CHAPTER III

PETROGRAPHY

The petrography of the various rocks constituting the area under study is detailed below:

3.1 BIJLI RHYOLITES

In hand specimens the rhyolite is porphyritic with various shades of grey, light green and brown colours. Microscopic studies revealed it to be essentially composed of quartz, orthoclase and albite phenocrysts which are embedded in a microcrystalline groundmass of quartz and potash feldspar. Sphene, apatite, zircon and iron ore occur as accessories while secondary chlorite and calcite are observed occasionally in minor amounts.

The phenocrysts of quartz are about 5 mm in size and are rounded, oval and irregular in shape. Some of them show embayed margins. Occasionally it shows undulose extinction. Granulation or crushing effects are not noticed. In some sections quartz phenocrysts are rimmed by mottled quartz, which shows optical continuity with the former. Feldspar phenocrysts are also about 5 mm in size, subhedral to anhedral in shape and usually show marginal corrosion and partial sericitization (Pl. 1a). K-feldspar is more predominant than plagio-
clase and mainly consists of perthitic orthoclase which often shows carlsbad twinning with 2V ranging from 71° - 76°. The plagioclase feldspar is albite variety (Ab₀⁻ Abq₂) showing albite and carlsbad twinning and rarely pericline twinning.

Flakes of dark green biotite are found and sometimes it is associated with green coloured chlorite. Biotite and chlorite form streaks, bands and patches oriented parallel to the flow layers. There are thin wavy or planar layers and bands consisting of a coarse aggregate of anhedral quartz with small amount of sericite and chlorite. Most of these layers appear to be drawn out gas cavities, later on filled up by quartz.

The matrix of rhyolites usually consists of micro-crystalline granular aggregate of quartz and K-feldspar. In some cases almost cryptocrystalline matrix has been noticed, but glass is absent. In some of the samples felty or pilotaxitic aggregates of feldspar microlites and laths mainly of orthoclase (0.05 to 0.5 mm) occur in fine-grained matrix with patchy chlorite, sericite, zoisite and dusty iron ores. Occasionally trachytic texture (Pl. 1b) with sub parallel arrangements of orthoclase microlites in highly altered matrix is observed. In some of the samples tuff with quartz phenocrysts (Pl. 1c) and ignimbrites with angular rhyolitic fragments are seen (Pl. 2a).
(a) Marginal corrosion and partial sericitisation of feldspar in the Bijli rhyolites. Crossed nicols (X90).

(b) Bijli rhyolite showing trachytic texture with parallel to sub-parallel alignment of orthoclase microlites. Crossed nicols (X90).

(c) Tuff (in Bijli rhyolites) showing quartz phenocrysts. Crossed nicols (X90).
3.2 PORPHYRITIC MICROGRANITE

Porphyritic microgranite is compact and dark reddish to brownish in colour. It contains phenocrysts of feldspar and quartz which range in size from 1 mm to 5 mm in diameter in a fine to medium grained crystalline groundmass of feldspar and quartz.

In thin sections it consists mainly of quartz, orthoclase, microcline, albite, biotite, chlorite and hornblende. Apatite, zircon and iron ores are found as accessories. Modal composition of porphyritic microgranite is given in table 9A. Quartz shows intergrowth with alkali feldspar giving rise to the characteristic granophyric texture (Pl. 2b) which shows various structural patterns in almost all the samples. Elongated blebs and vermicules of quartz replacing plagioclase feldspar from the margin producing myrmekitic texture has also been noticed (Pl. 2c).

Quartz (average 27%) occurs as subhedral grains with irregular boundaries as well as aggregates of anhedral granules. Some of the quartz grains show undulatory extinction. The intergranular space in between quartz clusters often contains dark reddish brown to black coloured iron oxides giving it a dusty appearance.

The K-feldspar (avg. 52%) which includes orthoclase and microcline dominates over the plagioclase
(a) Ignimbrite (in Bijli rhyolites) showing rhyolite fragments. Crossed nicols (X90).

(b) Granophyric texture in porphyritic microgranite. Crossed nicols (X90).

(c) Myremekitic texture in porphyritic microgranite. Crossed nicols (X200).
feldspar. It is mostly turbid due to kaolinisation. The plagioclase feldspar (avg. 8%) is of albite variety which is sericitised and clouded. It shows mainly albite twinning and less commonly carlsbad twinning. Due to alteration the twinning is not clear. Biotite and hornblende are usually bleached and chloritised and are most commonly associated with released magnetite grains.

3.3 DONGARGARH GRANITE

The Dongargarh granite is pink to grey in colour. Thin section studies revealed it to be consisting of quartz, microcline, orthoclase, plagioclase, biotite, hornblende and chlorite in decreasing order and shows hypidiomorphic granular texture. Apatite and zircon occur as accessories. The modal composition of various minerals constituting the Dongargarh granite is given in Table 11A.

Quartz (avg. 38%) occurs as subrounded to anhedral grains. It occurs as individual grains as well as inclusions within the feldspar. Occasionally it shows granulation and undulose extinction.

