

CHAPTER V

ORIGIN OF CORUNDUM



Corundum, of gem quality, found in Bo Phloi area has close relation with the distribution of the Bo Phloi Basalt. It has been believed to associate genetically with the basalt (Pnra Udom Pitayaphumichan and Khun Phian Lohapitaya, 1934; Charaljavanaphet, 1951; Bunjitradya and Prapaitrakul, 1973; Kaewbaidhoon and Potisat, 1974; Bunopas and Bunjitradya, 1975; Vichit, 1975; Vichit et al., 1978; Barr and Macdonald 1978 and 1981), though there was not any concrete evidence of imbedded corundum crystal in the basalt. Vichit (1975) proposed several possibilities for the origin of corundum as follows :

1. Corundum in xenoliths with or without reaction with wall rock (a) the shallow environment and (b) the deep environment
2. Corundum-bearing ultramafic and/or mafic xenoliths
3. Corundum as megacrysts in basalts

However, the lines of evidences lead Vichit (1975) to concluded that the corundum originated as megacrysts in the basalts seems to be most likely case in Thailand. Vichit et al. (1978) and Barr and Macdonald (1978 and 1981) have also advocated the high-pressure crystallization of corundum from the basaltic melt which is similar to

the origin of other megacrysts e.g. clinopyroxene, spinel and sanidine. The high-pressure origin of corundum was also mentioned by Wright (1971 and 1972) and Irving (1974 b).

Evidences supporting the hypothesis of corundum occurrence as megacrysts in the basalt are summarized by Vichit (1975) as follows :

1. The host basalts are of alkaline type which can be derived from the deep crust or upper mantle.

2. Low silica and high TiO_2 contents indicate a deep source of magma. These are the characteristics of corundum bearing basalt in Thailand, including the Bo Phloi Basalt (the auther).

3. The mineralogical and textural characteristics of megacrysts of aluminous clinopyroxene, spinel and/or pyropic garnet which are associated with corundum, indicate high pressure origin, the same as ultramafic and mafic xenoliths.

4. Isolated and well-shaped crystals of corundum reveal a direct crystallization from basaltic magma. Only a thin reaction rims has been noted. This indicates corundum is in equilibrium with magma since the time of formation.

From field evidences, the Bo Phloi corundum is found associated with isolated megacrysts of aluminous clinopyroxene and spinel in ground of basaltic terrain. Corundum crystal is neither found nor reported to be found within the basaltic rock samples in this area, except for the only one rock sample collected by the Late

Mr. Saman Buravas decades ago. It is probably suggested that corundum occurred together with those alumina-rich phase megacrysts at depth greater than that of this present-day basaltic outflow. So that corundum is rarely found in fresh rock samples, due to its mode of occurrence and to the highly decomposition and erosion of rocks in this tropical climate region.

It has never been reported that sillimanite, andalusite and cordierite are found associated with corundum or basaltic rock in this Bo Phloi area, as well as in other corundum bearing basaltic terrains (Vichit, 1975). So it seems not likely to suggest the origin of corundum as due to assimilation of metamorphosed aluminous sediments or as formed from the break down of andalusite, sillimanite and kyanite.

In case of corundum was already formed in some rocks (e.g. schist, gneiss and syenite) and brought up to the surface by basaltic rock; corundum embedded in these rocks would be expected. Although there are fragments of gneissic rock in the Bo Phloi Basalt, it seems not likely for corundum to occur by such process, even for the deep environment.

Corundum has never been found in ultramafic or mafic xenoliths as has been found in eclogite xenoliths in kimberlite and in garnet-corundum-kyanite assemblages in kimberlite (Schreyer and Seifert, 1969; Mathias et al., 1970; in Vichit, 1975). Mathias (1970, in Vichit, 1975) attributed this occurrence to partial melting of garnet peridotite in the the upper mantle.

As far as the existing data are concerned, corundum is not contained in any ultramafic or mafic xenoliths in alkali basalt at Bo Phloi area or anywhereelse in the world-wide. Corundum originated with megacrysts in basalts seems to be more reasonable and of the best possibility.

