

# THE TYPE MINERALOGY OF BELGIUM<sup>1</sup>

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(1 figure and 3 tables)

**ABSTRACT.-** The type-mineralogy of Belgium is reviewed. Thirty type-mineral/mineral names are presented, comprising fifteen approved valid species and fifteen non-valid minerals. Three undetermined/unnamed phases are also presented. The type-minerals are described from fifteen type-localities. The Visé area is the most prolific source for approved Belgian type-minerals. Eight of the valid phases are phosphate minerals.

**KEY-WORDS.-** Belgium, type mineralogy, review.

**RESUME.- Les minéraux types de Belgique.** Les minéraux types de Belgique sont passés en revue. 30 espèces sont signalées, comprenant 15 minéraux valides et approuvés et 15 espèces non valides. 3 phases indéterminées sans nom sont également mentionnées. Les minéraux types proviennent de 15 localités, la région de Visé étant la plus riche en espèces nouvelles. 8 minéraux types appartiennent au groupe des phosphates.

**MOTS-CLES.-** Belgique, minéraux types, recensement.

## 1.- INTRODUCTION

A review of the type-mineralogy of Belgium is presented. The listing of type-minerals from Belgium is as complete as possible, though the authors apologise for any omissions which might have arisen during the compilation of this work. Amendments and additions to this effect would be most gratefully received.

The term type-mineral may be defined as any mineral species that is described naturally for the first time and upon which the formal definition of the mineral is made. The locality from which such a mineral is initially described is known as the type-

locality. No attempt is made in this publication to sub-define any of the type-species into holotypes, cotypes, neotypes, metatypes and ideotypes as defined by Deliens (1977) and Dunn & Mandarino (1987). In this regard, Deliens (1977) reviews the conservation of holotype calcacite, fraipontite, franquenite, koninckite, richellite and viséite in the various institutions.

The validity (or non-validity) of all the documented minerals is taken in strict accordance with the recommendations of the Commission on New Minerals and Mineral Names (C.N.M.M.N.) of the International Mineralogical Association (I.M.A.). Valid type-mineral are therefore those minerals which have been approved by the Commission.

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Those minerals or mineral names that either lack formal approval by the Commission or have been rejected by the Commission are referred to as non-valid. Such Belgian phases may be conveniently grouped into one of the following categories :

- a) chemical varieties
- b) synonyms
- c) mechanical mixtures
- d) hypothetical compounds
- e) group name.

## 2.- LITERATURE REVIEW

For general accounts on Belgian mineralogy readers are referred to the publications by Buttgenbach (1947) and, more recently, by Fransolet & Mélon (1975) and Mélon, Bourguignon & Fransolet (1976).

Deliens (1985, 1987) reviews the contributions made by Belgian mineralogists world-wide, with regards type mineral species. In his 1987 compilation 82 new minerals are listed, 9 of which come from Belgium.

A list of type-minerals from Belgium is given in Table I.

Table 1.- List of Belgian Type-Mineral/Mineral Names

<u>Valid Minerals</u>	
Ardennite	Halloysite
Calclacite	Koninckite
Davreuxite	Ottrelite
Delvauxite	Richellite
Drugmanite	Vantasselite
Ferristrunzite	Viséite
Fraipontite	Willemite
Hopeite	
<u>Non-Valid Minerals</u>	
<u>Synonyms</u>	
Belgite	Lithion-Psilomelan
Dewalquite	Mangandisthen
Destinezite	Mn-chloritoid
Franquenite	Salmite
Galapektite	
<u>Chemical Varieties</u>	
	Bastonite
	Gosseletite
	Lohestite
<u>Mixtures</u>	
Moresnetite	Hypothetical compounds
	Ciplyte

## 3.- MINERALOGY OF BELGIAN TYPE MINERALS

### 3.1.- NAMED TYPE-MINERALS

The descriptions of all recorded Belgian type-minerals are presented in this section. Appropriate compositional and crystallographic data are also supplied, together with topographical information. Unless

otherwise stated all chemical formulae given is taken from Fleischer & Mandarino (1991). Thirty minerals/mineral names are presented, comprising fifteen non-valid species (in capitals) and fifteen non- valid phases.

### ARDENNITE

$Mn^{2+}_4 (Al, Mg)_6 (SiO_4)_2 (Si_3O_{10}) [ (As, V)O_4 ] (OH)_6$   
Orthorhombic.

Initially described from Salmchâteau, near Vielsalm, Luxembourg province, by von Lasaulx (1872a, 1872b and 1872c) and von Lasaulx and Bettendorf (1873). A second Belgian occurrence is described by Fransolet (1982) from the whetstone quarries near Bihain, Luxembourg province.

Data concerning the mineral chemistry of ardennite are given by von Lasaulx (1873, 1874, 1876); Bettendorf (1877); Prandtl (1905); Gossner & Strunz (1932). Zambonini (1922) introduces the terms arsenioardennite and vanadioardennite respectively, for the arsenic- and vanadium-predominant varieties. Reinecke & Hatzipanagioutou (1987) have demonstrated a marked degree of compositional substitutions involving Ca-Mn<sup>2+</sup>, Mg-Mn<sup>2+</sup>, Mn<sup>3+</sup>-Al and Fe<sup>3+</sup>-Al in various European ardennites.

