12.001 Introduction to Geology
Spring 2008

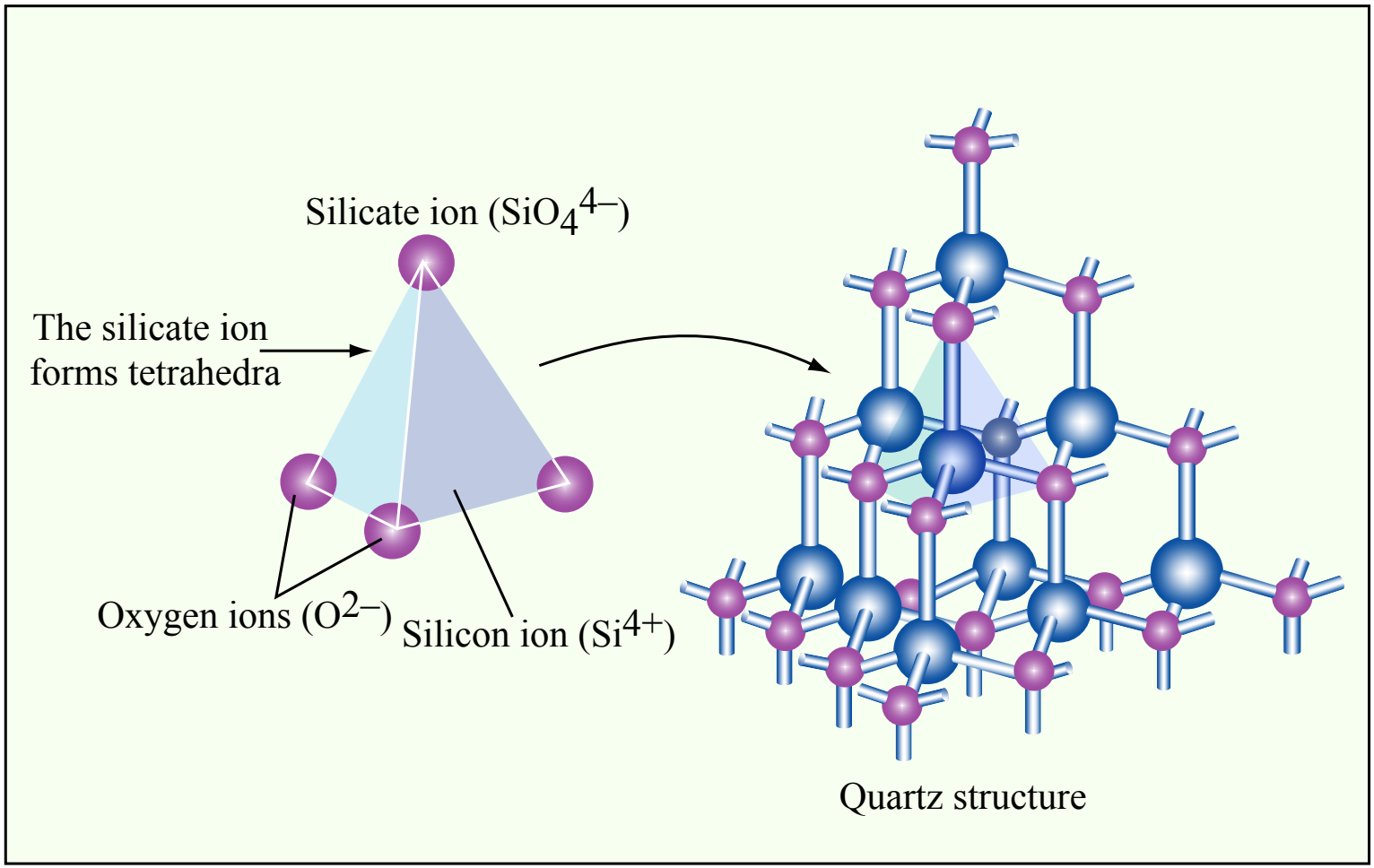

Figure by MIT OpenCourseWare.

