Université de Liège
Faculté des Sciences
Département de Géologie
Laboratoire de Minéralogie

The IMA-CNMNC nomenclature guidelines
Application to Belgian minerals

Antwerpen, December 13th, 2024
Prof. Frédéric Hatert

Plan of the talk

1. Definition of mineral species

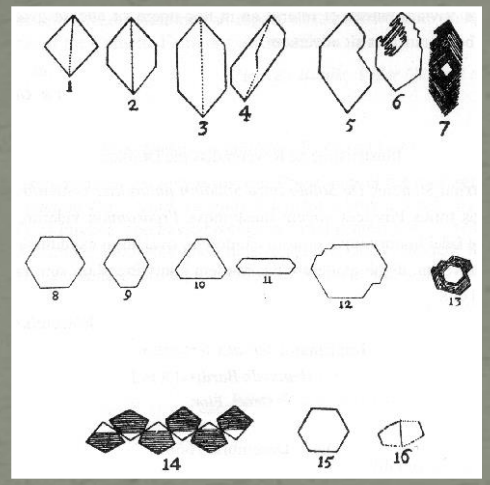
2. The naming of minerals

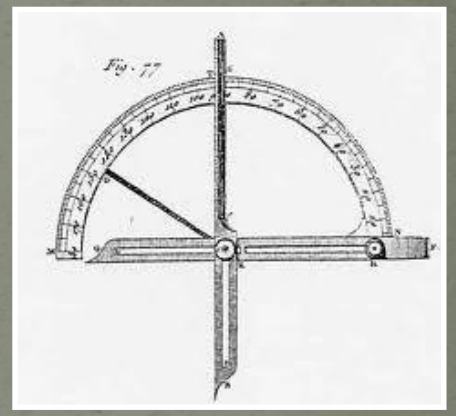
3. The « CNMNC-IMA »
   - 3.1. Role and composition of the CNMNC
   - 3.2. Belgian mineralogists and the CNMNC
   - 3.3. Recent nomenclature guidelines

4. Examples of nomenclature questions in Belgian minerals
   - 4.1. Definition of new species in Belgium
   - 4.2. Discreditations
   - 4.3. Revalidations
   - 4.4. Renamings
   - 4.5. Nomenclature of Belgian minerals

Law of consistancy of angles

Nicolas Sténon (1638-1686)



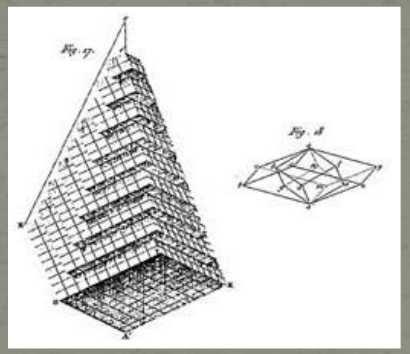


«Peu importe dans quelle mesure les faces d'un cristal peuvent varier dans leur taille ou dans leur forme; l'angle inter-facial reste constant, pourvu que les mesures soient effectuées à la même température ».

A mineral is a natural substance, chemically homogeneous, the surface of which is limited by planar faces. The angles between these faces are constant for the same mineral species.

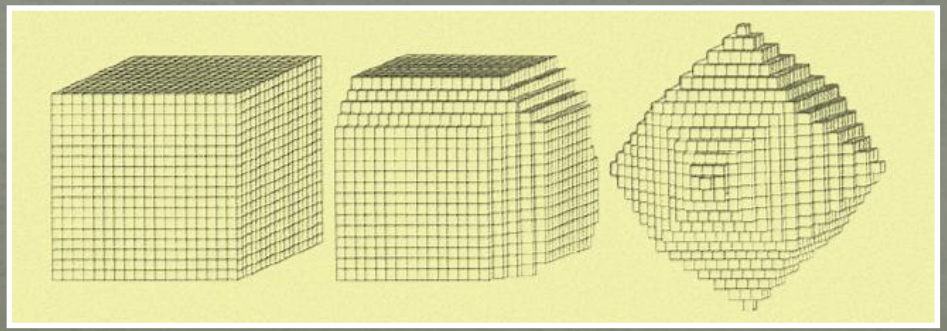
The « molécule intégrante » (1871)

René-Just Haüy (1743-1822)



Le clivage fournit la forme élémentaire de la « molécule intégrante ».

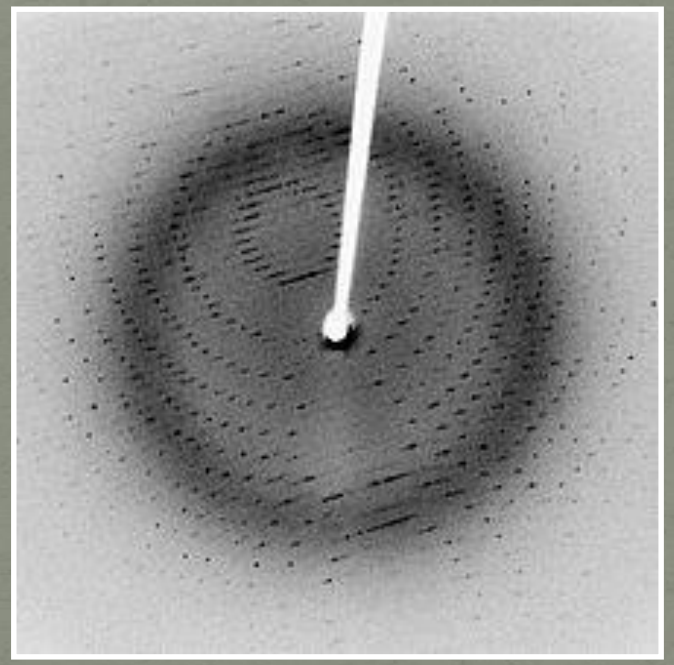
Première théorie descriptive de la structure interne des cristaux.

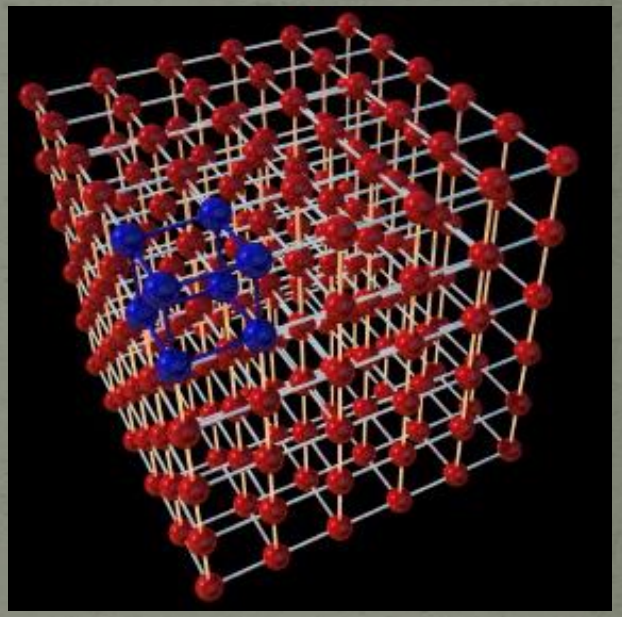


The crystal lattice

Discovery of X-ray diffraction by crystals

Max Von Laue (1879-1960)





Reticular theory of the crystal

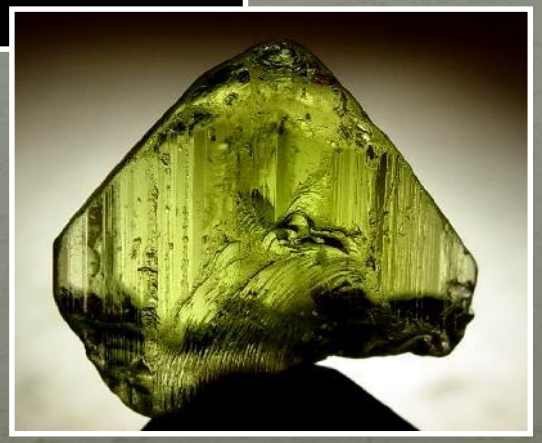
Crystal = unit-cell + atomic motif

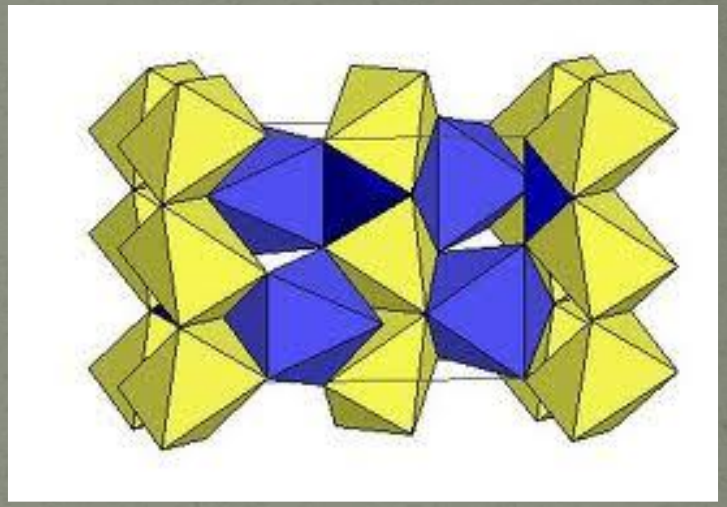
Two minerals can present the same crystal structure. However, to consider these minerals as distinct species, at least one atom in the structure must be replaced by an atom of different nature.

