CHAPTER I

INTRODUCTION

India is well known for its thick pile of tholeiitic flood basalts of Cretaceous-Eocene age covering over 500,000 sq.km and measuring over 2000 m in thickness, occurring in the western part of the country. In general the lava flows are practically horizontal in their disposition and have solidified under sub-aerial conditions. Both '<u>aa</u>' and '<u>pahoehoe</u>' types of flows, with varying content of zeolites and other cavity minerals, are present and it is possible to delineate the areas of dominance of aa or pahoehoe types. This province of basaltic rocks is known as the "Deccan Trap Province" in the geologic literature eversince Sykes introduced the term in 1833. The word "Deccan" is derived from the Sanskrit '<u>Dakshin</u>' meaning south and the "Trap" from Swedish word "trappa" meaning steps in allusion to the flat topped or terraced topography.

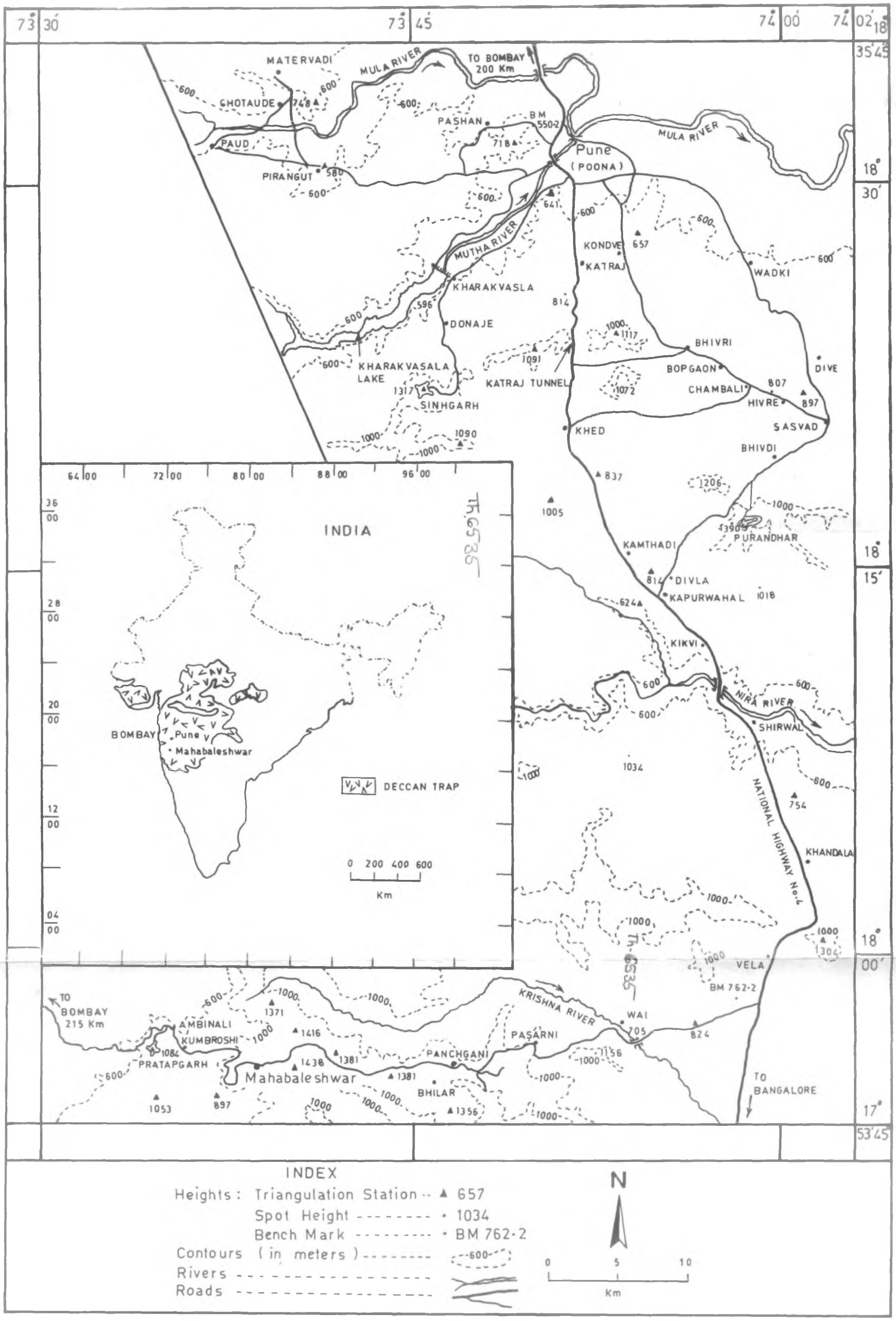
Petrographically these basalts show a typical porphyritic texture and dominance of labradorite to andesine plagioclase feldspar and augite or subcalcic augite along with several subordinate constituents including olivine (and/ or iddingsite) iron oxides, glass, and ilmenite in a widely

