## Recognition and Description of Minerals - Knowns

### ISOTROPIC MINERALS
- **Halite**: NaCl
- **Sylvite**: KCl
- **Fluorite**: CaF₂
- **Periclase**: MgO
- **Garnet**: (Ca,Mg,Fe²⁺,Mn)₃Al,Fe³⁺,Cr)₂(SiO₄)₃

### UNIAXIAL MINERALS
- **Quartz**: SiO₂
- **Calcite**: CaCO₃
- **Nepheline**: NaAlSiO₄
- **Apatite**: Ca₅(PO₄)₃(F,Cl,OH)
- **Zircon**: ZrSiO₄
- **Tourmaline**: Boro-Silicate

### BIAAXIAL MINERALS
- **Olivine**: (Mg,Fe)₂SiO₄
- **Orthopyroxene**: (Mg,Fe)₂Si₂O₆
- **Clinopyroxene**: (Ca,Mg,Fe,Al)₂Si₂O₆
- **Hornblende**: Ca₃(Mg,Fe,Al)₂Si₂O₆(OH)₂
- **Tremolite**: Ca₂Mg₅Si₈O₂₂(OH)₂
- **Actinolite**: Ca₂Fe₅Si₈O₂₂(OH)₂
- **Biotite**: K₂(Mg,Fe)₃Al₂Si₃O₁₀(OH,F)₂
- **Muscovite**: KAl₂(Al,Si)₃O₁₀(OH)₂
- **Chlorite**: (Mg,Al,Fe)₂Si₂O₅(OH)₂·(Mg,Al,Fe)₂O(H₂O)
- **Plagioclase**: (Na,Ca)(Al,Si)₃Si₂O₈
- **Alkali Feldspar**: KAlSi₃O₈
Features Useful in the Identification of a Mineral

- Shape of grains
- Degree of crystallinity
- Cleavage
- Twinning
- Alteration
- Associations

Shape of grains

- **Acicular** needle-like grains (actinolite, tremolite)
- **Bladed** elongate, slender (hornblende)
- **Columnar** elongate with equidimensional cross sections (quartz, pyroxenes)
- **Equant** equidimensional grains (quartz, olivine)
- **Fibrous** grains form long slender fibers (asbestos, sillimanite)
- **Lathlike** flat elongate grains (plagioclase)
- **Prismatic** crystal faces defined by prism (apatite)
- **Tabular** book shape (plagioclase)

Bladed Grains
Prismatic Grains

Degree of Crystallinity

- __________
  - grains have well formed crystal faces

- __________
  - poorly formed and/or irregular crystal faces

- __________
  - no regular crystal faces

Cleavage

- In grain mounts, __________ on grains indicate the presence of __________

- In thin section, cleavage is difficult to recognize in minerals with a low relief, under normal circumstances

- By closing the aperture diaphragm cleavage is more readily seen
Cleavage

• Grains at the edge of the section may exhibit cleavage more so than grains in the centre
• _____ between cleavages is useful for identifying the broad mineral group
  – Pyroxene - 2 at 90°
  – Amphibole – 2 at 56°/124°
  – Alkali Feldspar - 2 at 90°
  – Plagioclase – 2 cleavages at 94°

Twinning

• Presence and nature of the twins may be __________
• A variety of twin laws may be observed in thin section
Simple Twin
Two segments of one grain go extinct at different times on rotating the stage.

Contact Twins
Joined by a smooth twin plane separating the segments
Carlsbad-albite Twin Plane

Penetration Twin
Joined by an irregular contact
Polysynthetic Twin

Consists of numerous twin segments joined on parallel twin planes.

Abithe Twin Plane

Albite Twin Plane

Alteration

• The type of alteration product observed within an individual grain may be used to identify that grain.
  • e.g.
    – iddingsite alteration of olivine
    – sericite alteration of plagioclase
    – clay minerals from alkali feldspars

Olivine altering to Serpentine

[Image of olivine altering to serpentine]
Plag altering to Sericite

From: http://www.union.edu/Public/Geodpt/Courses/Petrology/Igneous Minerals.htm

Associations

- Knowing the common mineral associations in a variety of rock types may aid in making an “educated guess” as to the identity of an unknown mineral
- Knowing the mineral association for a given rock may aid in the identification of a specific mineral which might otherwise have been overlooked
- Appendix C of Nesse lists the common igneous, metamorphic and sedimentary rocks and expected mineralogy in each

