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## Chapter 1 : Clay mineral | rock | calendrierdelascience.com

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Mica minerals have a basic structural unit of the 2: This results in a charge deficiency that is balanced by potassium. General considerations Of the 28 known species of the mica group, only 6 are common rock-forming minerals. Muscovite, the common light-coloured mica, and biotite, which is typically black or nearly so, are the most abundant. Phlogopite, typically brown, and paragonite, which is macroscopically indistinguishable from muscovite, also are fairly common. Lepidolite, generally pinkish to lilac in colour, occurs in lithium-bearing pegmatites. Glauconite, a green species that does not have the same general macroscopic characteristics as the other micas, occurs sporadically in many marine sedimentary sequences. All of these micas except glauconite exhibit easily observable perfect cleavage into flexible sheets. Glauconite, which most often occurs as pelletlike grains, has no apparent cleavage. The names of the rock-forming micas constitute a good example of the diverse bases used in naming minerals: Compositions of the common rock-forming micas are given in the table. Few natural micas have end-member compositions. For example, most muscovites contain sodium substituting for some potassium, and diverse varieties have chromium or vanadium or a combination of both replacing part of the aluminum; furthermore, the Si: Al ratio may range from the indicated 3: Similar variations in composition are known for the other micas. Thus, as in some of the other groups of minerals e. There are, however, no complete series of solid solutions between any dioctahedral mica and any trioctahedral mica. Crystal structure Micas have sheet structures whose basic units consist of two polymerized sheets of silica  $\text{SiO}_4$  tetrahedrons. Two such sheets are juxtaposed with the vertices of their tetrahedrons pointing toward each other; the sheets are cross-linked with cations—for example, aluminum in muscovite—and hydroxyl pairs complete the coordination of these cations see figure. Thus, the cross-linked double layer is bound firmly, has the bases of silica tetrahedrons on both of its outer sides, and has a negative charge. The charge is balanced by singly charged large cations—for example, potassium in muscovite—that join the cross-linked double layers to form the complete structure. The differences among mica species depend upon differences in the X and Y cations. Although the micas are generally considered to be monoclinic pseudo-hexagonal, there also are hexagonal, orthorhombic, and triclinic forms generally referred to as polytypes. The polytypes are based on the sequences and number of layers of the basic structure in the unit cell and the symmetry thus produced. Most biotites are 1M and most muscovites are 2M; however, more than one polytype is commonly present in individual specimens. This feature cannot, however, be determined macroscopically; polytypes are distinguished by relatively sophisticated techniques such as those employing X-rays. The micas other than glauconite tend to crystallize as short pseudo-hexagonal prisms. The side faces of these prisms are typically rough, some appearing striated and dull, whereas the flat ends tend to be smooth and shiny. The end faces are parallel to the perfect cleavage that characterizes the group. Physical properties The rock-forming micas other than glauconite can be divided into two groups: Most of the properties of the mica group of minerals, other than those of glauconite, can be described together; here they are described as pertaining simply to micas, meaning the micas other than glauconite. Properties of the latter are described separately later in the discussion. The perfect cleavage into thin elastic sheets is probably the most widely recognized characteristic of the micas. The cleavage is a manifestation of the sheet structure described above. The elasticity of the thin sheets distinguishes the micas from similarly appearing thin sheets of chlorite and talc. The rock-forming micas exhibit certain characteristic colours. Muscovites range from colourless, greenish to blue-green to emerald-green, pinkish, and brownish to cinnamon-tan. Paragonites are colourless to white; biotites may be black, brown, red to red-brown, greenish brown, and blue-green. Phlogopites resemble biotites but are honey brown. Lepidolites are nearly colourless,

pink, lavender, or tan. Biotites and phlogopites also exhibit the property termed pleochroism or, more properly for these minerals, dichroism: When viewed along different crystallographic directions, especially using transmitted polarized light, they exhibit different colours or different absorption of light or both. The lustre of the micas is usually described as splendid, but some cleavage faces appear pearly. The minutely crystalline variety consisting of muscovite or paragonite or both, generally referred to as sericite, is silky. Consequently, micas can be scratched in either direction with a knife blade or geologic pick. Specific gravity for the micas varies with composition. The overall range is from 2. Glauconite occurs most commonly as earthy to dull, subtranslucent, green to nearly black granules generally referred to as pellets. It is attacked readily by hydrochloric acid. The colour and occurrence of this mineral in sediments and sedimentary rocks formed from those sediments generally are sufficient for identification. Origin and occurrence Micas may originate as the result of diverse processes under several different conditions. Their occurrences, listed below, include crystallization from consolidating magmas, deposition by fluids derived from or directly associated with magmatic activities, deposition by fluids circulating during both contact and regional metamorphism, and formation as the result of alteration processes—perhaps even those caused by weathering—that involve minerals such as feldspars. The stability ranges of micas have been investigated in the laboratory, and in some associations their presence as opposed to absence or some aspect of their chemical composition may serve as geothermometers or geobarometers. Distinct crystals of the micas occur in a few rocks. Micas occurring as large crystals are often called books; these may measure up to several metres across. In most rocks, micas occur as irregular tabular masses or thin plates flakes, which in some instances appear bent. Although some mica grains are extremely small, all except those constituting sericitic masses have characteristic shiny cleavage surfaces. Glauconite is formed in marine environments. It can be found on seafloors where clastic sedimentation, which results from the relocation of minerals and organic matter to sites other than their places of origin, is lacking or nearly so. Although some glauconite has been interpreted to have been formed from preexisting layered silicates. The common rock-forming micas are distributed widely. The more important occurrences follow: Biotite occurs in many igneous rocks. It alters rather easily during chemical weathering and thus is rare in sediments and sedimentary rocks. One stage in the weathering of biotite has resulted in some confusion. During chemical weathering, biotite tends to lose its elasticity and become decolorized to silvery gray flakes. In a fairly common intermediate stage, weathered biotite is golden yellow, has a bronzy lustre, and may be mistaken by inexperienced observers as flakes of gold. Phlogopite is rare in igneous rocks; it does, however, occur in some ultramafic silica-poor rocks. For example, it occurs in some peridotites, especially those called kimberlites, which are the rocks in which diamonds occur. Phlogopite also is a rare constituent of some magnesium-rich pegmatites. Its most common occurrence, however, is in impure limestones that have undergone contact metasomatism, a process through which the chemical composition of rocks is changed. Muscovite is particularly common in metamorphic gneisses, schists, and phyllites. In fine-grained foliated rocks, such as phyllites, the muscovite occurs as microscopic grains sericite that give these rocks their silky lustres. It also occurs in some granitic rocks and is common in complex granitic pegmatites and within miarolitic druses, which are late-magmatic, crystal-lined cavities in igneous rocks. Much of the muscovite in igneous rocks is thought to have been formed late during, or immediately after, consolidation of the parent magma. Muscovite is relatively resistant to weathering and thus occurs in many soils developed over muscovite-bearing rocks and also in the clastic sediments and sedimentary rocks derived from them. Paragonite is known definitely to occur in only a few gneisses, schists, and phyllites, in which it appears to play essentially the same role as muscovite. It may, however, be much more common than generally thought. Until fairly recently nearly all light-coloured micas in rocks were automatically called muscovite without checking their potassium: Its weathering is essentially the same as that of muscovite. Lepidolite occurs almost exclusively in complex lithium-bearing pegmatites but has also been recorded as a component of a few granites. Glauconite, as noted above, is forming in some present-day marine environments. It also is a relatively common constituent of sedimentary rocks, the precursor sediments of

