Annales de la Société Géologique de Belgique, T. 115 (fascicule 1) - 1992, pp. 33-62 Juin 1992

THE TYPE MINERALOGY OF AFRICA : ZAIRE

by

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(8 tables)

ABSTRACT.- The type-mineralogy of Zaire is reviewed. One hundred and ninety five type-minerals and mineral names are presented, comprising ninety one valid and one hundred and four non-valid type-phases. Zaire is the most productive African country for type-minerals. The ninety one approved species are described from twenty five type-localities. Thirty one of these minerals still remain unique to the respective type-occurrence. The Shinkolobwe deposit is the most prolific producer of new type-minerals in Zaire, ranking second in Africa as a whole. The Kobokobo pegmatite is the second most prolific producer of new minerals in Zaire; many of the recorded type-minerals from Kobokobo are unique to the deposit. Fifty three type-uranyl species are recorded from Zaire. The world's largest single assemblages of type-uranyl oxide hydrates and type-uranyl phosphates occur at Shinkolobwe and Kobokobo, respectively. Zaire is thus far the only documented source for REE-uranyl carbonate, uranyl selenite and thiocyanide phases.

KEYWORDS.- Africa; Zaire; Type-Mineralogy.

1. INTRODUCTION

1.1.- Foreword

An overview on the type-mineralogy of Zaire is presented. This publication is one of a series, by the author, on the type-mineralogy of Africa.

The listing of type-minerals from Zaire is as complete as possible, though the author apologises for any omissions which might have arisen during the compilation of this work. Amendments and additions to this effect would be most gratefully received.

1.2.- Type-Mineral Definitions and Terminologies

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 listed type-species into holotypes, cotypes or neotypes, as defined by Dunn and Mandarino (1988). This aspect covering Zairean type-minerals has however, been reviewed by Deliens (1977a).

The naming of new phases is naturally the prerogative of the author or authors concerned. It is therefore imperative that the allocated mineral name is spelt correctly in any subsequent reference to it, as any misspelling(s) could be legitimately interpreted as a separate mineral name.

The validity (or non-validity) of all documented minerals, in this publication, 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 that have been approved by the Commission.

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 phases may be conveniently grouped into one of the following categories:

a) inadequately described phases (status uncertain).

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b) phases that are identical to approved minerals (synonyms).

c) compositional variants of approved minerals (chemical varieties).

d) physical varieties of approved minerals.

e) names applied to end-member phases which, as yet, have no natural counterparts (hypothetical compounds).

f) Compositional mixtures (solid-solutions).

g) mechanical mixtures of two or more approved minerals (mixtures).

h) names that are used as group or generic terms (group names).

i) misspelt mineral names (spelling variants) usually arising through typographical misprinting or erroneous back transliterations.

j) unnamed phases.

The chemical variety sub-group includes those mineral names that carry non-adjectival modifiers (suffixes or prefixes) and which go to form derivative mineral names (an example is Th-crandallite for thorian crandallite).

Furthermore, because of the not-too-uncommon practice of misspelling minerals names it is sometimes difficult to ascertain whether or not that particular spelling version is original to the cited reference. This is especially so with the more common minerals and, in such cases, the mineral name is preceded by [?] in this publication.

Reference is also made to what the author has termed «the established literature». This term collectively refers to the following publications:

1. Lists of New Mineral Names, given in both Mineralogical Magazine and American Mineralogist.
2. The various editions of Dana's System of Mineralogy.
3. Chemical Index of Minerals by Max Hey (1955, 1962a).
4. A Manual of New Mineral Names 1892-1978, by P. Embrey and J. Fuller (1980).

1.3.- Zairean Overview

One hundred and ninety five valid type-minerals have been described from Zaire, for the period 1917-1990. Ninety one of these are valid mineral species, 33 of which come from the Shinkolobwe uranium deposit. The remainder are non-valid species comprising 38 spelling variants (including 6 queried [?] names); 36 synonyms; 18 chemical varieties; 5 inadequately characterised (status uncertain) phases; 3 mixtures, 2 physical varieties and 1 group name and 1 hypothetical compound. An additional 13 unnamed phases are also presented (section 4.2).

The first documented approved type-mineral from Zaire is cornetite (Buttgenbach 1917) from the L'Etoile du Congo mine, near Lubumbashi, Shaba province.

A summary of the recorded Zairean type-mineral names is presented in Table 1.

Table 1.- Recorded Type-Minerals and Mineral Names from Zaire

a) Valid Minerals :

Althupite
Andremeyerite
Anthoinite
Becquerelite
Bijvoetite-(Y)
Billietite
Briartite
Buttgenbachite
Cattierite
Cesplumtantite
Claringbullite
Combeite
Comblainite
Cornetite
Cuprosklodowskite
Curite
Delhayelite
Demesmaekerite
Derriksite
Dewindtite
Dumontite
Eylettersite
Florencite-(La)
Fourmarierite
Francoisite-(Nd)
Gallite
Götzenite
Guilleminite
Gysinite-(Nd)
Heterogenite-2H
Ianthinite (Schoep)
Juliënite
Kalipyrochlore
Kamitugaite
Kamotoite-(Y)
Kasolite
Kipushite
Kirschsteinite
Kivuite
Kolwezite
Lepersonnite-(Gd)
Likasite
Ludjibaïte
Lueshite
Lusungite
Marthozite
Masuyite
Metaschoepite
Metastudtite
Metavandendriesscheïte
Metavanmeersscheïte
Moreauite
Mundite
Oosterboschite
Oursinite
Paraschoepite
Parsonsite
Phuralumite
Plumbomicrolite
Protasite
Rankamaite
Ranunculite
Renierite
Richetite
Roubaultite
Saléeite
Sayrite
Schoepite
Schuilingite-(Nd)
Sengierite
Shabaite-(Nd)
Sharpite
Sklodowskite
Soddyite
Stilleite
Studtite
Swamboite
Thoreaulite
Threadgoldite
Triangulite
Trikalsilite
Upalite
Urancalcarite
Vaesite
Vandenbrandeite
Vandendriesscheïte
Vanmeersscheïte
Varlamoffite
Wakefieldite-(Ce)
Wyartite
Zairïte

b) Non-valid Minerals :

Compositional Varieties

Borgniezite
Cobalt-vaesite
Cupro-asbolane
Cuproplatine
Kobokobite
Kusuïte
Lead-becquerelite
Li-biotite
Nickel-cattierite
Selenio-molybdenite
Selenio-siegenite
Selenio-vaesite
Selenium molybdenite
Selenolinnaeite
Th-crandallite
Thorophosphuranylite
Thororenardite
Uranothorogummite

Synonym Status

Bialite
Bijvoetite
Chinkolobwite
Diderichite
Droogmansite
Epiianthinite
Gysinite
Heterogenite-H
Hydrotenorite
Ianthinite (Bignand)
Katangite
Keno-eylettersite
Keno-mitridatite
Lead microlite
Lepersonnite
Lubumbashite
Meta-saléeite
Mindigite
Mumbite
Plancheite I
Plancheite III
Plancheite X
Schoepite I
Schoepite II
Schoepite III
Schuilingite
Selenium-siegenite
Selenium-vaesite
Stainierite
Stasite
Topasolite
Trieuite
Uranolepidite
Vandendriesscheite I
Vandendriesscheite II
Wyartite I

Mixtures	*Hypothetical Molecule*	*Physical Varieties*	*Group Names*
Boodtite	Zn-tourmaline	Plancheite II	Columbotantalite
Chalcocite-rose grey		Wyartite II	
Renardite			

Spelling Variants

	Amenite		Ianthite
	Brandallite		Iianthinit(e)
	Caringbullite		Janthiniet
[?]	Carollite		Kirchsteinite
[?]	Chalcantite		Koluezite
	Chalcotrycite	[?]	Lithiophyllite
	Chervettetite		Lumbumbashite
	Chinkolobwhite		Meta-vanmeerscheite
	Cobalt-calcite		Parsmsite
[?]	Colombite		Saleite
	Complainite		Shinkolobwite
	Cupro-asbolite		Soddite
	Cuprosklodovskite		Stainerite
	Cuprosklovskite		Thoreaulith
	Cuprosklowdowskit	[?]	Torbenite
	Cuprosklowskite		Treadgoldite
	Epijanthinit	[?]	Triphyllite
	Gerhardite		Vandenbrandite
	Guileminite		Vanmeerscheite

Status Uncertain

Clino-sklodowskite	Eylettersite I	Tantalpolycrase
Cousinite	Eylettersite II	

2.- LITERATURE REVIEW

2.1.- Authors to approved Zairean type-minerals

The most prolific describers of type-minerals from Zaire are the combined team of Michel Deliens and Paul Piret. Both are accredited with the descriptions of 25 five approved type-phases, for the period 1979-1989. Michel Deliens has additionally described the polytype heterogenite-2H (Deliens and Goethals 1977).

Alfred Schoep (1921-1955) has described 13 type-phases from the Shinkolobwe; Schoep is also accredited with an additional 3 approved species. Johannes Vaes has described 8 approved type-Zairean minerals for the period 1947-1949. L. van Wambeke, working mainly on the Lueshe carbonatite and the Kobokobo pegmatite has described 6 new species for the period 1959-1975. Other prominent mineralogists in the same context include Th. Sahama (with Kai Hytonen) and Fabian Cesbron (and co-workers).

A summary of the more prominent authors to approved Zairean type-minerals, together with a list of the described phases, is presented in Table 2.

Table 2.- Listing of Principle Authors to Approved Zairean Type-Minerals

Henri Buttgenbach (1917-1933)

Cornetite	Fourmarierite	Thoreaulite
Cuprosklodowskite	Kipushite	

Fabian Cesbron and co-workers (1966-1971)

Demesmaekerite	Marthozite
Derriksite	Roubaultite

Michel Deliens and Paul Piret (1979-1989)

Althupite	Ludjibaite	Shabaite-(Nd)
Bijvoetite-(Y)	Metastudtite	Swamboite
Comblainite	Metavanmeersscheite	Threadgoldite
Francoisite-(Nd)	Moreauite	Triangulite
Heterogenite-2H	Mundite	Upalite
Kamitugaite	Oursinite	Urancalcarite
Kamotoite-(Y)	Phuralumite	Vanmeersscheite
Kolwezite	Ranunculite	Wakefieldite-(Ce)
Lepersonnite-(Gd)	Sayrite	

Th. Sahama < including Kai Hytonen > (1957-1959)

Andremeyerite	Delhayelite	Kirschsteinite
Combeite	Gotzenite	Trikalsilite

Alfred Schoep (1921-1955)

Becquerelite	Dumontite	Likasite	Sklodowskite
Buttgenbachite	Ianthinite	Paraschoepite	Soddyite
Curite	Julienite	Parsonsite	Vandenbrandeite
Dewindtite	Kasolite	Saléeite	

Johannes Vaes (1947-1949)

Billietite	Richetite	Studtite
Masuyite	Schuilingite-(Nd)	Vandendriesscheite
Renierite	Sengierite	

L. van Wambeke (1958-1975)

Eylettersite	Kivuite	Plumbomicrolite
Kalipyrochlore	Lusungite	Zairite

2.2.- Etymology of approved type-minerals

As stated in section 1.2. the naming of new minerals is at the discretion of the author(s) concerned. For the Zairean approved type-minerals, 56 are named for various scientific and non-scientific personages; 15 mineral names allude to their composition; 13 are named for the respective type-locality and 7 names relate to their physical or structural properties.

A summary of nomenclature derivations of approved type-species from Zaire is given in Table 3.