Strunz (1935) reviews the structure and morphology of ardennite suggesting a relationship to epidote; Donnay & Allman (1968) indicate the presence of the Si<sub>3</sub>O<sub>10</sub> group in ardennite. A detailed account on the general mineralogy of ardennite is given by Semet & Moreau (1965). Moore (1965) compares ardennite with orientite and zoisite. The structural relationship to epidote and pumpellyite are respectively reviewed by Donnay (1965) and Allmann & Donnay (1971). Pasero & Reinecke (1991) further suggest that ardennite is polytypic with sursassite and pumpellyite.

Ardennite is also recorded from several localities. In the Italian Piedmont : at Ceres, Val d'Ala (Zambonini, 1922) and in the Varenche Mn mine, Val de St. Barthélemy (Pelloux, 1946). From the Kajlidongri Mn deposit, Jhabua district, Madhya Pradesh, India (Nayak, 1963, 1967). In the Grants uranium district of McKinley county, New Mexico (Sun & Weber, 1955). From several localities in Japan, viz : the Asemi-gawa area, central Shikoku, Japan (Enami, 1986); in the Hakuryu Mn mine, Tokushima prefecture and as a constituent of boulders in the Kamogawa River, Ehime prefecture, Japan (Minakawa & Momoi, 1987). More recently described from the manganese- rich meta-quartzites at Mili, Evvia (Euboea) Island, Greece (Reinecke *et al.*, 1991). Also from Andros Island, Greece and at Haute-Maurienne, French Alps (Reinecke & Hatzipanagioutou, 1987; Pasero &

Reinecke, 1991). The paragenesis including ardennite in Haute-Maurienne is also described by Chopin (1978).

Dewalquite, identical to ardennite, was described almost simultaneously but independently from Salm-Château by Pisani (1872). Mangandisthen (von Lasaulx, 1872a) is yet another synonym for ardennite. Ardennite is named for the Ardennes region, where the type locality is situated.

#### **Bastonite** (= variety of BIOTITE)

An ammonian biotite (Darimont *et al.*, 1988) originally described by Des Cloizeaux (1862) from Bastogne, Luxembourg province. The phase, which contains up to 0.5%  $\text{NH}_4^+$ , occurs in quartz veins cutting low-grade meta-arkoses and sandstones.

Ammonian biotite is also recorded from the Tokuya batholith, Yamanashi prefecture, Japan (Tainosho *et al.*, 1989).

Named for the locality and should not be confused with bostonite (= chrysotile).

#### **Belgite** (= WILLEMITE)

A name introduced in 1916 by R. Panebianco (in Spencer, 1919) as a synonym for willemite from the occurrence at Altenberg. Panebianco apparently objected to naming minerals after kings, preferring - the name derived from the locality.

Named for the country, though in fact Moresnet at that time was a neutral state and separate from Belgium (in Embrey & Fuller, 1980).

#### **CALCLACITE**

$\text{CaCl}_2 \cdot \text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 10\text{H}_2\text{O}$   
Monoclinic or Triclinic.

A name given by Van Tassel (1945) to a phase that forms needle-like, fibrous efflorescences on certain museum samples of Viséan limestones and fossils stored in wooden draws. Natural status is questionable, though it is regarded as a distinct species. The crystal structure of calclacite is re-examined by Van Tassel (1958) and Giuseppetti *et al.*, (1970).

Until recently, calclacite represented the one and only acetate mineral. However, Zacek (1991) now describes a naturally-occurring calcium acetate monohydrate at Kladno, Bohemia, Czechoslovakia.

Named for the composition **calcium-CI-acetate** and the name should not be confused with the calcicase of Johannsen (1926) (= ANORTHITE).

#### **Ciptyte** [hypothetical ?]

A name presumably applied to a hypothetical (?) compound to account for the compositions of apatite from Cibly, Hainaut province (Ortlier, 1888). However, Van Tassel (1972) suggests that the well-crystallised apatites reported from Cibly in 1888, were in fact from Jumilla, Spain and not Belgium as presupposed.

Named for the locality and should not be confused with sipylite (= FERGUSONITE) of Mallet (1877).

#### **DAVREUXITE**

$\text{Mn}^{2+} \text{Al}_6 \text{Si}_4 \text{O}_{17} (\text{OH})_2$   
Monoclinic.

Originally described from Ottré, Luxembourg province by de Koninck (1878). Davreuxite occurs as fibrous masses in quartz veins, in close association with pyrophyllite and kaolinite. A review on the mineralogy of davreuxite is given by Fransolet & Bourguignon (1976) and Fransolet *et al.* (1984). The crystal structure of davreuxite is assessed by Sahl *et al.* (1984).

Named for Charles Joseph Davreux (1800-1863) Professor of Mineralogy at the University of Liège.

#### **DELVAUXITE** [Delvauxène]

$\text{Ca Fe}^{3+}_4 (\text{PO}_4, \text{SO}_4)_2 (\text{OH})_8 \cdot 4-6 \text{H}_2\text{O} (?)$   
Amorphous.

A name originally given to an ill-defined hydrous ferric phosphate from Berneau, near Visé, Liège province (Dumont, 1838). The phase occurs as translucent, yellowish brown, brownish-black to reddish material. Delvauxite is given species status in Deliens (1987) although Hey (1955) has suggested a conceivable identity to azovskite. A possible similarity between delvauxite, borickyite and fouchérite is also suggested by ech & Povondra (1979).

