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REVIEW ON STUDY OF DECCANTRAP FLOWS OF CHIKHALDARA GHAT SECTION (DIST. AMRAVATI) MAHARASHTRA

***Doke S.D.¹ and Kulkarni P.S.²**

¹*Department of Civil Engineering, Pravara Rural Engineering College, Loni, Dist: Ahmednagar (MS)-413736*

²*Maulana Azad College of Arts, Science and Commerce Aurangabad*

**Author for Correspondence*

ABSTRACT

Deccan Trap is major geological formation occurring in Peninsular India, covering 5,16,000 Square kilometer area of western and Central India. About 82% portion of Maharashtra is occupied by the Deccan Trap. Extensive research has been carried out by many workers to determine nature of Deccan Trap Volcanicity i.e. origin of this major Geological formation. There was lot of debate on this aspect. Considering Research of earlier workers attempt has been made to decipher nature of volcanicity that has produced the basalt flows in time and space and nature of parent magma, on the basis of detailed research work that has been carried out. The study area selected for the research is Chikhaldara Ghat Section of Amravati District in Maharashtra.

Keywords: *Deccan Trap, Research, Volcanicity, Geological Formation, Debate*

INTRODUCTION

In the annals of Peninsular India, geologically a significant catastrophe engulfed about 1/3rd of the land area at the end of cretaceous era. The so called catastrophic event was manifested in the form of outpouring of enormous volume of Basaltic lava that covered hundreds of square km. of the land through spasmodic eruptions which gave rise to piles of lava flows. These piles carved the Landscape of Deccan Plateau.



Figure 1.1: Distant View of Deccan Trap Basalt Flows

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The term Deccan Trap was first introduced by W.H. Sykes in 1833 after Swedish word Trapp / Trappa meaning stair to describe step like or terrace like formation (Figure 1.1). This is the second most extensive geological formation after Igneous and Metamorphic complex of Archaean era in Peninsular India (Figure 1.2). It occupies a large tract between Bombay in the west, Cutch in North West, Sarguja and Jashpur in the East, Belgaum in the south, and as far as Rajmahendri in South East, covering parts of states of, Maharashtra, Gujrat, Madhya Pradesh and Karnataka. Major part of Deccan Plateau in Maharashtra runs through Kelod, Nagpur and Pandharkawada in Vidarbha, East of Nanded, Deglur, Udgir and Umarga in Marathwada and East of Akkalkot and Miraj in Southern Maharashtra. In the West, Deccan Trap extends far beyond West Coast up to Bombay high and even beyond that. In Ratnagiri off shore Deccan Trap has been encountered in deep drill wells (Kalia 1988). Except Eastern part of Nagpur district, whole of Bhandara, Chandrapur and Gadchiroli districts and southern part of Sindhudurg district, all other districts of Maharashtra are occupied by Deccan Trap. Thus Maharashtra can be considered as house of Deccan Trap.

Wadia (1967) and Krishnan (1968) have advocated perfect horizontality of Deccan Trap Basalts. Crookshank (1936) has mentioned deviation from horizontality near Morghat. However these cases are not of Basalt to Basalt contact, but they represent the contact between Deccan trap and Gondwana rocks. Wadia (1967) has attributed deviation from horizontality at Rajpipala hills and other areas to the disturbances subsequent to consolidation of flows.