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which were apparently deposited on the deeper parts of ancient continental shelves. The name greensand is widely applied to glauconite-rich sediments. Most glauconite occurs as granules, which are frequently referred to as pellets. It also exists as pigment, typically as films that coat such diverse substrates as fossils, fecal pellets, and clastic fragments. Uses Because of their perfect cleavage, flexibility and elasticity, infusibility, low thermal and electrical conductivity, and high dielectric strength, muscovite and phlogopite have found widespread application. Sheets of muscovite of precise thicknesses are utilized in optical instruments. Ground mica is used in many ways such as a dusting medium to prevent, for example, asphalt tiles from sticking to each other and also as a filler, absorbent, and lubricant. It is also used in the manufacture of wallpaper to give it a shiny lustre. Lepidolite has been mined as an ore of lithium, with rubidium generally recovered as a by-product. It is used in the manufacture of heat-resistant glass. Glauconite -rich greensands have found use within the United States as fertilizer.

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## Chapter 2 : List of minerals (complete) - Wikipedia

*General Chemical Formulas and Organic Minerals" by J. Lima-de-Faria with Rakuten Kobo. This book presents the third volume of a complete development of the new structural classification of minerals, which is.*

Click here to see the Mineral Galleries. Carbonate hydroxylapatite Varietal name. Rockport, Cape Ann, Essex Co.  $\text{Ca}_2\text{B}_2\text{SiO}_4$  Class: Vesuvius, Napoli, Campania, Italy. Sierra de Cordoba, Argentina. Native Element , Subclass: Mramorskoi, Kosoibrod S , Ural Mts. Barranca de Cobre, Chihuahua, Mexico. Algodones mines, Coquimbo Calabozo , Chile. Discredited a mixture of two spinels Varietal name. Beaunan, Chaponost, Lyons near , France. Green beryl containing Cr or V Varietal name. Francisco vein, Morococha, Jauli, Peru. Vanadinite containing As Varietal name. Clay Canyon, Fairfield near , Utah Co. Berge Zdjár, Moravia, Czech Republic. Davib-East farm, Karibib near , Namibia. Ferrian aluminian diopside or augite Varietal name. Fayal, Azores, Atlantic Ocean. Ilmenogorsk-Vishnevogorsk alkaline complex, Miass near, Chelyabinsk. Carbonate-fluorapatite Varietal name. Muscovite with up to 4. Skien, Oslo near , Norway. Hydrous nickel silicates Varietal name. Pizzo Cervandone Cherbadung , Piemonte, Italy.  $\text{Al OH}_3$  Class: Capo di Bove, Roma, Italy.  $\text{Na}_2\text{Ca SO}_4$  Class: Villarubia, Ocana near , Toledo, Spain. Little Deer Park, Co. Hollerter Zug, Kirchen, Rheinland, Germany. Colorless variety of beryl Varietal name. Majuba Hill Mine, Pershing Co. Grafton near , Melvin Mt.  $\text{Pb}_2 \text{SO}_4 \text{F}_2$  Class: Excelsior mine, Cerro de Pasco, Pasco dept. Storr, Portree, Skye, Scotland. Helgeraen, Langesundfjord, Telemark, Norway. Franklin Furnace, Sussex Co. Searles Lake, San Bernardino Co. Bulfontein, Kimberley, South Africa. Mormors mine, Tunaberg, Sweden. Yellow-golden yellow variety of beryl Varietal name. Schwarzenberg, Sachsen Saxony , Germany. Ehrenfriedersdorf, Sachsen Saxony , Germany. Brownish red to orangish red variety of grossular, contains Fe. Limoges near , Haute-Vienne, France. Emerald-green variety of spodumene, contains Cr Varietal name. Kajlidongri, Jhabua State, India central. Subgroup in the amphibole group. Oravita Oravicza , Banat, Romania. Magnesian, manganian Fayalite Varietal name. Brookville, Windsor near , Hants Co. Erie and Enterprize veins, Ellsworth, Mammoth dist.  $\text{CaBe}_2 \text{PO}_4$  Class: Colorless variety of opal Varietal name. Enstatite-ferrosilite series Varietal name. Blue variety of elbaite Varietal name. Nanzenbach, Dillenburg near , Germany. Ishikawa district, Iwaki, Fukushima Pref. Gem varieties of jadeite or nephrite Varietal name. Jaroso ravine, Sierra Almagro, Ciudad Real dist. Colored, translucent to opaque cryptocrystalline variety of quartz Varietal name. Stassfurt deposit, Sachsen Saxony , Germany. Lilac to pink variety of spodumene Varietal name. Paul Island, Labrador coast , Newfoundland, Canada. Greifenstein, Ehrenfriedersdorf, Sachsen, Germany. Jas Roux, Hautes-Alpes, France. Fowey Consols mine, Tywardreath St. Blazey , Cornwall, England. Britannia mine, Snowdon, Caernarvonshire Gwynedd , Wales. Gem variety of lazurite Varietal name. Huelgoat mine, Brittany, France. Tiburon Peninsula, Marin Co. Mixture of crandallite and apatite Varietal name. Partially dehydrated laumontite Varietal name. South Portland, Cumberland Co. Ferrian biotite Varietal name. Alteration products of ilmenite or pseudorutile Varietal name. General term for hydrous iron oxides Varietal name. Goose Creek Quarry, Loudoun Co. Wheal Jane, Truro, Cornwall, England. Mancayan, Lepanto district, Luzon island, Philippines. Calcite containing Mn Varietal name. New London, New London Co. Ojuela mine, Mapimi, Durango, Mexico. Greiner, Sterzing, Tyrol, Austria. Sphalerite containing Fe and having black color Varietal name. Hematite pseudomorph of magnetite Varietal name. Cromford, Matlock near , Derbyshire, England. Stirling Hill mine, Ogdensburg, Sussex Co. Red Mountain locality 2 , Mendocino Co. Massive sepiolite suitable for carving Varietal name. Andradite containing Ti, black color Varietal name. Churchill, Mendip Hills, Somerset, England. Reddington Mine, Lake Co. Schneeberg, Sachsen Saxony , Germany. Intermediate member of the scapolite group.

