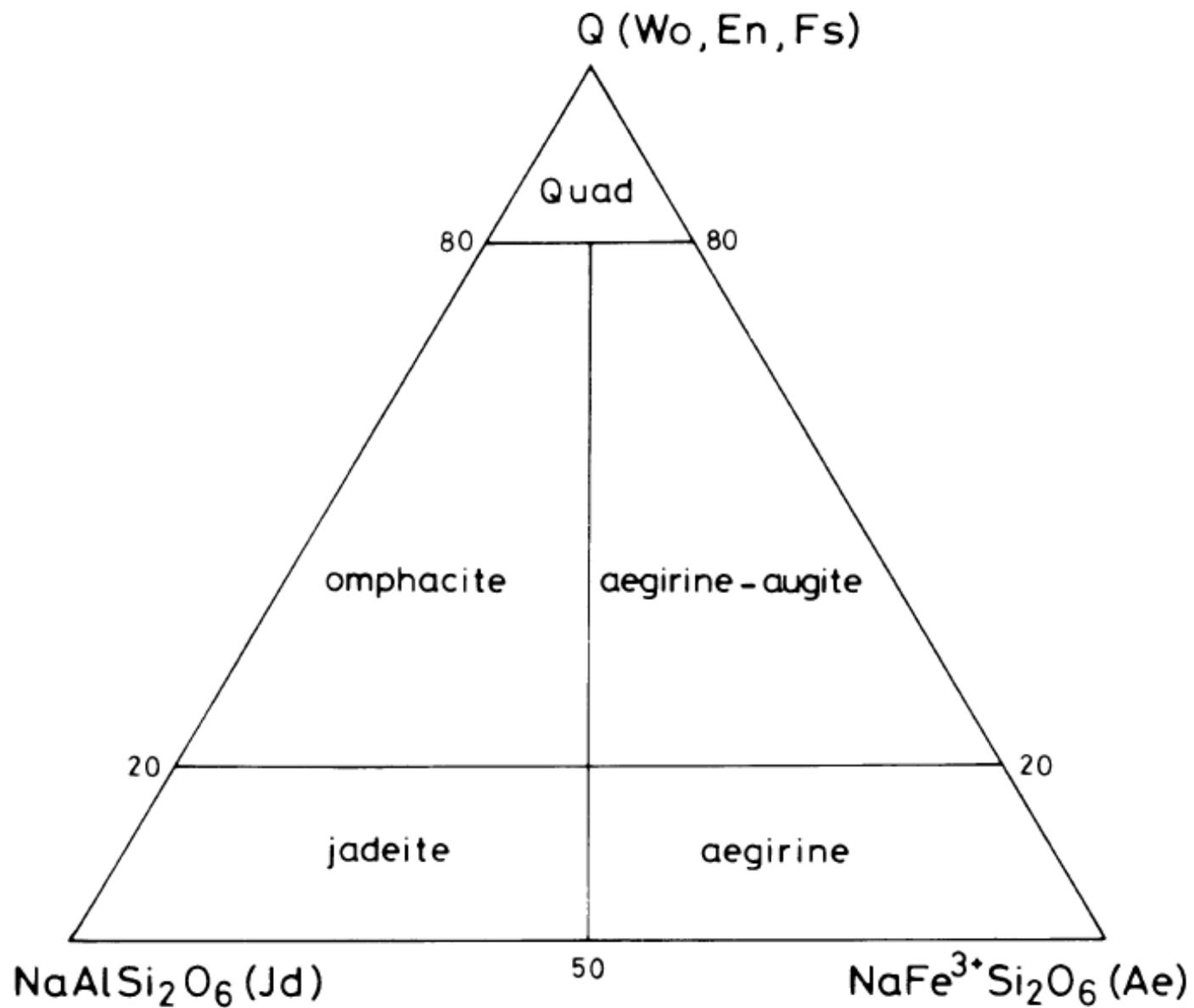
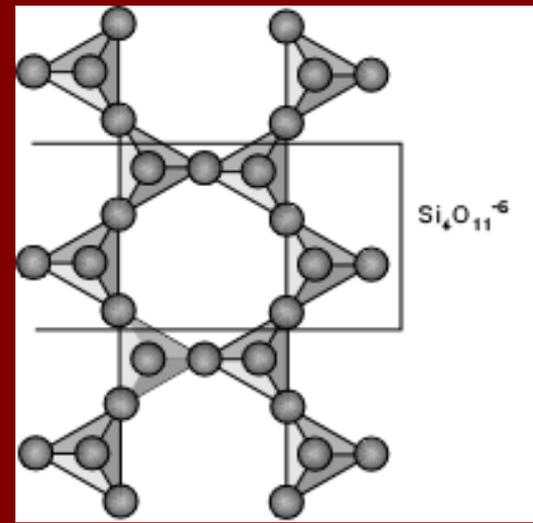


FIG. 6. Ca-Mg-Fe and Na pyroxenes, with accepted names. **Quad** represents the Ca-Mg-Fe pyroxene area (see Fig. 4).



