Nesosilicates Encyclopedia Article

Nesosilicates

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Nesosilicates

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**.

The simplest silicates are the nesosilicates, formed by individual silicon-oxygen tetrahedra. There is some substitution of aluminum for silicon in the tetrahedra, but not as much as in other types of silicate minerals. The negatively charged, isolated tetrahedra in nesosilicates are held together by various metal cations. The garnet group of nesosilicates is commonly found in metamorphic rocks and more rarely in **igneous rocks**, and the metal cations that are typically found in garnet minerals include aluminum, calcium, chromium, magnesium, manganese, and **iron**. Garnet minerals include almandine ($Fe_3Al_2Si_3O_{12}$), grossularite ($Ca_3Al_2Si_3O_{12}$), and uvarovite ($Ca_3Cr_2Si_3O_{12}$). The minerals of the **olivine** group are nesosilicates commonly found in iron- and magnesium-rich igneous rocks. The chemical formula of olivine is given as $(Mg, Fe)_2SiO_4$, but a complete solid solution exists between the end-members forsterite (Mg_2SiO_4) and fayalite (Fe_2SiO_4). The nesosilicate mineral zircon ($ZrSiO_4$) commonly forms in igneous rocks, and is so chemically stable that it becomes a common accessory mineral in many sediments and **sedimentary rocks**.

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