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## Chapter 3 : Cartea Structural Classification of Minerals: J. Lima-de-Faria Â | Books Express

*By J. Lima-de-Faria. ISBN ISBN ISBN ISBN This publication provides the 3rd quantity of an entire improvement of the hot structural type of minerals, that's in accordance with the inner crystal constitution, and is consequently its usual class. as a result of the huge area of the mineral nation, this paintings is split in 3.*

Vanadinite is an important ore of vanadium and a minor source of lead. Quartz Quartz is the most abundant mineral in the crust. It has many useful properties. Topaz Topaz is a mineral best known as a durable gemstone and its use in Mohs Hardness Scale. Calcite Calcite is a carbonate mineral with industrial, agricultural, medical and many other uses. Diopside Diopside - Gem material, ornamental stone, diamond indicator, industrial mineral. Fluorescent Minerals Fluorescent Minerals glow with spectacular colors under ultraviolet light. Mineral Hardness Mohs Hardness Scale is a set of reference minerals used for classroom hardness testing. Garnet Garnet is best known as a red gemstone. It occurs in any color and has many industrial uses. Geodes Geodes look like ordinary rocks on the outside but can be spectacular inside! The Mineral Diamond is a mineral with unique properties and many gem and industrial uses! Geology Dictionary Geology Dictionary - contains thousands of geological terms with their definitions. Corundum Corundum is the third hardest mineral. It is also the mineral of ruby and sapphire. Herkimer Diamonds Herkimer Diamonds Doubly-terminated quartz crystals used as specimens and gems. Streak Test The Streak Test is a method to determine the color of a mineral in powdered form. Minerals are the building blocks of our society. We use items made with them every day. Variscite Variscite is a yellowish green to bluish green mineral. It is similar to turquoise and cut as a gem. Mineraloids Mineraloids are amorphous naturally-occurring inorganic solids that lack crystallinity. Serpentine Serpentine - metamorphic rocks used in construction, architecture and lapidary work. Zircon Zircon is the primary ore of zirconium and a gemstone that is available in many colors. Rhodonite Rhodonite - a manganese silicate used as a minor ore of manganese and as a gemstone. A constituent of meteorites. Azurite Azurite - Used as an ore of copper, a pigment, ornamental stone and gem material. Hematite Hematite - the most important source of iron ore and mineral pigment since prehistory. Kyanite Kyanite is a metamorphic mineral used to make porcelain, abrasive products and gems. Cinnabar Cinnabar - the only important ore of mercury. Used in pigments until its toxicity was realized. Is Water a Mineral? Are Water and Ice Minerals? Comparing their properties with the definition of a mineral. Uses of Gold Gold has unique properties that make it one of the most useful minerals. Chalcopyrite Chalcopyrite - The most important ore of copper for over five thousand years. Ilmenite Ilmenite - The primary ore of titanium and source of most titanium dioxide. Tourmaline Tourmaline - the most colorful mineral and natural gem material on Earth. Spodumene Spodumene is a pegmatite mineral, an ore of lithium and sometimes a gemstone. Tumbled Stones Tumbled Stones are rocks that have been rounded, smoothed and polished in a rock tumbler. Mineral Rights Mineral Rights - Who owns the minerals under your land? Who wants to buy them? Rock Tumbling Rock Tumblers - All about rock tumblers and rock tumbling. Read before you buy a tumbler. Hardness Picks Hardness Picks - Mohs hardness testing with precise and easy-to-use hardness picks. Snowflakes How Do Snowflakes Form? They start as tiny crystals. Some grow on the way down. Dangerous Mines Abandoned Mine Accidents kill several people every year. Education can prevent deaths. Limonite Limonite - an amorphous iron oxide. An ore of iron and a pigment since prehistory. Geology Tools Geology Tools - Hammers, field bags, hand lenses, maps, hardness picks, gold pans. Crystal Habit Crystal Habit is the external shape displayed by a crystal or an aggregate of crystals. Uses of Talc Talc is a soft mineral used in cosmetics, paper, paint, ceramics and many other products. Learn how to pan for gold! Hand Lens Hand Lens A power folding magnifier in a metal case. A frequently used lab and field tool. Triboluminescence Triboluminescence is flash produced when a mineral is rubbed, scratched or broken. Images, code, and content on this website are property of Geology.

