Chapter III
Micro Fabric.
3.1 : Introduction :

It is needless to say that the microscopic domains reveal considerable information regarding deformation and structural evolution of the suites of rocks under reference. The term microfabric is defined by Hobbs et al (1976), as a complimentary term to microstructures. According to him, the term microstructure refers to the shape of the crystals, their binding characters; and the internal substructure in the form of defects, namely, deformation bands, lamellae, kinking, polygonisation, etc. Such details plus the relationship between different microstructures and their preferred orientation forms the term Microfabric. A thorough investigation of the deformational history of a rock is often done with the help of microfabric and its experimental simulation along with as for example the c-axis orientation of the quartz porphyroclasts and their dimensional orientation in response to strain. The property of quartz to yield by different microstructures and fabric asymmetries originating even at very low temperature and pressure conditions (White, 1979) makes it an ideal study material. A good amount of
experimental work and study of natural cases has been carried out by many workers such as, Wilson (1973, 1975); Majribanks (1976); Blacic (1975); Bouche (1977, 1978, 1981); White et al (1980); White (1976, 1977, 1979); Lister (1978, 1982); Simpson (1980, 1983, 1985); Tullis et al (1973, 1986); Law et al (1986); etc.

The pioneering of the work on microfabric was done by geologists like Christie (1964); Hobbs (1968); Tullis et al (1973), who performed many experimental and simulation work for the development of this aspect.

3.2 : Microstructures and Kinematic indicators :

Microstructural criteria may be commonly used to indicate chemically compatible, synchronous minerals in metamorphic rocks, although chemical criteria may also be necessary. There are certain microstructural and chemical criteria (Vernon, 1976) that may be diagnostic, especially if used together: (i) if all minerals are in contact with each other (Winkler, 1974) and show no evidence of mutual replacement; (ii) the grains and inclusions have shapes indicative of minimum interfacial free energy (Voll, 1960, 1961; Stanton, 1964; Kretz, 1966; Vernon, 1968, 1975, 1976); (iii) if no evidence of replacement of one mineral by another is observable (e.g. fine grained aggregate occurring in
cleavages and fractures, as irregular veinlets, or along grain boundaries). For the incompatible mineral assemblages, the change from one mineral assemblage to another is a necessary part of the chronological analysis of polymetamorphic rocks. Such an inference is supported by the absence of evidence for the foregoing criteria, and in addition, the following criteria are useful, especially if used together.

(i) the new assemblages show clear microstructural evidence of replacement of grains of the old assemblages (Zwart, 1963; Vernon, 1972, 1976; Kwak, 1974), especially where the new minerals occur preferentially along cleavages and fractures in the old mineral grains, and where partial pseudomorphs are preserved;

(ii) the old assemblages show microstructural evidence of strong deformation and partial recrystallisation, the new assemblages being confined to the finer-grained recrystallised areas, especially if forming a new foliation and/or lineation;

(iii) the new assemblage is known from experiment or thermoodynamic calculations to form under metamorphic conditions different from those of the old assemblages.

In spite of all these criteria, recognition of incompatible assemblages does not necessarily indicate a time break or discontinuous metamorphic conditions, although...
microprobe analysis may reveal evidence for such breaks (Vernon, 1977). Many workers have inferred time relationship between co-existing metamorphic minerals on the basis of microstructures such as the inclusion and partial inclusion ("moulding") of one mineral by another. However, as pointed out by Vernon and Powell (1976), a porphyroblast and its inclusion may nucleate at the same time (the included minerals forming many stable nuclei, the porphyroblast having only one). Thus, porphyroblasts and inclusions may belong to the same compatible mineral assemblage (Spry, 1962, 1969), or may be younger than its inclusions, in the case when the inclusions (a) consist of a number of minerals, (b) are idioblastic, or (c) have a preferred orientation unrelated to the crystal structure of the porphyroblast. Order of crystallisation have also been inferred for some metamorphic rocks on the basis of moulding relationship (Saggerson, 1974). But the microstructural relationships superficially indicating as "order of crystallisation" are also capable of supporting an alternative explanation.

