Silicates

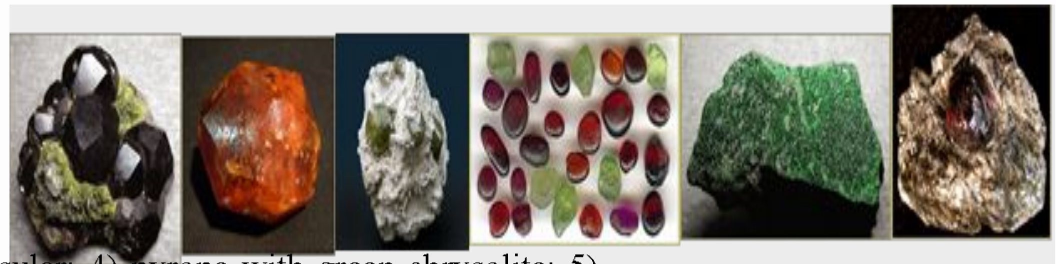
Olivine ***$(Mg,Fe)_2[SiO_4]$*** - isomorphous series: forsterite - *$Mg_2[SiO_4]$*, olivine - *$(Mg,Fe)_2[SiO_4]$*, fayalite - *$Fe_2[SiO_4]$*. It is allocated in the form of grainy solid aggregates and determined by the isometric grains (Figure 1), dark-green, glassy luster and paragenesis.

Origin and paragenesis. Typical hypogene minerals. Rock-forming minerals of ultrabasic and basic rocks. They are associated with skarn and metamorphic processes. Olivine in association with pyroxene, serpentine. Forsterite - in association with diopside, spinel, phlogopite, carbonates. Fayalite with other ferruginous minerals, sometimes with quartz. They are transformed into serpentine and talc under the influence of hydrothermal solutions. Olivine is easily weathered and destroyed in the surface conditions.

Value. Raw materials for producing technical glass. Chrysolite is a gemstone.

Garnets group $R_3^{2+}R_2$

Fe,Cr, Mn,Ti.



1) andradite with epidote; 2) spessartine; 3) grossular; 4) pyrope with green chrysolite; 5) uvarovite; 6) almandine in muscovite schists

Figure 2 – Garnets

Syngony of Garnets is cubic, the most common form is a rhombic dodecahedron.

Garnets have different colors: **pyrope** $Mg_3Al_2[SiO_4]_3$ - dark blood red, often transparent; **almandine** $Fe_3Al_2[SiO_4]_3$ - dark or brownish-red with a weak blue and purple tinge; **andradite** $Ca_3Fe_2[SiO_4]_3$ - red-brown; **grossular** $Ca_3Al_2[SiO_4]_3$ - honey-yellow, green, gray-green, greenish-brown; **uvarovite** $Ca_3Cr_2[SiO_4]_3$ - emerald green; **spessartite** $Mn_3Al_2[SiO_4]_3$ - color can be pink, red, yellowish-brown.

Garnets are determined by isometric grains and cubic crystals (Figure 2-3), the absence of cleavage, high hardness (h. 6.5-7.5).

Origin and paragenesis. Garnets - hypogene minerals. Pyrope - a typical mineral in kimberlites. Almandine -the most often found in nature, is the accessory mineral of acid intrusive and effusive rocks, usual in granite pegmatites and in metamorphic schists and gneisses. The main mass of Garnets andradit- grossular series are connected with skarns in the association with magnetite, epidote, actinolite, wollastonite, hematite, scheelite, and other minerals. Garnets are resistant in the surface conditions, accumulate in placers (pyrope and almandine usually).

Value. They are used as an abrasive material, transparent or translucent varieties- in jewelry.

Hornblende (hornblendite) $Ca_2Na(MgFe)_4(Al,Fe)[(Si,Al)_4O_{11}]_2(OH)_2$ - varieties: basaltic hornblende usually brown, uralite - fibrous pseudomorph of thehornblende by pyroxene.

The crystals are prismatic, columnar, less isometric shape. The solid masses of coarse and fine-grained aggregates, grains are elongated. Hornblende is usually determined by the angles between cleavage, dark green, dark-brown color. From other amphiboles reliably distinguished only by optical properties.

Origin and paragenesis. The main mineral of acid and intermediate igneous rocks (granite, syenite, diorite, granodiorite, and others.) Gabbro pegmatites, metamorphic amphibolites or amphibolite schists and gneisses. During hydrothermal processes hornblende passes into serpentine, chlorite, epidote, carbonate and quartz. During weathering it turns into nontronite, carbonates, opal, limonite, halloysite. It is opacitised in basic lavas and replaced by magnetite and pyroxene.

Value. Has no practical significance.

Talc $Mg_3[Si_4O_{10}](OH)_2$ - foliose, scaly, fine-grained and dense to cryptocrystalline masses. It is easily recognized by the low hardness (h. 1), pale greenish, fatty sensation in the hands, very perfect cleavage *Origin and paragenesis*. 1. It is formed by hydrothermal alteration of ultrabasic rocks - association is serpentine, magnesite, actinolite, magnetite. 2. Metamorphic in talc, talc-actinolite schist and others.

Value. It is used in metallurgy, chemical, rubber, paper industry, in medicine. The refractory material.

Serpentine $Mg_6[Si_4O_{10}](OH)_8$ - (reminds skin snake), variety - antigorite, ophite, serpofite. Dense masses of dark green color, soapy luster, mirror sliding.

Origin and paragenesis. It is formed due to olivine as a result of the impact of hydrothermal solutions on ultrabasic and carbonate rocks. Association with talc, chlorite, brucite, chrysotile asbestos, magnesite, chromite, magnetite. In the surface conditions it goes into montmorillonite, and then into a mixture of hydroxides -Al with silica.

