

LATERAL EXTENT OF BASALT FLOWS IN DECCANTRAP REGION

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Abstract: This study has been undertaken to determine lateral extent of Basalt Flows occurring at distant places in Deccan Trap region of Maharashtra. The basalt flows are having extensive lateral extent, at many places thick horizontal layers of Basalts are found to be occupying length up to 20 km on the land. As compare to lateral extent, thickness of such flows is less i.e. up to 120m therefore L/T ratio is more and their tops and bottoms are plane and horizontal. Such thick flows having great lateral extent are referred as Compact Basalt flows produced by cooling and consolidation of fluid lava. In this research work Compact Basalt flows exposed in four Hill sections located at distant places from each other have been correlated.

Index Terms - Flows, Lateral extent, Correlation, Compact Basalt, Amygdaloidal Basalt, L/T Ratio, Hill sections.

INTRODUCTION

Deccan trap Basalts have been formed by solidification of lava which flows and spread out as horizontal sheets, normally having 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 has 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.

Lateral Extent and Length to Thickness (l/t) Ratio:-

Field observations of basalt flows exposed in the various Ghat Sections show that 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. The morphology of different types of flows clearly indicates that there was significant difference in fluidity of lavas which after consolidation resulted into different types of flows



Fig 1 Thick extensive flows of Basalt in Chikhaldara

Morphology of Compact Basalt Flows

The Thick Extensive Flows of Compact Basalts studied in this region are having regular tabular form; their tops as a whole are plane surfaces. These flows are having considerable lateral extent and are traceable for longer distances i. e. up to 8 km e.g. flow nos.6 and 7. Because of steep slopes all flows could not be traced laterally. However on the basis of topographical expressions of the flows they can be recognized from a distance even on other side of the valley. As compared to lateral extent these flows are small in thickness (Max.47m, Min.12m and Average of the two is 29.5m) (Fig. 1). Therefore they have large l/t ratio. As stated above the Compact Basalt flows occurring in the area under investigation do not have any other form except the regular tabular form. It indicates that such a regular tabular form must have been acquired by cooling and consolidation of a very large quantity of fluid lava. The extensive lateral spread, large thickness, high l/t ratio and absence of vesicularity except in the top portions of individual flows indicate that the Compact Basalts are product of fissure type of volcanicity characterized by floods of enormous quantities of fluid basaltic lavas that spread over a few hundred square kilometers as thick horizontal sheets.

Table No.1: Sequence of Basalt Flows exposed in Chikhaldara Ghat Section

R.L.in m	No. of Flows	Flow Numbers	Type of Basalt flows	Thickness (m)
1005 to 1092	03	14,15 and 16	CAB	87
990 to 1005	01	13	VB	15
892 to 990	03	10,11 and 12	CAB	98
737 to 892	04	6,7,8 and 9	CPB	155
725 to 737	01	5	CAB	12
677 to 725	02	3 and 4	CPB	48
647 to 677	1	2	TIAB	30
600 to 647	1	1	CPB	47

CPB- Compact Porphyritic Basalt flow TIAB- Thin and Thick Irregular Amygdaloidal Basalt

CAB-Compact Aphanitic Basalt VB-Volcanic Breccia

Predominance of Compact Basalt flows:-In the vertical stretch of 492m of Chikhaldara ghat section Compact Basalts, Amygdaloidal Basalts are occurring in the form of Tabular and undulated flows respectively. Also Black, Red and Green Tachylytic Basalts are noticed in the form of thin bands. Their occurrences are as given in Table No.1. As shown in the

table, out of total stretch of 492m, Compact Basalt in the Chikhaldara ghat section is having vertical thickness of 447m. whereas Amygdaloidal Basalt flows (Compound Flow) are having comparatively lesser thickness of only 30m. These are Thin Irregular amygdaloidal basalt Flows. Volcanic Breccias with zeolitic matrix is only 15m in thickness.

Origin of Compact Basalt Flows:-

Thick and extensive flows of Compact Basalts having high l/t ratio occurring in Chikhaldara Ghat section indicate that the large quantity of Mobile Lava has been outpoured through the tensional cracks on the surface of the Earth. Thus floods of enormous quantities of Basaltic lavas have spread over few hundred square kilometers giving rise to thick horizontal sheets of Basalts.

AMYGDALOIDAL BASALT FLOWS:-

In a very small stretch Amygdaloidal Basalts are occurring in the form of thin and thick irregular flows, indicative of eruption of viscous lava (Fig.2)



Fig.2 Thin and thick irregular flows of Amygdaloidal Basalt

LATERAL EXTENT OF THE TYPE OF VOLCANICITY

To determine lateral extent of the basalt flows prevailing in the Chikhaldara ghat section, the flows of basalts occurring in the ghat section at the same elevations in three neighboring areas i.e in Toranmal (Tejankar A.V.2002), Mhaismal (Kulkarni P.S.) and Sinhagad (Marathe S.S.) have been taken into considerations.

