Chapter 1
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INTRODUCTION

1.1. General introduction

Climate is a major component of earth system and has a direct control over the various physical, chemical and biological processes of the earth. There is increasing scientific evidence that natural processes combined with the anthropogenic activities are changing the Earth's climate. Greenhouse gas emissions from fossil fuel use are altering the atmosphere, creating an uncertain future of global warming, altered pattern of precipitation and sea-level rise for the generation to come. The potential threat of global climate change is a very serious problem to the entire Earth and its ecosystems. Climatic system of the Earth underwent several episodes of yearly to millennial scale variations in the past and knowledge on the past variations is necessary for understanding and prediction of regional and global climate (Kutzbach, 1981; Duplessy, 1982; Prell and Kutzbach, 1987; Fontugne and Duplessy, 1986; Gasse et al., 1991; Clemens et al., 1991; Sirocko et al., 1993; Reichart et al., 1997; Overpeck et al., 1996; Lamy et al., 1998; von Rad et al., 1998a; Naidu and Shankar, 1999; Gupta and Anderson, 2005). Firstly, the weathering and erosional products of the rocks and denudational processes on land vary with the changing climatic conditions and one can able to decipher climate by studying the properties of sediments through time. As these sediments transport and deposit on the continental margins, the terrigenous sediments deposited offer continuous record of information about the climate of the landmasses. Secondly, the terrigenous flux that has been transported to the continental margins together with changing seasonal monsoonal conditions induce several changes in the physics, chemistry and biology of the oceans that in turn leads to the varying upwelling and related changes in the primary productivity of the oceans. As a consequence the organic carbon (OC) deposited on the sea floor varies. By studying the OC distribution
one can able to decipher the productivity changes. Therefore, the sediments deposited on the continental margins of the World Ocean act as natural laboratories for studying the past climatic and oceanographic variations both regionally and globally.

1.2. Scope and scientific importance of the study

The continental margin off western India is an ideal site to study the past climatic and oceanographic conditions, especially for four reasons. Firstly, the terrigenous sediments are from diverse sources. The nature of terrigenous sediments and their rate of deposition vary from north to south along the continental margin. For example, the sediments in the extreme north are derived from the River Indus, one of the largest Rivers of the World, supplying sediments from the Himalayas. As the northwestern margin of India is bordered by alluvial soils of Pakistan and arid landmasses such as Iran-Makran-Thar regions, aeolian sediment supply is also an important terrigenous flux in this part of the margin (Kolla et al., 1981a; Chester et al., 1985; Reichart et al., 1997; von Rad et al., 1999; Prins et al., 2000). The sediment input from the Narmada-Tapti Rivers, discharged through the Gulf of Khambat, forms the second largest source of sediment. Further south the moderate and minor seasonal rivers supply sediments on the central and southwestern margin of India. Although broad understanding has been achieved on the provenance of the sediments based on mineralogy (Nair et al., 1982a; Rao and Rao, 1995) of the surficial sediments and Sr-Nd isotopes (Kessarkar et al., 2003), palaeoclimatic studies using exclusively terrigenous sediments have not been attempted. On the other hand, environmental magnetism or rock-magnetic properties of the terrigenous sediments deposited on the margins depend on magnetic concentration, magnetic minerals and magnetic grain size of the sediments, which in turn is modified by the climatic conditions on land.
Secondly, the lateral distribution of sediments on the northwestern margin of India shows distinct sediment types. For example, the inner continental shelf is characterized by predominant terrigenous sediments, followed by relict sandy sediments on the outer shelf and a mixture of terrigenous and biogenous sediments on the continental slope (Rao and Rao, 1995; Rao and Wagle, 1997). The relict sandy sediments on the outer shelf are largely carbonate-dominated in the northwestern part and terrigenous sand-dominated in the southwestern margin of India (Rao and Wagle, 1997). The sediment cores recovered from the NW margin of India also exhibit the occurrence of relict lime muds in the lower sections of each core. Although extensive studies have been carried out on modern lime muds from the Bahamas and the Persian Gulf (Cloud, 1962; Wells and Illing, 1964; Neuman and Land, 1975; Steinen et al., 1988; Robbins and Blackwelder, 1992), their origin is still a subject of debate. Some argue that the lime muds are inorganic in origin (Cloud, 1962; Wells and Illing, 1964; De Groot, 1965, Milliman et al., 1993; Dix, 2001), and others propose disaggregation of codiacean algae as a source for lime muds (Lowenstam and Epstein, 1957; Matthews, 1966; Stockman et al., 1967; Neuman and Land, 1975). Identifying the sources of lime muds is important to quantify the sediment carbonate budgets and in estimating carbon cycles. The relict lime muds of the northwestern margin of India provide opportunity to understand their genesis and the influence of late Quaternary sea level changes on their distribution. The northwestern margin of India is furthermore influenced by late Quaternary neo-tectonic activity (Rao et al., 1996; Rao and Veerayya, 1996; Rao and Wagle, 1997; Rao et al., 2003; Merh, 2005). The radiocarbon dating of different sediment intervals in the cores off Kachchh may provide better understanding on the precise timing of neo-tectonic activity and flooding of the Gulf after the Last Glacial Maximum (~18,000 yrs BP).

