

TERNARY PHASE DIAGRAMS - FORSTERITE-ANORTHITE-SILICA

The attached phase diagram shows the equilibrium relationships at 1 atm for the ternary system Mg_2SiO_4 - $\text{CaAl}_2\text{Si}_2\text{O}_8$ - SiO_2 . This is a geologically interesting system since it contains the mineralogically important phases olivine, plagioclase, pyroxene and silica polymorphs. The phases present in the system are:

Forsterite - Mg_2SiO_4 Clinoenstatite - MgSiO_3 Anorthite - $\text{CaAl}_2\text{Si}_2\text{O}_8$ Cristobalite or tridymite (depending upon T) - SiO_2

Spinel - MgAl_2O_4 (NOTE: Spinel is projected into the system. Its chemistry cannot be represented by the components used in constructing the diagram).

These minerals can be treated as having fixed compositions.

1. Line DG is a _____
2. Line EF is a _____
3. Line DE is a _____
4. Point D is a _____
5. Point E is a _____
6. The phases present in a solid of composition *A* are _____, _____ and _____ . The relative proportions of the phases are?

7. The phases present in a solid of composition *B* are?

8. The phases present in a solid of composition *C* are?

9. Describe what happens during perfect equilibrium crystallization of liquids of composition *A* and *B*.

10. Describe what happens during perfect fractional crystallization of a liquid of composition *A*.

11. During equilibrium melting of a solid of composition *C*, what are the relative proportions of liquid and solid residue when tridymite is completely melted. At this point, what are the relative proportions of clinoenstatite and anorthite in the solid residue?

12. Describe what happens during perfect fractional melting of a solid of composition B .

13. Describe what happens during perfect equilibrium melting of a solid of composition A .

