CHAPTER 1

INTRODUCTION

The Deccan traps of which major portion is lost by erosion or sunk beneath the Arabian sea, still covers over 50,000 square kilometres of Indian land-mass and form one of the worlds largest flood basalt eruptions on the continent, in a remarkably shorter span of time. The accelerated oil exploratory drilling programme along the marginal basins and west coast of India has also established a limited temporal span for the Deccan basalts encountered in sub-crop (Sahni, 1988). Besides the central and western Deccan basalts, a number of outlying patches of rocks more or less similar in character and age are found in Belgam (Southern Karnataka), Jabalpur, Sirguja, Amerakantak, Kutch and Rajahmundry (Andhra Pradesh, eastern coast). In the extreme southern part of Peninsular India, a vitric tuff of volcanic origin has recently been reported between Ariyalur and Kinnyar groups, indicating the contemporaneity of the eruptive phase in widespread regions (Sahni, 1988).

The origin of such volcanic phenomena has always been problematic and the plate tectonic paradigm has not offered a solution (Duncan and Pyle, 1988). Alvarezet (198C) and Officer and Drake (1983) have proposed meteoritic impact theory for the volcanic activity which coincided with mass extinction of fauna at the Cretaceous-Tertiary boundary. These basaltic eruptions were also linked to the on-set of hotspot related volcanism in the western Indian Ocean (Morgan, 1972). Recently, Alt et al. (1989) have further supported the meteoritic impact theory. According to
them the close association of Deccan Plateau basalt with the timing of terminal Cretaceous boundary clay suggest that it is an impact crater large enough to form a lava lake, terrestrial equivalent of lunar maria, which caused pressure relief melting in the asthenosphere and initiated Chagos-Laccadive hotspot track.

From the above arguments regarding the origin of these volcanics, one thing would be clear that at the late Cretaceous period, the mantle under the Indian subcontinent and the adjoining areas was exceptionally active and ready to undergo such melting processes as to create voluminous flood basalts.

The present work is dealing with one of the outlying patches of such basaltic eruptions located near eastern margin of the Indian subcontinent away from the central and western provinces of Deccan basalts. In order to distinguish the main Deccan basalts, from Rajahmundry basalts, the author would like to refer the former as Deccan basalts and the later as Rajahmundry (RJY) basalts in the thesis.

1.1. LOCATION OF THE AREA

The study area, lies between latitude 17°00' to 17°05' N and longitude 81°30' E to 81°51' E. It includes the area from the east of Rajahmundry to the west of Deverapalli in the Godavari District, Andhra Pradesh. Exposures of Infra-trappeans, traps, Inter-trappeans and Supra-trappeans (such as Rajahmundry sandstones) are exposed in this area. The traps along with Inter-trappeans gently rise from the alluvial plains on either side of the Godavari river and attain a height of about 250 feet above M.S.L.
The area is bounded by low-lying alluvial plains in the south and Khondalite hill ranges to the north. It is also characterized by gradually sloping and flat-topped hillocks of the Gondwana rock formations and steep-sloped hillocks of the RJY traps. The active quarrying of the basaltic rock, for construction and road material, in and around Rajahmundry has resulted in exposing the fresh rocks for present study (Pl. 1 & 2).

The major river in the area is the Godavari. It flows across the Gondwana formations, RJY basalts and Tertiary sedimentary rocks and finally drains into the Bay of Bengal in the east. The Central part of the area is characterized by red and yellow loamy soils, while in the southern and the south-eastern parts, it is covered with black cotton soil.

1.2. PREVIOUS LITERATURE

Exploration of Godavari graben began with the classical works of Blan Ford (1856), Hughes (1877), Fiestmentel (1882), Fox (1931) and Gee (1932). The earliest reference to this area of Rajahmundry is by Benza and Cullin (1837). They published a report on these traps and associated Inter-trappean beds of Rajahmundry area. Subsequently, Elliot and Hislop (1865-1866) studied the collection of fossil flora of this area and considered Pangidi Inter-trappean beds to be of esturine origin. Medicott and Blanford (1879) suggested that the Pangidi Infra-trappeans beds (West Godavari District) showed Tertiary affinities and are marine. King (1880) described this as an outlier with important clues for the correlation of volcanic rocks with known series of fossiliferous rocks. Later, Das Gupta (1933) visited this area and collected samples from the Infra-trappean sandstone south of Duddukuru. He described fossil Cardita beauimontid'
a. Quarry section near Kateru (East Godavari Dt.,)
Note: The flow is covered by Rajahmundry sand stones (Supra-trappeans)  

b. A quarry overlooking Mary temple of Gouripatnam near Pangidi (West Godavari Dt.,)
Archiac on the basis of which he assigned upper Cretaceous age to the Infra-trappean sandstones.

