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Study of a deformed conglomerate horizon in the Sandur Schist Belt, Bellary District, Karnataka

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Abstract

The deformed pebbles of the conglomerate horizon occurring to the SE of Hospet have their longest and the intermediate axis lying on the schistosity plane. The long axis shows a strong preferred orientation. The intermediate axis is parallel or subparallel to the regional fold axis. The strain is plane strain type with slight elongation parallel to the intermediate axis or the regional fold axis.

Introduction

Deformed conglomerates are of fairly widespread development and are potentially good material for the estimation of strain. The present article is an attempt to elucidate the type and amount of strain in the deformed conglomerate (Fig. 1) in the Sandur schist belt, Karnataka. For this purpose the analysis of the axial ratios of the pebbles and the spatial orientation of their longest axis were studied in detail.

Geology

The conglomerate horizon crops out at a distance of about 6 – 7 km, southeast of Hospet (15°16′ : 76°23′). This forms a conformable lithounit and it is considered as a greywacke-conglomerate horizon indicating no stratigraphic break (Mishra, 1972). The geology of the area as worked out by Roy and Biswas (1977) can be summarised as follows:

The conglomerate horizon occurs in the eastern limb of a major, near isoclinal synformal syncline namely, Donimalai syncline plunging 20° to 40° towards N50°W. The associated rock types are metabasalt, banded ferruginous chert with iron ore, metagreywacke, andalusite bearing garnet-micaschist, and thin bands of carbon phyllite, belonging to Donimalai Formation of the Sandur Schist Belt. The average strike of the bedding plane (S_0) is N50°W – S50°E and dip 70° – 80° towards southwest. The rock formations have undergone two periods of deformation (F_1 and F_2), of which the earlier one is more prominent producing NW–SE trending major fold and schistosity (S_1). The later one (F_2) is of mild intensity producing broad warps and crenulation cleavage (S_2) almost at right angles to the early fold i.e. N60°E (approximately). The rock formations have attained lower greenschist facies to amphibolite facies of regional metamorphism, and it clearly indicates a time gap between F_1 and F_2.

The conglomerate occurs as a thin impersistent band of about 10 to 15 metres in thickness and about 3 km in strike length, laterally passing over to quartzite. The deformed pebbles are predominantly made of quartzite (>95%) and occasionally chert embedded in a siliceous matrix. The matrix is made up exclusively of fine grained slightly flattened quartz, cemented by very little amount of ferruginous matter. Biotite flakes are occasionally present, aligned parallel to schistosity (S_1). The ratio between pebble to matrix ranges from 50 : 50 to 80 : 20 with an average of 70 : 30. The well developed structural features in the horizon are schistosity (S_1) and a conspicuous lineation defined by the preferred orientation of the long axes of the pebbles. The longest axis (A) and the intermediate axis (B) of the pebbles always lie on the schistosity plane and the shortest axis (C) is at right angles to the schistosity plane.

Computational procedure

The principal factors that contribute to the variations in the measured shapes and orientations of deformed pebbles are (i) initial shape (ii) initial axial orientation (iii) ductility contrast of the particles to the total particle/matrix system (iv) strain homogeneity and (v) errors in measurement. Several workers have discussed the methods of determination of strain from deformed particles. Ramsay (1967), Dunnet (1969) and Elliot (1970) considered the strain to be homogeneous within the scale of the sample and the variation of the axial ratios and their orientations to be due solely to the variation in the initial shape and orientation of the pebbles. Mukhopadhyay (1973) pointed out that the strain is not absolutely homogeneous even on the scale of the thin section, but can be considered homogeneous in a statistical sense, and a part of the observed variations in the shape and orientation is due to these small random deviations from homogeneity.

Figure 1. Deformed pebbles in conglomerate—Sandur schist belt.

The amount of variation due to measurement error has not been determined in detail. It is likely that there may be greater error in the location of the axis for grains with low axial ratios than with high axial ratios. However, several measurements were made for a single pebble with great care and the mean value has been taken for the computation. The long (A), intermediate (B) and the short (C) axes of two hundred and twenty-eight pebbles were measured over a strike length of about 1.5 km from the conglomerate horizon. The collections were made from uniformly distributed exposures to assure that the distribution of the measurements was uniform.

