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# The system fayalite-albite-anorthite and the syenite problem

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## Abstract

The presence in a magma of fayalite, the iron end-member of the olivine binary series, affects the feldspars at pressure by lowering the temperatures at which they crystallize from the magma. Starting with estimates from published literature it becomes obvious that at pressure, fayalite becomes important because the pressure effects on the melting temperatures are very different: large for albite, and small for anorthite. In this experimental study, a powder of fayalite composition was combined with six finely ground natural feldspars from Ab to $An_{97}$ to make six bulk compositions. Using graphite crucibles in piston-cylinder apparatus at a pressure of 5 kbar, a cotectic in the ternary system was found to range from 1141 °C at An(Fa) to 1124 °C at Ab(Fa), with fayalite contents from 68 to 17 wt%, respectively. The results can be used to show that ternary feldspars saturated with fayalite and Fe monoclinic pyroxene will crystallize at a 5 kbar multiphase eutectic 1010 °C—56 °C below a calculated azeotropic point on the Ab-Or join. The results are used to compare the end points of two very different layered intrusions, Skaergaard and Kiglapait, and to illuminate the nature and origins of syenite and trachyte, which are leucocratic rocks unsaturated with mafic minerals. Because fayalite-saturated melts are responsive to pressure unequally on the feldspar end-members, olivine of intermediate composition will have a damped but potentially significant effect on feldspar fractionation in the lower crust of the Earth, possibly affecting the origin of anorthosite and syenite.

**Keywords:** Fayalite, olivine, feldspar, fractionation, melting experiments, syenite origin