Thirdly, upwelling associated productivity is largely seasonal on the western margin of India. Widespread upwelling and high surface productivity
occurs during the SW monsoon and results in permanent oxygen minimum zone on the continental slope between 150 m and 1200 m water depth (Wyrtki, 1971) and high organic carbon in the underlying sediments. Factors controlling the enrichment of organic matter in marine sediments are a matter of debate for several years. Two different hypotheses exist. Some argue productivity is the main controlling factor (Pederson and Calvert, 1990; Pederson et al., 1992; Calvert et al., 1995; Thompson et al., 1997), whereas others propose preservation in poor-oxygenated conditions is responsible for enrichment of organic carbon (Canfield, 1989; Demaison, 1991; Paropkari et al., 1992, 1993). Since the sediments cores were recovered at different depths on the continental margin off Saurashtra, a moderate productivity region, the down-core distribution of OC together with other sedimentological parameters are helpful in verifying both hypothesis and understanding the palaeoceanography of the region.

Fourthly, despite two major rivers (the Indus and Narmada -Tapti Rivers) debouching enormous sediments in the vicinity of the Gulf of Kachchh and Saurashtra peninsula, the relic sediments on the outer continental shelf of the northwestern India are not buried by recent clastic sediments. Where are the river-borne sediments deposited? The macro-tides operating at the Gulf of Kachchh act as a natural barrier for the alongshore sediment transport in this region (Nair et al., 1982b; Chauhan, 1994). Did the Indus-borne sediments deposited in the shelf south of the Gulf of Kachchh during low sea level conditions in the late Pleistocene/ early Holocene? What is the role of neo-tectonic activity in transporting and diverting river-borne sediments? In order to address these questions a better understanding is required on the provenance and transport pathways of fine-grained sediments deposited on the NW margin of India during the late Quaternary. Studies on clay mineralogy of the sediments in the gravity cores would be the most straightforward tool for identifying their provenance.
1.3. Objectives of the study

Keeping in view of the above, detailed investigations were carried out on the sediment cores collected along the northwestern margin of India. I have focused on the down-core variations in the (a) grain size, mineralogy and rock-magnetic properties of the terrigenous sediments, (b) sedimentological, mineralogical, geochemical and stable isotope characteristics of the lime muds and (c) organic carbon and carbonate content of the sediments.

The objectives of the present study are to

1) trace the climatic history and provenance of the sediments during the late Quaternary,

2) resolve the issues related to the genesis of lime muds and influence of late Quaternary sea level changes and neo-tectonic activity on their distribution and

3) report the nature of organic carbon (OC), productivity changes and factors controlling the OC distribution in the late Quaternary.

