

Crystallization history of basic intrusive rocks  
of Singapore and Linden Estate (Johore)

K.R. Chakraborty  
Dept. of Geology, University of Malaya, Kuala Lumpur.

The basic intrusive bodies at Singapore and Linden Estate (Johore) comprise a consanguineous suite of rocks ranging in composition from allivalite to tonalite, noritic and eucritic rocks being the most dominant members. The crystallization sequence appears to be:

Olivine + Plagioclase  $\rightarrow$  Calcic pyroxene  $\rightarrow$  Orthopyroxene  
(+ Pigeonite)  $\rightarrow$  Amphibole + Fe-Ti-oxide  $\rightarrow$  Biotite + Quartz.

Separation of early formed minerals has produced different types of cumulate rocks with variable intercumulus phases. Amphibole and other late crystallizing minerals do not occur as cumulus phase. The observed sequence suggests crystallization at shallow depth under progressively increasing  $P_{H_2O}$ , and is comparable to the low pressure experimental results of crystallization of calc-alkaline magmas (high alumina basalt).

The occurrence of an orthopyroxene-cumulate rock having orthopyroxene as the only cumulus phase is problematic and implies some complexities in the crystallization history.

Crystallization relationship of the pyroxenes appear to be complex. Inverted pigeonite sporadically occurs with apparently primary orthopyroxene while orthopyroxene and calcic clinopyroxene show cotectic relationship for the major part of the crystallization sequence suggesting a phase geometry where calcic clinopyroxene-pigeonite boundary surface terminates against that of calcic clinopyroxene-orthopyroxene. The cessation of pyroxene crystallization is coincident with the precipitation of amphibole.

The presence of primary cummingtonite is a unique feature. It is not ubiquitous but precedes hornblende. The magmatic crystallization of cummingtonite is probably conditioned by very low Ca-activity coupled with high  $a_{H_2O}$  as well as relatively high  $a_{SiO_2}/a_{H_2O}$  ratio.

\*\*\*\*\*