Mineral	Chemical formula	Cleavage planes and number of cleavage directions	Silicate structure	Specimen
		1 plane	Isolated tetrahedra	
Olivine	$(Mg, Fe)_2SiO_4$			

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Isolated tetrahedra (soro- and nesosilicates)

Olivine group: forsterite-fayalite solid solution

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Pyroxene	$(Mg, Fe)SiO_3$	2 planes at 90°	Single chains	

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Pyroxene	$(Mg, Fe)SiO_3$	2 planes at 90°	Single chains	Images removed due to copyright restrictions.
Amphibole	$Ca_2(Mg, Fe)_5Si_8O_{22}(OH)_2$	2 planes at 60° and 120°	Double chains	

Single chains of tetrahedra

Pyroxene group

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Double chains of tetrahedra

Amphibole group

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Amphibole	$Ca_2(Mg, Fe)_5Si_8O_{22}(OH)_2$	2 planes at 60° and 120°	Double chains	
Micas	Muscovite: $KAl_2(AlSi_3O_{10})(OH)_2$ Biotite: $K(Mg, Fe)_3AlSi_3O_{10}(OH)_2$	1 plane	Sheets	

Sheets of tetrahedra (phyllosilicates)

Mica group

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Pyroxene	$(Mg, Fe)SiO_3$	2 planes at 90°	Single chains	
Amphibole	$Ca_2(Mg, Fe)_5Si_8O_{22}(OH)_2$	2 planes at 60° and 120°	Double chains	
Micas	Muscovite: $KAl_2(AlSi_3O_{10})(OH)_2$ Biotite: $K(Mg, Fe)_3AlSi_3O_{10}(OH)_2$	1 plane	Sheets	
Feldspars	Orthoclase feldspar: $KAlSi_3O_8$ Plagioclase feldspar: $(Ca, Na)\ AlSi_3O_8$	2 planes at 90°	Three-dimensional framework	

3-D frameworks of tetrahedra (tectosilicates)

Feldspar group

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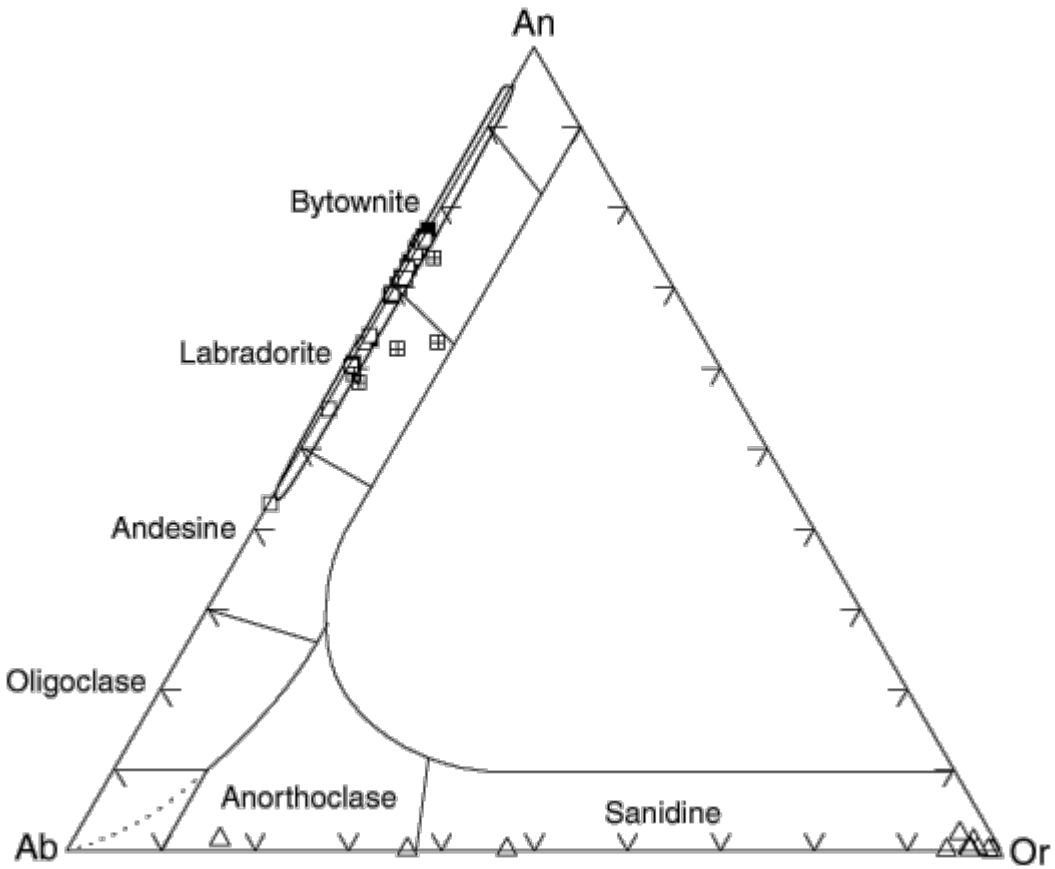
Feldspars