Table 3.- Nomenclature Derivation of Approved Type-Minerals from Zaire

After physical and crystal structure properties :

Heterogenite-2H	Oursinite	Ranunculite	Triangulite
Ianthinite	Paraschoepite	Trikalsilite	

After the chemical composition :

Althupite	Kalipyrochlore	Phuralumite
Cesplumtantite	Metaschoepite	Plumbomicrolite
Cuprosklodowskite	Metastudtite	Upalite
Florencite-(La)	Metavandendriesscheite	Urancalcarite
Gallite	Meta-vanmeersscheite	Wakefieldite-(Ce)

After the type-locality :

Kamitugaite	Kivuite	Lueshite	Zairite
Kamotoite-(Y)	Kolwezite	Lusungite	
Kasolite	Likasite	Shabaite-(Nd)	
Kipushite	Ludjibaite	Swamboite	

For people :

Anthoine, R.	Fourmarier, P.	Salee, A.
Becquerel, H.	François, A.	Sayre, D.
Bijvoet, M.	Guillemin, C.	Schoep, A.
Billiet, V.	Gysin, M.	Schuiling, H.J.
Briart, G.	Juliën, H.	Sengier, E.
Buttgenbach, H.	Kirschstein, E.	Sharp, R.R.
Cattier, F.	Lepersonne, J.	Sklodowska, M. (Mme)
Claringbull, G.F.	Marthoz, A.	Soddy, F.
Combe, A.D.	Masuy, G.	Stille, H.
Comblain, G.	Meyer, A.,	Studt, F.E.
Cornet, J.	Moreau, J.	Thoreau, J.
Curie, P.	Mund, M.	Threadgold, I.M.
Delhaye, F.	Oosterbosch, R.	Vaes, J.F.
Demesmaeker, M.G.	Parsons, L.	Van den Brande, P.
Derriks, J.J.	Protas, J.	Vandendriessche, A.
Dewindt, J.	Rankama, K.	Van Meerssche, M.
Dumont, A.	Renier, W.	Varlamoff, N.
Eyletters, E. (Mme Van Wambeke)	Richet, E.	Von Götzen, G.A.
	Roubault, M.	Wyart, J.

3.- TYPE MINERALOGY

3.1.- Type Mineralogy of the Named Phases

Recorded type-minerals and type-mineral names from Zaire are alphabetically presented below. Valid phases are highlighted in bold type and non valid phases are in italics. Only details concerning the type mode of occurrence are given, together with any updated crystal structure and chemical data. Up-to-date information on the status of non-valid minerals is also given.

Althupite

$AlTh(UO_2)[(UO_2)_3O(OH)(PO_4)_2]_2(OH)_3 \cdot 15H_2O$

Initially described by Piret and Deliens (1987) in the uranium-rich portion of the Kobokobo pegmatite, Kivu province, where it occurs as thin, submillimetric, yellow transparent tablets, associated with beryl and a series of other aluminium uranyl phosphates. Althupite remains unique to Kobokobo.

Amenite

An erroneous spelling of amesite from Kalongwe, Shaba province, given by Derriks and

Oosterbosch (1958). The name amenite should not be confused with the armenite of Neumann (1939).

Andremeyerite

$BaFe^{2+}{}_2Si_2O_7$

Andremeyerite is described as pale, emerald-green crystals in vesicles in melilite-leucite-nepheline lavas at Mount Nyiragongo, Kivu province (Sahama *et al.*, 1973). The phase remains unique to Mount Nyiragongo.

Anthoinite Anthoinite group

* $W^{6+}AlO_3(OH)_3$

First described as chalky white material with ferberite in quartz veins and placer concentrates at Mount Misobo, in the Kalima-Maniema district, Kivu province (Varlamoff 1947). The composition has since been redefined by Matsubara *et al.* (1984)*. Anthoinite, originally indexed as monoclinic, is now redetermined as triclinic (Niggli and Jager 1957).

The name anthoinite should not be confused with anthonyite, the copper hydroxyl chloride of Williams (1963).

Becquerelite

$Ca(U^{6+}O_2)_6O_4(OH)_6 .8H_2O$

Initially described by Schoep (1922d) as centimetric-sized, yellow crystals and crystalline crusts on altered uraninite from the Shinkolobwe uranium deposit, Shaba province.

The type material is evidently a plumboan variety, containing 5.25% PbO, which Schoep (op. cit.) attributes to impurities. The original composition for becquerelite was given as $UO_3 .2H_2O$ (in Schoep 1924a). Further studies on bequerelite were continued by Schoep (1924b, 1924c) Billiet (1926) and Ungemach (1929).

Schoep and Stradiot (1948) later described a lead-free becquerelite from Shinkolobwe and assigned a formula closer to $2UO_3 .3H_2O$; they further suggested that lead substituted for uranium in the original lead-bearing phase. Vaes (1948b 1949) on the other hand, regarded their analyses as erroneous and suggested that the Pb was in fact Ba. Vaes concluded that the 'lead-rich' becquerelite was actually the more recently-described billietite (Vaes 1947). He further suggested that becquerelite should be retained for material containing neither Pb nor Ba.

Frondel and Cuttitta (1953) later proposed a composition of $7UO_3 .11H_2O$ thus analagous to billietite. These authors further suggested the more general formula

$[U^{6+}{}_{1-x}(Ba,Pb)_x{}^{2+}]U^{6+}{}_6O_{20-4x}(OH)_{2+4x} .(10-2x)H_2O$

for the becquerelite-lead becquerelite-billietite series.

Protas (1957) however, reported the presence of major calcium in becquerelite, thus invalidating all earlier versions of the composition.

Refined crystal structure date for becquerelite are given by Potdevin and Brasseur (1958) and Toussaint and Brasseur (1959) though more recent data are presented by Piret-Meunier and Piret (1982)* and Pagoaga *et al.* (1987).

Bialite

hydrous Al-Mg-Ca phosphate

Originally described by Buttgenbach (1928) as minute, white needles on compact brown phosphatic rock from Mushishimano, Shaba province. Originally thought to be a magnesian tavistockite, but now proven identical to wavellite (Embrey and Fejer 1969).

Bijvoetite

A name given by Deliens and Piret (1982a) to a rare earth uranyl carbonate. The mineral has been renamed bijvoetite-(Y) in accordance with the Levinson Rule for rare earth-bearing phases (Levinson 1966; Bayliss and Levinson 1988; Nickel and Mandarino 1988).

Bijvoetite-(Y)

$(Y,Dy)^{3+}{}_2(U^{6+}O_2)_4(CO_3)_4(OH)_6 .11H_2O$

Bijvoetite-(Y) is the renamed bijvoetite, initially described as minute, sulphur-yellow tabular crystals occurring in the lower part of the oxidation zone at Shinkolobwe, Shaba province (Deliens and Piret 1982a). The phase occurs with curite lepersonnite-(Gd), sklodowskite, uranophane, becquerelite and rutherfordine. Bijvoetite-(Y) remains up to now unique to Shinkolobwe.

Billietite

* $Ba(U^{6+}O_2)_6O_4(OH)_6 .4H_2O$

Originally described from below the 57 metre-level of the Shinkolobwe uranium deposit, Shaba province, where it is found sparingly as amber yellow platelets in altered uraninite (Vaes 1947a).

Vaes suggested the formula $BaO. 6UO_3 .10H_2O$. for this phase, whereas Frondel and Cuttitta (1953) proposed a composition closer to $BaO. 6UO_3 .11H_2O$ and identical to that put forward by Brasseur (1949). Frondel and Cuttitta further suggested a more general formula for the becquerelite-lead becquerelite-billietite series of :

$[U^{6+}{}_{1-x}(Ba,Pb)_x{}^{2+}]U^{6+}{}_6O_{20-4x}(OH)_{2+4x} .(10-2x)H_2O$

Billietite was erroneously regarded by Schoep and Stradiots (1948) as a variety of becquerelite. The billietite crystal structure has subsequently been refined by Thoreau (1948) Potdevin and Brasseur (1958) and Toussaint and Brasseur (1959).

Pagoaga *et al.* (1987)* present more recent crystal structure and crystal chemistry data for billietite. The phase is isostructural with compreignacite.

Boodtite

Boodtite is recorded as friable, gray-black material, admixed with talc, kaolinite and quartz, from the Star of the Congo mine, Shaba province (de Leenheer 1936). Billiet and Vandendriessche (1939) suggest that boodtite, together with trieuite and mindigite, are all varieties of a single species having the formula $(Co_2O_3\,CuO).H_2O$. The phase is an impure heterogenite (Hey 1962c).

Borgniezite

A soda amphibole first described from carbonatites and adjacent schists at Lueshe, Kivu province by de Bethune and Meyer (1956). Previously recorded without a name by de Bethune in 1952. The mineral is regarded as a sodium amphibole (Leake 1978) and its status therefore still remains uncertain.

Brandallite

A misprint for (thorian) crandallite from the Kobokobo pegmatite, Kivu province (van Wambeke 1971). The name appears as thorian brandallite.

Briartite Stannite group

$Cu^{2+}_2(Fe^{2+},Zn)Ge^{2+}S_4$

Briartite-Renierite series

Briartite is the germanium analogue of stannite. The phase was first found as inclusions in chalcopyrite, renierite, tennantite and sphalerite from the Prince Leopold mine, Kipushi, Shaba province, (Francotte *et al.*, 1965). The type material is an iron-rich variety, containing between 5.1-9.5 wt% Fe; 6.9-10.8 wt% Zn and up to 1 wt% Ga.

A gallian-zincian (12.2 wt% Zn and 2.2wt% Ga) and zincian (12.2 wt% Zn and 2.6 wt% Fe) varieties were simultaneously described by these authors from the Tsumeb deposit in Namibia. A series between briartite and renierite is suggested by Levy (1968).

Buttgenbachite Connellite group

$Cu^{2+}_9Cl_4(NO_3)_2(OH)_{32}\,.2H_2O$

Buttgenbachite-Connellite series

Buttgenbachite is the nitrate analogue of connellite and was initially found as azure-blue, radiating crystalline sprays and felt-like aggregates in cavities of cuprite from the Likasi deposit, Shaba province (Schoep 1925a). Intermediate members of the series are also described from Likasi by Schoep (1926b) and Buttgenbach (1926b). The crystal structure of buttgenbachite has since been revised by Fanfani *et al.* (1973).

Caringbullite

An incorrect spelling of claringbullite, from the M'sesa copper deposit, Kambove, Shaba province, appearing in volume 29 (78M-0884) of Mineralogical Abstracts (1978).

[?] *Carollite*

A presumed misprint of carrollite from Kalongwe, Shaba province, given in Mineralogical Abstracts (1959-1960, p. 259) for the Derriks and Oosterbosch (1958) entry. It should be emphasised that carrollite is a frequently misspelt mineral name and that this documentation is not with certainty, the first record of such a misspelling (misprint).

Cattierite Pyrite group

CoS_2

Cattierite-Vaesite-Pyrite series

The cobalt analogue of pyrite originally described from the Shinkolobwe deposit, Shaba province (Kerr 1945). The phase occurs as tobacco-brown cubes, masses and disseminations in mineralised veins, especially below the 132 metre-level of the deposit (Derriks and Vaes 1956). The crystal structure of cattierite has been refined by Pratt and Bayliss (1979). Intermediate members (20.5-21.3 wt% Co) of the pyrite-cattierite binary system, occur in the Chibuluma deposit, Copperbelt province, Zambia (Riley 1965).

Cesplumtantite

$(Cs,Na)_2(Pb^{2+},Sb^{3+})_3Ta_8O_{24}$

Cesplumtantite occurs as colourless veinlets and elongated concretions in a museum specimen of thoreaulite from the Manono granite pegmatite, Shaba province (Voloshin *et al.*, 1986); cesplumtantite is associated with lithiotantite, cassiterite, microlite and calciotantite. The phase remains unique to Manono.

[?] *Chalcantite*

An erroneous spelling of chalcanthite given in de Kun (1965) with reference to the Shaban copper deposits. There appears to be no earlier recording of this name in any of the established literature.

Chalcocite - rose gray

Jointly described from the Kipushi (Zaire) and Tsumeb (Namibia) deposits as infillings along fractures in digenite (Schneiderhohn 1920). Ramdohr (1980) regards the phase as a mixture of lautite and betechtinite.

Chalocotrycite

An erroneous spelling of chalcotrichite given in de Kun (1965) with reference to the Shaban copper deposits. There appears to be no earlier recording of this name in any of the established literature.

Chervettetite

An incorrect spelling of chervetite cited under the wakefieldite-(Ce) entry for the Kusu deposit (Roberts *et al.*, 1990). There appears to be no earlier recording of this name in any of the established literature.

Chinkolobwhite

An erroneous spelling variant of chinkolobwite appearing in Rice (1955) under the sklodowskite entry. There appears to be no earlier recording of this name in any of the established literature.

Chinkolobwite

A name given by Schoep (1923b, 1923c) to a phase from the Kasolo Hill extension of the Shinkolobwe deposit, Shaba province. The mineral is identical to sklodowskite (Schoep 1925e).

Claringbullite

$Cu^{2+}{}_4Cl(OH)_7 \cdot nH_2O$

Simultaneously described by Fejer *et al.*(1977) from the M'sesa mine, Kambove, Shaba province (Zaire); the Nchanga West orebody of the Nchanga open pit, Copperbelt province (Zambia) and from Bisbee, Cochise county Arizona.

