Yuzhmorgeoligiya, *A. A. Sidorenko*, *A. Boris Petrov*, etc. have no specific laboratory for core-cutting and sub-sampling. Therefore, in some vessels cutting of the core liner and sub-sampling is performed inside the laboratory, whereas in others both activities are carried out on the deck, facing inconvenience and difficulties. In such a situation, the spcl plays an important role, since the assembling and disbanding of the spcl is easy and fast. Further, the sediment properties in the spcl are protected and the chance of core shortening is remote. Important advantages of using the spcl and its comparison with the existing methods are given in Table 1.

The only drawback for the present spcl could be that, half of the core liner with sample cannot be preserved for archive purpose. Though preserving half of the core is not a common practice, the improved version of the spcl will have an option for preserving half the portion of the core liner.

A 2 m long spcl was designed and tested to obtain 1 cm sediment sub-samples from near shore. The initial test gave successful results for precise and accurate sub-samples. The spcl is light-weight, portable, reusable and requires small budget for fabrication. The sub-sampling method by the spcl is user-friendly and has many advantages over the existing ones, e.g. it requires considerably less time, less manpower and small area for sub-sampling on-board.

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Study of the Salem–Attur shear zone, east of Salem, Tamil Nadu: a new kinematic interpretation

T. K. Biswal[1,*], V. Thirukumaran[2], Kamleshwar Ratre[1] and K. Sundaralingam[1]

[1]Department of Earth Sciences, Indian Institute of Technology Bombay, Powai, Mumbai 400 076, India
[2]Department of Geology, Government Arts College, Salem 636 007, India

A study of the mylonites of the Salem–Attur shear zone at Udayapatti and Sarkar Nattar Mangalam reveals that the shear zone developed in the form of a north-easterly vergent subhorizontal thrust which has been refolded into variable attitude due to late stage folding. The subhorizontal mylonitic foliation with NE trending stretching lineation bears testimony to such an explanation. The earlier impression that the shear zone is vertical comes from the folded part of the thrust as the mylonites have assumed a vertical attitude on the limb of the fold.

THE E–W running Salem–Attur shear zone (or Moyar–Bhavani–Salem–Attur shear zone) in Tamil Nadu forms an important tectonic line in the Southern Granulite Province (inset, Figure 1). Together with the Palghat–Cauveri shear zone, it demarcates a possible suture between two geologically distinct terrains, namely the northern and southern granulite terrains of Archaean and Neoproterozoic age respectively[1–4]. Apart from their ages, these terrains differ remarkably with regard to structural and metamorphic evolution. The northern terrain is marked by northeasterly structural grains that swing into the E–W direction along the Salem–Attur shear zone, and indicates an overall anticlockwise *P–T* path. The southern terrain, known as the Pandyan Mobile Belt, that resulted from the collision between Dharwar and Africa/Antarctica continental blocks during the Pan-African period, displays domal structures and records an overall clockwise path[5–8]. However, Bhaskar Rao *et al.*[9] and Ghosh *et al.*[10] suggest that the boundary between these two terrains lies further

*For correspondence. (e-mail: tkbiswal@iitb.ac.in)

south. Sense of movement along the Salem–Attur shear zone has been a matter of debate. Based on the apparent offset position between Bilirangan and Nilgiri Hill, Drury and Holt[11] interpreted it to be a dextral shear zone, while Naha and Srinivasan[12] explained it to be a vertical thrust on the basis of predominant down-dip stretching lineation. Further, Valdiya[13] explained the shear zone to be a low-angle thrust. In spite of the down-dip lineations and many shear kinematics suggesting dip-slip character, the shear zone has been interpreted to be a transpressional–dextral strike-slip shear zone[14–16].

