CHAPTER - 7
SUMMARY AND CONCLUSION

This study take into account the qualitative and quantitative make up of the parent rocks, weathering environments and products rendered in the different horizons of profiles developed under two (documented) contrasting climatic environments, viz, tropical humid (Neyyar Basin-NB, Kerala) and semi-arid (Tambraparni Basin-TB, southern Tamil Nadu).

The significant points emerging from this study are summarised below.

1. The Neyyar basin (NB, Thiruvananthapuram Dist, Kerala) and Tambraparni basin (TB, former Tirunelveli Dist., southern Tamil Nadu) are selected for this study. NB (Order= 6th; Length= 73 Km.; Area= 492 km^2) to the west and TB (Order= 7th, Length= 126 Km.; Area= 5969 $km^{2)}$ to the east of the Western Ghats (WG) are set back to back.

2. The NB lies on the western slope of the WG and extends up to Puvar in Thiruvananthapuram district, on the west coast of India. In NB, among the 18 selected profiles (out of 45), 7 belong to highland-HL and 11 belong to midland-ML. Again, 13 gentle, 4 very gentle and 1 steep category of slope.

3. The TB lies on the eastern slope of WG and joins the Gulf of Mannar at Punnaikkayal, Tamil Nadu. Among the 19 locations (out of 36), 6 fall in ML and 13 in HL. Slope of 17 very gentle and one steep. Relative relief – 18 Rises and one Hill.

4. The average annual rainfall of NB is 1580.70 mm with an average tempareture of 27.11^{0}C, and the average relative humidity at 8.30 hr. is 73.79% and at 17.30 hr. is 73.92%. Similarly, the average annual rainfall of TB is 697.85 mm with 28.92 ^{0}C and relative humidity at 8.30 hr. is 84 and at 17.30 hr. is 73.92%.

5. Data when plotted in Threvartha's diagram falls in the tropical humid domain for NB and semi-arid domain for TB. The contrasting climates, viz., tropical humid in NB and semi-arid in TB, qualified these basins for this study.

6. The profiles are developed on bedrocks like garnetiferousbiotite gneiss, charnockite, khondalite, leptynite and pyroxene granulite. Laterite (B-horizon) typical of tropical humid climate is present in all weathering profiles in NB, whereas, it is missing in TB; instead calcrete (indicator of semi-aridity is ubiquitous in TB.

7. Profiles in ML of NB are relatively thicker in comparison with HL. On the contrary, TB shows that profiles of HL are thicker than that of ML. Further, horizons in NB are thicker than those in TB. Mean thickness of A, B and C-horizons of NB are 95.0 cm, 368.0 cm and 369.0 cm, while in TB the corresponding values are 76.0 cm, 80.0 cm and 277.0 cm respectively. Between-basin-difference is best expressed in the thickness of B-horizons. Further, between NB and TB, profiles in NB are thicker (mean = 801.0 cm) than those of TB (mean = 417.0cm).

8. Thickness of profiles in NB shows a negative correlation with altitude, whereas, that of TB show a positive correlation with altitude. Again, influence of slope on thickness of horizons and profiles are obvious, in that NB has thicker horizons and profiles associated with gentler slopes. Further, horizons and profiles tend to be thicker in locations of low relief.

9. Inter-basin difference in the thickness of horizons and weathering profiles between NB and TB is a robust signature of differing climate (i.e., tropical humid vs. semi-arid) and hence processes involved in weathering. ,

10. The impact of weathering on texture of soil profiles was examined by studying the up-profile variation in G(gravel)-S(sand)-M(mud) content. The G, S and mud M percentage were plotted in the Folk (1961) textural classification diagram.

11. In NB, A-horizons are enriched in gravel (21-64%) than in TB (2-34%). The B-horizons show a wide range in texture i.e. muddy sandy gravel (msG) - gravelly muddy sand (gmS) - gravely mud (gM). The saprolite/saprock (C-horizon) gives rise to a detritus of gravelly muddy sand (gmS).

12. In contrast, in TB, B-horizons have muddy sandy gravel (msG) and gravelly muddy sand (gmS). C- horizon samples, in general, are sandy gravel (sG) or gravel.

13. In TB lower up profile mud content may be due to subdued chemical weathering in a semi-arid climate. The weathered rock is only partially kaolinised and the sand sized quartz grains and rock fragments are physically freed from the matrix without undergoing significant decomposition.

14. The study also reveals that climate has a direct influence on texture of detritus in the profiles developed in tropical humid and semi-arid climates.

15. The study of Petrography of light minerals (LMs) in NB and TB shows the minerals as quartz, K-feldspars- KF (fresh, turbid), plagioclase feldspars- PF (fresh, incipiently altered), alterite, and vermiculite.

16. The study of up-profile mineralogy shows that quartz and feldspars are chief indicators in the weathering domain. i.e., as feldspars weather and transforms, quartz exhibits a complementary enrichment in both basins.

