Geochemical evolution of basaltic flows from Dongargarh Supergroup, Bastar Craton, Central India

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Abstract. Composition of basalts in magmatic arcs influenced by the subducting lithosphere, mantle wedge, dehydration of oceanic crust, and/or crustal assimilation beneath the arc. In this paper, we compiled earlier published geochemical data of Dongargarh basalts to decipher the genesis of volcanic rocks. SiO₂ vs (FeO + MgO) plot of basalt suggests the volcanic rocks are tholeiitic in composition. Primitive mantle and REE normalized plots indicate either the source was enriched mantle or a possible interaction of depleted magmatic source with the Paleoarchean continental crust in the Bastar Craton. The primitive mantle normalized diagram shows a negative anomaly of Nb, Ti, and Ta indicates subduction-related magmatism. In addition to the basalt composition, variation diagrams for tectonic setting represent the continental arc-related magmatism. From the available geochemical data of basalts and earlier studies on Dongargarh volcanic, there was an oceanic ridge that was subducted beneath the continental plate. The source of Pitepani basalts was significantly enriched in HFSE and REE as compared to mid-oceanic basalts. Thus the study finds the volcanic rocks are part of enriched mantle source that formed in the subduction-related magmatism.

Keywords: Bastar Craton, Dongargarh Supergroup, Dongargarh volcanics, Basalt, Kotri-Dongargarh Mobile Belt.

1. Introduction

Mafic volcanic are found intercalated with granites in the Bastar Craton. This type of mafic-felsic volcanic intercalations with granitoids was more frequent during the Archean and early Proterozoic periods. The Neoarchean-Paleoproterozoic Kotri-Dongargarh mobile belt (KDMB) in the central part of the Bastar craton is considered to be composed predominantly of bimodal volcanism, volcano-sedimentary units and granitoids [4][23]. Different tectonic models have been proposed by earlier workers and considered these rock suites as a key factor in the construction of geotectonic models of KDMB [2][10][16][19][24][25][34]. An intra-cratonic rift model given for the evolution of Dongargarh Supergroup by Neogi et al. [19] and references therein, a subduction-related arc-magmatism model for KDMB has been proposed by Asthana et al. [3], Khanna et al. [10], and Santosh et al. [25]. The geochemical signature of boninite dykes from the Dongargarh Supergroup also gives the subduction-related characteristics [8]. Large igneous provinces model for the emplacement of Paleoproterozoic lamproites dykes [24] and mafic dyke swarms and mantle-derived mafic magmatism [31] in rift environment which was possibly induced by the plume.

According to proposed tectonic models and earlier published geochemical data, the KDMB may represent a complex tectonic evolution. Geochemical study of the mafic/basaltic flows from the Dongargarh Supergroup may provide crucial evidence in the evolution of KDMB and the Baster Craton. In this study, we assembled earlier published geochemical data of major basaltic flows from the Bastar
craton including Pitepani, Sitagota, Mangikhuta and Kotima formation of Dongargarh Supergroup. The study aimed to find a possible magmatic source of basaltic flows in the Dongargarh Supergroup and to propose a possible magmatic source and geochemical evolution of KDMB based on geochemical attributes.

2. Geological setting

Bastar Craton lies in the central part of the Indian shield and the boundaries of the craton are bordered by two mobile belts and two rifts/grabens. The northwestern and southeastern boundaries of the craton are bounded by Satpura Mobile Belt also known as Central Indian Tectonic Zone (CITZ) and Eastern Ghats Mobile Belt (EGMB). The Mahanadi graben defines the northeastern fringe of the craton and the Godavari graben demarcates the southwestern boundary of the craton. The Bastar Craton is composed mainly of five major tectonic belts: Sausar-Chilpi belt, Bengpal-Sukma belt, Sonakhan belt, Amgaon belt and Kotri-Dongargarh belt flanked the northern, southern, eastern, western and central part of the craton and three supracrustal sequences: Dongargarh suite, Sakoli suite and Sausar suite [24]. The oldest group among five belts is Bengal and Sukma group [22][26] and the Chilpi group represents the youngest age [17][18]. The gneissic complex is considered as the basement of the craton which essentially comprises tonalite-trondhjemite gneisses (TTG) and granites with paleo-archaean to neoproterozoic age [7][22][27].

