CHAPTER XII Summary and Conclusions

The petrology, petrochemistry and the magmatic history of the alkaline-carbonatite complex under investigation are summarised below:

1. The alkaline complex covers an area of 12 sq.km, almost circular in shape, having negative topography, a depression within the higher ridges of the surrounding country rocks of quartzo-feldspathic gneiss and sporadic granitic bodies.

2. Aerial photographs and satellite imageries indicate the complex is bounded by two sets of lineaments trending ENE-WSW and NNE-SSW, which are marked by brecciated, silicified shear zones.

3. The area experienced a series of igneous activity beginning with mafic-ultramafic suites and ending with carbonatite, that intruded the quartzo-feldspathic gneiss and granites.

4. The litho assemblages of the area have unique plutonic (magnetite+apatite+perovskite rocks, pyroxenites and ijolite suites), sub volcanic (shonkinite, foidal syenite, alkali syenites) and volcanic (phonolite and tuff) associations.

5. The carbonatites are intricately associated with all the rock types and represent both plutonic and sub volcanic suites.

6. The secondary processes are fairly widespread and are represented by the phosphatic chert breccias.
7. The pyroxenite, magnetite rock and ijolite series are supposed to have been derived from the same parental magma by fractional crystallization differentiation (Le Bas, 1977 p 277). Magnetite + apatite+ perovskite rocks and pyroxenites represent the early cumulate phases formed by partitioning of perovskite, magnetite, apatite and fractionation of pyroxenes, respectively.

8. The separation of early cumulate phase and subsequent crystallization of pyroxenes lead to the formation of two immiscible volatile rich liquids— one is the carbonate melt while the other is the silicate melt.

9. The silicate melt on fractional crystallization produces alkali pyroxenite-ijolite suite and further into shonkinite, foidal syenite and alkali syenite. Nepheline/foidal syenite is the marginal facies of ijolite while the alkali syenite is the late crystallized product. The syenitic rocks are associated with roof zones of the main ijolite-alkali pyroxenite intrusion.

10. The carbonate melt had silicate phases as minor amount which crystallized as olivine, pyroxene along with the calcites and dolomites. The carbonatites contain xenoliths of the older rocks on account of their forceful intrusion. The variations in the carbonatites, particularly the nature of silicates present as xenoliths and xenocrysts are attributed to the different stages of mixing with the other co-variants of the complex.
11. The sodic fenitization (deep seated) is associated with the ijolite or alkali pyroxenite and form nepheline and perthitic feldspars. The potash fenitization (shallow level) is associated with the carbonatites and caused widespread feldspathization. Late stage carbonation has also been considered as part of the fenitization. The melteigites are the metasomatic rocks produced by the nephelinization of the alkali pyroxenite by ijolite.

12. The fenites are divided into three zones (Zone I, II and III) based on diverse mineralogical and textural characteristics.

13. Triclinicity of the K-feldspar increases from zone I to Zone III.

14. The chemical signature of the rocks of the alkaline-carbonatite complex are dominantly silica undersaturated. Quartz normative rocks are few syenitic fenites and tuff.

15. The carbonatites are classified chemically into calcio-magnesio and ferro carbonatites and they follow the normal sequence of emplacement.

16. The mafic-ultramafic rocks are dominantly agpaitic, while the sub-volcanic rocks and late stage silicates are miaskitic.

17. The mg* values (mg/mg+fe molar) range between 0.57 and 0.91 in mafic-ultramafic suites; 0.06 to 0.65 in syenitic rocks; 0.56 to 0.92 in carbonatites; 0.71 to 0.90 in magnetite rocks and show a differentiation trend when plotted
against different oxides. The variation curves are linear.

18. The magnetite rocks contain more than 3% TiO₂, have perovskite in the interstitial spaces of magnetite, thus indicating that the titanium crystallized as perovskite. However, when TiO₂ content is less than 3%, the titanium occurs as solid solution in the magnetite, as no independent crystals of perovskite seen in the rock (Edgar, 1974 p 355).

19. The variation diagrams of oxides show increase in alkalis and decrease of lime, magnesia and ferrous iron with the progressive differentiation.

20. 'Petrogeny residua' system shows the normal crystallization process, the undersaturated part of the system produces only nepheline. The composition of the co-existing K-feldspar and nepheline depends on the rate of cooling (Edgar, 1974 p 355).

21. In the peralkaline residua system aegirine/acmite crystallizes inequilibrium with nepheline + albite. Although normative sodium metasilicates present as minor amount in some mafic-ultramafic rocks and syenitic fenites, yet quartz and albite association are not noticed in the complex. The sodium metasilicate appeared in the norm when K₂O/Na₂O ratio decreases 0.1.

22. The trace elements of the mafic-ultramafics, syenitic, carbonatites indicate enrichment in incompatible trace elements (both LIL and HFS elements). The normalization plot with primordial lava indicate these rocks
are both co-genetic and co-magmatic. There is strong fractionation observed in the LIL and HFS elements. There is preferential allotment of some trace elements with the particular rock types viz, Sr in carbonatites, Ba and Zr, Nb, Rb in syenites and Cr, V and Y in mafics.

23. The liquid immiscibility can be deduced from batch, cluster and scattered plots of carbonatites and silicates against mg* values.

24. The $\delta^{18}$O and $\delta^{13}$C suggest the pristine carbonatite composition is 7.02 ‰ SMDW and -3.68 ‰ PDB respectively, indicate that these are mantle derived (Deines, 1989) and product of fractional crystallization, formed between 700 $^\circ$C and 1000 $^\circ$C. The late carbonatites which forms at much higher level possibly indicate a temperature between 100 $^\circ$C and 600 $^\circ$C (Le Bas, 1977).

25. Following the Middlemost (1974) and Le Bas (1977) the composition of parental magma have been deduced by considering the volume of individual rocks present in the complex multiplied by the average chemical composition. The parental magma appears to be carbonated calcium rich ultramafic composition, which have high mg* values and hence peralkaline.

Considering the facts, stated above it may be concluded that the alkaline-carbonatite complex of the Samchampi-Samteran area of the Karbi Hills, is structurally
controlled, located in the Kaliyani graben at the intersection of two major lineaments. The parental magma is thought to be mantle derived and through fractional crystallization accompanied by liquid immiscibility give rise to the carbonatites.