We have carried out a structural study of the Salem–Attur shear zone between Udayapatti and Sarkar Nattar Mangalam village, 7 and 16 km east of Salem respectively, along the Salem–Belur Road. In an earlier study, Bhadra[15] reported phyllonites from the east of the area that shows steeply inclined foliation with near down-dip lineation. However, he described the lineations to be intersection lineation and interpreted them to (have resulted from) dextral shearing. Chetty and Bhaskar Rao[17] proposed a plumose structure for the shear zone.

The area covering Udayapatti and Sarkar Nattar Mangalam village exposes charnockites, mylonitic quartzofeldspathic schists/gneisses and hornblende–biotite schists (Figure 1). The charnockites enclose minor intercalations of mafic granulites and banded magnetite quartzite, all showing granulite facies of metamorphism. The charnockites are well-banded rocks consisting of alternate mafic and felsic bands; mafic bands are made up of equigranular ortho- and clino-pyroxenes, plagioclase and hornblende, and the felsic bands comprise quartz and alkali feldspar. The quartzofeldspathic schists are fine-grained and contain layers of quartz ribbons alternating with mica-rich layers; the quartz ribbons are recrystallized to smaller grains at places. Feldspar porphyroclasts occur along the schistosity plane. The hornblende–biotite schists represent a phyllonite carrying fine layers of biotite, hornblende and feldspar clasts. The quartzofeldspathic schists and hornblende–biotite schists are the retrogression products of charnockites and mafic granulites respectively, due to shearing and fluid activity along the shear zone, the pyroxene shows breakdown to hornblende and biotite. The schistosity defines the mylonitic foliation in the rock. The shear zone varies in width along the strike extension; it is narrow in the west and wider towards the east. This has been attributed partly to splaying and partly to late kinematic folding.

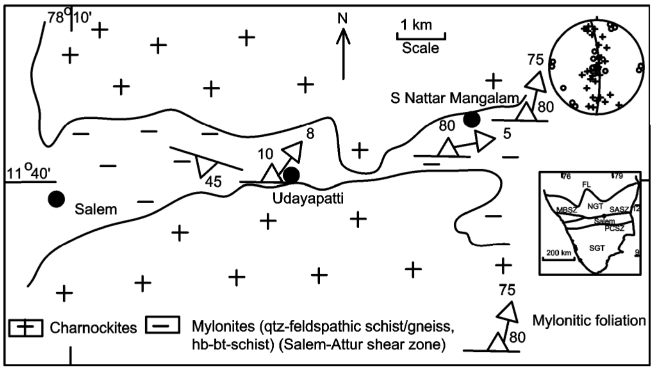

Figure 1. Geological map of the Salem–Attur shear zone, east of Salem, Tamil Nadu (modified after Geological Survey of India[21]). For clarity, few representative structural data are plotted in the map; the rest are included in the stereoplot shown in the top right corner of the figure. Crosses indicate pole of the foliation, while circles indicate lineations. Girdle suggests the folding of the mylonitic foliation by F_1 folds along the E–W axis. The lineations are spread out as explained in the text. (Inset) Generalized geological map of the Southern Granulite Province[7]. FL, Fermor's line; MBSZ, Moyar Bhavani shear zone; NGT, Northern Granulite terrain; SASZ, Salem–Attur shear zone; PCSZ, Palghat–Cauveri shear zone, and SGT, Southern Granulite Terrain.