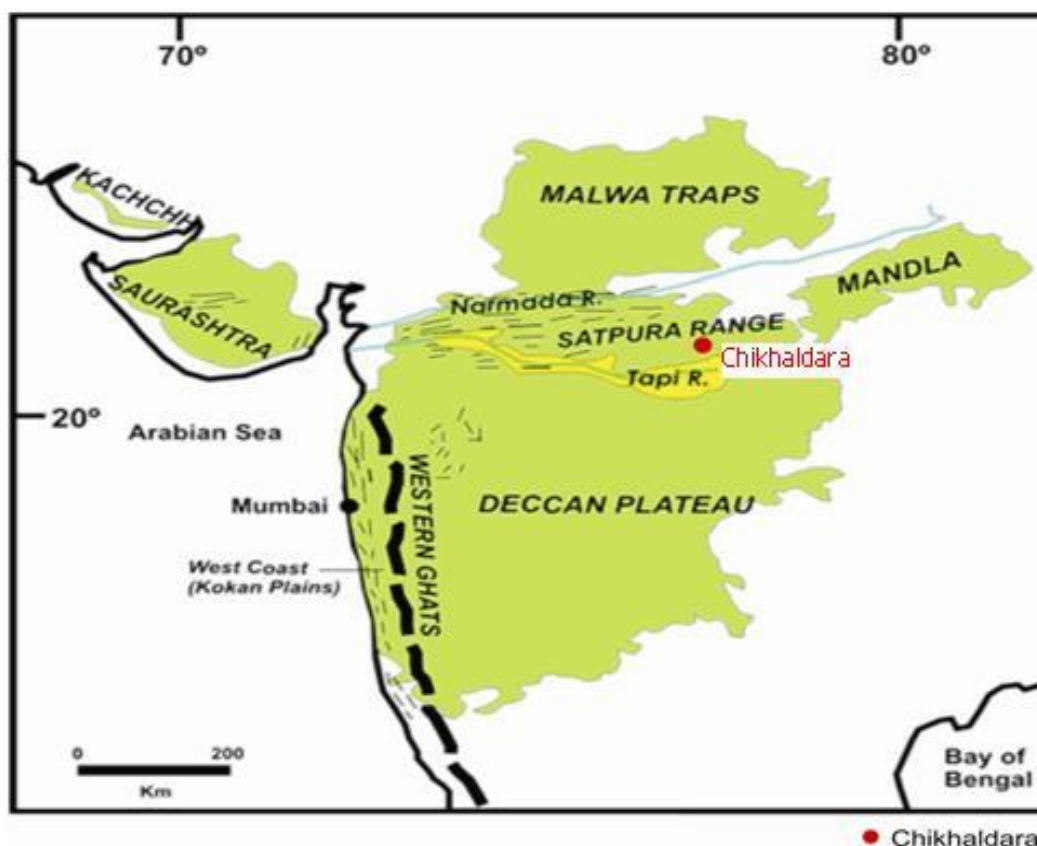


Figure 1.2: Area covering Deccan Trap formation

The Deccan Traps are made 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. (Karmarkar-1974, Gupte et.al.1974). In Jawahar-Igatpuri section in Western Ghats about 700m thickness is reported to be composed of 15 flows (Subbarao et.al 1988). On the western slope of Sahyadri between Kasara and

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Kalsubai, 21 flows are exposed in vertical span of 1381 m. From Poladpur to Mahabaleshwar within a vertical distance of 1200 m there are 47 flows. Compound flows of amygdaloidal basalts range in thickness from 30m to 200 m.

The total thickness of Deccan Trap is also variable in different parts because of undulating nature of ground over which the flows are overlying. The trap cover is thickest near Bombay coast, where it is almost 3000m. The section at Matheran is about 850 m thick, at Mahabaleshwar it is 1700 m thick. The Lava pile in Western Ghat is having combined thickness of 2500 m. In Melghat scarp, north of Achalpur in Amravati District the flows have total thickness of 700 m. In the Eastern part of Vidarbha total thickness varies from 70 m to 225 m. At Hingana in neighborhood of Nagpur, in bore holes drilled for coal prospecting thickness of traps has been found to vary between 50m to 70m.

Flow Types

The lava flows of two different types have been recognized. They are pahoehoe or ropy lava and the aa or block lava. Pahoehoe is mobile, solidifies with smooth and glazed surface have rope like wrinkles hence called as ropy structure. The flows are also recognized as compound (Amygdaloidal) when made of several smaller units. Karmarkar et.al. (1974), 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 units. In general compound flows show Pahoehoe characters, whereas simple flows show characteristics of Block or aa flows. The former predominate in western Maharashtra between Dhule, Buldhana, Aurangabad, Pune and Nasik whereas in the rest of the region of Maharashtra Simple flows are predominant (Figure 1.3).

The Compact Basalt flows are Thick extensive and free from vesicles, amygdales, except for small portions at the top and bottom of the flows. The major portion of these flows is jointed. The undulated Basalt flows having vesicles are called as Vesicular Basalts (Compound Flows). However these vesicles rarely remain empty but are generally filled with secondary minerals like varieties of silica, calcite, zeolites and these vesicular Basalts containing infilling of the secondary minerals are called as Amygdaloidal Basalts. In nature therefore Vesicular Basalts are rare in occurrence and Amygdaloidal Basalts are more. As mentioned earlier many of the amygdaloidal flows may be made of several smaller units forming compound flows.

Deccan Trap flows have horizontal attitude which can be observed along Western ghats and in the areas of Khandesh to Solapur and throughout Vidarbha region. However in the regions like Mumbai and Salsette islands and in the hills between Thane and Kalyan and west of Panvel the flows show dip varying between 8° and 12° towards west. In some areas very low dip between 2° to 5° is observed which may be due to slope of original land surface on which lava is outpoured.