## Chapter 4 : Magnesium: The mineralogy of Magnesium

*"This volume completes the three-volume series with the more complicated crystal structures that contain H<sub>2</sub>O molecules and organic minerals. These volumes appear to be the first published structure-based classification of the whole mineral kingdom.*

Clay mineral, any of a group of important hydrous aluminum silicates with a layer sheetlike structure and very small particle size. They may contain significant amounts of iron, alkali metals, or alkaline earths. General considerations The term clay is generally applied to 1 a natural material with plastic properties, 2 particles of very fine size, customarily those defined as particles smaller than two micrometres 7. Although, in a broader sense, clay minerals can include virtually any mineral of the above-cited particle size, the definition adapted here is restricted to represent hydrous-layer silicates and some related short-range ordered aluminosilicates, both of which occur either exclusively or frequently in very fine-size grades. The development of X-ray diffraction techniques in the s and the subsequent improvement of microscopic and thermal procedures enabled investigators to establish that clays are composed of a few groups of crystalline minerals. The introduction of electron microscopic methods proved very useful in determining the characteristic shape and size of clay minerals. Clay minerals are composed essentially of silica, alumina or magnesia or both, and water, but iron substitutes for aluminum and magnesium in varying degrees, and appreciable quantities of potassium, sodium, and calcium are frequently present as well. Some clay minerals may be expressed using ideal chemical formulas as the following: The SiO<sub>2</sub> ratio in a formula is the key factor determining clay mineral types. These minerals can be classified on the basis of variations of chemical composition and atomic structure into nine groups: Information and structural diagrams for these groups are given below. Montmorillonite and nontronite are named after the localities Montmorillon and Nontron, respectively, in France, where these minerals were first reported. Because sepiolite is a light and porous material, its name is based on the Greek word for cuttlefish, the bone of which is similar in nature. The name saponite is derived from the Latin sapon meaning soap, because of its appearance and cleaning ability. Baileychlore, brindleyite, corrensite, sudoite, and tosudite are examples of clay minerals that were named after distinguished clay mineralogists Sturges W. Structure General features The structure of clay minerals has been determined largely by X-ray diffraction methods. The essential features of hydrous-layer silicates were revealed by various scientists including Charles Mauguin, Linus C. West, and John W. Gruner through the late s to mids. These features are continuous two-dimensional tetrahedral sheets of composition Si<sub>2</sub>O<sub>5</sub>, with SiO<sub>4</sub> tetrahedrons Figure 1 linked by the sharing of three corners of each tetrahedron to form a hexagonal mesh pattern Figure 2A. Frequently, silicon atoms of the tetrahedrons are partially substituted for by aluminum and, to a lesser extent, ferric iron. The apical oxygen at the fourth corner of the tetrahedrons, which is usually directed normal to the sheet, forms part of an adjacent octahedral sheet in which octahedrons are linked by sharing edges Figure 3. The junction plane between tetrahedral and octahedral sheets consists of the shared apical oxygen atoms of the tetrahedrons and unshared hydroxyls that lie at the centre of each hexagonal ring of tetrahedrons and at the same level as the shared apical oxygen atoms Figure 4. The former type of octahedral sheet is called trioctahedral, and the latter dioctahedral. Such sheets, called hydroxide sheets, occur singly, alternating with silicate layers in some clay minerals. The unit silicate layer formed by aligning one octahedral sheet to one tetrahedral sheet is referred to as a 1: In another type, the unit silicate layer consists of one octahedral sheet sandwiched by two tetrahedral sheets that are oriented in opposite directions and is termed a 2: These structural features, however, are limited to idealized geometric arrangements. A Ideal hexagonal tetrahedral sheet. B Contracted sheet of ditrigonal symmetry owing to the reduction of mesh size of the tetrahedral sheet by rotation of the tetrahedrons. Single octahedron shaded and the sheet structure of octahedral units. Schematic presentation of A 1: Real structures of clay minerals contain substantial crystal strains and distortions, which produce irregularities such as deformed octahedrons and tetrahedrons rather than

polyhedrons with equilateral triangle faces, ditrigonal symmetry modified from the ideal hexagonal surface symmetry, and puckered surfaces instead of the flat planes made up by the basal oxygen atoms of the tetrahedral sheet. If the tetrahedral sheet contains only silicon in the cationic site and has an ideal hexagonal symmetry, the longer unit dimension within the basal plane is  $a$ . By this distortion mechanism, tetrahedral and octahedral sheets of a wide range of compositions resulting from ionic substitutions can link together and maintain silicate layers. Among ionic substitutions, those between ions of distinctly different sizes most significantly affect geometric configurations of silicate layers. Another significant feature of layer silicates, owing to their similarity in sheet structures and hexagonal or near-hexagonal symmetry, is that the structures allow various ways to stack up atomic planes, sheets, and layers, which may be explained by crystallographic operations such as translation or shifting and rotation, thereby distinguishing them from polymorphs. The former involves one-dimensional variations, but the latter generally three-dimensional ones. The variety of structures resulting from different stacking sequences of a fixed chemical composition are termed polytypes. If such a variety is caused by ionic substitutions that are minor but consistent, they are called polytypoids.

**Kaolin - serpentine group** Minerals of this group are 1: Their basic unit of structure consists of tetrahedral and octahedral sheets in which the anions at the exposed surface of the octahedral sheet are hydroxyls see Figure 4. A typical dioctahedral species of this group is kaolinite, with an ideal structural formula of  $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$ . Kaolinite is electrostatically neutral and has triclinic symmetry. Oxygen atoms and hydroxyl ions between the layers are paired with hydrogen bonding. Because of this weak bonding, random displacements between the layers are quite common and result in kaolinite minerals of lower crystallinity than that of the triclinic kaolinite. Dickite and nacrite are polytypic varieties of kaolinite. Both of them consist of a double 1:1 layer structure. Halloysite also has a composition close to that of kaolinite and is characterized by its tubular nature in contrast to the platy nature of kaolinite particles. Although tubular forms are the most common, other morphological varieties are also known: The structure of halloysite is believed to be similar to that of kaolinite, but no precise structure has been revealed yet. The dehydrated form has a basal spacing about the thickness of a kaolinite layer approximately  $1.7a$ . The difference of  $0.2a$ . Consequently, the layers of halloysite in the hydrated form are separated by monomolecular water layers that are lost during dehydration. In trioctahedral magnesium species, chrysotile, antigorite, and lizardite are commonly known; the formula of these three clay minerals is  $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$ . Chrysotile crystals have a cylindrical roll morphology, while antigorite crystals exhibit an alternating wave structure. These morphological characteristics may be attributed to the degree of fit between the lateral dimensions of the tetrahedral and octahedral sheets. On the other hand, lizardite crystals are platy and often have a small amount of substitution of aluminum or ferric iron for both silicon and magnesium. This substitution appears to be the main reason for the platy nature of lizardite. Planar polytypes of the trioctahedral species are far more complicated than those of dioctahedral ones, owing to the fact that the trioctahedral silicate layer has a higher symmetry because all octahedral cationic sites are occupied. In addition, recent detailed structural investigations have shown that there are considerable numbers of hydrous-layer silicates whose structures are periodically perturbed by inversion or revision of  $\text{SiO}_4$  tetrahedrons. Modulated structures therefore produce two characteristic linkage configurations: Antigorite is an example of the strip configuration in the modulated 1:1 layer structure. Greenalite, a species rich in ferrous iron, also has a modulated layer structure containing an island configuration.