Solid solutions:

Fayalite - Forsterite

Fe_2SiO_4 – Mg_2SiO_4





50 % CNMNC rule

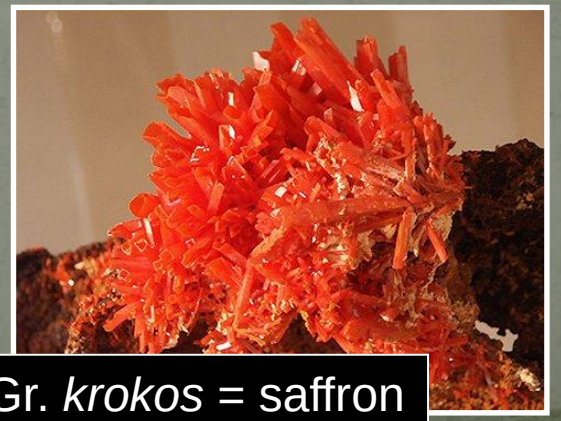
The names of minerals

Coulour

Albite, azurite, chlorite, crocoïte, erythrite, hematite, lazulite, leucite, oripigment, purpurite, rutile

Lat. *albus* = white

Gr. *aima* = blood



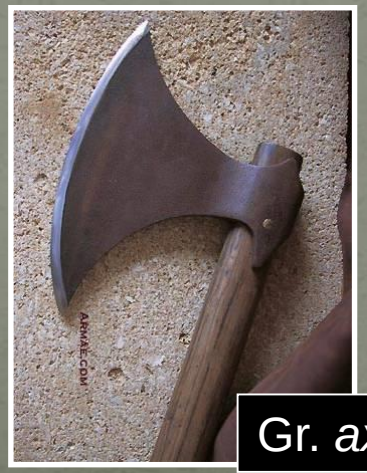
Gr. *krokos* = saffron

The names of minerals

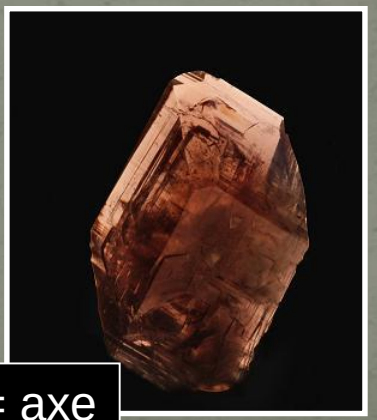
Morphology

Anatase, axinite, auriacusite, fibroferrite, oursinite, pyromorphite, pyrophyllite, staurolite, tetrahedrite

Gr. *stauros* = cross



Gr. *axine* = axe

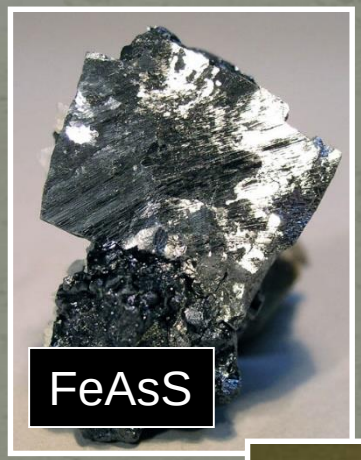


The names of minerals

Chemical composition

Anhydrite, arsenopyrite, babefphite, chalcocite, chalcopyrite, cobaltite, cuprite, cavansite, fluorapatite, ruthéniridosmine, sidérite, sodalite, uraninite

$CaSO_4$



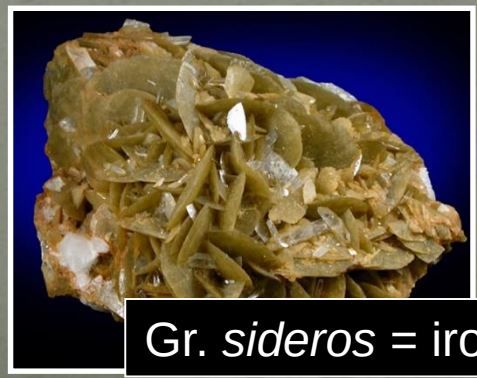
FeAsS

$CuFeS_2$

Cu_2O

$Ca(VO)Si_4O_{10}.4H_2O$

(Ir,Os,Ru)



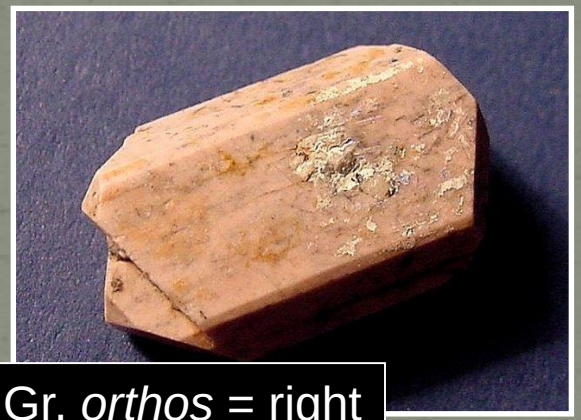
Gr. *sideros* = iron

The names of minerals

Physical properties

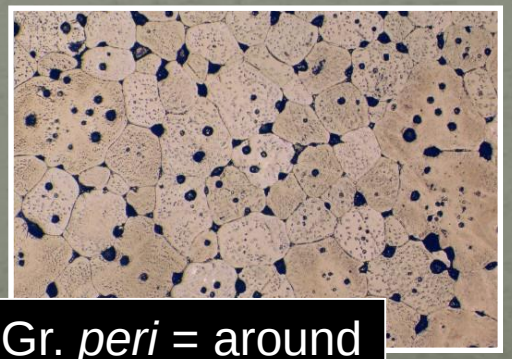
Barite, euclase, orthose, periclase, scorodite

