Preliminary Flow Stratigraphy of Asirgarh Volcanics, Burhanpur district, Madhya Pradesh

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Abstract: The Deccan traps offer excellent material for stratigraphic studies as the traps outcrop as an uninterrupted sequence of flows through of the terrain with occasional presence of few intertrappean beds. Krishnan (1960) has broadly classified the Deccan trap into lower, middle and upper stratigraphic grouped based on the distribution and relative proportion of intertrappean sedimentary beds an ash layers with relation to their height. The lower traps represent outlier part of the province. The middle trap comprises the central Deccan a Malwa plateau where as the western ghat near Maharashtra and Gujarat refers to upper traps.

In the Asirgarh area the detailed stratigraphic aspects of the various lava flows exposed are study have been carried out to understand the flow stratigraphy of the lava pile. This detailed study based on megascopic and microscopic characteristic of the rock and geochemical analysis. The detailed stratigraphic investigation carried out in 465m thick lava pile exposed in the study area permit the broad division of Malwa subgroup into three formations namely Dahinala, Asirgarh and Amba. The formation boundaries are differing by characters such as field character, phenocrystic assemblages and appearance of giant phenocrystic basalt horizon (GPB). The Deccan traps offer excellent material for stratigraphic studies as the traps outcrop as an uninterrupted sequence of flows through of the terrain. Considering the vastness of the area and magnitude of the problem, a sincere attempt has been made in this study to establish the stratigraphy of Asirgarh volcanic. It is hoped that these results may provide a model to bring out the regional evolution and structure of Deccan Traps as a whole.

Keywords*:* Deccan plateau, stratigraphy, chemical types.

I.INTRODUCTION:

The stratigraphy is the science of the study and interpretation of lava flows with respect to their identification, description of horizontal and vertical sequence and age relationship along with the correlation of stratigraphic units showing geochemical variation. The Deccan traps offer excellent material for stratigraphic studies as the traps outcrop as an uninterrupted sequence of flows through of the terrain with occasional presence of few intertrappean beds. The major part of the study area is underlain by hard rock's consisting mostly of thick sequences of basaltic flows a part of Deccan trap of Malwa group. Alluvium in the study area occurs as a narrow strip along the Tapi River

The investigations by various research groups on Deccan trap (Cox & Hawkes worth, 1984; Bodas et.al, 1985; Beane et.al, 1986; Devery & Lightfoot 1986; Subbarao et.al, 1994 & Khadri et.al; 1988 a&b, 1996) based on field geochemical, petro graphic and paleomagnetic investigations, a comprehensive stratigraphy for both western Deccan Basalt Province and Malwa traps have been established. In the Malwa region very limited work has been done to establish the flow stratigraphy. Khadri et.al, (1996 a&b) have made an attempt to correlate the Malwa traps from the Mograba-Burimandaw region with the Western Ghats stratigraphy in order to identify the relative stratigraphic sequence. In the Asirgarh area the detailed stratigraphic aspects of the various lava flows exposed are study have been carried out to understand the flow stratigraphy of the lava pile. This detailed study based on megascopic and microscopic characteristic of the rock and geochemical analysis. The detailed stratigraphic investigation carried out in 465m thick lava pile exposed in the study area permit the broad division of Malwa subgroup into three formations namely Dahinala, Asirgarh and Amba. The formation boundaries are differing by characters such as field character, phenocrystic assemblages and appearance of giant phenocryst basalt horizon (GPB).

II.Study Area:

The Asirgarh volcanics is situated in Burhanpur District of Madhya Pradesh which is located between latitude 21^0 11'- 21^0 52' N and longitude 75º55' – 76º30' E covered by Survey of India toposheet nos. 55C/1 to C/8 on 1:50,000 scale (Fig 1). The geological succession of study area is shown in table 1.The study area is occupied by alluvium and Deccan basalts which are horizontally disposed and traversed by well-developed sets of joints. The study area forming about 460m thick sequence of lava flow covering of an area of 4000 sq km. The study area is drained by Tapi River and Chhota Tawa River. Tapti flows from east to west and the River Narmada also flows here. The study area is situated in the valley of Narmada and Tapi River amidst the Satpura ranges, on the flat ground along the North bank of Tapi River. Asirgarh has a subtropical climate. It also has three major seasons such as summer, winter and monsoon. The state has particularly varied topography and therefore show the difference in the soil and vegetation.