**Pyrophyllite - talc group** Minerals of this group have the simplest form of the 2:1 layer structure. Pyrophyllite and talc represent the dioctahedral and trioctahedral members, respectively, of the group. One-layer triclinic and two-layer monoclinic forms are known for polytypes of pyrophyllite and talc. The ferric iron analogue of pyrophyllite is called ferripyrophyllite. Mica mineral group Mica minerals have a basic structural unit of the 2:1 layer structure. This results in a charge deficiency that is balanced by potassium ions between the unit layers. Formulas rendered may vary slightly due to possible substitution within certain structural sites. Various polytypes of the micas are known to occur. Among them, one-layer monoclinic 1M, two-layer monoclinic 2M, including 2M1 and 2M2, and three-layer trigonal 3T polytypes are most common. The majority of clay-size micas are dioctahedral aluminous species; those similar to muscovite are called illite and

generally occur in sediments. The illites are different from muscovite in that the amount of substitution of aluminum for silicon is less; sometimes only one-sixth of the silicon ions are replaced. This reduces a net unbalanced-charge deficiency from 1 to about 0. As a result, the illites have a lower potassium content than the muscovites. In the illites, stacking disorders of the layers are common, but their polytypes are often unidentifiable. Celadonite and glauconite are ferric iron-rich species of dioctahedral micas. Glauconite is a dioctahedral mica species with tetrahedral Al substitution greater than 0. Unlike illite, a layer charge deficiency of celadonite and glauconite arises largely from the unbalanced charge due to ionic substitution in the octahedral sheets. Vermiculite The vermiculite unit structure consists of sheets of trioctahedral mica or talc separated by layers of water molecules; these layers occupy a space about two water molecules thick approximately 4. This charge deficiency is satisfied with interlayer cations that are closely associated with the water molecules between the mica layers. The interlayer cation, however, is readily replaced by other inorganic and organic cations. A number of water molecules are related to the hydration state of cations located at the interlayer sites. Therefore, the basal spacing of vermiculite changes from about It has been reported that some dioctahedral analogues of vermiculite occur in soils. Smectite The structural units of smectite can be derived from the structures of pyrophyllite and talc. Unlike pyrophyllite and talc, the 2: The net charge deficiency is normally smaller than that of vermiculite from 0. This weak bond offers excellent cleavage between the layers. The distinguishing feature of the smectite structure is that water and other polar molecules in the form of certain organic substances can, by entering between the unit layers, cause the structure to expand in the direction normal to the basal plane. Thus this dimension may vary from about 9. In the latter type of smectites, those in which ferric iron is a dominant cation in the octahedral sheet instead of aluminum and magnesium, are called nontronite. The tetrahedral substitution is responsible for the net charge deficiency in the smectite minerals of this series. Besides magnesium and ferrous iron, zinc, cobalt, and manganese are known to be dominant cations in the octahedral sheet. Zinc dominant species are called sauconite. There are other types of trioctahedral smectites in which the net charge deficiency arises largely from the imbalanced charge due to ionic substitution or a small number of cation vacancies in the octahedral sheets or both conditions. Ideally  $x$  is zero, but most often it is less than 0.

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### Chapter 5 : Structural Classification of Minerals : J. Lima-de-Faria :

*General Chemical Formulas and Organic Minerals - Terapeutica Homeopatica: Compendio de Tratamientos Homeopaticos Completos Para Cada Afeccion - Taschenbuch Fur Den Fabrikbetrieb - That Old Girl Of Mine / I'm The Guy medley - So.*

Exceptions include lithium , sodium , potassium and ammonium carbonates, as well as many uranium carbonates. In aqueous solution , carbonate, bicarbonate, carbon dioxide, and carbonic acid exist together in a dynamic equilibrium. In strongly basic conditions, the carbonate ion predominates, while in weakly basic conditions, the bicarbonate ion is prevalent. Thus sodium carbonate is basic, sodium bicarbonate is weakly basic, while carbon dioxide itself is a weak acid. Carbonated water is formed by dissolving CO<sub>2</sub> in water under pressure. When the partial pressure of CO<sub>2</sub> is reduced, for example when a can of soda is opened, the equilibrium for each of the forms of carbonate carbonate, bicarbonate, carbon dioxide, and carbonic acid shifts until the concentration of CO<sub>2</sub> in the solution is equal to the solubility of CO<sub>2</sub> at that temperature and pressure. In living systems an enzyme, carbonic anhydrase , speeds the interconversion of CO<sub>2</sub> and carbonic acid. Although the carbonate salts of most metals are insoluble in water, the same is not true of the bicarbonate salts. In solution this equilibrium between carbonate, bicarbonate, carbon dioxide and carbonic acid changes consonant to changing temperature and pressure conditions. In the case of metal ions with insoluble carbonates, e. CaCO<sub>3</sub>, formation of insoluble compounds results. This is an explanation for the buildup of scale inside pipes caused by hard water. Carbonate ester In organic chemistry a carbonate can also refer to a functional group within a larger molecule that contains a carbon atom bound to three oxygen atoms, one of which is double bonded. Important organocarbonates include dimethyl carbonate , the cyclic compounds ethylene carbonate and propylene carbonate , and the phosgene replacement, triphosgene. Biological significance[ edit ] It works as a buffer in the blood as follows: This causes the equation to shift right, essentially increasing the concentration of hydrogen ions, causing a more acidic pH. Three important reversible reactions control the above pH balance: Crucially, this same buffer operates in the oceans. It is a major factor in climate change and the long-term carbon cycle, due to the large number of marine organisms especially coral which are formed of calcium carbonate. Increased solubility of carbonate through increased temperatures results in lower production of marine calcite and increased concentration of atmospheric carbon dioxide. This, in turn, increases Earth temperature and is a part of the carbon cycle largely ignored by the global news media.

