



Data Article

Geochemistry data of the nadergul granodiorite of the late archean hyderabad granite batholith, part of eastern dharwar craton, india; implications for composition of the lower continental crust



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ABSTRACT

The Nadergul granodiorite (NG), is a part of Hyderabad Granite Batholith (HGB), exposed at ground level covering an area of 6 km². Field observational data suggests that the NG is involved in the magma mixing mingling process. Petrographical data shows holocrystalline, phaneritic, coarse grained, inequigranular, mesocratic characteristics, essentially consists of quartz, orthoclase, plagioclase and microcline. The common accessory minerals are hornblende, biotite, clinopyroxene, zircon, fluorite, apatite and opaque. The myrmekitic texture is the most common intergrowth texture which seems to be magmatic origin. Geochemical data suggest that the NG is metaluminous and show calc-alkaline trend. It is characterised by SiO₂ content ranging from 63.55 % to 64.54%, moderate alkali content (Na₂O + K₂O = 5.6%), relatively high MgO content ranging from 2.8 % to 3.5 %. The total CaO-Na₂O-K₂O content ranges from 9.5 % to 10.4 %. The normalised REE patterns show LREEs enrichment with slight negative europium anomaly. The High Field Strength Elements such as Zr (67.3 to 114.3 ppm), Y (21.1 to 30.1 ppm),

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Nb (6.3 to 8.5 ppm) and Th (8.4 to 13.8 ppm) are relatively enriched. The granodiorite is I type, falls in the Volcanic Arc Granitoid (VAG) field in tectonic discrimination diagram.

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Specifications table

Subject	Earth Sciences
Specific subject area	Geochemistry
Type of data	Table Image Figure
How data were acquired	Analysis of samples using XRF and ICP MS
Data format	Raw and analyzed
Parameters for data collection	Based on field, petrography and geochemistry data these rocks classified as granodiorites
Description of data collection	Field evidences, textural interpretation, and geochemical data set were determined https://data.mendeley.com/submissions/ees/edit/f44xvcsstk?submission_id=DIB_54032&token=5eeebb51-a692-4abb-9cea-d18d3027e48f
Data source location	Nadergul area, Hyderabad Granite Batholith, Eastern Dharwar Craton, India
Data accessibility	Data are available within this article https://data.mendeley.com/submissions/ees/edit/f44xvcsstk?submission_id=DIB_54032&token=5eeebb51-a692-4abb-9cea-d18d3027e48f

Value of the Data

- The data presents the geological map, field observations, petrography and geochemistry of the Nadergul granodiorite.
- This data can be used to classify and characterize the rock to understand their petrogenesis.
- The data can be used to better understand the geochemical composition of Hyderabad Granite Batholith of Eastern Dharwar Craton.
- The data allows others to work further and useful to correlate the crustal rocks to understand their origin and evolution.

1. Data Description

The data set of this article provides detailed geological map of the Nadergul and surrounding area (Fig. 1), field photographs (Fig. 2), Microphotographs (Fig. 3), Major oxide and trace elements data table (Table 1) and various geochemical plots; Fig. 4 a. Ab-An-Or diagram after O'Connor [12], b. Classification of igneous rocks after Middlemost [8], c. SiO₂ versus K₂O diagram after Maniar & Piccoli [7], d. AFM diagram [5], e. A/NK vs A/CNK diagram [7], f. K₂O versus Na₂O diagram. Fig. 5 SiO₂ Vs Major oxides and trace elements for variation diagrams. Fig. 6 a. Y+Nb vs. Rb discrimination diagrams [13], b. R1-R2 diagram [2], c. Primitive mantel normalized multi-element diagram [19], d. Chondrite normalized REE diagram [9]. Fig. 7 a. Ternary-Qz-Ab-Or-diagram-after-Blundy-Cashman [3], b. Rb-Sr binary diagram, refer to the crustal thickness (after [4]).