The Kotri-Dongargarh belt is the north-south trending tectonic belt located at the central part of Bastar Craton and consisting of various cycles of volcanism and sedimentation [6][28]. The granitic plutons, intercalated volcanic and sedimentary sequences, and gneissic rocks are collectively considered as Dongargarh Supergroup located in the northwestern flank of the Bastar Craton [18]. The rocks of the Dongargarh Supergroup evolved in the Sitagota syncline [27] and the Amgaon group represented as the basement for the volcano-sedimentary sequence [19]. The Dongargarh Supergroup has been subdivided into two distinct lithostratigraphic successions: Nandgaon Group and Khairagarh Group, and the Dongargarh granites stratigraphically divides the older Nandgaon and younger Khairagarh Groups [3][6][19]. Nandgaon Group is composed of bimodal volcanism: the Bijli rhyolites and Pitepani mafic volcanic. Pitepani volcanic flows are typically composed of basalts, andesite and basaltic andesites. Manikyamba et al. [14] proposed that the Bijli rhyolites (ages of 2479 Ma and 2463 Ma), Dongargarh granites (age of 2465 Ma), and Pitepani volcanic (age of 2471 Ma by Asthana et al. [3]) shows a contemporaneous evolution. The Khairagarh group is composed of three volcanic and three sedimentary intercalated sequences. The lowermost sedimentary sequence is the Bortalao formation and is composed of sandstone and/or conglomerates. The volcanic sequence overlying the Bortalao formation is Sitagota basalts. Sitagota basalt is overlain by a sedimentary sequence of quartz arenite named as Karutola formation. Mangikhuta basalt and/or basaltic-andesite formation underlain by Karutola formation. The overlying Ghogra formation is consisting of sub-arkosic arenite. The uppermost sequence of the Dongargarh Supergroup is the Kotima basalts. The detrital U-Pb zircon maximum depositional ages of sedimentary sequences of the Khairagarh group are reported as 2463 Ma for Bortalao formation, 2453 Ma for Karutola formation, and 2210 Ma for Ghogra formation [10]. The Khairagarh group is unconformably overlain by the Chilpi group of rocks.

3. Result and Discussion

The present study involves the compilation and comparison of previously published geochemical data of basaltic flows from the Northern and Central parts of the Bastar Craton and Central Dongargarh Orogen (CDO). Basaltic flows of Pitepani, Sitagota, Mangnikhutta, and Kotima belong to Central Dongargarh Orogen and the whole rock data are compiled from Khanna et al. [10] and Neogi et al. [19]. Geochemical data of basaltic flows from central parts of Bastar Craton taken from Srivastava et al. [31].


Representative geochemical data of basalts and basaltic-andesites are taken from Srivastava et al. [32] that belongs to the northern and central parts of the Bastar Craton.

