CHAPTER XIII

METABASITES

13.01 The metabasites include amphibolite, amphibole (hornblende) schist, metadolerite and metanorite. The amphibolite and hornblende schist extend in a large tract in the eastern part of the map area and is found also as thin veins in migmatite areas whereas metanorite occurs as a dyke to the west of Pandal. Metadolerite occurs further south near Pur as a small dyke within the amphibolite terrain.

HORNBLENDE SCHIST AND AMPHIBOLITE

13.02 The main constituent mineral in these rocks is hornblende with some amount of plagioclase and quartz. The accessories include sphene, apatite and opaque minerals.

Hornblende

13.03 It occurs as the major constituent and forms more than 75% of the bulk schists, and more in amphibolite. It occurs typically as medium to coarse grained subautomorphic bladed crystals and its preferred dimensional orientation yields a schistosity. Massive rocks where such preferred orientation is feeble or absent, and nearly exclude other minerals, are described as "amphibolites" in this
account. The hornblende crystals usually look fresh and are devoid of inclusions unlike the hornblendes in calc-silicate metasediments. Optical properties of two such hornblendes are given below:

<table>
<thead>
<tr>
<th>Slide No.</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>128</td>
<td>Slide No. 348</td>
</tr>
<tr>
<td>X</td>
<td>Pale yellowish green</td>
</tr>
<tr>
<td>Y</td>
<td>Yellowish green</td>
</tr>
<tr>
<td>Z</td>
<td>Pale green</td>
</tr>
<tr>
<td>Absorption</td>
<td>Z&gt;Y&gt;X</td>
</tr>
<tr>
<td>(N_X)</td>
<td>1.638 ± 0.002</td>
</tr>
<tr>
<td>(N_Z)</td>
<td>1.664 ± 0.002</td>
</tr>
<tr>
<td>(N_Z - N_X)</td>
<td>0.026</td>
</tr>
</tbody>
</table>

\[Z'\wedge C = 27^\circ-29^\circ\]
\[2V_X = 68^\circ\]

Generally, the hornblende is actinolitic with higher refractive indices than the tremolite variety.

**Plagioclase**

13.04 Plagioclase occurs in small proportions as fine to medium grained, subautomorphic crystals. The optical properties of a plagioclase from a hornblende schist is
as follows:

\[
N_x = 1.562 \pm .002
\]

\[
2V_z = 80^\circ
\]

Symmetric extinction = 35°

The variety is labradorite with composition Ab_{37} An_{63}. Plagioclase from an amphibolite (slide No. 348) shows \(N_x = 1.551 \pm .001\) and is less calcic.

**Quartz**

13.05 Quartz occurs in minor proportions and is fine grained xenomorphic in habit. Lensoidal (flattened) crystals paralleling the schistosity defined by hornblende are also seen.

**Accessories**

13.06 Sphene occurs in considerable proportion and is small, equant or lozenge-shaped. Clustering of a number of sphene crystals is often seen at places.

Apatite is rare and occurs as small xenomorphic rounded crystals.

Opaque minerals occur as very fine inclusions in sphene, and are patchy and brown coloured in reflected light; these may be limonite.
Texture

13.07 Well marked schistosity is found in hornblende schist which is defined by preferred dimensional orientation of hornblende crystals; quartz is often flattened and occurs parallel to this schistosity. Massive amphibolite shows haphazard orientation of the hornblende crystals which generally constitute the whole bulk of the rock.

Metanorite

13.08 Metanorite occurs as a small dyke (15 m wide) cutting across quartzite and marble to the west of the village Kolpura. It runs for a length of 50 m.

13.09 It is massive, hard, grey coloured and contains pyroxene, amphibole, plagioclase and quartz.

Hypersthene (Bronzite)

13.10 Hypersthene occurs as the dominant constituent (50%) in the rock and is coarse grained, subautomorphic to xenomorphic in habit. It shows the characteristic scheme of pleochroism from pale pink to greyish blue. Schiller inclusions are seen. Hypersthene is often surrounded by smaller crystals of hornblende (uralite) and plagioclase, and is occasionally partly enclosed in the hornblende.
crystals, indicating derivation of the latter (uralite) from hypersthene.