A review of the occurrence of delvauxite at Berneau is given by Van Tassel (1959). Delvauxite is also recorded from several localities in Bohemia (Czechoslovakia) as at Litosice (Bouska *et al.*, 1960) and at Zeleznik and Pisek (in Palache *et al.*, 1951). Also from Payerbach and Koralpe, Austria (Kahler, 1962). A delvauxite like mineral occurs in Quaternary deposits of the Moscow Basin, Russia (Vakusevich, 1947).

The phase picite seems to be identical to delvauxite, in which case further possible localities include Giessen and Waldgirmes, Nassau, Germany; Hrbek and Trubin, Bohemia, Czechoslovakia and in the Kerch Peninsula, Ukraine (in Palache *et al.*, 1951) Originally named delvauxène by Dumont, but changed by Haidinger (1845) to delvauxite. The name "delvaux" appears in the "Bulletin de l'Académie de Belgique" (1838, p. 147). The name delvauxine is yet another spelling variant given in Chester (1896).

Named for the Belgian chemist J. Delvaux de Fenffe (1782-1863) who first analysed the mineral and the name should not be confused with the delvauxite/delvauxène (= borickyite) of von Hauer (in Palache *et al.*, 1951).

### Destinezite [= DIADOCHITE]

$\text{Fe}^{3+}_2(\text{PO}_4)(\text{SO}_4)(\text{OH}) \cdot 5\text{H}_2\text{O}$   
Triclinic.

Originally described from Carboniferous (Namurian) sediments at Argenteau, near Visé, Liège province, by Jorissen (1880). The phase is a coarsely crystalline diadochite, but given species status by Deliens (1987). Hey (1955) suggests that destinezite is isomorphous with sarmientite. The chemistry and crystallography of destinezite is investigated by Cesàro (1885, 1897) and Toussaint and Mélon (1955).

The occurrence at Argenteau is further reviewed by Toussaint & Mélon (1955) and Van Tassel (1956). Destinezite is also recorded from several localities in Namur province of Belgium as at Védren, (in Palache *et al.* 1951) and at Haut-le-Wastia (Van Tassel, 1985). The phase also occurs at Nucice, Chvaletice and Prague-Vysocany, Bohemia, Czechoslovakia (Slavik, 1928; Bouska *et al.*, 1960). Other localities include Cyprus (Mélon & Donnay, 1936); the Blyava pyrite deposit, southern Urals, Russia (German, 1956) and at Matrazntimre, Hungary (Foldvari & Nagy, 1985).

Povarennykh (1972) gives the alternative spelling of destinesite, though the phase is named for P. Destinez (1847-1911).

### Dewalquite [= ARDENNITE]

Orthorhombic.

A name given by Pisani (1872, 1873) to a phase from Salmchâteau, Ardennes, which subsequently proved to be ardennite. The name ardennite however, has priority.

The difference between dewalquite and ardennite was evidently based on the fact that ardennite was an

arsenic-free, vanadium-bearing silicate, whereas dewalquite was an arsenic containing silicate, with only minor vanadium.

However von Lasaulx (1876) and Bettendorff (1877) reaffirmed the presence of two varieties of ardennite, one arsenic-dominant, the other vanadium-dominant, a view supported by Zambonini (1922) and thereby relegating dewalquite to variety status.

Reviews on dewalquite mineralogy are given by Corin (1927-1928; 1928-1929); Brasseur (1930) and Buttgenbach (1930-1931).

Named for the Belgian geologist, G. Dewalque.

### DRUGMANITE

$\text{Pb}_2(\text{Fe}^{3+},\text{Al})\text{H}(\text{PO}_4)_2(\text{OH})_2$   
Monoclinic. Datolite group.

Initially described by Van Tassel *et al.* (1979) from Richelle, near Visé, Liège province, where it occurs as pale yellow to colourless, sub-millimetric platy crystals. Drugmanite occurs with pyromorphite, anglesite, corkite and phosphosiderite in vugs in mineralised limestones.

The crystal structure of drugmanite is refined by King and Sengier-Roberts (1988).

Named for the Belgian mineralogist J. Drugman (1875-1950).

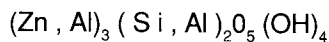
### FERRISTRUNZITE

$\text{Fe}^{3+}\text{Fe}^{2+}_2(\text{PO}_4)_2(\text{OH})_3 \cdot 5\text{H}_2\text{O}$   
Triclinic. Strunzite group.

First described from the Mont des Groseilliers, along the Nimy-Blaton canal, Hainaut province (Peacor *et al.* 1987). Ferristrunzite occurs as greyish-yellow, acicular rosettes on Carboniferous (Visean-Namurian) shales and phanites. The phase was perhaps earlier described by Van Tassel (1966) as a manganese-free strunzite.

An additional occurrence of ferristrunzite at Kohleiche, near Wuppertal, Germany is detailed by Schertl & Heckmann (1988).

The phase is named for its compositional relationship to strunzite and should not be confused with ferrostrunzite, the ferrous analogue of strunzite from Mullica Hill, New Jersey (Peacor *et al.* 1983).