The computational procedure followed is that of Mukhopadhyay (1973). Linear correlations using A and B, and B and C were computed to test whether the pebbles come from a single population. The approximate linear model used is $Y_i = B X_i + e_i$, where e_i is the unobserved random variable responsible for the deviation from a perfect linear correlation, β is the slope of the straight line of best fit passing through the origin and $\beta = \frac{\Sigma X_i Y_i}{\Sigma Y_i^2}$.

The goodness of linear correlation is given by $\gamma = \frac{\Sigma X_i Y_i}{\sqrt{\Sigma X_i^2 Y_i^2}}$. For an ideal correlation the value of γ must be unity. The Y_i and X_i correspond to the shorter

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Small scale ripple superimposed on large scale ripple

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Abstract

Small scale ripple superimposed on large scale ripple have been observed in the Talchir rocks of Giridih basin. Both the small scale and large scale ripple observed are combined flow ripple with greater wave influence. The ripples were formed in wave agitated glacial lake.

Introduction

Small scale ripples superimposed on large scale ripple (Fig. 1) have been observed in the Talchir sediments of Giridih (Gondwana) basin. The structure under discussion occurs in silty sandstone. The purpose of the present note is to describe the structure hitherto not reported from glaciofluvial Talchir sediments and also to give a general interpretation of the structure.

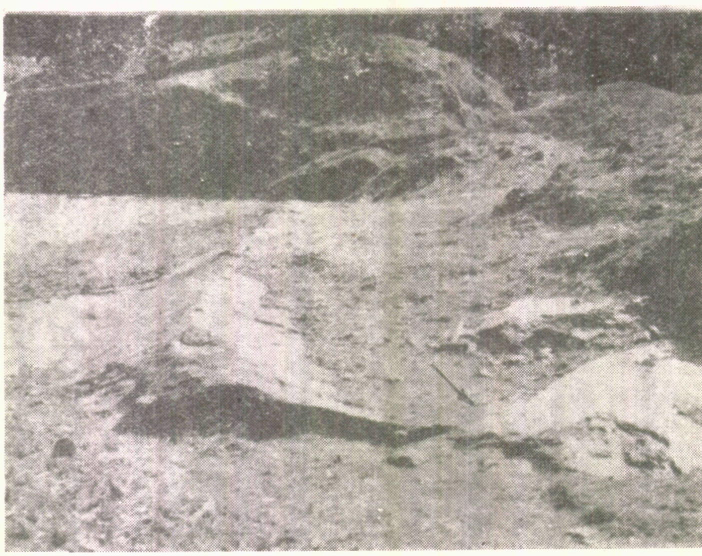

Figure 1.

Description of the structure

The structure is a large wavy structure on which small ripples are superimposed. The larger feature has a continuous straight crest for at least 8 metres. The profile is sharp crested but rounded and symmetrical. The average spacing is 3.5 metres, height 0.60 metres, and the chord is 3.70 metres.

The small scale ripples show a variation of ripple parametres in vertically successive layers. The crest continuity could be measured up to a maximum distance of 50 cm. The profile of the ripple in the lower units is rounded and symmetrical whereas in the upper unit it is slightly angular and asymmetric. The small ripple succession is climbing in nature. The ripple height, spacing and chord varies from 8.5 to 34.2 cm, 25.7 to 55.8 cm and 21.4 to 70.00 cm respectively, from bottom upward direction.

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Jurassic ammonites from Chharap valley, Himachal Pradesh, India

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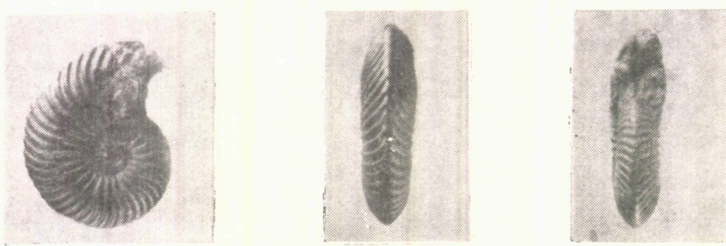
Abstract

The present paper describes two species of ammonites (*Scarburgiceras* cf. *scarburgense* and *S. praecordatum*) from the Laptal Formation exposed in the Chharap valley of Himachal Pradesh. The ammonites are suggestive of Lower Oxfordian age for the upper units of the Laptal Formation.