The mylonitic foliation in general strikes E–W and dips steeply to north and south (stereoplot, Figure 1) as seen around Sarkar Nattar Mangalam village. The lineations occur in the form of the grooves and ribs, and are more akin to ductile slickenside striae[18] than stretching lineation (Figure 2 *a*). However, the ductile slickenside striae and the stretching lineation could be parallel in the study area. Hence the term mylonitic lineation has been used hereafter to describe these linear features. The mylonitic lineations are either down-dip or steeply plunging around the above-mentioned locality, and give the impression that the Salem–Attur shear zone is subvertical in nature with dip-slip character. However, a continuous zone of mylonites with thickness about 5 m showing remarkably subhorizontal mylonitic foliation is observed at Udayapatti. Subhorizontal mylonitic lineations are grooved on the subhorizontal foliations. This indicates subhorizontal slip in the NE–SW direction. Further, tight to isoclinal recumbent folds (F_s) with axial, planar shear fractures occur intrafolialy within the subhorizontal foliations (Figure 2 *b*), suggesting the synkinematic development of such folds during shearing. In contrast, horizontal lineations are also observed on subvertical foliation at certain sectors. This has driven some of the earlier workers to suggest the Salem–Attur shear zone to be a strike-slip shear zone. However, the variation in attitude of the mylonitic foliations as well as the lineations is ascribed here to latekinematic folding F_1. The F_1 folds occur in small to outcrop scale as open to tight folds with crenulation cleavages (Figure 2 *c*), the axial plane of the fold strikes ENE–WSW and plunge varies from very gentle to steep. The mylonitic foliations have attained steep attitude and the lineations appear down-dip on the limbs of the F_1 fold; where the fold becomes steeply plunging the lineations are rotated. Further, along the crenulation cleavage, biotite and hornblende are developed, suggesting amphibolite facies assemblage having been superimposed over the mylonitic assemblage.

The microfabric analysis was carried out on thin sections oriented parallel to the mylonitic lineation, called vorticity profile plane[19]. The sections produce maximum asymmetric features. The mylonitic foliations in horizontally foliated rocks near Udayapatti contain finely recry-

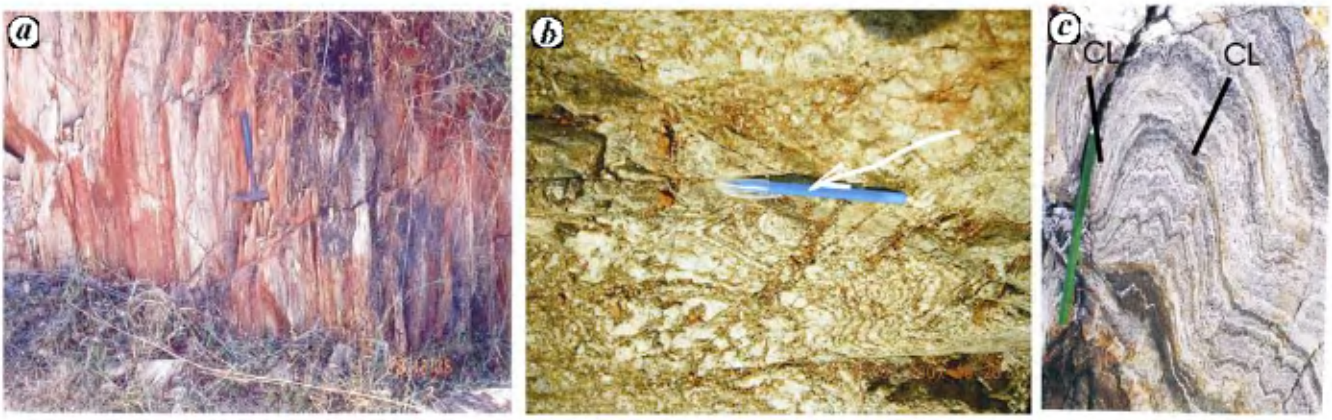

Figure 2. ***a***, E–W striking vertical mylonitc foliation with down-dip lineations, near Sarkar Nattar Mangalam. ***b***, Gneissosity in the charnockites is folded during thrusting producing recumbent folds (F_s) with axial planar shear fractures (pen parallel). ***c***, ENE–WSW trending F_1 upright fold developed on the mylonitic foliation. This has brought variation to the attitude of the foliation as well as lineation from horizontal to vertical. At places, the folds attain subvertical plunge where the lineations assume horizontal attitude in ENE–WSW trend. Hornblende and biotite are grown parallel to the crenulation cleavage (CL) associated with the fold. The crenulation cleavage vis-à-vis mylonitic foliation will show reverse shear sense on either limbs of the fold.