Gr. *barys* = heavy



Gr. *orthos* = right

Gr. *eu* = good,
klas = cleavage



Gr. *peri* = around

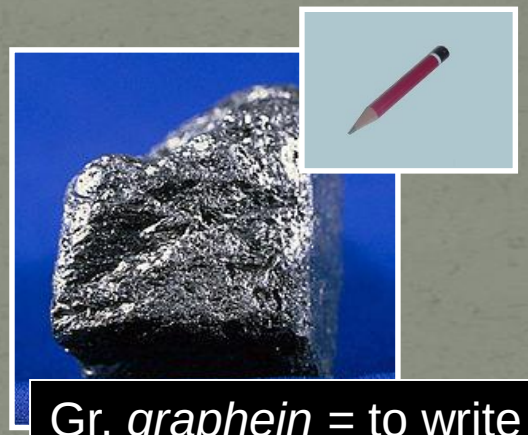
Gr. *skorodion* = similar to garlic

The names of minerals

Use

Fluorite, graphite, muscovite, pharmacolite, pyrite, pyrolusite

Muscovy glass

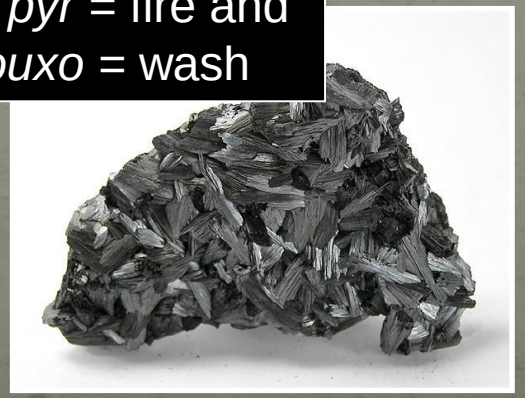


Gr. *graphein* = to write

Gr. *pyr* = fire

Lat. *fluere* = flow

Gr. *pyr* = fire and *louxo* = wash



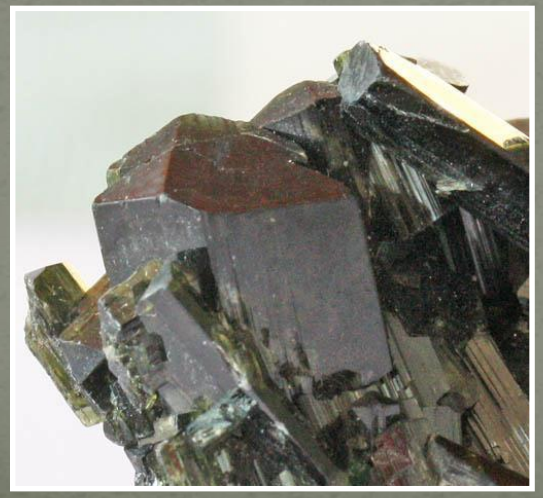
$CaHAsO_4.2H_2O$
Gr. *pharmaki* = poison

The names of minerals

Structural features

Clinoenstatite, clinomimetite, orthoserpierite, parafransoletite, parahopeite

- Ortho: Gr. *orthos* = right: orthorhombic
- Clino = Gr. *klinein* = inclined: monoclinic
- Para = Gr. *para* = besides: structural analogies



The names of minerals

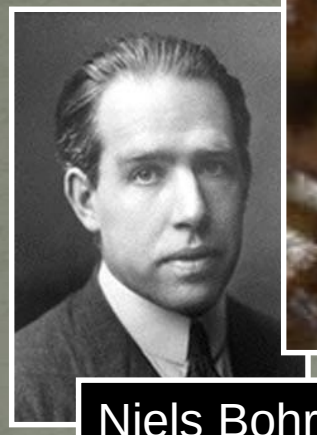
Type locality

Andalousite, atacamite, brazilianite, ettringite, lakebogaite, lovozérite, luxembourgite, montebrasite, tyrolite

The names of minerals

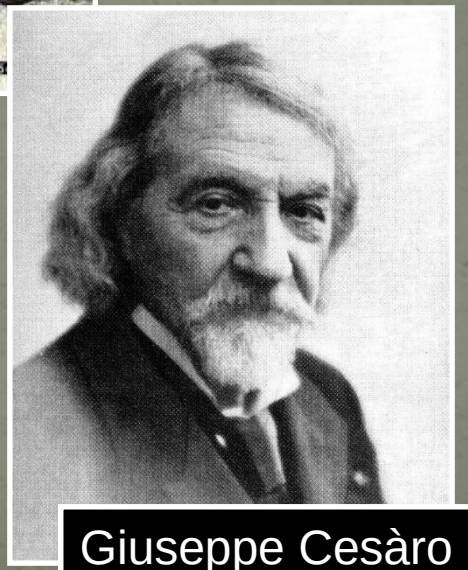
Honouring famous mineralogists

Bobfergusonite, breithauptite, cesarólite, eskolaite, haüyne, hurbutite, mandarinoite, millerite, moissanite, nielsbohrite, sillimanite, wollastonite…



Niels Bohr

Joe Mandarino



Giuseppe Cesàro

The IMA-CNMNC: composition

IMA = International Mineralogical Association

12 Officers, 6 Commissions, 4 Working groups

CNMNC = Commission on New Minerals, Nomenclature and Classification

4 Officers, 38 Members (1 or 2 members per IMA country)

Ferdinando Bosi (Italy): Chairman
Frédéric Hatert (Belgium): 1st Vice-Chair (Nomenclature)
Marco Pasero (Italy): 2nd Vice-Chair (CNMNC mineral list, CNMNC Newsletter)
Stuart Mills (USA): Secretary (Mineral groups)

The IMA-CNMNC: roles

Roles of the CNMNC

- Evaluation of new mineral species proposals
- Validation of mineral names
- Mineralogical nomenclature
  (discreditations, revalidations, redefinitions, renamings, …)
- Classification of minerals
  (groups, supergroups, sub-classes, classes, families, …)

Outreach

- CNMNC website
- IMA mineral list
- List of unnamed minerals
- CNMNC Newsletter

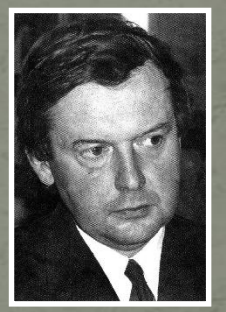
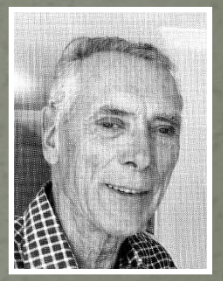
Belgium and the CNMNC

CNMNC was created in 2006

Following the fusion of the Commission on New Minerals and Mineral Names (CNMMN) with the Commission on Classification of minerals (CCM)

CNMMN was founded in 1959

Chair: Michael Fleischer (USA)
Vice-Chair: Max Hey (UK)
Treasurer: François Permingeat (Toulouse, France)


Belgian mineralogists members of theCNMNC

~ 1962 to 1993: Jules Moreau (Louvain et LLN)
1994 to 2002: Michel Deliens (IRSNB, Bruxelles)
2003 to 2006: Frédéric Hatert (Liège)
2007 to 2012: André-Mathieu Fransolet (Liège)
2012 to 2016: Simon Philippo (Luxembourg)
Since 2016: Fabrice Dal Bo (Liège)

Minerals described before 1959: « Grandfathered »

The Dominant-constituent rule

The Canadian Mineralogist
Vol. 46, pp. 717-728 (2008)
DOI: 10.3749/canmin.46.3.717

THE IMA–CNMNC DOMINANT-CONSTITUENT RULE REVISITED AND EXTENDED

FRÉDÉRIC HATERT§

Vice-Chairman, Commission on New Minerals, Nomenclature and Classification (CNMNC) of the International Mineralogical Association (IMA), Laboratory of Mineralogy, University of Liège, Bâtiment B-18, B–4000 Liège, Belgium

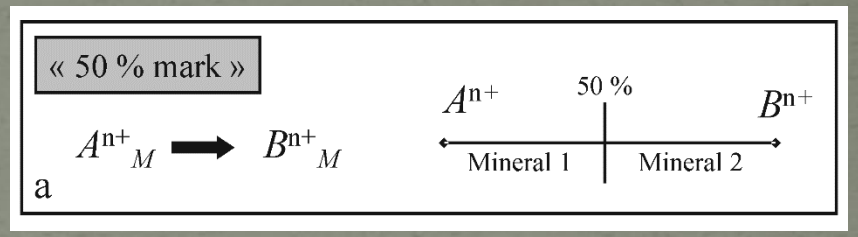
ERNST A.J. BURKE

Chairman, Commission on New Minerals, Nomenclature and Classification (CNMNC) of the International Mineralogical Association (IMA), Faculty of Earth and Life Sciences, Vrije Universiteit Amsterdam, De Boelelaan 1085, NL–1081 HV, Amsterdam, The Netherlands

« Constituent »

- Cations
- Anions
- Cationic, anionic, or molecular groups
- Vacancies

« 50 % mark »



Diopside **Hedenbergite**

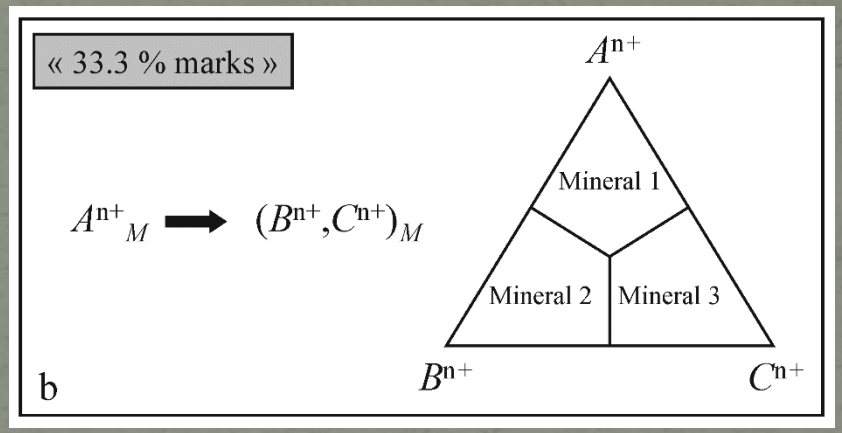
$CaMgSi_2O_6 \rightarrow CaFeSi_2O_6$

$Mg^{2+} \rightarrow Fe^{2+}$

Homovalent substitutions on one crystallographic site

Homovalent substitutions on one site

Homovalent substitutions on one site: multiple solid solutions



Preisingerite group

Preisingerite, $Bi_3(AsO_4)_2OOH$
Schumacherite, $Bi_3(VO_4)_2OOH$
Petitjeanite, $Bi_3(PO_4)_2OOH$