The potash feldspar (avg. 33%) includes microcline, orthoclase and perthite of which microcline is predominant over the other two. Microcline predominantly occurs as microcline-microperthite (Pl. 3a). Perthite occurs in
the form of stringes, veins, and patches. It frequently encloses small grains of quartz, plagioclase laths (Pl. 3b) and also occasionally small perthite patches (Pl. 3c). Sometimes perthite shows twinning (Pl. 4a). The presence of anti-perthite is also a frequent phenomena in this granite (Pl. 4b). The K-feldspars are partially kaolinised and sericitised.

The plagioclase feldspar (avg. 24%) which is mostly of albite and oligoclase variety with 2V varying from 78° to 83°, occurs as large phenocrysts or laths of various dimensions. Plagioclase usually shows albite and carlsbad twinning, but discontinuous albite twinning and bending (Pl. 4c) and a type of twinning with the twin lamellae occurring at right angles to each other simulating microcline are also occasionally observed.

Some of the plagioclase grains also show broken and faulted nature (Pl. 5a,b). The presence of discontinuous and bent twin lamellae in plagioclase indicates stress conditions during its crystallisation, whereas, the presence of broken and faulted plagioclase laths indicates a post-tectonic activity.

Biotite and hornblende occur as laths, linear shreds, irregular clusters and are mostly associated with released iron ores. Biotite is brown in colour and strongly pleochroic and sometimes show bleaching
(a) Microcline micropertite in Dongargarh granite. Crossed nicols (X90).

(b) Dongargarh granite showing plagioclase lath in perthite. Crossed nicols (X90).

(c) Dongargarh granite showing perthite within perthite. Crossed nicols (X90).
(a) Perthite in Dongargarh granite showing Carlsband twinning. Crossed nicols (X90).

(b) Antiperthite in Dongargarh granite. Crossed nicols (X90).

(c) Plagioclase in Dongargarh granite showing discontinuous and bent albite lamellae. Crossed nicols (X90).
(c) Broken plagioclase lath in Dongargarh granite. Crossed nicols \((X90)\).

(b) Plagioclase lath showing faulting like dislocation in Dongargarh granite. Crossed nicols \((X90)\).

(c) Ophitic to sub-ophitic texture in Pitepani basic volcanics. Crossed nicols \((X90)\).
effects and alteration to chlorite. Hornblende is usually dark green in colour and pleochroic and generally shows alteration to chlorite. Apatite is found in needle forms as well as stumpy subhedral crystals. Zircon is associated with biotite clusters in which it is often present as inclusions.

3.4 PITEPANI BASIC VOLCANICS

The Pitepani volcanics are pale green to brownish grey in colour. They consist of both porphyritic and non-porphyritic varieties with euhedral and subhedral phenocrysts of plagioclase laths in pale green aphanitic groundmass. Some specimens have vesicles which are filled with calcite and quartz. Under the microscope, these volcanics show ophitic to sub-ophitic texture (Pl. 5c), porphyritic and occasionally quench plagioclase textures (Pl. 6a). They are essentially made up of plagioclase, clinopyroxene and minor iron ores with or without interstitial glass. The phenocrysts of plagioclase and pyroxene are embedded in a fine groundmass which is composed of plagioclase, pyroxene, chlorite, sericite, calcite, epidote and iron ores. The mineral assemblage suggests that these volcanics have suffered greenschist facies metamorphism.
Phenocrysts: Plagioclase phenocrysts which are of andesine and labradorite variety occur in all the samples. They are usually subhedral to euhedral in shape and are commonly twinned on albite and carlsbad laws. The plagioclase phenocrysts are saussuritised and have given rise to aggregates of chlorite, epidote and calcite. Inclusions of iron ores and pyroxene grains are observed in it. Clinopyroxene phenocrysts which are mostly of augite occur in all the samples and exhibit ophitic to sub-ophitic texture. They are subhedral to anhedral in form and mostly exhibit uniform extinction, but some of them show undulose extinction also. They are partly altered to colourless amphibole and chlorite. Generally the alteration has started from the margin to the interior of the grain (Pl. 6b). Occasionally iron ores and glass occur as inclusions.

Groundmass: The groundmass of the basic volcanics is essentially composed of plagioclase microlites, pyroxene grains, iron ores and show hyalopilitic texture. Plagioclase microlites are saussuritised and sericitised and have given rise to chlorite, epidote and calcite.

Pyroxene (augite) occurs as granular aggregates and occupies mostly the interstitial space between the plagioclase laths. Inclusions of opaque oxides are also observed in it. In some of the samples glass is
(a) Plagioclase showing quench texture in Pitepani basic volcanics. Crossed nicols (X90).

(b) Augite showing alteration to chlorite at the margins in Pitepani basic volcanics. Crossed nicols (X90).

(c) Augite phenocrysts showing porphyritic texture in Sitagota basic volcanics. Crossed nicols (X90).
present and occurs as infillings in the interstices of the grain constituents of the groundmass.