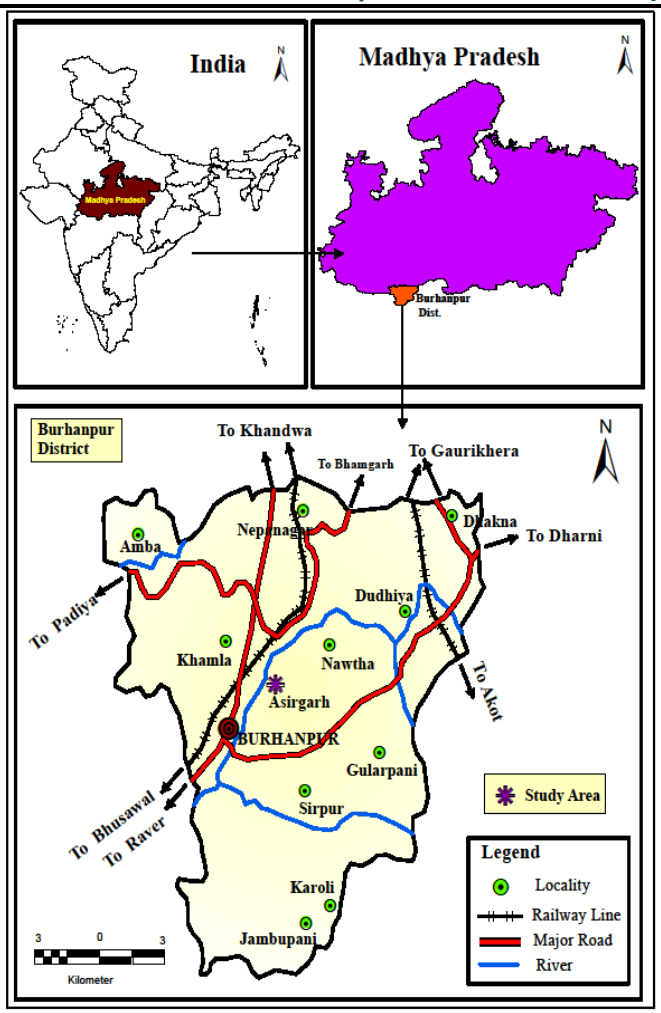

Fig.1 Location map of Study Area

Table 1: Geological succession of the study area

AGE	Formation	Lithology
Quaternary	Alluvium	Yellow color clay, With sand bed and Silt with course sand, Gravel and Boulder
----------Angular Unconformity----------		
Upper Cretaceous to Lower Eocene	Deccan trap (Malwa Group)	**Amba Formation** **Asirgarh Formation** **Dahinala Formation**
----------Unconformity----------		
Lower Triassic to Cretaceous	Gondwana super group	Sandstone

III.Methods of investigation:

For flow stratigraphy investigation representative samples were selected from 11 field traverses. The traverses name are Amba, Bandaria, Boribuzurg, Astaria, Rajpura, Dahinala, Asirgarh, Ashadevi, Gullarpani, Tulyamal and Bhilkheri. These representative samples are covering the entire stratigraphic sequences at the study area. Based on petrographic investigation coupled with geological mapping as well as chemical variation, the Malwa subgroup exposed at Asirgarh region can be subdivided into three formations namely Amba, Asirgarh and Dahinala comprising of 16 different lava flows. Detailed stratigraphy of various lava flows exposed in study area based on chemical classification of rock samples in hand specimens and in thin sections to identity various mineral phases, textural characters and their distribution. Chemical types are divided into different such a CT_1, CT_2 CT3, CT4and CT_5. Chemical types CT_1 shows the aphyric to microphyric characteristics, CT_2 shows the mafic phyric, CT_3 shows the plagioclase phyric with mafic horizons in between, CT_4 shows the Plagioclase phyric and CT_5 shows the Giant plagioclase basalt characteristics.