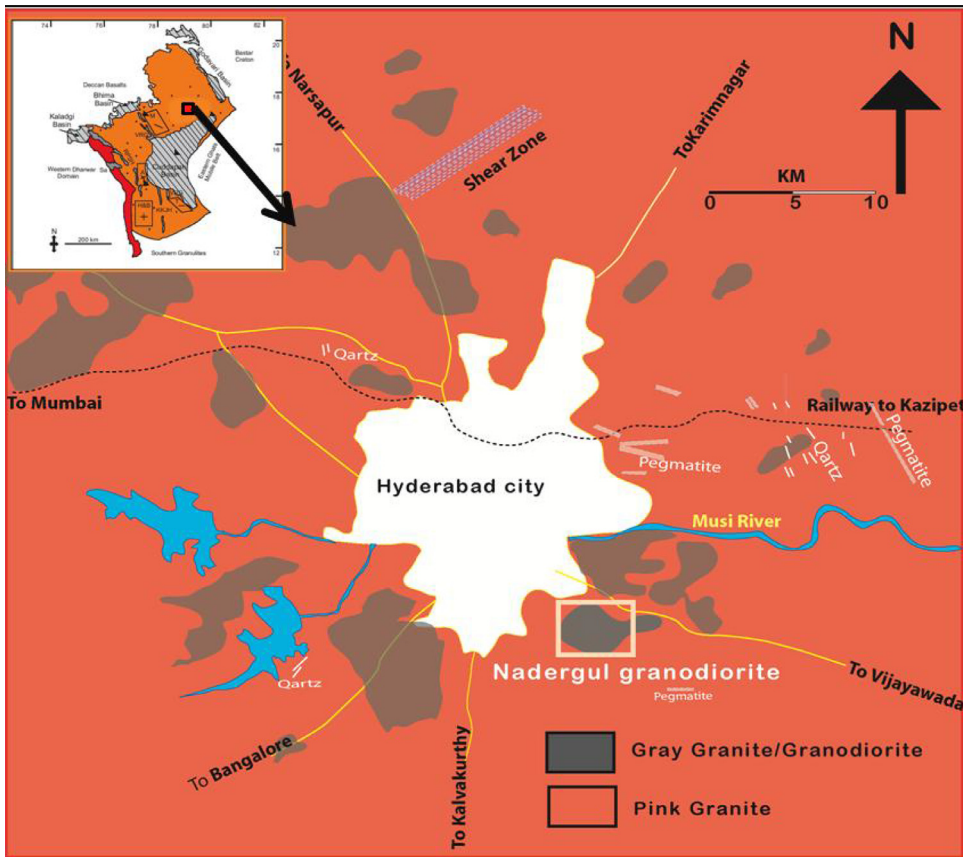


Fig. 1. Geological map of the Hyderabad Granite Batholith region showing the exposed late Archean granitoids and associated quartz and pegmatite veins.

2. Experimental Design, Materials, and Methods

Granitoids of late Archean (~ 2.7 to 2.5 Ga) are Na and Ca rich Tonalite-Trondhjemite-Granodiorites (TTGs) and high-Mg diorite suite. The TTGs are silica and alumina rich, large voluminous bodies occurred due to basalt partial melting [1]. The Mg rich diorites are silica poor, diorite to granodiorite in compositions, formed typically from the melts derived from mantle rocks. The Eastern Dharwar Craton (EDC) largely consists of these late Archean granitic intrusions into older TTG gneisses, greenstone belts and calc-alkaline rocks [6].

The Nadergul granodiorite (NG) is a part of the Hyderabad Granite Batholith (HGB), perhaps a largest granitic body occupies the northern part of EDC. The HGB contains variety of granitoids with grain size, color and textural variations. The profuse occurrence of aplites, quartzofelspathic veins and pegmatites are very common. This batholith is intracratonic, a known equivalent of 2.5Ga Closepet granite. Praveen et al. [15] classified the granitic rocks of HGB as aplites, granites, granodiorites, monzogranites, syenogranites, alaskites, etc., whereas Narshimha et al. [11] discussed the crystallization history of the K-rich granites suggested that the intergrowth textures (perthite) are of magmatic origin due to elevated temperatures for a longer time. Narshimha et al. [10] characterized the Proterozoic Punugodu granite occurred to the east of Cuddapah basin, and interpreted them as hypersolvus within plate anorogenic granites. Rama Rao et al [16] and Subba Rao and Suresh [18] inferred the HGB origin to fractional crystallization