Boundary at 33.3 %

Schoenfliesite

Schoenfliesite,$MgSn(OH)_6$
Natanite, $FeSn(OH)_6$
Wickmanite, $MnSn(OH)_6$
Mushistonite, $CuSn(OH)_6$
Vismirnovite, $ZnSn(OH)_6$
Burtite, $CaSn(OH)_6$

Boundary at 16.6 %

Independant homovalent substitutions

Independant homovalent substitutions on two sites

Columbite group

$Fe^{2+} \rightarrow Mn^{2+}$
A Site

$FeTa_2O_6$	$MnTa_2O_6$
Tantalite-(Fe)	Tantalite-(Mn)
Columbite-(Fe)	Columbite-(Mn)
$FeNb_2O_6$	$MnNb_2O_6$

$Ta^{5+} \rightarrow Nb^{5+}$
B Site

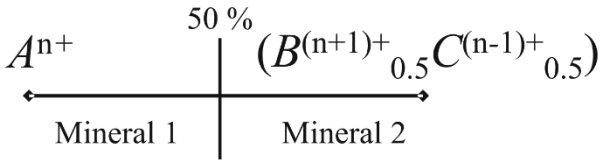
Ferrocolumbite, Crystal Park, El Paso So., Colorado, USA
(from Webmineral.com)

Heterovalent substitutions on one site

Heterovalent substitutions on one site

« 50 % mark »

$$A^{n+}{}_M \rightarrow (B^{(n+1)+}{}_{0.5} C^{(n-1)+}{}_{0.5})_M$$



Monazite-(Ce) **Cheralite**

« Valency-imposed double-site occupancy »!

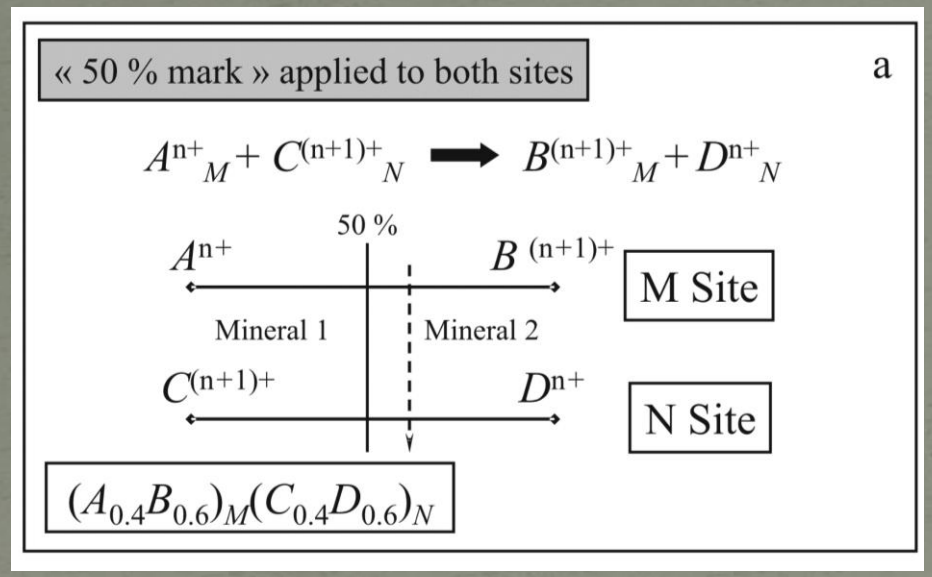
$Ce(PO_4) \rightarrow (Ca_{0.5}Th_{0.5})(PO_4)$

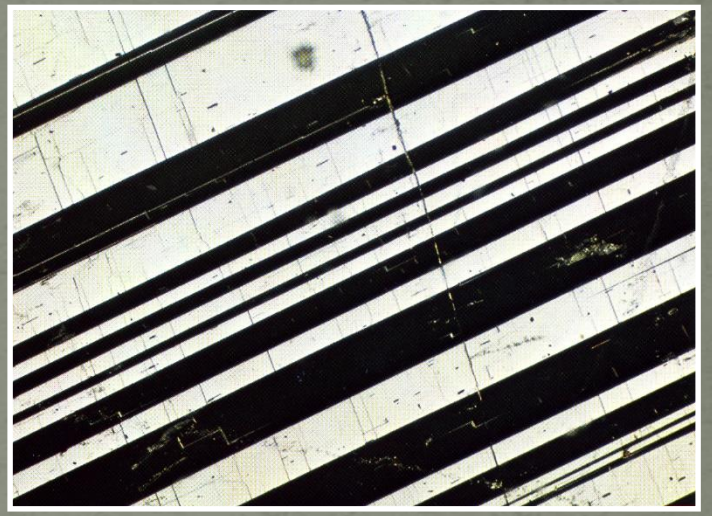
$Ce^{3+} \rightarrow 0.5\ Ca^{2+} + 0.5\ Th^{4+}$

>< 50 % rule!

Coupled heterovalent substitutions

Coupled heterovalent substitutions on two sites





Albite **Anorthite**

$Na(AlSi_3O_8) \rightarrow Ca(Al_2Si_2O_8)$

$Na^+ + Si^{4+} \rightarrow Ca^{2+} + Al^{3+}$

Valency-imposed double-site occupancy

Valency-imposed double-site occupancy

Schorl → **Elbaite**

$NaFe^{2+}_3Al_6(Si_6O_{18})(BO_3)_3(OH)_4 \rightarrow Na(Li_{1.5}Al_{1.5})Al_6(Si_6O_{18})(BO_3)_3(OH)_4$

$Fe^{2+} \rightarrow 0.5\ Li^{+} + 0.5\ Al^{3+}$

Tremolite → **Richterite**

$\square Ca_2Mg_5(Si_8O_{22})(OH)_2 \rightarrow Na(NaCa)Mg_5(Si_8O_{22})(OH)_2$

$\square_A + Ca^{2+}_B \rightarrow Na^{+}_A + Na^{+}_B$

Tremolite, Selleck Road,
West Pierrepont,
New York, USA
(from Webmineral.com)

Classification of minerals

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

STUART J. MILLS[1,*], FRÉDÉRIC HATERT[2], ERNEST H. NICKEL[3,**] and GIOVANNI FERRARIS[4]

- Group: Same crystal structure and chemically similar elements
- Supergroup: Two or several groups with essentially the same structure, and constituted by similar chemical elements
- Sub-class: Nésosilicates, sorosilicates, inosilicates, cyclosilicates, phyllosilicates, tectosilicates + borates
- Class: Elements, sulfides, oxydes, halogenides, carbonates, nitrates, borates, sulfates, phosphates, silicates
- Family: Groups or supergroups with structural and/or chemical analogies

Now we have to define and name all groups and supergroups!