IV.SRATIGRAPHY OF ASIRGARH VOLCANIC:

In present stratigraphy, the important criteria are that the ability to distinguish number various lava flows and trace them in different field sections on regional scale. Based on petrographic investigation coupled with geological mapping as well as chemical variation, the Malwa subgroup exposed at Asirgarh region can be subdivided into three formations namely Amba, Asirgarh and Dahinala comprising of 16 different lava flows. Astaria, Dahinala, Asirgarh, Amba traverse shows the entire stratigraphic sequence exposed in the study area with better development of various flows.

4.1Stratigraphy of Dahinala formation:

This formation is well exposed near Dahinala, Tulymal, Bhilkheri villages in the study area. It lies towards lowermost part of the stratigraphic sequence showing (Table 2) the fine grained, mafic phyric basalt at the base with highly evolved Giant plagioclase basalt sequence at the top. This formation is characterized by six lava flows showing variable thickness due to pinching and swelling nature. This formation is characterized by the presence of six different lava flows which can be divided into different CTs such as CT_1, CT_2 CT_3, CT_4 and CT_5. Petro graphically; this formation is characterized by the presence of highly evolved Giant plagioclase basalt showing glomeroporphyritic texture, this formation is acting as a marker horizon between Dahinala and Asirgarh formation.

4.1.1Chemical Type (CT_1):

This flow is characterized by fine grained, in nature with the presence of microphenocryst of plagioclase and clinopyroxene embedded in opaque rich groundmass with the presence of plagioclase and occasional clinopyroxene with the presence of aphantic and sub-ophitic relationship. In thin section, it shows aphanitic, sub-ophitic texture with the abundance of plagioclase showing albite and Carlsbad twinning.

4.1.2Chemical Type (CT_2):

The flow is characterized by fine to medium grained, compact, massive, mafic phyric basalt with the presence of distinctly grains of plagioclase and clinopyroxene. In thin section, it shows aphanitic, sub-ophitic texture with the abundance of plagioclase showing albite and Carlsbad twinning and clinopyroxene embedded in the fine grained.

4.1.3Chemical Type (CT_3):

The flow is characterized by medium grained, hard, compact, massive, mafic phyric basalt with the presence of amygloidals. In thin section it shows sub-ophitic, ophitic texture with flow structure and plagioclase showing twinning.

4.1.4Chemical Type (CT_4):

The flow is characterized by the presence of large phenocryst of plagioclase showing porphyritic texture enclosed in the sub-ophitc groundmass. In thin section it shows medium to coarse grained with amyloidal and plagioclase show albite and Carlsbad twinning and show flow structure also.

4.1.5Chemical Type (CT_5):

The flow is characterized by medium to coarse grained, compact, massive, with the presence of large phenocryst of plagioclase showing porphyritic texture indicating highly evolved nature. In thin section it shows medium to coarse grained of plagioclase and clinopyroxne with the presence of porphyritic relationship.

4.2Stratigraphy of Asirgarh Formation:

This formation is well exposed near Rajpura, Astaria and Gullarpani villages in the study area. It lies towards middle part of the stratigraphic sequence showing (Table 2) the fine to medium grained, mafic phyric basalt at the base with highly evolved Giant plagioclase basalt sequence at the top. This formation is characterized by six lava flows showing variable thickness due to pinching and swelling nature. This formation is characterized by the presence of six different lava flows which can be divided into different CTs such as CT_1, CT_2 CT_3, CT_4 and CT_5. Petro graphically, this formation is characterized by the presence of highly evolved Giant plagioclase basalt this formation is acting as a marker horizon between Asirgarh and Amba formation.