Lineaments

A study of Land-Sat imagery carried out by Rajurkar et.al. (1990) has revealed several lineaments traversing Maharashtra Plateau. This study is summarized in Table No. 1.1.

These lineaments throw some light on the nature of tectonic activity in the region. The Tapi lineament, which forms southern margin of Satpura horst represents a zone of weakness along which there has been recurrent activity during different geologic periods, as is evidenced from the inliers of Achaean and Gondwana rocks in the Deccan Trap and thick alluvial deposits of quaternary age in the Tapi and Purna valleys. The crustal block, south of Tapi. Purna lineaments comprising the Maharashtra plateau appears to be tectonically a stable block forming basement for Pakhal, Sullavai, Penganga and Gondwana sedimentary sequences and thick Deccan Trap lava pile. The Godavari lineament of Pranhita Godavari valley has controlled formation of these basins and their sedimentation. The faulted margins of these basins indicate that some of the lineaments are fault lineaments which had recurrent activity during different geological periods. Over the Maharashtra plateau, in addition to NNW to NW trending Godavari lineaments, there are dominantly ENE-NE trending lineaments which represent cooling joints and fractures in the lava flows with no tectonic significance. The Godavari lineament occurring in the trap flows appear to be manifestations of the basement lineaments, the activation of which in post Deccan Trap period is observed in Warna and Kaddam. Although some evidences of recurrent activity have been

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observed in the case of some fault lineaments in the Maharashtra crustal block south of Tapi-Purna lineaments, the block as a whole appears to be tectonically stable.

Table 1.1: Lineaments Traversing Maharashtra Plateau

Sr. No.	Lineament	Extent	Direction
1	Sahyadri	50 Km. wide	Parallel to west coast
2	Chiplun	Mumbaito Ratnagiri	NNW-SSE
3	Warna	100km length	NW-SE (Course of Warna River
4	Ghod	225 Km. long	NW-SE (Course of Ghod River)
5	Upper Godavari	Westof Nasik up to neighborhood ofParbhani 280 Km. long	WNW-ESE
6	Kaddam Lineament	280 Km. long	Courseof Kaddam River
7	Tapi	1200 Km. long extending from vicinityof Jalgaon in west to Dhanbad in Bihar in the East	Northern border of Maharashtra (Course of Tapi River)
8	Purna	200 Km. long from south of Amravati up to Jalgaon in west where it joins Tapi lineament	WNW-ESE

Origin of Basalt Flows

Deccan trap is major geological formation occurring in peninsular India. After independence observations which have been made during geological investigations by experts for engineering sites in various parts of Deccan trap area and for ground water exploration in drought prone areas have revealed that there is considerable variation in its field characters which have not been mentioned by earlier workers. These observations have initiated the government organizations like GSI, ONGC and a few Geology Departments at University and College levels in Maharashtra state to undertake further studies which were mainly confined to Geochemical studies of Basalts. The origin of Deccan volcanic province has been much debated. The debate concerns whether the magmas formed by melting a giant mantle plume, Normal Plate tectonic processes or impact of large extra terrestrial bollide. This paper deals with the research work carried out to determine nature of volcanicity of Chikhaldara Ghat section. The work on Deccan Trap by earlier researchers is as given below. West (1959) found on the basis of Geological and Geophysical evidences, that the Deccan trap flows originated in those areas where dykes are found,

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namely in Cutch, Saurashtra, North Konkan, The Tapi and Narmada valleys and the Gondwana basins of Satpuras and further east and they travel long distance to other parts of the outcrop.

Wilson (1963) felt that the Hawaiian island chain, which is located in the middle of large oceanic plate, could not be explained by shallow mantle processes required by Plate Tectonics. Wilson model for the Hawaiian volcanic chain called for generation of magmas from a spatially fixed thermal plume rooted in the deep, non convecting mantle.

Agashe and Gupte (1968, 1971) attributed Deccan Trap as the product of fissure type of volcanicity, but have shown that in addition to fissure type, central type of volcanicity also existed in some part of Deccan Trap area of Western Maharashtra.

Gupte *et al.*, (1971), Karmarkar (1974, 1978) Kulkarni (1975) Marathe (1976, 1980), Kulkari (1984) and Tejankar (2002) on the basis of systematic studies have determined the field characters of basalt flow exposed in road cuts and in railway cuts taken for ghat sections from R.L. 40 m to R.L. 1220 m over a large area of Deccan Trap formations, have shown that there is distinct variation in the nature of volcanicity at different times and at different places in Western Maharashtra, Marathwada and Khandesh regions of Maharashtra state.