Anfibólio



IMA REPORT

Nomenclature of the amphibole supergroup

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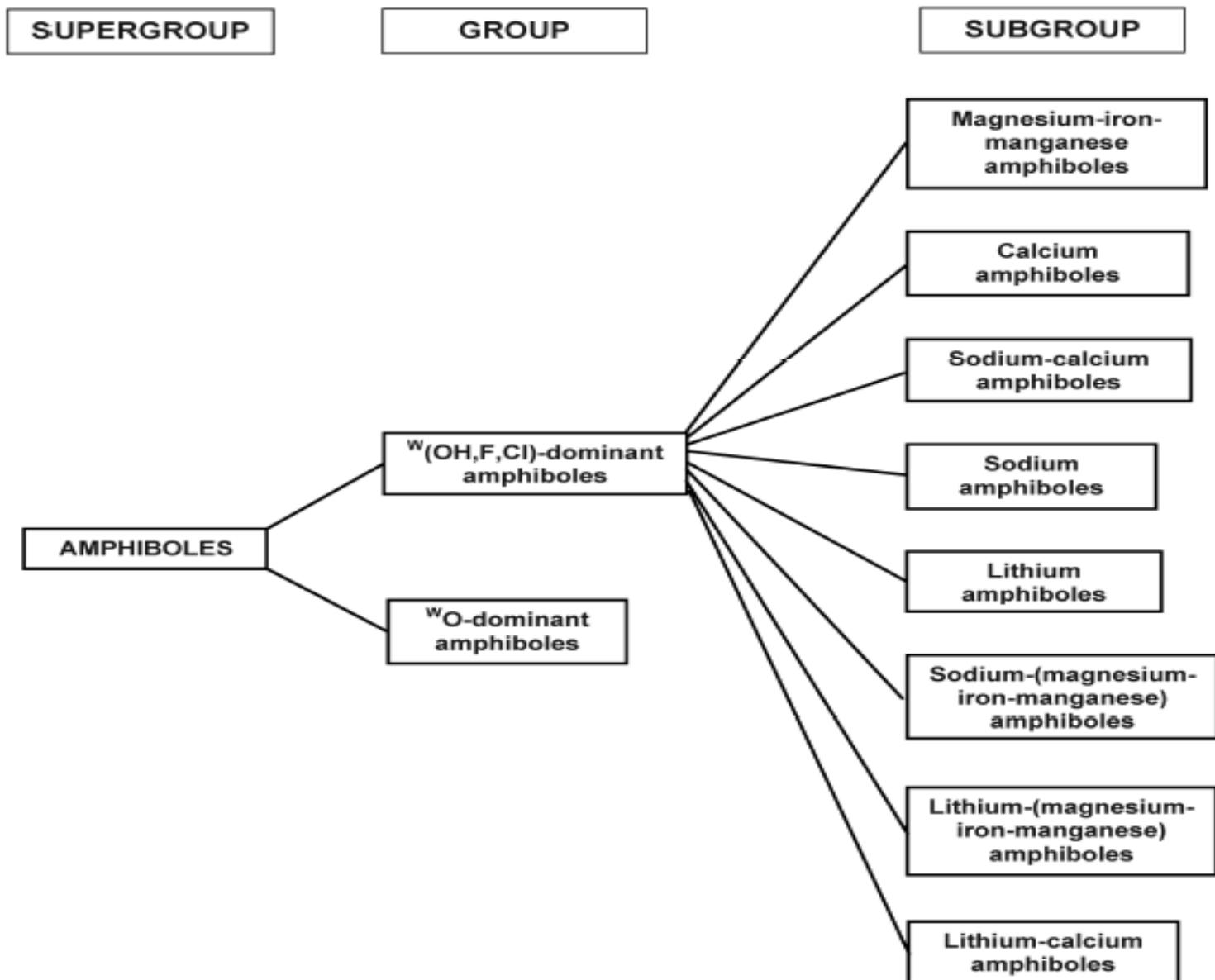
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ABSTRACT

A new classification and nomenclature scheme for the amphibole-supergroup minerals is described, based on the general formula $AB_2C_5T_8O_{22}W_2$, where A = \square , Na, K, Ca, Pb, Li; B = Na, Ca, Mn^{2+} , Fe^{2+} , Mg, Li; C = Mg, Fe^{2+} , Mn^{2+} , Al, Fe^{3+} , Mn^{3+} , Ti^{4+} , Li; T = Si, Al, Ti^{4+} , Be; W = (OH), F, Cl, O^{2-} . Distinct arrangements of formal charges at the sites (or groups of sites) in the amphibole structure warrant distinct *root names*, and are, by implication, distinct species; for a specific root name, different homovalent cations (e.g., Mg vs. Fe^{2+}) or anions (e.g., OH vs. F) are indicated by prefixes (e.g., ferro-, fluoro-). The classification is based on the A, B, and C groups of cations and the W group of anions, as these groups show the maximum compositional variability in the amphibole structure. The amphibole supergroup is divided into two groups according to the dominant W species: $^W(OH,F,Cl)$ -



APPENDIX FIGURE 2. The supergroup-group-subgroup hierarchy of the amphiboles.

Table 1g. Group nomenclature for the amphibole supergroup.