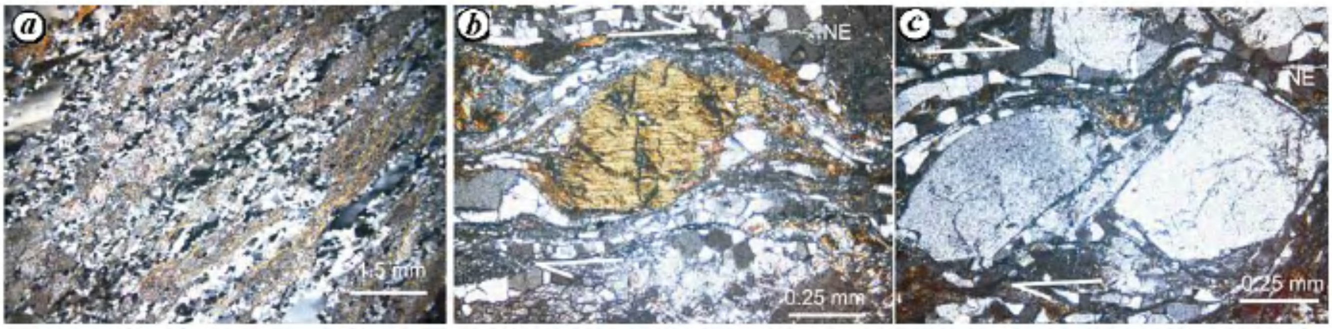

Figure 3. ***a***, Photomicrograph shows mylonitic foliation in subhorizontal foliation, marked by undulose extinction in quartz lenses and ribbons. Marginal granulation is observed in quartz ribbons. ***b***, Photomicrograph of the hornblende fish; thrust slip to NE is indicated. ***c***, High-angle fractures in feldspar clasts showing book-shelf gliding.

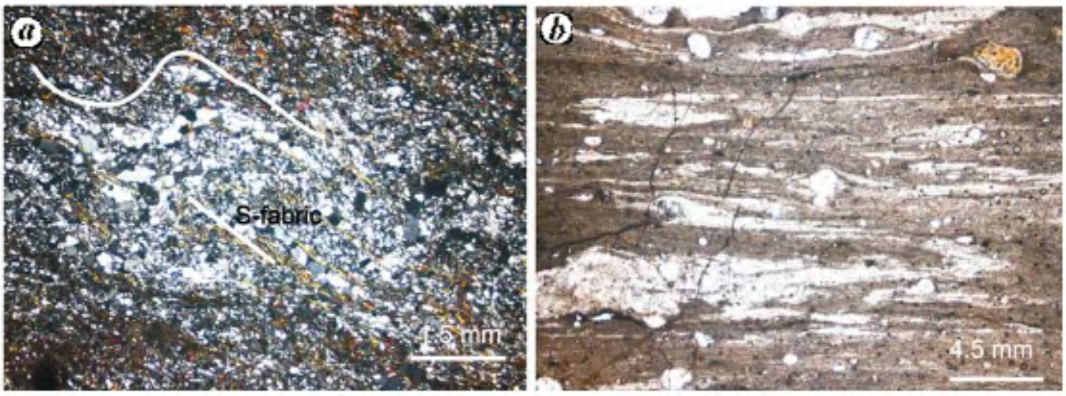

Figure 4. ***a***, Photomicrograph of the asymmetric fold in phyllonite; left lateral shear is indicated. ***b***, Photomicrograph of the isoclinal fold and delta-type porphyroclasts; thrust slip to NE is indicated. The folds are extremely thickened at the hinge and thinned at the limb, suggesting flattening.