1.4. Physiography and Geologic set up of the study area

Arabian Sea is a semi-enclosed basin forming the northern arm of the Indian Ocean, surrounded by the dry land masses of Africa, Arabia, the Iran-Makran-Thar regions towards west and north and by the coastal highlands of western India towards east (Kolla et al., 1981a; Fig. 1.1). Indus, the sixth major river in the world in terms of sediment discharge brings enormous sediments to the Arabian Sea (~400 million tons of suspended and bed load before the construction of dams - Mangala dam in the year 1967 and Tarbela dam in 1976
Fig. 1.1. Physiographic provinces of the Arabian Sea (modified after Kolla et al., 1981a)
The hatched area represents the study area. (The cores used for rock magnetic studies extends beyond the hatched area - see Fig. 3.1).
that reduced to ~45 million tons at present – Milliman et al., 1984). The Narmada and Tapti rivers debouch 58.7 million cu. m. of water and several tons of suspended and bed load annually through the Gulf of Khambat (Rao, 1975). Besides, many small rivers and streams drain into the Arabian Sea from western India. The arid regions in the north and west of Arabian Sea (Arabian Peninsula and Iran-Makran area) contribute negligible riverine flux, but abundant aeolian material (~100 million tons annually - Sirocko and Sarnthein, 1989) to the Arabian Sea by transporting through the dry, northwesterly Shamal winds (Kolla et al., 1981a). The heavy sediment load from the Indus forms an extensive physiographic feature in the Arabian Sea called the 'Indus Fan'. The Indus-borne sediments extend as far as 1500 km away from its mouth (Lisitzin, 1972). The Indus and its tributaries drain the glaciers and the mountain slopes of the Himalayas and the Indo-Gangetic basin. The lithologic units in the Indus drainage area include slates, phyllites, quartzites, mica-schists, carbonaceous and graphitic schists, crystalline lime stones, dolomites, biotite-gneiss, granulites, intrusive igneous rocks like granite, pegmatite and dolerite and the various lithologic units of Siwalik and Salt Range formations (Krishnan, 1982). The Narmada and Tapti Rivers drain the Vindhyan, Satpura systems and the Deccan Traps. The tributaries of the Narmada and Tapti and some minor rivers like Mahi and Sabarmati drain the Aravalli mountain ranges and the younger formations of Gujarat and Rajasthan and discharge their sediment load in to the Arabian Sea through the Gulf of Khambat (Krishnan, 1982). The Gulf of Kachchh and Gulf of Khambat are two prominent embayments along the northwestern margin of India and are also the most prominent macro-tidal (average tidal range of ~4 m, Babu et al., 2005) sites of India. The Gulf of Kachchh receives little runoff from the land, whereas the Gulf of Khambat receives abundant run off from the land.

The hinterland region of Saurashtra is located astride the Tropic of Cancer and forms an important part of dry lands of western India. The monsoon rains are restricted to June - September and the rest of the months are dry. The geology of
the Saurashtra region is the result of complex interaction between tectonism and sea level changes during the Cenozoic (Chamyal et al., 2003). The basic framework was formed due to sequential fragmentation of the western continental margin of the Indian plate during the late Mesozoic as it collided with the Eurasian plate in the north (Biswa, 1987). The break up of the margin resulted in the formation of Kachchh, Khambat and Narmada rift basins (Biswa, 1987). The coastline of Saurashtra is highly varied and characterized by the presence of narrow belt of low ridges and cliffs of miliolite limestones and other shore deposits (Chamyal et al., 2003). The Saurashtra peninsula is largely covered by Deccan Trap basaltic flows. Cretaceous sediments crop out in the northeastern part and a thin veneer of Tertiary and Quaternary sediments occur along the coast (Bhattacharya and Subrahmanyam, 1986). Sedimentary sequences ranging in age from Jurassic to Pleistocene are found in the interior of Saurashtra and in the coastal regions in the northern part of the Gulf of Kachchh (Fig.1.2).

The physiography of the continental shelf is a result of the depositional and erosional processes that occurred during the glacio-eustatic sea level fluctuations (Wagle et al., 1994). The tectonic movements and the isostatic adjustments might have further modified the physiography. Except in the Gulf of Kachchh and Gulf of Khambat, the topography of the inner shelf is smooth with no major undulations. The physiographic features of the order of 5-10 m high occur on the outer shelf. Submarine terraces and notches are observed on the continental slope off Saurashtra. A carbonate platform, also called as 'Fifty Fathom Flat' is the largest topographic feature on the outer continental shelf of the northwestern margin of India. The water depth on the platform ranges between 60 and 110 m. The width of the continental shelf varies from about 100 km south of the mouth of Indus to 160 km southwest of the Gulf of Kachchh. The width of the continental shelf is only 70 km off Saurashtra. The shelf width is greatest (~345 km) off Mumbai and decreases southwards (Rao and Wagle, 1997). The shelf break
Fig. 1.2. Geology of the western margin of India. Onshore geology after Anonymous (1965) and offshore geology after Rao and Wagle (1996)
occurs at about 80-140 m off Saurashtra and at about 90 m off the platform (Rao and Wagle, 1997). Two distinct sediment types occur on the continental shelf: modern clastic clays on the inner shelf and relict sandy sediments on the outer shelf. Relic deposits on the outer shelf and carbonate platform comprise abundant aragonite faecal pellets, oolites, *Halimeda* grains and a few bivalves, benthic and planktic foraminifers. The platform also contains indurated aragonite muds, *Halimeda* - and pelletal limestones, coralline algal nodules, a few coral fragments, oyster shells and dolomite encrustations (Nair, 1971; Nair et al., 1979; Rao et al., 1994, 2003a&b). *Halimeda* bioherms of early Holocene age were also reported on the platform (Rao et al., 1994). Continental slope comprises silty clays that are an admixture of dominant terrigenous and biogenic components (Rao and Rao, 1995).