Amphibole supergroup				
Mg-Fe-Mn-Li group	Calcic group	Sodic-calcic group	Sodic group	Na-Ca-Mg-Fe-Mn-Li group
Anthophyllite	Actinolite	Aluminobarroisite	Arfvedsonite	Ferri-ottoliniite
Clinoferroholmquistite	Alumino-ferrotschermakite	Alumino-magnesiotaramite	Dellaventuraitite	Ferriwhittakerite
Cummingtonite	Alumino-magnesioadanagaite	Aluminotaramite	Eckermannite	Ottoliniite
Ferri-clinoferroholmquistite	Aluminotschermakite	Barroisite	Ferri-ferronybøite	Whittakerite
Ferri-clinoholmquistite	Cannilloite	Ferri-barroisite	Ferri-cnybøite	
Ferripedrizite	Chloro-potassichastingsite	Ferrikatophonite	Ferro-eckermannite	
Ferro-anthophyllite	Chloro-potassicpargasite	Ferri-ferrobarroisite	Ferroglaucophane	
Ferrogedrite	Edenite	Ferri-magnesiotaramite	Fluoro-ferroleakeite	
Ferrohalmquistite	Ferri-ferrotschermakite	Ferritaramite	Fluoro-magnesi-arfvedsonite	
Ferropedrizite	Ferritschermakite	Ferriwinchite	Fluoronybøite	
Fluoro-sodic-pedrizite	Ferro-actinolite	Ferrobarroisite	Fluoro-potassic-magnesi-arfvedsonite	
Gedrite	Ferro-edenite	Ferriorichterite	Glaucophane	
Grunerite	Ferrohornblende	Ferrowinchite	Kornite	
Holmquistite	Ferrokaersutite	Fluoro-alumino-magnesiotaramite	Közulite	
Manganocummingtonite	Ferropargasite	Fluoro-potassic-richterite	Leakeite	
Manganogrunerite	Ferrotschermakite	Fluororichterite	Magnesi-arfvedsonite	
Proto-anthophyllite	Ferrocannilloite	Katophorite	Magnesianiebeckite	
Protoferro-anthophyllite	Fluoro-edenite	Magnesiokatophonite	Nybøite	
Protomangano-ferro-anthophyllite	Fluoro-magnesiostingsite	Magnesiotaramite	Obertiite	
Sodicanthophyllite	Fluoropargasite	Parvowinchite	Potassicarfvedsonite	
Sodic-ferri-clinoferroholmquistite	Fluoro-potassichastingsite	Potassic-fluororichterite	Potassicleakeite	
Soedic-ferri-ferropedrizite	Hastingsite	Richterite	Potassic-magnesi-arfvedsonite	
Sodic-ferripedrizite	Joemithite	Taramite	Riebeckite	
Sodic-ferro-anthophyllite	Kaersutite	Winchite	Ungarettiite	
Sodic-ferrogedrite	Magnesiostingsite			
Sodicgedrite	Magnesiornblende			
	Magnesiostadanaite			
	Pargasite			
	Parvo-mangano-edenite			
	Parvo-manganotremolite			
	potassic-aluminoadanagaite			
	Potassic-ferristadanaite			
	Potassic-ferropargasite			
	Potassic-hastingsite			
	Potassic-magnesiostingsite			
	Potassic-magnesiostadanaite			
	Potassicpargasite			
	Potassicstadanaite			
	Sadanaite			
	Tremolite			
	Tschermakite			



⁸ References: Leake *et al.* (1997, 2003), Nickel & Nichols (2007), Back & Mandarino (2008). Only amphiboles found in nature are reported.

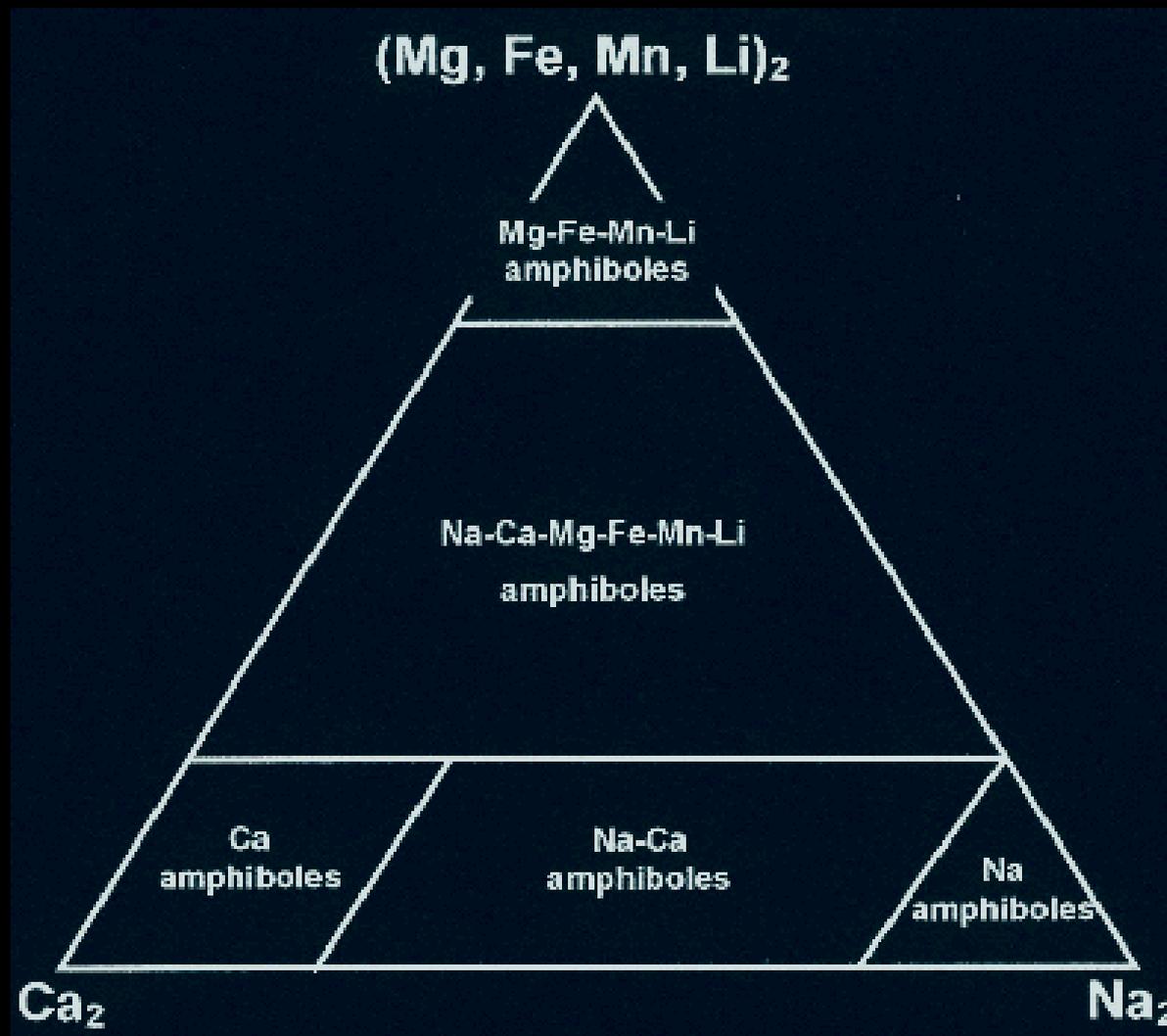
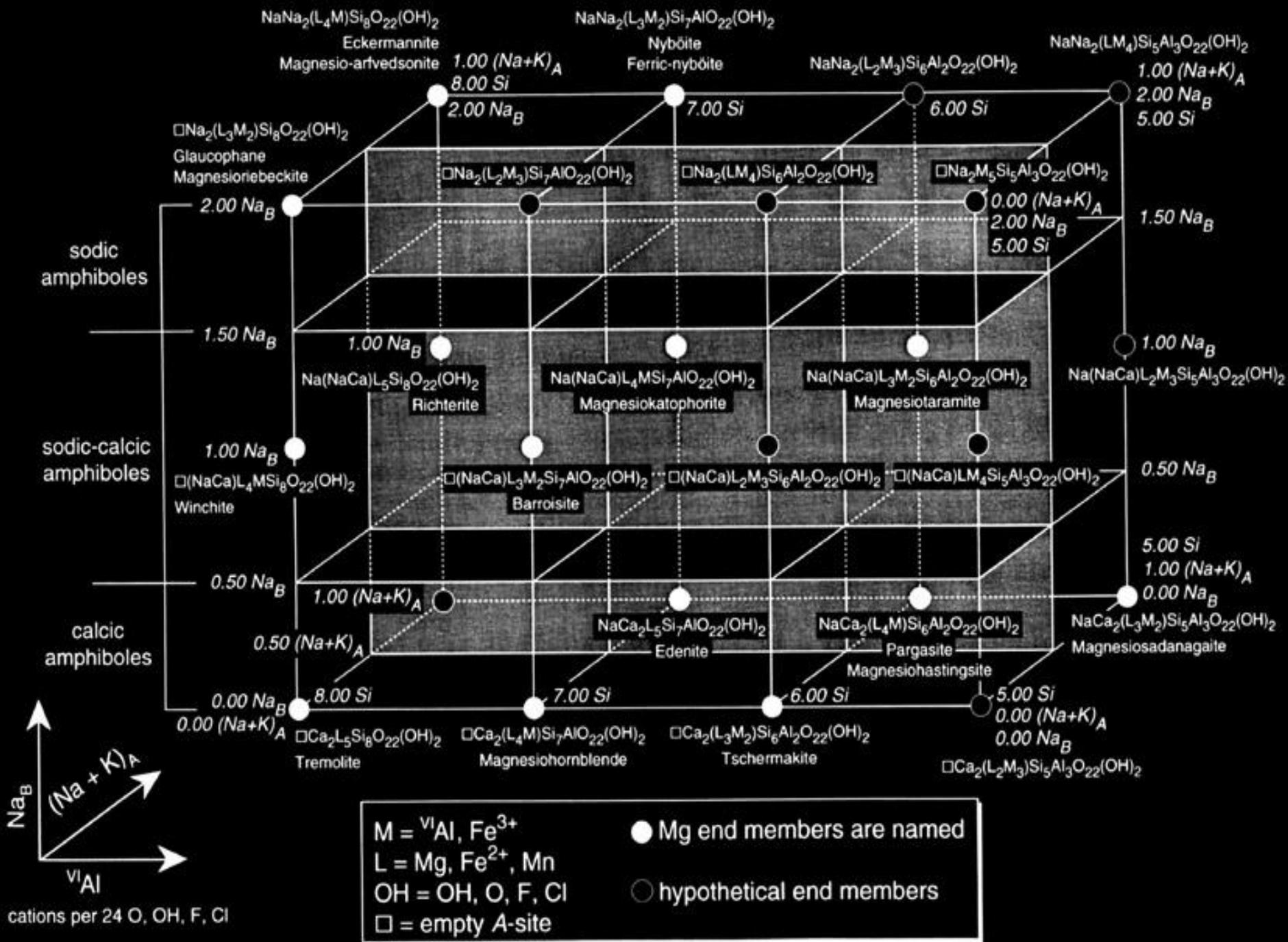


