**12.109 Lecture Notes**
**September 13, 2005**

**Rock Forming Minerals II**
**Structure and composition of: FELDSPARS**

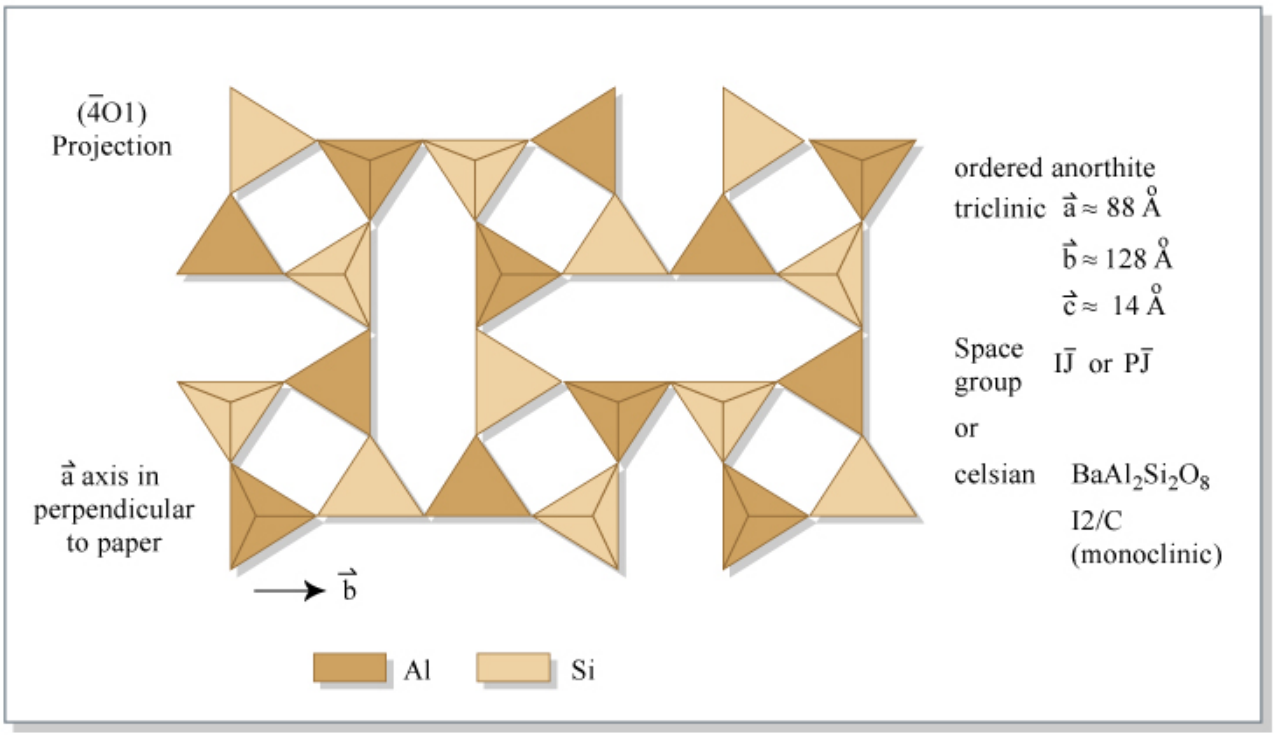
**Feldspars**
The "meat and potatoes" of crustal igneous rocks
(most abundant igneous mineral in the crust)

Feldspar from the German "feldspat," crystals found in the field

Alkali feldspars are any mixture of Albite, $NaAlSi_3O_8$, and Kspar, $KAlSi_3O_8$
Kspar has three polymorphs:

| | | | |
|---|---|---|---|
| Sanidine | high T | monoclinic | C2/m |
| Orthoclase | | monoclinic | C2/m |
| Microcline | low T | triclinic | $C\bar{1}$ |