17. In NB, quartz shows considerable up-profile enrichment from bed rock (34.5%) to A-horizon (98.8%). K- and plagioclase feldspars exhibits near total elimination with progressive weathering up in the profiles. Further, the mean content of total KF in bedrock is 36.2%, which decreases to 34.3 in C, 5.3 in B and 0.28% in A-horizon. Fresh KF, in spite of their notable presence (36.2%) in bed rock, is meager (0-7.5) in overlying horizons. Turbid K-feldspars is present in C- (32.1%), but wither off quickly in B- (3%) and A- horizon (0.1%).

18. PFs are more sensitive to weathering as evidenced by their near total destruction on weathering from bed rock (29.2) to C (0.99), B (0.07) and A (0.30%) horizons. Content of fresh- and incipiently altered plagioclases are meager (<1%) in C- to- A –horizons, indicating their near total elimination under a humid weathering domain. Alterite is present in notable amounts in C- and B- (1-41.2%), but almost depleted in A-horizon.

19. In TB, the portrait of LM is different from that of NB. Quartz show relative enrichment from bed rock (30.5) to A-horizon (77%), but is lower than that of NB. Average KF in bedrocks is 40.4%, which upon weathering, drops to 23.0 in C, 26.2 in B and 18.6% in A-horizon. In contrast to NB, turbid KFs are abundant in C- (11.0), B (20.0) and A- (13.9%) horizons. In contrast to NB, fresh KFs are partially retained in horizons of profiles in TB.

20. In contrast to NB, total PFs in TB are partly retained in C (10.1) B (6.8) and A- (4.0%) horizons. Similarly, incipiently altered plagioclases are also persisting in these horizons. Compared to NB, the content of alterites are very low (<1%) to almost absent.

21. XRD analysis of select detritus supports the findings of modal analysis generated from the petrographic study in both NB and TB.

22. The results of modal analysis amply vouch for variance in intensity of weathering under contrasting climates in NB and TB. In NB, PF suffers near total loss in the initial stages of weathering, but the alteration and loss of KF succeeds at a later stage. On the contrary, TB displays simultaneous but retarded loss of both PF and KF. This differential path and pattern of alteration of feldspars under contrasting climates in NB and TB is well depicted in the QPK plot.

23. An estimate of loss and gain (LG) of feldspars give an excellent picture of differential weathering under humid and semi-arid climate. In NB, KF has suffered a loss of 81% in B- horizon as against 50% in TB. In NB, loss of PF in B is 99% compared to 57% in TB. Collectively, the extent of loss of total feldspar is 91% in B's of NB as against 51% in TB.

24. The chemical analysis of detritus and bed rock from different horizons of soil profiles from NB and TB were done for estimating the major elemental oxides, viz., SiO_2, Al_2O_3, FeO, Fe_2O_3, TiO_2, CaO, MgO, Na_2O, K_2O and MnO.

25. In general, the up-profile behaviour of these oxides in both the basins is more or less comparable i.e. relative enrichment of alumina and total Fe, and depletion of silica and bases like Na, K, Ca and Mg are noticed in both the basins. However, the quantum of these changes differs between the basins.

26. Silica dominates all the horizons of NB and is followed by Al2O3, FeO, Fe2O3, TiO2, K2O, MgO, CaO and Na2O in the decreasing order of abundance. However, in TB, the more or less same pattern is followed, but, the content of Na2O, K2O, CaO, MgO are relatively higher suggesting a weak degree of weathering.

27. Several indices of weathering has been employed to assess the degree of weathering in both basins, viz., Leaching Factor-LF; Product Index-PI; Weathering Index-WI; Modified Weathering Potential index-MWPI; Chemical Index of Alteration-CIA, Chemical Index of Weathering-CIW and Index of weathering , IW. All these indices (except PI) clearly brought out the variance in the degree of weathering between the basins and hence are useful tools (especially CIA) to assess weathering under contrasting climates.

28. The analysis of chemical data using A-CN-K and A-CNK-FM trilinear plots reveals that Ca, Na and K are mobile in tropical humid (NB) as well as semi-arid (TB) environment. In both environments Ca and Na are relatively more mobile than K and the extent of mobility (i.e., quantum of loss) of these elements is more in humid than in semi-arid weathering regime.

29. Again, in another attempt using A-CNK-FM plots, the analysis brings out the differences between mobility of Ca, Na, K, Fe and Mg during weathering in humid and semi-arid environments. Ca, Na and K are highly mobile under humid weathering such that these elements are almost depleted in the last stages of weathering.

30. Bivariate plots of Bases vs. R_2O_3 and Bases vs. Alumina were found to be useful in discriminating weathering under contrasting environments. This approach has implications to paleoclimatic studies. Efficacy of these molar bivariate plots as templates was checked with data from two modern weathering domains viz, laterite (humid, Kerala) and weathered amphibolite (semi-arid, Karnataka and the data points fall in the respective segments in the plot and correctly matched.

****