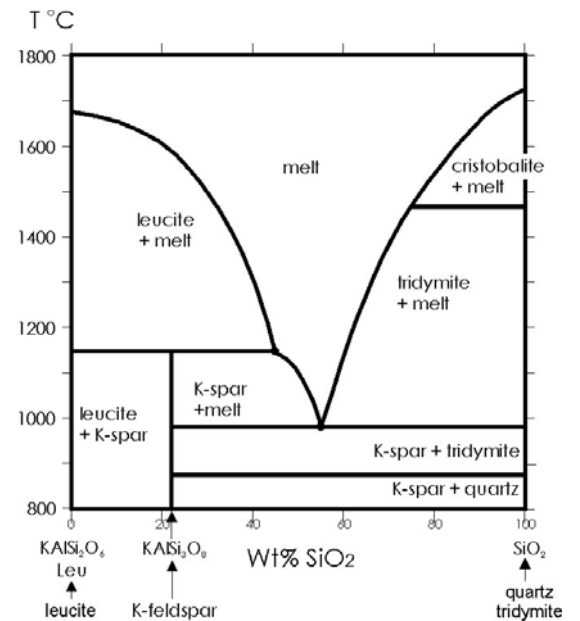


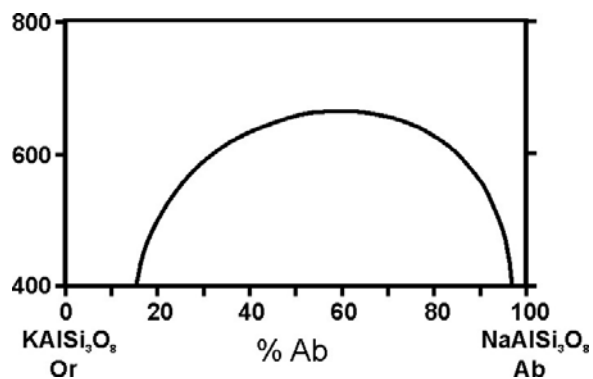
- 6 Consider a system involving the minerals: quartz (SiO_2), kyanite (Al_2SiO_5), albite ($\text{NaAlSi}_3\text{O}_8$), and jadeite ($\text{NaAlSi}_2\text{O}_6$). How many components are needed to describe this system?
- 7 Draw a phase diagram that has a eutectic. What is the significance of a eutectic?

- 8 Consider the diagram shown. Which phases melt congruently and which melt incongruently?



- 9 On the diagram shown, label the solvus and the miscibility gap.

What is the significance of the two different fields on the diagram (one below the arc shaped curve and one above)?

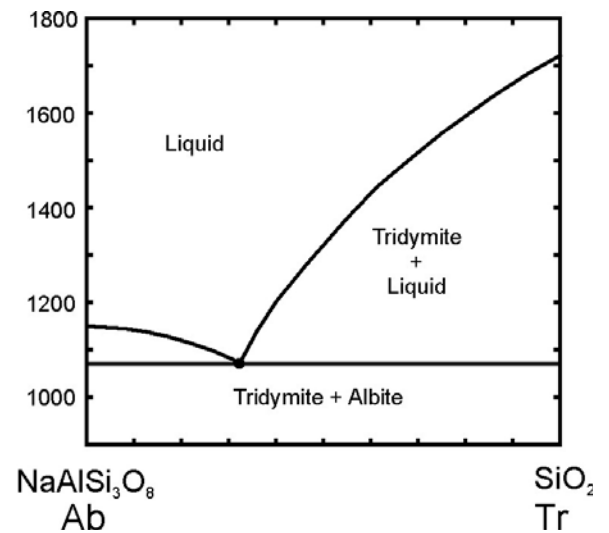


- 10 The ocean floor is made of large quantities of basalt. Why? Where did the basalt come from and why are there no rocks that are more silicic?

- 11 How can you distinguish between alkali feldspar and plagioclase feldspar in thin section? Be specific about what properties you would rely on and what the different feldspars would look like. Make drawings if it would help explain.

12 Volcanic rocks are generally porphyritic or pyroclastic. Contrast these two terms and explain how and why each occurs.

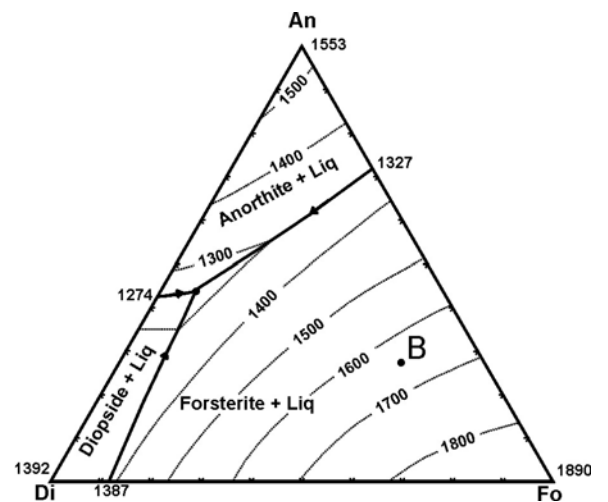
13 Given the phase diagram shown here, what will be present (compositions and proportions) if a rock containing 33% albite and 66% quartz is heated to 1200°C?