The Basalt Flows exposed at the same R.Ls of Chikhaldara in Toranmal, Mhaismal and Sinhagad Ghat Sections are given in Table Nos. 2, 3 and 4 respectively.

1. Comparison between Chikhaldara, Toranmal, Ghat sections:-

The Toranmal ghat is located at a distance of 283.416 km towards N 80° W of Chikhaldara, the Basalt flows exposed at the same R.Ls in Chikhaldara and Toranmal Ghat sections are given in Table No. 2

In Chikhaldara ghat section Thick extensive flow of Compact Basalt is making up major bulk of the entire section. It is covering about 91 % of the ghat section whereas in the same stretch i.e. from R.L. 600 to R.L. 1092m, thick extensive flows of Compact Basalt in Toranmal ghat section are making upto 100%. This is an indication of predominance of fissure type of volcanic activity in both the areas which are towards North East and North West part of Maharashtra state. The occurrence of Amygdaloidal Basalt flows in Chikhaldara ghat section, making a very small stretch of 6% and Volcanic Breccia making only 3%, indicates that in Chikhaldara ghat section there have been fissure type of volcanic activity along with to a very small extent, different type of volcanic activity must have persisted in the form of viscous lava outpouring through a large number of small outlets occurring in groups as shown by Karmarkar (1974) and Kulkarni P.S. (1984). The comparison shows that in Northeast and Northwest part of Deccan Trap area above the R.L.600m Fissure type of activity was prevalent.

The Basalt flows occurring in the same stretch of these ghats show a lot of difference in their lithology (Table No.2). Between R.L.1005-1092m in Chikhaldara Ghat section the flows are 100% Compact Aphanitic Basalts whereas in Toranmal Ghat Section Compact Aphanitic Basalts makeup only 43% and remaining 57% is Compact Porphyritic Basalts. Such variation in lithology is shown in Table 2. This indicates that even though the volcanicity of these two Ghat sections is predominantly of Fissure type, lithologically they make totally different flows. These Ghat sections are 283.416 Km apart. Such being the case the Basalt flows of these two sections could not be correlated.

Table 2. Comparison between Chikhaldara and Toranmal Ghat sections

R.L. in meter	Chikhaldara					Toranmal				
	CB	% CAB	% CPB	AB/V B	%	CB	% CAB	% CPB	AB/V B	%
1005 To 1092	87	100	-	-	-	87	43	57	-	-
990 To 1005	-	-	-	15	100	15	-	100	-	-
892 To 990	98	100	-	-	-	98	65	35	-	-
737 To 892	155	-	100	-	-	155	21	79	-	-
725 To 737	12	100	-	-	-	12	17	83	-	-
677 To 725	48	-	100	-	-	48	31	69	-	-
647 To 677	-	-	-	30	100	30	-	100	-	-
600 To 647	47	-	100	-	-	47	-	100	-	-

Comparison between Chikhaldara and Mhaismal Ghat Sections

For comparison of nature of volcanicity in Chikhaldara ghat section with that of ghat section in central part of Deccan Trap, only Mhaismal hill station is available. In the Mhaismal Ghat which is located towards S 56°W of Chikhaldara, at a distance of 244.856 Km, the basalt flows which are occurring are, as shown in Table No.3. The common vertical stretch of these two ghat sections falls between R.Ls 737m and 990m. Both the Ghat sections show predominance of Compact Basalt, indicating fissure type of eruption. As stated earlier these two ghat sections are 244.856 Km apart from each other, hence even though Compact Basalt Flows are occurring their field characters and types are quite different. The table shows that between R.L.737 m and 892m in Chikhaldara Ghat section CompactAphaniticBasalt flows are making 155m thickness whereas in Mhaismal Ghat Section out of total thickness of 155m CompactAphaniticBasalt is 113m thick and remaining 42m thick pile is of irregular Amygdaloidal Basalt. This goes to show that in spite of predominance of fissure type of eruption the flows occurring in these two Ghat sections cannot be correlated.

