

**THE PÉRCIO DE MORAES BRANCO COLLECTION OF RARE MINERALS  
OF THE UNIVERSIDADE LUTERANA DO BRASIL (ULBRA).\*\***

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**ABSTRACT**

*The Mineral Collection of the Lutheran University of Brazil is one of the most valuable mineral collections of the South American Continent and consists of approximately 500 catalogued minerals of which about 200 can be classified as rare or very rare. The majority of them are present in paragenesis with other minerals in the form of euherdic, subherdic and anherdic crystals. The minerals come from different mineralogic provinces including Denmark, United States of America, Canada, Italy, Romania, Russia, Sweden, Brazil, Mexico, Chile, Slovenia, Germany, Algeria, England and others. The Collection is organized in mineralogical classes with the exception of meteorites, organic compounds and mineraloids and is found on permanent display and open to visitors in the Laboratory of Mineralogy, Building I, Central Campus of ULBRA in Canoas, RS, Brazil.*

**Keywords:** Rare Minerals, Mineralogic Provinces, Mineralogical Classes, Meteorites.

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\*\*This paper is dedicated to the 10<sup>th</sup> anniversary (1988-1998) of the Chemistry Course at ULBRA.

## RESUMO

*A coleção de minerais da Universidade Luterana do Brasil, constitui-se numa das mais valiosas coleções mineralógicas do Brasil, com aproximadamente 500 espécies catalogadas das quais, aproximadamente, 200 podem ser enquadradas como raras a muito raras. Grande parte das mesmas apresenta-se em paragênese com outros minerais, havendo cristais euédricos, subédricos e anédricos. Os minerais provêm de diversas províncias mineralógicas, como Dinamarca, Rússia, Estados Unidos da América, Canadá, Itália, Romênia, Brasil, México, Suécia, Chile, Argentina, Alemanha, Argélia e Inglaterra, entre outras. A Coleção encontra-se sistematizada em classes mineralógicas, com exceção dos meteoritos e mineralóides, estando em exposição permanente na sala 127 - Prédio I (Laboratório de Mineralogia) da ULBRA, Campus de Canoas.*

## INTRODUCTION

The purpose of this paper is to stimulate the collection of minerals and present reasons that we consider of importance in this activity. In addition, this paper aims to present a partial list of rare minerals present in the Pércio de Moraes Branco Collection of the Lutheran University of Brazil - ULBRA.

The ULBRA Mineral Collection was acquired from the collector Pércio de Moraes Branco in October 1996 thanks to the good will and sensibility of Dr. Ruben Eugen Becker, Magnificent Rector of the Lutheran University of Brazil. This acquisition permitted the permanence in Rio Grande do Sul of one of Brazil's major mineralogic collections. This collection was later enriched with samples already existing in the University and through exchange with Paulo Anselmo Matioli, who is one of largest private collectors of the country.

Before the public exposition, the Collection passed through revision and systematic organization under the supervision of Professor Paulo César Pereira das Neves with help of geologists Paulo Anselmo Matioli, Milena Matioli and Kátia Beppler. The organization was done using the systematics of Klein and Hurlbut Jr<sup>1</sup>. The chemical compositions were compiled from the work of Fleischer and Mandarino<sup>2</sup>. Other references used in the classification included the works of Branco<sup>3</sup>, Milovsky and Kononov<sup>4</sup> and of Klockmann and Rhämdor<sup>5</sup>.

The Collection was formally inaugurated on August 13, 1997 is located in Room 127, Building I, Main Campus of ULBRA in Canoas and is an integral part of the Department of Chemistry (Science Museum). It is open to public visitation and was visited by about 2,000 persons since its inauguration.

## MINERALS AND MINERAL COLLECTORS

Collecting things is part of human nature. Many of us have a tendency that begins in childhood to collect objects of different kinds in an orderly or disordely manner. As children we collect figurines, decals, coins, stamps, etc. As adults we

tend to prefer more valuable objects such as watches, clocks and works of art. We may even continue to collect coins and stamps, only that with a different vision and disposition paying more attention to the monetary value and not only for the pleasure of having a large quantity of the things that we like.

Collecting minerals is then no strange custom. On the contrary, it is a very common one in places like the United States of America and Italy, for example. On the other hand, in Brazil in spite of the great diversity and abundance of mineral treasure and specially of precious stones and gems there are only a few collectors.

Until a few years ago (the end of the 1980's) there were relatively few mineral collectors. Only recently, especially due to the large demand for minerals for energization, cure and other esoteric purposes there has been a large interest in mineral collection among the general public and at the present time it is not difficult to encounter people that collect minerals. This increasing interest in mineral collection is now also present among Brazilian children. Its reasons, however, are not easy to judge.

#### REASONS FOR COLLECTING MINERALS

Being able to collect so many other different things why would a person choose to collect minerals? A good reason may be their beauty, especially of those minerals that are well crystallized. But this reason is too obvious, for every collector seeks and searches for objects that are pleasant to the eye. A more specific reason is the possibility to obtain pieces for the collection without need to purchase them or make exchange. Collections, as a whole, grow and are expanded through exchange and purchase from other collectors. Minerals, however, are much more accessible since they occur freely in nature. This is particularly true for collectors that work in the mineral field such as geologists and mining engineers.

Another characteristic of mineral collection is its universality. Collections of stamps, coins, works of art are usually related to a particular country or region of the Earth. It is true, they may have a certain international flavor and outlook, but they are not naturally international like minerals. Besides, what other kind of collection can count with samples that originate far from the Earth, like meteorites, tectites or rock samples from the Moon? What is the age of a document, work of art or coin, measured in centuries or millenia when compared to the age of minerals and rocks that span millions of years?

Another characteristic of minerals is that they are substances produced without human participation, and as such they are not subject to personal evaluation as far as the ability of who made them and the artistic disposition or taste of who produced them. The minerals, beautiful or not, are as they are because Mother Nature made them so, not because of the more or less able hands that molded them. Besides, characteristics that may be classified as defects, are very often details that make the sample very rare, if not unique.

For geologists and other geoscientists the collection of minerals is the best way to recognize them. The constant handling, the comparative examination of individual samples of the same type or species coming from different regions and

the observation of peculiarities help the collector to develop an acute perception of the characteristics of the material that is being collected. This type of perception cannot be obtained even by reading and studying the best manuals and treatises of mineralogy.

Although there exist a large number of minerals that are easily damaged because of their softness, sensibility to light, humidity and other factors, as a whole, minerals have a very high physical resistance and endurance, much superior to living beings, and also greater than that of objects such as paintings, stamps and photographs. This is another good reason to collect minerals.

## HOW TO COLLECT MINERALS

The first big decision faced upon beginning the collection of minerals is as to what type of material one should collect. Systematic collections include all type of minerals and diversity is the main objective and the aspect of major value. Systematic collections are usually the best option for beginners. With the passing of time collectors may decide to specialize, collecting only a specific group of minerals. A collection limited to a few types of minerals is indicated when there are limitations of space or of financial resources. For a systematic collection to be important it needs to grow and this requires space. On the other hand, a specific collection may rival with that of good museums. A good example of this is given by Jules Sauer, one of the greatest jewellers from Brazil. Although he has the means to acquire a wide variety of minerals from all over the world, he collects only tourmalines.

