6.4: Metamorphic Grade

Metamorphic grade refers to the range of metamorphic change a rock undergoes, progressing from low (little metamorphic change) grade to high (significant metamorphic change) grade. Low-grade metamorphism begins at temperatures and pressures just above sedimentary rock conditions. The sequence slate → phyllite → schist → gneiss illustrates an increasing metamorphic grade.

Geologists use index minerals that form at certain temperatures and pressures to identify metamorphic grade. These index minerals also provide important clues to a rock’s sedimentary protolith and the metamorphic conditions that created it. Chlorite, muscovite, biotite, garnet, and staurolite are index minerals representing a respective sequence of low-to-high grade
rock. The figure shows a **phase diagram** of three index minerals—sillimanite, kyanite, and andalusite—with the same chemical formula (Al$_2$SiO$_5$) but having different crystal structures (**polymorphism**) created by different pressure and temperature conditions.

![Phase Diagram](image)

**Figure \(\PageIndex{1}\):**

**Andalusite**
Some metamorphic rocks are named based on the highest grade of index mineral present. Chlorite schist includes the low-grade index mineral chlorite. Muscovite schist contains a slightly higher grade muscovite, indicating a greater degree of metamorphism. Garnet schist includes the high-grade index mineral garnet and indicating it has experienced much higher pressures and temperatures than chlorite.