Care should be taken in the chronological analysis of crystallization and deformation. Because many complex microstructural relationships may be interpreted in terms of a single metamorphic assemblage, rather than a sequence of assemblages. Some microstructural interpretations involving
growth of individual mineral at a separate time imply unjustified metamorphic changes. Even, relatively unambiguous microstructural relationships between minerals can sometimes be explained by contrasting metamorphic reactions (Vernon, 1977). The highly foliated metamorphic rocks initiate the thought of the mechanisms responsible for the formation of the foliation. This is specially important since the layers of phyllosilicates (e.g. biotite) play a major role also in the formation of foliation marked by crenulation cleavage (Trouw, 1973; Hobbs, et al., 1976). The various mechanisms for the development of preferred orientation of layer silicates may be conveniently divided into rotation mechanism and growth mechanism. Both groups of mechanisms tend to produce a preferred orientation perpendicular, or approximately perpendicular to the direction of shortening and both may have operated in the development of a given foliation. Which mechanism predominates will depend on condition of metamorphism and deformation, and this in turn will decide the details of the final microstructure. In low grade rocks rotation plays an important role, while in high grade rocks, growth is the prominent mechanism(s) (e.g., stress; growth along the length of the pre-existing layer silicates preserving the original preferred orientation (Oertel, 1970); growth of the layer silicates with their cleavage planes (001) parallel to the direction of shortening in a rock with initial random orientation of the layer silicate
(Vernon, 1976). The term 'mica beard' is preferred by Ramson (1965) to a micro foliation structure in low grade rocks containing clastic grains that are coarser than the layer silicate phase; and possibility of growth in "pressure shadows" by solid diffusion. Thus there are two competing mechanisms for the formation of the foliation; the foliation developed by rotation and the other by growth. However, most foliations probably develop by a combination of both of these mechanisms (Williams, 1977).

For the formation of the foliation, the state of the rock at the time of development of foliation is an important factor. It is suggested that regional foliations generally develop in rocks that have been previously lithified, though there may be exceptions. High grade rocks probably tend to behave more as solid bodies at the time of development of foliation and intracrystalline deformation mechanisms are probably active in many cases.

Many "basement" gneisses have a very complex history despite of their superficial structural simplicity e.g. the polymetamorphic Lewision gneisses (Sutton and Watson, 1950; Ramsay, 1963) and the Carn Chuinneag and Incheae gneisses (Harker, 1962). In such polymetamorphic rocks, the distinction between different episodes of deformation is essential. The chronological separation of the different episodes may be
done from the study of thin sections of the rocks. As a general rule the later structures are less deformed than the earlier ones and cut across them. The inclusions are probably older than their host where they are idioblastic, consist of a variety of species or have a preferred orientation of the pilcic type. Fringes or bordering of one mineral around another are commonly younger than the central core e.g., chlorite around pyrite. The time relation of fine and coarse grained aggregates of the same mineral are particularly difficult to interpret. A disparity in grain size in one mineral does not necessarily imply an age difference between large and small crystals because a considerable range of sizes can be produced during normal recrystallisation due to differences in nucleation or supply of material. Large crystals could size also by abnormal or secondary annealing. Multiple phase metamorphism (polymetamorphism) is suggested by multiple foliation and by crystals which have complex time relations (Spry, 1983). The textures of many metamorphic rocks are the results of the complex interaction of deformation and crystallisation. Commonly the deformational history can be outlined by study of porphyroblasts especially with the help of the orientation and arrangement of inclusions in them (Turner and Weiss, 1963; Bell, 1985).

The main features of the mineral grains which are suggestive of strain rates as well as temperature conditions
are known as the kinematic indicators. These indicators were described by many workers such as Christie (1964); Bell and Etheridge (1973); Hobbs et al (1976); Tullis et al (1973); etc. Important amongst these indicators are:

(a) undulose extinction: indicative of an early stage of deformation, possibly developed when one sign of dislocation is prominent (White, 1979). This shows an optical inhomogeneity;

(b) deformation bands, deformation lamellae: These are the planar regions within grains which are formed due to different kinds of deformation and different refractive indices respectively (Hobbs et al, 1976). The defects are produced due to faster strain rate and low temperature causing activation of intracrystalline movement;

(c) Core and mantle structure (Mortar texture): The core of the porphyroclast is defined by deformation bands and its mantle by peripheral undeformed, strain free, subgrains, formed due to release of strain energy beyond critical stress, aiding strain free grains. This may be described as a grain refinement process,

(d) Polygonisation (Dynamic recovery): Here the new strain free subgrains are arranged into low angle boundaries and bear a definite morphology indicative of
initial stage of recovery. The dislocations are dissolved due to an increase in their density and thus it results in the formation of 'original style of grains'. This is characteristic of low to intermediate temperature conditions;

(e) Subgrain formation: These primarily develop due to either static or dynamic recovery. The changes take place when one sign of dislocation density reaches maximum. Generally, the first subgrains are elongated and are narrow; and at comparatively higher temperatures equidimensional subgrains are formed (White, 1979).