Another important factor intimately related to the space available is the size of the samples present in the collection. Obviously, if the space is restricted a large number of samples of big dimension can not be accommodated and the choice is the one of "cabinet", "thumb nails" or "micromount" collections, as American geologists call them. The samples present in a collection, however can not be so small that their identification is made difficult. Samples of common minerals that require the reading of the tag in order to be identified are too small. The distinctive characteristics should be easily recognizable.

A collection increases not only through exchange of minerals but also through exchange of information among collectors. At times, an experienced mineralogist with a solid background in geology can have difficulty in identifying a sample that another person with less formal training identifies with ease. The same may be true in regards to the origin of the mineral. An experienced collector may identify the unknown origin of a mineral on the basis of a few typical physical characteristics. This exchange is more fruitful when done through societies of mineralogists and collectors. In such a case, the information reaches a larger public and the scientific value of the information is formally recognized and better employed.

Another good source of information are museums. Collectors should appreciate the beauty of the samples on display, learn about their composition and origin and propose exchange of materials and information. A true and conscient

collector respects his fellow collectors. When taking samples from a prospection site, he never takes more than the necessary and does not do any damage to the samples the he does not take. Other scientists and collectors that may visit the same site and deserve the opportunity to find what they are searching for. There may be some exceptions: in quarries where all the rocks removed are used for gravel, a true collector not only may but he must collect everything within his reach and donate the samples that he does not need to museums and schools or exchange them with other collectors.

On an identification tag that accompanies a mineral on exposition the following information is considered essential: name of the mineralogic species, chemical composition, crystal system and origin. The written information should be presented in a manner that is in visual harmony with the mineral on display and special care should be given to the size of the tag.

## REASONS FOR COLLECTING MINERALS

According to Frederick H. Pough, one of North American's greatest mineralogists, only Mineralogy among the basic sciences in an educational pastime for it combines Chemistry, Physics and Mathematics.

## RARE MINERALS IN THE MINERAL COLLECTION OF THE LUTHERAN UNIVERSITY OF BRAZIL - ULBRA

Below we present a list of the rare samples present in the mineral collection of the Lutheran University of Brazil. The samples are listed with the respective mineralogic classes. Rare species were considered all those that are not listed as common in the Mineral Tables by Dietrich<sup>6</sup>.

### a) ORGANIC COMPOUNDS

\* Idrialite -  $C_{22}H_{14}$  - Orthorrombic System - Idrija, Slovenia.

\* Mellite -  $Al_2[C_6(COO_6)] \cdot 18H_2O$  - Tetragonal System - Tartabanya, Hungary.

### b) NATIVE ELEMENTS

\* Antimony - Sb - Trigonal System - Arsenic Group - Lake George Mine, New Brunswick, Canada.

\* Arsenic - As - Cubic System - Kuse Mine, Sarawak, North Bau, Borneo, Indonesia.

\* Bismuth - Bi - Trigonal System - Arsenic Group - Pietra Majori, Sarrabus, Sardinia, Italy.

\* Cohenite -  $(Fe,Ni,Co)_3C$  - Orthorrombic System - Nandan Meteorite, Nandan, Lihu, People's Republic of China.

- \* Iron terrestrial - Fe - Cubic System (body-centered), alpha-iron - Tajymir, Russia.
- \* Iron-nickel meteoric - (Fe-Ni) - Cubic System - Bendengó Meteorite - Bendengó River, Monte Santo, Bahia, Brazil.
- \* Kamacite - (Fe,Ni) - alpha-Nickel-iron - Cubic System (body-centered) - Nandan Meteorite, Nandan, Lihu, People's Republic of China.
- \* Osbornite - TiN - Cubic System - Vaca Muerta Meteorite, Taltal, Atacama, Chile.
- \* Palladium - Pd - Cubic System - Gongo Soco, Caeté, Minas Gerais, Brazil.
- \* Platinum - Pt - Cubic System - Gongo Soco, Caeté, Minas Gerais, Brazil.
- \* Schreibersite - (Rhabdite) -  $(\text{Fe},\text{Ni})_3\text{P}$  - Tetragonal System - Vaca Muerta Meteorite, Taltal, Atacama, Chile.
- \* Taenite - (Ni,Fe) -  $\gamma$ -Nickel-iron - Cubic System (face-centered) - Nandan Meteorite, Nandan, Lihu, People's Republic of China.

### c) SULFIDES and SULFOSALTS

Due to chemical affinity the sulfide and sulfosalts classes also includes tellurides, arsenides, sulfoarsenides and antimonides (Klein & Hurlbut Jr<sup>1</sup>).

- \* Apuanite -  $\text{Fe}^{2+}\text{Fe}_4^{3+}\text{Sb}_4^{3+}\text{O}_{12}\text{S}$  - Tetragonal System - Mina Bucca Della Vena, Santa Zzema, Lucca, Toscana, Italy.
- \* Boulangerite -  $\text{Pb}_5\text{Sb}_4\text{S}_{11}$  - Monoclinic System - Cleaveland Mine, Stevens County, Washington, USA.
- \* Calaverite -  $\text{AuTe}_2$  - Monoclinic System - Strong Mine, Colo County, Colorado, USA.
- \* Cubanite (variety Chalmersite) -  $\text{CuFe}_2\text{S}_3$  - Orthorrombic System - Mina do Morro Velho, Nova Lima, Minas Gerais, Brazil.
- \* Digenite -  $\text{Cu}_9\text{S}_5$  - Cubic System - Mina Capoeira, Parelhas, Rio Grande do Norte, Brazil.
- \* Geocromite -  $\text{Pb}_{14}(\text{Sb,As})_6\text{S}_{23}$  - Monoclinic System - Falün, Sweden.
- \* Löllingite -  $\text{FeAs}_2$  - Orthorrombic System - Löllingite Group - Lavra do Jocão, Conselheiro Pena, Minas Gerais, Brazil.
- \* Metacinnabar -  $\text{HgS}$  - Sphalerite Group - Cubic System - Idrija, Slovenia.
- \* Pentlandite -  $(\text{Fe},\text{Ni})_9\text{S}_8$  - Cubic System - Pentlandite Group - Nickel Mine, Sudbury, Ontario, Canada.
- \* Polydymite -  $\text{NiNi}_2\text{S}_4$  - Cubic System - Linnaeite Group - Nickel Mine, Sudbury, Ontario, Canada.
- \* Rayite -  $(\text{Ag,Tl})_2\text{Pb}_8\text{Sb}_8\text{S}_{21}$  - Monoclinic System - Herja Mine, Baia Sprie, Maramures, Romania.
- \* Semseyite -  $\text{Pb}_9\text{Sb}_8\text{S}_{21}$  - Monoclinic System - Herja Mine, Baia Sprie, Maramures, Romania.
- \* Skutterudite -  $\text{CoAs}_{2,3}$  - Cubic System - Bou Azzer, Anti Atlas, Morocco.
- \* Sudburyite -  $(\text{Pd},\text{Ni})\text{Sb}$  - Hexagonal System - Nickeline Group - Nickel Mine, Sudbury, Ontario, Canada.