FIG. 2. The present classification (Leake *et al.* 2004) for the five main groups of amphibole.



Granada



IMA REPORT

Nomenclature of the garnet supergroup

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ABSTRACT

The garnet supergroup includes all minerals isostructural with garnet regardless of what elements occupy the four atomic sites, i.e., the supergroup includes several chemical classes. There are presently 32 approved species, with an additional 5 possible species needing further study to be approved. The general formula for the garnet supergroup minerals is $\{X_3\}[Y_2](Z_3)\varphi_{12}$, where X , Y , and Z refer to dodecahedral, octahedral, and tetrahedral sites, respectively, and φ is O, OH, or F. Most garnets are cubic, space group $Ia\bar{3}d$ (no. 230), but two OH-bearing species (henritermierite and holtstamite) have tetragonal symmetry, space group, $I4_1/acd$ (no. 142), and their X , Z , and φ sites are split into more symmetrically unique atomic positions. Total charge at the Z site and symmetry are criteria for distinguishing groups, whereas the dominant-constituent and dominant-valency rules are critical in identifying species. Twenty-nine species belong to one of five groups: the tetragonal henritermierite group and the isometric bitikleite, schorlomite, garnet, and berzeliite groups with a total charge at Z of 8 (silicate), 9 (oxide), 10 (silicate), 12 (silicate), and 15 (vanadate, arsenate), respectively. Three species are single representatives of potential groups in which Z is vacant or occupied by monovalent (halide, hydroxide) or divalent cations (oxide). We recommend that suffixes (other than Levinson modifiers) not be used in naming minerals in the garnet supergroup. Existing names with suffixes have been replaced with new root names where necessary: bitikleite-(SnAl) to bitikleite, bitikleite-(SnFe)