*The most time, the rate of discovery of new minerals is general approach of the structural systematics is steadily increasing. Now it is found that natural based on the analysis of the strength distribution processes select some mineral species, and and of the directional character of the bonds in this number is increasing by*

One definition of a mineral encompasses the following criteria: In the simplest sense, this means the mineral must be solid. Represented by a chemical formula. Minerals are chemical compounds, and as such they can be described by fixed or a variable formula. Many mineral groups and species are composed of a solid solution; pure substances are not usually found because of contamination or chemical substitution. For example, the olivine group is described by the variable formula  $Mg, Fe 2SiO_4$ , which is a solid solution of two end-member species, magnesium-rich forsterite and iron-rich fayalite, which are described by a fixed chemical formula. Mineral species themselves could have a variable composition, such as the sulfide mackinawite,  $Fe, Ni 9S_8$ , which is mostly a ferrous sulfide, but has a very significant nickel impurity that is reflected in its formula. This generally means crystalline; however, crystals are also periodic, so the broader criterion is used instead. The formal definition of a mineral approved by the IMA in Biogenic substances are explicitly excluded by the IMA: However, if geological processes were involved in the genesis of the compound, then the product can be accepted as a mineral. Recent changes have included the addition of an organic class, in both the new Dana and the Strunz classification schemes. The IMA Commission on New Minerals and Mineral Names adopted in a hierarchical scheme for the naming and classification of mineral groups and group names and established seven commissions and four working groups to review and classify minerals into an official listing of their published names. For example, Lowenstam stated that "organisms are capable of forming a diverse array of minerals, some of which cannot be formed inorganically in the biosphere. Skinner views all solids as potential minerals and includes biominerals in the mineral kingdom, which are those that are created by the metabolic activities of organisms. Skinner expanded the previous definition of a mineral to classify "element or compound, amorphous or crystalline, formed through biogeochemical processes," as a mineral. Microorganisms can precipitate metals from solution, contributing to the formation of ore deposits. They can also catalyze the dissolution of minerals. To date, over 80, liquid crystalline compounds have been identified. The formal Nickel definition explicitly mentioned crystallinity as a key to defining a substance as a mineral. A article defined icosahedrite, an aluminium-iron-copper alloy as mineral; named for its unique natural icosahedral symmetry, it is a quasicrystal. Unlike a true crystal, quasicrystals are ordered but not periodic. Minerals are not equivalent to rocks. A rock is an aggregate of one or more minerals [32] or mineraloids. Some rocks, such as limestone or quartzite, are composed primarily of one mineral—calcite or aragonite in the case of limestone, and quartz in the latter case. Rocks can also be composed entirely of non-mineral material; coal is a sedimentary rock composed primarily of organically derived carbon. The major examples of these are quartz, the feldspars, the micas, the amphiboles, the pyroxenes, the olivines, and calcite; except for the last one, all of these minerals are silicates. For example, muscovite, a white mica, can be used for windows sometimes referred to as isinglass, as a filler, or as an insulator. Gems are minerals with an ornamental value, and are distinguished from non-gems by their beauty, durability, and usually, rarity. There are about 20 mineral species that qualify as gem minerals, which constitute about 35 of the most common gemstones. Gem minerals are often present in several varieties, and so one mineral can account for several different gemstones; for example, ruby and sapphire are both corundum,  $Al_2O_3$ . The basic level of definition is that of mineral species, each of which is distinguished from the others by unique chemical and physical properties. For example, quartz is defined by its formula,  $SiO_2$ , and a specific crystalline structure that distinguishes it from other minerals with the same chemical formula termed polymorphs. When there exists a range of composition between two mineral species, a mineral series is defined. For example, the biotite series is represented by variable amounts of the endmembers phlogopite, siderophyllite, annite, and eastonite. In