- \* Tochilinite -  $6\text{Fe}_{0.9}\text{S} \cdot 5(\text{Mg},\text{Fe}^{2+})(\text{OH})_2$  - Monoclinic or Triclinic Systems - Ottawa, Canada.
- \* Troilite - FeS - Hexagonal System - Nandan Meteorite, Nandan, Lihu, People's Republic of China.
- \* Valleriite -  $4(\text{Fe},\text{Cu})\text{S} \cdot 3(\text{Mg},\text{Al})(\text{OH})_2$  - Hexagonal System - Mina El Teniente, Rancáguia, Chile.
- \* Versiliaite -  $\text{Fe}_4^{2+}\text{Fe}_8^{3+}\text{Sb}_{12}^{3+}\text{O}_{32}\text{S}_2$  - Orthorrombic System - Mina Bucca Della Vena, Santa Zzema, Lucca, Toscana, Italy.

### e) OXIDES and HYDROXIDES

- \* Akaganeite -  $\beta\text{-Fe}^{3+}(\text{O},\text{OH},\text{Cl})$  - Monoclinic System (Pseudo Tetragonal) - Nandan Meteorite, Nandan, Lihu, People's Republic of China.
- \* Bindheimite -  $\text{Pb}_2\text{Sb}_2\text{O}_6(\text{O},\text{OH})$  - Cubic System - Stibconite Group - Pereta Mine, Grosseto, Toscana, Italy.
- \* Cervantite -  $\text{Sb}^{3+}\text{Sb}^{5+}\text{O}_4$  - Orthorrombic System - Pereta Mine, Grosseto, Toscana, Italy.
- \* Chalcophanite -  $(\text{Zn},\text{Fe}^{2+},\text{Mn}^{2+})\text{Mn}_4^{3+}\text{O}_7 \cdot 3\text{H}_2\text{O}$  - Trigonal System - Tamara, Tunisia.
- \* Emmonsite -  $\text{Fe}_2^{3+}\text{Te}_3^{4+}\text{O}_9 \cdot 2\text{H}_2\text{O}$  - Triclinic System - Coral Zone, Louisville, Jefferson County, Kentucky, USA.
- \* Feroxyhyte -  $\delta\text{-Fe}^{3+}\text{O}(\text{OH})$  - Hexagonal System - Nandan Meteorite, Nandan, Lihu, People's Republic of China.
- \* Hercynite -  $\text{Fe}^{2+}\text{Al}_2\text{O}_4$  - Cubic System - Spinel Group - San Vito, Monte Somma, Vesuvio, Napoli, Italy.
- \* Hollandite -  $\text{Ba}(\text{Mn}^{4+},\text{Mn}^{2+})_8\text{O}_{16}$  - Monoclinic (Pseudo Tetragonal) System - Cryptomelane Group - Hurdal, Norway.
- \* Maghemite -  $\gamma\text{-Fe}_2\text{O}_3$  - Nandan Meteorite, Nandan, Lihu, People's Republic of China.
- \* Minium -  $\text{Pb}_2^{2+}\text{Pb}^{4+}\text{O}_4$  - Tetragonal System - Mine Kurfürst Ernest, Bonkhausen, Sauerland, Germany.
- \* Ramsdellite -  $\text{Mn}^{4+}\text{O}_2$  - Orthorrombic System - Mistake Mine, Yavapai County, Arizona, USA.
- \* Senarmontite -  $\text{Sb}_2\text{O}_3$  - Cubic System - Hamitate, Djebel, Constantine, Algeria.
- \* Simpsonite (Calogerasite) -  $\text{Al}_4(\text{Ta},\text{Nb})_3(\text{O},\text{OH},\text{F})_{14}$  - Trigonal System - Alto do Giz, Ecuador, Rio Grande do Norte, Brazil.
- \* Tripuhyite -  $\text{Fe}^{2+}\text{Sb}^{5+}\text{O}_6$  - Tetragonal System - Ferrotapiolite Group - Pereta Mine, Grosseto, Toscana, Italy.
- \* Uranmicrolite - (Djalmaite)  $(\text{U},\text{Ca},\text{Ce})_2(\text{Ta},\text{Nb})_2\text{O}_6(\text{OH},\text{F})$  - Cubic System - Pyrochlore Group - São João Del Rei, Minas Gerais, Brazil.
- \* Valentinitite -  $\text{Sb}_2\text{O}_3$  - Orthorrombic System - Sidi Adris, Algeria.
- \* Varlamoffite (a variety of Cassiterite) -  $(\text{Sn},\text{Fe})(\text{O},\text{OH})_2$  - Tetragonal System - Cligga Mine, Cornwall, England.
- \* Wodginite -  $\text{Mn}^{2+}(\text{Sn}^{4+},\text{Ta})\text{Ta}_2\text{O}_8$  - Monoclinic System - Bernic Lake, Manitoba, Canada.

## g) HALIDES

- \* Boleite -  $Pb_{26}Ag_{10}Cu_{24}^{2+}Cl_{62}(OH)_{48}.3H_2O$  - Cubic System - Mina de Plutón, Santa Rosalia, Boleo, Baja California, Mexico.
- \* Chlorargyrite (Cerargyrite) -  $AgCl$  - Cubic System - Silver Reef Ledge, Utah, USA.
- \* Cryolite -  $Na_3AlF_6$  - Monoclinic System - Ivigtut, Greenland, Denmark.
- \* Diaboleite -  $Pb_2Cu^{2+}Cl_2(OH)_4$  - Tetragonal System - Mina de Plutón, Santa Rosalia, Boleo, Baja California, Mexico.
- \* Eriochalcite -  $Cu^{2+}Cl_2.2H_2O$  - Orthorrombic System - Mina La Farola, Copiapó, Atacama, Chile.
- \* Gearsutite -  $CaAl(OH)F_4.H_2O$  - Monoclinic System - Mina Mato Preto, Cerro Azul, Paraná, Brazil.
- \* Kainite -  $MgSO_4.KCl.3H_2O$  - Monoclinic System - Bochnia, Cracow, Poland.
- \* Lawrencite -  $(Fe^{2+},Ni)Cl_2$  - Trigonal System - Nandan Meteorite, Nandan, Lihu, People's Republic of China.
- \* Nantokite -  $CuCl$  - Cubic System - Mina La Farola, Copiapó, Atacama, Chile.
- \* Onoratoite -  $Sb_8O_{11}Cl_2$  - Monoclinic System - Pereta Mine, Grosseto, Toscana, Italy.
- \* Sal ammoniac -  $NH_4Cl$  - Cubic System - Fichtelberg, Saxonia, Germany.
- \* Sellaite -  $MgF_2$  - Tetragonal System - Serra das Éguas, Brumado, Bahia, Brazil.
- \* Weberite -  $Na_2MgAlF_7$  - Orthorrombic System - Ivigtut, Greenland, Denmark.

## h) CARBONATES

- \* Artinite -  $Mg_2(CO_3)(OH)_2.3H_2O$  - Monoclinic System - Clear Creek, San Benito County, California, USA.
- \* Burbankite -  $(Na,Ca)_3(Sr,Ba,Ce)_3(CO_3)_5$  - Hexagonal System - Pedreira da Prefeitura, Poços de Caldas, Minas Gerais, Brazil.
- \* Burkeite -  $Na_6(CO_3)(SO_4)_2$  - Orthorrombic System - Searles Lake, San Benito County, California, USA.
- \* Canavesite -  $Mg_2(CO_3)(HBO_3).5H_2O$  - Monoclinic System - Pereta Mine, Grosseto, Toscana, Italy.
- \* Dawsonite -  $NaAl(CO_3)(OH)_2$  - Orthorrombic System - Monte Ammiata, Toscana, Italy.
- \* Dypingite -  $Mg_5(CO_3)_4(OH)_2.5H_2O$  - Monoclinic System (?) - Rapid Creek, Yukon, Canada.
- \* Hydrotalcite -  $Mg_6Al_2(CO_3)(OH)_{16}.4H_2O$  - Trigonal System - Hydrotalcite Group - Dypingdal, Snarum, Buskerud, Norway.
- \* Ikaite -  $CaCO_3.6H_2O$  - Monoclinic System - Ika, Ivigtut, Greenland, Denmark.
- \* Manasseite -  $Mg_6Al_2(CO_3)(OH)_{16}.4H_2O$  - Hexagonal System - Manasseite Group - Dypingdal, Snarum, Buskerud, Norway.
- \* Nullaginit -  $Ni_2(CO_3)(OH)_2$  - Monoclinic System - Rosasite Group - Cottonwood Mine, Bolivia Ghost Town, Churchil County, Nevada, USA.