3:5 **Sitagota basic volcanics**

Sitagota basic volcanics are mostly fine to medium grained, and dark grey to greenish grey in colour. They are porphyritic in nature and at places consist of large tabular plagioclase phenocrysts in dense aphanitic groundmass. In some samples vesicles have been noticed which are filled up by silica and calcite.

Under the microscope they commonly show porphyritic texture (Pl. 6c), though ophitic to sub-ophitic texture has also been observed (Pl. 7a). They are essentially made up of plagioclase, clinopyroxone, and minor iron ores in a groundmass of plagioclase, pyroxene, epidote, chlorite and iron oxides. The relative percentage of the phenocrysts varies in different samples of the volcanic rocks. The mineral assemblage suggest that these volcanics have suffered greenschist facies metamorphism.

**Phenocrysts**: Plagioclase phenocrysts which are mostly of andesine and labradorite variety, occur in all the samples. The laths are subhedral to euhedral of various size. Laths as big as 2 cm. in length have also been observed. They are commonly twinned on albite law and
occasionally on carlsbad law. Sometimes they show penetration twinning also (Pl. 7b). Plagioclase is generally altered giving rise to an aggregate of chlorite and epidote which sometimes show schistosity (Pl. 7c). Opaques and pyroxene occasionally occur as inclusions in it. Sometimes plagioclase phenocrysts contain groundmass material (chlorite) giving a sort of pseudozoning (Pl. 8a).

Clinopyroxene phenocrysts which are mostly of augite occur almost in all the samples. They are commonly subhedral to anhedral in form and sometimes exhibit ophitic to sub-ophitic texture in relation to plagioclase. Inclusions of iron oxides and glass are common in it. Olivine occurs rarely and is mostly altered to antigorite.

**Groundmass:** Appreciable variation in the composition of the groundmass is noticed and it is essentially composed of plagioclase, pyroxene and iron oxides and show hyalopilitic texture (Pl. 8b). Most of the plagioclase laths and pyroxene grains show alteration and have given rise to chlorite, epidote and calcite. The plagioclase microlites, which are mostly andesine and labradorite in composition occur as small laths and occasionally exhibit linear development. The pyroxene occurs as granular aggregate and occupies interstitial spaces of the
plagioclase laths. It is mostly altered, colourless to dark brown in colour and exhibits patchy or wavy extinction. Inclusions of iron oxides are also observed in it. Magnetite, which constitutes the most common of the opaque oxides, occurs as small grains of different sizes in different samples of these basic volcanics.

3.6 MANGIKHUTA BASIC VOLCANICS

Megascopically Mangikhuta basic volcanics are broadly similar in appearance. They are dark green to blackish green in colour and include both porphyritic and non-porphyritic varieties, the later variety being predominant. At places it is vesicular and the vesicles are filled up with chalcedony and calcite.

Under microscope it commonly shows hyalopilitic texture (Pl. 8c) and sometimes porphyritic. It is essentially made up of plagioclase and pyroxene with secondary epidote, chlorite, calcite and devitrified brown glass. The mineral assemblage suggests that these volcanics have suffered greenschist facies metamorphism.

Phenocrysts: The phenocrysts in the Mangikhuta volcanics mainly consists of plagioclase and pyroxene of different sizes (average 0.5 cms). Plagioclase phenocrysts which are mostly of oligoclase and andesine variety occur in
(a) Ophitic to sub-ophitic texture in Sitagota basic volcanics. Crossed nicols (X90).

(b) Plagioclase laths showing penetration twinning in Sitagota basic volcanics. Crossed nicols (X90).

(c) Chlorite and epidote showing schistosity in Sitagota basic volcanics. Crossed nicols (X90).
(a) Groundmass in Plagioclase laths showing pseudo-zoning in Sitagota basic volcanics. Crossed nicols (X90).

(b) Hyalopelitic texture displayed by plagioclase microlites in Sitagota basic volcanics. Crossed nicols (X90).

(c) Plagioclase microlites showing hyalopelitic texture in Kangikhuta basic volcanics. Crossed nicols (X90).
all the samples. Generally they are subhedral to euhedral. They are commonly twinned on albite and carlsbad laws and are saussuritised giving rise to aggregates of chlorite and epidote. Pyroxene phenocrysts which are mostly of augite are subordinate to plagioclase phenocrysts and are mostly altered to chlorite.

**Groundmass**: The groundmass of the Mangikhuta volcanics is made up of plagioclase microlites, pyroxene, quartz and devitrified brown glass. The plagioclase microlites are altered to epidote, chlorite and calcite. Pyroxene is found to have been partly altered to chlorite. Quartz occurs as small granular aggregates and generally occupies interstitial spaces between plagioclase microlites and pyroxene grains. Little amount of iron oxide which is mostly magnetite occurs as dusty inclusions in pyroxene grains. Dark brown glass is present in all the samples and occurs mostly as infillings in the interstices of the constituent minerals of the rock.