Clino-sklodowskite

$Mg(H_3O)_2[UO_2/SiO_4]_2 \cdot 3H_2O$

A name given by Strunz (1957) for a supposed monoclinic dimorph of orthorhombic sklodowskite from the Shinkolobwe, Shaba province and Jachymov, Czechoslovakia. Status of clino-sklodowskite remains uncertain.

Cobalt-calcite

A name given to a phase from the Tantara deposit, Shaba province (de Kun 1965). No doubt a variant of cobaltocalcite. There appears to be no earlier recording of this name in any of the established literature.

Cobalt-vaesite

Cattierite-Vaesite series

A name given to a cobaltoan vaesite by Derriks and Vaes (1956) occurring between the 114 and 150 metre-levels of the Shinkolobwe deposit, Shaba province. The phase contains between 9.5-12.9% Co and thus an intermediate member of the cattierite-vaesite series.

[?] *Colombite*

A probable spelling misprint for columbite from the Kobokobo pegmatite, Kivu province (Safiannikoff and van Wambeke 1967).

Columbotantalite (Columbo-tantalite)

A non-commital generic term for members of the columbite-tantalite series from the Kobokobo pegmatite, Kivu province (van Wambeke 1958a; de Kun 1959). The term was initially used by Lancsweert (1954) in his review on deposits of the Maniema district. The name is now commonly applied to members of the columbite-tantalite series.

Combeite Combeite group

$*Na_2Ca_2Si_3O_9$

Combeite was first described as poorly-developed colourless, sub-millimetric prisms in nephelinites from Mount Shaheru, the extinct southern cone of Mount Nyiragongo, Kivu province (Sahama and Hytonen 1957a). The composition of combeite has since been redefined by Fischer and Tillmanns (1983, 1987)*.

A low temperature modification of combeite is reported from the Mayener Feld, Germany (Fischer and Tillmanns 1983). Dawson *et al.* (1989) have described combeite from the Oldoinyo Lengai carbonatite lava complex, Tanzania.

Comblainite Pyroaurite group

$(Ni^{2+},Co^{3+})(OH)_2(CO_3) \cdot nH_2O$

Comblainite occurs as turquoise blue, cryptocrystalline alterations of uraninite and associated with heterogenite, becquerelite, curite and rutherfordine, in the Shinkolobwe deposit, Shaba province (Piret and Deliens 1980a). The phase remains unique to Shinkolobwe.

Complainite

A misprint for comblainite appearing in the index to volume 31 of Mineralogical Abstracts (1980).

Cornetite Cornetite group

$Cu^{2+}{}_3(PO_4)(OH)_3$

First described as small, blue crystals, associated with heterogenite and pseudomalachite, in fine-grained sandstone from the Star of the Congo mine, Shaba province (Buttgenbach 1917). The crystal structure of cornetite was established by Ungemach (1929) though a more recent refinement is given by Berry (1950).

Th mineral was apparently first recorded from the Bwana Mkubwa mine, Copperbelt province, Zambia, in 1910 (in Reeve 1963) which was later fully described by Hutchinson and Macgregor (1931).

The name cornetite should not be confused with corneite, a rock term of Michot (1959-1960) or perhaps with the ornetite, a spelling variant oruetite (Koechlin 1911).

Cousinite

$Mg(U^{6+}O_2)_2(MoO_4)_2(OH)_2 \cdot 5H_2O$

Recorded as black thin blades, on altered ore containing uraninite and molybdenite at Shinkolobwe, Shaba province (Vaes 1958). Cousinite is associated with wulfenite. The status remains uncertain and is doubtless identical to a variety of umohoite.

Cupro-asbolane

Initially described from the Kambove deposit, Shaba province (de Leenheer 1938b). The phase contains 20.78 wt% CuO and 13.40 wt% Co_2O_3. Cupro-asbolane is considered to be a member of the psilomelane group. The mineral is a cobaltian-cuprian wad.

Cupro-asbolite

A spelling variant of cupro-asbolane from Kambove, Shaba province (de Leenheer 1938b).

Cuproplatine

A name given to presumably a copper-bearing platinum from placers of the Lubero district, Kivu province (Caron et al., 1986). There appears to be no earlier recording of this name in any of the established literature.

Cuprosklodovskite

The original spelling of cuprosklodowskite (Buttgenbach 1933b).

Cuprosklodowskite

* $Cu[(UO_2)_2(SiO_3OH)_2] \cdot 6H_2O$ (1975)

First described as yellowish-green needles in the Kambove and Kalongwe deposits, Shaba province (Buttgenbach 1933b).

Refined crystal data for cuprosklodowskite are given by Melon and Dejace (1959) and Rosenzweig and Ryan (1975)*. Crystal chemistry studies on uranyl silicates, by Stohl and Smith (1981) place cuprosklodowskite in a group in which the U:Si ratio is 1:3. The composition of cuprosklodowskite has more recently been revised by Smith (1984).

Cuprosklowdowskit

An erroneous spelling variant of cuprosklodowskite from Shaba province (Betechtin 1971).

Cuprosklowskite

A spelling variant of cuprosklodowskite (Buttgenbach 1933b).

Curite

$Pb^{2+}{}_2U^{6+}{}_5O_{17} \cdot 4H_2O$

Initially found as orange-yellow, acicular crystals and crystal aggregates from the Shinkolobwe uranium deposit, Shaba province (Shoep 1921). Further studies on bequerelite were made by Billiet (1926). More recent X-ray powder data for curite are provided by Deliens (1977b) whereas its crystal structure has more recently been redetermined by Mereiter (1979).

Curite commonly occurs either as pseudomorphs after uraninite at Shinkolobwe (Vernadsky and Chamie 1924; van Aubel 1927; Schoip 1930; Hacquaert 1927a, 1927b) or as a constituent of colloform 'gummite' crusts (Schoep and de Leenheer 1937).

Delhayelite Delhayelite group

$(Na,K)_{10}Ca_5Al_6Si_{32}O_{80}[Cl_2F_2(SO_4)]_3 \cdot 18H_2O$

Delhayelite was first recorded as colourless, platy crystals in kalsilite-melilite-nephelinite lava from Mount Shaheru, the extinct southern cone of Mount Nyiragongo, Kivu province (Sahama and Hytonen 1959). Minerals of the delhayelite group are reviewed by Dorfman and Chiragov (1986).

Hydrodelhayelite, a hydrated alteration product of delhayelite is recorded from the Khibina alkaline massif, Kola, USSR (Dorfman and Chiragov 1979).

Demesmaekerite

$Pb^{2+}{}_2Cu^{2+}{}_5(U^{6+}O_2)_2(Se^{4+}O_3)_6(OH)_6 \cdot 2H_2O$

Initially found as bottle-green, crystalline material, in the lower part of the oxidation zone within altered dolomites of the Musonoi copper-cobalt deposit, near Kolwezi, Shaba province (Cesbron *et al.*, 1965). Demesmaekerite occurs with cuprosklodowskite, kasolite, malachite, chalcomenite, guilleminite, chalcocite and selenian digenite. The structure of demesmaekerite has

since been refined by Ginderow and Cesbron (1983). The phase remains unique to Musonoi.

Derriksite

$$* Cu^{2+}_4(U^{6+}O_2)(Se^{4+}O_3)_2(OH)_6$$

Described by Cesbron *et al.* (1971) as rare green microcrystalline crusts on selenian digenite in the lower part of the oxidation zone at Musonoi, Shaba province. Derriksite occurs with demesmaekerite and chalcomenite and remains unique to Musonoi.

The essential water molecule given in the original formula is in fact absorbed and not bonded (Ginderow 1983) and the composition is revised accordingly*.

Dewindtite

$$Pb^{2+}(U^{6+}O_2)_2(PO_4)_2 .3H_2O$$

Described by Schoep (1922a) from the Shinkolobwe uranium deposit, Shaba province, where it occurs as a canary yellow powder, associated with torbernite, dumontite and kasolite. Stasite described by Schoep (1922b) was considered to be dimorphous with dewindtite. Schoep (1925b) later reviewed the physical properties and mineral chemistry of dewindtite.

The validity of type dewindtite is doubted by Ross (1956) who considers the phase to be a possible mixture of lead autunite and renardite.

In fact dewindtite is a true mineral species whereas renardite is a mixture of sheets of dewindtite and of phosphuranylite (Piret *et al.*, in press).

Diderichite

The phase was named and described by Vaes (1947a) from the Shinkolobwe deposit, Shaba province, where it occurs as yellow-green, fibrous crusts and laths. Diderichite is identical to rutherfordine (Frondel and Meyrowits 1956).

Droogmansite

Droogmansite occurs as small orange-yellow globules with sklodowskite and curite in the Kasolo Hill extension of the Shinkolobwe deposit, Shaba province (Buttgenbach 1925). The mineral appears to be related to sklodowskite and remains inadequately described. Droogmansite is identical to kasolite. (Deliens, 1978).

Dumontite

$$* Pb^{2+}_2[(U^{6+}O_2)_3O_2(PO_4)_2] .5H_2O$$

Dumontite is the phosphate analogue of hügelite and initially found as ochre-yellow crystalline material in the Shinkolobwe uranium deposit, Shaba province (Schoep 1924g) occurring with parsonsite and metatorbernite. Studies on dumontite were continued by Billiet (1926). Thoreau *et al.* (1958) have confirmed the composition of dumontite and its crystal structure has since been revised by Piret and Piret-Meunier (1988)*.

Epiianthinite

Initially described as yellow crystals from the Shinkolobwe deposit, Shaba province (Schoep and Stradiots 1947). The mineral is either identical to wyartite (Guillemin and Protas 1959) or schoepite. X-ray spectra of most epiianthinite are identical to those of schoepite (M. Deliens, pers. comm.).

Epijanthinit

A spelling variant of epiianthinite given by Hintze (1937)

Eylettersite Crandallite group

$$(Th^{4+},Pb)Al_3(PO_4)(SiO_4)(OH)_6$$

Crandallite-Eylettersite series

Eylettersite is the thorium analogue of crandallite and is recorded as creamy-white, pulverulent nodules in the Kobokobo pegmatite, Kivu province (van Wambeke 1972). The phase is associated with cyrtolite, columbite, apatite and phosphuranylite and, thus far, remains unique to Kobokobo.

Eylettersite I

A name given to altered eylettersite from the Kobokobo pegmatite, Kivu province (van Wambeke 1972).

Eylettersite II

A name given to an additional alteration product of eylettersite from the Kobokobo pegmatite, Kivu province (van Wambeke 1972).

Florencite-(La) Crandallite group

$$(La, Ce)^{3+}Al_3(PO_4)_2(OH)_6$$

Florencite-(La) is the lanthanum analogue of crandallite, initially described as a lanthanum-rich florencite by Lefebvre and Gasparrini (1980) in altered siltstones of the Shituru copper deposit, Shaba province. The phase remains unique to Shituru.

Fourmarierite

$$Pb^{2+}U^{6+}_4O_{13} .4H_2O$$

Originally described as reddish-orange to carmine-red crystals from the Shinkolobwe uranium deposit, Shaba province, (Buttgenbach 1924b; Melon 1924; Schoep 1924d). Fourmarie-

rite from Shinkolobwe occurs as alteration pseudomorphs after uraninite, along with torbernite and kasolite.

Studies on fourmarierite were continued by Billiet (1926). with Brasseur (1948) suggesting the formula $PbO.4UO_3.7H_2O$. Toussaint and Brasseur (1959) gave further structural data, though more recent X-ray powder values for fourmarierité are provided by Deliens (1977b).

Francoisite-(Nd)

$(Nd,Y,Sm,Ce[(U^{6+}O_2)_3O(OH)(PO_4)_2]\ .6H_2O$

Francoisite-(Nd) was described by Piret *et al.* (1988) from uraniferous pockets in the Kamoto copper-cobalt deposit, near Kolwezi, Shaba province. Francoisite-(Nd) occurs as yellow aggregates of tabular crystals and remains unique to Kamoto.

Gallite Chalcopyrite group

$Cu^{2+}Ga^{2+}S_2$

Gallite, the gallium analogue of chalcopyrite, is the first recorded gallium mineral. The mineral was initially described by Strunz *et al.* (1958b) from the Prince Leopold mine, Kipushi, Shaba province and from Tsumeb, Namibia.

Gallite, the unnamed mineral-(O) of Strunz *et al.* (1958a) is regarded by Ramdohr (in Ramdohr 1980) as a Ga^{3+} sulphide.

Gerhardite

An erroneous spelling of gerhardtite (Wells and Penfield 1885) given in de Kun (1965) with reference to the Shaban copper deposits.