varying proportion. The secondary minerals include chalcedony, zeolites, calcite, etc. Chemically they may be referred to as silica saturated quartz normative tholeiites.

The Deccan Traps, though have been studied for over a century, very little attention has been provided to the interlayered red and green horizons present in this enormous sequence of the basaltic lava flows. In order to fill in this lacuna a study of these horizons, in the region between Poona (Lat. $18^{\circ}32'$N; Long $73^{\circ}32'$E) and Mahabaleshwar (Lat. $17^{\circ}56'$N; Long. $73^{\circ}40'$E), (Fig. 1.1), involving field and laboratory work, was undertaken as a research project for the degree of Doctor of Philosophy.

Review of Previous work :

Geology of the area studied has been described by quite a few workers. Amongst these the works of Sahasrabudhe (1950), Sowani (1953), and Kanegaonkar (1977) directly relate to the area studied. Kanegaonkar has described the geology of the area around Pune including, the Katraj Ghat, the Diwa Ghat and the Purandhar Fort hill section in her Ph.D. thesis. While describing the red and green zones associated with the basalt flows she has used the term "Red Bed". Krishnamurti and Majumdar (1977) have given the succession of lava flows in the



FIG·1·1 : LOCATION MAP

Sinhgarh Fort hill and have described 13 horizons designated as "red boles". Kanegaonkar and Powar (1976) have given the petrochemistry and the trace element distribution in the basaltic sequence of the Purandhar Fort hill.

The area around Mahabaleshwar has attracted several workers including Blanford (1872), Fox (1923), Konda (1971), Sahasrabudhe et al (1977), Deshmukh et al (1977) etc. Though the bauxite pockets occurring at Mahabaleshwar, Bhilar and Panchgani have been described by Fox in the year as early as 1923, the clays developed in the lateritic sequence capping the basaltic flows have so far not been investigated. Valeton (1967) has discussed the genesis of these and several other bauxites developed on trap basalts in India, on modern lines.

In the earlier half of this century the conspicuous red horizons did attract a few geologists. However their work was concentrated mainly on the hydrological aspects of these horizons. Narke (1938) studied the utility of these horizons as water bearing formations occurring on the hill forts of the Western Ghats. Joshi (1943) has commented upon the nature of the intertrappean red boles and the associated basalt rock near Poona and Satara of the then Bombay Province. However, only abstract of his paper is published. Adyalkar and

Suryanarayana (1976) have studied in detail the importance of the red horizons as aquifers in the Deccan Trap terrain.

Deshpande (1964), in a brief note, has described two horizons one around Saswad near Poona and the other in the Kelghar Ghat near Mahabaleshwar and has termed them as "red bole".

Pascoe (1964) has opined that these red and green horizons represent volcanic ash and are much more prevalent towards the upper parts of the Deccan Traps. According to him several ash beds are seen around Poona on the hills formerly used as forts. He has also mentioned the horizon at the lower gateway of the fortress of Sinhgarh near Poona and a few beds in the Khambatki Ghat.

Pascoe (op.cit) has distinguished red bole from ash beds and has commented upon its formation and red colouration. These are considered to be the old soils developed in the manner in which the capping of laterite, so universally characteristic of trap surface today, originated.

Walker (1969) after visiting the Deccan Trap terrain, expressed that the red horizons occurring here though commonly called boles are mostly not true boles. In his opinion a bole

is a basalt weathered *in situ* to a red rock. He refers the red horizons in Deccan as sedimentary or tuff beds and not as boles and suggests that they acquired colour due to baking as a result of successive eruptions.

