Research Paper Geology

# Occurrence, Mineralogical Characteristics And Classification of the Granites and Associated Pegmatites in Narnaul Area, Mahendragarh District, Haryana, India

| | |
|---|---|
| **Naveen Kumar Kanyan** | Research Scholar, Department of Geology, Kurukshetra University, Kurukshetra - 136119, HARYANA |
| **Dr. A.R. Chaudhri** | Professor, Department of Geology, Kurukshetra University, Kurukshetra - 136119, HARYANA |
| **Dr. Naresh Kumar** | Assistant Professor, Department of Geology, Kurukshetra University, Kurukshetra - 136119, HARYANA |

**ABSTRACT**

Granites and associated Pegmatites in the Narnaul area occur as irregular intrusions, dyke and vein. Quartz, orthoclase, albite, muscovite, biotite, acicular & prismatic tourmalines, actinolite, calcite, beryl, and garnet are observed in the granites and associated pegmatites. These are classified on the basis of mode of occurrence, shape, size, color, internal zoning, and detailed mineralogical and petrological studies. Granites are classified into Grey granite and Pink Granite whereas pegmatites are classified into simple or undifferentiated and complex or differentiated type. Simple pegmatite consist mainly quartz, orthoclase, albite, muscovite and tourmaline whereas complex pegmatite consists of quartz, orthoclase, albite, biotite, muscovite, tourmaline (acicular and prismatic), ±beryl, ±garnet, ±actinolite, and ±calcite. Petrological and mineralogical data indicates that the Narnaul granites and associated pegmatites are formed due to different propulsive of the hydrothermal fluids during the tectonometamorphic sequences at the terminal stage of Delhi orogeny.

**KEYWORDS** Granites, Pegmatites, Classification, Narnaul, Haryana.

## INTRODUCTION

The present study area Narnaul lies between lattitude 28°2´-28°7N´ and longitude 76°3´- 76°7´E in the Survey of India topographical sheet no.53D/4/SW. The exposed rocks in the area constitute to the Delhi Supergroup, which is equivalent in age to Cuddapah Supergroup of Andhra Pradesh. Narnaul forms the northern most flank of exposed Aravalli range in Haryana State. The Aravalli range extending from the Gulf of Cambay in Gujarat to southern parts of Haryana. Aravalli range comprises Banded Gneissic Complex, Aravalli Supergroup, Delhi Supergroup and Vindhyan Supergroup.

In southern part of Haryana, metasedimentary rocks belong to the Palaeo - Meso Proterozoic period (between 900 and 1600 Ma according to Crawford, 1970) of Delhi Supergroup are exposed in the of Aravalli mountain range. Pant et al (2008) has reported 945 ±14 Ma of the age of metamorphism of Delhi Supergroup rocks exposed in the southern Haryana. The reported age is based on the determination of Th, corrected U & Pb dating of monazites from the subcalcic Fe-Mg amphibole rocks in the Bayal area of Mahendragarh District in southern Haryana. Granites and associated pegmatites of the Narnaul area are associated with different metasediments exposed in the area and occur as parallel linear ridges, inselbergs and isolated hills. The different metasediments are identified as mainly of quartzite with lesser amount of schist, granitic gneiss, basic rocks, calc rocks, phyllite and slate. Granites and pegmatites have sharp contact with host rock and blurred contact with each other.

## GEOLOGICAL SETTING, CLASSIFICATION AND MINERALOGICAL CHARACTERISTICS

On the Basis of the detailed mapping and petromineralogical studies, ~ 50 granites and associated pegmatite bodies were determined in the Narnaul area. Most of the granites and associated pegmatites introducing into the quartzite, but also occur within the granitic gneiss schist, basic rock, calc rock, slate and phyllite. Granites and associated pegmatite occurs as irregular mass, dykes, are typically tabular, small and cross vein and lengthened lenses**.** They have trend in NNE strike direction with low dip angle.

Granites and associated pegmatite show sharp contact with the host rocks and their dimensions are variable (0.5 m - 250 m length and 0.5 - 100 m width). They consist mainly quartz (smoky, milky, yellowish brown), orthoclase, albite, biotite, muscovite, tourmaline**,** calcite, beryl, garnet, hornblende and natrolite in the decreasing order of abundance among various types & locations. In the study area quartz, calcite and beryl enriched pockets are extracted/ plucked locally within the pegmatite. Detailed accounts on the occurrence, association, extension, mineralogy of the granites and associated pegmatites are provided in the paper.

### Classification of Granites and Associated Pegmatites

Based on Color, occurrence, association, structure, texture and mineralogy the Narnaul Granites are classified into two groups i.e. Grey Granite and Pink Granite.