**Table 1(a).** Representative whole-rock analysis of Basalts from Central Dongargarh Orogen, Bastar Craton

| Trace elements | Central Bastar Craton | Northern and Central Bastar Craton |
|----------------|-----------------------|-----------------------------------|
|                | RK1 | RK2 | RK3 | RK4 | RK5 | RK6 | RS1 | RS2 | RS3 |
| SiO₂           | 49.33 | 49.30 | 52.02 | 50.48 | 48.80 | 51.32 | 50.16 | 48.57 | 48.84 |
| TiO₂           | 0.99 | 0.33 | 0.58 | 0.49 | 0.93 | 0.57 | 1.36 | 1.01 | 1.15 |
| Al₂O₃          | 14.99 | 15.15 | 13.17 | 14.35 | 14.17 | 11.23 | 15.46 | 13.25 | 13.97 |
| Fe₂O₃          | 13.48 | 10.12 | 11.50 | 11.25 | 14.96 | 13.28 | 15.28 | 15.56 | 15.38 |
| MnO            | 0.18 | 0.16 | 0.17 | 0.17 | 0.20 | 0.18 | 0.19 | 0.21 | 0.21 |
| MgO            | 6.64 | 8.45 | 7.40 | 8.01 | 6.64 | 10.51 | 3.25 | 6.70 | 6.08 |
| CaO            | 10.62 | 10.64 | 9.66 | 11.40 | 9.60 | 8.42 | 8.92 | 10.69 | 10.14 |
| Na₂O           | 2.15 | 2.50 | 2.15 | 1.72 | 2.36 | 1.59 | 2.81 | 1.70 | 2.21 |
| P₂O₅           | 0.12 | 0.08 | 0.08 | 0.07 | 0.13 | 0.12 | 0.18 | 0.07 | 0.12 |
| K₂O            | 0.44 | 0.66 | 0.97 | 0.44 | 1.02 | 1.21 | 0.46 | 0.34 | 0.29 |
| Total          | 98.94 | 97.39 | 97.70 | 98.38 | 98.81 | 98.43 | 98.07 | 98.10 | 98.39 |
Table 1(b). Representative whole-rock analysis of Basalts from Central Dongargarh Orogen, Bastar Craton

| Major oxides | Northern and Central Bastar Craton | Central Dongargarh Orogen |
|--------------|-----------------------------------|--------------------------|
| SiO$_2$      | 49.10                             | 48.83                    |
| TiO$_2$      | 1.25                              | 1.30                     |
| Al$_2$O$_3$  | 14.02                             | 13.47                    |
| Fe$_2$O$_3$  | 15.30                             | 15.53                    |
| MnO          | 0.21                              | 0.21                     |
| MgO          | 5.92                              | 5.11                     |
| CaO          | 9.26                              | 9.60                     |
| Na$_2$O      | 2.12                              | 2.33                     |
| P$_2$O$_5$   | 0.13                              | 0.14                     |
| K$_2$O       | 0.57                              | 0.65                     |
| Total        | 97.88                             | 96.47                    |
| Trace elements |                                  |                          |
| Cr           | 120.00                            | 80.00                   |
| Ni           | 100.00                            | 60.00                   |
| Rb           | 46.00                             | 25.00                   |
| Ba           | 140.00                            | 181.00                  |
| Sr           | 147.00                            | 154.00                  |
| Nb           | 5.00                              | 4.00                    |
| Ta           | 0.40                              | 0.20                    |
| Zr           | 87.00                             | 90.00                   |
| Hf           | 2.30                              | 2.30                    |
| Y            | 27.00                             | 25.00                   |
| Ga           | 17.00                             | 18.00                   |
| Th           | 1.10                              | 1.20                    |
| U            | 0.30                              | 0.30                    |
| La           | 8.20                              | 9.70                    |
| Ce           | 18.50                             | 21.80                   |
| Pr           | 2.58                              | 3.04                    |
| Nd           | 11.80                             | 12.50                   |
| Sm           | 3.40                              | 3.60                    |
| Eu           | 1.12                              | 1.23                    |
| Gd           | 4.30                              | 4.60                    |
| Tb           | 0.80                              | 0.80                    |
| Dy           | 4.90                              | 5.20                    |
| Ho           | 1.10                              | 1.10                    |
| Er           | 3.00                              | 3.20                    |
| Tm           | 0.47                              | 0.48                    |
| Yb           | 3.10                              | 3.10                    |
| Lu           | 0.47                              | 0.49                    |
Table 1(c). Representative whole-rock analysis of Basalts from Central Dongargarh Orogen, Bastar Craton