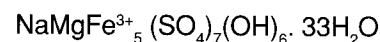
**FRAIPONTITE**

Monoclinic. Sepechlorite. 1H and 1M - polytypes.

Fraipontite occurs as colourless to yellowish-white, micaceous flakes in the zinc deposit at Moresnet, Liège province (Cesàro, 1927; Fransolet & Bourguignon, 1975).

A 1H cuprian fraipontite (11.20-12.26% CuO) is described by Dimitriadis (1977) from the Laurion deposit, Greece. Fraipontite is also recorded from Tsumeb, Namibia (Medenbach *et al.*, 1983) and in the Copperthwaite vein, Swaledale, North Yorkshire, England (Ryback & Tandy, 1992).

Named for the palaeontologist J. Fraipont (1857-1910) of the University of Liège.

**Franquenite** [= SLAVIKITE]

Trigonal.

Described from the Cambrian (Mousty) schists, near Franquénies, Brabant province, by Van Tassel (1944). The phase occurs as yellow efflorescences composed of minute hexagonal scales. Here, franquenite occurs as a recent sulphate mineral with ferroan pickeringite, melanterite, possible fibroferrite and gypsum on shale.

Franquenite is identical to slavikite (Van Tassel, 1949) and is named for the locality.

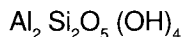
**Galapektite** [= MONTMORILLONITE]

Initially described from Angleur, Liège province (Breithaupt, 1832). The phase is a typical dioctahedral montmorillonite (Faust, 1957). The spelling variant galapektite is used by Dana (1892.). Etymology uncertain.

**Gosseletite** [= viridine = manganian ANDALUSITE]  
Orthorhombic.

A name given by Anten (1923) to a green, manganese bearing silicate phase from Salmchâteau, Liège province. Corin (1934) shows the phase to be a manganian andalusite (= viridine). Reviews on the occurrence of viridine at Salmchâteau are given by Deschodt (1966); Herbosch (1967) and Kramm (1979).

Named for the Belgian geologist J. Gosselet.

**HALLOYSITE**

Monoclinic. Kaolinite-Serpentine (Kandite) group.

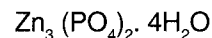
First described from Angleur, near Liège, Liège province by Berthier (1826), though the phase lenzinite, an ill-defined mixture containing halloysite, was earlier described in 1816.

Mehmel (1935) describes two polytypes, halloysite-7A and halloysite-10A. Structural data for halloysite are given by Mehmel (*op. cit.*); Brindley & Goodyear (1948). Hofmann *et al.* (1962); Brindley *et al.* (1948, 1963) and Mitra & Bhattacharjee (1975). The nomenclature of the halloysitic clays is reviewed by MacEwan (1947) and more recently by Keller & Johns (1976), Faust (1955) and Churchman & Carr (1975).

Halloysite is of widespread occurrence, commonly occurring with kaolinite as the result of weathering or hydrothermal alteration of feldspars. Other localities in Belgium include Richelle, Liège province; in the contact zones of Viséan limestones and Coal Measures of the Bleton area, Hainaut province (Gulinck & Dekeyser, 1958) and in the peneplain deposits of the Louveigné-Florzé area (Buurman & Van der Plas, 1968).

A number of synonymus have been used for halloysite since its initial description; Hey (1955) lists endellite, hydrated halloysite, hydrokaolin, hydrohalloysite, gummite (of Breithaupt), glagerite, gloscollite, indianait, lenzinite, lithomarge (part), Fuller's earth (part), tuesite (part), steinmark (part) and smectite (of Salvétat). Ablykite is also identical to halloysite (Sedletzky & Yusupova, 1940). Glocker (1837) gives the erroneous spelling halloyit.

Named for the Belgian geologist J.J. d'Omalus d'Halloy (1783-1875) who first observed the mineral. The name should not be confused with the halloysite (= metahalloysite) of Hendricks (1938).

**HOPEITE**

Orthorhombic.

Originally found in the Altenberg zinc deposit, near Moresnet, Liège province (Brewster, 1824).

The crystal structure of hopeite is refined by Mamedov *et al.* (1961); Liebau (1962, 1965); Gamidov *et al.* (1963); Kawahara *et al.* (1972, 1973); Whitaker (1972, 1975) and by Hill & Jones (1976). Thermodynamic values for hopeite are given by Perez & Nancollas (1984). Braithwaite (1988) compares the IR spectra of the various zinc phosphates, including hopeite.

Hopeite is also described from the Broken Hill deposit, Kabwe, Zambia (Spencer, 1908; Buttgenbach, 1909). In the H.B. mine, Salmo, British Columbia (Walker, 1916). Recorded from the Palermo No. 1 pegmatite, New Hampshire (Segeler *et al.*, 1981) and from a locality in Bolivia (Ahlfeld & Reyes, 1943). The phase is more recently recorded from Bad Ems, Germany (Dietrich & Bode, 1984).

Synonyms for hopeite include Prismatoidischer Zinkphylit (Breithaupt, 1832) and Stilbite duovigésimale (in Palache *et al.* 1951). The phases -hopeite and -hopeite from Broken Hill, Zambia (Spencer, 1908) are likewise identical to hopeite, as probably is the phase hibbenite of Phillips (1916).

Named for the chemist T.C. Hope (1766-1844) of Edinburgh University.