Introduction

The Mesozoic succession is farily well developed in the Chharap valley which lies in the northeastern corner of Himachal Pradesh within the coordinates 32°32′ to 33°00′N : 77°35′ to 78°00′E. During the palaeontological and stratigraphical in-



1a 1b 1c

2a 2b 2c

Figure 1. *Scarburgiceras* cf. *scarburgense* XI a) lateral view b) ventral view c) apertural view

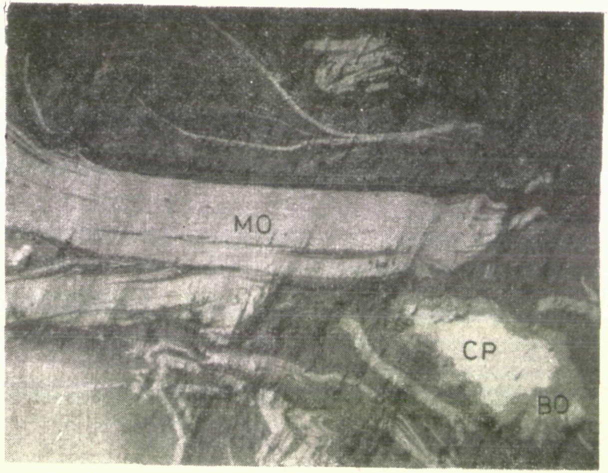
Figure 2. *Scarburgiceras praecordatum intermedia* XI a) lateral view b) ventral view c) apertural view

vestigations in parts of Sarchu and Chharap valleys of Ladakh and Himachal Pradesh, the author made fossil collections from different stratigraphic horizons. An outline of the geology of this region along with geological map has been published by Raina and Bhattacharya (1977).

The ammonites (*Scarburgiceras* cf. *scarburgense* and *S. praecordatum*) des-

PLATE I

1



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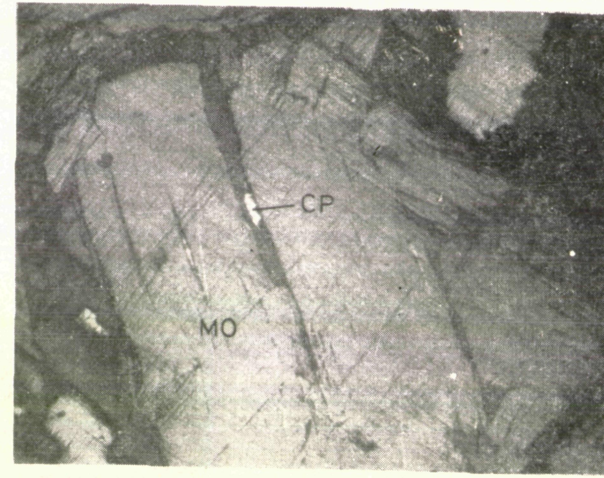

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and the longer axis of the individual measurement of the pebbles which in this case is either B_1 and A_1 or C_1 and B_1. The values of β and γ for the two sets of measurements A & B and B & C are given in Table I.

Since γ has a very high value indicating a good linear correlation between A_1 & B_1 and B_1 & C_1, it can be concluded that the pebbles come from a single population characterised by an axial ratio which is equal to β. Good linear correlations are also exhibited by the plots of A *vs.* C and B *vs.* C. It is to be noted that the value of β does not give the arithmetic mean of the individual axial ratio measurements.

