Preface

The Western Continental Margin of India (WCMI) mainly evolved during two major rift-drift episodes in the geological past. The first phase of rifting commenced during the Late Cretaceous between southwest India and eastern Madagascar was associated with the Marion hotspot volcanism. The second phase of rifting commenced during the Early Tertiary between India-Laxmi Ridge and Seychelles preceded by a short span of rifting between Seychelles-Laxmi Ridge and India. The latter phase of rifting was associated with the emplacement of Massive Deccan flood basalt erupted by the Reunion hotspot during 68.5–62 Ma. The Reunion hotspot related volcanism occurred on continental to oceanic lithosphere as the Indian plate moved over the hotspot, emplacing numerous magmatic intrusive/extrusive bodies along the western continental margin of India. Considerable stretching during the rifting episodes, and volcanism associated with the hotspots had obliterated the pre-existing geology and initial configuration of the margin. The margin, which is considered as a passive margin, is characterized by i) a northward widening NW-SE trending continental shelf, ii) a shelf edge limited by ~200 m isobath, iii) a continental slope deepening from 200 to 2000 m isobaths, and iv) deep sedimentary basins. The WCMI is characterized by ~300 km wide continental shelf in Kutch-Saurashtra region which gradually narrows down southward to ~50 km in Kerala offshore region.

The present study is focused on the southwestern part of the western continental margin of India, which is comprised of narrow continental shelf, wide slope, Laccadive Basin, Laccadive Ridge and eastern part of the Arabian Basin. Despite the fact that the India-Madagascar breakup produced an extensive volcanic province along eastern Madagascar and numerous volcanic flows and intrusives in the southwest Indian shield, the Southwest Continental Margin of India (SWCMI) is generally considered as a non volcanic passive margin. Whereas the northwest continental margin of India developed during the breakup between Laxmi Ridge-India and Seychelles, is considered as a volcanic passive margin due to contemporaneous outbursts of the Deccan volcanics. SWCMI is characterized by a number of structural and tectonic features which were formed due to extensional tectonics during India – Madagascar breakup under the
influence of Marion hotspot, and later modified by magmatic episodes of the Réunion hotspot as well as collision between Indian and Eurasian continental plates. Considerable parts of these features are concealed under thick sediment cover and volcanic flows.

The present study aims to decipher stratigraphy, sedimentation history, crustal structure and Continent Ocean Transition (COT) along SWCMI, in order to provide constraints to improve the understanding of tectonic evolution of the margin. The primary dataset used for the study is 2D Multi-Channel Seismic (MCS) reflection data acquired along twelve seismic lines across the SWCMI. Other major data set used for the study include shipborne as well as satellite altimetry derived free air gravity anomalies across the margin. Published results on seismic refraction, drill wells and magnetic isochrones have also been utilized for the study.

The study reveals five major seismic stratigraphic units in the sedimentary basins as well as several structural and tectonic features of the SWCMI. The study brings out, for the first time, Seaward Dipping Reflectors (SDRs) along the western flank of the Laccadive Ridge, and the anomalous basement depth of the Arabian Basin. 2D crustal modeling using gravity data reveals Lower Crustal Body (LCB) of high P-wave velocity beneath the SWCMI. The results of the study explain the volcanic nature of the continental margin, continent-ocean transition and impact of the Reunion hotspot on the margin.

The study forms the thesis that has been organized in eight chapters as follows:

**Chapter 1** gives a brief description of southwest continental margin of India. The chapter presents study area, and the scope and objectives of the present study. Further the chapter discusses briefly the continental margins with a special reference to passive continental margin.

**Chapter 2** presents a review of previous pertinent studies to synthesize present knowledge about the geologic and tectonic settings of the study area and adjoining region. The chapter deals with the present knowledge of subsidence,
sedimentation and general stratigraphy of the study area and briefly describes the evolutionary history of the western continental margin of India.

Chapter 3 deals with various types of geological and geophysical data used for the present study. Major geophysical data include multi channel seismic reflection and ship borne as well as satellite altimetry derived free air gravity anomaly data. Results of seismic refraction studies in the Arabian Sea, and Deep Seismic Sounding (DSS) studies of the Western Dharwar Craton (WDC) and Deccan Traps adjacent to the study area are used for crustal structure modeling across the southwest continental margin of India. Published drill well data of the southwest continental margin of India constitute major geological dataset to study litho- and chrono-stratigraphy of the study area. Data compiled from published magnetic isochron map of the Arabian Basin, tectonic chart of SW India and General Bathymetry Chart for the Oceans (GEBCO) are used as supporting database for the study.

Chapter 4 deals with the analysis of multi channel seismic reflection profiles across the southwest continental margin of India. Numerous structural and tectonic features are identified during the analysis. The interpreted seismic profiles are presented in the form of line drawing sections. Further, the identified seismic sequences are correlated with published drill well information to describe them in terms of various sedimentary depositional units and to understand the sedimentation history of the study area.

Chapter 5 presents discussion on various structural and tectonic features delineated during analysis of the MCS reflection profiles. Further the chapter presents computation of basement depth anomalies in the Arabian Basin. The basement depth anomalies in the basin are calculated as the difference between the depths to the oceanic basement corrected for sediment load, and predicted by lithospheric thermal model. The results indicate anomalous depth to basement of oceanic crust in the Arabian Basin of age range 63–42 Ma, suggesting that subsidence in this basin does not follow the age–depth relationship of normal oceanic crust.
Chapter 6 discusses in detail the occurrence of Seaward Dipping Reflectors (SDRs) along the western flank of the Laccadive Ridge and its relationship with the Indo-Madagascar separation associated with Marion hotspot volcanism during the Late Cretaceous. The chapter further presents 2D crustal models across the SWCMI and discusses the crustal structure of the margin.

Chapter 7 discusses sedimentation history of the study area. The chapter further deals with tectonic implications of seaward dipping reflectors along the western flank of the Laccadive Ridge, and basement depth anomalies in the Arabian Basin. Finally, the chapter addresses continent-ocean transition, rift related magmatism and neotectonic activities along the SWCMI.

Chapter 8 presents summary and conclusions of the study. The chapter is followed by references, in alphabetical order, of the literatures cited in the text.