| Major oxides | KS4 | KM1 | KM2 | KM3 | KM4 | KK1 | KK2 | KK3 | KK4 |
|--------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| SiO₂         | 49.20 | 48.18 | 49.43 | 52.65 | 51.64 | 52.43 | 50.97 | 49.92 | 52.10 |
| TiO₂         | 1.19  | 0.65  | 0.71  | 0.78  | 0.81  | 0.71  | 0.65  | 0.62  | 0.86  |
| Al₂O₃        | 12.96 | 15.69 | 15.96 | 16.92 | 16.27 | 12.63 | 12.30 | 10.78 | 12.74 |
| Fe₂O₃        | 15.49 | 13.78 | 13.39 | 10.77 | 12.04 | 12.24 | 13.12 | 12.42 | 12.87 |
| MnO          | 0.20  | 0.15  | 0.15  | 0.13  | 0.14  | 0.17  | 0.19  | 0.16  | 0.19  |
| MgO          | 8.71  | 11.10 | 9.74  | 7.55  | 7.78  | 11.99 | 10.63 | 9.54  | 9.27  |
| CaO          | 9.52  | 7.61  | 7.14  | 7.96  | 7.89  | 6.17  | 8.52  | 14.63 | 8.14  |
| Na₂O         | 2.24  | 1.33  | 1.51  | 1.66  | 1.68  | 2.98  | 2.56  | 1.21  | 3.01  |
| K₂O          | 0.12  | 0.07  | 0.08  | 0.10  | 0.10  | 0.09  | 0.07  | 0.09  | 0.10  |
| K₂O          | 0.41  | 1.44  | 1.90  | 1.48  | 1.57  | 0.58  | 0.98  | 0.64  | 0.72  |
| Total        | 100.04 | 100.00 | 100.01 | 100.00 | 99.92 | 99.99 | 99.99 | 100.01 | 100.00 |