Refractive indices of hypersthene are measured as follows:

\[ N_X = 1.691 \pm 0.001 \]
\[ N_Z = 1.703 \pm 0.001 \]
\[ N_Z - N_X = 0.012 \text{ and } 2V_X = 68^\circ. \]

The mineral contains appreciable amount of ferrous iron (composition 70 mol % MgSiO$_3$ + 30 mol % FeSiO$_3$, determined from optical properties) and the variety may be called bronzite (Winchell, 1961, p. 405).

Hornblende

13.11 Hornblende occurs as an abundant constituent (25%) in the rock, and as large subautomorphic to xenomorphic crystals. Sometimes smaller crystals with fainter pleochroism (uralite) occur around hypersthene.

Hornblende is pleochroic -

\[ X = \text{Yellowish green} \]
\[ Y = \text{Faint green} \]
\[ Z = \text{Green} \]
\[ N_X = 1.681 \pm 0.001 \]
Hornblende contains opaque inclusions.

**Plagioclase**

13.12 It is also abundant in the rock and constitute about 20% of total bulk. It occurs as coarse, subautomorphic, and at places, equant crystals. Fine crystals of plagioclase also occur around the larger plagioclase crystals, and are possibly the crushed recrystallised products of the larger porphyroblasts. Margin of the larger crystals are usually highly corrugated. Twinning is characteristic and bending and slip of the twin lamellae along certain planes are often seen.

Symmetric extinction = 29°

$$2V_z = 77°$$

Variety is labradorite (Ab_{48} An_{52}).

**Diopside**

13.13 Diopside occurs in small proportions and is large, subautomorphic, short prismatic in habit; $Z \wedge C = 37°$.

13.14 Quartz, zoisite and opaques occur in very low proportions; quartz is xenomorphic in habit and is rimmed
with ferruginous material; zoisite is xenomorphic granular and occurs around the plagioclase crystals; opaques are patchy in occurrence.

**Texture**

13.15 All the minerals except plagioclase have a tendency to grow as xenomorphic crystals, and thus an overall granoblastic texture is formed.

Granulation and recrystallisation around the hyperssthene and plagioclase crystals define a mortar texture at places.

**Metadolerite**

13.16 A small body (30 m x 8 m in length and width respectively) of metadolerite occurs in strike continuation of the amphibolites in the southern part of the map area at around 500 m ESE of Pur. It is a hard, brittle, grey coloured rock with the following constituent minerals:

**Augite**

13.17 It occurs as coarse grained xenomorphic crystals and constitute about 30\% of the total bulk of the rock. $Z\&C = 44^\circ$; alteration to hornblende (uralite) along margin is seen at places.
Hypersthene

13.18 It occurs as coarse grained subautomorphic to xenomorphic crystals. It is strongly pleochroic from pink (X) to bluish grey (Z). It also alters to hornblende (uralite) along the margins.

Hornblende (Uralite)

13.19 It occurs as an alteration product of the pyroxenes; the crystals are small, xenomorphic and granular; scheme of pleochroism is -

- X = Colourless to yellow
- Y = Pale brown
- Z = Greenish brown

Absorption $Z > Y > X$

$Z \Delta C = 17^\circ$.

Sometimes, the pyroxenes are completely replaced by the hornblende crystals (uralite).

Plagioclase

13.20 It forms about 50% of the total volume of the rock, and occurs as medium to coarse grained, subautomorphic crystals with margins highly corroded. R.I. is higher in both the vibration directions with respect to Canada Balsam. Symmetric extinction is $34^\circ$; the species is labradorite ($Ab_{38} An_{62}$).
Calcite occurs in very minor amount as an alteration product of hornblende.

Opaque mineral is rare and is pale brown in reflected light; it is magnetite.

Texture

13.21 Augite, hornblende and partly hypersthene occur as xenomorphic crystals and plagioclase as subautomorphic crystals with highly corroded margins. The plagioclase crystals usually occur haphazardly with elongation oriented at any direction, but cluster at places in a stellate fashion; these crystals are partly or wholly enclosed in augite and uralite (hornblende altered after pyroxene), and thus a blastophitic texture is formed.