

# Field Characters of Basalt Flows, a Case Study of Chikhaldara Hill Section (Amravati)

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**Abstract**— Field characters of Basalt Flows give clue to the nature of Deccan Trap volcanicity, therefore to determine field characters of Basalt flows i.e. their thickness, lateral extent, jointing pattern, etc, the Hill Section of Chikhaldara hill station, which is located 100 km. north west of Amravati (Maharashtra), has been selected along which these flows are exposed. This paper is detail geological information of the different types of Basalt flows, obtained by undertaking thorough field survey from R.L.600m (foot of the hill) up to R.L. 1092m. (Chikhaldara Hill Station). The attempt has been made to determine type of volcanic activity either Fissure type or Central type, which has produced these flows of Basalts.

**Key words:** Central type, Deccan Trap, Field Characters, Fissure type, Geological, volcanicity.

## 1. INTRODUCTION

The Deccan traps are made up of layers of several lava flows with thickness of individual flow ranging from few meters (7m) to as much as 40m maximum and can be traced for a distance of 20 km [1]. The total thickness of Deccan Trap is also variable in different parts because of undulating nature of ground over which the flows are occurring. The Trap cover is maximum at Bombay coast, where it is almost 3000m. The section at Matheran is about 850m thick and at Mahabaleshwar it is 1700m thick. In Melghat scarp, north of Achalpur in Amravati District the flows have total thickness of 700m. In eastern part of Vidarbha total thickness varies from 70m to 225m.

The lava flows of two different types have been recognized, they are pahoehoe or ropy lava and the aa or blocky lava. Pahoehoe solidifies with smooth and glazed surface having rope like wrinkles hence called as ropy structure. The flows are also recognized as compound (Amygdaloidal) when made up of several small units. Karmarkar et.al. (1973) called such flow units as Thin and Thicker Irregular Amygdaloidal Basalt Flows, as each unit possesses criteria of demarcation of flows with irregular top surface. Simple flows are uniform over large area and made of single unit. In general compound flows show pahoehoe characters, where as simple flows show characteristics of Block or aa flows. The former predominates in western maharashtra between Dhule, Buldhana, Aurangabad, Pune and Nasik where as in the rest of region of Maharashtra Simple flows are predominant. The compact basalt flows are thick extensive and free from vesicles, amygdales except for small portions at the tops and bottoms of the flows. The major portion of these flows is

jointed. The undulated basalt flows having vesicles which are mostly filled by secondary minerals are called as compound flows or Amygdaloidal basalts.

Kulkarni P.S. (1985) demarcated various flows in different ghat sections of NE and central part of Maharashtra[2].



Fig.1 Thick horizontal flows of Basalt

The Deccan Trap flows have horizontal attitude that can be

observed along Western Ghats and in the areas of Khandesh to Solapur and throughout Vidarbha region (Fig. 1)

## 2. Study Area

In this research work attempt has been made to determine nature of volcanicity in the north East part of Deccan Trap formation i.e Vidarbha region of Maharashtra. The study area is a hill section of Chikhaldara Hill Station, in which basalt flows are clearly exposed in approach road to Chikhaldara Hill station (R.L. 1092 m) and hill ranges 77°19' North 21°24' East. This Hill Station is situated at a distance of 100km North West of Amravati (Fig.2).

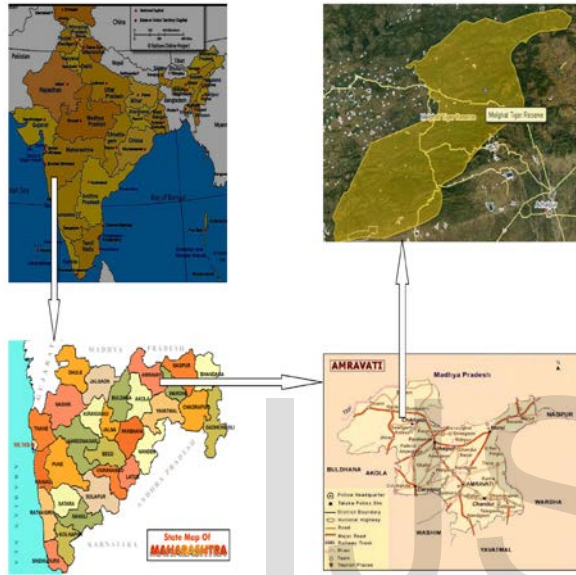


Fig.2 Study Area

## 3. Field Characters of the Basalt Flows

As shown by earlier workers [3], Karmarkar [4], Kulkarni S.R. [5], Marathe[6], Kulkarni P.S. [7], who gave more stress on the field studies of the basalt flows, which can give clue to the nature of Volcanicity. Therefore much stress has been given to the studies of Field characters of Basalt Flows exposed in the Chikhaldara Ghat section (Fig.1). For this purpose traverses have been taken from foot of the hill (R.L. 600m) up to Chikhaldara hill station (R.L. 1092m). During field work all the Basalt flows were demarcated and traced in the cuttings along the road to determine their extent, thickness and field characters. The vertical variations of all the flows from top to bottom were critically studied. Wherever possible vertical thicknesses of the basalt flows were actually measured. On the basis of demarcation of the basalt flows their chronological sequence in vertical stretch of 492m is depicted.