4.2.1Chemical Type (CT_1):

This flow is characterized by fine grained, in nature with the presence of microphenocryst of plagioclase and clinopyroxene embedded in opaque rich groundmass with the presence of plagioclase and occasional clinopyroxene with the presence of aphantic and sub-ophitic relationship. In thin section, it shows aphanitic, sub-ophitic texture with the abundance of plagioclase showing albite and Carlsbad twinning.

4.2.2Chemical Type (CT_2):

The flow is characterized by fine to medium grained, compact, massive, mafic phyric basalt with the presence of distinctly grains of plagioclase and clinopyroxene. In thin section, it shows aphanitic, sub-ophitic texture with the abundance of plagioclase showing albite and Carlsbad twinning and clinopyroxene embedded in the fine grained.

4.2.3Chemical Type (CT_3):

The flow is characterized by medium grained, hard, compact, massive, mafic phyric basalt with the presence of amygloidals. In thin section it shows sub-ophitic, ophitic texture with flow structure and plagioclase showing twinning.

4.2.4Chemical Type (CT_4):

The flow is characterized by the presence of large phenocryst of plagioclase showing porphyritic texture enclosed in the sub-ophitc groundmass. In thin section it shows medium to coarse grained with amyloidal and plagioclase show albite and Carlsbad twinning and show flow structure also.

4.2.5Chemical Type (CT_5):

The flow is characterized by medium to coarse grained, compact, massive, with the presence of large phenocryst of plagioclase showing porphyritic texture indicating highly evolved nature. In thin section it shows medium to coarse grained of plagioclase and clinopyroxne with the presence of porphyritic relationship.

4.3Stratigraphy of Amba Formation:

This formation is well exposed near Amba, Bandaria and Asirgarh villages in the study area. It lies towards uppermost part of the stratigraphic sequence showing (Table 2) fine grained, aphyric basalt at the base with mafic phyric basalt at the top. This formation is characterized by six lava flows showing variable thickness due to pinching and swelling nature. This formation is characterized by the presence of six different lava flows which can be divided into different CTs such as CT_1, CT_2 CT_3, and CT_4.

4.3.1Chemical Type (CT_1):

This flow is characterized by fine grained, in nature with the presence of microphenocryst of plagioclase and clinopyroxene embedded in opaque rich groundmass with the presence of plagioclase and occasional clinopyroxene with the presence of aphantic and sub-ophitic relationship. In thin section, it shows aphanitic, sub-ophitic texture with the abundance of plagioclase showing albite and Carlsbad twinning.

4.3.2Chemical Type (CT_2):

The flow is characterized by fine to medium grained, compact, massive, mafic phyric basalt with the presence of distinctly grains of plagioclase and clinopyroxene. In thin section, it shows aphanitic, sub-ophitic texture with the abundance of plagioclase showing albite and Carlsbad twinning and clinopyroxene embedded in the fine grained.

4.3.3Chemical Type (CT_3):

The flow is characterized by medium grained, hard, compact, massive, mafic phyric basalt with the presence of amygloidals. In thin section it shows sub-ophitic, ophitic texture with flow structure and plagioclase showing twinning.

4.3.4Chemical Type (CT_4):

The flow is characterized by the presence of large phenocryst of plagioclase showing porphyritic texture enclosed in the sub-ophitc groundmass. In thin section it shows medium to coarse grained with amyloidal and plagioclase show albite and Carlsbad twinning and show flow structure also.