Prefixes and suffixes

Prefixes:

- Preferred to facilitate the pronounciation of common names
- Maximum 2 chemical prefixes
- A combination of chemical, structural, or other prefixes is alloxed

Examples: Fluorapatite, clinoferroholmquistite, …

CNMNC guidelines for the use of suffixes and prefixes in mineral nomenclature, and for the preservation of historical names

Frédéric HATERT[1,*], Stuart J. MILLS[2], Marco PASERO[3] and Peter A. WILLIAMS[4]

Suffixes:

- Maximum 3 chemical suffixes
- With parentheses: framework cations
- Without parentheses: extra-framework cations (zéolites)
- Cations and anions cannot be used together (the anion must be a prefix)

Examples: Jahnsite-(CaMnMn), chabazite-Ca, fluorapophyllite-(K)

Belgium: Mineral honouring persons

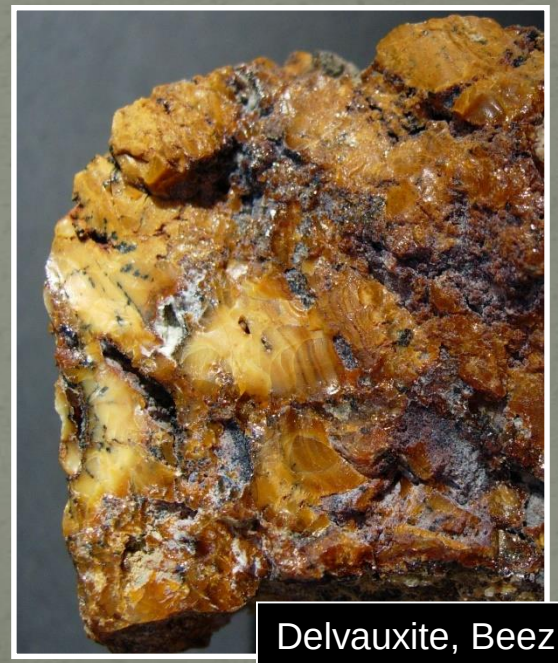
Davreuxite
$MnAl_6Si_4O_{17}(OH)_2$

Davreuxite, Salmchâteau

Charles-Joseph Davreux (1800-1863)
Chemist, pharmacist, and et naturalist from Liège

Delvauxite
$Ca(Fe^{3+})_4(PO_4)_2(OH)_8.4\text{-}5H_2O$

Jean-Charles Delvaux de Fenffe (1782-1863)
Chemist and physicist from Liège



Delvauxite, Beez

Belgium: Mineral honouring persons

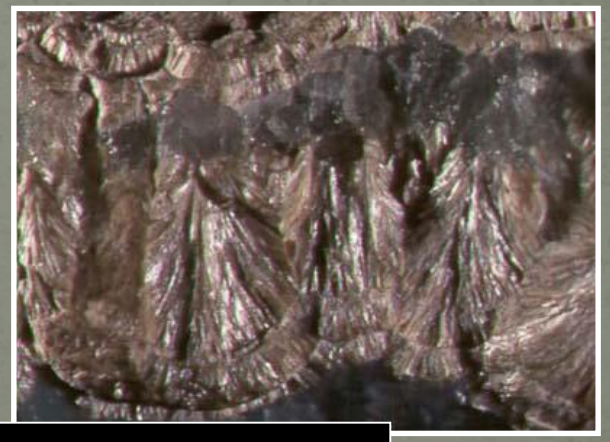
Drugmanite
$Pb_2Fe^{3+}(PO_4)(PO_3OH)(OH)_2$

Drugmanite, Richelle

Julien Drugman
(1875-1950)
Chemist and mineralogist from Brussels

Fraipontite
$(Zn,Al)_3(Si,Al)_2O_5(OH)_4$

Julien Fraipont
(1857-1910)
Zoologist and palaeontologist from Liège



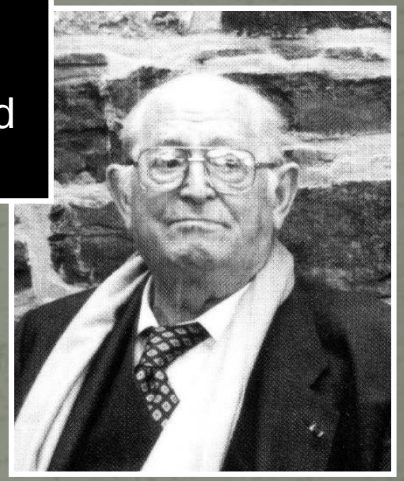
Fraipontite, La Calamine

Belgium: Mineral honouring persons

Graulichite-(Ce)
$(Ce,La,Nd,Ba)(Fe^{3+},Al)_3(AsO_4)_2(OH)_6$

Graulichite-(Ce), Hourt

Jean-Marie Graulich
(1920-2001)
Geologist from Liège and Bruxelles

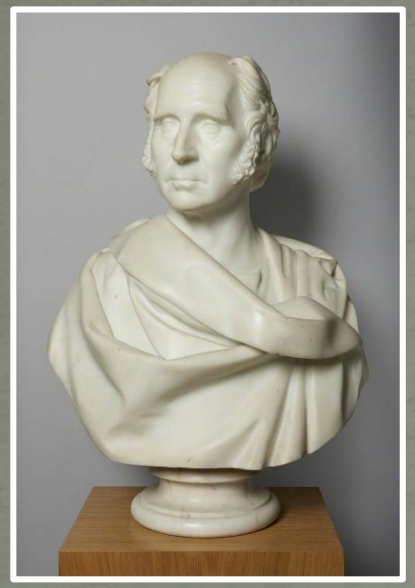


Halloysite
$Al_2Si_2O_5(OH)_4.2H_2O$

Jean-Baptiste d'Omalius d'Halloy
(1793-1875)
Geologist from Liège

Halloysite, Beez

Belgium: Mineral honouring persons



Thomas-Charles Hope (1766-1844)
Chemist from Scotland

Hopeite
$Zn_3(PO_4)_2.4H_2O$

Hopeite, La Calamine

Koninckite
$FePO_4.3H_2O$

Laurent-Guillaume de Koninck (1809-1887)
Chemist and mineralogist
(Leuven, Liège)

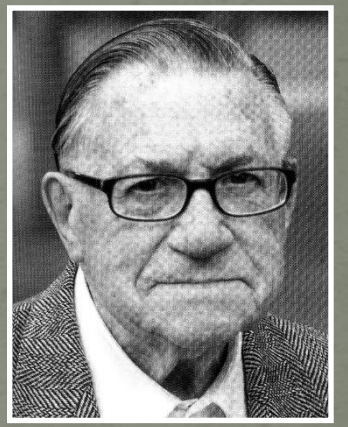
Koninckite, Richelle

Belgium: Mineral honouring persons

Vantasselite
$Al_4(PO_4)_3(OH)_3.9H_2O$

Vantasselite, Bihain

René Van Tassel
(1916-2013)
Mineralogist from Brussels



Viaeneite
$(Fe,Pb)_4S_8O$

Willy Viaene
(1940-2000)
Mineralogist at KUL

Viaeneite, Engis

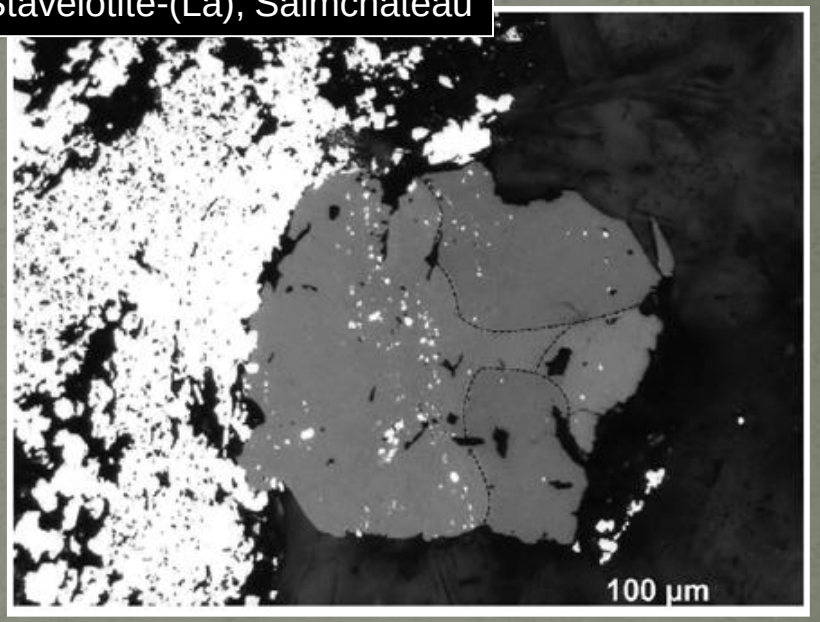
Willemite
Zn_2SiO_4

Willemite, La Calamine

Belgium: Mineral named after localities

Stavelotite-(La)
$La_3(Mn^{2+})_3Cu^{2+}(Mn^{3+},Fe^{3+},Mn^{4+})_{26}(Si_2O_7)_6O_{30}$

Stavelotite-(La), Salmchâteau



Richellite
$Ca(Fe^{3+})_2(PO_4)_2(OH,F)_2$

Koninckite on richellite, Richelle

Belgium: Minerals discredited

Bastonite

↓

Variety of biotite rich in NH_4^+

« Bastonite », Bastogne

Lohestite

↓

Mixture of kaolinite, pyrophyllite, sercite, and chlorite

Maximilien Lohest
(1857-1926)
Geologist from Liège

Belgium: Minerals discredited

Moresnetite

↓

Mixture of hemimorphite and sauconite

Moresnet

Salmite

↓

Mn-bearing chloritoïd (ottrélite?)