Trace elements

|         | Cr    | Ni    | Rb    | Ba    | Sr     | Nb     | Ta     | Zr     | Hf     | Y      | Ga     | Th     | U      | La     | Ce     | Pr     | Nd     | Sm     | Eu     | Gd     | Tb     | Dy     | Ho     | Er     | Tm     | Yb     | Lu     |     |
|---------|-------|-------|-------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| KS4     | 234.00 | 179.00 | 14.00 | 183.00 | 4.00   | 0.25   | 98.00  | 2.60   | 34.00  | 18.00  | 14.00  | 2.00   | 0.70   | 10.91  | 24.41  | 3.31   | 13.96  | 3.85   | 1.25   | 4.65   | 0.83   | 5.36   | 1.23   | 3.41   | 0.54   | 3.68   | 0.58   |
| KM1     | 946.00 | 183.00 | 47.00 | 75.00  | 5.10   | 0.35   | 83.00  | 2.50   | 16.00  | 14.00  | 4.00   | 4.00   | 1.30   | 16.88  | 33.73  | 4.06   | 15.23  | 3.16   | 0.74   | 2.73   | 0.41   | 2.42   | 0.53   | 1.45   | 0.22   | 1.55   | 0.24   |
| KM2     | 851.00 | 163.00 | 57.00 | 110.00 | 5.80   | 0.42   | 92.00  | 2.70   | 17.00  | 15.00  | 4.30   | 4.30   | 1.40   | 17.11  | 35.51  | 4.31   | 16.25  | 3.41   | 0.75   | 2.91   | 0.44   | 2.62   | 0.56   | 1.53   | 0.23   | 1.63   | 0.25   |
| KM3     | 209.00 | 74.00  | 71.00 | 131.00 | 6.40   | 0.44   | 109.00 | 2.80   | 19.00  | 15.00  | 4.30   | 4.50   | 2.60   | 17.90  | 35.11  | 4.18   | 15.00  | 3.06   | 0.82   | 3.34   | 0.50   | 3.02   | 0.65   | 1.72   | 0.27   | 1.63   | 0.27   |
| KM4     | 196.00 | 69.00  | 71.00 | 132.00 | 5.80   | 0.42   | 92.00  | 2.60   | 17.00  | 13.00  | 4.50   | 4.90   | 1.10   | 15.73  | 32.60  | 3.95   | 14.12  | 2.81   | 0.76   | 3.09   | 0.45   | 2.82   | 0.61   | 1.60   | 0.25   | 1.65   | 0.26   |
| KK1     | 308.00 | 82.00  | 67.00 | 173.00 | 1.70   | 0.12   | 39.00  | 1.20   | 11.00  | 8.00   | 4.90   | 4.90   | 1.50   | 7.24   | 14.61  | 1.87   | 7.35   | 1.60   | 0.57   | 1.84   | 0.29   | 1.76   | 0.39   | 1.83   | 0.61   | 1.50   | 0.17   | 1.60   |
| KK2     | 456.00 | 130.00 | 25.00 | 133.00 | 2.10   | 0.17   | 52.00  | 1.50   | 13.00  | 12.00  | 1.50   | 1.50   | 1.00   | 8.08   | 16.84  | 2.09   | 7.88   | 1.58   | 0.20   | 2.50   | 0.17   | 1.50   | 0.40   | 1.40   | 0.95   | 12.65  | 1.40   | 1.58   |
| KK3     | 777.00 | 206.00 | 12.00 | 111.00 | 2.50   | 0.17   | 56.00  | 1.50   | 12.00  | 9.00   | 1.50   | 1.50   | 1.00   | 5.95   | 16.84  | 1.65   | 6.49   | 2.21   | 0.40   | 2.70   | 0.32   | 2.11   | 0.40   | 1.60   | 0.66   | 2.38   | 2.11   | 2.21   |
| KK4     | 217.00 | 67.00  | 13.00 | 195.00 | 2.70   | 0.17   | 65.00  | 1.60   | 15.00  | 14.00  | 1.40   | 1.40   | 1.00   | 8.52   | 18.43  | 1.65   | 9.54   | 2.21   | 0.40   | 2.70   | 0.32   | 2.51   | 0.40   | 2.51   | 0.66   | 2.38   | 2.51   | 2.51   |
Table 1(d). Representative whole-rock analysis of Basalts from Central Dongargarh Orogen, Bastar Craton