(f) Recrystallisation: Recrystallisation is indicative of higher temperature conditions and slow strain rates. The grains are strain free and are essentially formed due to grain boundary variation and thus differ significantly from recovery. The grain growth is random due to variations in temperature.

(g) Crack seal fibre growth: The filled fractures are marked by strain free ribbons of minerals due to high pressure and temperature. Such strain free ribbons suggest a possible tectonic transport. This is possibly best described by Ramsay (1980), and Cox et al (1983).

(h) Duplex structure: It is defined by minimum number of porphyroclasts and higher proportion of subgrains with
sutured grain boundaries (Wilson, 1973). The structure is indicative of high temperature condition.

(1) Cataclasite: The quasi-elastic deformation of any rock material results in granulation and crushing without significant recrystallisation as is recently defined by Wise et al (1985).

Majority of the above indicators are typically displayed by quartz, making it an ideal mineral constituent for microfabric investigation of deformed rocks.

The present work is based on the microfabric analysis of the assemblages involving quartz, amphibole, garnet, and mica which occur as important mineral constituents of the Archaeans. In case of the Proterozoics, the study was confined to quartz, the dominant constituent of arenites, which is capable of yielding immense information. The study was carried out using a petrographic microscope and Universal Stage to determine the orientation of the different microstructural elements and assess their significance as kinematic indicators. The microsections were cut orthogonally containing the 'ac' and 'bc' planes (as per Turner and Weiss, 1963). On the basis of kinematic indicators, the probable deformation path is interpreted and on the basis of style of microstructures and strain, degree of deformation achieved by the rocks is evaluated (Please see Chapter V: Discussion).
3.3 : Microfabric of the Archaean:

Petrographically, the Archaean rocks of the study area are medium grained schists and gneisses constituted of quartz, amphibole, garnet, biotite, epidote and having a well foliated character due to quartz rich layers alternating with the mafics in parallel arrangement. Quartz is often elongated and quite conspicuous. The prominent banding of these rocks is well marked by the biotite folios with their cleavage planes (001) at right angles to the maximum direction of the shortening. These folios often swing and wrap around the garnet porphyroblasts which are frequently idioblastic.

The highly elongated and ribboned quartz occurs in association with the biotite and garnet in the foliation planes. These quartz are too narrow in comparison with their length. Deformation lamellae / bands across the direction of elongation and also parallel or sub-parallel to the length of the ribbons are present. The outer margins are curved and sutured. The biotite flakes and the garnets have formed in distinct bands separated from the amphibole rich domains. The garnets in the biotite rich domains are highly fractured with at least two sets of parallel shear fractures. These sets of parallel fractures are at right angles to the direction of elongation of quartz and the foliation. The pole diagrams of fractures in garnets are represented in the
Fig. No. 3.1. The amphibole plates are also highly elongated, studded with inclusions, and broken in irregular narrow laths. Their boundary demarkation is quite distinct from the biotite-rich domains. The garnets in the amphibole rich domain are generally smaller and idioblastic. But here, the garnets are less fractured and seldom bear any inclusions as compared to those in the biotite rich domains. The quartz in such domains are elongate, and showing undulose extinction. Another feature noted here is the presence of close spaced shear fractures filled with quartz elongated parallel to the walls of the fracture and differently oriented as compared to the quartz grains in the foliation planes. Such a feature is seen markedly in the section 19X4. These quartz filled fractures easily pass through the amphiboles and quartz ribbons at high angles. Notably, none of these fractures are seen to pass through the garnets. They bypass the garnets and follow the same direction again. In particular, in sections 19X3 and 19X1, two sets of the shear fractures subtending an angle of 30° to 35° to the foliation are well marked. These sets of fractures are more or less parallel to the fractures in garnets of biotite rich domains described earlier. The fractures are filled with quartz ribbons and give rise to a 'crack seal fibre growth' (Ramsay, 1980; Cox et al, 1983).