Götzenite Seidozerite group

$Na_2Ca_5Ti^{4+}(Si_2O_7)_2F_4$

Götzenite-Rosenbuschite series

Götzenite was originally described by Sahama and Hytonen (1957a) from Mount Shaheru, the extinct southern cone of Mount Nyiragongo, Kivu province. Götzenite from the type locality occurs as colourless, prismatic, sub-millimetric crystals in ipinitic nephelinite lavas. The composition of götzenite has since been refined by Sahama *et al.* (1966). Götzenite forms an isomorphous series with rosenbuschite (Neumann 1962) thereby representing the titanium end-member. The phase is also isostructural with hainite (Johan and Cech 1989).

Calcium rinkite (Borneman-Starynkevick 1935) is a rare-earth-niobian-strontian götzenite (Sahama 1960). Similarly, turite (Kukharenko *et al.*, 1965) is redefined as a cerian götzenite.

Guileminite

A misprint of guilleminite given by Roberts *et al.* (1990) under the marthozite type-entry.

Guilleminite

$Ba(U^{6+}O_2)_3(Se^{4+}O_3)_2(OH)_4\ .3H_2O$

Originally found as canary yellow coatings, silky masses and tabular crystals in geodes in the oxidation zone within altered dolomites of the Musonoi copper-cobalt deposit, Shaba province (Pierrot *et al.*, 1965).

The phase is also recorded from Shinkolobwe (Gautier *et al.*, 1989) and a guilleminite-type mineral of similar composition occurs in pitchblende veins from the Liauzun-en-Olloix granite, Puy-de-Dôme, France (Agrinier *et al.*, 1966).

Gysinite

A name initially given by Sarp and Bertrand (1985) to a rare earth-bearing carbonate from Shinkolobwe. The mineral has since been renamed gysinite-(Nd) in accordance with the Levinson Rule (see Nickel and Mandarino 1988).

Gysinite-(Nd)

$Pb^{2+}(Nd,La)^{3+}(CO_3)_2(OH)\ .H_2O$

Gysinite-(Nd) is the renamed gysinite and corresponds to the lead-neodymium analogue of ancylite. The mineral was first described by Sarp and Bertrand (1985) from the Shinkolobwe uranium deposit, Shaba province, where it occurs as light pink to reddish pink, millimetric euhedra, with malachite, schuilingite-(Nd) cerussite, talc-chlorite, bornite, wulfenite, kasolite, garnet and gold. The true locality is, however, Kasompi, Shaba, Zaire, as determined from the associated minerals (M. Deliens, pers. comm.).

Gysinite-(Nd) is also described from Sardinia, Italy (Olmi *et al.*, 1988).

Heterogenite-H

Presumably a synonym for heterogenite-2H from the Mindigi deposit, Shaba province, mentioned by Deliens and Goethals (1973).

Heterogenite-2H

$(Co^{2+},Ni^{2+})O(OH)$

Heterogenite-2H is the hexagonal dimorph of heterogenite-3R and initially described from the Mindigi deposit, Shaba province (Deliens and

Goethals 1973). Heterogenite-2H with a nickel content much less than that of the type material is also recorded from New Caledonia (Llorca 1986).

Hydrotenorite

A phase originally described from l'Etoile du Congo mine, Shaba province (de Leenheer 1937). The mineral appears to be a mixture of tenorite, chrysocolla and water. Billiet and Vandendriessche (1938) suggest that hydrotenorite is identical to tenorite.

Ianthinite (of Bignand)

An ianthinite-type phase described by Bignand (1955) from the Shinkolobwe deposit, Shaba province. The mineral is identical to wyartite (Guillemin and Protas 1959).

Ianthinite (of Schoep)

$U^{4+}U^{6+}{}_5O_{17}\ .10H_2O$

Described by Schoep (1925c, 1926a, 1926c) as violet to black crusts and veinlets in altered uraninite from the Shinkolobwe uranium deposit, Shaba province (see also Guillemin and Protas 1959a, 1959b).

Ianthite

An error for the ianthinite (of Schoep) from Shinkolobwe, given by English (1939).

Iianthinit

Another spelling variant of ianthinite (of Schoep) appearing in Hintze (1937).

Janthiniet (Janthinit)

The original Flemish spelling of ianthinite (of Schoep) from Shinkolobwe.

Juliënite

$Na_2Co^{2+}(SCN)_4\ .8H_2O$

Juliënite occurs as thin crusts of minute blue, acicular crystals, associated with Co-rich wad, in the Chamibumba (Shamitumba) deposit, Kambove district, Shaba province (Schoep 1928b, 1931). Further studies on juliënite were carried out by Cuvelier (1933) and Schoep and Billiet (1934a, 1934b). Originally and erroneously regarded as the cobalt analogue of buttgenbachite; the composition was more correctly deduced by Cuvelier and de Sweemer (1932) and de Sweemer (1933). The phase remains unique to Chamibumba and is compositionally unique, being the first and, thus far, only recorded naturally-occurring thiocyanide.

The name should not be confused with julianite (= tennantite) of Dana (1892).

Kalipyrochlore Pyrochlore group

$(K,Sr,Na)_2(Nb,Ti)_2O_6(O,OH)\ .nH_2O$

Pyrochlore subgroup

Originally recorded as an unnamed phase by van Wambeke (1965) from the Lueshe carbonatite, Kivu province. The mineral was found as millimetric octahedra with ilmenite, barian goyazite and rutile in both the carbonatite and the adjacent alluvium and residual soils. The phase corresponds to the potassium analogue of pyrochlore and named accordingly by Hogarth (1977). The phase remains unique to Lueshe.

Kamitugaïte

$Pb^{2+}Al(U^{6+}O_2)_5(PO_4)(AsO_4)(OH)_9\ 9.5H_2O$

Kamitugaite was described by Deliens and Piret (1984a) as thin, yellow transparent tablets in the oxidation zone Kobokobo pegmatite, Kivu province where it occurs with triangulite, threadgoldite, dumontite and studtite. The phase remains unique to Kobokobo.

Kamotoïte-(Y)

$(U^{6+}O_3)_4(Y,Nd,Gd,Sm,Dy)^{3+}{}_2(CO_3)_3\ 4.5H_2O$

Described by Deliens and Piret (1986b) from the Kamoto copper-cobalt deposit, Shaba province, where it occurs as bright yellow crusts on a uraninite matrix. The mineral is also recorded from a pegmatite in Norway (M. Deliens, pers. comm.).

Kasolite

$Pb^{2+}(U^{6+}O_2)(SiO_4)\ .H_2O$

Kasolite-Uranophane series

Kasolite was first found as ochre-yellow, flakes in the Shinkolobwe deposit, Shaba province (Schoep 1921b).

Further studies on kasolite were made by Buttgenbach (1922) and Billiet (1926). Sidorenko *et al.* (1975) suggest that kasolite belongs to one of three groups of uranyl silicates, in which the $UO_2/[SiO_4]^{4-}$ ratio is given as unity; however, more recent studies on uranyl silicates, by Stohl and Smith (1981) place kasolite in a group in which the U:Si ratio is 1:3.

Pilbarite, from the Wodgina pegmatites, Western Australia (Simpson 1910) is a mixture containing kasolite (Honea 1957).

The name kasolite should not be confused with kasoite (see Spencer 1937) - a barian feldspar.

Katangite

Katangite was originally described from the Tantara deposit, Shaba province, Buttgenbach (1921) and initially thought to be identical to chrysocolla. Further studies on katangite were carried out by Schoep (1930c) who compared the phase to bisbeeite. Katangite is identical to either plancheite or chrysocolla (van Oosterwyck-Gastuche 1974, 1977).

The name katangite should not be confused with katungite, the alkali ultrabasic volcanic rock of Holmes (1937).

Keno-eylettersite

A name suggested by van Wambeke (1971) for relatively unaltered eylettersite from the Kobokobo pegmatite, Kivu province. The term keno- is taken from a proposal by Permingeat (*in* van Wambeke 1971) who suggests it as a prefix modifier for cation deficient members belonging to the pyrochlore group.

Keno-mitridatite Zaire/Rwanda

A name suggested by van Wambeke (1971) for relatively unoxidised mitridatite from the Kobokobo pegmatite, Kivu province and the Buranga pegmatite (Rwanda). The term keno- is taken from a proposal by Permingeat (*in* van Wambeke 1971) who suggests it as a prefix modifier for cation deficient members belonging to the pyrochlore group.

Kipushite

$(Cu^{2+},Zn)_5Zn(OH)_6(PO_4)_2 .H_2O$

Kipushite-Phillipsburgite Series

Originally described from the Kipushi copper deposit, Shaba province (Buttgenbach 1926a, 1927, 1932). The mineral was later thought by Buttgenbach (1941) to be arakawaite (= veszelyite). Kipushite is reinstated as a distinct species (Piret *et al.*, 1985) on material from the Kipushi mine; the phase occurs with pseudomalachite, hemimorphite, malachite, pyromorphite, veszelyite, vauquelinite and libethenite.

Braithwaite and Ryback (1988) record a slightly arsenatian kipushite from the Black Pine mine, Phillipsburg, Montana and a highly arsenatian kipushite is reported from Potts Gill, Caldebeck Fells, Cumbria, England. Braithwaite and Ryback further suggest the existence of a solid solution series between the arsenate analogue philipsburgite (Peacor *et al.*, 1985) and kipushite.

Kirchsteinite

A misprint of kirschsteinite appearing under the iron monticellite entry of Roberts *et al.* (1990).

Kirschsteinite Olivine group

$Ca(Fe^{2+},Mg)(SiO_4)$

Kirschsteinite-Monticellite series

Kirschsteinite is the name given by Sahama and Hytonen (1957b) to a mineral approaching the Fe^{2+} end-member of the monticellite-$CaFe^{2+}SiO_4$ series. The phase occurs in melilite-nephelinite lavas from Mount Shaheru, Kivu province, where it occurs as slightly greenish, massive material associated with kalsilite, götzenite and combeite. The type material is a magnesian variety containing between 50 mol% and 76.5 mol% kirschsteinite.

Magnesian kirschsteinite (containing ~51 mol% kirschsteinite) is recorded from the Tazheran Massif, Transbaikalia, USSR (Konev *et al.*, 1970) and in the Angra dos Reis achondrite meteorite, Brazil (Prinz *et al.*, 1977).

An unusual, semi-natural occurrence of kirschsteinite is recorded from residues of a salt horizon of the Salado Formation, near Carlsbad, New Mexico (Kahn and Smith 1966).

Kivuïte Phosphuranylite group

$(Th^{4+},Ca,Pb)H_2(U^{6+}O_2)_4(PO_4)_2(OH)_8 .7H_2O$

Kivuite is the thorium analogue of both phosphuranylite and renardite. The phase was first described by van Wambeke (1958b, 1958c) as minute, yellow plates, in the Kobokobo pegmatite, Kivu province; kivuite occurs with uraninite, phosphuranylite, renardite, cyrtolite, columbite-tantalite (columbotantalite) and apatite. A plumbian kivuite is also recorded from Kobokobo. The phase remains unique to the deposit.

The name should not be confused with kivite, a melanocratic leucite-basanite from the Birunga volcanic field, Zaire (Finchk 1912; Lacroix 1923).

Kobokobite

Frondelite-Rockbridgeite series

Kobokobite occurs as dull green crusts of radiating fibres and masses in the Kobokobo pegmatite, Kivu province (Thoreau 1957). The phase is regarded as an intermediate member of the frondelite-rockbridgeite series having $Fe^{2+} = Mn^{2+}$, though is perhaps identical to rockbridgeite.

Koluezite

A spelling error for kolwezite, from the type-occurrence, appearing in volume 33 (82M-1807) of Mineralogical Abstracts (1982).

Kolwezite Rosasite group

$(Cu^{2+},Co^{2+})_2(CO_3)(OH)_2$

Kolwezite-Rosasite series

Kolwezite is the cobalt analogue of rosasite and glaucosphaerite. The mineral was first described by Deliens and Piret (1980) from the Kolwezi-Kamoto-Musonoi deposit, Shaba province. Kolwezite occurs as black, microcrystalline crusts and pale brown, millimetric, isolated spherules, associated with cobaltoan dolomite.

Kolwezite is also recorded in oxidised ore of the Tuckers Tunnel uranium deposit, near Durango, Colorado (Williams 1982).

Kusuïte

A name originally given to a rare earth vanadate from the Kusu deposit (Deliens and Piret 1977). The phase is redefined by Deliens and Piret (1986a) as a plumboan variety of wakefieldite-(Ce) in accordance with the Levinson rule for the rare earth-bearing minerals.

Lead-becquerelite

An unnecessary name given by Frondel and Cuttitta (1953) to plumboan becquerelite from the Shinkolobwe deposit, Shaba province.