### KONINCKITE

$\text{Fe}^{3+}\text{PO}_4 \cdot 3\text{H}_2\text{O}$   
Tetragonal.

Described originally from Richelle, near Visé, Liège province (Cesàro, 1884). Koninckite occurs as small yellow, spherical aggregates of radiating needles with richellite. The crystallographic properties of koninckite were refined by Van Tassel (1968).

Koninckite is also recorded from the New Idria Hg mine, San Benito county, California (Bradley, 1937). A manganian variety of koninckite (mangankoninckite) containing 2.72 %  $\text{Mn}_2\text{O}_3$  is described as an alteration product of triphylite from the Kyrk-Bulak pegmatite region, in the Turkestan Range of northwestern China (Beus, 1950).

Named for the Belgian palaeontologist Laurent Guillaume de Koninck (1809-1887).

### Lithion Psilomelan [= a mixture]

A name given by Laspeyres (1876) to a presumed lithium-bearing psilomelane from Salmchâteau, Luxembourg province. Franolet (1979) shaved that the phase is possible mixture of lithiophorite and cryptomelane.

Named for the compositional relationship to psilomelane.

### Lohestite [viridine = manganian andalusite]

Another name given by Anten (1923) to a supposed manganian andalusite (= viridine) from phyllites of the

Belgian Ardennes. The phase occurs as isotropic knots and is considered to represent a stage in the formation in andalusite. Theunissen (1970) shows that lohestite is in fact identical to kaolinite and results from the alteration of andalusite.

Named for Prof. J. Maximin Lohest.

### Mangandisthen [= ardennite]

A provisional name given to ardennite from Salmchâteau, Luxembourg province, by H. Heymann (in von Lasaulx, 1872a). Named in allusion to a possible compositional relationship to kyanite.

### Moresnetite [= mixture]

Described initially from the Altenberg zinc deposit, near Moresnet, Liège province, by Risse (1865). The phase is a mixture of hemimorphite and sauconite (Esquevin, 1957).

Zinalsite from Akdzhal, Kazakhstan (Chukhrov, 1956) is considered identical to moresnetite (in Guillemin & Permingeat, 1958).

Named for the locality.

### Mn-chloritoid

An unnecessary name given to otrérite by Povarennykh (1972).

### OTTRELITE

$(\text{Mn}^{2+}, \text{Fe}^{2+}, \text{Mg})_2\text{Al}_4\text{Si}_2\text{O}_{10}(\text{OH})_4$   
Monoclinic and triclinic.

Described initially from the Cambrian (Salmian) phyllites near Otré, Liège province (Dethier, 1818; Damour & Des Cloizeaux, 1842). Further details on otrérite are given by Alger (1846); Renard and de la Vallée Poussin (1879); Gosselet (1888); Mélon (1938) and Michot (1955). Halferdahl (1961) suggests that the name otrérite be used for the Mn-end member of the chloritoid group.

Bustamante-Santa Cruz (1974) concludes that otrérite is one of three types of "chloritoid" from Belgium and further data on otrérite from the type-locality are given by Franolet (1978).

Otrérite is also described from the Pakhals of Yellandlapad area, Andhra Pradesh, India (Rao, 1969) and from the central Caucasus USSR (Vardanyants,

1938). As a constituent of chlorite-schists on Vooruitzicht Farm, Melsetter and in the Inyanga area, Zimbabwe (in Warner, 1972). In porphyries in the New Helen mine, Michipicoten Harbour, Ontario (Walker & Parsons, 1925) and in schists of the Panamint Range, Inyo county and at Yreka, Siskiyou county, California (MacMurphy, 1932; Murdoch & Webb, 1966).

Chester (1896) gives the name karstin as a synonym of otrérite; Povarennykh (1972) suggests the alternative name Mn-chloritoid. Otrérite itself is named for the locality and the name should not be confused with the otrérite (= diallage) of Wolff (in Hey, 1955).

### RICHELLITE

$\text{Ca}_3\text{Fe}^{3+}_{10}(\text{PO}_4)_8(\text{OH},\text{F})_{12}\cdot n\text{H}_2\text{O}$   
Amorphous.

Richellite was first described from Richelle near Visé in Liège province (Cesàro & Desprets, 1883; Cesàro, 1884). The phase occurs as reddish to yellowish brown massive, compact or foliated material, associated with halloysite, allophane and koninckite. The amorphous, globular or vermicular iron phosphate described from Richelle by Van Tassel (1959) is also probably richellite.

Named for the locality and should not be confused with richetite of Vaes (1947).

### Salmite [= chloritoid]

near  $(\text{Fe}^{3+},\text{Mn},\text{Mg})_2\text{Al}_4\text{Si}_2\text{O}_{10}(\text{OH})_4$

Initially described from the Stavelot Massif, near Vielsalm, Liège province, by Prost (1884). The formula given above is taken from Hey (1955). The phase is a variety of chloritoid (see Mélon, 1938).

Also recorded from Vanlup, Hillswick, Mainland, Shetland Isles (in Dana, 1892).

Named for the Salmian metamorphic region and should not be confused with salmoite of Larsen (1921).

### VANTASSELITE

$\text{Al}_4(\text{PO}_4)_3(\text{OH})_3\cdot 9\text{H}_2\text{O}$   
Orthorhombic.