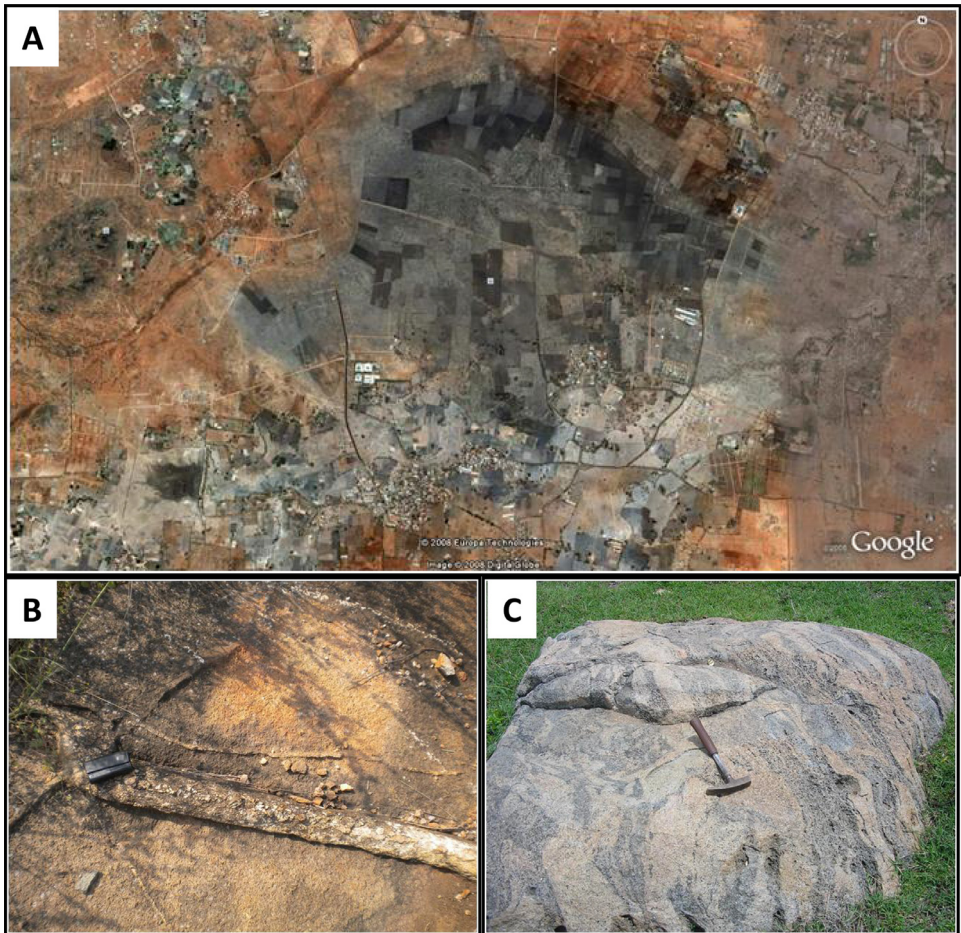


Fig. 2. A) Satellite Image of Nadergul area, Hyderabad showing the NG outcrop; B) Field photograph showing granite vein within the granodiorite; C) Field photograph showing melt generation and migration as evidenced by the presence of leucosomes and melanosomes entrapment.

of the melts, generated by lower crustal anatectic process. In continuation of that, we generated the date for NG, located in the Nadergul area of Hyderabad, produced field, petrography and geochemical data which is vital to characterize the rock and discuss its petrogenesis so as to link the tectonic evolution of EDC.

2.1. Field observations and Petrography

The NG rock is coarse grained, mesocratic, porphyritic, exposed at ground level over an area of 6 km² and bounded by pink granites. A typical granitic outcrop is shown in a satellite image in Fig. 2A. Granitic veins occurred within the NG body, show felsic nature, fine-medium grained rock consists quartz, orthoclase and plagioclase (Fig. 2B) with similar mineralogical characteristics to the surrounding granites. Magma mixing mingling characteristics are observed at contact margin of the NG body as evidenced by the presence of leucosomes and melanosomes entrapment (Fig. 2C). A total of 10 fresh samples were collected during the fieldwork. Petrographical