1.5. Tectonic framework and neo-tectonic history of the region

The northwestern continental margin and inland region exhibit a number of faults and horsts and graben structures. Notable amongst the tectonic elements are the Kachchh rift, the Cambay rift, the Narmada rift and the Kathiawar rift (Fig.1.3). The Kachchh region is controlled by numerous E-W faults and falls in the seismically active zone V. It is located quite close to the junction of the western continental margin and the geosynclinal belt of Sindh-Baluchistan (Merh, 2005). The Saurashtra peninsula is bordered by major faults and rift basins to its north, south and east and forms a horst block in relation to its surrounding area. It is the uplifted part of the WSW plunging basement arch and is a divide between the northern Kachchh-Saurashtra shelf and the southern Bombay-Kerala shelf. Bhattacharya and Subrahmanyam (1986) identified WNW-ESE trending fault that extend across the Saurashtra continental margin between Porbandar and Varaval and considered it as a major linear tectonic feature in this area. The Saurashtra arch, which is an extension of the Aravalli range subsided along the eastern margin fault of Cambay Basin during Early Cretaceous forming
Fig. 1.3. Tectonic map of Western India (After Biswas, 1988)
an extensive depositional platform continuous with the Kachchh shelf and a part of the arch was uplifted in the late Quaternary (Mahadevan, 1994). The Saurashtra Arch separates the Saurashtra offshore basin from the Kachchh offshore basin. The Saurashtra Peninsula in the east and Narmada Graben in south mark the limits of the Saurashtra offshore basin (Fig. 1.3).

Historic events like disruption of River Saraswati, westward migration of Sutlej around 5ka BP and the decline of Harappan civilization around 4 ka BP (1900 BC) are attributed to the tectonic activity in the region (see Merh, 2005 and references therein). Imprints of severe tectonic and eustatic movements in the NW margin of India are also preserved in the Great Rann, the landmass lying north of the Gulf of Kachchh. Marine conditions existed in the Great Rann in the past and with gradual recession of sea, the area changed over to an estuary, that received sediments from Saraswati and Sutlej and today it is an area of high aridity. A massive earthquake around 1000 years back (1030 AD) is believed to be responsible for the uplift of the Great Rann and westward migration of the River Indus (see Merh, 2005). Presence of submarine terraces off Saurashtra-Bombay at 130, 145 and 170 m water depths that lie well below the glacio-eustatic sea-level low of —120 m, occurrence of inter-tidal limestones dated 11,980 yrs BP at 130 m depth, the mismatch between the depth and radiocarbon ages of oolite samples from the Fifty Fathom Flat (Rao et al., 1996; Rao and Veerayya, 1996; Rao and Wagle, 1997) and the corresponding glacio-eustatic sea level position (Fairbanks, 1989) and relic deposits dated 12550 yr BP at 35 m depth in the Gulf of Kachchh are evidences in favour of late Quaternary of neo-tectonic activity (Rao et al., 2003a).

1.6. Climatic and oceanographic set up

The Indian monsoon system is one of the major climatic systems of the world and showed drastic variations ever since its origin from late Miocene (cf.
Gupta and Anderson, 2005). The Indian monsoon system is controlled by seasonal reversal of wind system wherein during summer (June – September) the South Asian landmass is warmer than the ocean, driving winds from SW to NE towards the continents resulting in southwest monsoon or summer monsoon. During winter (November – February) the pressure cells reverse and thus the winds blow from NE to SW forming the northeast monsoon or winter monsoon. During the northern winter, when the snow cover increases the albedo, atmospheric pressures are high over Central Asia and this sets up a pressure gradient between Central Asia and the Inter Tropical Convergence Zone at about 10°S, forcing the dry and cold northeasterly winds of the winter monsoon (Reichart et al., 1997). Snow and ice melt at the end of the winter diminishes the albedo over Central Asia, causing a reversal of pressure gradient. This seasonal reversal of the Indian monsoons is one of the most spectacular features of Earth’s climate system (Webster, 1987). The summer monsoon brings heavy rains over the Indian land mass whereas during winter monsoon season the precipitation is low.