Table 3: Comparison between Chikhaldara and Mhaismal Ghat Sections

R.L. in meter	Chikhaldara					Mhaismal				
	CB	% CAB	% CPB	AB/VB	%	CB	% CAB	% CPB	AB/VB	%
892 To 990	98	100	-	-	-	28	-	100	-	-
737 To 892	155	-	100	-	-	113	-	100	42	100

Comparison between Chikhaldara and Sinhagad ghat section

Marathe et.al studied sequences of basalt flows exposed above R.L.920m occurring between Girawali and Kelghar ghat on Satara Mahabaleshwar Road for determination of nature of volcanicity. Although these two ghat sections are far away from each other they have been considered for comparison above R.L 920m. The area between R.L. 892 and 1092m is common to both, within this stretch Compact Basalt is occurring in both the ghat sections compact Basalt is occurring, these ghat sections are 441.795 km apart. Sinhagad is towards S45° west of Chikhaldara. For correlation of the flows, field characters and lithology are compared. It has been observed that there is vast difference in their field characters

Table 4 Comparison between Chikhaldara and Sinhagad

RL	CHIKHALDARA					SINHAGAD				
	CB	%CAB	%CPB	AB/VB	%	CB	%CAB	%CPB	AB/VB	%
1005 to 1092	87	100	-	-	-	82	61	39	05	100
990 to 1005	-	-	-	15	100	15	-	100	-	-
892 to 990	98	100	-	-	-	98	-	100	-	-

Table 5: Types of flows with their percentage in different ghat sections

Types of Basalt	% of Basalt Flows between RLs 600m to 1092m			
	Chikhaldara	Toranmal	Mhaismal	Sinhagad
CPB	51	69	77	72.50
CAB	40	31	-	25
TIAB	06	-	23	-
VB	03	-	-	2.50

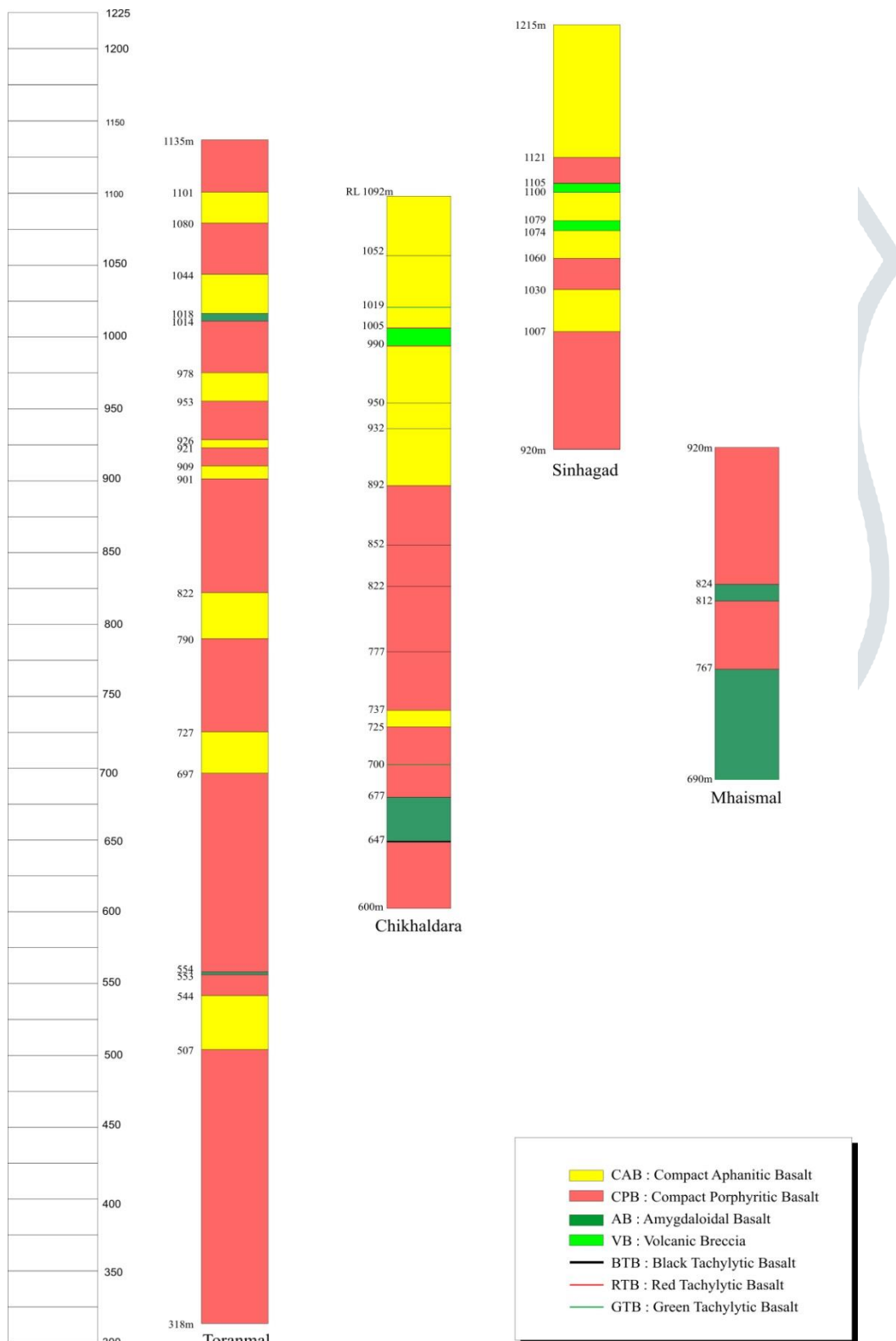


Fig.4 Comparative study of Chikhaldara,Toranmal,Mhaismal and Sinhagad ghat sections