In some sections (16AY1) the garnets are themselves arranged in alternate rows parallel to the foliation marked by
FIG. 3.1 DENSITY CONTOUR DIAGRAMS FOR FRACTURES IN GARNETS IN ARCHAEAN METASEDIMENTS OF AJRA. CONTOURS AT 1%, 4%, 8% PER ONE PERCENT AREA.
biotite flakes. This becomes more conspicuous when these
garnets are small, and showing well marked outlines.

The highly elongated ribbons of quartz continue to
show the effects of deformation. The form of low deformation
markings such as undulose extinction, deformation lamellae,
deformation bands, etc., are oblique to the length of the
grains which are dimensionally elongated parallel to the
foliation direction. The biotite flakes are mostly in
contact with quartz but in the quartz rich domain as in 13BX1,
13AX1 they are scattered and are randomly oriented. The
amphiboles mostly appear as elongated laths in association
with subhedral grains of quartz as against the elongated
ribbons observed in others. Some of the amphibole grains are
very small and appear as if they are broken pieces of larger
prophyroblasts. The elongate quartz grains, at times, show
kink bands parallel to the maximum direction of elongation
(13AY1) and suddenly disappearing within the crystal domain.
There is variation in the orientation of these bands in
adjacent quartz porphyroclasts. At times they occur even at
right angles to each other. As one moves from the core of the
quartz porphyroclasts towards their margins the proportion of
formation of the new grains with definite boundaries increases.
The equigranular granoblastic quartz grains are dominant in
sections 13Xa and 13B. The boundary deformations and a kind
of progressive variation in the grain boundaries is represented
in Fig. No. 3.3.
3.4 : **Microfabric of the Proterozoics**:

The arenites representing the Proterozoic Kaladgi Super Group studied in the area of investigation are apparently free from effects of deformation as observed from the microscopic examination. However, after a careful study under the microscope it is possible to appreciate some of the features that must have developed in response to deformational episodes. The important observations are detailed below.

Quartzites with undeformed spherical and oblate detrital quartz grains enclosed by irregular secondary overgrowth which maintain the same optical orientation as the enclosed detrital grains (authigenic growth) are very common. The boundary between the overgrowth and the detrital grain is generally outlined by very fine dusty coating. These are well sorted, equigranular and well-rounded clastic quartz grains. Here the undulatory extinction is shown by the quartz grains. Deformation lamellae and deformation bands are few. The secondary overgrowths are seen almost in all of them and the grains are interlocked in most of the parts of the microsections. Generally, no sign of sub-grains formation and dimensional orientation is observed. In section 12A (Location 1, Fig. 3.2) the original clastic grains occur along with smaller equi-dimensional new grains which are also without any sign of deformation. In the case of 23B (Location 2, Fig. 3.2) some
FIG. 3-2 SAMPLE LOCATIONS OF KALADGIS.
of the porphyroclasts have given rise to new, small sub-
grains, internally, and also along their margins. At the
same time the initial undeformed grains are also present in
these sections. In a few thin sections, though the secondary
overgrowths are present, some newly recrystallised small
grains are also formed at their boundaries in 25A and 25B
(location 3, Fig. 3.2). For the sections 27A, 27B, (Location
4, Fig. 3.2), the detrital grains are separate and do not have
common boundaries due to overgrowth as in the other previous
sections. The new grains are few and are free from deforma-
tional effects. In 34A (Location 5, Fig. 3.2), the detrital
grains are very large as compared to the other sections, but
finer grains are still present. In other words, the grains
size is inhomogeneous. In some parts, specially in 34B, the
orthogonal sections of 34A, the domains of highly sutured and
deformed grains are marked adjacent to the detrital grains.
The sutured grains show internal deformation lamellae and
new-grains formation parallel to the longer dimension of the
porphyroclast. The effect of deformation is evidenced by the
development of undulose extinction in many grains of the
sections 1A2 and 1B1 (Location 6, Fig. 3.2). Here the grain
boundaries become sutured or styolitic, but very few new
deformation lamellae are observed in these quartzites.