- \* Schröckingerite -  $\text{NaCa}_3(\text{UO}_2)(\text{CO}_3)_3(\text{SO}_4)\text{F} \cdot 10\text{H}_2\text{O}$  - Triclinic System - Huemul Mine, Malargüe, Mendoza, Argentina.
- \* Stichtite -  $\text{Mg}_6\text{Cr}_2(\text{CO}_3)(\text{OH})_{16} \cdot 4\text{H}_2\text{O}$  - Orthorrombic System - Hydrotalcite Group - Stichtit Hill, Dundas, Tasmania, Australia; Campo Formoso, Bahia, Brazil.
- \* Urancalcarite -  $\text{Ca}(\text{UO}_2)_3(\text{CO}_3)(\text{OH})_6 \cdot 3\text{H}_2\text{O}$  - Orthorrombic System - Huemul Mine, Malargüe, Mendoza, Argentina.
- \* Weloganite -  $\text{Sr}_3\text{Na}_2\text{Zr}(\text{CO}_3)_6 \cdot 3\text{H}_2\text{O}$  - Triclinic System (Pseudo Trigonal) - Francon Quarry, Montreal Island, Quebec, Canada.

#### i) NITRATES

- \* Nitratine - (Soda Niter)  $\text{NaNO}_3$  - Trigonal System - Oficina Maria Elena, Salitreras, Atacama, Chile.
- \* Nitro -  $\text{KNO}_3$  - Orthorrombic System - Morro do Chapéu, Irecê, Bahia, Brazil.

#### j) IODATES

- \* Bellingerite -  $\text{Cu}_2^{2+}(\text{IO}_3)_6 \cdot 2\text{H}_2\text{O}$  - Triclinic System - Oficina Maria Elena, Salitreras, Atacama, Chile.
- \* Brüggenite -  $\text{Ca}(\text{IO}_3)_2 \cdot \text{H}_2\text{O}$  - Monoclinic System - Oficina Maria Elena, Salitreras, Atacama, Chile.

#### k) BORATES

- \* Boracite -  $\text{Mg}_3\text{B}_7\text{O}_{13}\text{Cl}$  Orthorrombic System (Pseudo Cubic) - Stassfurt Mine, Stassfurt, Germany.
- \* Kurnakovite -  $\text{MgB}_3\text{O}_3(\text{OH})_5 \cdot 5\text{H}_2\text{O}$  - Orthorrombic System - Kern County, Boron, California, USA.
- \* Ludwigite -  $\text{Mg}_2\text{Fe}^{3+}\text{BO}_5$  - Orthorrombic System - Ludwigite Group - Corcolle, Roma, Italy.
- \* Meyerhofferite -  $\text{Ca}_2\text{B}_6\text{O}_6(\text{OH})_{10} \cdot 2\text{H}_2\text{O}$  - Triclinic System - Mt. Blanco DC., Kern County, California, USA.
- \* Szaibelyite -  $\text{MgBO}_2(\text{OH})$  - Monoclinic System - Herja Mine, Baia Sprie, Maramures, Romania.
- \* Vonsenite -  $\text{Fe}_2^{2+}\text{Fe}^{3+}\text{BO}_5$  - Orthorrombic System - Ludwigite Group - Corcolle, Roma, Italy.

#### l) PHOSPHATES

- \* Anapaite -  $\text{Ca}_2\text{Fe}^{2+}(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$  - Triclinic System - Kerch, Crimea, Ukraine.
- \* Arrojadite -  $\text{KNa}_4\text{CaMn}_4^{2+}\text{Fe}_{10}^{2+}\text{Al}(\text{PO}_4)_{12}(\text{OH},\text{F})_2$  - Monoclinic System - Rapid Creek, Yukon, Canada.
- \* Augelite -  $\text{Al}_2(\text{PO}_4)(\text{OH})_3$  - Monoclinic System - Asbestos, Quebec, Canada.