Garnet
(001) slice

Atomic sites

Brown - X

Green - Y

Blue - Z

Red - ϕ

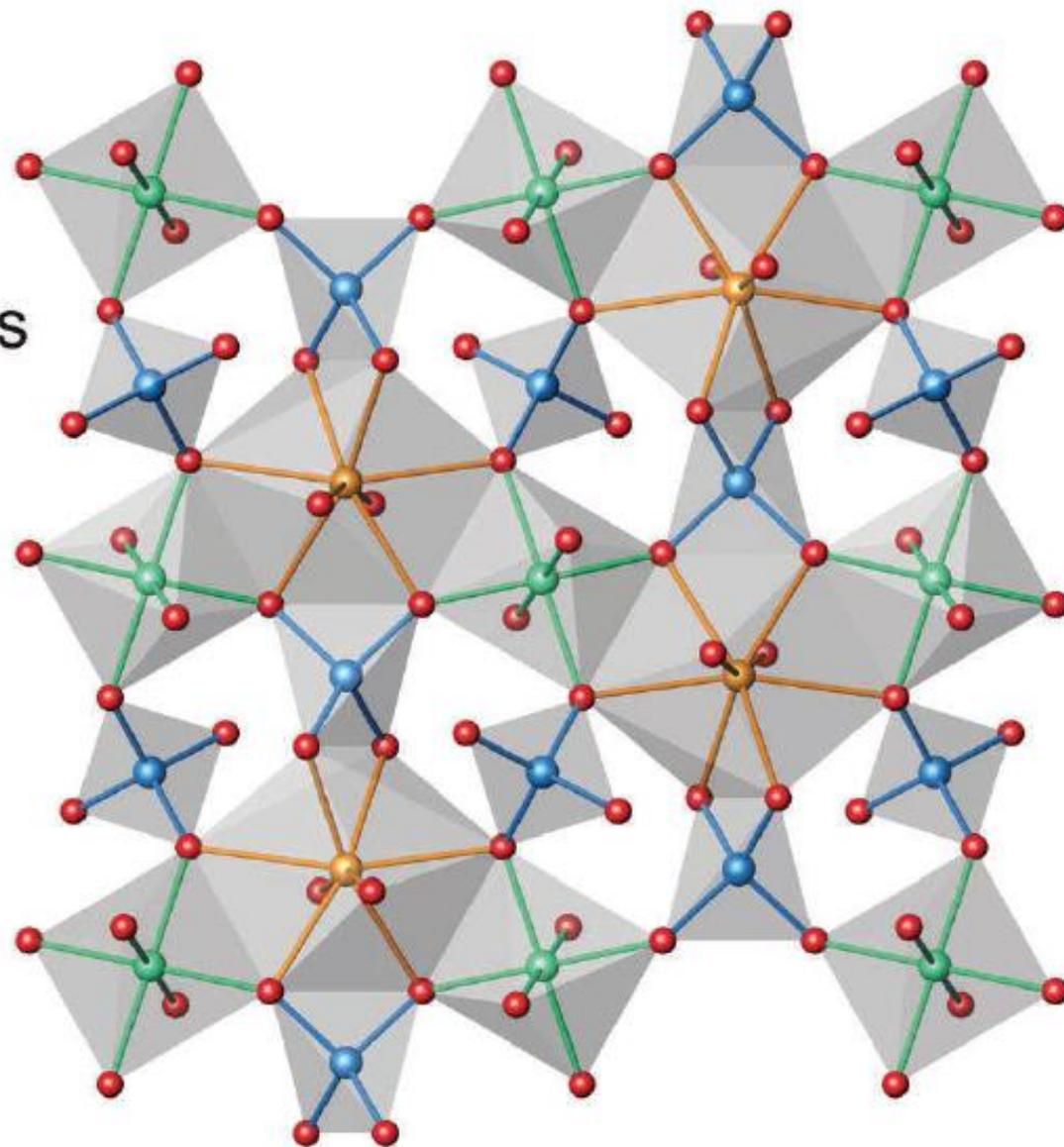


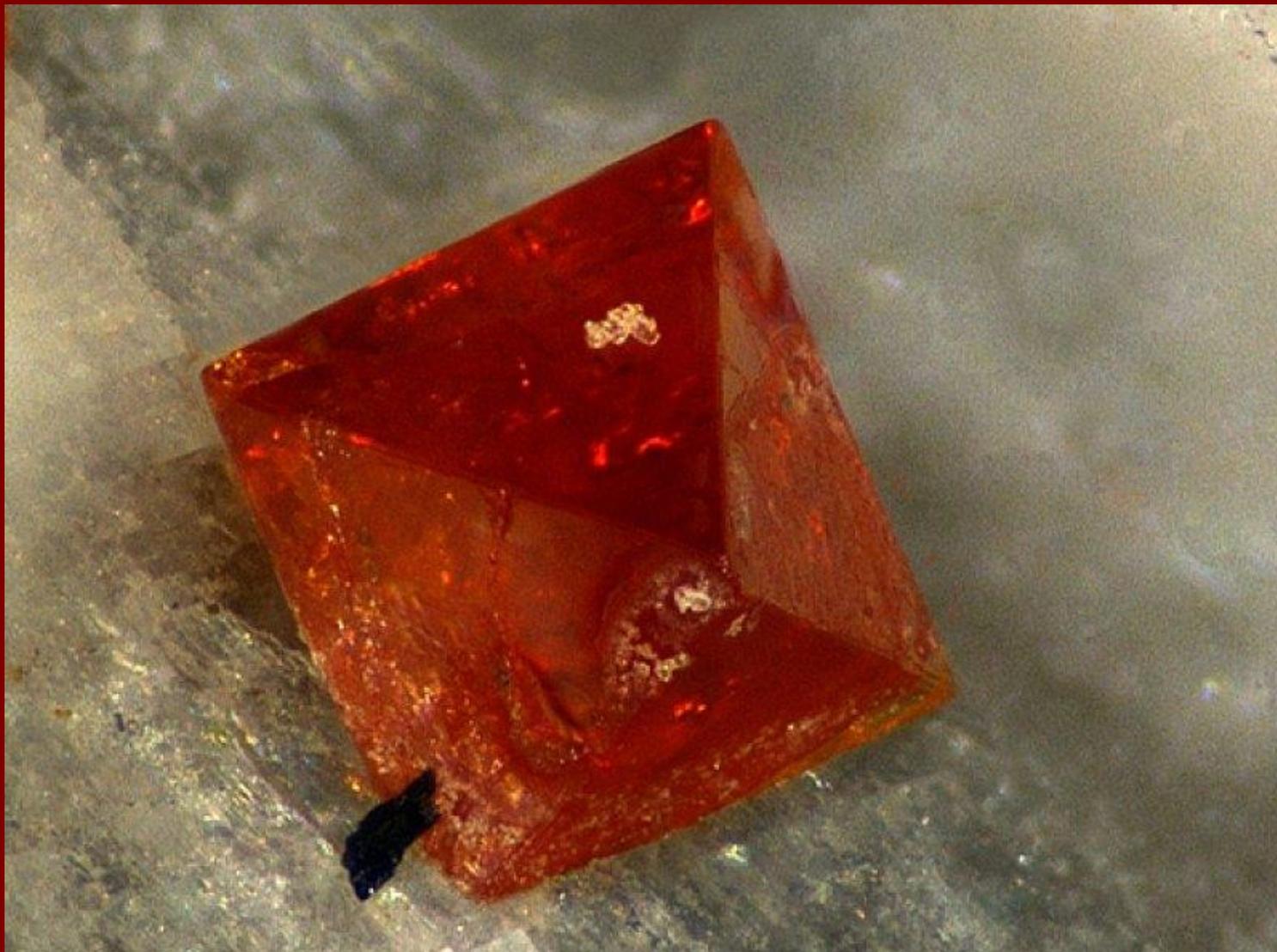
FIGURE 2. Portion of the garnet structure projected along [001].