Lead microlite

An unfortunately-used synonym for plumbomicrolite from the Mumba district, Kivu province (Sayad Eid and von Knorring 1976).

Lepersonnite

A name initially given by Deliens and Piret (1982a) to a rare earth-bearing mineral from Shinkolobwe. Renamed lepersonnite-(Gd) in accordance with the Levinson Rule for rare earth minerals (Nickel and Mandarino 1988).

Lepersonnite-(Gd)

$Ca(Gd,Dy,Y,Tb)^{3+}{}_2U^{6+}{}_{24}(CO_3)_8(Si_4O_{76})\ .6H_2O$

First found as bright yellow, mammillary crusts and isolated spherules consisting of radiating acicular crystals with bijvoetite-(Y) in the Shinkolobwe uranium deposit, Shaba province (Deliens and Piret 1982a). Lepersonnite-(Gd) is the renamed lepersonnite. The phase remains unique to the type-locality.

Li-biotite

An abbreviated form for lithian biotite appearing in the index of Mineralogical Abstracts (1961-1962) and referring to a phase from the Manono pegmatite, Shaba province (Herman *et al.*, 1960-1961). There appears to be no recording of this name in any of the established literature.

Likasite

* $Cu^{2+}{}_3(OH)_5(NO_3)\ .2H_2O$

First described as blue, tabular crystals on cuprite, or bottle-blue masses in cuprite, from the Likasi deposit, Shaba province (Schoep *et al.*, 1955); likasite may be pseudomorphed by malachite. Originally regarded as a phosphate-nitrate, but the composition of likasite has since been revised by Effenberger (1986)*.

Declerq *et al.* (1977) suggested the presence of the phosphite (P^{3-}) radical in likasite, though this has been discounted by Fleischer and Cabri (1978).

A likasite-like mineral is recorded from Pitkin county, Colorado (Rouse 1982) but otherwise the phase remains unique to Likasi.

[?] *Lithiophyllite*

A spelling misprint for lithiophilite from the Kobokobo pegmatite, Kivu province (Safiannikoff and van Wambeke 1967).

Lubumbashite

Described from the Lubumbashi area, Shaba province (de Leenheer 1934a, 1934b). The phase is identical to heterogenite.

Ludjibaïte

$Cu^{2+}{}_5(PO_4)_2(OH)_4$

A dimorph of pseudomalachite occurring as blue-green blades, forming crest-like aggregates on deep green pseudomalachite in red micaceous shale at Ludjiba, Zaire, with libethenite (Piret and Deliens 1988).

Lueshite $NaNb^{5+}O_3$ Perovskite group

Lueshite - Perovskite series

Lueshite is a dimorph of natroniobite (Bulakh *et al.*, 1960) and initially described by Safiannikoff (1959) from the contact zone of the cancrinite syenite and pyrochlore-rich carbonatite at Lueshe, Kivu province. The mineral occurs as black, centimetric cubes and as encrustations on yellow mica.

Lueshite is identical to the earlier described igdloite, an inadequately characterised mineral from Igdlunguaq, Greenland (Dano and Sorensen 1959). The name lueshite has priority. A titanian variety (titanium lueshite) containing 17.47-22.18% TiO_2 is recorded from the Kovdor massif, USSR (Lapin and Kazakova 1966), and represents

an intermediate member of the lueshite-perovskite series.

The name lueshite should not be confused with either luetheite, the hydrated copper-aluminium arsenate phase of Williams (1977) or its erroneous spelling variant luethite, which appears in volume 30 of Mineralogical Abstracts (1979).

Lumbumbashite

A spelling variant of lubumbashite given by Hey (1955).

Lusungite Crandallite group

$(Sr,Pb^{2+})Fe^{3+}_3(PO_4)_2(OH)_5 .H_2O$

Lusungite is described as dark brown, pulverulent masses, associated with goethite and quartz, in the phosphate-rich zone of the Kobokobo pegmatite, Lusungu River district, Kivu province (van Wambeke 1958a). Lusungite is isostructural with hidalgoite, svanbergite and plumbogummite. The phase remains unique to Kobokobo.

Marthozite

$Cu^{2+}(U^{6+}O_2)_3(Se^{4+}O_3)_3(OH)_2 .7H_2O$

Described by Cesbron *et al.* (1969) as yellowish-green to greenish-brown microcrystals, associated with uranophane, kasolite, malachite, chalcomenite, sengierite and several other uranyl selenites, in the oxidation zone within altered dolomites of the Musonoi copper-cobalt deposit, Shaba province. The phase remains unique to Musonoi.

Masuyite

$Pb^{2+}_3U^{6+}_8O_{27} .10H_2O$

Masuyite was originally described as orange-red scales in cavities within uraninite from below the 57 metre-level of the Shinkolobwe uranium deposit, Shaba province (Vaes 1947a). Masuyite occurs with uranophane, sklodowskite and sharpite. More recent X-ray powder data for masuyite is provided by Deliens (1977b). Also occurs at Kamoto, Shaba.

Meta-saléeite

A name suggested by Mrose (1950) for type saleeite, which corresponds to meta-autunite-I. The name may be an unnecessary synonym for meta-autunite.

Metaschoepite

$U^{6+}O_3 .1\text{-}2H_2O$

Metaschoepite occurs as a yellow alteration product of schoepite in the Shinkolobwe uranium deposit, Shaba province (Christ and Clark 1960).

Metastudtite

$U^{4+}O_4 .2H_2O$

A natural peroxide mineral, first described from the Shinkolobwe uranium deposit, Shaba province (Deliens and Piret 1983b). Metastudtite is found as pale yellow, fibrous aggregates, in either grey dolomitic rock associated with wolsendorfite, or on massive uraninite associated with uranophane, kasolite and soddyite. The phase remains unique to Zaire.

Metavandendriesscheite

$Pb^{2+}U^{6+}_7O_{22} .<12H_2O$

Initially described from the Shinkolobwe uranium deposit, Shaba province (Christ and Clark 1960). The phase occurs as an alteration of vandendriesscheite and remains unique to Shinkolobwe.

Meta-vanmeerscheïte

A misprint for meta-vanmeersscheïte appearing in the 32nd list of new mineral names (Hey 1982).

Meta-vanmeersscheïte

$U^{6+}(U^{6+}O_2)_3(PO_4)_2(OH)_6 \div>2H_2O$

First described as canary-yellow tablets in the hydrothermal and supergene alteration zones of the Kobokobo pegmatite, Kivu province, associated with vanmeersscheïte and studtite (Deliens and Piret 1982a). The phase remains unique to Kobokobo.

Mindigite

Described by de Leenheer (1934a, 1934b) as pitch-black, glassy, botryoidal crusts from the Mindigi deposit, Shaba province. A manganoan mindigite is recorded from Kambove and Luashi, Shaba province (de Leenheer 1936). Billiet and Vandendriessche (1939) suggest that mindigite, together with trieuite and boodtite, are all varieties of a single species having the formula $(Co_2O_3\ CuO) .H_2O$. Mindigite is identical to heterogenite (Hey 1962c).

Moreauïte

$Al_3(U^{6+}O_2)(PO_4)_3(OH)_2 .13H_2O$

Moreauïte was first described from the uranium-rich portion of the Kobokobo pegmatite, Kivu province (Deliens and Piret 1985). Moreauïte occurs as nodules and books of greenish yellow tablets, associated with furongite, phosphosiderite and ranunculite. The phase remains unique to Kobokobo.

Mumbite

A name given by Stepanov *et al.* (1982) to pyrochlore from alluvials of the Mumba district, Kivu province. The name should not be confused with mundite of Deliens and Piret (1981a).

Mundite

$$Al(U^{6+}O_2)_3(PO_4)_2(OH)_3\ 5.5H_2O$$

Mundite is recorded as yellow, tabular crystals, associated with other aluminium uranyl phosphates, in the uranium-rich portion of the Kobokobo pegmatite, Kivu province (Deliens ans Piret 1981a). The phase remains unique to Kobokobo.

The name mundite should not be confused with mumbite of Stepanov *et al.* (1982).

Nickel cattierite

A name applied to a nickelian cattierite from Shinkolobwe, Shaba province (Derriks and Vaes 1956).

Oosterboschite

$$(Pd,Cu)_7Se_5$$

Oosterboschite was first described by Johan *et al.* (1970) from the oxidation zone of the Musonoi deposit, near Kolwezi, Shaba province. The phase occurs as polysynthetically-twinned, sub-millimetric grains, with palladian trogtalite, covellite and selenian digenite.

Oosterboschite is one of only two naturally-occurring palladium selenides so far recorded; the other phase is palladseite (Davis *et al.*, 1977). Phase relationships amongst the various palladium selenides have been studied by Olsen *et al.* (1979). Oosterboschite remains unique to Musonoi.

Oursinite

$$(Co^{2+},Mg)(U^{6+}O_2)_2Si_2O_7\ .6H_2O$$

Initially recorded as an unnamed phase from the Shinkolobwe deposit, Shaba province (Deliens and Piret 1982a). The mineral has now been fully characterised and named by Deliens and Piret (1983a). Oursinite occurs as pale yellow acicular crystals forming radial aggregates associated with soddyite, kasolite, schoepite, sklodowskite, torbernite, lepersonnite, bijvoetite and curite. Oursinite remains unique to the type-locality.

Paraschoepite

$$U^{6+}O_3\ .2H_2O$$

Initially described from the Shinkolobwe uranium deposit in Shaba province, as yellow crystals on schoepite (Schoep and Stradiot 1947). Paraschoepite is also recorded with arsenuranylite, in the oxidation zone of an unspecified deposit in the USSR (Belova 1958).

Parsmsite

A spelling error for parsonsite, from Shinkolobwe, listed in Embrey and Fuller (1980).

Parsonsite

$$Pb^{2+}(U^{6+}O_2)_2(PO_4)_2\ .2H_2O$$

Parsonsite is the phosphate analogue of hallimondite (Walenta and Wimmenauer 1961) and was first recorded as a brownish, crystalline powder, with metatorbernite, in the Shinkolobwe uranium deposit, Shaba province (Schoep 1923a, 1923c).

Chemical and crystal structure data for parsonsite are given by Frondel (1950).

Phuralumite

$$Al_2(U^{6+}O_2)_3(PO_4)_2(OH)_6\ .10H_2O$$

Phuralumite is found as sub-millimetric, lemon-yellow prismatic crystals, with meta-autunite, phosphuranylite and other aluminium uranyl phosphates, in the uranium-rich portion of the Kobokobo pegmatite, Kivu province (Deliens and Piret 1979b). The crystal structure of phuralumite has since been refined by Piret *et al.* (1979a) and is of the phosphuranylite type. Phuralumite remains unique to Kobokobo.

The name phuralumite should not be confused with the phurcalite of Deliens and Piret (1978) a hydrated calcium uranyl phosphate from East Germany.

Plancheite I

A name given by van Oosterwyck-Gastuche (1977) for plancheite from Tantara, Shaba province, that the now proves identical with shattuckite.

Plancheite II

A name given by van Oosterwyck-Gastuche (1977) for asbestiform plancheite from Tantara, Shaba province.

Plancheite III

A name given by van Oosterwyck-Gastuche (1977) for a variety of plancheite from Shaba province.

Plancheite X

A working name given by van Oosterwyck-Gastuche (1974) for a variety of plancheite from Tantara, Shaba province.

Plumbomicrolite Pyrochlore group

$(Pb^{2+}Na,Ca)_2(Ta,Nb,Ti)_2(O,OH)_7$

Microlite subgroup

Plumbomicrolite is the lead analogue of microlite, initially described from alluvial cassiterite deposits of the Mumba district, Kivu province (Safiannikoff and van Wambeke 1961). The phase occurs as greenish-yellow and orange crystalline masses and rare octahedra, associated with manganotantalite, microlite and simpsonite.

Plumbomicrolite is also recorded from the Mount Ploskaya amazonite pegmatite, Kola Peninsula, USSR (Stepanov *et al.*, 1984).

Protasite

$Ba(U^{6+}O_2)_3O_3(OH)_2 .3H_2O$

Protasite occurs as bright orange, pseudo-hexagonal, sub-millimetric platelets, associated with uraninite, at Shinkolobwe, Shaba province, (Pagoaga *et al.*, 1985). The crystal structure and crystal chemistry of protasite have since been redetermined by Pagoaga *et al.* (1987)*.