14 Consider the ternary diagram shown and a rock that contains anorthite, forsterite, and diopside, such that its overall composition plots at point B.

If you heat it, at what approximate temperature will the rock begin to melt?

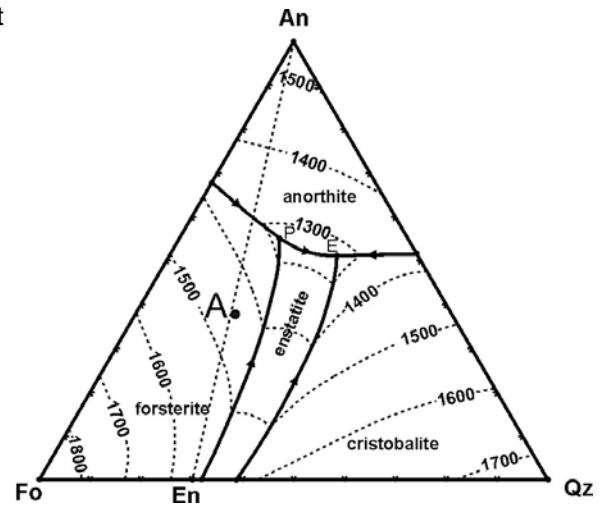
What will be the composition of the first drop of melt? (Give % values.)



- 15 Consider a melt of composition A (shown on the diagram). If this melt cools, at what temperature will crystallization begin?

At what approximate temperature will it be entirely solid?

What minerals will be present when it is completely solid, and in what approximate proportions?



- 16 What is a tuff, and why are there no tuffs of basaltic composition?

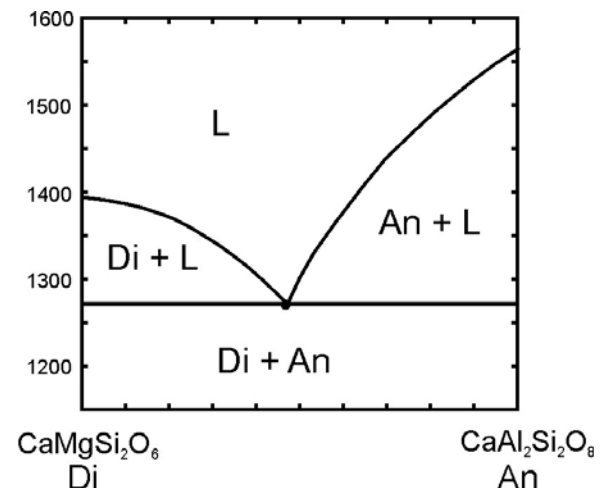
- 17 Why are the metamorphic rocks found in the centers of mountain belts typically higher grade than those found around the margins?

- 18 What is the affective domain? Is the affective domain more important or less important when it comes to students learning in college?

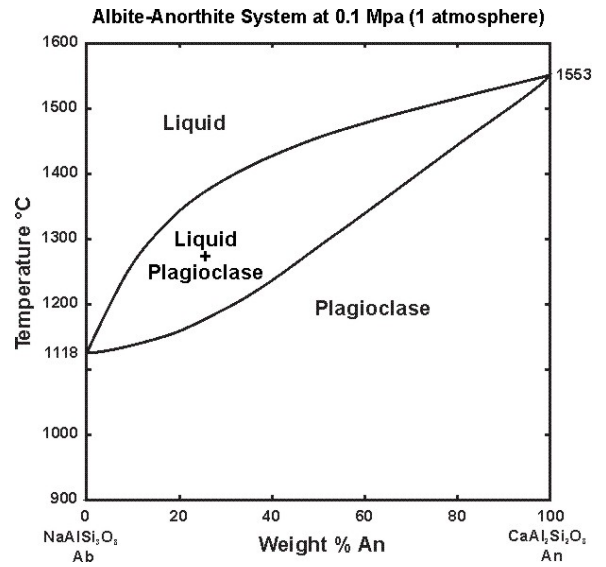
19 Why are basaltic lavas more common than rhyolitic lavas?

20 Ultramafic igneous rocks are rare. Especially extrusive ultramafic igneous rocks. Why are UM igneous rocks rare, and why are the extrusive ones rarer than the intrusive ones?

21 Some igneous rocks contain large well-formed diopside crystals surrounded by a mass of much smaller anorthite crystals. Other rocks contain large well-formed anorthite crystals surrounded by a mass of small diopside crystals. Explain this using the Di-An phase diagram shown.