### 3.1 Compact Basalts

They are almost tabular in form having considerable thickness and large lateral extent. Their thickness varies from 7m to 30m and can be traced up to distance of 20 km. immediately below top surface of the flow up to some depth the rock is generally hydrothermally altered, vesicular, amygdaloidal. Middle and

lower portions of Compact Basalt Flows are black in colour, nonvesicular, aphanitic or porphyritic in nature and dissected by joints, which are the contraction cracks. Different types of jointing patterns can be observed in middle and lower portions of the flows.

#### 3.1.1 Demarcation of two successive flows of Compact Basalts

Though Compact Basalt Flows are similar in lithological characters they can be demarcated from each other on the basis of criteria given below.

1. Some portion near top of individual flow of Compact Basalt is vesicular, amygdaloidal and purple due to hydrothermal alteration
2. Lithologically two flow of Compact Basalt may be alike but sometimes there is vast difference in jointing pattern of two consecutive flows
3. Even on the basis of appearance of weathered surfaces of joint blocks, two flows can be demarcated from each other. The compact aphanitic basalts develop smooth surfaces; whereas porphyritic basalts develop rough and pitted surfaces on weathering, due to dislodging of plagioclase phenocrysts.
4. Sometimes there is occurrence of a band of Black, Red or Green Tachylytic basalt in between two flows of Compact Basalt

(Fig.3)

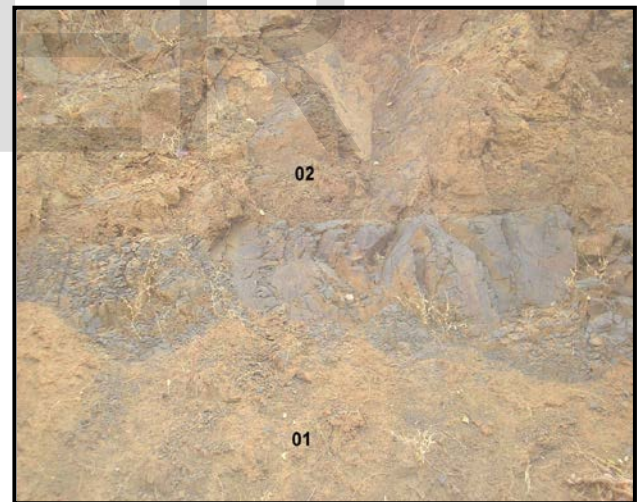


Fig.3 Band of Black Tachylytic Basalt in between two Flows

Along Chikhaldara Ghat section 14 flows of Compact basalts have been demarcated out of which seven flows are of Compact Aphanitic Basalts and seven are of Compact Porphyritic Basalts.

### 3.2 Amygdaloidal Basalt Flows

These are compound flows occurring as thin and thick irregular in form. They are amygdaloidal throughout their thickness. Most of the original gas cavities are filled up with secondary minerals like white coloured zeolites, silica, calcites and green coloured chlorophaites. Very rarely empty gas cavities occur in these flows.

### 3.2.1 Demarcation of two successive Amygdaloidal Basalt Flows

Thin and thick flows of Amygdaloidal basalt occur one above the other forming thick pile. Contacts between the flows are fused; therefore entire pile of the flows occurs as one homogenous mass. As these flows are amygdaloidal and unjointed throughout their thickness they are rather difficult to demarcate from each other. However following criteria are used to demarcate them

1. Occurrence of Pipe amygdales at the bottom of each flow
2. Ropy structure at the top of each flow

During the field work we came across three types of Tachylytic basalts

1. Black Tachylytic Basalt
2. Green Tachylytic Basalt
3. Red Tachylytic Basalt

These bands of tachylytic basalts are occurring in between two consecutive basalt flows (Fig.3)

### 3.3. Volcanic Breccia

Along the ghat section there is occurrence of a flow of Volcanic Breccia in which basaltic rock fragments are held together in zeolitic matrix. Thin band of red tachylytic basalt is occurring at the top of this flow.

### Lithology of the Compact Basalt Flows

On the basis of Lithology of Compact Basalt Flows, it is also observed that Compact Porphyritic Basalt flows from R.L.600 m to R.L.892 m occur in succession (Except Flow No. 2 of Amygdaloidal Basalt between R.L.647 m to R.L. 677 m and Flow No. 5 of Compact Aphanitic Basalt occurring in between R.L. 725 m. and R.L. 737 m).

Similarly above R.L. 892 m up to Chikhaldara hill station (R.L. 1092 m.) six flows of Compact Aphanitic Basalt occur in succession (except volcanic breccia which occurs between R.L. 990 m and R.L. 1005 m).