Rankamaite

$(Na,K,Pb^{2+},Li)_3(Ta,Nb,Al)_{11}(O,OH)_{30}$

Rankamaite-Sosedkoite series

Originally described from alluvials of the Mumba area, Kivu province, where it occurs as massive, white to creamy white, felted matrix, on corroded crystals of simpsonite and cassiterite, in water-worn pebbles to 100g (von Knorring *et al.*, 1969).

Rankamaite, the Na-hydrous analogue of sosedkoite (Voloshin *et al.*, 1984) is also described from pegmatites in the USSR.

Ranunculite

$(H_3O)Al(U^{6+}O_2)(PO_4)(OH)_3 .3H_2O$

Ranunculite was first described by Deliens and Piret (1979a) in the uranium-rich portion of the Kobokobo pegmatite, Kivu province. Ranunculite occurs as sub-millimetric, golden-yellow, nodules, with meta-autunite, phosphuranylite and a series of other aluminium uranyl phosphates. The phase remains unique to Kobokobo.

Renardite Phosphuranylite group

$Pb^{2+}(U^{6+}O_2)_4(PO_4)_2(OH)_4 .7H_2O$

Renardite is the lead analogue of phosphuranylite and was first found as yellow crystals in the shinkolobwe uranium deposit, Shaba province (Schoep 1928a).

The phase is now regarded as a mixture of sheets of dewindtite and phosphuranylite (Piret *et al.*, in press).

Renierite

$Cu^{2+}{}_{11}(Ge^{2+}As)Fe^{2+}{}_4S_{16}$

Briartite-Renierite series

Renierite was initially described as inclusions in chalcopyrite, sphalerite, galena and tennantite at the Prince Leopold mine, Kipushi, Shaba province.

The phase was first noted by Thoreau (1928) and described in detail as presumed 'orange bornite' or chalmersite by Legraye (1933). Renierite was fully characterised and named by Vaes (1948a). Bernstein (1986) suggests a coupled solid solution series between the zincian and arsenian end-members; the type material is presumably an arsenian variety.

The crystal structure of renierite has more recently been refined by Bernstein *et al.* (1989).

Zincian (to 1.23% Zn) arsenian (to 4.95% As) and gallian (to 0.56% Ga) varieties of renierite are recorded at Tsumeb (in Lombaard *et al.*, 1986). Arsenian and zincian varieties of renierite are also described from Ruby Creek, Alaska and Jamestown, Colorado (Bernstein op. cit.) and from the Furutobe mine (4.9% As) Japan (Hayashi *et al.*, 1985).

A series between briartite and renierite is suggested by Levy (1968). The name renierite should not be confused with reinerite of Geier and Weber (1958).

Richetite

$Pb^{2+}(U^{6+}O_2)_4O_5 .4H_2O$

Described as black hexagonal tablets, with uranophane, from below the 57 metre-level of the Shinkolobwe deposit, Shaba province (Vaes 1947a). Crystal structure data for richetite are given by Piret and Deliens (1984). Richetite remains unique to Shinkolobwe.

Roubaultite

$* Cu^{2+}{}_2(U^{6+}O_2)_3(CO_3)_2O_2(OH)_2 .4H_2O$

Roubaultite occurs as platy, green crystalline rosettes on uraninite in the Shinkolobwe uranium deposit, Shaba province (Cesbron *et al.*, 1970). Roubaultite occurs in the oxidation zone of the deposit, with becquerelite, vandenbrandeite, soddyite and cuprosklodowskite. The phase was originally described as a hydrated copper uranyl hydroxide but the composition has since been redefined by Ginderow and Cesbron (1985)*. Roubaultite is also recorded in dolomitic rocks of the Kamoto deposit, Shaba province (Deliens 1988). The phase remains unique to Zaire.

Saleite

The original, but erroneous, spelling of saléeite given by Thoreau and Vaes (1932) for the type material.

Saléeite Autunite group

$^{*}\ Mg(U^{6+}O_2)_2(PO_4)_2 \cdot 10H_2O$

Novacekite-Saléeite series

Saléeite is the phosphate analogue of novacekite and was first described under the name saleite from the Shinkolobwe uranium deposit, Shaba province (Thoreau and Vaes 1932). A series between saléeite and novacekite is suggested by Frondel (1951). Piret and Deliens (1980b) have noted that holotype saléeite dehydrates under normal atmospheric conditions; the decahydrate phase however is regarded as the fully-hydrated form, as earlier suggested by Mrose (1950) for material from Schneeberg.

Members of the saléeite-novacekite series, including an arsenatian saléeite, containing 4.5% As_2O_5, occur at Schneeberg, East Germany (Mrose 1950).

Sayrite

$Pb^{2+}{}_2(U^{6+}O_2)_5O_6(OH)_2 \cdot 4H_2O$

Described as yellow-orange to red-orange, prismatic crystals, with uranophane, becquerelite, masuyite and richetite, from the Shinkolobwe uranium deposit, Shaba province (Piret *et al.*, 1983). Sayrite remains unique to Shinkolobwe.

Schoepite

$U^{6+}O_3 \cdot 2H_2O$

Schoepite was initially described by Walker (1923) in altered uraninite ore from the Shinkolobwe uranium deposit, Shaba province. The phase occurs as minute yellow drusy or granular crystals, with becquerelite, curite and vandendriesscheite.

Further studies on schoepite were carried out by Buttgenbach (1924) and Schoep (1924a, 1924b, 1924c). Schoepite from Shinkolobwe may contain up to 4.56% PbO (Schoep 1924a). The crystal structure of schoepite has since been refined by Ungemach (1929) and Toussaint and Brasseur (1959).

Schoepite I

A name given to amber brown, unaltered schoepite from Shinkolobwe, Shaba province by Christ and Clark (1960).

Schoepite II

A name given to a yellow alteration product of schoepite from Shinkolobwe, Shaba province by Christ and Clark (1960); the phase is identical to metaschoepite.

Schoepite III

A completely-yellow alteration product of schoepite from Shinkolobwe, Shaba province is termed schoepite III by Christ and Clark (1960) which they consider to be identical to paraschoepite.

Schuilingite

A name originally given by Vaes (1947c) to a hydrated lead-coper-calcium hydroxyl-carbonate, from Kasompi. The phase has a substantial rare earth content and is renamed schuilingite-(Nd) on a re-evaluation of its composition by Piret and Deliens (1982b).

Schuilingite-(Nd)

$^{*}\ Pb^{2+}Cu^{2+}(Nd,Sm,Gd,Y)^{3+}(CO_3)_3(OH) \cdot 1.5H_2O$

Originally described by Vaes (1947c) from the Kasompi deposit, Shaba province. The phase occurs as turquoise to azure-blue, crystalline crusts, associated with cerussite, calcite and pyrite.

The validity of schuilingite-(Nd) as a distinct species was confirmed by Guillemin and Pierrot (1957). Originally described as a hydrated hydroxyl-carbonate of Pb, Cu and Ca; the composition was more recently redefined by Piret and Deliens (1982b)*. The phase apparently remains unique to Zaire.

Selenio-molybdenite

A name applied by Derriks and Vaes (1956) to a selenian molybdenite from the Shinkolobwe deposit, Shaba province. The name is also used by Vuorelainen and Hakli (1964) for selenian molybdenite from the Kuusamo district, Finland.

Seleniosiegenite (Selenio-siegenite)

Essentially a selenian siegenite, containing 11% Se, from the Shinkolobwe deposit, Shaba province (Vaes 1947b; Derriks and Vaes 1955). The name is also applied by Vuorelainen and Hakli (1964) to a selenian siegenite from the Kuusamo. district, Finland.

Seleniovaesite (Selenio-vaesite)

Essentially a selenian vaesite, containing 19% Se, from the Shinkolobwe deposit, Shaba province (Vaes 1947b; Derriks and Vaes 1955). The name is also applied by Vuorelainen and Hakli (1964) to a selenian vaesite from the Kuusamo district, Finland.

Selenium molybdenite

A name applied to the hypothetical selenium analogue of molybdenite, by Derriks and Vaes

(1956) to account for the selenium content of molybdenite from Shinkolobwe, Shaba province. The name is now a synonym of drysdallite.

Selenium-siegenite

A name given by Derriks and Vaes (1956) to presumably selenio-siegenite from Shinkolobwe, Shaba province.

Selenium-vaesite

A name given by Derriks and Vaes (1956) to presumably selenio-vaesite from Shinkolobwe, Shaba province.

Selenolinnaeite

An unnecessary name for selenian linnaeite from Shaba province (Cuvelier 1929). The name selenio-linnaeite is applied by Vuorelainen and Hakli (1964) to a selenian linnaeite from the Kuusamo district, Finland.

Sengierite Carnotite group

$Cu^{2+}{}_2(U^{6+}O_2)_2(VO_4)_2(OH)_2 .6H_2O$

Initially described as small green crystals from Luiswishi, Likasi district, Shaba province (Vaes and Kerr 1949); sengierite occurs with malachite, chrysocolla and vandenbrandeite. Piret *et al.* (1980)* have recently refined the crystal structure of sengierite.

Shabaite-(Nd)

$Ca(Nd,Sm,Y)_2(U^{6+}O^{2+})(CO_3)_4(OH)_2 .6H_2O$

Shabaite-(Nd) is described by Deliens and Piret (1989) from the Kamoto-East copper-cobalt deposit, Shaba province. Shabaite-(Nd) remains unique to the type-locality.

Sharpite

$Ca(U^{6+}O_2)_6(CO_3)_5(OH)_4 .6H_2O$

First described as yellowish-green, fibrous crusts from the Shinkolobwe deposit, Shaba province (Melon 1938). Sharpite occurs with uranophane, curite, becquerelite and masuyite and was initially regarded as an uranyl carbonate.

Shinkolobwite

A spelling variant of chinkolobwite (= sklodowskite) from the Shinkolobwe deposit and perhaps the more appropriate form.

Sklodowskite

$(H_3O)_2Mg(U^{6+}O_2)_2(SiO_4)_2 .4H_2O$

Sklodowskite was first described as citron yellow, crystalline aureoles to pitchblende within the upper oxidation zone in the Shinkolobwe deposit, Shaba province (Schoep 1924e, 1924f).

The phase was considered isomorphous with uranophane (Schoep 1927) and a comparison between uraonophane and sklodowskite is given by Billiet (1936). Gorman (1957) however, gives data that preclude complete isomorphism between uranophane and sklodowskite. Crystal structure data for sklodowskite are given by Mokeeva (1959) and Gevork'yan *et al.* (1979).

Soddite

The initial, but erroneous spelling of soddyite (Schoep 1922c) given to the type material.

Soddyite

$(U^{6+}O_2)_2(SiO_4) .2H_2O$

Initially described as pale yellow, fine-grained, crystalline material, intermixed with curite, metatorbernite, sklodowskite and kasolite, in the Shinkolobwe deposit, Shaba province (Schoep 1922c). Originally named soddite but corrected to soddyite by Billiet (1926).

Sidorenko *et al.* (1975) suggest that soddyite belongs to one of three groups of uranyl silicates, in which the ratio $UO_2/[SiO_4]^{4-}$ is >1. Crystal structure refinement for soddyite is given by Gevork'yan *et al.* (1979) and that for synthetic soddyite by Belokoneva *et al.* (1979).

Stainerite

An erroneous spelling of stainierite given by Rice (1955).

Stainierite

Stainierite was originally described from Mindigi, Shaba province, (Cuvelier 1929; Schoep 1930b) and regarded as the crystalline equivalent of heterogenite. Schoep and Cuvelier 1930) proposed the name stainierite and suggested the formula $(Co,Fe,Al)_2O_3 .H_2O$. De Jong (1930) has reviewed the mineral chemistry of stainierite. Hey (1962c) considers stainierite to be identical to heterogenite.

However, Orcel *et al.* (1958) regard stainierite as distinct from heterogenite, being of the brucite-type with the composition $Co(OH)_2$; Yakhontova and Gruder (1980) consider stainierite to be a valid species and recognise several polytypes (stainierite-2H and stainierite-3H) to which the general formula $HCoO_2$ can be applied.

Stasite

Initially considered to be a dimorph of dewindtite, occurring at Kasolo, Shaba province (Scheop 1922b). Stasite is identical to dewindtite (Schoep 1923a, 1923c).

Stilleite Sphalerite group

$ZnSe$

Stilleite is the selenium analogue of sphalerite and first described as massive, grey, metallic grains, associated with linnaeite, seleniovaesite, molybdenite and clausthalite and as inclusions in linnaeite and seleniovaesite in the Shinkolobwe deposit, Shaba province (Ramdohr 1956).