TABLE 1. A classification of the 32 approved species in the garnet supergroup

Z charge	GROUP or species name	Class	X	Y	Z	φ
0	Katoite	Hydroxide	Ca ₃	Al ₂	□	(OH) ₁₂
3	Cryolithionite	Halide	Na ₃	Al ₂	Li ₃	F ₁₂
6	Yafsoanite	Oxide	Ca ₃	Te ₂ ⁶⁺	Zn ₃	O ₁₂
8	HENRITERMIERITE	Silicate				
	Holtstamite		Ca ₃	Al ₂	Si ₂ □	O ₈ (OH) ₄
	Henritermierite		Ca ₃	Mn ₂ ³⁺	Si ₂ □	O ₈ (OH) ₄
9	BITIKLEITE	Oxide				
	Bitikleite		Ca ₃	Sb ⁵⁺ Sn ⁴⁺	Al ₃	O ₁₂
	Usturite		Ca ₃	Sb ⁵⁺ Zr	Fe ₃ ³⁺	O ₁₂
	Dzhuluite		Ca ₃	Sb ⁵⁺ Sn ⁴⁺	Fe ₃ ³⁺	O ₁₂
	Elbrusite		Ca ₃	U _{0.5} ⁶⁺ Zr _{1.5}	Fe ₃ ³⁺	O ₁₂
10	SCHORLOMITE	Silicate				
	Kimzeyite		Ca ₃	Zr ₂	SiAl ₂	O ₁₂
	Irinarassite		Ca ₃	Sn ₂ ⁴⁺	SiAl ₂	O ₁₂
	Schorlomite		Ca ₃	Ti ₂	SiFe ₂ ³⁺	O ₁₂
	Kerimasite		Ca ₃	Zr ₂	SiFe ₂ ³⁺	O ₁₂
	Toturite		Ca ₃	Sn ₂ ⁴⁺	SiFe ₂ ³⁺	O ₁₂
12	GARNET	Silicate				
	Menzerite-(Y)		Y ₂ Ca	Mg ₂	Si ₃	O ₁₂
	Pyrope		Mg ₃	Al ₂	Si ₃	O ₁₂
	Grossular		Ca ₃	Al ₂	Si ₃	O ₁₂
	Spessartine		Mn ₃ ²⁺	Al ₂	Si ₃	O ₁₂
	Almandine		Fe ₃ ²⁺	Al ₂	Si ₃	O ₁₂
	Eringaite		Ca ₃	Sc ₂	Si ₃	O ₁₂
	Goldmanite		Ca ₃	V ₂ ³⁺	Si ₃	O ₁₂
	Momoiite		Mn ₃ ²⁺	V ₂ ³⁺	Si ₃	O ₁₂
	Knorringite		Mg ₃	Cr ₂ ³⁺	Si ₃	O ₁₂
	Uvarovite		Ca ₃	Cr ₂ ³⁺	Si ₃	O ₁₂
	Andradite		Ca ₃	Fe ₂ ³⁺	Si ₃	O ₁₂
	Calderite		Mn ₃ ²⁺	Fe ₂ ³⁺	Si ₃	O ₁₂
	Majorite		Mg ₃	SiMg	Si ₃	O ₁₂
	Morimotoite		Ca ₃	TiFe ²⁺	Si ₃	O ₁₂
15	BERZELIITE	Vanadate, arsenate				
	Schäferite		Ca ₂ Na	Mg ₂	V ₃ ⁵⁺	O ₁₂
	Palenzonaite		Ca ₂ Na	Mn ₂ ²⁺	V ₃ ⁵⁺	O ₁₂
	Berzeliite		Ca ₂ Na	Mg ₂	As ₃ ⁵⁺	O ₁₂
	Manganberzeliite		Ca ₂ Na	Mn ₂ ²⁺	As ₃ ⁵⁺	O ₁₂

Notes: Formulas are given in the form {X₃}[Y₂](Z₃) φ ₁₂. Group names are given in capitals.