Studies have shown that the cyclic variability in the obliquity and precession of earth’s orbit that affected the intensity of solar insolation controlled the intensity of summer monsoon in the past (Prell and Kutzbach, 1987; Clemens et al., 1991). Marine records of past climatic changes from Arabian sea showed that the monsoon was significantly weaker than present during glacial times, much stronger than present during the early to mid-Holocene and weaker up to the present day (Duplessy 1982; Van Campo et al., 1982; Prell, 1984; Prell et al., 1990; Sirocko et al., 1991).

The northern Arabian Sea is a unique environment characterized by strong seasonal variability of monsoonal upwelling and high primary productivity that favor an exceptionally broad and stable mid-water oxygen-minimum zone (OMZ). During the northeast monsoon, biological productivity is low (289 mg C
m$^{-2}$ day$^{-1}$ – Sarupriya and Bhargava, 1993) and the monsoonal winds of the southwest monsoon cause widespread upwelling and high surface productivity (720 mg C m$^{-2}$ day$^{-1}$ – Sarupriya and Bhargava, 1993) in the western Indian margin.

1.7. Previous studies

Marine geological investigations in the Arabian Sea started with the *HMS Challenger* Expedition during 1872-76. This is followed by *Vityaz* (1889), *Valdivia* (1889-99), *Mabahiss - John Murray* (1933-34) and *Albatros* (1947-48) Expeditions. Topography and Sediment distribution in the Arabian Sea was first reported by Sewell (1935). Wiseman and Bennett (1940) presented organic carbon and nitrogen distribution in the Arabian Sea sediments by using the samples collected during John-Murray Expedition (1933-1934). The International Indian Ocean Expedition (IIOE- 1961-1965) sediment samples and oceanographic data were collected from the west coast of India. During IIOE, *INS Krishna* surveyed the western continental shelf of India between Bombay and Cochin, whereas *R/V Meteor* collected samples in different traverses across the shelf and slope region off Bombay – Cochin. *Oceanographer* studied northern Arabian Sea and focused on the shelf and slope off Bombay-Saurashtra. *Requisite* studied the northern Arabian Sea and *Vladimir Vorobyeo* the western continental shelf of India. *Vityaz* studied the deep Arabian Basin. *R/V Vema* of the Lamont-Doherty Geological Observatory and *USNS Wilkes* also carried out investigations along several transects in the Arabian Sea (Kolla et al., 1981a). The continental margin off Pakistan and western India was studied for the first time by the cruises of *R/V Meteor* and *M/V Machhera* during the International Indian Ocean Expedition (IIOE; Dietrich et al., 1966). The Indian research vessels such as *INS Darshak, RV Gaveshini, ORV Sagar Kanya, Samudra Manthan and Samudra Saudhikama* carried out subsequently detailed studies and collected sediments along the western continental margin of India.
Magnetic susceptibility ($\chi_m$, hereafter discussed as MS) is related to total magnetic mineral concentrations in the sediments. The MS signal is largely controlled by magnetic mineral concentration, grain size, carbonate dilution and the presence of dia- and paramagnetic minerals (Bloemendal et al., 1988). Magnetic susceptibility studies on the sediments of the Arabian Sea are few and include studies from the sediment cores collected during the Ocean Drilling Program (ODP) and deep Arabian Sea (Bloemendal and de Menocal, 1989; Shankar et al., 1994a; Sykes and Kidd, 1994; Meynadier et al., 1995; Hounslow and Maher, 1999). These workers used magnetic susceptibility as a proxy to study the source of the lithogenic and aeolian flux and the magnetic responses to climatic changes. Meynadier et al. (1995) used the magnetite/hematite ratio to study the influence of Antarctic Bottom Water Current in transporting fine-grained magnetic minerals to the Somali Basin. Prins et al. (2000) used magnetic susceptibility to identify the aeolian and Indus-borne sediments in turbidites of the Indus Fan. Karbassi and Shankar (1994) applied rock magnetic techniques locally to the riverine and estuarine sediments of Mulki (minor) River, for stream-bed load sediments (Shankar et al., 1994b) and off-shore placers of the SW coast of India (Shankar et al., 1996). There are no detailed studies on the sediments of the western margin of India. In this thesis, magnetic susceptibility and other remanent magnetic parameters were measured for the first time for the sediments in gravity cores collected along the western margin of India and inferred that provenance of the sediments controls on the rock-magnetic parameters and climatic conditions prevailed during the late Quaternary.