A still higher amount of deformation is seen in the
section 10A, 11B, 7B, 22A, 28A, 36A, 48X and 48Y (Locations
7, 8, 9, 10, 11, 12, 13 respectively Fig. 3.2). The quartz grains are inequidimensional. The large detrital quartz porphyroclasts show the deformational lamellae highly oblique to their dimensional orientation. The growth of the deformational lamellae is in continuation with the formation of internal sub-grains with sutured boundaries. In some parts the large quartz porphyroclasts are without any deformational effects. The new grains are completely free of undulose extinction and occur as small grains along the margins of old grains and as a series of new grains along the regions of misorientation between two adjacent large host grains. The relationship of the new grains and the hosts is clear and precisely the separation of the new small grains from the large host is visible. This is so because in many places of the section, the new grains within an old grain contain the traces of its original boundary. From the average size of the quartz grains the old and new grains are easily distinguished. In 28A, the internal growth of quartz in a porphyroclast is along the previous deformation lamellae, and still the sutured boundaries are irregular and uneven. The deformation of the new grains is distinct from the host grains. In exceptional cases detrital grains with their secondary boundaries are also noted as in Section No. 36A. The equidimensional grains often have even borders showing
only the initial stages of deformation and less commonly a formation of new grains. The undulose extinction and deformation lamellae are the parts of newly formed grains, but their frequency is insignificant and is not comparable with the total mass. A few smaller grains which may be the relics of the original grains are also noted. The dimensionally more elongated grains in 48X and 48Y are more of coarser, new grains. Their boundaries are less sutured but more curved.

Still more elongated, deformation free new grains are seen in 49X, 49Y (Location 14, Fig. 3.2). The boundaries are curved and are without sutures.

3.5 : Grain Boundary Relations :

The grain boundary is controlled by the temperature and pressure. Experience tells that the grain relationship becomes more and more complex with increasing temperature (Wilson, 1973). Microsections which exhibit the variation in the grain boundaries are examined and their sketches are prepared with the help of direct tracing of the photographs and checking under the petrological microscope (Fig. 3.3). A progressive deformational history may be delineated with the help of study of grain boundary development as per strain rate environment.
FIG. 3-3: GRAIN BOUNDARY RELATIONSHIP IN AN INCREASING STRAIN ENVIRONMENT.
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FIG. 3-3. GRAIN BOUNDARY RELATIONSHIP IN AN INCREASING STRAIN ENVIRONMENT.
(i) The original, grain boundary is visible and for most of them the secondary authogenic growth of silicious material has coated the original boundaries (undeformed grains), (sketch 1).

(ii) The grains have lost their initial boundaries (except few). Some of the boundaries are sutured (sketch 2).

(iii) In some of the grains, the common boundaries of the grains are lost due to the formation of new grains along the margin (sketch 3 and 4).

(iv) The grains are elongated and their common boundaries are irregular. In some places these are separated by the formation of new-grains quartz and hornblende plates (sketch 5).

(v) The elongation of the new grains and reduction in the porphyroclasts boundaries. Formation of hornblende is more in number and occupying the gap between the quartz porphyroclasts. The late shear fractures have passed through the grains (sketch 6).

(vi) The ribbons of highly elongated grains (quartz), the arrangement of the biotite cleavage (001) parallel to the elongated quartz ribbons (sketch 7).

(vii) The boundary of the quartz grains are curved and warped around the garnet porphyroclasts. The boundaries between elongated quartz ribbons are somewhat unclear (sketch 8).
(viii) The maximum extension of the grain boundary elongation, warping around the garnets and the presence of the parallel, flakes of biotites (sketch 9 and 10).

A careful study of the grain boundaries clearly brings out the influence of pressure (for Proterozoics) and pressure and temperature (for Archaean).
Plate 3.1

Photomicrograph 1

Badami orthoquartzite. Original boundaries of the detrital grains are well marked.

C.N.; x 65
Loc.: Chandiwadi, Foot hills

Photomicrograph 2

Badami orthoquartzite showing inhomogeneity of grain size and also the grain boundaries of the original detrital grains.

C.N.; x 65
Loc.: Chandiwadi, Foot hills
Plate 3.2

Photomicrograph 1

Badami quartzite showing formation of the new grains and the initial stages of deformation of the quartz clasts in the form of undulose extinction. The grain boundaries are somewhat sutured.

C.N.; x 65
Loc.: Panori village

Photomicrograph 2

Badami quartzite showing distinctly sutured grain boundaries and undulose extinction of quartz. New grain formation is also seen.

C.N.; x 65
Loc.: Panori village
Photomicrograph 1

Badami quartzite showing clear cut development of new grain and suturing along the grain boundaries.