First described from a quartzite quarry, near Bihain, in the Stavelot Massif, Luxembourg province (Fransolet, 1987) vantasselite occurs as millimetric rosettes of tin-white, transparent lamellae on metapelitic dump material. The phase is associated with

wavellite, variscite, cacoxenite, turquoise, clinocllore and muscovite.

Vantasselite is structurally similar to vashegyite and matulaite.

Named for the Belgian mineralogist René Van Tassel (b. 1916).

### WISEITE

$\text{Ca}_{10}\text{Al}_{24}(\text{SiO}_4)_6(\text{PO}_4)_7\text{O}_{22}\text{F}_3\cdot 72\text{H}_2\text{O}$   
Cubic.

Initially described as white, wart-like, botryoidal clusters of oolitic aggregates from Visé, Liège province (Mélon, 1942).

Viséite is regarded as a zeolite, analogous to analcime; the structure of viséite and its relationship to analcime is reviewed by McConnell (1952, 1990). The chemical composition of viséite from the type locality is revised by Dunn & Appleman (1977) who suggest that the elevated silica content of Mélon's analyses is due to admixed opal; furthermore, the phase contains only trace amounts of sodium and a reduced calcium content. Viséite is closely related to perhamite (Dunn & Appleman *op. cit.*).

Named for the locality.

### WILLEMITE

$\text{Zn}_2\text{SiO}_4$   
Trigonal.

Initially described from the zinc deposit of Moresnet, Liège province by Lévy (1830).

However, the phase was first recognised as a distinct mineral from the Franklin-Sterling Hill deposit, New Jersey (Vanuxem & Keating, 1824). The American phase was not named, but known locally as siliceous zinc oxide.

In view of the fact that willemite was named and characterised on Belgian material, Moresnet is regarded as the type-locality. Cianciulli (1982) however, considers willemite as a type mineral of Franklin-Sterling Hill, as do Nickel & Nichols (1991).

Moresnet willemite is recorded from the Hegelsbrücke and Schmalgraf mines, where it occurs as transparent white, yellow or reddish brown crystals to 3 mm. Other Belgian localities include Angleur, Engis and Theux.

Table 2.- Belgian type-occurrences

Locn.	Type-locality	Province	Valid phases	Non-valid phases
1	Angleur	Liège	halloysite	galapektite
2	Bastogne	Luxembourg		bastonite
3	Blaton	Hainaut	ferristrunzite	
4	Ciply	Hainaut		cyplite
5	Franquénies	Brabant		franquenite
6	<b>Stavelot Massif:</b> Bihain, Ottré and Salmchâteau	Luxembourg	ardennite davreuxite ottrélite vantasselite	dewalquite gosseletite lithion-psilomelan lohestite mangandisthen Mn-chloritoid salmite
7	<b>Vieille Montagne:</b> Altenberg and Moresnet	Liège	fraipontite hopeite willemite	belgite moresnetite
8	<b>Visé area:</b> Argenteau, Berneau, Richelle and Visé	Liège	delvauxite drugmanite koninckite richellite viséite	destinezite

The crystallographic properties of willemite were reviewed by Penfield (1894); Palache & Graham (1913, 1914); Clark (1916); Gordon (1922); Bragg & Zachariasen (1930); O'Daniel & Tscheischwili (1944) and Khan *et al.*, (1971). Thermodynamic data for willemite are presented by Fedorov *et al.* (1979) and Ovchenko *et al.* (1974, 1975) have studied the variations in composition of synthetic willemite.

Reviews on willemite fluorescence are given by Liebisch (1912); Spencer (1927); Palache (1928); Servigne (1943) and Robbins (1986, 1987, 1988, 1989) and its cathodoluminescent properties by Bhalla (1970). The relationship between willemite and hemimorphite is discussed by Markham (1960).

Willemite is a relatively rare mineral, though its fluorescent properties and use as a gem mineral explains why it is eagerly sought by mineral and gem collectors alike. The value of willemite as a gemstone is reviewed by Pough (1974). An appraisal of willemite occurrences world-wide is given below.

In Germany at Büsbacherberg, Aachen, Rheinland and in the slag heaps at Letmathe/Sauerland (Spencer,

1927; Schnorrer-Köhler, 1983). At Möchlingeralpe, Obir, Carinthia, Austria (Walter & Postl, 1983). From Mussartüt, Ilimaussa alkaline intrusion and in Lujavrites of the Motzfeldt centre, Greenland (Des Cloizeaux, 1862; Metcalf-Johnson, 1977; Finch, 1990). In slags at Laurion, Greece (Schnorrer-Köhler *et al.*, 1991). At Konnerud, Drammen district, Norway (Goldschmidt, 1911 - in Spencer, 1927). From Czechoslovakia (Robbins, 1987).

Russian occurrences include the Irunovskiy deposit, Transbaikalia (Kornilovich *et al.*, 1974); in the Khibina alkalic massif, Kola, Russia (Shlyukova *et al.*, 1979) and from various metasomatite localities in the "old" Soviet Union (Marchenko, 1987); from the Kumysh-Tag deposit, Kirghizia.