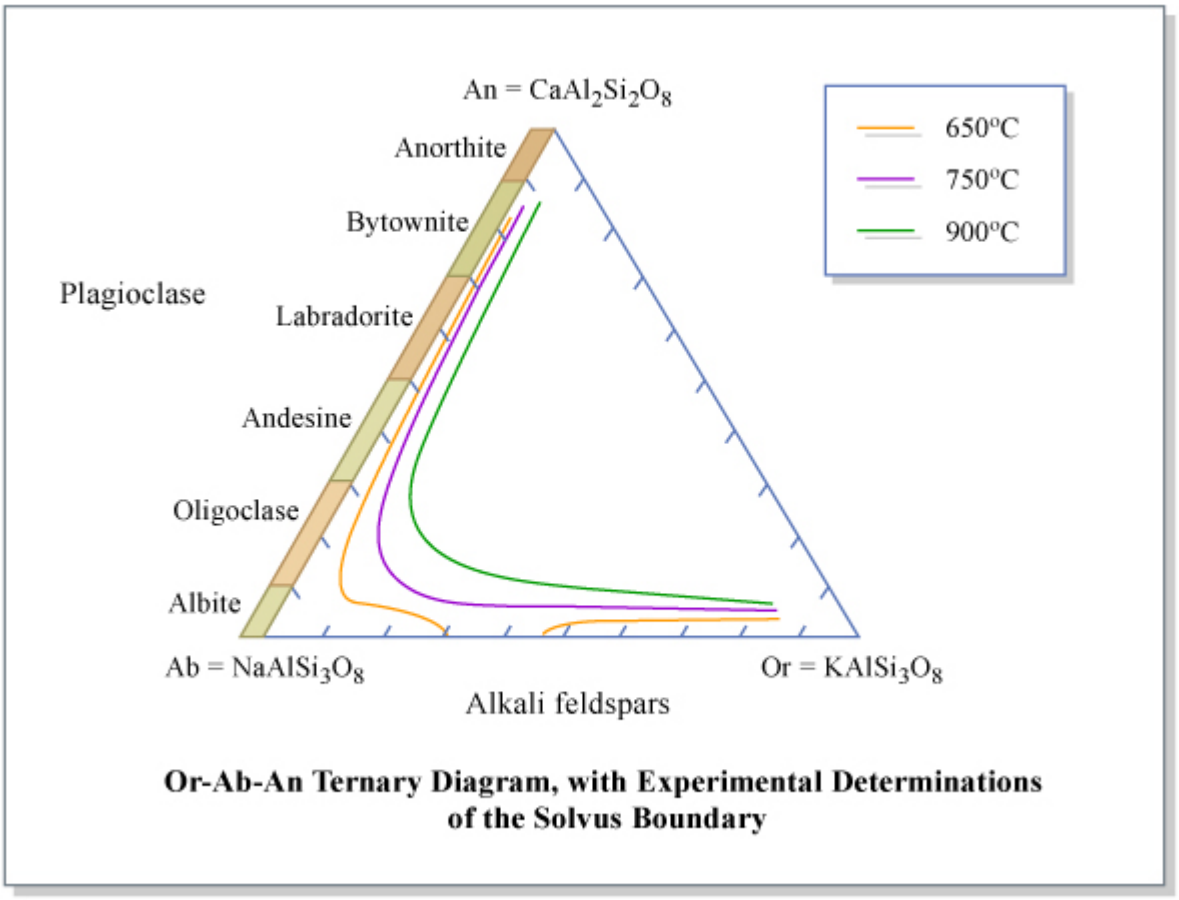
Structure
Based on 4 member ring/square consisting of $SiO_4$ and $AlO_4$ tetrahedra




Link the squares in a "double crank shaft"
Symmetry of these ring structures makes the perfect cleavages, 88º and 92º

Tectosilicate (framework silicate) – silicate where all Si tetrahedra are linked together at apices
Ring often notated "$T_4O_8$", tetrahedral anion, alkali cations in holes balance charge