- \* Carbonate-hydroxylapatite - (Dahllite)  $\text{Ca}_5(\text{PO}_4,\text{CO}_3)_3(\text{OH})$  - Hexagonal System - Apatite Group - Carnaúba dos Dantas, Rio Grande do Norte, Brazil.
- \* Chalcosiderite -  $\text{Cu}^{2+}\text{Fe}^{3+}_6(\text{PO}_4)_4(\text{OH})_8\cdot4\text{H}_2\text{O}$  - Triclinic System - Turquoise Group Somerset, England.
- \* Cornetite -  $\text{Cu}_3^{2+}(\text{PO}_4)(\text{OH})_3$  - Orthorrombic System - Star Mine, Lubumbashi, Democratic Republic of Congo.
- \* Eosphorite -  $\text{Mn}^{2+}\text{Al}(\text{PO}_4)(\text{OH})_2\cdot\text{H}_2\text{O}$  - Monoclinic System - Lavra da Ilha, Itinga, Minas Gerais, Brazil.
- \* Ernstite -  $(\text{Mn}^{2+}_{1-x}\text{Fe}^{3+}_x)\text{Al}(\text{PO}_4)(\text{OH})_{2-x}\text{O}_x$  - Monoclinic System - Lavra da Ilha, Itinga, Minas Gerais, Brazil.
- \* Frondelite -  $\text{Mn}^{2+}\text{Fe}^{3+}_4(\text{PO}_4)_3(\text{OH})_5$  - Orthorrombic System - Lavra do Jocão, Conselheiro Pena, Minas Gerais, Brazil.
- \* Goyazite -  $\text{SrAl}_3(\text{PO}_4)_2(\text{OH})_5\cdot\text{H}_2\text{O}$  - Trigonal System - Crandallite Group - Rapid Creek, Yukon, Canada.
- \* Hinsdalite -  $(\text{Pb},\text{Sr})\text{Al}_3(\text{PO}_4)(\text{SO}_4)(\text{OH})_6$  - Trigonal System - Beudantite Group - Mina Los Bolones, Combarbala, IV Region, Chile.
- \* Hentschelite -  $\text{Cu}^{2+}\text{Fe}^{3+}_2(\text{PO}_4)_2(\text{OH})_2$  - Monoclinic System - Lazulite Group - Rajo de Vicuña, Andacollo, Chile.
- \* Hureaulite -  $\text{Mn}_5^{2+}(\text{PO}_4)_2[\text{PO}_3(\text{OH})]_2\cdot4\text{H}_2\text{O}$  - Monoclinic System - Lavra do Jocão, Conselheiro Pena, Minas Gerais, Brazil.
- \* Hydroxylherderite -  $\text{CaBe}(\text{PO}_4)(\text{OH})$  - Monoclinic System - Benett Quarry, Buckfield, Maine, USA.
- \* Ludjibaite -  $\text{Cu}_5^{2+}(\text{PO}_4)_2(\text{OH})_4$  - Triclinic System - Star Mine, Lubumbashi, Democratic Republic of Congo.
- \* Ningyoite -  $(\text{U,Ca,Ce})_2(\text{PO}_4)_2\cdot1\text{H}_2\text{O}$  - Orthorrombic System (Pseudo Hexagonal) - Rhabdophane Group - Ningyo-Toge Mine, Tottori, Japan.
- \* Pseudomalachite -  $\text{Cu}_5^{2+}(\text{PO}_4)_2(\text{OH})_4$  - Monoclinic System - Rajo de Vicuña, Andacollo, Chile.
- \* Rhabdophane-(Ce) -  $(\text{Ce},\text{La})\text{PO}_4\cdot\text{H}_2\text{O}$  - Hexagonal System - Rhabdophane Group - Ningyo-Toge Mine, Tottori, Japan.
- \* Rockbridgeite -  $(\text{Fe}^{2+},\text{Mn}^{2+})\text{Fe}^{3+}_4(\text{PO}_4)_3(\text{OH})_5$  - Orthorrombic System - Lavra do Jocão, Conselheiro Pena, Minas Gerais, Brazil.
- \* Roscherite -  $\text{Ca}(\text{Mn}^{2+},\text{Fe}^{2+})_2\text{Be}_3(\text{PO}_4)_3(\text{OH})_3\cdot2\text{H}_2\text{O}$  - Monoclinic and Triclinic Systems - Lavra da Ilha, Itinga, Minas Gerais, Brazil.
- \* Scholzite -  $\text{CaZn}_2(\text{PO}_4)_2\cdot2\text{H}_2\text{O}$  - Orthorrombic System - Reaphook Hill, Queensland, Australia.
- \* Scorzalite -  $(\text{Fe}^{+2},\text{Mg})\text{Al}_2(\text{PO}_4)_2(\text{OH})_2$  - Monoclinic System - Lazulite Group - Carnaúba dos Dantas, Rio Grande do Norte, Brazil.
- \* Souzalite -  $(\text{Mg},\text{Fe}^{2+})_3(\text{Al},\text{Fe}^{3+})_4(\text{PO}_4)_4(\text{OH})_6\cdot2\text{H}_2\text{O}$  - Monoclinic System - Rapid Creek, Yukon, Canada.
- \* Wardite -  $\text{NaAl}_3(\text{PO}_4)_2(\text{OH})_4\cdot2\text{H}_2\text{O}$  - Tetragonal System - Rapid Creek, Yukon, Canada.
- \* Whiteite-(CaFeMg) -  $\text{Ca}(\text{Fe}^{2+},\text{Mn}^{2+})\text{Mg}_2\text{Al}_2(\text{PO}_4)_4(\text{OH})_2\cdot8\text{H}_2\text{O}$  - Monoclinic System - Whiteite Group - Rapid Creek, Yukon, Canada.

\* Zanazziite -  $\text{Ca}_2(\text{Mg},\text{Fe}^{2+})(\text{Mg},\text{Fe}^{2+},\text{Al})_4\text{Be}_4(\text{PO}_4)_6(\text{OH})_4 \cdot 6\text{H}_2\text{O}$  - Monoclinic System - Lavra da Ilha, Itinga, Minas Gerais, Brazil.

### m) ARSENATES AND VANADATES

- \* Bayldonite -  $\text{PbCu}_3(\text{AsO}_4)_2(\text{OH})_2 \cdot \text{H}_2\text{O}$  - Monoclinic System - Wheal Carpenter, Saint Hilary, Cornwall, England.
- \* Carnotite -  $\text{K}_2(\text{UO}_2)_2\text{V}_2\text{O}_8 \cdot 3\text{H}_2\text{O}$  - Monoclinic System - Huemul Mine, Malargüe, Mendoza, Argentina.
- \* Ceruleite -  $\text{Cu}_2\text{Al}_7(\text{AsO}_4)_4(\text{OH})_{13} \cdot 12\text{H}_2\text{O}$  - Triclinic System - Mina Los Bolones, Combarbala, IV Region, Chile.
- \* Cornwallite -  $\text{Cu}_5^{2+}(\text{AsO}_4)_2(\text{OH})_4 \cdot \text{H}_2\text{O}$  - Monoclinic System - Wheal Jewell, Saint Day, Cornwall, England.
- \* Descloizite -  $\text{PbZn}(\text{VO}_4)(\text{OH})$  - Orthorrombic System - Descloizite Group - Itacarambi, Minas Gerais, Brazil.
- \* Erythrite -  $\text{Co}_3(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$  - Monoclinic System - Vivianite Group - Modum, Norway; Bou Azzer, Anti Atlas, Morocco.
- \* Hidalgoite -  $\text{PbAl}_3(\text{AsO}_4)(\text{SO}_4)(\text{OH})_6$  - Trigonal System - Beudantite Group - Mina Los Bolones, Combarbala, IV Region, Chile.
- \* Huemulite -  $\text{Na}_2\text{MgV}_{10}^{5+}\text{O}_{28} \cdot 24\text{H}_2\text{O}$  - Triclinic System - Huemul Mine, Malargüe, Mendoza, Argentina.
- \* Kemmlitzite -  $(\text{Sr},\text{Ce})\text{Al}_3(\text{AsO}_4)(\text{SO}_4)(\text{OH})_6$  - Trigonal System - Beudantite Group - Mina Los Bolones, Combarbala, IV Region, Chile.
- \* Metaschoderite -  $\text{Al}_2(\text{PO}_4)(\text{VO}_4) \cdot 6\text{H}_2\text{O}$  - Monoclinic System - Van Nav San Clain, Fish Creek Range, Eureka County, Nevada, USA.
- \* Metatyuyamunite -  $\text{Ca}(\text{UO}_2)_2\text{V}_2^{5+}\text{O}_8 \cdot 3\text{H}_2\text{O}$  - Orthorrombic System - Huemul Mine, Malargüe, Mendoza, Argentina.
- \* Mottramite -  $\text{PbCu}^{2+}(\text{VO}_4)(\text{OH})$  - Orthorrombic System - Descloizite Group - Barranca del Cobre, Chihuahua, Mexico.
- \* Olivenite -  $\text{Cu}_2^{2+}(\text{AsO}_4)(\text{OH})$  - Orthorrombic System - Clara Mine, Wolfach, Schwarzwald, Germany.
- \* Parnauite -  $\text{Cu}_9^{2+}(\text{AsO}_4)_2(\text{SO}_4)(\text{OH})_{10} \cdot 7\text{H}_2\text{O}$  - Orthorrombic System - Majuba Hill, Pershing County, Nevada, USA.
- \* Pharmacosiderite -  $\text{KFe}^{3+}(\text{AsO}_4)_3(\text{OH})_4 \cdot 6 \cdot 7\text{H}_2\text{O}$  - Cubic System - Wheal Garland, Cornwall, England.
- \* Roselite -  $\text{Ca}_2(\text{Co}^{2+},\text{Mg})(\text{AsO}_4)_2 \cdot 2\text{H}_2\text{O}$  - Monoclinic System - Roselite Group - Bou Azzer, Anti Atlas, Morocco.
- \* Saneroite -  $\text{Na}_2(\text{Mn}^{2+},\text{Mn}^{3+})_{10}\text{Si}_{11}\text{VO}_{34}(\text{OH})_4$  - Triclinic System - Mina Gambatesa, Genova, Liguria, Italy.
- \* Schlossmacherite -  $(\text{H}_3\text{O},\text{Ca})\text{Al}_3(\text{AsO}_4,\text{SO}_4)_2(\text{OH})_6$  - Trigonal System - Beudantite Group - Mina Los Bolones, Combarbala, IV Region, Chile.
- \* Stibivanite -  $\text{Sb}_2^{3+}\text{V}^{4+}\text{O}_5$  - Monoclinic System - Mina Bucca Della Vena, Santa Zzema, Lucca, Toscana, Italy.
- \* Tyuyamunite -  $\text{Ca}(\text{UO}_2)_2\text{V}_2\text{O}_8 \cdot 5 \cdot 8\text{H}_2\text{O}$  - Orthorrombic System - Huemul Mine, Malargüe, Mendoza, Argentina.