The renowned occurrence at Franklin-Sterling Hill, New Jersey is well documented (see Vanuxem & Keating, 1824; Mixer, 1868; Penfield, 1894 and Palache & Graham (1913); also from the Andover Fe mine, New Jersey (Cook, 1972); from several occurrences in Arizona, including the Mammoth mine, Pinal county; in the Gleeson-Quartzite area, Yuma county; Red Cloud mine, Yuma county and at Modoc Mountain, Graham county (Lindgren & Hillebrand, 1904; Edson,



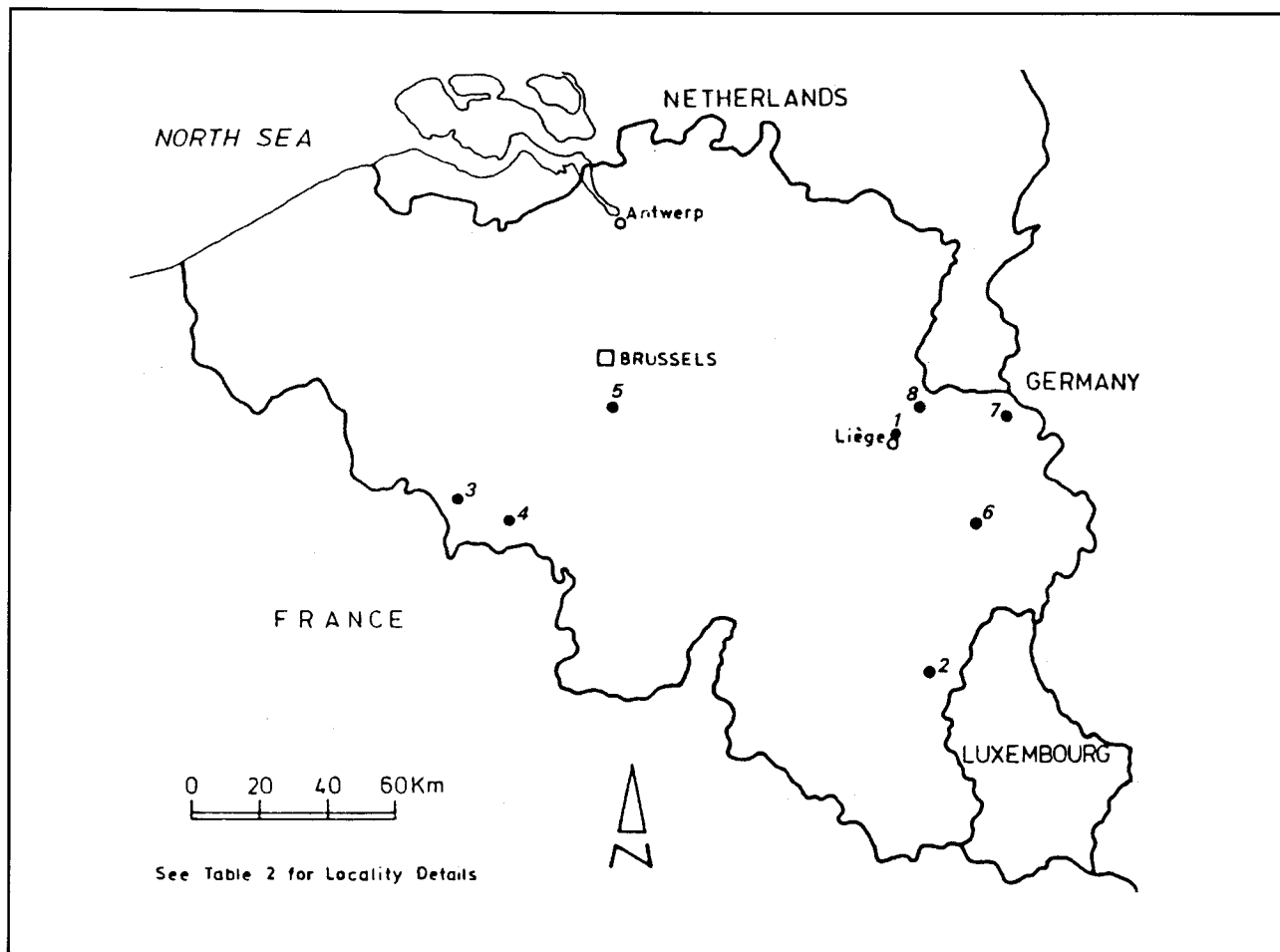


Fig. 1.- Type-locality Map for Belgium

1980; Robbins, 1988); in the Merritt mine and in the Socorro Peak district, Socorro county, New Mexico (Genth, 1887. Penfield, 1894; Moates 1991); from the Ygnacio and Cerro Gordo mines, Inyo county and in the Holcomb Valley, California (Merriam, 1936; Robbins, 1986); at Salida, Chaffee county, Colorado (Penfield, 1894); from the Talisman mine, Beaver county, Utah (Clark, 1916). From Mont St. Hilaire, Quebec (Bank, 1975) and at Kirkmount, Pictou county, Nova Scotia (Sangster, 1986). At Peñoles, Durango and from a locality in Sinaloa, Mexico (Spencer, 1927). In the El Sauce quarry, Colón, Cordoba province and from San Martin, San Luis province, Argentina (Angelelli & Gordon, 1948; Gay & Hiller, 1968). At Serro do Cantinho, Januária district, Minas Gerais, Brazil (Guimarães, 1948).