The sphalerite-stilleite isomorphous series is reviewed by Klemm (1961). A mercurian stilleite occurs at Cerro de Umango, Argentina (in Ramdohr 1980).

Studtite

$U^{4+}O_4.4H_2O$

First described as whitish-yellow to yellow, acicular crystals, associated with uranophane and rutherfordine in the Shinkolobwe uranium deposit, Shaba province (Vaes 1947a).

Originally thought by Vaes to be a hydrated uranium carbonate but later confirmed by Walenta (1974) as a hydrated peroxide (the first recording of a natural peroxide mineral).

Swamboite Uranophane group

$U^{6+}H_6[(U^{6+}O_2)(SiO_4)]_6 .3H_2O$

Occurs as very plate yellow, sub-millimetric needles on soddyite crystals, with curite and lining small cavities in de-calcified hematite sandstones, from the Swambo deposit, near Shinkolobwe, Shaba province (Deliens and Piret 1981). Swamboite remains unique to Swambo.

Tantalpolycrase

A name given to an inadequately-described phase from the Liha district (van Wambeke 1967).

Th-crandallite

An unnecessary name given to thorian crandallite from the Kobokobo pegmatite, Kivu province (van Wambeke 1971).

Thoreaulite

$Sn^{2+}Ta_2O_6$

Thoreaulite is the tantalum analogue of foordite and was first described from the Manono pegmatite, Shaba province (Buttgenbach 1933).

Maksimov *et al.* (1976) have refined the crystal structure of thoreaulite, largely confirming the previously published dimensions of the monoclinic cell. Nekrasov *et al.* (1982) suggest that tin is present as Sn^{4+} in thoreaulite.

Thoreaulith

A spelling variant of thoreaulite from the Manono pegmatite, given by Betechtin (1971).

Thorophosphuranylite

An unnecessary name for a thorian phosphuranylite from the Kobokobo pegmatite, Kivu province (van Wambeke 1958b).

Thororenardite

An unnecessary name for a thorian renardite from the Kobokobo pegmatite, Kivu province (van Wambeke 1958b).

Threadgoldite Autunite group

$Al(U^{6+}O_2)_2(PO_4)_2(OH) .8H_2O$

Meta-vanuralite-Threadgoldite series

Threadgoldite is the phosphate analogue of meta-vanuralite; the phase was described initially in the uranium-rich portion of the Kobokobo pegmatite, Kivu province (Deliens and Piret 1979c). Threadgoldite occurs as greenish-yellow micaceous, tabular, millimetric crystals with other aluminium uranyl phosphates. The torbernite-type crystal structure of threadgoldite was deduced by Piret *et al.* (1979b) and more recently refined by Khosrawan-Sazedji (1982).

Topasolite

A name given to topaz by de Khun (1965) with reference to material from the Mokaima deposit, Kailo district.

[?] *Torbenite*

A misprint for torbernite from Shinkolobwe, given in Deliens (1979).

Treadgoldite

An erroneous spelling of threadgoldite listed in the 32nd list of New Mineral Names (Hey 1982).

Triangulite Ranunculite group

$Al_3[(U^{6+}O_2)(PO_4)]_4(OH)_5 .5H_2O$

First described as bright yellow aggregates of flat triangular or rhombohedral crystals, associated with meta-autunite, beryl, metamict zircon, phsphuranylite, ranunculite and furongite in the quartz-feldspar-columbite zone of the Kobokobo pegmatite, Kivu province, (Deliens and Piret 1982b). The phase remains unique to Kobokobo.

Trieuite

$Co^{3+}{}_4Cu^{2+}O_7 .6H_2O$

A black, amorphous mineral occurring in the l'Etoile du Congo mine, Shaba province (de Leenheer 1935) and regarded as a cuprian heterogenite. Billiet and Vandendriessche (1939) suggest that trieuite, together with mindigite and boodtite, are all varieties of a single species having the formula $(Co_2O_3\ CuO) .H_2O$. Trieuite is identical to heterogenite (Hey 1962c).

Trikalsilite (Tri-kalsilite)

$(K,Na)AlSiO_4$

Trikalsilite occurs as colourless, massive, parallel growths, associated with nepheline and kalsilite in porphyritic lavas from Kabfumu, northern Kivu province, where it was first described by Sahama and Smith (1957c).

Trikalsilite is polymorphous with kalsilite, kaliophilite and tetrakalsilite. The crystal structure of trikalsilite has since been revised by Bonaccorsi *et al.* (1988). The phase remains unique to Kabfumu.

[?] *Triphyllite*

A misprint for triphylite from the Kobokobo pegmatite, Kivu province (de Kun 1965).

Upalite

$* Al[U^{6+}O_2)_3O(OH)(PO_4)_2] .7H_2O$

Found as amber-yellow, sub-millimetric needles associated with meta-autunite, phosphuranylite and other aluminium uranyl phosphates, in the uranium-rich portion of the Kobokobo pegmatite, Kivu province (Deliens and Piret 1979b). The phase remains unique to Kobokobo.

Revised crystal structure and compostional data are given by Piret and Declerq (1983)*.

The name upalite should not be confused with that of cupalite (Razin *et al.*, 1985) a naturally-occurring copper-aluminium alloy.

Urancalcarite

$Ca(U^{6+}O_2)_3(CO_3)(OH)_6 .3H_2O$

Urancalcarite occurs as bright yellow, acicular crystals, associated with uranophane, uraninite, wyartite and masuyite, in the Shinkolobwe deposit, Shaba province (Deliens and Piret 1984b). Urancalcarite remains unique to Shinkolobwe.

Uranolepidite

The mineral occurs as dark green, lamellar masses in the Shinkolobwe, deposit, Shaba province (Thoreau 1932, 1933). Uranolepidite is identical to vandenbrandeite (Schoep 1932).

Uranothorogummite

Described by (van Wambeke 1967) from the Mapembe pegmatite. Also recorded by van Wambeke from Kasika and Lueshe, Kivu province. Uranothorogummite is a uranian thorogummite.

Vaesite Pyrite group

NiS_2

Cattierite-Vaesite series.

Vaesite is the nickel analogue of pyrite and originally described from the Kasompi deposit, Shaba province (Kerr 1945). Vaesite occurs as grey, metallic cubes and octahedra, associated with pyrite and randomly disseminated in dolomite.

A ferrian-(cobaltian)-vaesite occurs with villamaninite at Carmenes, Spain (Hey 1962c). A cobaltian vaesite (17.0-17.8 wt% Co) occur in the Kalgoorlie district, Western Australia (Ostwald 1980).

The name should not be confused with vasite, a spelling variant of wasite (in Dana 1892).

Vandenbrandeite

$Cu^{2+}(U^{6+}O_2)(OH)_4$

Initially described as a dark green alteration product of uraninite from the Kalongwe deposit, Shaba province (Schoep 1932) associated with kasolite, sklodowskite and cuprosklodowskite. More recent compositional and crystal structure data are given by Milne and Nuffield (1951).

Vandenbrandeite is also recorded from the Shinkolobwe deposit where it was originally described as uranolepidite (Thoreau 1933). The phase is apparently unique to Zaire.

Vandenbrandite

A spelling variant of vandenbrandeite given in the 7th edition fo Dana's System of Mineralogy (Palache *et al.*, 1944).

Vandendriesscheite

$Pb^{2+}U^{6+}{}_7O_{22} .12H_2O$

Originally, from the Shinkolobwe uranium deposit, Shaba province, occurring as amber orange crystals associated with fourmarierite and rutherfordine (Vaes 1947a).

The crystal structure was later refined by Thoreau (1948) and Toussaint and Brasseur (1959). Deliens (1977b) has provided new X-ray powder data for vandendriesscheite.

Vandendriesscheite I

A name applied to vandendriesscheite from Shinkolobwe, by Christ and Clark (1960).

Vandendriesscheite II

A name applied to metavandendriesscheite from Shinkolobwe, by Christ and Clark (1960).

Vanmeerscheite

A misprint for vanmeersscheite appearing in the 32nd list of new mineral names (Hey 1982).

Vanmeersscheïte

$U^{6+}(U^{6+}O_2)_3(PO_4)_2(OH)_6 \cdot 4H_2O$

First described as canary-yellow tablets in the hydrothermal and supergene alteration zones of the Kobokobo pegmatite, Kivu province, associated with metavanmeersscheïte and studtite (Deliens and Piret 1982a). The phase remains unique to Kobokobo.

Varlamoffite

$* (Sn^{4+}Fe)(O,OH)_2$

Initially described from the Atondo deposit, Kalima district, where it occurs both as yellow, massive, earthy fillings in geodes lined with cassiterite and as pseudomorphs after stannite. The mineral, first thought to be cassiterite, was first noted by de Dycker and fully characterised and named by Buttgenbach (1947). The phase was earlier described from Bolivia as souxite (Herzenberg 1946) for which the formula $SnO_2\ nH_2O$ was given. Because the Zairean material was more fully investigated, the Bolivian phase is relegated to synonym status (Buttgenbach 1950).

Buttgenbach gave the formula as H_2SnO_3. Gastellier (1950) however suggest that the Fe^{3+} component of varlamoffite is of a structural nature and not due to admixed iron minerals as previously supposed. The composition of varlamoffite has since been revised by *Niggli (1953) who considers it to be a valid species on the basis of X-ray data though this has been queried by Alexander and Flinter (1965). Antun (1960) confirms varlamoffite as a distinct species and not a mixture.

Wakefieldite-(Ce) Xenotime group

$(Ce^{3+}, La^{3+}, Nd^{3+})VO_4$

Wakefieldite-(Ce) is the renamed kusuite and is the cerium analogue of wakefieldite-(Y). The phase was initially described from the oxidation zone of the Kusu deposit, 85km southwest of Kinshasa, Bas Zaire province (Deliens and Piret 1977; Deliens and Piret 1986a); associated minerals include mottramite, chervetite, cuprite, dioptase, heyite, malachite, plancheite and vanadinite. The type material is a plumboan variety.

A lead-free wakefieldite-(Ce) is recorded from Tifernine, Morocco (Baudracco-Gritti *et al.*, 1987).

Wyartite

$Ca_3U^{4+}U^{6+}O_2)_6(CO_3)_2(OH)_{18} \cdot 3\text{-}5H_2O$

Wyartite occurs as a black to velvet-black alteration product of wolsendorfite and uraninite, from the Shinkolobwe deposit, Shaba province (Guillemin and Protas 1959). Wyartite is the redefined ianthinite of Bignand (1955) and thus distinct from the ianthinite of Schoep (Destas *et al.*, 1958).
Two forms of wyartite have been observed by Clark (1960) which are accordingly designated wyartite I and II. The phase remains unique to Shinkolobwe.

Wyartite I

One of the two distinct forms of wyartite from the Shinkolobwe deposit, Shaba province observed by Clark (1960). Wyartite I is presumably the equivalent of wyartite.

Wyartite II

One of the two distinct forms of wyartite verified by Clark (1960) from the Shinkolobwe deposit. Wyartite II represents a variety of wyartite, in which there are changes to the internal structure, but no visible external changes.

Zairïte Crandallite group

$Bi^{3+}(Fe^{3+}Al)_3(PO_4)_2(OH)_6$

Zairïte is the ferric analogue of waylandite and initially described from the Etaetu deposit, Kivu province (van Wambeke 1975). Zairïte occurs as greenish masses in the weathering zone of the deposit, together with wolframite and an unnamed bismuth phosphate. The phase remains unique to the type locality.

Zn-tourmaline Tourmaline group

$NaZn_3Al_6B_3Si_6O_{27}(OH,F)_4$

A name appearing in the index of Mineralogical Abstracts (volume 16) and referring to the blue zincian elbaite described by Jedwab (1962) from pegmatites of the Muika district. This phase contains 2.85% ZnO.

The name is more recently used for the hypothetical zinc end-member of the tourmaline group by Sokolov *et al.* (1988) with reference to zincian tourmalines (containing up to 3.83% ZnO) from unspecified rare metal pegmatites in the USSR. The name may perhaps be retained for the hypothetical end-member.

3.2.- Type-Mineralogy of the Unnamed Phases

Thirteen unnamed phases are presented, several of these still remain uncharacterised.

Al-PO_4-hydrate

The phase occurs with mitridatite in the Kobokobo pegmatite, Kivu province (van Wambeke 1971).

Bi-PO_4

Occurs with zairite from the Etaetu deposit, Kivu province (van Wambeke 1975).

Ca-Mg-uranyl molybdate

Recorded by Deliens (1975b) from the Shinkolobwe deposit, Shaba province, where it occurs with iriginite, umohoite, wulfenite, zippeite and siegenite.

