QUARTZ-FABRIC IN A DUCTILE SHEAR ZONE, PURULIA, WEST BENGAL

S. BHATTACHARYA

Geological Study Unit, Indian Statistical Institute, Calcutta-700035.

ABSTRACT

Quartz-shape fabric and C-axis fabric in the quartizite mylonites from a ductile shear zone in Purulia, West Bengal represent only the late stage strain increment. It is suggested that gliding planes of quartz are perdominantly basel (0001) with some associated activity on prism ($10\bar{1}0$) and rhombohedral ($10\bar{1}1$).

The mylonites occur in a lineer E. - W belt along or close to the northern boundary of the Signbhum mobile belt, in the Purulia district of West Bengal. The Chhotanagpur granite-gneiss occurring to the north is unaffected by mylonitisation, which is an early phemenon with respect to granite intrusion and granitization.

The mylonitized rocks are quartzites, micaceous quartizites, carbonaceous clays and feldspathic schists. In terms of matrix grain size (<0.1 mm) and degree of recrystallization, these mylonites are of Proto-mylonite type.

GEOLOGICAL REGIONAL STRUCTURAL FRAMEWORK

The supracrustal rocks of the Sighbhum mobile belt have recorded two phases of folding. The early and most prominent deformation has produced a group of light to isoclinal folds on bedding with steep northerly dipping axial planar schistosity, the second group of folds and puckers on schistosity has variable but low plunge. The axial planar crenulation cleavage strikes NNE - SSW or NW - SW, and is subvertical.

In the mylonites the folds on banding are isoclinal, reclined and the axial planar foliation is parallel to the schistosity (S) outside the mylonite zone (Fig. 1). While the folds on bedding outside the mylonie zone have variable plunge, in the mylonites they are of reclined type with axes parallel to the downdip mineral lineation. Such rotation of folds axes towards the direction of maximum elongation is a commeon feature of ductile shear zones (Bell 1978 ; Eisbaacher 1970).

The minor folds (on bedding banding) in the mylonites have a consistent asymmetry which indicates a thrust movement, with the northern block riding towards south (Bhattacharya op. cit.).

MICROSTRUCTURES

The most pervasive and mesoscopically recognised foliation in the mylonites, is a mylonitic foliation (L - surface of Berthe *et al.* 1979). On microscopic scale it is sense of movement are exemplified by 'mica fish, 'foliation fish' & 'drag folds' (Figs. 2 & 3) (Hanmer 1986).

An oblique planar fabric (S - surface of Berthe *et al.* 1979) is only recognized on microscopic scale and is defined by elongate quartz grains or aggregates of recrystallized quartz grains (Fig. 4). The angle between S and C surfaces is around 30°. This planar fabric (obiique quartz foliation, S) represents the xz pnae for the late stage strain increment. A down-dip lineation in the mylonities is commonly defined by stripping and mineral lineation on the mylonitic foliation and indicates the stretching lineation.

Short and discrete fractures oblique to the

c-surfaces represents the 'c' shear bands (Berthe *et al* 1979), resulting from the late stage strain increment.

In the YZ secions, in quartz lenses are nearly circular, indicating a construction type of strain.

QUARTZ-SHAPE FABRIC

The elongate-quartz grains in the XZ sections define the X-Z plane of finite strain. The axial ratio (R) of these grains and the obliquity between the long dimention and the shear cleavage (c - surface), have been studied in five samples under the micropscope (Fig. 5). Mean values of R ranges from 1.99 to 2.27 while mean obiquity varies from 21° to 44°. In R -ϕ Plots of individuals samples R varies from 1 to 4, while ϕ varies from 5° to 85°. The large fluctuation in ϕ values and much less variation in R values, is consistent with relatively low strain