Vielsalm

Viséite

↓

Mixture of crandallite with other phases

« Viséite », Visé

Belgium: Minerals revalidated

Destinézite
$(Fe^{3+})_2(PO_4)(SO_4)(OH).6H_2O$

Pierre Destinez
(?-1911)
Technician in Mineralogy and Palaeontology at Liège

Destinézite, Beez

Ottrélite
$MnAl_2O(SiO_4)(OH)_2$

Ottrélite, Ottré

Chloritoïde, Vielsalm

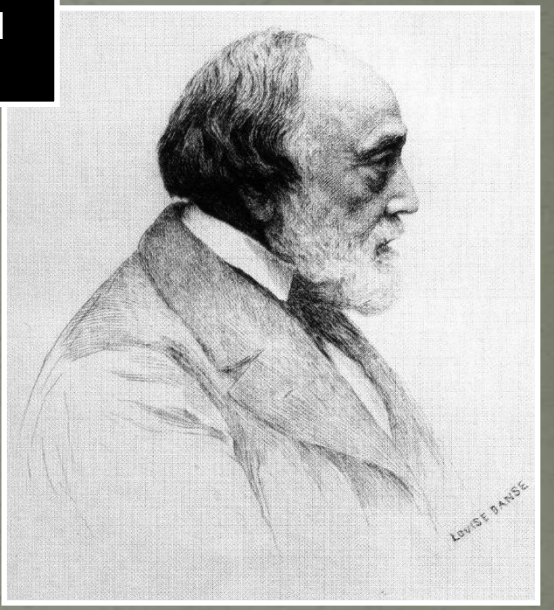
Belgium: Minerals renamed

Dewalquite (Pisani, 1872)

↓

Ardennite (von Lasaulx, 1872)

Gustave Dewalque (1828-1905)
Mineralogist, geologict and palaeontologist at Liège



Ardennite, Salmchâteau

Ardennite, Salmchâteau

Ardennite

↓

Ardennite-(As)
$Mn_4(AlMg)Al_4[Si_5(As,V)]O_{22}(OH)_6$

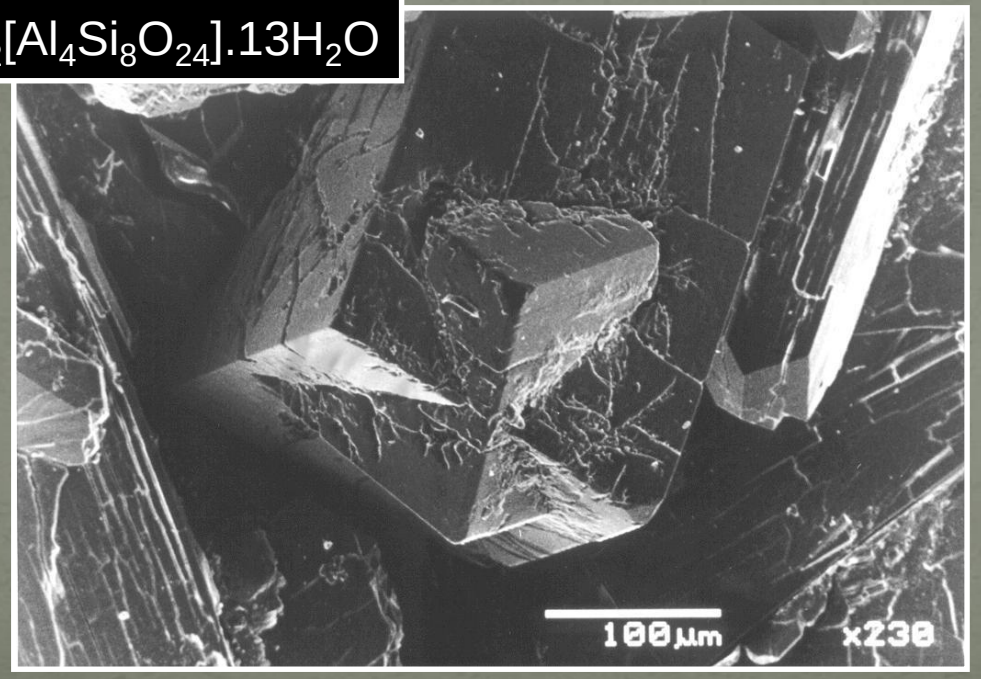
Belgium: Mineral with suffixes

GEOLOGICA BELGICA (2005) 8/1-2: 33-42

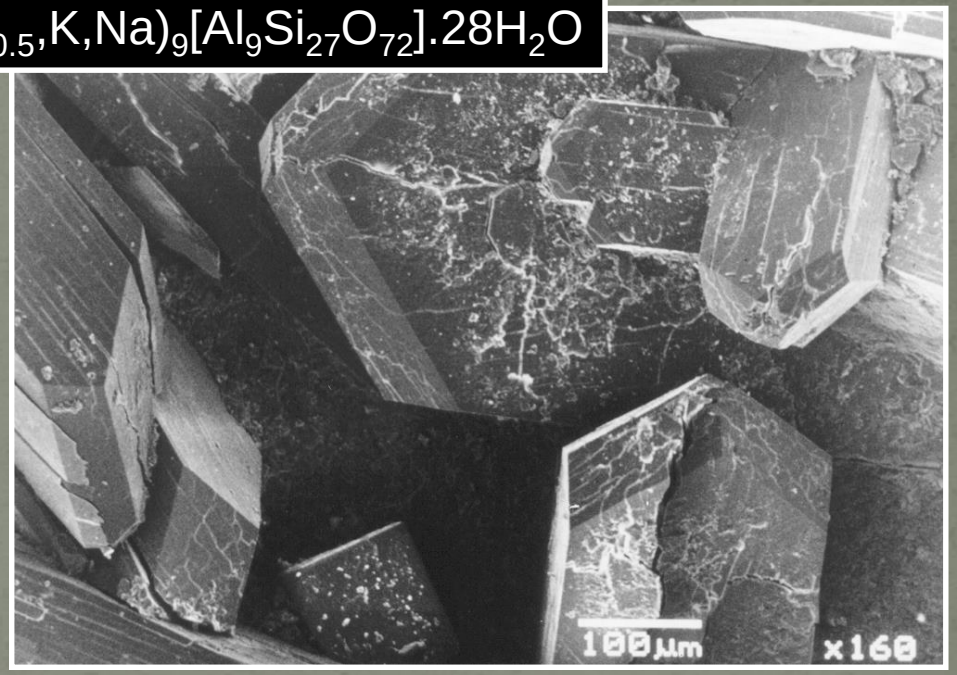
ZEOLITES, PREHNITE, AND PUMPELLYITE FROM BERTRIX, BELGIAN ARDENNES

Frédéric HATERT[1] & Thomas THEYE[2]