Gupte (1970) contradicting and commenting upon Walker's observations argued that these horizons are 'red boles' and have been formed by the atmospheric weathering of the hydrothermally altered red and purple basalts or black tachylitic basalts. He considers that these layers also occur within the lava flows and not necessarily in between two successive eruptions. Gupte (1971) concludes that at all places these horizons represent products of normal weathering of red and purple basalts.

Kulkarni (1975) while describing geology of the Satara area (close to the present area) has commented upon the genesis of such horizons and argues that these are red boles and are formed from intrusive red tachylitic basalts.

Raja Rao (1977) has expressed that the top surface of the lava flows comprise of thin crusts of glass which on alteration gave rise to red bole and mark the flow contacts. Thin layers (5-10 cm) of tuffs are described from Nasik, Dhule and Thana areas. They show angular pieces of glass or vesicular

rock set in a brownish unidentifiable mass.

Najafi et al (1981) have described the geology and geochemistry of the three ghats, viz. Mahad-Mahabaleshwar, Ambenali-Pratapgarh and Panchgani-Wai and have observed 35, 8 and 16 interflow layers respectively in them and varying in thickness from 15 cm to 2 meters. From the major element and trace element distribution in the basalts they have shown that the higher amount of K, Rb and Ba observed in some of the flows may be explained by assuming contamination of the basalt magma by acid melts derived from the crust.

Parthasarathy and Shah (1981) have given some engineering properties of the red interflow layers in the Bombay area. These properties include apparent specific gravity : 2.20 - 2.30; porosity : 3.00; water absorption : 4.00; compressive strength (kg/cm^2) : 400; static elasticity modulus ($\times 10^5$ kg/cm^2) : 1.00; ultrasonic pulse velocity (m/sec) : 2800 - 3500 and swelling coefficient : 0.022.

On reviewing the available literature on the Indian occurrences and that on similar occurrences in other parts of the World, several points arise as regards the exact nature of these conspicuous and attractive layers. While some workers rely only on the field observations, others have

made only passing references. In this light following questions need consideration :

1. Whether they represent tuffs,
2. If they are regarded as pyroclastic in nature, how did the material originate from lava flows
   (a) from the same bulk or (b) from the same explosive activity,
3. If so, what is the nature of deposition of these tuffs,
4. Whether they are altered tops of lava flows,
5. If they are altered tops of lava flows how and when did the alteration take place,
6. Whether they are true red boles,
7. Whether they are fossil laterites,
8. Are they baked soils,
9. What is the cause of the contrasting red and green colours.

It was therefore found extremely interesting to tackle this long awaited problem using the modern techniques. Following the initial field work and laboratory work it was observed that the Clay Geology would be an important aspect of the whole problem. Though initially it was proposed to investigate only the interflow zones, a study of the other clay bearing horizons in the area was also felt necessary for

the better understanding of the 'clays' in general, the processes responsible, and the possibility of any relation between the nature of the material in the interflow zones and the different weathering modes. The results of these studies are presented and discussed in this thesis.

It was found that three types of clays are present in the area. The first variety of clays occurs in the red and green tuffaceous horizons, beautifully exposed in the road cuttings along the ghat sections. The second variety of clays forms the transported river clays frequently used by local people for rough pottery, and brick making. The third variety of clay comes from the lithomarge zones of the lateritic sequences of Panchgani, Mahabaleshwar and Pratapgarh.

In order to study the clays and the material in the interflow horizons, traverses were taken along roads and ghats from Poona in the following areas :

1. Pune-Sinhgarh,
2. Pune-Katraj-Khandala-Wai-Panchgani-Mahabaleshwar-Pratapgarh,
3. Pune-Saswad-Purandhar-Kapurwhal
4. Pune-Kondhwe-Bapdeo Ghat-Saswad

(Fig. 1·1: Location Map).

During the field work samples representing different clayey horizons were collected and their relationships with the underlying as well as overlying flows were recorded.

During the laboratory work more attention was provided to the usage of modern determinative physical methods of analysis such as X-ray diffraction, infrared absorption, thermoanalysis and scanning electron microscopy along with conventional petrographical studies and chemical analyses. These methods are described in detail at relevant sections in the present thesis.