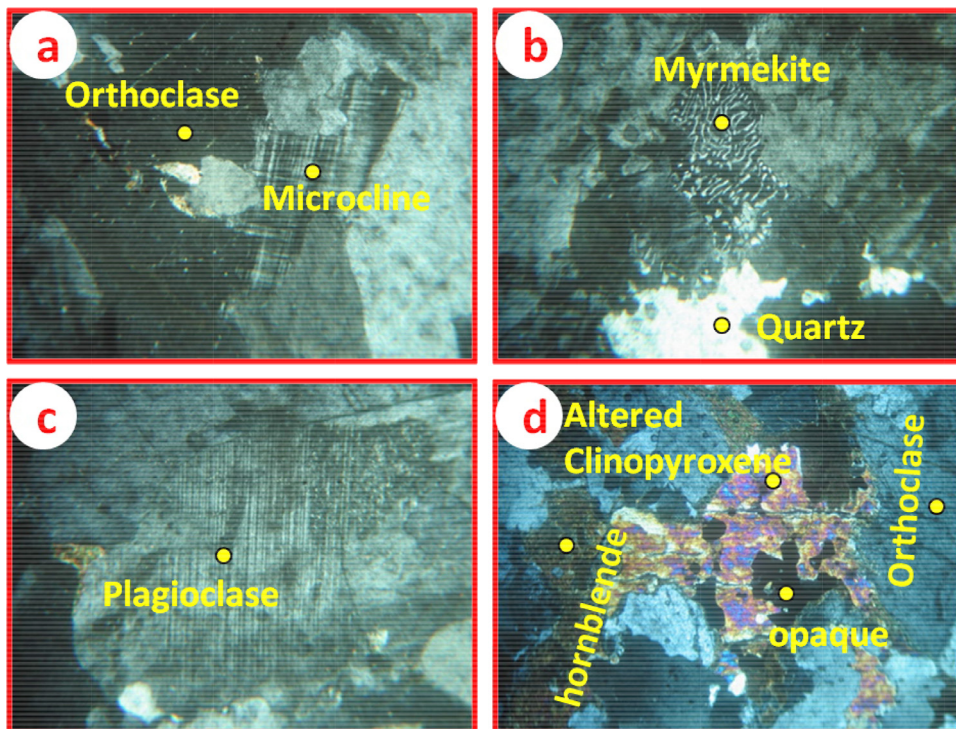


Fig. 3. Photomicrographs of Nadergul Granodiorite showing a) Microcline with tartan twinning and anhedral shape surrounded by Orthoclase; b) Myrmekite Intergrowth of quartz in altered plagioclase; c) Multiple albite twinning in altered plagioclase; d) Altered clinopyroxene associated with opaques and hornblende.

works were carried out in the department of Applied Geochemistry, Osmania University using Leica DM EP model petrological microscope. Petrographically, the NG consists of plagioclase, orthoclase and quartz as essential minerals whereas clinopyroxene, hornblende, biotite, apatite, fluorite, opaques, and zircons are accessory minerals. Microcline is anhedral show low relief, formed as interstitial grains with crosshatched twinning seems to crystallized at high temperature and inverted to triclinic structure (Fig. 3a). Myrmakite intergrowth of quartz in plagioclase is common textural feature of magmatic origin (Fig. 3b). Plagioclase is mostly euhedral coarse grained phenocryst surrounded by other essential and accessory minerals show the porphyritic textures. Very straight multiple twinning in plagioclase is typically primary twins (Fig. 3c). Sausuritization of plagioclase is common feature, indicating that Ca rich in plagioclase is higher temperature one, which is less stable than its counterpart at low temperatures. Quartz occurs as fine to medium grained, mostly anhedral showing undulatory extinction. Clinopyroxene is coarse grained with irregular shapes showing uralitization, whereas the hornblende and opaques show intimate association (Fig. 3d).

2.2. Geochemistry

Rock samples were crushed and pulverized to fine powders manually by using the agate mortar. Major and minor oxides were determined by using XRF, nearly 34 trace elements including REE were analysed using ICP-MS.