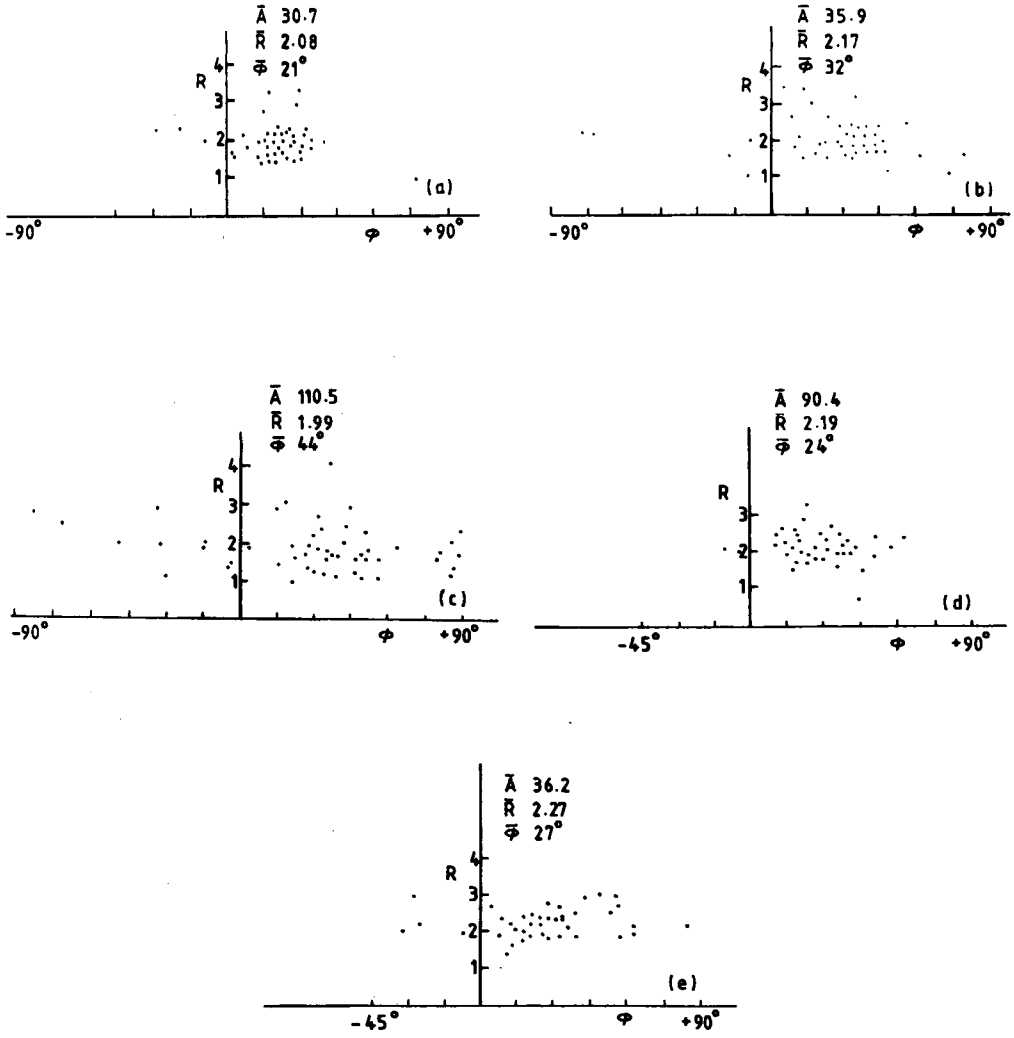

Fig. 5 : R versus ϕ plots of five samples, measured on XZ sections. a(A-12), b(K-16), c(K-14), d(K-42), e(S-1)

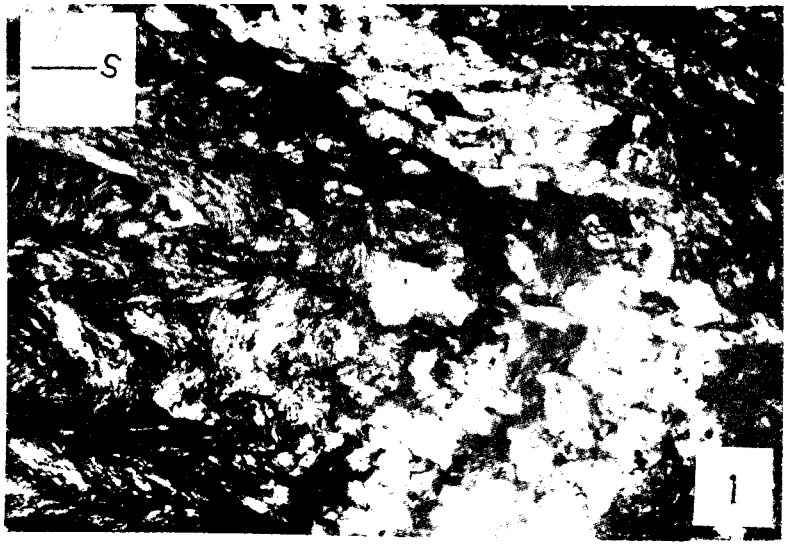

Fig. 1 : Isoclinal fold in mylonite, YZ section, fold axis parallel to stretching lineation X. Width of photograph 2mm.