C.N.; x 65

Loc.: Chandiwadi, foot of the third hill

Photomicrograph 2

Badami orthoquartzite showing the original detrital grain boundaries of quartz clast together with the deformed grains showing undulose extinction and deformation lamellae.

C.N.; x 65

Loc.: Chandiwadi, foot of the third hill
Plate 3.4

Photomicrograph 1

A feldspathic orthoquartzite showing new grain formation and sutured grain boundaries. Sericite flakes mark the original bedding.

C.N.; x 65

Loc.: Ramtirth, Foot hills

Photomicrograph 2

A Badami quartzite showing dimensional orientation and sutured boundaries marking foliation (Bedding plane foliation?)

C.N.; x 65

Loc.: Panori village
Plate 3.5

Photomicrograph 1

An amphibole bearing quartzose schist showing parallelism of the elongated quartz porphyroclasts and the laths of amphibole marking the foliation. Deformation lamellae at high angles to the grain elongation are distinct.

C.N.; x 65

Loc.: Ajra, Hiranyakeshi river bed, North of the Ajra bridge.

Photomicrograph 2

The same rock as above but showing somewhat polygonal quartz grains and deformation bands and lamellae.

C.N.; x 65

Loc.: Ajra, Hiranyakeshi river bed, North of the Ajra bridge.
Photomicrograph 1

An amphibole bearing quartzose rock showing elongated quartz clasts marking the foliation and showing intense development of the deformation lamellae and bands (i) At almost right angles to the elongation of the clasts, and (ii) parallel to the elongation.

C.N.; x 65

Loc.: Ajra, Hiranyakeshi river bed, South of the Ajra bridge.

Photomicrograph 2

Photo showing a large porphyroclast of quartz sub-divided into many new grains imparting a mosaic texture. The grains are in different orientation. Micro shears at high angles to the elongation of the original quartz clast are well developed.

C.N. x 65

Loc.: Ajra, Hiranyakeshi river bed, South of the Ajra bridge.
Plate 3.7

Photomicrograph 1

A quartz amphibole schist showing the dimensional elongation of quartz clasts and amphiboles together with small polygonal grain arranged parallel to the foliation.

C.N. \( \times 65 \)

Loc.: Hiranyakeshi river bed, Chandiwadi village.

Photomicrograph 2

The rock same as above showing a highly elongated quartz porphyroclast with deformational lamellae marking the rhombohedral slip.

C.N.; \( \times 65 \)

Loc.: South of the Ajra bridge.
Plate 3.8

Photomicrograph 1

Photo showing well developed fracture sets in the large garnet porphyroblasts in biotite rich domains. The biotite folios and the quartz ribbons marking the foliation swing around the garnet porphyroblasts. The large garnets have irregular boundaries with quartz.

P.P.L.; x 65

Loc. : Hiranyakeshi river bed near Ajra.

Photomicrograph 2

Photo showing fractured garnet porphyroblasts pushing aside the mica folios. The small garnets are devoid of fractures and inclusions. Quartz occurs as elongated ribbons.

P.P.L.; x 65

Loc. : Hiranyakeshi river bed near Ajra.
Plate 3.9

Photomicrograph 1

Photo showing quartz drawn into highly elongated ribbons marking strong foliation of the rock.

C.N.; x 65

Loc.: Hiranyakeshi river bed, Ajra

Photomicrograph 2

Photo showing development of deformation bands parallel to the elongation of quartz porphyroclasts. New grains are developed at the boundaries which are sutured.

C.N.; x 65

Loc.: Hiranyakeshi river bed, Ajra
Photomicrographs

A photo-composite showing elongation of quartz porphyroclasts with sutured boundaries and development of small new grains. The deformation lamellae are in different orientation. The grain elongation marks the foliation along with the biotite flakes.

C.N.; x 65

Loc.: Hiranyakeshi river bed, Ajra.
Plate 3.11

Photomicrograph 1

Photo showing crack-seal texture in which the micro fractures are filled with quartz fibres.

C.N.; x 65

Loc.: Hiranyakeshi river bed, Ajra.

Photomicrograph 2

Photo showing crack-seal texture in the same rock as above. The microfractures cut through all other constituents excepting the small garnets (marked by arrow).

P.P.L.; x 65

Loc. : Hiranyakeshi river bed, Ajra.