stallized mica layers alternating with extremely stretched quartz ribbons that shows undulose extinction and marginal recrystallization (Figure 3 *a*): The clasts are dominantly alkali feldspar, which show rotation suggesting thrust slip towards NE. Hornblende fish is observed showing distinct tail that suggests thrust slip in the similar direction (Figure 3 *b*). Microfaults inside the feldspar porphyroclast show sinistral shearing antithetic to the main shearing (Figure 3 *c*). S–C fabric is observed in phyllonite where the C-fabric is defined by shear bands marked by growth of mica and polygonized thin quartz ribbons, while the S-fabric is defined by an oblique growth of quartz and biotite to C-fabric. The angularity between S and C suggests a sinistral shearing. This is further substantiated by sinistral asymmetric folds developed in the quartz ribbons where the S-fabric remains axial planar to the folds (Figure 4 *a*). Isoclinal folds with large degree of flattening are observed in the mylonites (Figure 4 *b*).

The subhorizontal mylonitic foliation with northeasterly lineation leads to the implication that the Salem–Attur shear zone represents a northeasterly vergent subhorizontal to low-angle thrust (Figure 5), and that the thrusting postdates the granulite facies metamorphism. The thrust zone splays and rejoins; thus isolated lenses of low-strain charnockitic blocks occur inside the shear zone. Since the thrusting has been developed on a well-banded metamorphic rock, folds (F_s) are developed on the bandings due to buckling instability. Progressive shearing has turned these folds from open to tight and isoclinals (Figure 4 *b*) and subhorizontal shear fractures are developed parallel to the axial plane of the folds. Subsequently, the thrust planes are folded by ENE–WSW trending upright fold (F_1), which has brought variation in attitude of the thrust planes and mylonitic foliation (Figure 5). Thus the mylonitic foliations show dip variation from north to south and the mylonitic lineations are folded along the E–W axes to show down-dip plunge on such steep foliations. The F_1 folding has contributed towards widening of the shear zone in some sectors. Further, the F_1 folds show variation in plunge. As a result the down-dip mylonitic lineations are rotated to subhorizontal attitude with increase in plunge amount of the fold.

From this study we interpret that that the Salem–Attur shear zone developed as a low angle to subhorizontal thrust and subsequently was folded to assume variable attitude. This study has wide implications as the Salem block is considered to be a foreland fold-thrust belt created during collision of the Northern and Southern Granulite blocks[20].

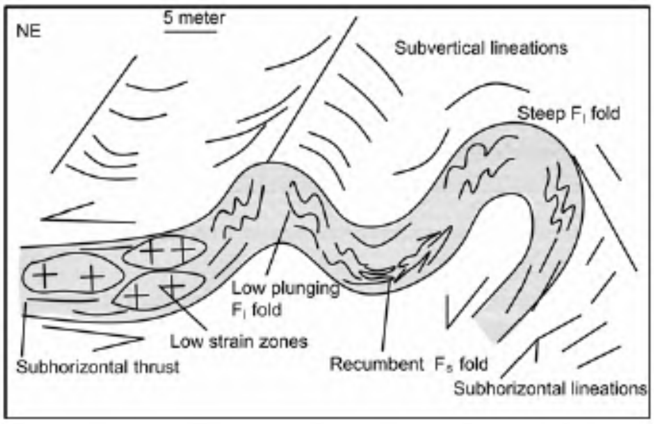

Figure 5. Schematic diagram showing NE-directed subhorizontal thrust (representing the Salem–Attur shear zone) that has been folded by F_1 folds. The folds vary in plunge from gentle (left and central) where the mylonitic lineations are down-dip, to steep where lineations are rotated to horizontal attitude. The thrust encloses a number of horses of charnockites (low strain zone, cross marks).