|          | NP1  | NP2  | NP3  | NS1  | NS2  | NS3  | NM1  | NM2  |
|----------|------|------|------|------|------|------|------|------|
| Major oxides |      |      |      |      |      |      |      |      |
| SiO₂     | 54.87| 54.38| 51.80| 50.77| 49.80| 50.41| 53.09| 51.77|
| TiO₂     | 0.55 | 0.55 | 0.52 | 0.91 | 0.87 | 0.56 | 0.57 | 0.58 |
| Al₂O₃    | 12.69| 12.69| 12.72| 13.97| 14.36| 13.35| 13.22| 13.00|
| Fe₂O₃    | 8.68 | 8.70 | 9.44 | 11.55| 11.60| 9.37 | 9.88 | 10.65|
| MnO      | 0.17 | 0.16 | 0.16 | 0.18 | 0.18 | 0.15 | 0.15 | 0.17 |
| MgO      | 7.69 | 7.95 | 9.51 | 6.84 | 9.52 | 9.86 | 6.53 | 6.62 |
| CaO      | 10.03| 10.06| 9.81 | 9.93 | 9.52 | 9.86 | 6.53 | 6.62 |
| Na₂O     | 2.15 | 1.95 | 1.73 | 2.08 | 2.64 | 2.47 | 1.41 | 1.42 |
| P₂O₅     | 0.14 | 0.15 | 0.06 | 0.13 | 0.11 | 0.06 | 0.09 | 0.09 |
| K₂O      | 1.20 | 1.16 | 1.41 | 0.98 | 0.34 | 0.87 | 1.92 | 1.28 |
| Total    | 98.17| 97.75| 97.16| 97.34| 96.47| 96.40| 95.82| 95.25|
| Trace elements |      |      |      |      |      |      |      |      |
| Cr       | 474.00| 469.00| 533.00| 240.00| 111.00| 389.00| 512.00| 409.00|
| Ni       | 101.00| 99.00| 171.00| 120.00| 144.00| 143.00| 184.00| 190.00|
| Rb       | 44.00 | 43.00| 52.00| 25.00 | 7.00 | 22.00 | 54.00 | 36.00 |
| Ba       | 318.00| 297.00| 206.00| 176.00| 47.00 | 183.00| 410.00| 283.00|
| Sr       | 296.00| 304.00| 134.00| 132.00| 139.00| 154.00| 109.00| 71.00 |
| Nb       | 6.00  | 6.00 | 6.00 | 4.00 | 4.00 | 4.00 | 7.00 | 8.00 |
| Zr       | 92.00 | 92.00| 43.00| 73.00 | 68.00| 46.00 | 86.00 | 85.00 |
| Hf       | 2.00  | 2.00 | 2.00| 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Y        | 18.00 | 16.00| 16.00| 26.00 | 25.00| 16.00 | 19.00 | 20.00 |
| Th       | 5.20  | 5.20 | 1.30 | 1.30 | 1.20 | 1.20 | 6.20 | 6.10 |
| U        | 1.50  | 1.50 | 1.50| 2.50 | 0.50 | 0.50 | 2.50 | 2.00 |
| La       | 21.00 | 21.00| 5.50 | 8.50 | 7.50 | 6.00 | 18.00 | 17.00 |
| Ce       | 37.00 | 37.00| 37.00| 17.00| 16.00 | 13.00| 32.00 | 33.00 |
| Nd       | 13.00 | 13.00| 3.00 | 9.00 | 6.00 | 3.00 | 11.00 | 11.00 |
| Sm       | 3.20  | 3.20 | 1.60 | 2.80 | 2.40 | 1.70 | 2.80 | 2.80 |
| Eu       | 0.75  | 0.80 | 0.40 | 0.90 | 0.90 | 0.60 | 0.70 | 0.60 |
| Tb       | 0.20  | 0.20 | 0.50 | 0.80 | 0.40 | 0.20 | 0.50 | 0.80 |
| Yb       | 1.50  | 1.70 | 1.50| 2.60 | 2.40 | 1.70 | 1.70 | 1.80 |
| Lu       | 0.20  | 0.20 | 0.20| 0.35 | 0.35 | 0.20 | 0.25 | 0.25 |
SiO$_2$ ranges from 48-54 wt%, Fe$_2$O$_3$ from 8-16 wt%, MgO shows a little wide range from 3-15 wt% and Al$_2$O$_3$ from 11-15 wt%. Based on the Ti-content of the studied Basalts, these are subdivided into two groups; low-Ti basalts having Ti < 0.9 wt% and relatively high-Ti basalts having Ti > 0.9 wt% [1][10][13]. The plot of compiled data are showing the composition of basalt to basaltic-andesite in composition, lying in the sub-alkaline field in the total alkalis versus silica (TAS) diagram (Figure 1). REE pattern of all samples on chondrite normalized (Figure 3.a) plot shows a significant enrichment of LREE as compared to HREE concentration. A strong negative of Nb, Ta and variable negative P, Ti anomalies are also recognized relative to neighbouring elements on primitive mantle normalized spider plots (Figure 3.b).

Basaltic flows in Dongargarh Belt collectively represents tholeiitic composition. Khanna et al. [10] described that Mangikhuta and Kotima basalts are high in Mg#, and low in FeO*, TiO$_2$, Y and Yb as relative to Pitepani basalts. Asthana et al. [3] categorised the Pitepani suits as high-Mg, low-Ti suits and low-Mg, high-Ti suits. Whereas Sitagota basalts show a wider range in concentration of these elements and can be grouped into high-Ti basalts and low-Ti basalts [1][10][13].