### (1) Grey Granite

The Grey granites are named mainly on the basis of color. These granites showing grey to white appearance due to dominating plagioclase feldspar during field study (Fig. 1.A). Grey granite consist mainly quartz, plagioclase (dominant), microcline, orthoclase, tourmaline and muscovite as essential minerals while apatite and ilmenite are observed as accessory minerals. Quartz is observed fine to coarse grained, subhedral to anhedral and shows undulose extinction. Plagioclase is subhedral to anhedral, shows lamellar twinning. Prismatic tourmaline and subhedral quartz showing hypidiomorphic texture in thin section (Fig. 2. A).

Grey granites are further classified into two categories on the basis of grained size, these are

Medium grained grey granite (MGG) and (ii) Coarse grained grey granite (CGG).

 ISSN - 2250-1991

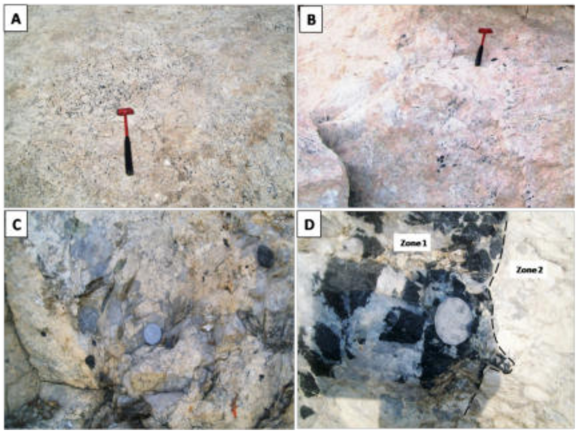
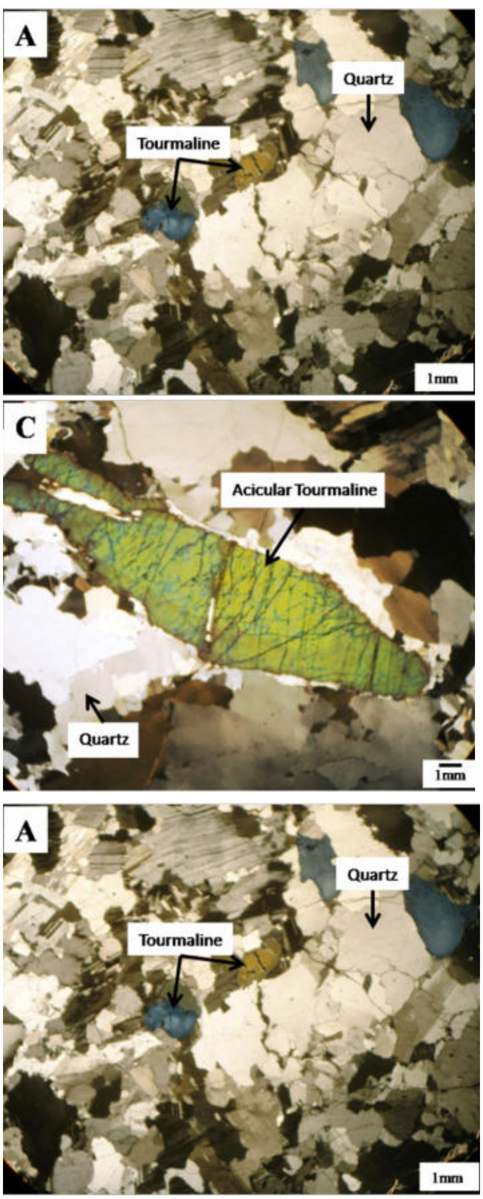



**Fig.1. Field Photographs of Granites and Pegmatites (A) Grey granite consist albite (dominant), quartz and tourmaline. (B) Pink granite having orthoclase with flesh red color, quartz, and tourmaline. (C) Big crystals of quartz and Muscovite observed in simple pegmatite. (D) Concentration of quartz and tourmaline displays Zone 1 and albite enrichment in Zone 2 observed in complex pegmatite.**



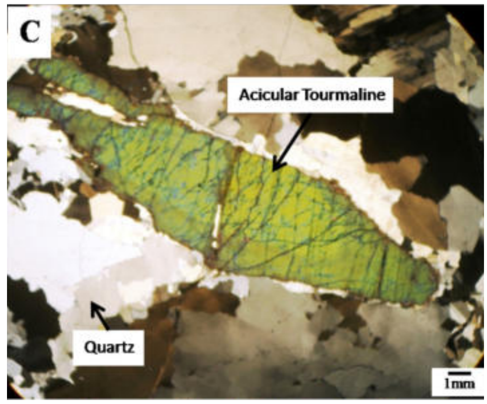




**Fig. 2: Photomicrograph showing (A) Prismatic tourmaline and subhedral quartz showing hypidiomorphic texture in Grey granite. (B). Phenocrst of Microcline showing cross-hatch twinning embedded in the fine grained quartzofelspathic groundmass in Pink granite (c) Acicular tourmaline and subhedral quartz showing hypidiomorphic texture in Simple pegmatite (d) Both Prismatic and acicular tourmaline and subhedral albite with polysynthetic twinning showing granophyric texture in complex pegmatite.**