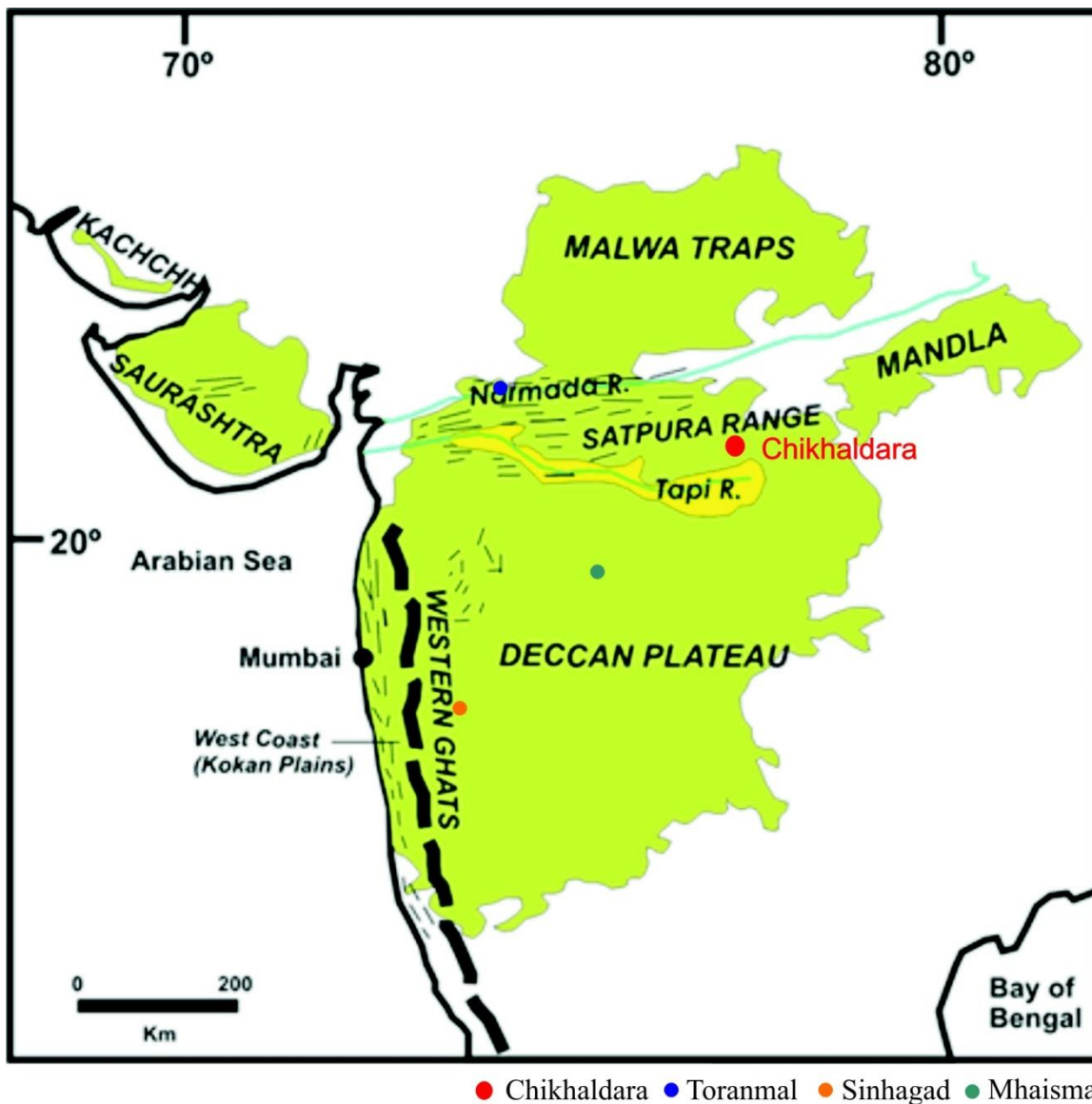


Fig. 5. Deccan Plateau

CONCLUSION

In all the areas of Deccan Trap region the Compact basalts are predominantly occurring at higher levels above R.L. 677m This is in agreement with central part of Deccan Trap (Mhaismal, Kulkarni P.S.1984), North West part of Deccan Trap (Toranmal, Tejankar A.V.2002) and Western part of Deccan Trap (Sinhagad, Marathe S.S.1980). (Table 5). Though the flows of Basalts occurring above R.L. 677m are of Compact Basalts in western part central part and North East part of Maharashtra they cannot be correlated

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