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Monitoring bird diversity in Western Ghats of Kerala

J. Praveen[1,]* and P. O. Nameer[2]

[1]No. 14/779(2), Ambadi, Kunnathurmedu P.O., Palakkad 678 013, India
[2]Centre for Wildlife Sciences, College of Forestry, Kerala Agricultural University, Thrissur 680 656, India

This communication elaborates a case study in Kerala, where 61 surveys have been conducted from 1990 to 2008 in 21 protected areas and reserve forests in the southern Western Ghats for monitoring bird fauna using the amateur bird-watcher network. Four different methodologies have been used in these surveys, with encounter-based transects being the most common. A significant result of these surveys is in identifying the relative conservation value of these forest areas in protecting endemic and threatened avifauna.

THE Western Ghats, identified as one of the biodiversity hotspots of the world, is a 1600 km long chain of mountain ranges running parallel to the western coast of the Indian peninsula. Among the three distinct sections of the Western Ghats, the southern Western Ghats is one of the richest abodes of tropical moist forests in the country. A large portion of the southern Western Ghats falls within Kerala, with a few significant spur hills extending into the neighbouring Tamil Nadu, viz. Nilgiris, Palani, High-Wavies and the Kalakkad. The restricted range and habitats of many of these endemics are under threat. Among the 16 Western Ghats endemics, one is Endangered, three Vulnerable and four Near-Threatened. Three of the endemics have different races in the Western Ghats – Grey-breasted Laughing-thrush (*Garrulax jerdoni*) has three races, White-bellied Shortwing (*Brachypteryx major*) and Rufous Babbler (*Turdoides subrufus*) have two races each. Some of these races are considered as full species by recent authors[1].

Avian studies in the southern Western Ghats have been sporadic. Figure 1 summarizes the periods of important ornithological workers in the region. However, ornithological expeditions into these bio-rich areas have been much restricted until the advent of the large-scale, coordinated bird surveys, which began in the 1990s; an activity which is significantly contributing to the ornitho-knowledge in the Western Ghats of Kerala.

Bird monitoring using volunteer-based networks is a tested strategy to cover large areas in several countries, mostly resulting in bird atlases. Dunn and Weston[2] reviewed 272 bird atlas projects from 50 countries in six continents and found that most of them (82.4%) are from Europe and North America. These projects were mostly run by ornithological societies, and had resulted in at least 27.9 million records of birds over an area roughly 31.4% the land area of the earth, involving at least 108,000 contributors. Two such efforts worth mentioning in India are Asian Wetland Count conducted since 1987 and MigrantWatch[3] launched by the National Centre for Biological Sciences (NCBS) in 2007. In Kerala, the Malabar Nature History Society (MNHS) runs a Common Bird Monitoring Programme (CBMP) using volunteers in several districts and has had moderate success (Sashikumar, pers. commun.).

The concept of a bird survey using the amateur bird-watcher network for monitoring the protected areas in Kerala was envisaged in the Silent Valley National Park in December 1990. Since then 61 surveys have been conducted till date and the Kerala Forest Department (KFD) has played a pivotal role in the activity – logistically and financially (Figure 2). Most of these surveys were anchored by various NGOs (Figure 3), and they now form the backbone of the Indian Bird Conservation Network (IBCN) in Kerala. Results of these surveys are prepared as a report by the NGOs and circulated among the participants and the KFD. When found relevant, a concise report in the form of an article is published by the coordinator(s) in a peer-reviewed journal[4–9].

Details of the bird surveys conducted between 1990 and 2008 in the Western Ghats of Kerala are given in Table 1 and Figure 4. About three bird surveys per year have been conducted during this time. However, there have been years (2003) during which up to eight surveys were done, while there have been some of the early years which had only one bird survey. Regular bird monitoring has been done in Shendurney Wildlife Sanctuary (WLS; 13 years) in South Kerala and at Aralam WLS (9 years) in North Kerala. Round-the-year monitoring with surveys in three different seasons has been conducted in Chinnar WLS (1998–99) and Silent Valley National Park

*For correspondence. (e-mail: paintedstork@gmail.com)