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contrast, a mineral group is a grouping of mineral species with some common chemical properties that share a crystal structure. The pyroxene group has a common formula of  $XY_{2}Si_{2}O_{6}$ , where X and Y are both cations, with X typically bigger than Y; the pyroxenes are single-chain silicates that crystallize in either the orthorhombic or monoclinic crystal systems. Finally, a mineral variety is a specific type of mineral species that differs by some physical characteristic, such as colour or crystal habit. An example is amethyst, which is a purple variety of quartz. James Dwight Dana, a leading geologist of his time, first published his *System of Mineralogy* in 1837; as of 1990, it is in its eighth edition. The Dana classification assigns a four-part number to a mineral species. Its class number is based on important compositional groups; the type gives the ratio of cations to anions in the mineral, and the last two numbers group minerals by structural similarity within a given type or class. The less commonly used Strunz classification, named for German mineralogist Karl Hugo Strunz, is based on the Dana system, but combines both chemical and structural criteria, the latter with regards to distribution of chemical bonds. Linnaeus divided the natural world into three kingdoms – plants, animals, and minerals – and classified each with the same hierarchy. Eight elements account for most of the key components of minerals, due to their abundance in the crust. For example, a magma rich in iron and magnesium will form mafic minerals, such as olivine and the pyroxenes; in contrast, a more silica-rich magma will crystallize to form minerals that incorporate more  $SiO_2$ , such as the feldspars and quartz. In a limestone, calcite or aragonite both  $CaCO_3$  form because the rock is rich in calcium and carbonate. A corollary is that a mineral will not be found in a rock whose bulk chemistry does not resemble the bulk chemistry of a given mineral with the exception of trace minerals. For example, kyanite,  $Al_2SiO_5$  forms from the metamorphism of aluminium-rich shales; it would not likely occur in aluminium-poor rock, such as quartzite. The chemical composition may vary between end member species of a solid solution series. For example, the plagioclase feldspars comprise a continuous series from sodium-rich end member albite  $NaAlSi_3O_8$  to calcium-rich anorthite  $CaAl_2Si_2O_8$  with four recognized intermediate varieties between them given in order from sodium- to calcium-rich: Chemical substitution and coordination polyhedra explain this common feature of minerals. In nature, minerals are not pure substances, and are contaminated by whatever other elements are present in the given chemical system. As a result, it is possible for one element to be substituted for another. In the example of plagioclase, there are three cases of substitution. Feldspars are all framework silicates, which have a silicon-oxygen ratio of 2: In mineralogy, coordination polyhedra are usually considered in terms of oxygen, due its abundance in the crust. An alternate way of describing the coordination of the silicate is by a number: Various cations have a specific range of possible coordination numbers; for silicon, it is almost always 4, except for very high-pressure minerals where the compound is compressed such that silicon is in six-fold octahedral coordination with oxygen. Bigger cations have a bigger coordination numbers because of the increase in relative size as compared to oxygen the last orbital subshell of heavier atoms is different too. Changes in coordination numbers leads to physical and mineralogical differences; for example, at high pressure, such as in the mantle, many minerals, especially silicates such as olivine and garnet, will change to a perovskite structure, where silicon is in octahedral coordination. Illustrated here is a pseudomorph of kaolinite after orthoclase. Here, the pseudomorph preserved the Carlsbad twinning common in orthoclase. Changes in temperature and pressure and composition alter the mineralogy of a rock sample. Changes in composition can be caused by processes such as weathering or metasomatism hydrothermal alteration. Changes in temperature and pressure occur when the host rock undergoes tectonic or magmatic movement into differing physical regimes. Changes in thermodynamic conditions make it favourable for mineral assemblages to react with each other to produce new minerals; as such, it is possible for two rocks to have an identical or a very similar bulk rock chemistry without having a similar mineralogy. This process of mineralogical alteration is related to the rock cycle. An example of a series of mineral reactions is illustrated as follows. When exposed to weathering, it reacts to form kaolinite  $Al_2Si_2O_5(OH)_4$ , a sedimentary mineral, and silicic acid: For example, quartz will change into a variety of its  $SiO_2$  polymorphs, such as tridymite and cristobalite at high temperatures, and coesite at high pressures. A mineral can be identified by several physical properties, some of

them being sufficient for full identification without equivocation. In other cases, minerals can only be classified by more complex optical, chemical or X-ray diffraction analysis; these methods, however, can be costly and time-consuming. Physical properties applied for classification include crystal structure and habit, hardness, lustre, diaphaneity, colour, streak, cleavage and fracture, and specific gravity. Other less general tests include fluorescence, phosphorescence, magnetism, radioactivity, tenacity response to mechanical induced changes of shape or form, piezoelectricity and reactivity to dilute acids. Crystal twinning Topaz has a characteristic orthorhombic elongated crystal shape. Crystal structure results from the orderly geometric spatial arrangement of atoms in the internal structure of a mineral. This crystal structure is based on regular internal atomic or ionic arrangement that is often expressed in the geometric form that the crystal takes. Even when the mineral grains are too small to see or are irregularly shaped, the underlying crystal structure is always periodic and can be determined by X-ray diffraction. Crystals are restricted to 32 point groups, which differ by their symmetry. These groups are classified in turn into more broad categories, the most encompassing of these being the six crystal families.

Chapter 7 : Mineral - Wikipedia

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Minerals and their names that were reported in the literature and generally accepted by professional scientists before were accepted by the CNMNC, without review or change. From onward all new minerals had to be approved by the Commission. In order to clarify procedures and language, in Ernest H. Nickel went on to explain what the Commission meant by each of the words. Nickel did not expand upon his statement that a mineral is an "element or a chemical compound". The mineral may be a single chemical element, such as carbon C [diamond or graphite], sulphur S , gold Au , or copper Cu. Natural metal alloys with definite compositions may be approved as minerals [e. Or it may be a chemical compound that has a more-or-less definite empirical chemical formula that represents its composition. Many NMNMC approved minerals allow substitutions of similar ions in specific crystallographic sites e. It is well known that many minerals exist as end members of a continuous series and in most cases are never purely one end or the other of the series. Thus, while the pure end member has a definite composition and chemical formula, specimens within the series, excluding these end members, will exhibit some variability in composition. In nature nearly all? A rock is not a mineral, nor is a mineral a rock. However, the components of a rock are minerals. Most types of rock have multiple minerals, a few have only one. For example, by definition, granite is composed of alkali feldspar s and quartz. They are the essential minerals to make the rock granite. Basalt is a rock that has plagioclase feldspars and pyroxenes as essential minerals. Either rock may have other minerals but they are not required. Limestone, and quartzite are each composed mostly of a single mineral calcite and quartz respectively , but the areal extent of their deposition makes them, by definition, a rock. These essentially single mineral rocks are termed monomineralic rocks; anorthosite composed mostly of plagioclase and marble composed mostly of calcite are two more examples. A mineral cannot be a mixture. For example, limonite is a mixture of hydrated iron oxides and hydroxides and is not a single chemical phase entity. It is mostly intimately mixed goethite, akaganeite, lepidocrocite, and jarosite. Another mixture, wad, is a variable mix of manganese oxides. Crystallinity 2D Xl-Array Minerals are nearly always crystalline substances. That is, they exhibit a short range, three dimensional, periodicity of their atomic structure. When suitably illuminated by X-rays, or similar wavelengths of radiation, a pattern of spots is generated which can be interpreted as planes identifiable by Miller Indices. The dimensions of the unit cell and axial angles are also required. There is only one currently-approved mineral that is a liquid at normal temperatures, mercury , which, being a liquid, has no crystal structure and cannot produce a diffraction pattern. Water is not a mineral species, but the solid form ice is. There are, however, a small number of amorphous minerals. Opal is, perhaps, the best known. When the composition is precisely defined through careful analysis, the substance is proven to be unique and a single phase, and when it is shown that a diffraction pattern is impossible, an amorphous substance may be considered by the CNMNC. However this is on a case-by-case basis. In some rocks, radioactivity has destroyed the crystal structure of one or more minerals. Those substances are said to be metamict. If the metamictization occurred with reasonable certainty due to geologic processes, and it can be shown that the original substance was crystalline and of the same bulk composition, then it can be approved as a mineral. Anthropogenic substances Anthropogenic substances are those produced by humans. They are not minerals. Any crystals that are found on or in any man-made object are not a mineral. Anthropogenic substances Modified by Geologic Processes In general, the CNMNC does not approve substances as minerals when they are formed by geologic processes operating on anthropogenic substances. The major exception was the "grandfathering" of many of the minerals created by action of sea water on slags at Laurium, Greece, and some crystals found on corroded processed metals, such as abhurite found on tin ingots underwater. Crystalline substances that are formed by natural weathering, solution, and crystallization as a new depositional phase on mine tailings, ore dumps, or slag heaps are seldom approved. Biogenic substances