From Abenab, Aukas, Guchab, Nageib and Tsumeb, Namibia (Spencer, 1927; Servigne, 1943; Ramdohr, 1980). In the Mindouli, Djoue and Pimbi deposits, Congo (Le Chatelier, 1893 - in Spencer, 1927; Lacroix, 1910). At Bou Thaleb, Constantine, Algeria (Lacroix, 1900 - in Spencer, 1927). From Jebel Recas, Tunisia (Lacroix, 1910); in the Lubi River area, Kananga district, Zaire (Buttgenbach, 1927). From several Zambian localities, including the Sable

Antelope and Broken Hill deposits, Central province and as large masses in the Star Zinc and Excelsior prospects, Lusaka district, Zambia (Buttgenbach, 1919; Spencer, 1927).

Identified as a constituent of silicified wood at Mahuda, Bihar, India (Mitra & Sen, 1956). Also from Cho-Dan, southeastern Asia (Lacroix, 1913). In the Billy Springs and Beltana deposits, Flinders Range, South Australia (Keller, 1990).

A dark blue violet cobaltan willemite (xingsaoite), containing 25.41% CoO, is described from the oxidized zone of the Xing gold deposit, Hunan province, China (Zhen & Huang, 1989).

A beryllian willemite, containing 0.53 % BeO, is described from an unspecified locality in European USSR (Gurvich, 1965). Mangaoan willemite (troostite, tephro-willemite, Mn-willemite) is well known from the Franklin-Sterling Hill deposits, New Jersey (Shepard, 1832; Wurtz, 1851) and more recently described from Langban, Värmland, Sweden (Nysten, 1983).

Uncertain occurrences listed by Spencer (1927) include; Wanlockhead, Scotland; Raible, Italy;

Kucsaina, Serbia; Upper Silesia, Poland; Temora, New South Wales and from the Walsh-Tinaroo mining district, Queensland.

Spelling variations on the name willemite include villemite and wilhelmite (in Dana, 1892, p. 460) and willemine (Chester, 1896, p. 288). Williamit (Rammelsberg, 1847 - in Spencer, 1927) and willimasite and hebetine (in Dana, 1892, p. 460) and belgite (see before) are other synonyms for willemite.

Named in honour of King Willem I of The Netherlands (1772-1843) who had given Lévy the Professorship at the University of Liège. Lévy himself, was banished from France during the French Restoration.

### 3. 2.- UNNAMED MINERALS

#### Undetermined sulphate phase

An undetermined sulphate mineral is associated with copiapite in the Vedrin Pb-Zn deposit, Namur province (Van Tassel, 1947). The mineralisation at Vedrin is reviewed by Evrard (1943).

#### Undetermined Fe-Cu-Te phase

The phase occurs as yellow, sub-millimetric inclusions in covellite from the Salmchâteau deposit, Luxembourg province (du Ry *et al.*, 1976).

#### Undetermined Ca-phosphate-carbonate

An undetermined mineral reported by Berger (1965) in the Lienne Valley Mn deposits, Liège province.

### 4.- TOPOGRAPHICAL TRENDS FOR THE NAMED TYPE MINERALS

There are fifteen Belgian type-mineral localities, distributed across four of the nine provinces (viz: Brabant, Hainaut, Liège and Luxembourg).

The greatest number of Belgian type-minerals occurs in the Visé area; 5 valid species are recorded from here, along with 1 invalid phase; the mineralogy of the Richelle occurrence, near Visé is reviewed by Fransolet *et al.* (1974).

The Stavelot massif (comprising the occurrences of Bihain, Ottré and Salmchâteau) is a source for 4

valid type- minerals, together with 7 invalid type-minerals and 1 unnamed phase. The mineralogy of the Salmchâteau occurrence is reviewed by du Ry *et al.* (1976) and that of the Viesalm area by Bourguignon (1964).

The Vieille Montagne zinc district is a source for 3 valid phases and 2 discredited minerals.

A summary of Belgian the type-localities is given in Table 2; the location numbers listed in the first column of the Table correspond to those shown on the locality map (fig. 1).

Table 3.- Chemical classification of the approved Belgian Type-Minerals

<u>Phosphates</u>		<u>Silicates</u>
Delvauxite	Koninckite	Ardennite
Drugmanite	Richellite	Davreuxite
Ferristrunzite	Vantasselite	Fraipontite
Hopéite	Viséite	Halloysite
		Ottrélite
	<u>Chlor-acetate</u>	Willemite
	Calclacite	

### 5.- MINERAL CHEMISTRY TRENDS FOR THE APPROVED TYPE-MINERALS

Of the fifteen approved type-minerals, four are Fe-dominant minerals (delvauxite, ferristrunzite, koninckite and richellite), three are Al-dominant minerals (halloysite, vantasselite and viséite), three are Mn-dominant minerals (ardennite, davreuxite and ottrélite), and a further three are Zn-dominant phases (fraipontite, hopeite and willemite). Drugmanite and calclacite are Pb- and Ca-dominant species, respectively.

In terms of the anionic mineral chemistry, eight of the approved type-minerals are phosphates, six are essentially silicate phases and calclacite is a chlor-acetate. The conventional anionic grouping of approved Belgian type-species is presented in Table 3. Calclacite, though of semi-natural status, is the first recorded acetate species.

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