**2. Pink Granite**

The Pink granites are named on the basis of color and mineral compositions. During field study these granites are showing flash red to pinkish color (Fig. 1.B). This color is reflected due to the abundant presence of Orthoclase and microcline. Pink granite consist mainly quartz, K-Feldspar (microcline & orthoclase) in dominant, plagioclase, tourmaline and muscovite as essential minerals while apatite, biotite and ilmenite are observed as accessory minerals. Microcline is the common alkali feldspar occurring in pink granite and shows characteristic cross-hatched twinning in thin section (Fig. 2. B).

Pink granites are further classified into two categories on the basis of grained size, these are

(i) Medium grained Pink granite (MPG) and (ii) Coarse grained Pink granite (CPG)

**3. Pegmatites**

Detailed historical reviews on the classifications of the pegmatite are provided in Babu (1993). Based on occurrence, association, structure, texture and mineralogy (Jahns, 1955) the Narnaul pegmatites are classified into groups and sub groups, They are:

**(i) Simple or undifferentiated and (ii) Complex or differentiated types.**

**(i) Simple or undifferentiated Pegmatite**

Big crystal and concentrated of quartz, albite, tourmaline, muscovite and biotite is observed in simple pegmatite during field study (Fig. 1.C). Simple pegmatite consist phenocryst of quartz, K-feldspar (perthite, microcline), albite, tourmaline (either prismatic or acicular), muscovite and biotite as essential minerals and luxullianization, kaolinization of orthoclase and sericitation of albite are also observed as minor phase.in thin section. Acicular tourmaline and subhedral quartz showing hypidiomorphic texture in thin section (Fig. 2.C).

**Complex or differentiated types**

The complex type are further classified as subtypes such as partly complex (contains either acicular or prismatic tourmaline), fully complex (contains both type of tourmalines), replacements & completely zoned and incompletely zoned. Partly complex type has quartz, orthoclase, muscovite and acicular or prismatic tourmaline. Fully complex type has both acicular & prismatic tourmaline, ± beryl / calcite crystals / transparent or crystals of quartz / malachite in addition to minerals in partly Complex type. Complex pegmatites are predominantly exposed as compared to simple pegmatites in the study area.

During field survey concentration of quartz and tourmaline in zone 1 and concentration of albite and quartz in zone 2 is observed in complex type pegmatite (Fig. 1.D). Both Prismatic and acicular tourmaline and subhedral albite with polysynthetic twinning showing granophyric textur in thin section (Fig. 2.D).

**4. Modal Analysis (vol. %) of the Narnaul granites and Associated pegmatites.**
Detailed petrological studies were carried out by using Leitz 12 pol S microscope with swift Point Counter and Cam2com software at Department of Geology, Kurukshetra University.

The modal composition of (volume %) of selected gnanites and associated pegmatites are shown in Table 1. Among from these samples, sample no. N1n1, A4n4, k3n3, R2n2 are represented for granites and sample no. A7, R7(B), R18, F3 and R6 are for pegmatites. The modal composition (volume %) of these samples showing the range of minerals quartz(6.7-60.3), Orthoclase(0.0-40.9), Microcline(0.0-29.1), perthite(0.0-33.6), albite(0.5-43), biotite(0.0-10.9), muscovite(0.0-8.6), Actinolite(0.0-4.2), Tourmaline(0.0-48.9), Garnet(0.0-1.8), zeoloite(0.0-14.1) and calcite(0.0-73.1). The modal composition of (volume %) of selected gnanites and associated pegmatites of the study area are plotting mainly in the field of granite, alkali granite and quartz rich granitoid fields of QAP diagram (Fig. 3) (Streckeisen, 1973). They are also plotting in the fields (Lameyre and Bowden, 1982) granitoids formed by crustal fusion process.