Figure 1. Total alkali versus silica (TAS) diagram [12] showing basalt to the basaltic-andesite composition for the studied basalts.

Figure 2. a. Chondrite normalized REE diagram [33], b. Primitive mantle normalized diagram [33] for basaltic flows of Bastar Craton.

Several mafic dykes in the Bastar Craton [30][31] and Dongargarh volcanic magmatism [19] were emplaced in rift setting. Srivastava et al. [31] and Santosh et al. [25] proposed that the emplacement of these mafic dykes in intra-cratic rift setting were influenced by the plume. Crustal contamination was involved in the generation of some basalts in the Bastar Craton. Initial εNd and εHf values and mantle normalized diagram for basaltic flows of Dongargarh suggest the possible source of basaltic volcanism was generated either through the blending of the depleted mantle and enriched mantle source [10][19].
or crustal contamination of melt generated during subduction [10][25]. Low-Mg and high-Ti basalts of Pitepani represents that its magmatic source is crustal contaminated [3].

Negative Nb anomaly and low Nb/Th ratio with relatively high LREE in the composition of basaltic rocks despite geological age (e.g., subduction-related basaltic magmatism in Archean time by Smithies et al. [29], Hoffmann et al. [9], Khanna et al. [11], and in Phanerozoic time by Yogodzinski et al. [35] are suggestive of subduction-related arc magmatism. The chondrite normalized and primitive mantle normalized data of mafic and ultramafic volcanic from the Dongargarh belt shows subduction-related magmatism in arc settings [25].
By comparing all the geochemical data of basaltic flows from central Dongargarh Orogen it is observed that strong depletion in Nb, Ta and Ti concentration relative to other trace elements of basaltic samples (K-series, N-series, RK-series and RS-series) on mantle normalized diagram (Figure 3. b) and shows a higher concentration of light-REE over heavy-REE on chondrite normalized diagram (Figure 3. a) marks the subduction-related magmatism for the basaltic flow of Central Dongargarh belt in the Baster Craton. Khanna et al. [10] mentioned that the mantle source of the Dongargarh basalts may modify by subduction derived components. The Nb/Yb and Th/Yb ratios (Figure 5. a) of compiled geochemical data represent that there was possible crustal contamination in the generation of basaltic magmatism of the Dongargarh Belt. Low TiO$_2$/Yb (≤ 0.8) and relatively high Nb/Yb (>1.0) values on Nb/Yb vs TiO$_2$/Yb plot (Figure 5. b) and REE plot represent the Dongargarh basaltic flows were formed from the fertile mantle source. On MgO vs TiO$_2$ plot (figure 4) all studied basalt samples clustered around two locus. One cluster of basalts showing high-Ti with low-Mg and another cluster of basalts representing low-Ti with high-Mg. Enrichment of Ti in group-II basalts may accompanied by crustal contamination of the basaltic source. As compared to mid-oceanic basalts and island arc basalts the within plate basalts have low concentrations of Mg, Fe, Ti and other compatible elements [5]. The Zr vs Ti plot (Figure 3) for the Dongargarh basalts indicate the samples are fall in the arc and MORB setting but the majority of the samples belong to the arc setting. It suggests that the basaltic magma generated in MOR to arc setting and the basaltic magmatism was not related to intra-plate eruptions.

4. Conclusion
Dongargarh basaltic flows can be categorized into two groups: Group-I basalts having High-Mg and Low-Ti, and Group-II basalts having Low-Mg and High-Ti. REE patterns and primitive mantle normalized plots of compilied geochemical data of basaltic flows represents the subduction-related magmatism and enriched mantle source. Zr vs. Ti discrimination diagram and Nb/Yb vs. Th/Yb ratios suggest that the basaltic melt generated in subduction environment and ascending melt may contaminate during magma-crust interaction.

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