Fig. 2 : 'Foliation fish' in XZ section of mylonites. Width of photograph 2 mm.

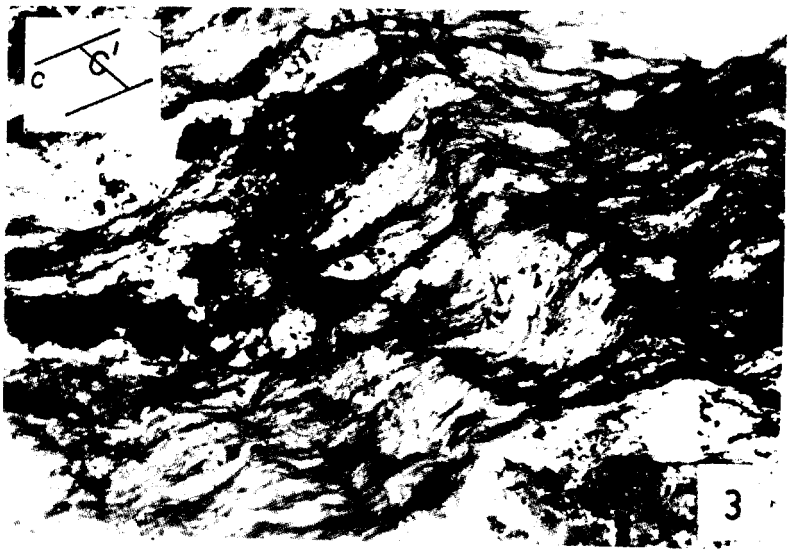

Fig. 3 : Discrete C′ fractures, shear bands indicating late stage strain increment. Width of photograph 2 mm.

Fig. 4 : Elongate quartz grains oblique to C - surfaces in the XZ section. Width of photograph 2 mm