**Table 1: Modal Analysis (vol. %) of the Narnaul granites and associated pegmatites**

| | Granite | | | | | Pegmatite | | | |
|---|---|---|---|---|---|---|---|---|---|
| Mineral Composition | N1n1 | A4n4 | K3n3 | R2n2 | K2n2 | A7 | R7(B) | R18 | F3 | R6 |
| Quartz | 27.1 | 48 | 49.2 | 34.7 | 58.6 | 60.3 | 47.2 | 43.8 | 28.3 | 6.7 |
| Orthoclase | 3.7 | | | 40.9 | 9.5 | 9 | 27.2 | 10.4 | 10 | |
| Microline | | 29.1 | 5 | | 3.3 | 0.8 | | 20.8 | | |
| Perthite | | 13.2 | 33.6 | 4.4 | | | | 2.6 | | |
| Albite | 43 | 0.5 | 2.5 | 12.4 | 22.7 | 18.7 | 0.2 | 19.6 | 5.6 | 2.2 |
| Sericite | | | | | | | | | | |
| biotite | | 0.8 | | | | | 10.9 | | 0.8 | 2 |
| muscovite | 8.6 | 7.5 | | 3.9 | | | | | 7.4 | |
| Actinolite | | | | | | | | | | 4.2 |
| Tourmaline | 17.5 | | 10.1 | 4.4 | 6.8 | 11.8 | | 2.8 | 48.9 | |
| Garnet | | 1.8 | | | | | | | | |
| Zeolite | | | | | | | | | | 14.1 |
| Calcite | | | | | | | 15.1 | | | 73.1 |

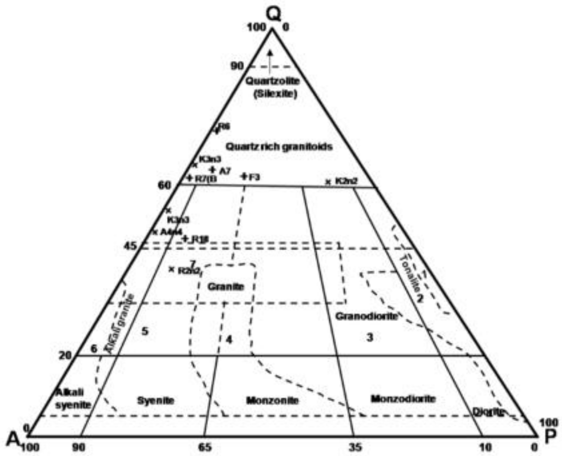



**Fig. 3. Quartz - Alkali feldspar - Plagioclase diagram (Streckeisen, 1973) with field of Lameyre and Bowden (1982). Sample numbers A4n4, K3n3, N1n1, R2n2, K2n2, A7,R7(B), R18, F3, R6. Symbols: Granite ( X ) and Associated Pegmatite ( + ).**

**DISCUSSION AND CONCLUSIONS**
In Narnaul area the geological setting and petromineralogical characters suggested that the granites and pegmatites fluids are generated due to the partial melting of metasediments occurring and subsequently undergone replacement process which are evidenced by the presence of complex pegmatite type. Large tourmaline, calcite, quartz, orthoclase crystals in the Narnaul granite and associated pegmatites suggest the low rate of nucleation of crystals coupled with high diffusivity of melt due to high vapor content which induced the rapid cooling than crystallization. The presence of garnet and natrolite in the different types of granites and pegmatites of present study areas indicate the presence of regional as well as contact metamorphic conditions in their formation. Occurrence of beryl and tourmaline in the present granites and pegmatites indicate the high concentration of flux elements such as boron, and beryllium which lower the temperature of the solidification of the granitic and pegmatitic melt. The observed low thermal gradients assemblages coupled with a wall rock temperature are supporting the granites and pegmatites emplacement within the amphibolite facies metamorphic terranes of Aravalli mountain belt in the Narnaul area of southern Haryana.

Hence the current data suggest that various types of granites and associated pegmatites in the Narnaul area are due to the different pulses of hydrothermal event at the terminal metamorphic-tectonic episodes associated with Delhi orogenic cycle.

**REFERENCES**

[1] Babu, P.V.R. (1993) Tin and rare metal pegmatites of the Bastar-Koraput Pegmatites Belt, Madhya Pradesh and Orissa, India: characterisation and classification. Jour. Geol. Soc. India, v.42, pp.180-190. || [2] Crawford, A.R. (1970) The Precambrain geochronology of Rajasthan and Bhundelkhand. Northern India. Can. Jour. Earth Sci., v.7. pp. 91-110. || [3] Jahns, R.H. (1955) The study of pegmatites. Econ. Geol., v.50, pp. 1025-1130. || [4] Lameyre, J., and Bowden, P., (1982). Plutonic rock types series: Discrimination of various granitoid series and related rocks. Journal of Volcanology and Geothermal Research, 14, 169-186 | [5] Pant, N.C., Kundu, A. and Joshi, S. (2008) Age of metamorphism of Delhi Supergroup rocks – Electron microprobe ages from Mahendragarh District, Haryana. Jour. Geol. Soc. India, v.72 (3), pp.365-372. | [6] Streckeisen, A.L., (1973). Plutonic rocks: Classification and nomenclature | recommended by the IUGS subcommision on the systematics of Igneous Rocks. | Geotimes., v. 18,pp. 26-30.