Lime muds are potentially produced by several mechanisms; mechanical disintegration of biological skeletal components, disaggregation of calcareous green algae, inorganic precipitation, bioerosion, erosion of tidal flat mud deposits, organic and bio-geochemical processes (Bathurst, 1971). Modern lime muds have been reported from the carbonate banks and platforms off Florida,
Bahamas, Southern Belize and the Persian Gulf (Ginsburg, 1956; Lowenstam and Epstein, 1957; Cloud, 1962; Wells and Illing, 1964; DeGroot, 1965; Matthews, 1966; Stockman et al., 1967; Mitterer, 1972; Neuman and Land, 1975; Steinen et al., 1988; Boardman and Carney, 1991; Macintyre and Reid, 1992; Robbins and Blackwelder, 1992; Milliman et al., 1993; Dix, 2001). Despite numerous detailed investigations on these modern lime muds there are no consensus on the origin of the lime muds. Inorganic origin and disintegration of codiacean algae as a primary source for the lime muds have gained popularity over other mechanisms of lime mud formation. The lime muds from the continental slope off the Gulf of Kachchh at depths between 150 and 500 m were reported (Vaz et al., 1993) and no further detailed studies were conducted to understand the genesis of lime muds. In this thesis detailed sedimentological, geochemical and stable isotope (oxygen and carbon) studies of the lime muds together with their radiocarbon age measurements were carried out in five sediment cores collected at water depths between 56 and 121 m and reported their origin and relevance of late Quaternary sea level changes and neo-tectonic activity on their distribution.

Wiseman and Bennett (1940) were the first to report the distribution of organic matter in the sediments of the Arabian Sea. Subsequently several workers reported the distribution and characteristics of organic matter in the sediments off western India (Kidwai and Nair, 1972; Rajamanickam and Setty, 1973; Paropkari, 1979; Rao and Rao, 1989; Ramamurty and Murty, 1989; Paropkari et al., 1992, 1993; Calvert et al., 1995; Thamban et al., 1997; Nagendranath et al., 1997; Babu et al., 1999; Rao and Veerayya, 2000; Bhushan et al., 2001; Thamban et al., 2001; Agnihotri et al., 2002, 2003; Pattan et al., 2003; Prabhu et al., 2004; Prabhu and Shankar, 2005). Organic carbon studies from the continental shelf and slope off Pakistan were also reported (von Rad et al., 1995; Cowie et al., 1999; Keil and Cowie, 1999; von Rad et al., 1999; Schulte et al., 2000; Suthhof et al., 2000). Kolla et al. (1981b) prepared a map on the distribution of organic carbon for the entire
Arabian Sea. Organic carbon in the sediment cores of the deep Arabian Sea was also reported (Reichart et al., 1997). Rixen et al. (2000a) studied the organic carbon flux in the Arabian Sea using data from the sediment trap experiments. In this thesis organic carbon distribution in the sediment cores collected across the continental shelf and slope of the northwestern India at depth between 56 m and 420 m is reported and discussed the factors controlling its distribution.

Several workers reported the mineralogy of the fine-grained (<2 μm) surficial sediments in the Arabian Sea, Bay of Bengal and Indian Ocean in general (Gorbunova, 1966; Griffin et al., 1968; Rateev et al., 1969; Goldberg and Griffin, 1970). Stewart et al. (1965) were the first to report the clay mineralogy of the northwestern margin of India. Subsequently Mattait et al. (1973), Nair et al. (1982a and b) and Rao and Rao (1995) reported regional studies on mineralogy of the <2μm fraction of the sediments covering the entire western margin and provenance of the sediments. Clay mineral distribution in different parts of the western margin was also reported (Bhattacharya, 1984; Rao et al., 1983; Guptha and Hashimi, 1985; Rao, 1991). Thamban et al. (2002) studied a few sediments cores on the SW margin of India and reported climatic variations during the late Quaternary. Kessarkar et al. (2003) studied clay mineralogy together with Sr-Nd isotopes of the few selected cores and reported their provenance. In this thesis I have studied the clay mineralogy of the sediments in five gravity cores collected at depths between 56 and 420 m depth and report their provenance during the late Quaternary and the influence of neo-tectonic activity in their distribution.