**n) SULFATES, CROMATES AND MOLIBDATES**

- \* Arthurite -  $\text{Cu}^{2+}\text{Fe}_2^{3+}(\text{AsO}_4,\text{PO}_4,\text{SO}_4)_2(\text{O},\text{OH})_2 \cdot 4\text{H}_2\text{O}$  - Monoclinic System - Arthurite Group - Mina La Farola, Copiapó, Atacama, Chile; Hingston Down Mine, Cornwall, England.
- \* Campigliaite -  $\text{Cu}_4^{2+}\text{Mn}^{2+}(\text{SO}_4)_2(\text{OH})_6 \cdot 4\text{H}_2\text{O}$  - Monoclinic System - Mina El Teniente, Rancagua, Chile.
- \* Connellite -  $\text{Cu}_{19}^{2+}\text{Cl}_4(\text{SO}_4)(\text{OH})_{32} \cdot 3\text{H}_2\text{O}$  - Hexagonal System - Saint Just, Cornwall, England.
- \* Epsomite -  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$  - Orthorrombic System - Cueva de los Gitanos, Cataluña, Spain.
- \* Klebebergite -  $\text{Sb}_4^{3+}\text{O}_4(\text{OH})_2(\text{SO}_4)$  - Orthorrombic System - Pereta Mine, Grosseto, Toscana, Italy.
- \* Misenite -  $\text{K}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  (?) - Monoclinic System - Stassfurt Salt Mine, Sachsen, Germany.
- \* Peretaite -  $\text{CaSb}_4^{3+}\text{O}_4(\text{OH})_2(\text{SO}_4)_2 \cdot 2\text{H}_2\text{O}$  - Monoclinic System - Pereta Mine, Grosseto, Toscana, Italy.
- \* Pickeringite -  $\text{MgAl}_2(\text{SO}_4)_4 \cdot 22\text{H}_2\text{O}$  - Monoclinic System - Halotrichite Group - Libros, Terrel, Spain.
- \* Picromerite -  $\text{K}_2\text{Mg}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  - Monoclinic System - Picromerite Group - Rössleben, Germany.
- \* Polyhalite -  $\text{K}_2\text{Ca}_2\text{Mg}(\text{SO}_4)_4 \cdot 2\text{H}_2\text{O}$  - Triclinic System - Bochnia, Cracow, Poland.
- \* Ponsjakite -  $\text{Cu}_4^{2+}(\text{SO}_4)_2 \cdot \text{H}_2\text{O}$  Monoclinic System - Mina El Teniente, Rancagua, Chile.
- \* Retgersite -  $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$  - Tetragonal System - Cottonwood Mine, Bolivia Ghost Town, Churchil County, Nevada, USA.
- \* Schulenbergite -  $(\text{Cu}^{2+},\text{Zn})_7(\text{SO}_4,\text{CO}_3)_2(\text{OH})_{10} \cdot 3\text{H}_2\text{O}$  - Trigonal System - Wheal Unity, Cornwall, England.
- \* Serpierite -  $\text{Ca}(\text{Cu}^{2+},\text{Zn})_4(\text{SO}_4)_2(\text{OH})_6 \cdot 3\text{H}_2\text{O}$  - Monoclinic System - Grube, Friedrichsegen, Lahn, Denmark.
- \* Tamarugite -  $\text{NaAl}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  - Monoclinic System - Mina Le Cetine, Siena, Toscana, Italy.
- \* Wroewolfeite -  $\text{Cu}_4^{2+}(\text{SO}_4)_2(\text{OH})_6 \cdot 3\text{H}_2\text{O}$  - Monoclinic System - Nantycagal Mine, Cardigan Shire, Wales.

**o) SILICATES**

- \* Afghanite -  $(\text{Na},\text{Ca},\text{K})_8(\text{Si},\text{Al})_{12}\text{O}_{24}(\text{SO}_4,\text{Cl},\text{CO}_3)_3 \cdot \text{H}_2\text{O}$  - Hexagonal System - Cancrinite Group - Pitigliano, Grosseto, Toscana, Italy.
- \* Babingtonite -  $\text{Ca}_2(\text{Fe}^{2+},\text{Mn})\text{Fe}^{3+}\text{Si}_5\text{O}_{14}(\text{OH})$  - Triclinic System - Maramello, Genova, Liguria, Italy.
- \* Balangeroite -  $(\text{Mg},\text{Fe}^{3+},\text{Fe}^{2+},\text{Mn}^{2+})_{42}\text{Si}_{16}\text{O}_{54}(\text{OH})_{40}$  - Orthorrombic System - Balangero, Val di Lanzo, Piemonte, Italy.
- \* Benitoite -  $\text{BaTiSi}_3\text{O}_9$  - Hexagonal System - Big Creek, Fresno, California, USA.