Co-Mg-Ni-uranyl silicate (= oursinite)

Recorded by Deliens and Piret (1982a) from the Shinkolobwe mine, Shaba province. The phase has now been fully characterised and is named oursinite (Deliens and Piret 1983a).

Cu-Cl

Recorded from emission spectrograms of flows from the Nyiragongo volcano, Kivu province (Herman *et al.*, 1960). Perhaps identical to tolbachite ($CuCl_2$) of Bergasova and Filatov 1983).

K-Co-F $KCoF_3$

Recorded as a sublimate from Nyiragongo, Kivu province (Herman *et al.*, 1960), though the mineral, in fact, may be a laboratory product. The phase is given as $KCaF_3$ in Mineralogical Abstracts.

K-Mg-F $KMgF_3$

Recorded as a sublimate from Nyiragongo, Kivu province (Herman *et al.*, 1960). The phase in fact, may be a laboratory product.

K-Zn-SO_4 $K_2Zn(SO_4)_2 .2H_2O$

Occurs as a sublimation product in the Rugarama cone, Nyamuragira volcano, Kivu province (Deliens 1975).

Mn-Co-Cu-oxide hydrate

$(Mn,Co)_2O_3\ CuO\ .3H_2O$

Recorded by de Leenheer (1936) with malachite from the Ruashi deposit, Shaba province.

Mn^{3+}-Mn^{4+}-Co-Cu-oxide hydrate

$3(Mn_2O_3\ MnO_2)Co_2O_3\ 3CuO\ .8H_2O$

Recorded by de Leenheer (1936) from the Kambove deposit, Shaba province.

K-analogue pyrochlore (= kalipyrochlore)

Recorded by van Wambeke (1965) from the alluvials and residuals deposits associated with the Lueshe carbonatite, Kivu province. The phase is now fully characterised and named kalipyrochlore (Hogarth 1977).

Sr-Fe-Pb-W-PO_4

A mineral of the goyazite-gorceixite group occuring as brown powdery coatings on diamond from alluvials of the Lowa Rive, Maniema district, Kivu province (Varlamoff 1964).

Wodginite-like mineral

A wodginite-like mineral is mentioned by von Knorring (1974) as occurring with simpsonite, rankamaite and cassiterite, in the Mumba area, Kivu province.

4.- TOPOGRAPHICAL MINERALOGY OF THE VALID TYPE-MINERALS

4.1.- Topographical Trends

A total of 292 valid type-minerals are documented from Africa, for the period 1838-1988 (Daltry in press); this number has now increased to 299, for the same period ending 1990. Zaire is the most productive country for African type-minerals as shown in Table 4.

Table 4.- Principle Countries for Approved African Type-Minerals

Position	Country	Number of type-phases
1	Zaire *	91
2	Namibia	59
3	South Africa	53
4	Morocco	15
5	Madagascar	11
6	Gabon	9
7	Kenya	7
7	Uganda	7
9	Zambia	6
9	Zimbabwe	6
10	Tanzania	5

The 91 approved Zairean minerals are described from 25 type-localities, mostly in Kivu provinces, as summarised in Table 5. The number of Zairean type-localities is the largest for any of the African countries.

Table 5.- Type-Locality Listing for Zaire

Type-Locality	Nos. of Valid Type-Phases	Type-Locality	Nos. of Valid Type-Phases
Shinkolobwe	33	Atondo	1
Kobokobo	14	Shamitumba	1
		Eta-Etu	1
Musonoi	5	Kabfumu	1
Nyiragongo-Shaheru	5	Kolwezi	1
		Kusu	1
Kipushi	4	Ludjiba	1
Kamoto-East	3	M'sesa mine, Kambove	1
Kasompi	3	Misobo Mount	1
		Shituru	1
Kalongwe	2	Etoile de Congo	1
Likasi	2	Swambo	1
Lueshe	2		
Luishwishi	2		
Monono	2		
Mumba	2		

The Shinkolobwe deposit is the most prolific producer of Zairean type-minerals, followed by the Kobokobo pegmatite and the Musonoi and Nyiragongo-Shaheru localities. Table 6 shows that the Shinkolobwe deposit is the second-most productive source in Africa for type-minerals. Kobokobo ranks 3rd and both the Musonoi and the Nyiragongo volcanic lava occurrences rank equal 8th, along with the Bou Azzer (Morocco) deposit.

Table 6.- Principle African Type-Localities

Rank*	Type-Locality Valid minerals	Number of
1	Tsumeb polymetallic deposit, Namiba	46
2	**Shinkolobwe U deposit, Zaire**	33
-	Bushveld igneous complex, RSA	15
3	**Kobokobo pegmatite, Zaire**	14
4	Mounana U-V deposit, Gabon	9
5	Bon Accord Ni deposit, RSA	7
-	Kimberley diamond pipes, RSA	6
6	Tachgagalt Mn deposit, Morocco	6
6	Kombat Fe-Mn deposit, Namibia	6
8	Bou Azzer Co-Ni deposit, Morocco	5
8	**Musonoi Cu-Co deposit, Zaire**	5
8	**Nyiragongo lavas, Zaire**	5
11	Antsakoa pegmatite, Madagascar	4
11	Bultfontein kimberlite, RSA	4
11	Rustenburg Pt mine, RSA	4

* out of 112 recorded African type-localities.

It should be emphasised that Shinkolobwe comprises two localities - the Shinkolobwe mine and the Kasolo Hill radium mine, some 2 km to the southwest. Both occurrences are part of the same deposit and thus collectively referred to as Shinkolobwe in this paper (see Schoep 1930a). Type-mineral listings for the more prominent of the Zairean type-occurrences is given in Table 7.

4.2.- Topographical Trends for the Unique Type-Minerals

Also indicated on Table 7 are those type-minerals which, thus far, remain unique to the respective type-locality (up to the time of publication); there are 39 such minerals for Zaire. The Table also shows that 13 type-minerals from the Kobokobo pegmatite are unique to the locality, as are 9 of the type-phases from Shinkolobwe.

Table 7.- Type-Mineral Listing for Selected Zairean Type-Deposits

Kamoto-East Co-Cu deposit

* Francoisite-(Nd)
Kamotoite-(Y)
* Shabaite-(Nd)

Kipushi Cu deposit

Briartite **
Gallite **
Kipushite
Renierite

Kobokobo pegmatite

* Althupite
* Eylettersite
* Kamitugaite
* Kivuite
* Lusungite
* Metavanmeersscheite
* Moreauite
* Mundite
* Phuralumite
* Ranunculite
Threadgoldite
* Triangulite
* Vanmeersscheite

Musonoi Cu-Co deposit

* Demesmaekerite
* Derriksite
Guilleminite
* Marthozite
* Oosterboschite
* Upalite

Nyiragongo-Shaheru lavas

* Andremeyerite
Combeite
Delhayelite
Götzenite
Kirschsteinite

Shinkolobwe U deposit

Becquerelite
* Bijvoetite-(Y)
Billietite
Cattierite
* Comblainite
Curite
Dewindtite
Dumontite
Fourmarierite
Ianthinite (Schoep)
Vandendriesscheite
Kasolite
* Lepersonnite-(Gd)
Masuyite
Metaschoepite
Metastudtite
* Metavandendriesscheite
* Oursinite
Paraschoepite
Parsonsite
* Protasite
Roubaultite
Saléeite
* Sayrite
Schoepite
Scharpite
Sklodowskite
Soddyite
Stilleite
Studtite
* Urancalcarite
* Richetite
* Wyartite

* *Remaining type-minerals unique to Zaire*

Cesplumtantite
Florencite-(La)
Julienite
Kalipyrochlore
Likasite
Trikalsilite
Ludjibaite
Swamboite
Zairite

* Unique to the type-locality
** Joint type-locality

Furthermore, the 3 type-minerals from Kamoto occur only at this locality and 4 of the 5 type-minerals from Musonoi are unique to that deposit. In addition 5 type-minerals still remain unique to Zaire in general: guilleminite, metastudtite, roubaultite, schuilingite-(Nd) and vandenbrandeite.

5.- MINERAL CHEMISTRY OF THE VALID TYPE-MINERALS

5.1.- Dominant Metal Cation Trends

Cesplumtantite, gallite, lepersonnite-(Gd), juliënite, lusungite, schuilingite and thoreaulite respectively represent the first Cs^{+-}, Ga^{2+-}, Gd^{3+}, Co^{2+-}, Sr^{2+-}, REE^{3+} (general) and Sn^{2+}-bearing African type-minerals. Gallite is also the first recorded gallium mineral. Zaire also has the largest assemblage of type-neodymium phases worldwide [viz: francoisite-(Nd) gysinite-(Nd) schuilingite-(Nd) and shabaite-(Nd)].

5.2.- Anionic Group Trends

The conventional chemical grouping of all approved Zairean type-species is presented in Table 8.

As shown the uranyl minerals predominate; 53 uranium-bearing type-species are recorded from Zaire, the most predominant groups being the uranyl phosphates and the uranyl oxide hydrates.

Seventeen of the 42 documented uranyl phosphate minerals were first described from Zaire. Twelve of these are from the Kobokobo pegmatite and represents the single largest assemblage of type-uranyl phosphates for any locality.

Furthermore, eleven of the Kobokobo type-phosphates are aluminium-uranyl species.

Fifteen of the 23 recorded uranyl oxide hydrates were first found in Zaire, 14 of which occur at Shinkolobwe. The uranyl oxide hydrate assemblage at Shinkolobwe is also the largest number of type-uranyl oxide hydrates for any single deposit worldwide.

There are 8 recorded type-uranyl carbonate minerals from Zaire. Four of these are rare earth-bearing phases and compositionally-unique to Zaire. The 4 type-uranyl selenites from Musonoi represent the total number of documented uranyl selenites in the mineral kingdom and is thus the single largest assemblage of its type anywhere in the world. Like-wise, studtite and metastudtite are the only representatives of naturally-occurring peroxide minerals and julienite is the only natural thiocyanide on record.

Table 8.- Chemical Group Classification of Zairean Approved Type-Minerals

Sulphide	*Sulphogermanides*	*Selenide*
Cattierite	Briartite	Oosterboschite
Gallite	Renierite	Stilleite
Vaesite		

Complex Oxide		*Hydroxide*
Cesplumtantite	Plumbomicrolite	Heterogenite-2H
Kalipyrochlore	Rankamaite	Varlamoffite
Lueshite	Thoreaulite	

Uranyl Oxide Hydrates		*Uranyl Peroxide Hydrates*
Becquerelite	Paraschoepite	Metastudtite
Billietite	Protasite	Studtite
Curite	Richetite	
Fourmarierite	Sayrite	
Ianthinite (Schoep)	Schoepite	
Masuyite	Vandenbrandite	
Metaschoepite	Vandendriesscheite	
Metavandendriesscheite		

Halogen Compounds	*Thiocyanide*	*Nitrate*
Buttgenbachite	Juliënite	Likásite
Claringbullite		

Carbonates	*Phosphates*	
Comblainite	Cornetite	Ludjibaïte
Gysinite-(Nd)	Eylettersite	Lusungite
Kolwezite	Florencite-(La)	Zairïte
Schuilingite-(Nd)	Kipushite	

Uranyl Carbonates	*Uranyl Phosphates*	
Bijvoetite-(Y)	Althupite	Parsonsite
Kamotoite-(Y)	Dewindtite	Phuralumite
Lepersonnite-(Gd)	Dumontite	Ranunculite
Roubaultite	Francoisite-(Nd)	Saléeite
Shabaite-(Nd)	Kamitugaite	Threadgoldite
Sharpite	Kivuite	Triangulite
Urancalcarite	Metavanmeersscheite	Upalite
Wyartite	Moreauite	Vanmeersscheite
	Mundite	

Vanadate	*Uranyl Divanadate*	*Uranyl Selenites*	*Tungstate*
Wakefieldite-(Ce)	Sengierite	Demesmaekerite	Anthoinite
		Derriksite	
		Guilleminite	
		Marthozite	

Silicates	*Aluminosilicates*	*Uranyl Silicates*
Andremeyerite	Trikalsilite	Cuprosklodowskite
Combeite		Kasolite
Delhayelite		Oursinite
Gotzenite		Sklodowskite
Kirschsteinite		Soddyite
		Swamboite

ACKNOWLEDGEMENTS

The author would like to acknowledge the use of Mineralogical Abstracts and Lists of New Minerals appearing in the various editions of Mineralogical Magazine and The American Mineralogist, during the compilation of this work. Thanks are also given to M. Deliens and A.-M. Fransolet for reviewing and improving the manuscript.

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