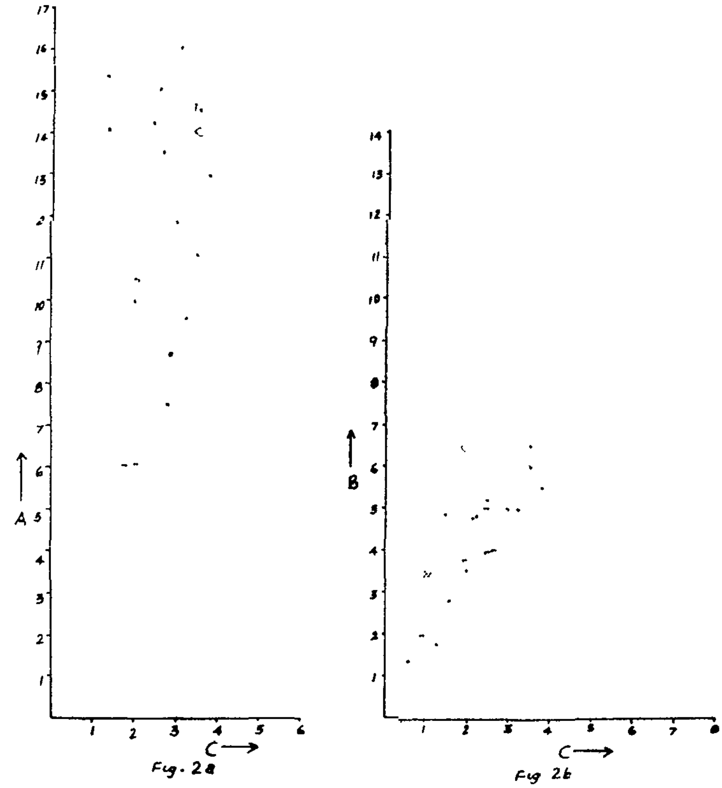

Figure 2 Plots showing good correlation between (a) A & B and (b) B & C.

The next step in the computation of the strain is to determine the nature of the original population which can be, (i) a population consisting of elliptical particles with random orientation; (ii) a population of elliptical particles with a preferred orientation; (iii) a population of nearly circular grains (Mukhopadhyay 1973). The first two possibilities have been rejected in the present case as neither of these two possibilities are expected to show a very good linear correlation between their long and short axis with varying amounts of strain and also the long axis to have a preferred orientation parallel to the schistosity as observed in the present case. Hence, the original population is considered to consist of nearly circular pebbles and the computed value of β gives the axial ratio of the strain ellipse.

From the axial ratio of the strain ellipsoid the deviatoric components of strain parameters were computed. The radius (R) of a sphere having the same volume as the ellipsoid is calculated. The deviatoric component of the principal quadratic elongation are $\sqrt{\lambda_1} = X/R$; $\sqrt{\lambda_2} = Y/R$ and $\sqrt{\lambda_3} = Z/R$ where $X > Y > Z$. The deviatoric components of principal natural strain are $\epsilon_1 = \text{Log}_e\ X/R$, $\epsilon_2 = \text{Log}_e$

Y/R and $\epsilon_3 = \text{Log}_e\ Z/R$. The magnitude of strain can also be expressed by a single value as $\gamma_0 = 2/3\sqrt{(\epsilon_1 - \epsilon_2)^2 + (\epsilon_2 - \epsilon_3)^2 + (\epsilon_3 - \epsilon_1)^2}$. The values of λ, ϵ and γ_0 are given in Table I. The symmetry of the strain ellipsoid is expressed by $\nu = \frac{2\epsilon_2 - \epsilon_1 - \epsilon_3}{\epsilon_1 - \epsilon_3} = 0.11$ i.e., $0 < \nu < 1$. Hence, the strain ellipsoid has the intermediate axis slightly longer than the radius of the constant volume sphere. It also indicates that there has been little amount of extension along the Y-axis or the fold axis (F_1).

TABLE I. The computed values of axial ratio, correlation coefficient, quadratic elongation, natural strain and magnitude of strain for the pebbles.

βxy	γxy	βyz	γyz	$\sqrt{\lambda_1}$	$\sqrt{\lambda_2}$	$\sqrt{\lambda_3}$	ϵ_1	ϵ_2	ϵ_3	γ_0
1.76	0.94	1.99	0.96	1.83	1.04	0.52	0.26	0.02	0.28	0.32

Conclusion

During the regional folding (F_1) of the Sandur schist belt with consequent parallelism of the bedding plane (S_0) and schistosity (S_1), the former was gradually obliterated and the pebbles essentially aligned themselves, with their longest (A) and intermediate (B) axes in the schistosity plane. The longest axis (A), of the pebbles during deformation developed a uniformity of orientation on the schistosity plane. This uniformity in spatial orientation might have also been assisted by close spacing among the pebbles. The B-axis of the pebbles are parallel or subparallel to the regional major fold axis plunging approximately 20° to 30° towards NW. The later phase of deformation (F_2) that has produced only minor puckering or kink bands on schistosity plane (S_1) is of mild nature and has no appreciable effect on the shape of the already deformed pebbles. The value of λ_1, λ_2 and λ_3 determined (Table I) indicate that $\lambda_1 > \lambda_2 > \lambda_3$ and $\lambda_2 \simeq 1$. Hence, the strain is plane strain type with slightly elongation parallel to the Y-axis.

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