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Nearly all chemical compounds that were formed strictly from biological materials by biological processes are not minerals. If geological processes were involved in the formation of the compound then it may be accepted as a mineral. There are several minerals that result from the action of calcium rich water percolating through bat guano in caves. Many phosphate mineral deposits contain minerals crystallized in large part on the ocean floor from the mobilization of the phosphate ion from fish bone, teeth, etc. The mobilization and precipitation is a geologic process. Coal, which has the appearance of a massive mineral, has no crystalline structure and is not a mineral. Rather, it is either a sedimentary or metamorphic rock, in either case of biologic origin.

**Extraterrestrial substances** In the past, the definition of a mineral often included the words, "from the earth". With the advent of the exploration of space, and even from the study of meteorites that have landed on our planet, it became apparent that "space materials" and earth materials are much the same. Geological processes on earth and "out there" are also quite similar. Minerals from the moon and planets, asteroids and comets, and meteorites are often identical with those found in the crust of the earth. Some minerals from these sources have been found to be unique. A mineral is a chemical element or compound that: The only liquid approved as a mineral is mercury. And most importantly, has been exhaustively studied and characterized by mineralogists, declared unique in its composition and structure, and the original specimens that was studied deposited for preservation in a professionally curated museum.

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*5 Capacity Restrictions The capacity of plant} with vintage v depends on the initial capacity inicap and capacity adjustments in subsequent years tn. Capacity adjustment can either mean an addition to or replacement of existing plants.*

They are many compounds used as solvents, medicine, catalysts etc. Let us see organic compounds examples in detail. These are the compounds which have just carbon and hydrogen elements in them. The bonds between two carbons can vary as one, two or even three. These compounds are used widely. Like ethene is used in making plastic bags i. While the acetylene gas is used in gas welding for joining of metal parts. As the name indicates, these compounds are similar to the above but form a ring in their structures. They are formed by a single bond between two carbon atoms in the chain. Compounds with functional groups. The same aliphatic compounds can have Oxygen, nitrogen , sulfur, etc. These chemical points in the molecule are called as functional groups. These functional groups impart a distinctive character to the plain aliphatic chain or rings. Functional groups having carbon, hydrogen, and oxygen. These have an OH group linked to a carbon atom in the chain. Examples include formaldehyde, acetaldehyde. Formaldehyde is used to store biological specimens. They are also found in carbohydrate monomers. These are the structures having oxygen linked with a double bond to a carbon atom i. Some examples include acetone, glucose, sucrose, fructose, etc. Acetone is used as a solvent. While Fructose and other sugars are used as food source for carbohydrates. Alcohols are those molecules having -OH moiety linked to carbon atom directly. There are many types of alcohols based on the molecular size. They are used as solvents due to their high polarity. But not all of them can be used due to volatility issues. Ethyl alcohol, methyl alcohol and propane alcohol are widely used due to volatility and solubility properties. Also ethanol is widely used for alcoholic beverages and also as a disinfectant to kill microbes. These are the molecules which form oils and fats. Examples include Arachis oil, sesame oil, mustard oil, etc. They have long chemical structure and susceptible to oxidation when kept open for air for long periods. Some of them are used as cooking oil, for massage, etc. They are the compounds having a profuse odor. Hence named as ethers. They have an oxygen atom linked to two carbon atoms. Diethyl ether used as an anesthetic. When esters break down, they release fatty acids and alcohols. They have -COOH structure in their molecules. These fatty acids are used to make soaps. These are the compounds formed by reaction of acids and amines. Amides form substances like proteins, silk, and even drugs like paracetamol. These are basic in nature and have an ammonia moiety. Examples codeine used for cough treatment. They are used as dyes to impart color to drugs, indicators in titration, etc. These structures have both carboxylic and also amine moiety. There are many amino acids in the body. They help in the maintenance of body through the formation of proteins. These compounds are cyclic in nature but are unsaturated. They have an odor of their own. Benzene used as a solvent. These structures are quite complex as seen in the diagram above. They form cholesterol and other structures. They are derived from fats and lipids. They are used as body boosters, drugs. Perchloric acid  $\text{HClO}_4$  , citric acid, tartaric acid. Unlike inorganic acids which are liquid in nature, these acids are in solid state. They are also not as strong as inorganic acids. These are the ones which have halogens in their chemistry. Carbon tetra chloride  $\text{CCl}_4$ . These tests help to know the nature of the unknown compound in the lab.

### Chapter 9 : Donald B Peck - What is a Mineral? - The Definition of a Mineral

*"This volume completes the three-volume series with the more complicated crystal structures that contain H 2 O molecules and organic minerals. These volumes appear to be the first published structure-based classification of the whole mineral kingdom.*