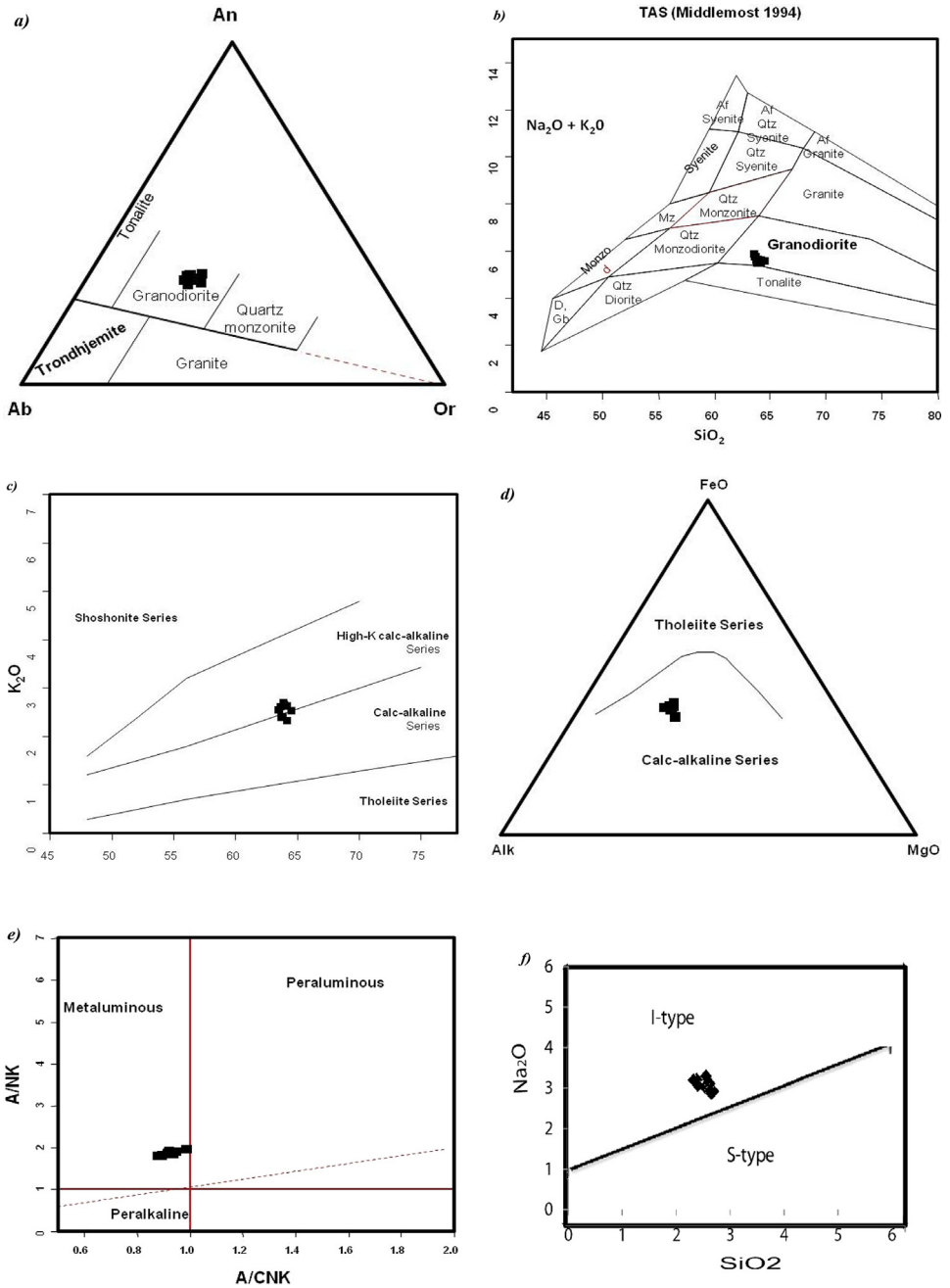


Fig. 4. a) Ab-An-Or diagram for NG samples showing the Granodiorite nature after O'Connor [12], b) Classification of igneous rocks after Middlemost [8]. Whereas the samples plot in the granodiorite field, c) SiO_2 versus K_2O diagram after Maniar & Piccoli [7] for NG, d) AFM diagram [5] showing the calc alkaline nature, e) A/NK vs A/CNK diagram [7] for NG depicting the Metaluminous nature, f) K_2O versus Na_2O diagram showing that NG samples plot in the I-type granite field.