### Vertical variation in Lithologic Characters of Compact Basalt Flows

There is definite variation in the lithology of the basalt flows from their top surfaces to the bottom of the flows. The top surface of every flow is almost horizontal with minor local undulations. Therefore from the distance Compact Basalt Flows appear as thick extensive tablets. The top portion of every flow has become vesicular amygdaloidal and hydrothermally altered. Due to hydrothermal alteration top portion of the flows have become purple.

It is observed that there are ramifications of thin injections of Black / Red / Green tachylytic basalts (Black injections in Flow No. 1, Red injections in Flow No. 12, 13 and Green injections in Flow No. 3 and 14) These injections merge into each other at higher level forming thin discontinuous bands and pockets of Black / Red / Green tachylytic basalts on the top of the flows. The vesicular amygdaloidal top portion of every Compact Basalt Flow is almost unjointed fresh in condition; however at some places on weathering sheet jointing is developed in it. The middle lower portions of all the Compact Basalt flows are free from vesicles, amygdales, hydrothermal alteration and they occur in

true sense as Black Compact Basalts. The middle lower portions of all the Compact Basalt flows are dissected by joints which are the weak planes developed during cooling and consolidation of the lava. These weak planes open up at the surface on exposure to atmospheric conditions. Different patterns of jointing and joint spacing are occurring in different flows. These flows have different pattern of joint spacing. It is observed that in Aphanitic flows there is some consistency in pattern of jointing but consistency was not noticed in Compact Porphyritic Basalts.

Some flows are dissected by three mutually perpendicular sets of joints due to which joint block acquire rectangular shape and are resting one above the other. In some of the cases vertical joints deviate from the vertical nature giving rise to wedge shaped joint blocks

### Nature of Volcanicity

The main object of this work is to determine nature of volcanicity in NE part of Maharashtra. The field characters of Basalt flows throw much light on the nature of volcanic activity. For this purpose the area of Chikhaldara was selected to study field characters of of Basalt Flows exposed in the Ghat Section. The Ghat Traverses were undertaken to determine field characters of flows occurring in hill section. Sixteen flows exposed in the Ghat Section have now been discussed in detail as they provide clue to the nature of volcanic activity which produced them. Before doing this, however, it is necessary to discuss briefly how the field characters of flows depend on nature of volcanic activity and therefore, provide clues to its nature. [1]

As Lava flows are formed by solidification of liquid which flows and spread out as a sheet, they normally have a large lateral extent as compared to thickness. The relation between lateral extent and thickness depends upon fluidity of lava. The ratio of lateral extent/thickness of flow ( $l/t$ ) increases with fluidity or mobility of lava. Also if lava is fluid enough to flow freely, its top surface will be plane and horizontal. Therefore although all lava flows show a form more or less like a sheet, only those flows show regular sheet like form which have large lateral extent and comparatively large  $l/t$  ratio. In an undisturbed succession of this type of flows the tops and bottoms have horizontal plane surfaces. Therefore they show regular tabular form. Also with ample supply of lava the sheets attain considerable thickness and cover extensive areas. On the other hand if lava is not fluid but is viscous in nature then instead of flowing over large extensive area the lava will tend to pile up, the result will be irregular bulbous form having less  $l/t$  ratio because thickness is more as compared to its lateral extent. The top surfaces of such flows, instead of being horizontal and tabular, will be irregular, lenticular in form having slopes in all directions, because of extensive elevation and depressions. Thus the surfaces of such flows will not be smooth and will be showing irregularities typical to top surfaces of viscous liquids. The tops of such flows are generally ropy. The nature of bottom of flow is determined by nature of land surface on which it is outpoured. Bottom of such flows in a succession will also be irregular. If supply of lava for each flow is less then lateral extents of such flows will be limited. The continual eruption of this type of flows will result in a pile of small flows with irregular form; their tops and bottoms showing

conspicuous undulations and irregularities.

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## CONCLUSION

In view of all the above considerations, an attempt is being made to determine nature of Deccan Trap Volcanicity on the basis of field characters of basalt flows observed in Chikhaldara Hill Section. As can be seen from detailed descriptions of basalt flows exposed in the Chikhaldara Hill Section, there is a lot of variation in their thickness, lateral extent and l/t ratio. Most of the flows are found to be of Compact Basalts which are thick and extensive having high l/t ratio. Also few flows of Amygdaloidal Basalts have been observed which are having limited lateral extent and low l/t ratio. It has been observed that all these characters are governed by gas cavities. The Compact Basalt flows which are thick and extensive are free from gas cavities whereas, Amygdaloidal Basalts which are having limited lateral extent and low l/t ratio are vesicular amygdaloidal throughout their length and thickness. Such a variation in thickness, lateral extent and l/t ratio indicates that different types of volcanic activities had given rise to different types of flows.

When morphology of different types of flows is taken in to consideration then it is concluded that the Basalt flows of the Hill section are produced by Fissure type of Volcanicity.

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