- \* Buergerite -  $\text{NaFe}_3^{3+}\text{Al}_6(\text{BO}_3)_3\text{Si}_6\text{O}_{21}\text{F}$  - Trigonal System - Tourmaline Group - Lavra do Escondido, Governador Valadares, Minas Gerais, Brazil.
- \* Caporcianite (a variety of Laumontite) -  $\text{CaAl}_2\text{Si}_4\text{O}_{12} \cdot 4\text{H}_2\text{O}$  - Monoclinic System - Zeolite Group - Montecatini, Val di Celina, Toscana, Italy.
- \* Carpholite -  $\text{Mn}^{2+}\text{Al}_2\text{Si}_2\text{O}_6(\text{OH})_4$  - Orthorrombic System - Krasno, Czech Republic.
- \* Chapmanite -  $\text{Sb}^{+3}\text{Fe}_2^{3+}(\text{SiO}_4)_2(\text{OH})$  - Monoclinic System - Mina Tafone, Grosseto, Toscana, Italy.
- \* Charoite -  $\text{K}(\text{Ca},\text{Na})_2\text{Si}_4\text{O}_{10}(\text{OH},\text{F}).\text{H}_2\text{O}$  (?) - Monoclinic System - Chare, Kola, Russia.
- \* Clintonite -  $\text{Ca}(\text{Mg},\text{Al})_3(\text{Al}_3\text{Si})\text{O}_{10}(\text{OH})_2$  - Monoclinic System - Mica Group - Lago Della Vacca, Adamello, Lombardia, Italy.
- \* Cowlesite  $\text{CaAl}_2\text{Si}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$  - Orthorrombic System - Zeolite Group - Antrim, Northern Ireland.
- \* Creaseyite -  $\text{Pb}_2\text{Cu}_2^{2+}\text{Fe}_2^{3+}\text{Si}_5\text{O}_{17} \cdot 6\text{H}_2\text{O}$  - Orthorrombic System - Mammoth Saint Anthony Mine, Tiger, Pima County, Arizona, USA.
- \* Cuspidine -  $\text{Ca}_4\text{Si}_2\text{O}_7(\text{F},\text{OH})_2$  - Monoclinic System - Pitigliano, Grosseto, Toscana, Italy; Magliano Romano, Roma, Italy.
- \* Davyne -  $(\text{Na},\text{Ca},\text{K})_8\text{Al}_6\text{Si}_6\text{O}_{24}(\text{Cl},\text{SO}_4,\text{CO}_3)_{2-3}$  - Hexagonal System - Cancrinite Group - Cava di Pollena, Monte Somma, Vesuvio, Italy.
- \* Deerite -  $(\text{Fe}^{2+},\text{Mn}^{2+})_6(\text{Fe}^{3+},\text{Al})_3\text{Si}_6\text{O}_{20}(\text{OH})_5$  - Monoclinic System (Pseudo Orthorrombic) - Longvalle Quarry, Fresno County, California, USA.
- \* Epistilbite -  $\text{CaAl}_2\text{Si}_6\text{O}_{16} \cdot 5\text{H}_2\text{O}$  - Monoclinic System - Zeolite Group - Osilo, Sardinia, Italy.
- \* Ferrierite -  $(\text{Na},\text{K})_2\text{Mg}(\text{Si},\text{Al})_{18}\text{O}_{36}(\text{OH}) \cdot 9\text{H}_2\text{O}$  - Orthorrombic and Monoclinic Systems - Zeolite Group - Monastire, Sardinia, Italy.
- \* Fluorrichterite -  $\text{Na}_2\text{Ca}(\text{Mg},\text{Fe}^{2+})_5\text{Si}_8\text{O}_{22}(\text{F},\text{OH})_2$  - Monoclinic System - Amphibole Group - Wilbeforce, Ontario, Canada.
- \* Fraipontite -  $(\text{Zn},\text{Al})_3(\text{Si},\text{Al})_2\text{O}_5(\text{OH})_4$  - Monoclinic System - Kaolinite-Serpentine Group - Silver Hill Mine, Gleeson, Arizona, USA.
- \* Franzinit -  $(\text{Na},\text{Ca})_7(\text{Si},\text{Al})_{12}\text{O}_{24}(\text{SO}_4,\text{CO}_3,\text{OH},\text{Cl})_3 \cdot \text{H}_2\text{O}$  - Hexagonal System - Cancrinite Group - Magliano Romano, Roma, Italy.
- \* Fresnoite -  $\text{Ba}_2\text{TiSi}_2\text{O}_8$  - Tetragonal System - Big Creek, Fresno, California, USA.
- \* Ganophyllite -  $(\text{K},\text{Na})_2(\text{Mn},\text{Al},\text{Mg})_8(\text{Si},\text{Al})_{12}\text{O}_{29}(\text{OH})_7 \cdot 8-9\text{H}_2\text{O}$  - Monoclinic System - Mina Gambatesa, Genoa, Liguria, Italy.
- \* Gillespite -  $\text{BaFe}^{2+}\text{Si}_4\text{O}_{10}$  - Tetragonal System - Big Creek, Fresno, California, USA.
- \* Gismondine -  $\text{Ca}_2\text{Al}_4\text{Si}_4\text{O}_{16} \cdot 9\text{H}_2\text{O}$  - Monoclinic System - Zeolite Group - Capo Pula, Sardinia, Italy.
- \* Gmelinite -  $(\text{Na}_2\text{Ca})\text{Al}_2\text{Si}_4\text{O}_{12} \cdot 6\text{H}_2\text{O}$  - Hexagonal System - Zeolite Group - Glenarm, Antrim, Northern Ireland.
- \* Gyrolite -  $\text{NaCa}_{16}(\text{Si}_{23}\text{Al})\text{O}_{60}(\text{OH})_5 \cdot 15\text{H}_2\text{O}$  - Triclinic System (Pseudo Hexagonal) - Poona, Maharas, India.
- \* Hyalite (a variety of opal) -  $\text{SiO}_2 \cdot n\text{H}_2\text{O}$  - Amorphous - Valec, Slovenia.

- \* Kaersutite -  $\text{NaCa}_2(\text{Mg},\text{Fe}^{2+})_4\text{Ti}(\text{Si}_6\text{Al}_2)\text{O}_{22}(\text{OH})_2$  - Monoclinic System - Amphibole Group - Mont Saint Hilaire, Quebec, Canada.
- \* Kaliophilite -  $\text{KAlSiO}_4$  - Hexagonal System - Orvello, Roma, Lazio, Italy.
- \* Kalsilite -  $\text{KAlSiO}_4$  - Hexagonal System - Orvello, Roma, Lazio, Italy.
- \* Kinoite -  $\text{Ca}_2\text{Cu}_2^{2+}\text{Si}_3\text{O}_8(\text{OH})_4$  - Monoclinic System - Christmas Mine, Gila County, Arizona, USA.
- \* Krauskopfite -  $\text{BaSi}_2\text{O}_4(\text{OH})_2 \cdot 2\text{H}_2\text{O}$  - Monoclinic System - Big Creek, Fresno, California, USA.
- \* Latiumite -  $(\text{Ca},\text{K})_8(\text{Al},\text{Mg},\text{Fe})(\text{Si},\text{Al})_{10}\text{O}_{25}(\text{SO}_4)$  - Monoclinic System - Latiume, Roma, Lazio, Italy; Magliano Romano, Roma, Lazio, Italy.
- \* Liottite -  $(\text{Ca},\text{Na},\text{K})_8(\text{Si},\text{Al})_{12}\text{O}_{24}[(\text{SO}_4),(\text{CO}_3),\text{Cl},\text{OH}]_4 \cdot \text{H}_2\text{O}$  - Hexagonal System - Cancrinite Group - Pitigliano, Grosseto, Toscana, Italy.
- \* Macdonaldite -  $\text{BaCa}_4\text{Si}_{16}\text{O}_{36}(\text{OH})_2 \cdot 10\text{H}_2\text{O}$  - Orthorrombic System - Big Creek, Fresno, California, USA; Rush Creek, Fresno, California, USA.
- \* Magnesioferrikatophorite -  $\text{Na}_2\text{Ca}(\text{Mg},\text{Fe}^{2+})_4\text{Al}(\text{Si},\text{Al})\text{O}_{22}(\text{OH})$  - Monoclinic System - Amphibole Group - Kipawa, Quebec, Canada.
- \* Manganophyllite (Manganese biotite) -  $\text{K}(\text{Mg},\text{Fe}^{2+})_3(\text{Al},\text{Fe}^{3+})\text{Si}_3\text{O}_{10}(\text{OH},\text{F})_2$  (a Mn-rich variety of biotite) - Monoclinic System - Mica Group - Langban Mine, Filipstad, Sweden.
- \* Marialite -  $3\text{NaAlSi}_3\text{O}_8 \cdot \text{NaCl}$  - Tetragonal System - Scapolite Group - Cava di Pollena, Monte Somma, Vesuvio, Italy.
- \* Mattheddeleite -  $\text{Pb}_{20}(\text{SiO}_4)_7(\text{SO}_4)_4\text{Cl}_4$  - Hexagonal System - Monte Arci, Sardinia, Italy.
- \* Meionite -  $3\text{CaAl}_2\text{Si}_2\text{O}_8 \cdot \text{CaCO}_3$  - Tetragonal System - Scapolite Group - Cava di Polleno, Monte Somma, Vesuvio, Italy.
- \* Melanophlogite -  $\text{SiO}_2$  with organic compounds - Cubic or Tetragonal Systems (Pseudo Cubic) - Il Fortullino, Livorno, Italy.
- \* Melilite -  $(\text{Ca},\text{Na})_2(\text{Al},\text{Mg})(\text{Si},\text{Al})_2\text{O}_7$  - Tetragonal System - Melilite Group - Laghetto, Roma, Lazio, Italy; Orvello, Roma, Lazio, Italy.
- \* Merwinite -  $\text{Ca}_3\text{Mg}(\text{SiO}_4)_2$  - Monoclinic System - Crestmore Quarry, Mendocino County, California, USA.
- \* Milarite -  $\text{Kca}_2\text{AlBe}_2\text{Si}_{12}\text{O}_{30} \cdot 0.5\text{H}_2\text{O}$  - Hexagonal System - Osumilite Group - Pegmatito de Jaraguá, Timóteo, Minas Gerais, Brazil.
- \* Muirite -  $\text{Ba}_{10}\text{Ca}_2\text{Mn}^{2+}\text{TiSi}_{10}\text{O}_{30}(\text{OH},\text{Cl},\text{F})_{10}$  - Tetragonal System - Big Creek, Fresno, California, USA.
- \* Mullite -  $\text{Al}_6\text{Si}_2\text{O}_{13}$  - Orthorrombic System - Mina do Leão I, Minas do Leão, Rio Grande do Sul, Brazil.
- \* Narsarsukite -  $\text{Na}_2(\text{Ti},\text{Fe}^{3+})\text{Si}_4(\text{O},\text{F})_{11}$  - Tetragonal System - Mont Saint Hilaire, Quebec, Canada.
- \* Naujakasite -  $\text{Na}_6(\text{Fe}^{2+},\text{Mn}^{2+})\text{Al}_4\text{Si}_8\text{O}_{26}$  - Monoclinic System - Naujakasik, Kvanefjeld Tunnel, Illimaussaq Complex, Greenland, Denmark.
- \* Norbergite -  $\text{Mg}_3(\text{SiO}_4)(\text{F},\text{OH})_2$  - Orthorrombic System - Humite Group - Pargas, Finland.
- \* Okenite -  $\text{Ca}_{10}\text{Si}_{18}\text{O}_{46} \cdot 18\text{H}_2\text{O}$  - Triclinic System - Poona, Maharastra, India.