Supergrupo do pirocloro



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THE PYROCHLORE SUPERGROUP OF MINERALS: NOMENCLATURE

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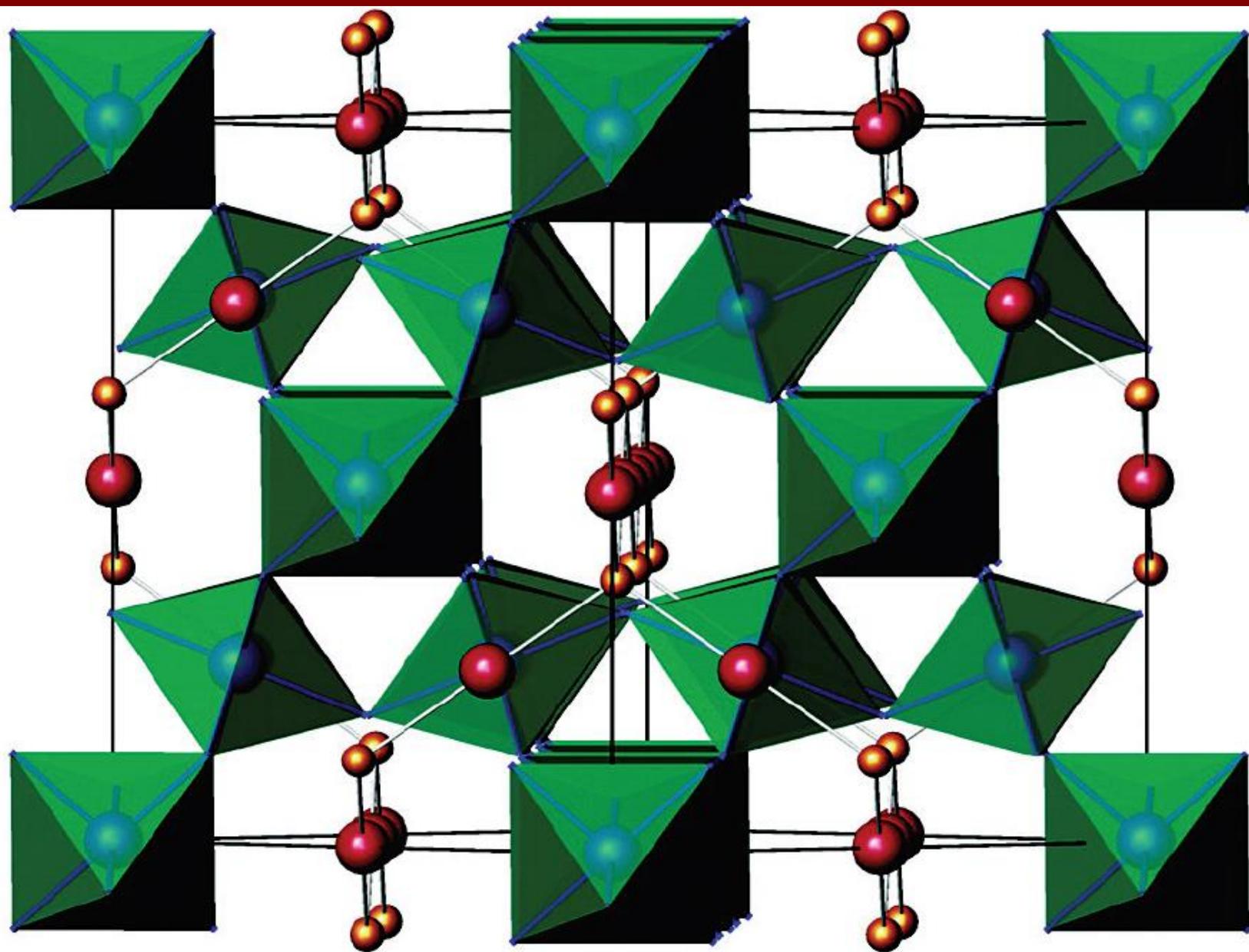


FIG. 1. Ideal pyrochlore crystal structure viewed along the $[110]$ axis (A red, Y orange and BO_6 octahedra in green) (Henderson *et al.* 2007).

TABLE 6. FORMULAE OF ALL 28 PYROCHLORE SPECIES FOR WHICH ANALYTICAL EVIDENCE IS DEEMED ADEQUATE

1	oxycalciopyrochlore*	$\text{Ca}_2\text{Nb}_2\text{O}_6\text{O}$
2	hydropyrochlore*†	$(\text{H}_2\text{O}, \square)_2\text{Nb}_2(\text{O}, \text{OH})_6(\text{H}_2\text{O})$
3	hydroxykenomicrolite*†	$(\square, \text{Na}, \text{Sb}^{3+})_2\text{Ta}_2\text{O}_6(\text{OH})$
4	oxystannomicrolite*	$\text{Sn}_2\text{Ta}_2\text{O}_6\text{O}$
5	oxystibiomicrolite*	$(\text{Sb}^{3+}, \text{Ca})_2\text{Ta}_2\text{O}_6\text{O}$
6	hydroxycalcioroméite*†	$(\text{Ca}, \text{Sb}^{3+})_2(\text{Sb}^{5+}, \text{Ti})_2\text{O}_6(\text{OH})$
7	hydrokenoelsmoreite*†	$\square_2\text{W}_2\text{O}_6(\text{H}_2\text{O})$
8	fluornatromicrolite	$(\text{Na}, \text{Ca}, \text{Bi})_2\text{Ta}_2\text{O}_6\text{F}$
9	hydroxycalciopyrochlore†	$(\text{Ca}, \square)_2\text{Nb}_2(\text{O}, \text{OH})_6(\text{OH})$
10	fluorcalciopyrochlore†	$(\text{Ca}, \square)_2\text{Nb}_2(\text{O}, \text{OH})_6\text{F}$
11	kenoplumbopyrochlore†	$(\text{Pb}, \square)_2\text{Nb}_2\text{O}_6(\square, \text{O})$
12	oxycalciobetafite†	$\text{Ca}_2(\text{Ti}, \text{Nb})_2\text{O}_6\text{O}$
13	fluornatroroméite†	$(\text{Na}, \text{Ca})_2\text{Sb}_2(\text{O}, \text{OH})_6\text{F}$
14	fluornatropyrochlore	$(\text{Na}, \text{REE}, \text{Ca})_2\text{Nb}_2(\text{O}, \text{OH})_6\text{F}$
15	oxynatropyrochlore	$(\text{Na}, \text{Ca}, \text{U})_2\text{Nb}_2\text{O}_6(\text{O}, \text{OH})$
16	fluorstrontipyrochlore	$(\text{Sr}, \square)_2\text{Nb}_2(\text{O}, \text{OH})_6\text{F}$
17	oxyplumbopyrochlore	$\text{Pb}_2\text{Nb}_2\text{O}_6\text{O}$
18	oxytropyrochlore-(Y)	$(\text{Y}, \square)_2\text{Nb}_2\text{O}_6\text{O}$
19	fluorkenopyrochlore	$(\square, \text{Na}, \text{Ce}, \text{Ca})_2(\text{Nb}, \text{Ti})_2\text{O}_6\text{F}$
20	fluorcalciomicrolite	$(\text{Ca}, \text{Na})_2\text{Ta}_2\text{O}_6\text{F}$
21	oxycalciomicrolite	$\text{Ca}_2\text{Ta}_2\text{O}_6\text{O}$
22	kenoplumbomicrolite	$(\text{Pb}, \square)_2\text{Ta}_2\text{O}_6(\square, \text{O}, \text{OH})$
23	hydromicrolite	$(\text{H}_2\text{O}, \square)_2\text{Ta}_2(\text{O}, \text{OH})_6(\text{H}_2\text{O})$
24	hydrokenomicrolite	$(\square, \text{H}_2\text{O})_2\text{Ta}_2(\text{O}, \text{OH})_6(\text{H}_2\text{O})$
25	oxyuranobetafite	$(\text{U}, \text{Ca}, \square)_2(\text{Ti}, \text{Nb})_2\text{O}_6\text{O}$
26	fluorcalcioroméite	$(\text{Ca}, \text{Sb}^{3+})_2(\text{Sb}^{5+}, \text{Ti})_2\text{O}_6\text{F}$
27	oxycalcioroméite	$\text{Ca}_2\text{Sb}_2\text{O}_6\text{O}$
28	oxyplumboroméite	$\text{Pb}_2\text{Sb}_2\text{O}_6\text{O}$