Table 1

Major and rare element analyses of the Nadergul granodiorite samples

Sl. No Sample	1 NG-1	2 NG-2	3 NG-3	4 NG-4	5 NG-5	6 NG-6	7 NG-7	8 NG-B	9 NG-9	10 NG-10
Major Oxides (wt%)										
SiO ₂	64.5	63.9	63.9	63.8	63.7	63.8	64.2	63.6	64.2	64.0
Al ₂ O ₃	14.4	14.4	14.0	14.9	14.7	14.9	14.3	14.6	14.3	14.5
Fe ₂ O ₃	5.7	5.8	6.3	6.0	5.8	5.9	6.1	5.7	5.8	6.3
MnO	0.1	0.1	0.1	0.1	0.1	0.6	0.2	0.1	0.1	0.1
MgO	3.1	3.1	3.2	3.0	2.8	2.9	3.2	3.6	3.0	3.1
CaO	4.3	4.3	4.4	4.3	4.5	4.1	4.3	4.6	4.1	4.5
Na ₂ O	3.0	3.0	2.9	3.2	3.1	3.1	3.0	3.3	3.2	2.9
K ₂ O	2.5	2.6	2.7	2.4	2.6	2.4	2.6	2.6	2.3	2.7
TiO ₂	0.5	0.5	0.5	0.6	0.5	0.5	0.5	0.6	0.5	0.4
P ₂ O ₅	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total	98.4	98.0	98.3	98.4	98.1	98.5	98.5	98.8	97.7	98.7
Trace elements (ppm)										
Sc	9.8	10.4	11.0	9.9	10.4	10.0	10.3	11.0	9.6	11.0
V	56.4	50.9	50.6	48.5	49.8	56.0	51.3	50.8	49.0	50.3
Cr	22.2	20.0	23.4	22.1	18.9	22.7	20.8	23.0	21.9	19.2
Co	20.3	20.4	21.4	21.1	20.6	20.6	21.0	21.6	20.8	21.2
Xi	4.9	3.2	5.5	4.0	4.2	4.8	3.5	5.9	4.1	4.1
Cu	1.0	1.0	0.8	0.8	1.0	1.0	1.0	0.9	0.8	1.0
Zn	28.7	29.8	27.8	26.0	26.3	28.9	29.3	27.1	26.0	26.9
Ga	19.4	19.0	19.2	20.0	19.7	19.7	19.0	19.1	20.1	19.7
Rb	102.6	102.3	111.8	101.2	103.1	102.5	102.4	112.0	101.3	102.9
Sr	388.1	368.6	337.9	353.7	396.0	378.2	369.2	338.8	354.2	396.2
Y	21.1	22.6	30.2	27.8	23.4	21.3	22.6	30.0	28.0	23.6
Zr	67.3	96.8	72.0	114.4	67.5	67.4	96.9	72.2	114.0	67.5
Xb	7.5	7.8	8.5	8.1	6.7	7.5	7.9	8.4	8.1	6.4
Cs	0.9	0.9	0.8	0.7	0.7	0.8	0.9	0.8	0.7	0.7
Ba	1002.9	906.4	853.4	749.0	957.0	1000.0	906.4	862.0	752.0	962.1
La	40.8	39.6	42.0	43.8	40.6	42.0	40.1	42.9	44.0	40.6
Ce	76.3	75.3	83.6	83.6	78.4	76.5	75.5	83.6	83.5	78.3
Pr	8.2	8.2	9.3	9.1	8.7	8.2	8.2	9.3	9.1	8.8
Xd	32.5	33.2	37.9	36.5	35.2	32.6	33.2	38.0	36.9	35.5
Sm	5.9	6.4	7.3	6.8	6.6	5.6	6.4	7.3	6.7	6.7
Eu	1.5	1.4	1.3	1.3	1.6	1.5	1.4	1.3	1.4	1.6
Gd	5.3	5.4	6.4	5.9	5.6	5.3	5.6	6.4	5.9	5.6
Tb	0.7	0.7	0.9	0.8	0.7	0.7	0.7	0.9	0.8	0.7
Dy	3.7	3.9	5.1	4.7	4.1	3.7	3.9	5.0	4.5	4.0
Ho	0.4	0.4	0.6	0.5	0.4	0.4	0.4	0.6	0.5	0.4
Er	1.3	1.5	1.9	1.8	1.5	1.3	1.4	1.8	1.8	1.5
Tin	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Yb	1.5	1.7	2.3	2.1	1.7	1.5	1.8	2.4	0	1.9
Lu	0.2	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Hf	2.0	2.8	2.1	3.3	2.0	2.0	2.8	2.1	3.3	1.9
Ta	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.2
Pb	17.2	17.3	19.8	19.4	18.3	17.2	17.4	19.8	19.4	18.2

Geochemical data of Nadergul porphyritic granodiorite presented in Table 1. The data show that SiO₂ content of samples are ranging 63.5 - 64.5% with an average 63.9%; alkali content (Na₂O + K₂O) 5.5 - 5.7%; CaO contents are 4.13 - 4.64%. These major contents are indicative of high-K calc-alkaline type. Al₂O₃ contents are 14.0-14.85% with aluminium saturation index A/CNK ranging 0.89 - 0.98%. In the feldspar triangle [12] Ab-An-Or diagram and total alkalis Vs silica (TAS) diagram [8] the NG samples plot in the field of granodiorite (Figs. 4a & b). In the SiO₂ vs. K₂O diagram of Peccerillo & Taylor [14] their compositions range falls in the field of high-K calc-alkaline series to calc-alkaline series at relatively high K₂O content averaging 2.54% (Fig. 4c). The NG samples in AFM diagram [5] is also exhibiting the calc alkaline nature (Fig. 4d). When plotted in A/CNK-A/NK diagram [17], samples occupy the metaluminous field (Fig. 4e). Further-

