Cyclosilicates Encyclopedia Article

Cyclosilicates

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Cyclosilicates

The most abundant rock-forming **minerals** in the **crust** of the 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 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**.

In cyclosilicates, the tetrahedra form rings of 3, 4, or 6 tetrahedra. However, most cyclosilicates are formed from a framework of six tetrahedra, giving them the formula $(Si_6O_{18})^{-12}$, and examples of this type of mineral includes the **gemstones** beryl (including the varieties emerald and aquamarine, and tourmaline. Beryl, found in **granite**, pegmatites, and mica **schist**, has the chemical formula $Be_3Al_2(Si_6O_{18}$. Deposits of beryl that are not of gem quality are an important ore of the metal beryllium. Minerals in the tourmaline group, found in granite pegmatites and as accessory minerals in igneous and metamorphic rocks, can also be present in veins and as a detrital mineral in sediments and sedimentary **rock**. Varieties of tourmaline include schorlite, also called black tourmaline or **iron** tourmaline, $NaFe_3B_3Al_3(OH)_4(Al_3Si_6O_{27})$; dravite, also called brown tourmaline or magnesium tourmaline, $NaMg_3B_3Al_3(OH)_4(Al_3Si_6O_{27})$, and elbaite, a lighter-colored, lithium-bearing variety also called alkali tourmaline, $Na_2Li_3B_6Al_9(OH)_8(Al_3Si_6O_{27})_2$.