SUMMARY AND CONCLUSION

The following conclusions have been drawn from the textural, mineralogical and geochemical studies of the modern sediments of the Vellar river drainage basin and its surrounding environments.

The overall decreasing grain size along the 115 km distance of the river course is mainly due to the decreasing competency of the water, and to a lesser extent, due to abrasion. The moderately sorted sediments in the fresh water river channel and the poorly sorted sediments in the estuary are close functions of the mean size of sediments. In the estuary, the addition of silt and clay modes to the sand mode renders them poorly sorted. The change in skewness from nearly symmetrical to positive in river channel is the consequence of the progressive addition of fine population down stream. Kurtosis did not show any significant change in river channel. Mostly, the river channel sediments are meso kurtic but the estuarine sediments are predominantly of lepto and very lepto kurtic. In general, the variation in sorting, skewness and kurtosis along the river channel are closely related to mean size. The beach sands are characterised by the mean size in the range of medium to fine sand, with well sorted, very negatively skewed to nearly symmetrical skewness, and abundant platy to very lepto kurtic. The tidal channel
of poorly sorted, and very positively skewed. However, the kurtosis ranges from platy to very lepto kurtic. The above variations are due to the constant movement of the tidal currents which lead to the removal of significant amount of fine particles from the tidal channel and also the deposition of sand near the juncture of tidal channel and estuary and silt and clay in calm area. The nearshore marine sediments show comparatively wide range of phi mean size and are well sorted to poorly sorted, with negative to very positive skewness. Even though, the kurtosis varies from platy to extremely lepto kurtic, very lepto kurtic sediments are predominant. The above variations are due to an environment which is subjected to a high rate of deposition besides the severe turbulence prevailing in the area.

A high proportion of sand is present at the head of the estuary with silt and clay as subordinates. The sand proportion decreases towards the confluence. The silt content is comparatively lower than the clay content downstream. However, the central part of the estuary shows a very clear decreasing trend of sand and increasing trend of clay content. This is attributed to the existence of a low hydraulic condition in the central part, compared to that in the northern and southern sides. The variation seen in the northern and southern sides may be due to the influence of ebb and flood current. These currents can transport the sediments in opposite directions on either
side of the estuary which results in the removal of fine size.

The tidal channel sediments show a high degree of compositional variability and are composed of a large proportion of muddy sand and mud and low percentages of sandy mud. This clearly indicates that these variations are due to the hydraulic fluctuations prevailing in the tidal channel. The nearshore marine sediments show a very little clay content compared to the high silt content. This may be due to the significant wave-energy in the nearshore, which would tend to maintain clay particles in suspension and consequently increase the silt and sand content in the sediment.

The CM pattern of the river channel and estuarine sediments indicate that the majority of the river sediments are transported by rolling and suspension and a small part by graded suspension. But the estuarine sediments are transported mainly by graded suspension. Data on the beach sediments suggest that these are also transported by graded suspension. The tidal channel deposits are the consequence of tractive currents, which are not as strong as the river currents. The nearshore marine sediments are deposited under combined action of tractive currents and graded suspension. The FM, LM, and AM diagrams along with CM patterns characterise the grain size image of these deposits.

Hornblende, garnets, opaques and pyroxenes are the dominant constituents in the heavy mineral
assemblages with minor amounts of zircon, epidote, sillimanite, rutile, monazite, kyanite, biotite and altered minerals. In all the environments, the fine size grade (125 to 62 micron) contains a higher proportion of heavy minerals compared to medium and coarse size grades. The decrease of heavy minerals downstream is explained on the basis that the heavy minerals once entrained in the sediments are not carried away by subsequent currents, and the size-density settling velocity principle also plays a role in the deposition of heavy minerals upstream. The overall number percentage increase in amphiboles and pyroxenes and decrease in opaques and garnets downstream in the three size grades are mainly due to the differences in their density and the decreasing competency of the currents. The increase in amphiboles/garnets ratio and decrease in density index and shape index downstream have been attributed to the difference in the density and the shape of the minerals. The greater resistivity of quartz, compared to feldspar leads to the increase of quartz/feldspar ratio, in the three size grades, downstream. This suggests that the sediments are not matured. In the beach and nearshore environments, the variations in heavy mineral concentrations are mainly due to their hydraulic equivalence, longshore currents and the source rocks. Based on the mineralogical study, it is suggested that the chief contributors of these minerals are mainly high grade metamorphic rocks and basic igneous rocks. Based on this conclusion it is proposed that
the sediments may be derived from their origin point namely Chitarai, Tainandamalai, Kalrayans, Kollaimalai and Pachaimalai hills, where the rock types mainly consist of biotite gneisses, hornblende gneisses, magnetite, quartzite, charnockite, granite, ultrabasic and basic intrusives. Moreover, that these heavy mineral suites have not altered significantly in the river channel, estuary, beach and nearshore environments is a fact suggestive of the minimum or rather nil influence of the external aspects.

The different environments of Vellar river basin divulge that montmorillonite is the most dominant clay mineral followed by kaolinite. Illite is present only in the southern and central sectors of the nearshore marine environment. It is inferred that the sources for clay minerals are magnesium rich rocks, red soils, and the overburden of Neyveli lignite deposits. From the study, it is deduced that differential flocculation and size segregation have played a significant part in the formation of the clay minerals.