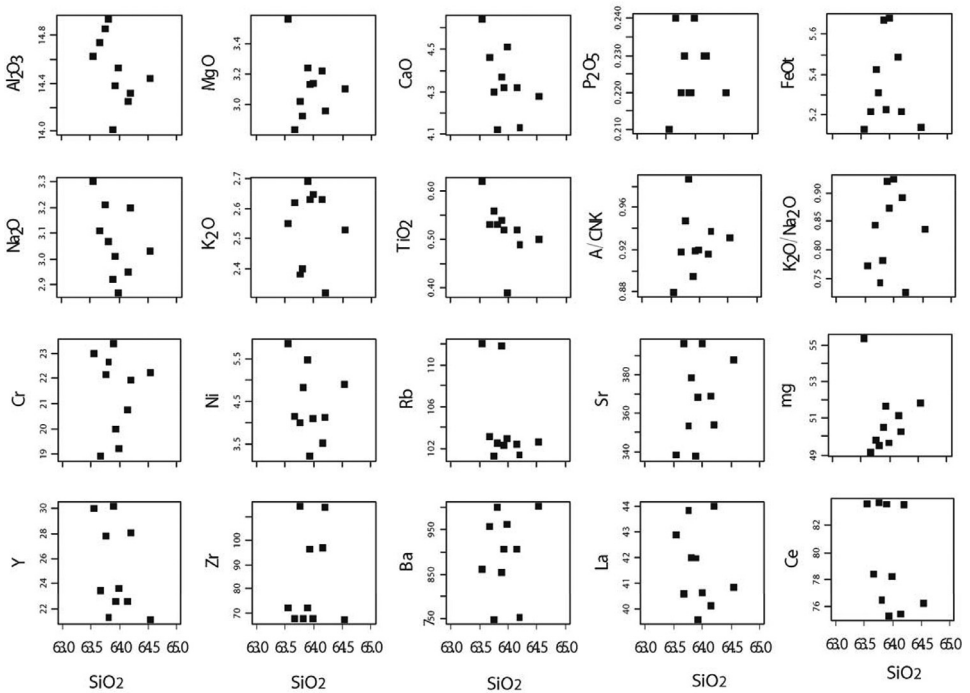


Fig. 5. SiO_2 Vs Major oxides and trace elements for variation diagrams of Nadargul Granodiorite

more, the moderate concentrations of MgO (avg. 3.1wt%), CaO (avg. 4.3wt%) and Fe_2O_3 (avg. 5.9 wt%) are characteristic for an acidic magma as source. The presence of biotite as one of the main mafic mineral, high concentration of quartz, orthoclase feldspar, albite and smaller amounts of mafic minerals like hornblende and pyroxene indicate an acidic magma as the source. When plotted on K_2O versus Na_2O diagram that the NG showing I-type character as they fall in the I-type granite field (Fig. 4f).

Harker variation diagrams (Fig. 5) for Nadargul granodiorite show that CaO , Na_2O , Al_2O_3 , TiO_2 , and P_2O_5 decreasing linear trends suggesting crystal fractionation of biotite, hornblende, pyroxene, plagioclase, titanomagnetite and apatite. K_2O , MgO , P_2O_5 , FeO showing increasing trends as SiO_2 increases. Moreover, decreasing is not well defined but is marked by scatter reflected plagioclase fractionation as well as melts contamination. SiO_2 vs Na_2O shows a negative trend. Overall the major oxide data of the samples in Harker variations diagrams show different behavior, where one group fairly showing clear trends, the others are scattered along the poorly defined trend, indicating the crustal contamination of the magma. On the other hand, most of the trace elements are scattered showing no relation with SiO_2 , except Ba and Sr with positive trends, and Ce, La and Y having slightly negative trends. These features also indicate possible contamination of magma during fractionation.

The NG rocks are exclusively of I-type, as indicated by SiO_2 vs Zr and K_2O vs Na_2O discrimination diagrams. On the Rb vs Y+Nb, Y vs Nb, Rb vs Ta+Nb and Ta vs Yb tectonic discrimination diagram of Pearce et al [13], the samples fall in the Volcanic Arc Granite (VAG) field (Fig. 6a), indicating magmatic arc setting. The binary variation diagram $R1=4\text{Si}-11(\text{Na}+\text{K})-2(\text{Fe}+\text{Ti})$ vs $R2= -6\text{Ca}+2\text{Mg}+\text{Al}$ (after [2]) indicating that the granodiorite are belongs to pre-plate collision setting (Fig. 6b). Comparison of abundance patterns of the samples show rich in Large Ion Lithophile elements (LILE) and depleted in High Field Strength Elements (HFSE). The NG granodiorite shows Nb, Ce, Sr, Zr, Ti negative anomalies whereas Rb, Th, K and Pb elements positive