- \* Osumilite -  $(K,Na)(Fe^{2+},Mg)_2(Al,Fe^{3+})_3(Si,Al)_{12}O_{30}$  - Hexagonal System - Osumilite Group - Monte Arci, Sardinia, Italy.
- \* Pargasite -  $NaCa_2(Mg,Fe^{2+})_4Al(Si_6Al_2)O_{22}(OH)_2$  - Monoclinic System - Amphibole Group - Pargas Valley, Finland.
- \* Piemontite (Piedmontite) -  $Ca_2(Al,Mn^{3+},Fe^{3+})_3(SiO_4)_3(OH)$  - Monoclinic System - Epidote Group - Prabnora Mine, St. Marcel, Val D'aosta, Piemonte, Italy.
- \* Pitiglianoite -  $K_2Na_6Si_6Al_6O_{24}(SO_4).2H_2O$  - Hexagonal System - Cancrinite Group, Pitigliano, Grosseto, Toscana, Italy.
- \* Polylithionite -  $KLi_2AlSi_4O_{10}(F,OH)_2$  - Monoclinic System - Mica Group - Varutrark, Sweden.
- \* Pumpellyite-( $Fe^{2+}$ ) -  $Ca_2Fe^{2+}Al_2(SiO_4)(Si_2O_7)(OH)_2.H_2O$  - Monoclinic System - Pumpellyite Group - Campegli, Genova, Italy.
- \* Pyroxmangite -  $Mn^{2+}SiO_3$  - Triclinic System - Maramello, Genoa, Liguria, Italy.
- \* Rectorite - a clay mineral, Monoclinic System, 1:1 regular interstratification of a dioctahedral Mica and a dioctahedral Smectite - Solmestai Quarry, Djibouti, Somalia.
- \* Sanbornite -  $BaSi_2O_5$  - Orthorrombic System - Big Creek, Fresno, California, USA.
- \* Sarcolite -  $NaCa_6Al_4Si_6O_{24}F$  - (?) System - Cava Novella, Monte Somma, Vesuvio, Napoli, Italy.
- \* Serandite -  $Na(Mn^{2+},Ca)_2Si_3O_8(OH)$  - Triclinic System - Mont Saint Hilaire, Quebec, Canada.
- \* Spurrite -  $Ca_5(SiO_4)_2(CO_3)$  - Monoclinic System - Crestmore Quarry, Mendocino County, California.
- \* Stellerite -  $CaAl_2Si_7O_{18}.7H_2O$  - Orthorrombic System - Zeolite Group - Alghero, Bosa Route, Sardinia, Italy.
- \* Sugilite -  $KNa_2(Fe^{2+},Mn^{2+},Al)_2Li_3Si_{12}O_{30}$  - Hexagonal System - Osumilite Group - Wessels Mine, Kuruman, Cape Province, South Africa.
- \* Taramellite -  $Ba_4(Fe^{3+},Ti,Fe^{2+},Mg)_4(B_2Si_8O_{27})O_2Cl_x$  - Orthorrombic System - Big Creek, Fresno, California, USA; Rush Creek, Fresno, California, USA.
- \* Tinzenite -  $(Ca,Mn^{2+},Fe^{2+})_3Al_2BSi_4O_{15}(OH)$  - Triclinic System - Axinite Group - Mina Gambatesa, Genova, Liguria, Italy.
- \* Traskite -  $Ba_9Fe_2^{2+}Ti_2(SiO_3)_{12}(OH,Cl,F)_6.6H_2O$  - Hexagonal System - Rush Creek, Fresno, California, USA.
- \* Tundrite-(Ce) -  $Na_3(Ce,La)_4(Ti,Nb)_2(SiO_4)_2(CO_3)_3O_4(OH).2H_2O$  - Triclinic System - Chare, Kola, Russia.
- \* Tuscanite -  $K(Ca,Na)_6(Si,Al)_{10}O_{22}[SO_4,CO_3,(OH)_2].H_2O$  - Monoclinic System - Magliano Romano, Roma, Italy.
- \* Verplanckite -  $Ba_2(Mn^{2+},Fe^{2+},Ti)Si_2O_6(O,OH,Cl,F)_2.3H_2O$  - Hexagonal System - Big Creek, Fresno, California, USA.
- \* Walstromite -  $BaCa_2Si_3O_9$  - Triclinic System - Big Creek, Fresno, California, USA.
- \* Wöhlerite -  $NaCa_2(Zr,Nb)Si_2O_7(O,OH,F)_2$  - Monoclinic System - Saga II, Tvedal, Norway.

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