Sahni (1934) on the basis of fossil flora suggested that Inter-trappean beds are of Tertiary age. According to Rao and Rao (1935, 1937, 1939) the calcareous algae of the genera Chara and Aciculeria are of early Tertiary age. From the study of foraminifera in these beds, they also arrived at similar conclusions. Crookshank (1937) also considered these traps to be of Eocene age.

Rama Rao (1956) studied the fauna of Infra-trappean beds and considered them to be of Danian age, while the outliers of basalts and Intra-trappeans to be of early Eocene age.

Sahasrabudhe (1963) regarded Rajahmundry outlier belonging to the basalts of Deccan Traps. He opines that they show normal magnetization with steeper inclination. Shastry et al. (1961-63) reported Forminifera from the Raghavapuram shales exposed near Tirupati village in the West Godavari District. Mathur and Evans (1964) are of the view that the Inter-trappeans are of late Cretaceous to Paleocene age.

Bhalla (1967) studied the Foraminifera and Ostrocoda from the Inter-trappean beds and concluded that they were deposited under fluctuating marine conditions. Mahabali and Rao (1973) and Satyanarayana (1975) described the species Dadoxylon merembriorylon and Gingo wood from the Inter-trappean beds near Rajahmundry. Mahabale (1977, 1978) also reported petrified Ginko wood from the lower series of the Rajahmundry sandstones (Supra-trappeans) at Pangidi and suggested Miocene age. Guha and Raju (1978) recorded various microfossils from the Inter-trappean beds of Duddukuru and suggested a late Paleocene age and a shallow marine conditions of deposition for these beds. Shastry (1981) reports that the
marine Inter-trappean sediments from the deep wells drilled by ONGC along east coast of India indicate an upper Cretaceous age, while the Inter-trappeans found in the out-crops near Rajahmundry indicate Paleocene to lower Eocene age. He thus, believes that Rajahmundry Inter-trappeans show significantly marine affinity, while the Inter-trappeans elsewhere in west and central India are continental. Sastry and Lahiri (1981) were also of the similar view. They suggest esturine environment for Rajahmundry with connections to open sea while other basins, elsewhere, are in the form of small pools, lakes and marshes indicated by the fossil remains comprising freshwater forms. Prasad (1986) recorded fish remains from the Inter-trappean beds of Duddukuru village (West Godavari District).

The first systematic description of the basalts of the Rajahmundry area was given by Washington (1922). Subsequently, Venkayya (1949) observed a close similarity in major element composition between the flows of this region and those of Deccan traps, supporting the view of Krishnan (1941) and others that the traps of Rajahmundry are comagmatic to the Deccan traps.

Recently, Bakshi and Krishnabrahmam (1987) with their gravity survey data proposed two sets of fractures intersecting at depth near Rajahmundry area.

1.3. OBJECTIVES OF PRESENT STUDY

Most of the earlier workers, have studies this area with emphasis mainly on paleontological aspects and no serious attempt has been made to evaluate the nature of the volcanic rocks or their petrogenetic aspects. The present work therefore has been taken up to study the following
aspects of Rajamundry basalts.

1. Flow characteristics, their nature, types, extent and their association with other rocks of the area.

2. The textural and mineralogical characteristics.

3. Chemical characteristics of RJY basalts. With the help of major, minor and trace elements (including REE) chemistry, the following aspects have been studied.
   
a. The extent of secondary alternation and weathering influence on various elements.

b. Elemental relationships (major vs major, major vs trace, trace vs trace) have been worked out to find out petrogenetic aspects, with the help of correlation coefficients.

c. The tectonomagmatic nature of the melt with the help of finger-print elements.

d. Nature of the parental magma.

e. Extent of partial melting and fractional crystallization processes to understand the petrogenesis.

f. The temperature of crystallization of various mineral phases, in
order to work out the sequence of crystallization in the RJY basaltic melt with the help of thermometry.

5. And finally, to reconstruct a tectono-magmatic model for these basalt and to compare them with Deccan basalts (both central and western).

1.4. METHODOLOGY ADOPTED

Apart from the systematic field work and sample collection from different flows and outcrops, detailed mineralogical studies were carried out under optical microscope using universal stage techniques, refractive index determination and finally microprobe analysis on selected samples to substantiate the optical studies.

In order to understand geochemistry of these rocks, major and trace element studies were carried out. The major and trace elements for the twelve samples of Kateru area were carried out at National Geophysical Research Institute, Hyderabad, by using the Varian Techtron Model AA-100 of Atomic Absorption Spectrophotometer (Shapparo and Bernock, 1982). International U.S.G.S standards were used for calibration. FeO was determined by titration (using platinum crucibles). Double runs were made to check the reproducibility. The samples were also analysed by X-Ray fluorescence spectrometry methods (Govil, 1985) to further check the reproducibility.

Selected microprobe analyses has been carried out on plagioclase and
Pyroxenes were analyzed by standard wavelength dispersive methods using an accelerated voltage of 15 kV, and a beam current of 10 nA. A mixture of minerals, synthetic oxides, and pure metals were employed as standards.