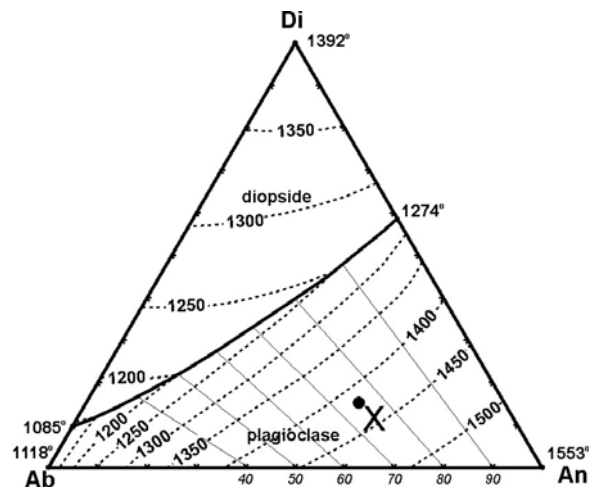


22 According to this phase diagram shown, what will be present if plagioclase (that has composition 40% anorthite and 60% albite) is heated and begins melting until it is half solid and half liquid? What will the temperature be and what compositions will be present?



23 Consider the plagioclase melting diagram above. Suppose we start at high temperature with a melt that is 50:50 albite:anorthite. It cools and crystallizes a little bit and then the crystals settle to the bottom of the magma chamber where they are no longer able to react with the melt. This process is repeated many times. Eventually, the last drop of melt is gone and all is solid. Make a sketch showing what the magma chamber will look like and show what the mineral compositions will be in different parts of the magma chamber.

24 Consider a melt of composition X (see diagram). If it cools, what minerals will be present in the final rock, and in what approximate proportions?

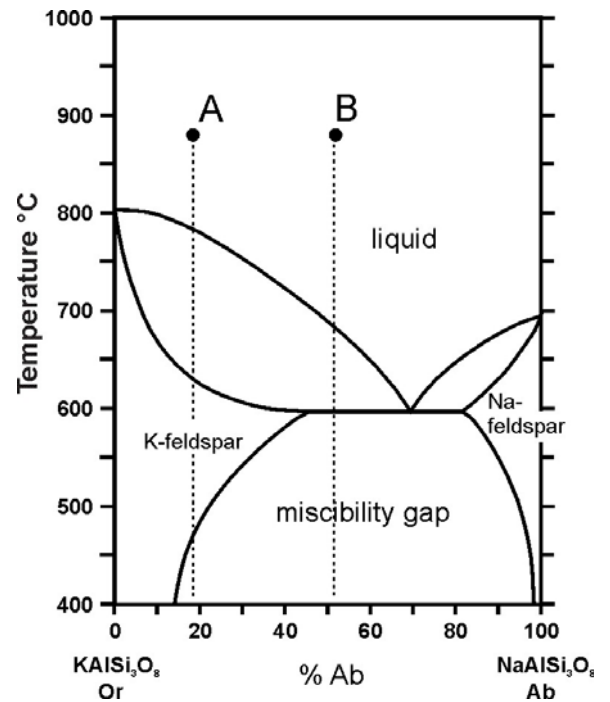


- 25 At the Stillwater Complex, rocks are in repetitive layers. Chromite and olivine-rich rocks at the bottom. Orthopyroxene-rich rocks above, and capped by clinopyroxene-rich rocks. Then the sequence repeats. Many times. Explain how this layered sequencing may have formed.
- 26 Although the correlation is not perfect, the minerals at the bottom of Bowen's Reaction Series are generally richer in alkalis and alkaline earth elements, and those at the top of the series are richer in Mg and Fe. Why?

- 27 Consider the phase diagram and the two compositions labeled A and B.

For each, trace the cooling and crystallization path as the temperature drops to 400°C. How will the proportions of solids and liquids change, and how will their compositions change, as cooling progresses?

After the system has cooled, and all reactions have stopped, what will be present? In particular, what will be the difference in the final product for composition A and composition B.



- 28 A bright young geologist name Sheila is studying a granite from near Kenora, Ontario. She finds that the granite contains small amounts of spinel, cordierite, and garnet – unusual minerals for a granite. She concludes that this granite must have formed by melting of sedimentary rocks. Evaluate her conclusion. Why do you think she concluded what she did, and do you think she is correct?

- 29 A Canadian geologist named Rudy is studying ultramafic magmas near Timmins, Ontario. He concludes that they must come from the mantle because, he says, there is no source for ultramafic magmas in the Earth's crust. What do you think of his ideas?
- 30 Is Earth's mantle made of igneous, metamorphic, or sedimentary rocks? Explain and justify your answer.