Table 2: Detailed stratigraphy of various formations exposed in the study area

Result and Discussion:

Group	Sub Group	Formation	Thickness (m)	Flow	Characteristic Features	CT	Phenocryst			Grain Size
							P1	Cpx	O1	
DECCAN TRAPS	MALWA	AMBA	10-15	XVI	Medium grained, mafic micro phyric compact, massive Basalt.	CT_2	X	X	X	M
			30-36	XV	Fine to medium grained, minutely amygloidal pl. phyric compact Basalt	CT_4	X	X	-	M
			25-31	XIV	Medium grained, pl. mafic phyric compact Basalt. Vesicles at the top.	CT_3	X	X	X	M
			25-30	XIII	Fine grained, massive compact, aphyric Basalt	CT_1	-	X	X	F
		ASIRGARH	10 -15	XII	Medium to coarse grained, micro phyric compact massive GPB pl.mafic phyric Basalt	CT5	X	X	X	C
			46-53	XI	Fine grained, compact aphyric Basalt with amygdales	CT_1	X	X	X	F
			40-43	X	Fine grained, massive compact, pl micro phyric Basalt	CT_4	X	X	-	F
			10-15	IX	Fine grained, amygdaloidal, compact aphyric Basalt	CT_1	-	X	X	F
			25-30	VIII	Fine grained, massive compact, pl mafic microphyric Basalt..	CT_3	X	X	X	F
			30-38	VII	Fine to medium grained, mafic phyric compact massive aphyric Basalt. With vesicles structure.	CT_2	X	X	X	M
		DAHINALA	10-15	VI	Coarse grained compact massive GPB with mega phenocrysts of plagioclase.	CT_5	X	X	X	C
			15-20	V	Fine grained, aphyric amygdaloidal compact Basalt	CT_1	X	X	X	F
			15-20	IV	Fine to medium grained, pl phenocrysts, compact massive vesicular Basalt	CT_4	X	X	-	M
			15-20	III	Fine grained, massive compact massive plagioclase mafic phyric Basalt	CT_3	X	X	X	F
			35-43	II	Fine grained, compact, massive aphyric Basalt	CT_1	-	X	X	F
			25-30	I	Fine grained, compact, massive mafic phyric Basalt	CT_2	X	X	X	F

The study area is characterized by the presence of 400m–440m thick lava sequence or pile which has been divided into three formations namely 'Dahinala Formation', 'Asirgarh Formation', 'Amba Formation 'consisting of 16 lava flows grouped into 5 chemical types. In the study area that the older formations are well exposed towards the north western part whereas, the younger

Formations are well exposed towards the western part of study area. The older formations are well exposed near Dahinala, Tulymal, Bhilkheri villages in the study area and showing the fine grained, mafic phyric basalt at the base with highly evolved Giant plagioclase basalt sequence at the top. It lies towards lowermost part of the stratigraphic sequence showing the fine grained, mafic phyric basalt at the base with highly evolved Giant plagioclase basalt sequence at the top. This formation is characterized by six lava flows showing variable thickness due to pinching and swelling nature. This formation is characterized by the presence of six different lava flows such a CT_1, CT_2 CT3, CT4and CT_5.

The younger formations are well exposed near Amba; Bandaria and Asirgarh villages in the study area and showing fine grained aphyric basalt at the base with mafic phyric basalt at the top. It lies towards middle part of the stratigraphic sequence showing the fine to medium grained, mafic phyric basalt at the base with highly evolved Giant plagioclase basalt sequence at the top. This formation is characterized by six lava flows showing variable thickness due to pinching and swelling nature. This formation is characterized by the presence of six different lava flows such a CT_1, CT_2 CT3, CT4and CT_5.

The middle formation is well exposed near Rajpura, Astaria and Gullarpani villages in the study area. It lies towards middle part of the stratigraphic sequence showing the fine to medium grained, mafic phyric basalt at the base with highly evolved Giant plagioclase basalt sequence at the top. This formation is characterized by the presence of six different lava flows such a CT_1, CT_2 CT3, and CT4. The detailed stratigraphy of the Asirgarh volcanic describes in the Table 2.

Most of the flows appear horizontal in the field at and around the adjoining region. In the study area, the formation boundaries do not lie at the same stratigraphy levels in the different traverses. The basalt flows dip northward with easterly components to the east and westerly component to the west. Extensive mapping and correlation of large number of field traverses in the study area indicate thickening and thinning of the various lava flows, which might be responsible for the dipping of the flows. The results indicate considerable match in the stratigraphic sequence. However, certain flows seem to pinching out in the surrounding areas with most of the flows showing variable thickness.