O futuro

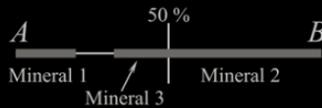
BINARY PARTIAL SOLID SOLUTIONS

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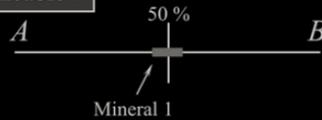
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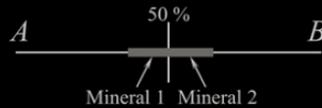


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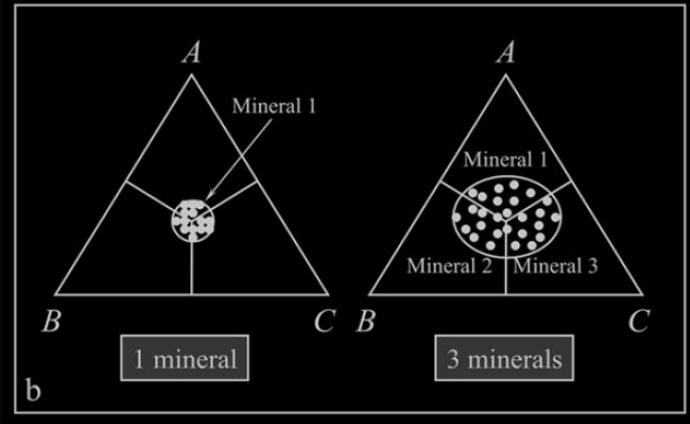
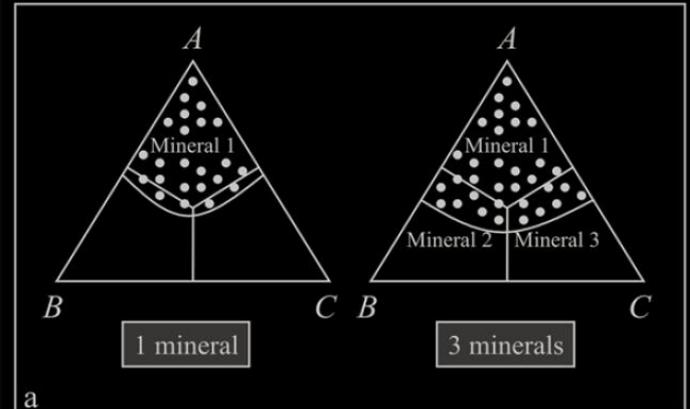
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c

FIG. 4. Diagrammatic representations of partial binary solid-solution series. a. Series with a miscibility gap. b. Series with a miscibility gap, but with one member encompassing the midpoint. c. Series with members limited around the midpoint.

TERNARY PARTIAL SOLID SOLUTIONS



Nomes alternativos para minerais do grupo do pirocloro

1. pirocloro-(NaF)
2. fluorpirocloro-(Na)
3. natropirocloro-(F)
4. fluornatropirocloro
5. natrofluorpirocloro



Qual é a importância de um nome?

Você já parou para pensar a razão de alguém dar um nome científico para um cachorro? Por que chamar a espécie do cão de *Canis familiaris*?

O *Canis familiaris* é chamado de cachorro em português, em inglês é *dog* e em francês é *chien*. Então, em cada lugar do mundo, o *Canis familiaris* tem um nome vulgar.

O nome científico é uma forma de se reconhecer uma espécie universalmente.

Regras de como se escreve o nome científico:

1. É geralmente binominal (composto de dois nomes – o primeiro indica o gênero e os dois juntos a espécie).
2. Deve ser escrita em itálico ou destacado do corpo do texto (sublinhado, por exemplo).
3. A primeira palavra é escrita com a inicial maiúscula.
4. Todas as outras letras do segundo nome são minúsculas.
5. Caso haja dois nomes científicos para a mesma espécie, vale o mais antigo.

Muito obrigado!