Krishnan (Geology of India and Burma 1982) found that towards end of Mesozoic era enormous outpouring of lava flows took place, which spread over vast areas of western, central and southern India. These flows issued through long narrow fissures in the earth's crust from a large magma basin and are therefore called fissure eruptions. The flows are called Traps due to their step like appearance.

Ghosh and Pal (1984) have given evidence of Fissure eruption observed in Khargone and Dhar Districts (GSI spl. publ. No.14 pp. 108-110).

Mahoney *et al.*, (1985) carried out an isotopic investigation of some alkalic and tholeiitic basaltic lavas in the northern Deccan area along the Narmada River. These lavas are essentially contemporaneous. They determined that the alkali and tholeiitic lavas have similar isotopic composition and are roughly equal in volume in that particular Narmada section.

Richard *et al.*, (1989) Duncon and Richards (1991) used the Deccan Traps eruption as spectacular example of mantle plume activity, the basic idea is that the Deccan magmas formed by melting a giant "plume head" that rose from the core mantle boundary. This plume head was anchored to the source by long tail that created the Chagos-Laccadive volcanic chain. A jump of a ridge that is now the Central Indian Ridge about 40 million years ago broke up the chain and the original plume tail is now creating volcanism on Reunion Island.

Chatterjee and Rudra (1992) stated that Deccan Trap Volcanic Province having enormous size predominantly made up of tholeiitic lavas of Deccan appear to have erupted some 65 m.y. ago, when Indian continent was rapidly migrating northward. There are several other voluminous basalt provinces on earth like the Deccan, such as Parana Basalts of South America, Siberian Traps (Russia), Karoo (Africa), Columbia River Basalts (North America), Caribbean Sea Floor Basalts and Ontong Java Plateau (Western Pacific Ocean). Subbarao *et al.*, (1994) have given stratigraphy and structure of Central Deccan Basalt Province and proposed various eruptive models which appear to have been originated due to iso-static adjustment. Gautam (1995) determined that bulk of the lavas are tholeiitic with <7% MgO and carry phenocrysts of Plagioclase and Olivine. Many also contain augite phenocrysts. Pigeonite phenocrysts are rare. Aside from tholeiite, carbonatites and other mafic alkaline lavas also occur in minor amounts.

Sen (1995) given an important argument in favor of the plume origin of the Deccan is that too much lava came out in too short a time requiring some special melting mechanism that does not fit the normal Plate Tectonic schemes. Much finer age refinement with radioisotope dating of the lavas and a more accurate estimate of the volume of the lavas are needed to have a stronger constraint on the eruption rate of the Deccan. Without such refinement, the mean eruption rate could have varied between 1 and 40 Km³ per year. Simple volume consideration of erupted lavas suggests that Deccan Tholeiites or their parent magmas were generated in much greater volume than carbonatites and alkali magmas.

Sano *et al.*, (2001) describes differentiation processes of Deccan Trap Basalts based on Geochemical and Petrological studies. He further stated that the Phenocryst assemblage and Chemical Trend of the least

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contaminated basalts can be explained by fractional crystallization in shallow chambers under Faylite–Magnetite-Quartz (FMQ) buffered conditions. Seth (2005), Chandrasekharam *et al.*, (1978) have doubted the plume theory as far as the origin of the Deccan Trap is concerned they noted that Deccan Basalts predominantly erupted through fissures in the crust and proposed a model of shallow mantle melting in which pre existing rift zones were reactivated and magma simply poured out of fissures. Chenet *et al.*, (2007) carried out paleomagnetic study which suggests that there were episodic bursts of lava eruption with intermittent quiescence.

Reddy (2012) observed that Deccan Volcanic Province comprises vast thickness of laterally extensive basaltic flows that presently covers an area about 500000 Km² of west-central India. These lavas are near horizontal and exposed thickness is about 2000m.

The estimated maximum thickness is about 4000m. The bulk of sequence of Deccan Volcanic Province was erupted at Cretaceous Tertiary boundary 66Ma ago over short time span of 1 million year. Although Deccan Volcanic Province comprises predominantly Tholeiitic basalts, it contains minor volumes of alkali basalts and various more evolved rocks.

CONCLUSION

On the basis of Literature review it is observed that most of the researchers are of the opinion that the huge mass of Deccan Trap covering 1/3rd of Peninsular India is product of fissure type of volcanic eruption and the parent magma producing the Deccan Plateau is mainly tholeiitic in nature.

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