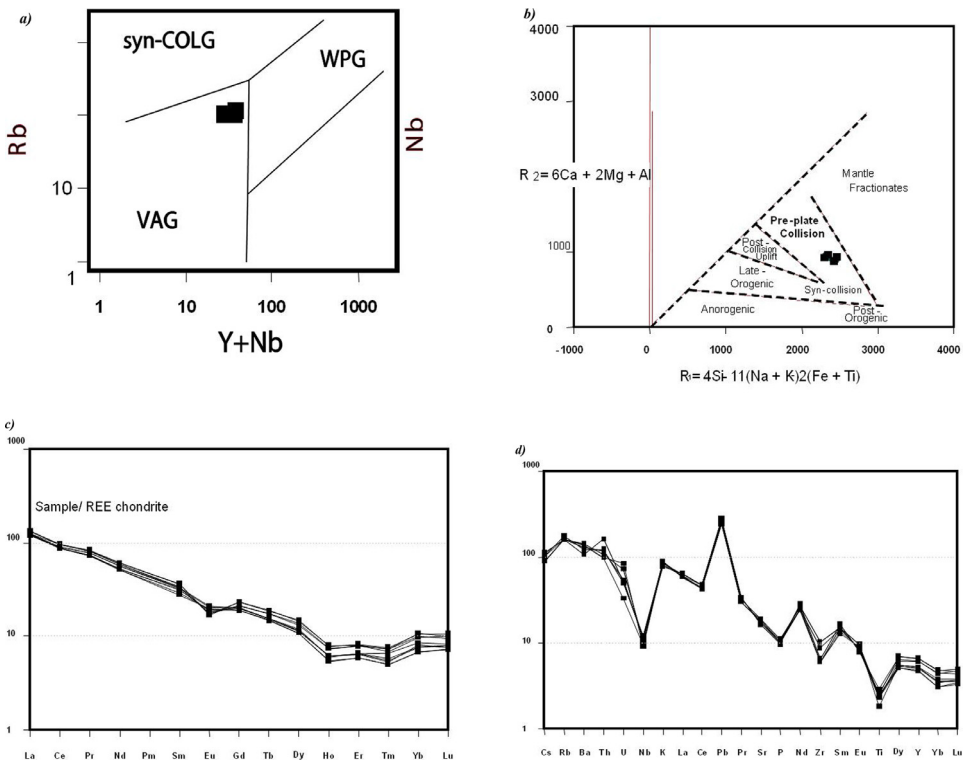


Fig. 6. a) Y+Nb vs. Rb discrimination diagrams [13], showing the tectonic setting of Nadergul granitoids, b) R1-R2 diagram [2] depicting the position of the NG, c) Primitive mantle normalized multi-element diagram [19], d) Chondrite normalized REE diagram for NG [9].

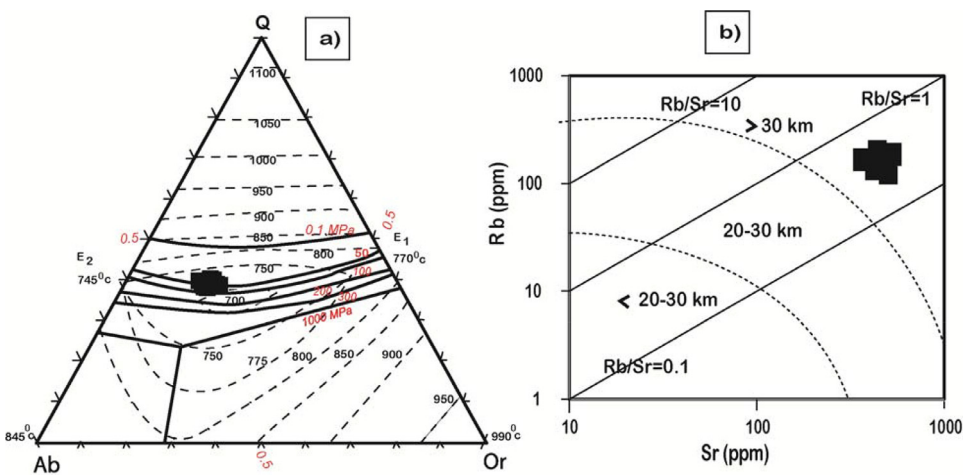


Fig. 7. a) Ternary-Qz-Ab-Or-diagram-after-Blundy-Cashman [3] showing the crystallization temperatures for NG samples, b) Rb-Sr binary diagram, the dashed lines refer to the crustal thickness (after [4]).

anomalies (Fig. 6d). The negative Nb anomaly is suggesting the involvement of crustal material in the magmatic processes. The chondrite normalised Rare Earth elements patterns for the granodiorite show enriched Light Rare Earth elements (LREE) with respect to the Heavy Rare Earth elements (HREE), with well defined, negative Ti, Nb and Zr anomalies, may be due to contamination or mixing of lower crustal melts by upper crustal material (Fig. 6c). The slightly Eu, Ba and Sr negative anomalies indicate a less fractionation of plagioclase.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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