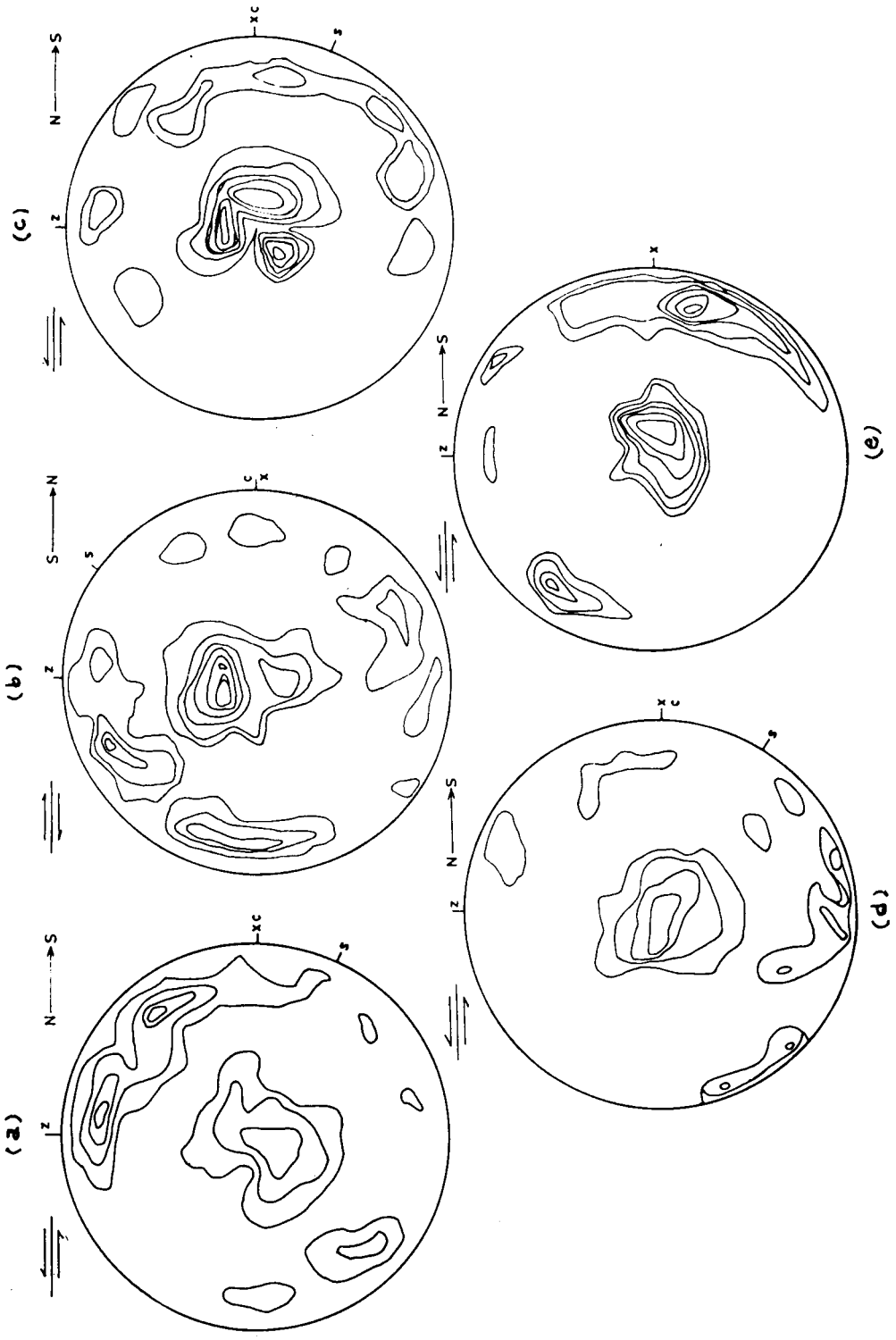

Fig. 6 : C-axis pole figures on XZ planes contoured.

in the rocks (as deduced from quartz C-axis fabric and greater degree of recrqslallization noted. However, it should be noted that the finite strain rocord in the rocks represents only the late strain increment.

QUARTZ C - AXIS FABRIC

For studying c - axis fabric of quartz in mylonites five amples were selected having more than 50% quartz, and with a narrow range of grain size (0.03 to 0.06 mm). C - axis fabric of quartz in the XZ sections of the five samples, were measured using a U -stage. The c - axis pole figures (lower hemishepre projection) have been contoured and relative orientations of the traces of S, c and c' microstructures shown for all the five samples (Fig. 6).

All the c - axis pole figures show characteristic fabric pattern . Two distinct elements in the fabrics pattern are - a stronge point maximum close to Y and a partial small circle (annular) girdle about Y, at an angular distance of 70 from Y. There is a distinct asymmetry related to the non-coaxial nature of strain (obliquits of c & s surfaces).

The high point maximum close to Y is generally correlated with glide dominated by the prism 1010 {a} system and some associated activity on basal 0001 {ca} system (White 1976, Burg 1986).

The small circle girdle around Y is not common but reported earlier by Fairbairn (1949) and Mancktelow (1981). The maximum in the girdles at high angle to c - planes indicates that slip systems other than prism 1010 were operative, the most likely slip system involve is the rhombohedral 10T1 system.

ACKNOWLEDGEMENT

The work was carried out under a research project sponsored by Department of Science & Technology, Govt. of West Bengal. Prof D. Mukhopadhyay's comments on the first manuscript were helpul.

REFERENCES

Bell, T. H. 1978 : Progressive deformation & reorientation of fold axes in a ductile mylonite zone. Tectonophysics, 44, 285-320.

Berthe, D. Choukroune P & Jegouzol P. 1979 : Orthogneiss, mylonite and non-coaxial deformation of granites : the example of the South Armonian shear zone. Jour Struct. Geol. 31-42.

Bhattacharya, S. 1989 : Ductile shear zone in Purulia, West Bengal Ind. Jour Geol. 61 3 172-178.

Burg, J. P. 1986 : Quartz shape fabric variations and c-axis fabrics in a ribbon-mylonite : arguments for an oscillating foliation. Jour, Struct. Geol. 8, 123-131.

Eisbacher, G. H. 1970 : Deformation mechanics of mylonite rocks and fractured granites in Cobequid, Mountains, Norn Scotia, Canada, Geol. Soc. Am.Bull., 81, 2009-2020.

Fairbairn, H. W. 1949 : Structural Petology of deformed rocks. Addison-Wesley, Cambridge, Massachusetts.

Hanmer S, 1986 : Asymmetrical pull aparts and foliation fish as kinematic indicators. Jou. Struct. Geol. 8, 111-122.

Mancktelow, N. S. 1981 : Strain variation between quartz grains of different crystallogaphic orientation in a naturally deformed metasiltsone. Tectnophysics 78, 73-84.

White, S. 1976 : The effects of strain on the microstrucures, fabrics & deformation mechanism in quartzites. Phil. Trans. Royal Soc. London, A 283, 69-86.

Manuscript Received August 5, 1992
Revised Manuscript Received April 2, 1994