Value. It is used as an ornamental stone and in the chemical industry for obtaining the magnesium compounds.

Kaolinite $Al_4[Si_4O_{10}](OH)_8$ - forms finely dispersed dense aggregates with size of grains about 1 micron and less, earthy, powdery masses. Color is white, painted in a reddish color because of mechanical impurities of iron hydroxides. The hardness 1-1.5. It has a haracteristic "clayey" smell in the moistened condition. It is greasy to the touch. Its precise diagnostics is possible with the help of X-ray diffraction, thermal analysis and electron microscopy.

Origin and paragenesis. It is formed by the weathering of feldspars, micas and other aluminosilicates. Association - feldspar, mica, zeolites. During metamorphism goes into chlorite, talc, mica, and cyanite. During hydrolysis goes into aluminum hydroxides, silica.

Value. It is used in the construction business, ceramic, paper, rubber industry, in the production of refractory materials, linoleum, coloring matter and others.

Minerals of micas group:

muscovite $KAl_2[AlSi_3O_{10}](OH,F)_2$,

biotite $K(Fe,Mg)_3[AlSi_3O_{10}](OH,F)_2$

Muscovite $KAl_2[AlSi_3O_{10}](OH,F)_2$ is formed lamellar crystals, foliose-grained scaly aggregates. Sericite - finely scaly muscovite, has a silky luster. Fuchsite - chromic muscovite bright emerald green color. Muscovite is colorless in thin cleavage plates, gray, dark gray, often with a yellowish or greenish tinge. Luster is a glassy, pearlescent on the cleavage planes. Cleavage is very perfect. Hardness 2-3.

Origin and paragenesis. 1. In pegmatites, mainly in granite. Association with microcline, oligoclase, biotite, schorl, apatite. 2. Ordinary mineral in greisens. Association - topaz, lepidolite, quartz, wolframite, cassiterite, molybdenite, and others. 3. Sericite is

formed in the hydrothermal process. 4. It is also formed in metamorphic rocks - crystalline schists.

Value. Muscovite - dielectric, a valuable raw material for the electrical industry.

Biotite $K(Fe,Mg)_3[AlSi_3O_{10}](OH,F)_2$ - the crystals are lamellars, scaly up to finely scaly aggregates. Color is black. Cleavage is very perfect. Hardness 2-3.

Origin and paragenesis. It is widespread in granites and granite pegmatites; alkaline pegmatites and in metamorphic rocks (gneisses and schists). In igneous rocks - quartz, hornblende, plagioclase, K-feldspars. In pegmatites - muscovite.

Value. Biotite is unsuitable as a dielectric because it contains iron. In some cases from biotite in passing is retrieved rubidium and cesium.

Chlorites $(MgFe)_5\ Al[AlSi_3AO_{10}](OH)_8$ - name is given in connection with the coloring, from Greek "chloros" means "green." The group includes more than 25 chlorite minerals from which are widespread - penninite and clinochlore. The color of chlorites is changed from light yellow to dark green almost black (thuringite). Cleavage is very perfect. Hardness 2-3. Chlorites, reliably differ from each other only by means of X-ray diffraction, thermal analysis, and other diagnostic methods. They have typical green color unlike micas and lack of elasticity.

Origin and paragenesis. Chlorites are characteristic for metamorphic rocks, where they form chlorite green schists.They are also formed by hydrolysis of hornblende and biotite and their transformation into chlorite. This process is called chloritization. They are formed in skarns and hydrothermal veins. During weathering they are transforming into montmorillonite, halloysite, kaolinite. Often they are formed mixed-layer minerals.

Value. Large accumulations of iron chlorites (thuringite, chamosite) - iron ores.


Albite $Na[AlSi_3O_8]$ – color is white. Often found sugary grained albite - finely granular aggregate and albite - cleavelandite - foliose aggregates with bluish color in granite pegmatites.

Oligoclase - is determined by a gray-white color and parallel lineart on the surface of the cleavage. Moonstone is oligoclase with tender blue irisation.

Labradorite - named after the place of discovery, the peninsula of Labrador (North America). Color is black with distinctive blue irisation on the cleavage planes.

Origin and paragenesis. Endogenous minerals. They are formed in the magmatic rocks and pegmatites, metamorphic rocks. They are known in skarns and greisens. They are unstable in the surface conditions and completely decomposed and transformed depending on physico-chemical conditions into kaolinite and other kandites or smectites.

Value. They are used as ceramic raw materials. Labradorite - facing stone. Moonstone - ornamental stone.

Orthoclase ***K[AlSi$_3$O$_8$].*** The name comes from the Greek word "orthoclase" - "right cleaving" because the angle between the directions of cleavage is 90^0. Orthoclase crystals are well-formed, often twins as well as solid crystalline mass. Orthoclase has a characteristic white, greyish and yellowish color. It has the following varieties: *adularia* -water-transparent crystals with characteristic wedge shape; sanidine - high-temperature

modification, typical for volcanic rocks; *moonstone* - adularia with pale blue, silver pearlescent. Orthoclase indistinguishable in appearance from microcline. Precise diagnostics is possible by optical and X-ray data. Orthoclase, as well as microcline has perfect cleavage in two directions and has a hardness 6-6.5.

Origin and paragenesis. Rock-forming mineral for acid and alkaline rocks and pegmatites. The largest accumulations of orthoclase and microcline are associated with granitic pegmatites. Association for acid rocks - quartz, plagioclases, biotite, micas, hornblende, and others.

Value. Raw materials for the ceramic industry. Moonstone is used in jewelry.