Chabazite-Ca
$Ca_2[Al_4Si_8O_{24}].13H_2O$



Stilbite-Ca
$(Ca_{0.5},K,Na)_9[Al_9Si_{27}O_{72}].28H_2O$



Extra-framework cations

Suffix without parentheses

Belgium: Minerals with suffixes

Pumpellyite-(Al), a new mineral from Bertrix, Belgian Ardennes

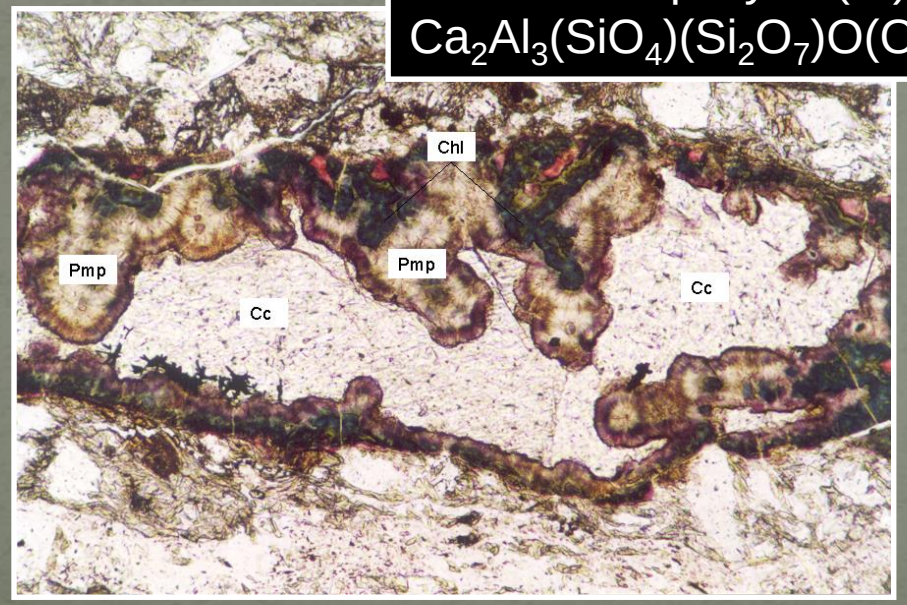
FRÉDÉRIC HATERT[1,*], MARCO PASERO[2], NATALE PERCHIAZZI[2] and THOMAS THEYE[3]

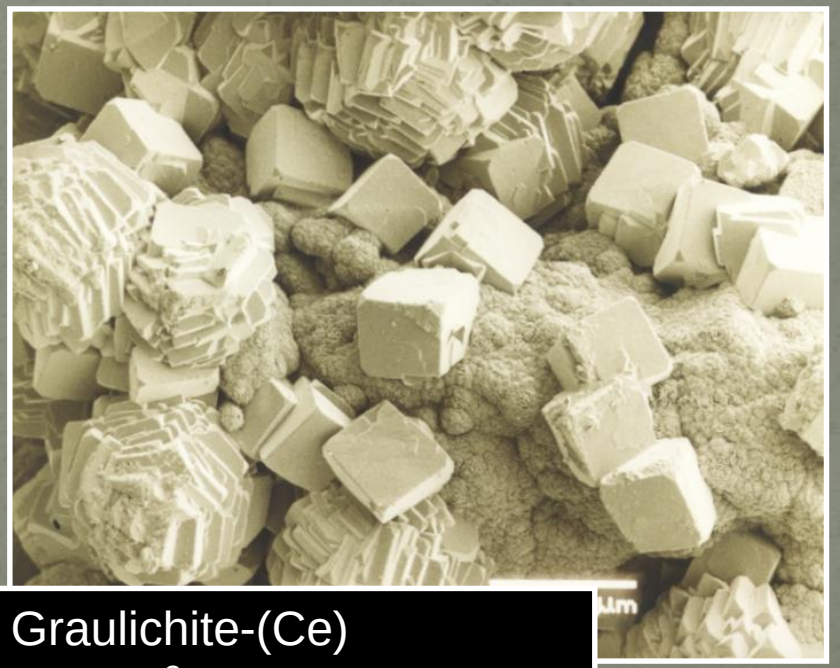
[1] Laboratoire de Minéralogie, Département de Géologie, Bâtiment B18, Université de Liège, 4000 Liège, Belgium
[*] Corresponding author, e-mail: fhatert@ulg.ac.be
[2] Dipartimento di Scienze della Terra, Università degli Studi di Pisa, Via S. Maria 53, 56126 Pisa, Italy
[3] Institut für Mineralogie und Kristallchemie, Universität Stuttgart, Azenbergstraße 18, 70174 Stuttgart, Germany

Framework cations

Suffixes with parentheses

Pumpellyite-(Al)
$Ca_2Al_3(SiO_4)(Si_2O_7)O(OH).H_2O$





Graulichite-(Ce)
$(Ce,La,Nd,Ba)(Fe^{3+},Al)_3(AsO_4)_2(OH)_6$

Belgium: Minerals with REE suffixes

LES CARBONATES DE TERRES RARES DE BERTRIX,

BELGIQUE

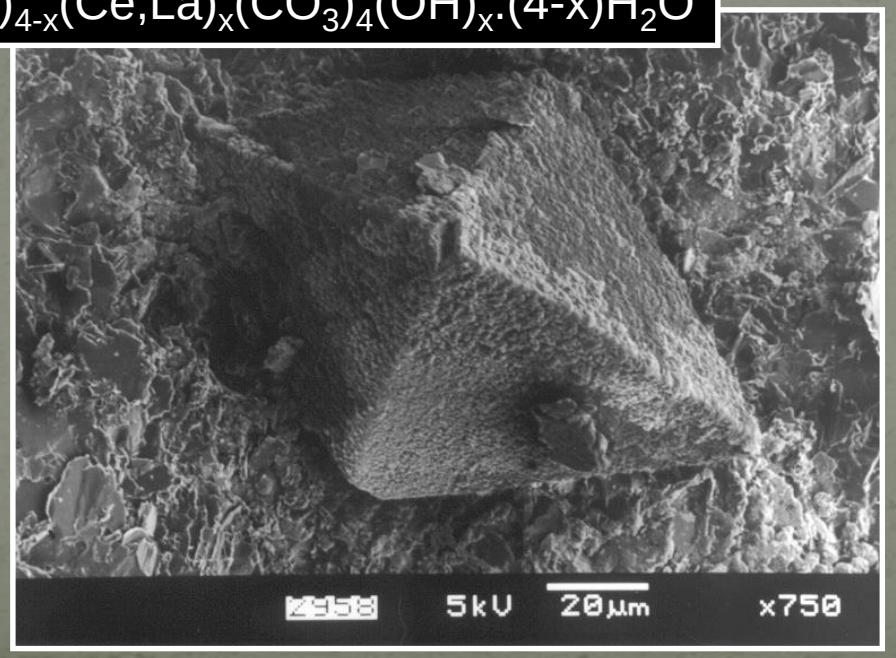
Frédéric HATERT

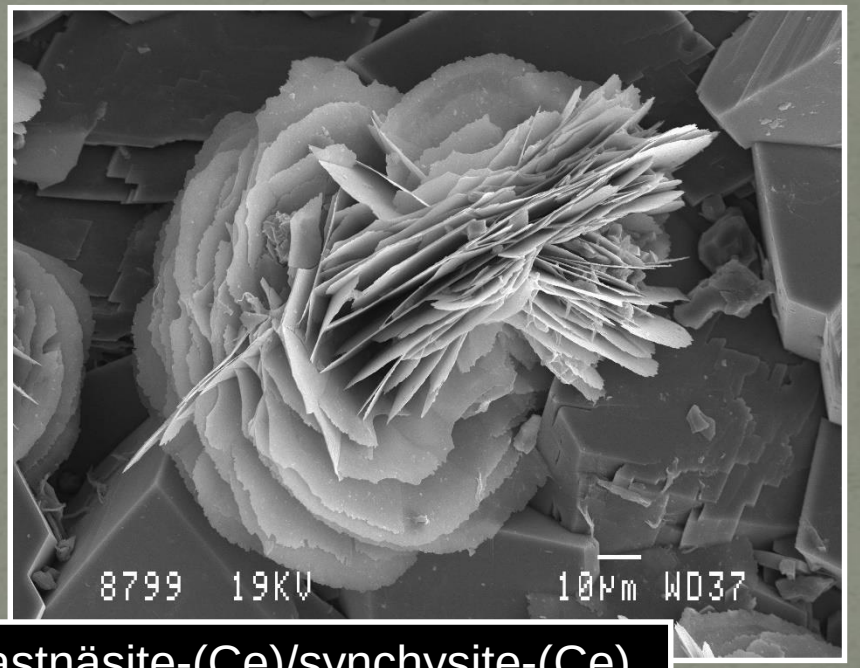
REE = Framework cations

Suffixes with parentheses

Calcioancylite-(Ce)