ANORTHITE

$CaAl_2Si_2O_8$

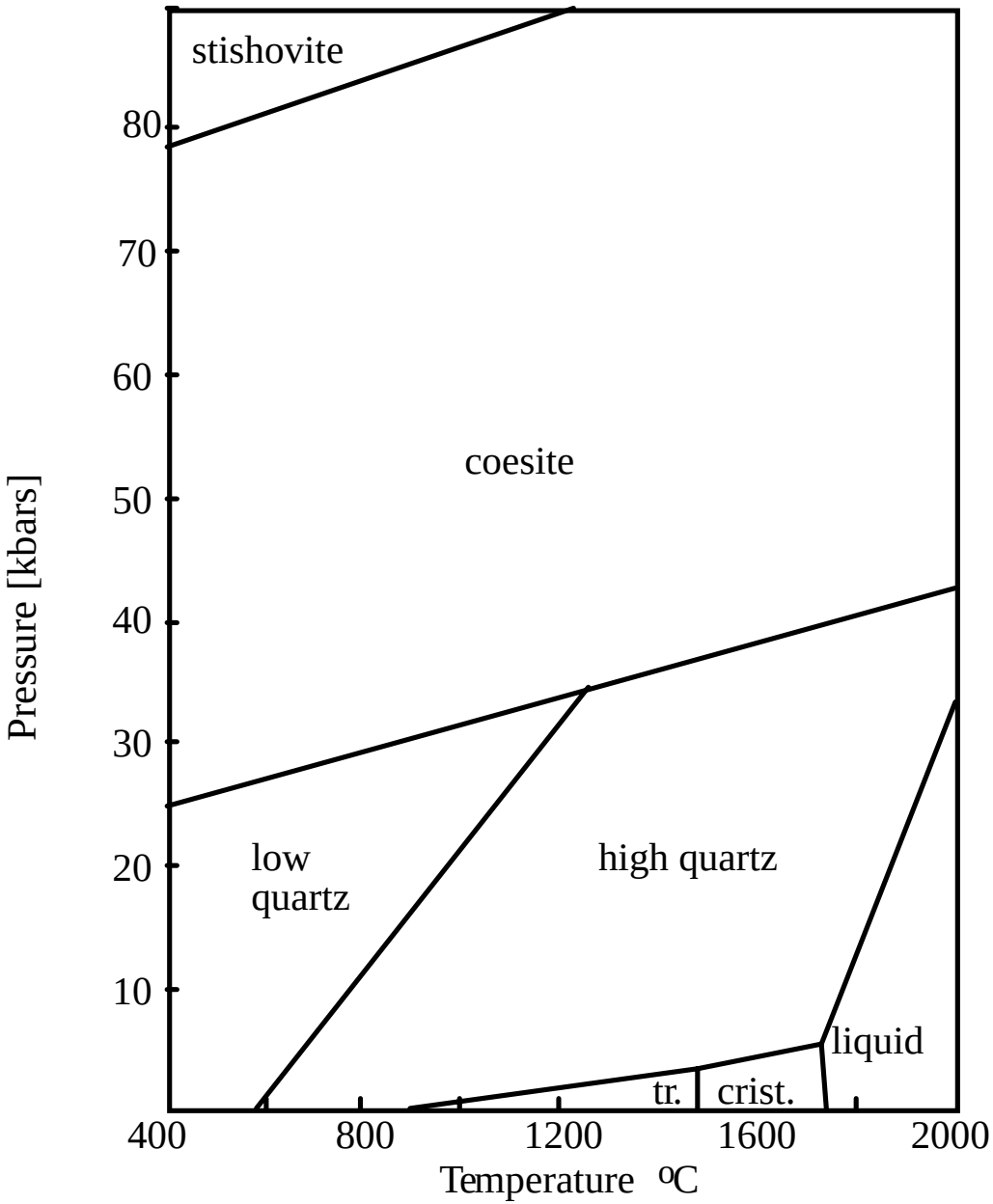


ALBITE

$NAlSi_3O_8$

ORTHOCLASE

$KAlSi_3O_8$


stishovite
coesite
low
quartz
high quartz
liquid
tr.
crist.
80
70
60
50
40
30
20
10
400
800
1200
1600
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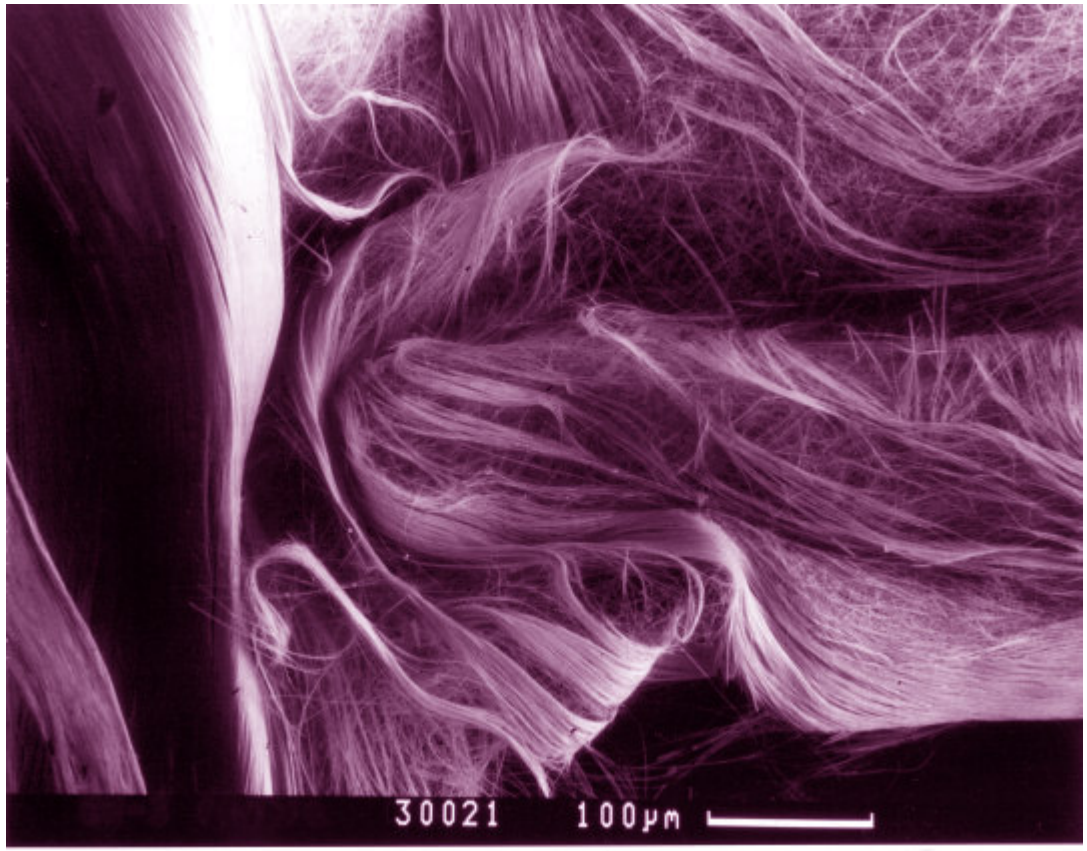
Pressure [kbars]
Temperature °C



Rose-colored nanofibers cause the color in rose quartz: George Rossman, CalTech

Name	Composition
amber	hydrocarbon (fossil resin)
beryl	$Be_3Al_2Si_4O_{18}$
aquamarine	"
emerald	"
chrysoceryl	$BeAl_2O_4$
catseve	"
corundum	Al_2O_3
ruby	" (with trace of Cr)
sapphire	" (with trace of Ti)
diamond	C
feldspar	$KAlSi_3O_4$
amazonstone	"
garnet	$(Ca,Mg,Fe)_3(Al,Fe,Cr)_2(SiO_4)_3$
jadeite	$Na(Al,Fe)Si_2O_4$
peridot	Mg_2SiO_4
opal	hydrous silica
pearl	$CaCO_3$
quartz	SiO_2
agate	"
amethyst	"
jasper	"
onyx	"
spinel	$MgAl_2O_4$
topaz	$Al_2SiO_4(F,OH)_2$
turquoise	$CuAl_4(PO_4)_4(OH)_8 \cdot 5H_2O$