The organic carbon content in the bulk sediments of the river channel and nearshore marine environments is negligible or nil. But in the tidal channel and estuarine environments it shows a comparatively higher amount owing to the size of the sediments, i.e. finer the sediment, greater the organic carbon and organic production of these environments. In clay fraction, the nearshore marine, tidal channel and estuarine environments contain high amount of organic carbon than the river channel due to
the hydrobiological conditions existing in these environments, which in turn is reflected in the high production of planktons that is normally available in the size range of clay. Clay minerals may also lead to the increase of the organic carbon content in the clay fraction. The carbonate content in the bulk and clay fraction of different environments is mainly due to the availability of carbonate mineral and carbonate shell material.

The geochemical distributions of Si, Al, Fe, Mg, Ca, Na, K, Ti, P, and Mn in the bulk and clay fractions of the sediments of the different environments have been discussed in relation to the physico-chemical conditions of the depositional environments, organic matter, carbonate content and clay minerals. In the nearshore marine sediments, the phosphate in bulk sediments is deposited with iron as ferric phosphate. However, in the river it may be contributed by organic waste and the excess fertilizer used on land. The tidal channel and estuarine environments show that the phosphate in bulk sediments comes from organic sources of these environments as well as from river or marine sources. The variation of phosphate in the clay fraction mainly depends upon its clay mineralogy. The iron in the bulk sediments of the river and nearshore environments depends on the mineralogy of the sediments and the precipitation of ferrous hydroxide. However, in the estuarine and tidal channel bulk sediments, organic matter also helps to increase the iron content besides the above
The variation in the distribution of Na and K in the bulk sediments are closely related to the mineralogical composition of the sediments, variation of salinity in the water column and the salt content of the pore solution. However, in the clay fraction, the slight variation among environments is the result of ion exchange in the lattice of clay mineral composition. Ca concentration in the bulk sediments of the various environments show that the variation is influenced by the amount of shell fragments available in the sediments. However, in the clay fraction, the variation is attributed to the mineralogy of the clay fraction and the availability of clay size planktonic calcareous tests. The variation of Mg concentration in the bulk and clay fraction of the sediments of different environments may be due to the mineralogy of bulk and clay fractions and the availability of MgCO$_3$ shell fragments. The Si and Al concentrations in the bulk and clay fraction of the sediments of different environments demonstrate that their variations are manifestations of the mean size of the sediments i.e. the availability of clay mineral. When the amount of clay content reduces the
concentration of Al decreases whereas Si increases. Further, when the clay minerals are available in large quantity, the Al content increases and Si content decreases.

The trace elements Cu, Co, Ni, Zn, Cr, and Cd are correlated with major elements, carbonates, organic carbon and clay minerals. In general, the presence of significant quantities of iron and manganese in the different environments plays an important role in the adsorption of the above said trace elements in those oxides. The organic carbon also helps to concentrate these materials in these environments. However, clay minerals play an important role in the trace element concentration, through cation exchange, by fixation of these elements in their lattice structure. In the bulk sediments, mineralogy of the sediment also helps to concentrate trace elements along with the above said factors.

The R - mode factor analysis has yielded the identification of eleven factors such as grain size-Si factor, Al factor, iron oxide coating-Fe factor, Mg-Mg rich minerals factor, Ca factor, Na and K factors, Ti factor, P factor, Mn oxide-Mn factor, and organic matter-organic carbon factor which influence the concentration of elements in the sediments. Among the above factors the first eight factors are common to both the groups, while the last three factors influence only the major and trace elements group. These factors supplement the explanation offered in the
preceding section, for the variation in geochemical elemental concentration of the sediments.

In general, the bulk sediments of estuary contain highest amounts of Cu, Co, Ni, Zn, and Cd; while the nearshore sediments hold larger amount of Cr compared to the other environments. However, in the nearshore environments, clay faction contains highest amount of Cu, Co, Zn, and Cr. But in the case of Ni, river clay shows higher amounts and for Cd estuarine clay hold larger amount than the other environments.

The trace element concentrations of different environments of Vellar river show slightly higher amount than the unpolluted estuaries. However, it is concluded that these concentrations are due to the variations in the mineralogy of the sediments, the contribution of source rocks and the physico-chemical enrichments of trace elements in the different environments. Hence there is no trace elemental pollution in these environments by anthropogenic sources, in addition to the fact that there are no major industries located on the banks of this river. Based on the above reasons it is suggested that the present data can be considered as a background data for the different environments of the study area.

These studies reveal that the variation in texture, mineralogy and geochemistry of the sediments are useful in characterising the sediments in different environments of the Vellar river basin. The studies on the trace elements suggest a real mechanism of the
sediment - water - biota interactions. Moreover, the present study invokes some interest on the future study of the clay mineral variation and the carbonate mineral variation in this area. It is hoped that the data presented in this thesis regarding the texture, mineralogy and chemistry of the sediments of the different environments of the Vellar river basin may be used to differentiate the paleoenvironment, which could positively have an identical geological setting to that of the modern Vellar river basin. In addition, the trace metal concentration can be used as background data for the future studies in this area as well as elsewhere.