The experimental work on the system diopside-forsterite-anorthite at high pressure (Figure 35) shows that the corundum can possibly crystallize from the melt together with diopside and spinel at the pressure somewhere between 15-20 kbar or higher, and the temperature around 1450° c (Pressnall et al., 1978). This pressure and temperature ranges would be in consistent with the crystallization conditions of other megacrysts. Diopside and sanidine which are the majority among megacrysts suppose to crystallize primarily together with olivine or spinel. If this process has proceeded only a short instance before ascending of the magma to the surface. The basaltic rock may not contain any corundum. This is perhaps equivalent to the basaltic flows cropping out in this area. However, if parts of the basaltic liquid have been trapped, the crystallization may descend until the appearance of corundum before eruption. This corundum-bearing basaltic flow may inevitably overlies the earlier eruptive corundum-lacking basalt, and was completely weathered and eroded away. Sirinawin (1981) suggested that the corundum found with olivine nephelinite at Nong Bon, Trat province, cannot be genetically related with the olivine nephelinite. However, it is presumably that the pre-existing corundum crystals were picked up from a depth corresponding to approximately 20 kbar or a little higher which was above the level of crystal fractionation of that olivine nephelinite.

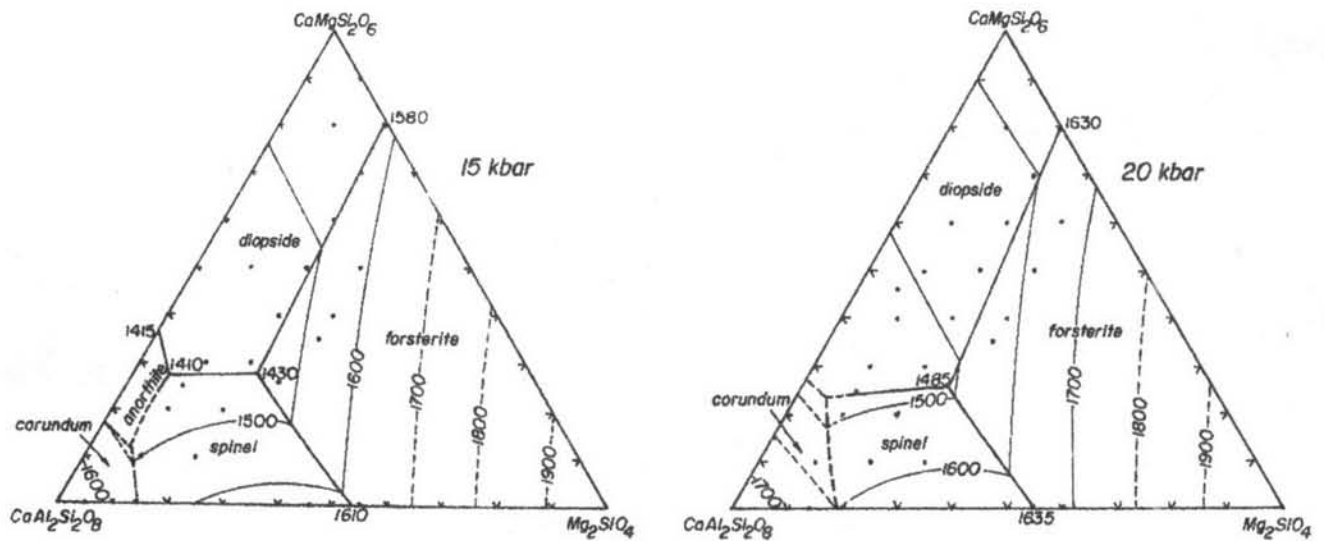


Figure 35 Liquidus phase relations on the join $\text{CaMgSi}_2\text{O}_6$ - Mg_2SiO_4 - $\text{CaAl}_2\text{Si}_2\text{O}_8$ at 15 and 20 kbar (wt. %). Filled circles are compositions studied. Heavy lines (dashed where equilibrium not demonstrated) are liquidus boundary lines and light lines (dashed where inferred or equilibrium not demonstrated) are liquidus isotherms. Temperatures are in $^{\circ}\text{C}$. (after Presnall et al., 1978).