American Mineralogist, Volume 86, pages 547–554, 2001

Graphical analysis of the orthopyroxene-pigeonite-augite-plagioclase equilibrium at liquidus temperatures and low pressure

RAIS M. LATYPOV,[1,*] MICHAIL I. DUBROVSKII,[1] AND TUOMO T. ALAPIETI[2]

[1] Geological Institute, Kola Science Centre, Apatity, 184200, Russia
[2] Institute of Geosciences, University of Oulu, FIN–90014, Finland

ABSTRACT

There are both natural and experimental observations of the coexistence of three pyroxenes—orthopyroxene (Opx) + pigeonite (Pig) + augite (Aug)—with plagioclase (Pl). Commonly, the assemblage occurs as an intermediate product in the following fractionation trend of a mafic magma: Opx + Aug + Pl → Opx + Aug + Pig + Pl → Aug + Pig + Pl. To clarify the phase-equilibria constraints on the existence of this mineral assemblage, we have graphically analyzed the change in topology of an isobaric–isoplethic section, Ol-Aug-Pl-Qtz [with *fe* = 25–50%, where *fe* = Fe/(Fe + Mg), and An = 50%], arising from an increase in the *fe*-value of silicate liquid. The analysis shows that the stability field of the mineral assemblage Opx + Aug + Pig + Pl is restricted, and can only crystallize in the interval between two invariant points—T_1^4(Ol + Opx + Pig + Aug + Pl + L) and T_2^4(Qtz + Opx + Pig + Aug + Pl + L)—that emerge successively during expansion of a liquidus volume of pigeonite within the isobaric–isoplethic section Ol-Aug-Pl-Qtz. At *fe*-values lower than T_1^4, the 3-pyroxene assemblage cannot exist due to the absence of a contact surface between the primary volumes of plagioclase and pigeonite. At *fe*-values greater than T_2^4, the assemblage is unstable due to separation of the primary volumes of orthopyroxene and augite.