Tectosilicates Encyclopedia Article

Tectosilicates

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Tectosilicates

The most abundant rock-forming **minerals** in the **crust** of Earth are the silicates. They are formed primarily of **silicon** and **oxygen**, together with various **metals**. The fundamental unit of these minerals is the silicon-oxygen tetrahedron. These tetrahedra have a pyramidal shape, with a relatively small, positively charged silicon cation (Si^{+4}) in the center and four larger, negatively charged oxygen anions (O^{-2}) at the corners, producing a net charge of −4. **Aluminum** cations (Al^{+3}) may substitute for silicon, and various anions such as hydroxyl (OH–) or fluorine (F–) may substitute for oxygen. In order to form stable minerals, the charges that exist between tetrahedra must be neutralized. This can be accomplished by the sharing of oxygen cations between tetrahedra, or by the binding together of adjacent tetrahedra with various metal cations. This in turn creates characteristic silicate structures that can be used to classify silicate minerals into **cyclosilicates, inosilicates, nesosilicates, phyllosilicates, sorosilicates**, and tectosilicates.

Silicon-oxygen tetrahedra form a three-dimensional framework in the tectosilicates, and minerals of this type comprise about 64% of Earth's crust. In addition, the tectosilicate minerals known as the feldspars are the most abundant group of the rock-forming silicates. Feldspars include the alkali feldspars microcline and orthoclase, both of which have the same chemical formula ($KAlSi_3O_8$), but which form in progressively lower-temperature bodies of **magma** within the earth, and also form **crystals** with different characteristic shapes. Another alkali **feldspar**, sanidine, has the chemical formula $(K,Na)AlSi_3O_8$, and forms in **lava** that has been extruded onto the surface of the earth. The **plagioclase** feldspars all form in molten **rock**, and there is gradation in composition between abite ($NaAlSi_3O_8$) and anorthite ($CaAl_2Si_2O_8$). Another common tectosilicate mineral is **quartz** (SiO_2), which forms in many geological environments. Pure quartz is as transparent as **glass**, but varieties include amethyst, which is colored purple by the presence of small amounts of **iron**; rose quartz, which is colored pink by small amounts of titanium, and milky quartz, which appears white due to the presence of small fluid droplets.