Conclusions:

The Asirgarh volcanics has been classified into three formations namely Amba, Asirgarh and Dahinala comprising of 16 different lava flows based on petrographic and geochemical investigation coupled with geological mapping as well as chemical variation. Amba, Asirgarh and Dahinala traverse shows the entire stratigraphic sequence exposed in the study area with better development of various flows and the formation names are given by the village name like Amba, Asirgarh and Dahinala. The formation boundaries are differing by characters such as field character, phenocrystic assemblages and appearance of giant phenocrystic basalt horizon (GPB). The Deccan traps offer excellent material for stratigraphic studies as the traps outcrop as an uninterrupted sequence of flows through of the terrain. Considering the vastness of the area and magnitude of the problem, a sincere attempt has been made in this study to establish the stratigraphy of Asirgarh volcanic. It is hoped that these results may provide a model to bring out the regional evolution and structure of Deccan Traps as a whole.

Acknowledgements:

The financial assistance received from UGC, New Delhi to SFRK vide sanction letter No: F.No;34/45/2008 regarding major research project entitled "Flow stratigraphy, Petrogenesis and Paleomagnetism of Asirgarh Volcanics, Burhanpur District, Madhya Pradesh with emphasis on search and identification of magmatic pulses for assessment of their role in the greatest mass extinctions of the earth history" is hereby acknowledged..

REFERENCES:

[1] Beane, J. E., Turner, C.A., Hooper, P. R., Subbarao, K.V., Walsh, J.N., 1986. Stratigraphy, Composition and from of DeccanBaslats, Western Ghats, India. Bull. VolcannoI.,Vol: 48,pp.61 – 83.

[2]Bodas, M.S., Khadri, S.F.R., Subbarao, K.V,, Hooper, P.R. and Walsh, J.N. 1985 Proc. Indian. Geol. Congr., V. Session, Bombay, pp. 339-346

[3]Cox , K. G. and Hawkesworth, G. J., 1984. Relative contribution of crust and mantle to flood Basalt Volcanism, Mahabaleshwar area, Deccan Traps. Phil. Trans. R. Soc. Lond. Vol : A 310, pp. 627-641.

[4]Devey C.W.,Lightfoot, P.C., 1986; Volcanlogicaland tectonic contour of stratigraphy and structure in the Western deccan traps, Bull. Volcano. VI: 48, pp. 195-207.

[5]Khadri , S.F.R., Subbarao, k. V., and Bodas,M.S., 1988 (a).Magnetic studies on a thick pile of Deccan Trap flows at Kalsubai. Memoir No. 10. Jour. Geol. Soc. India.pp. 163-180.

[6]Khadri , S.F.R., Subbarao, k. V., P.R. and Walsh, J.N., (1988b) Stratigraphy of Thakurwadi formation, western deccan Basalt Province, India, Memoir No. 10, J. Geol. Soc. India. Pp. 281-304.

[7]Khadri , S.F.R., Subbarao, k. V., and Walsh, J.N., 1996b . Stratigraphy from and structure of the east pune Basalts, Western Deccan Basalt province, India.Jour . Geol. Soc. Ind. Mem. No. 38, W. D. West Volume.

[8]Khadri, S. F. R. Subbarao, K. V., and Walsh, J. N., 1996a.Stratigraphy form and structure of the east Pune Basalt, Western Deccan Basalt Province, India. In: W. D. West vol. Jour. Geol. Soc. Ind. Mem.No.38.

[9]Krishnana,M.S., 1960. Geology of India Burma.Highnbothams, Madras, pp. 604.

[10]SubbaRao, K.V., Chandrasekharam, D., Navaneethkrishnan, P. and Hooper, P.R., 1994. "Stratigraphy and structure of parts of the Central Deccan Basalt Province, Eruptive Models.Volcanism (Radhakrishnamurthy volume)," Wiley Eastern Limited, Bombay pp. 321-332.