$(Ca,Sr)_{4-x}(Ce,La)_x(CO_3)_4(OH)_x.(4-x)H_2O$



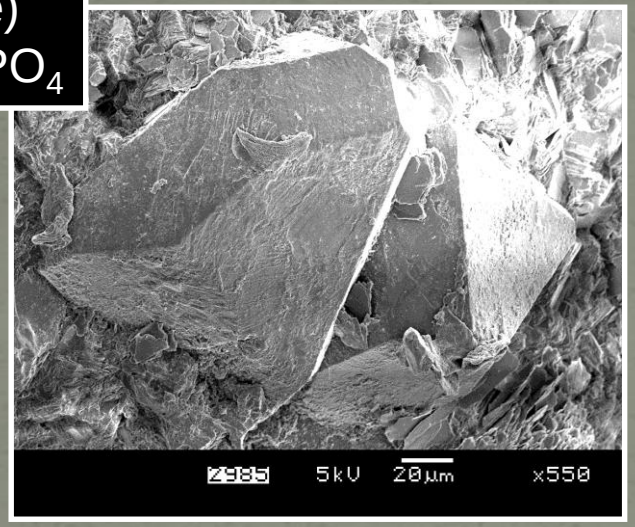


Bastnäsite-(Ce)/synchysite-(Ce)

$(Ce,La)(CO_3)F/Ca(Ce,La)(CO_3)_2F$

Belgium: Minerals with REE suffixes

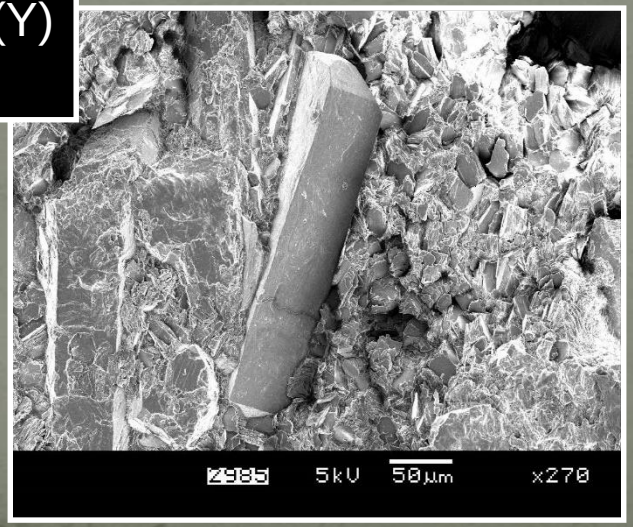
Monazite-(Ce)
$(Ce,La,Nd,Th)PO_4$

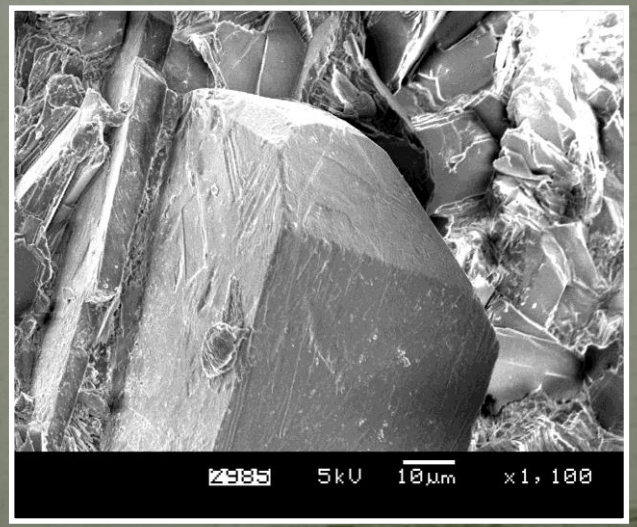


Florencite-(Ce)
$CeAl_3(PO_4)_2(OH)_6$

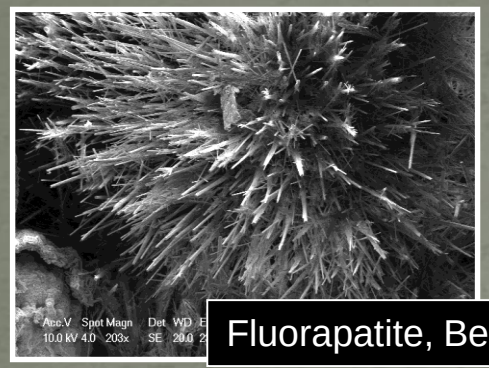
Salmchâteau

Xénotime-(Y)
YPO_4





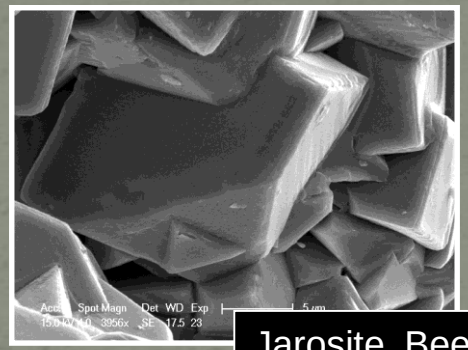
Belgium: Minerals with chemical prefixes



Fluorapatite, Beez

Fluorapatite
$Ca_5(PO_4)_3(F,OH,Cl)$

Natrojarosite
$NaFe^{3+}_3(SO_4)_2(OH)_6$



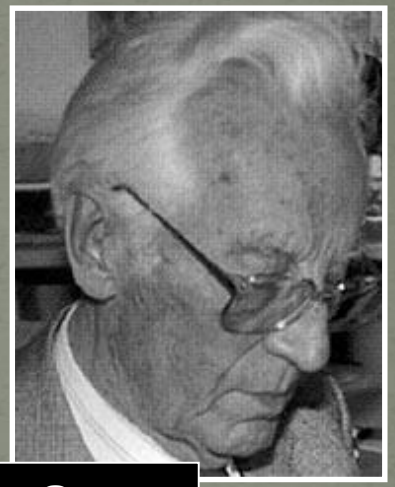
Jarosite, Beez

Ferrimolybdite
$Fe^{3+}_2(MoO_4)_3.8H_2O$

Ferrimolybdite, La Helle

Ferristrunzite
$Fe^{3+}Fe^{2+}_2(PO_4)_2(OH)_3.5H_2O$

Ferristrunzite, Blaton



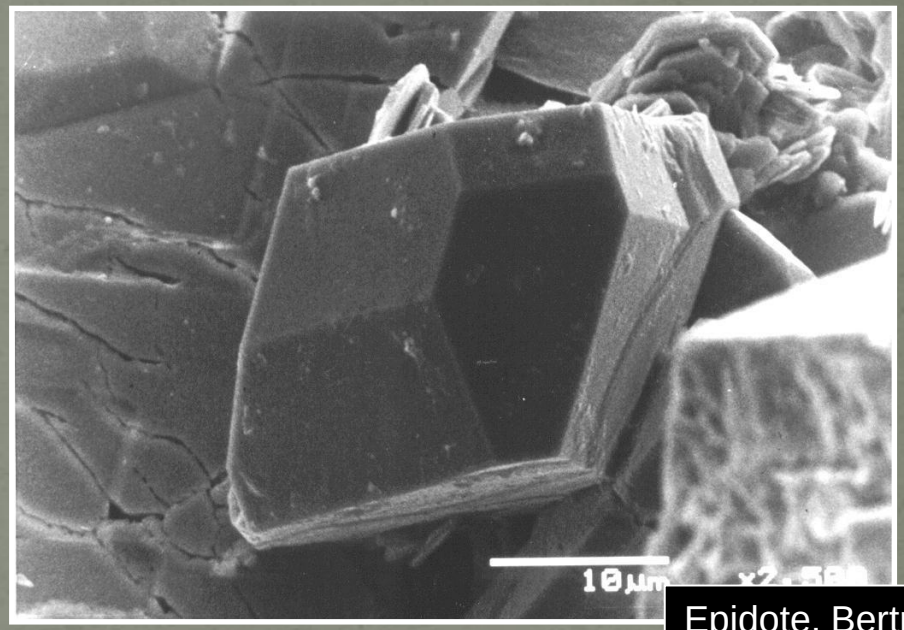
Hugo Strunz

Belgium: Mineral other prefixes

Metatorbernite
$Cu^{2+}(UO_2)_2(PO_4)_2.8H_2O$

Metatorbernite, Cahay

Clinozoïzite
$Ca_2Al_3(SiO_4)_3(OH)$



Epidote, Bertrix

Meta-autunite
$Ca(UO_2)_2(PO_4)_2.2\text{-}6H_2O$

Tetranatrolite
$(Na,Ca)_{16}[Al_{19}Si_{21}O_{80}].16H_2O$

Conclusions

- The CNMNC plays a fundamental role in the evaluation of new species, and in the nomenclature and classification of minerals.
- Belgian mineralogists are very active in those fields.
- Belgium is the ideal research field for systematic mineralogy, due to its variety of geological and geochemical environments.