Calcium feldspar = Anorthite



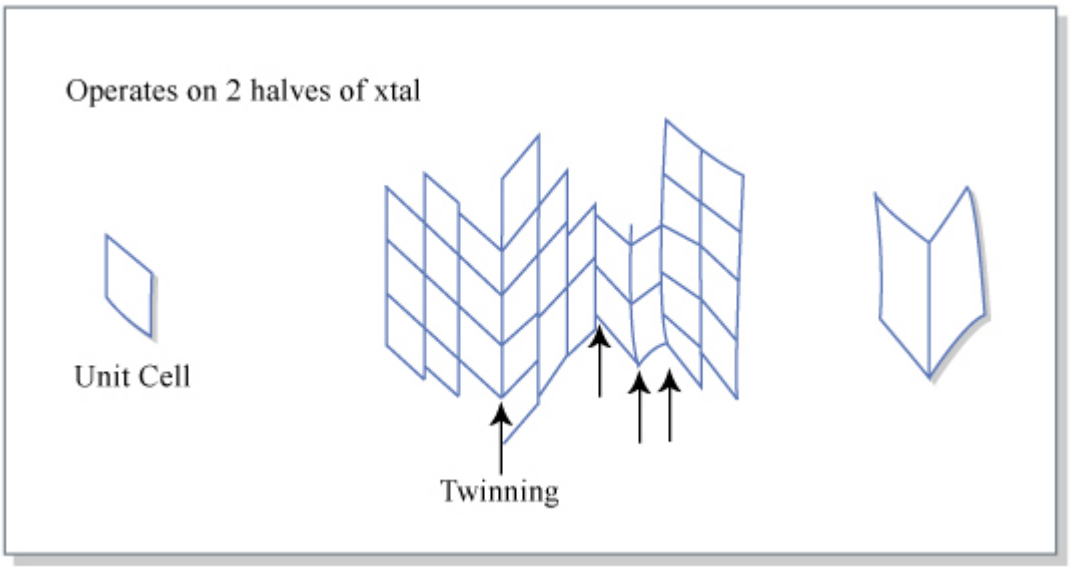

**Or-Ab-An Ternary Diagram, with Experimental Determinations of the Solvus Boundary**

<u>Plagioclase</u>
Plagioclase twinning
Polysynthetic (repeated)
Simple (two crystals related by a twin operation)

Review of mineralogy:
Twin operation – symmetry operation not part of symmetry group of crystal

| | |
|---|---|
| Symmetry operations | elements |
| Reflection | mirror plane |
| Rotation | axis |

Twin happens when a symmetry element not part of the crystal structure operates on two halves




Sanidine & Orthoclase monoclinic, Microcline triclinic
variation in atomic arrangement of feldspars due to changes in temperature we can measure this ordering using optics or xrays → give you T of equilibrium

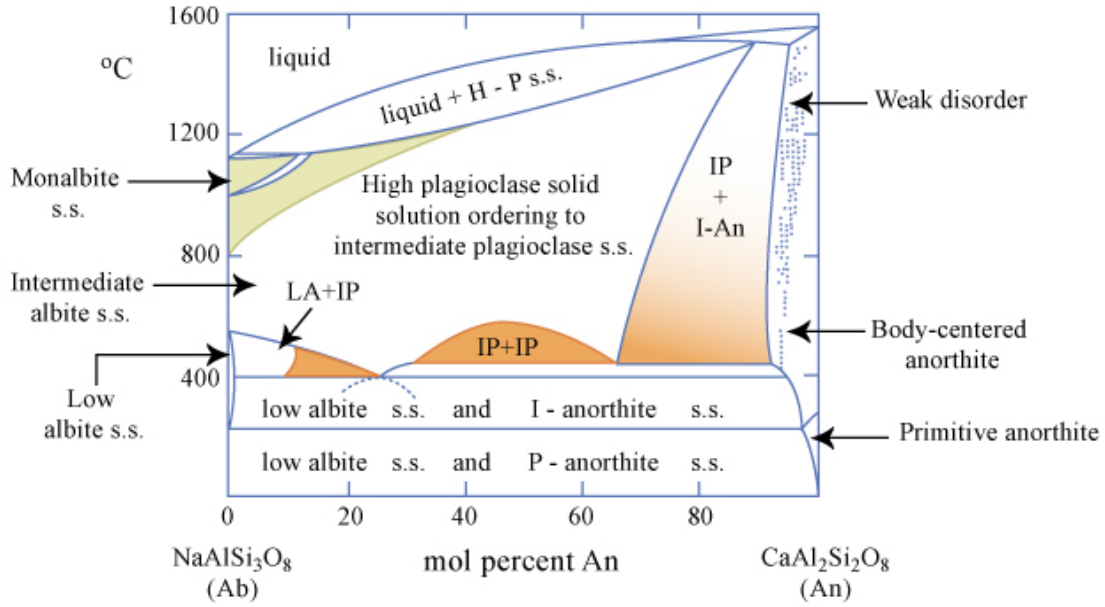
Al/Si distribution
Kspar $KAlSi_3O_8$ in crystal structure are 2 crystallographically distinct tetrahedral sites, $T_1$ and $T_2$
At higher T, Al and Si are randomly distributed over $T_1$ and $T_2$
So average site occupancy is .25 Al, .75 Si
As T goes down, $T_1$ prefers Al

Si – O bond 1.61 Å
Al – O bond 1.73 Å
So unit cell length along c axis changes with motion of Al atoms

Anorthite has 2x the amount of Al, different Al/Si arrangement → anorthite always triclinic, unit cell of symmetry 2x length of alkali feldspars

Plagioclase series Albite—Anorthite

Polysynthetic twinning can be used to determine An content to ~2-4 mole%
From extinction angle, see handout




Possible phase diagram for plagioclase feldspars.