Mineralogy of Common Igneous Rocks

<table>
<thead>
<tr>
<th>Rock Type</th>
<th>Major (&gt;10%)</th>
<th>Minor (&lt;10%)</th>
<th>Accessory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Felsic (granite, rhyolite, granodiorite, etc.)</td>
<td>Quartz, K-feldspar, plagioclase (Ab&lt;5)</td>
<td>Muscovite, biotite, hornblende</td>
<td>Muscovite, epidote, magnetite, ilmenite, opx, cpx, clinozoisite, clinopyroxene, hornblende, sanidine, biotite, muscovite, plagioclase, amphibole, olivine</td>
</tr>
<tr>
<td>Intermediate (andesite, tuff, dike, basalt, etc.)</td>
<td>Plagioclase (And), hornblende</td>
<td>Quartz, biotite, muscovite, opx, cpx</td>
<td>Muscovite, epidote, magnetite, ilmenite, opx, cpx, clinozoisite, clinopyroxene, hornblende, sanidine, biotite, muscovite, plagioclase, amphibole, olivine</td>
</tr>
<tr>
<td>Mafic (basalt, gabbro, norite, peridotite)</td>
<td>Plagioclase (Lab-By), cpx, opx, olivine</td>
<td>Biotite, hornblende</td>
<td>Muscovite, epidote, magnetite, ilmenite, opx, cpx, clinozoisite, clinopyroxene, hornblende, sanidine, biotite, muscovite, plagioclase, amphibole, olivine</td>
</tr>
<tr>
<td>Si-deficient (pyroxide, phonolite)</td>
<td>K-feldspar, plagioclase (Ab-And), nepheline, leucite, sodalite</td>
<td>Biotite, muscovite, Na-amphibole, Na-pyroxene</td>
<td>Muscovite, epidote, magnetite, ilmenite, opx, cpx, clinozoisite, clinopyroxene, hornblende, sanidine, biotite, muscovite, plagioclase, amphibole, olivine</td>
</tr>
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From: Nesse 2004, Appendix C.1
### Mineralogy of Common Sedimentary Rocks

<table>
<thead>
<tr>
<th>Clastic</th>
<th>Carbonate</th>
<th>Evaporite</th>
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<tbody>
<tr>
<td>Quartz</td>
<td>Calcite</td>
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</tr>
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<td>K-feldspar</td>
<td>Dolomite</td>
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<td>Calcite</td>
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<tr>
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**Clastic material**

### Mineralogy of Common Metamorphic Rocks

#### Rock Type

<table>
<thead>
<tr>
<th>Rock Type</th>
<th>Common</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Pelitic   (low pressure)</td>
<td>Quartz, plagioclase, muscovite, chlorite, biotite, garnet, chloritoid, annularenne, hypersthene, stilpnomelane, epidote, K-feldspar</td>
<td>Apatite, hematite, ilmenite, zircon, spinel, epidote, garnet, kyanite, andalusite, sillimanite, scapolite, omphacite, Na-amphibole, calcite, dolomite, epidote, garnet, cpx, amphibole, biotite, quartz, clinozoisite, chlorite, epidote, garnet, biotite, chlorite, garnet, talc, brucite</td>
</tr>
<tr>
<td>Mafic (low pressure)</td>
<td>Quartz, diopside, epidote, psilomelane, hypersthene, biotite, olivine, quartz, garnet, biotite, stilpnomelane, scapolite, paragonite, clinozoisite, kyanite, andalusite, sillimanite, garnet, chloritoid, cordierite, hornblende, opx</td>
<td>Apatite, epidote, garnet, olivine, brucite, corundum, graphite, hematite, ilmenite, magnetite, titanite, magnetite, spinel, chlorite, epidote, garnet, biotite, chlorite, garnet, talc, brucite</td>
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<tr>
<td>Carbonate (medium pressure)</td>
<td>Quartz, plagioclase, epidote, garnet, pyroxene, leucite, kyanite, sillimanite, staurolite, Na-amphibole, calcite, dolomite, epidote, garnet, cpx, amphibole, biotite, quartz, K-feldspar</td>
<td>Apatite, hematite, ilmenite, magnetite, zircon, spinel, epidote, garnet, kyanite, andalusite, sillimanite, scapolite, omphacite, Na-amphibole, calcite, dolomite, epidote, garnet, cpx, amphibole, biotite, quartz, K-feldspar</td>
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<tr>
<td>Granitic Gneiss (high pressure)</td>
<td>Quartz, K-feldspar, plagioclase, micas, cordierite, hornblende, opx</td>
<td>Apatite, epidote, garnet, olivine, brucite, corundum, graphite, hematite, ilmenite, magnetite, titanite, magnetite, spinel, chlorite, epidote, garnet, biotite, chlorite, garnet, talc, brucite</td>
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<tr>
<td>Metagraywacke (high and low pressure rocks)</td>
<td>Quartz, plagioclase, epidote, cummingtonite, lawsonite, chlorite, biotite, stilpnomelane, muscovite, omphacite, feldspar, biotite, olivine, garnet, serpentine, talc, brucite</td>
<td>Apatite, hematite, ilmenite, magnetite, zircon, spinel, epidote, garnet, kyanite, andalusite, sillimanite, scapolite, omphacite, Na-amphibole, calcite, dolomite, epidote, garnet, cpx, amphibole, biotite, quartz, K-feldspar</td>
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**Accessory**

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