NE-SW Strike-Slip Fault in the Granitoid from the Margin of the South East Dharwar Craton, Degloor, Nanded District, Maharashtra, India

Md. Babar, R. D. Kaplay, Soumyajit Mukherjee, Souradeep Mahato and Chandrakant Gurav

1 Introduction

Present study emphasizes deformations in the basement granite from the 'South East Deccan Volcanic Province' (SEDVP) around Degloor/Diglur. W dipping thrusts (Kaplay et al. 2013), steep normal faults, fault planes dipping towards S, from basalts and deformations from Quaternary deposits (Kaplay et al. 2017a) were reported from the area around Nanded. Similarly, Kaplay et al. (2017b) studied the margin of SEDVP around Kinwat lineament, Maharashtra, India, (northern part of Nanded district). The E-W strike-slip faults (with maximum net-slip of 24 cm) were identified in the basement granite from the Kinwat region. The zone was designated as the 'Western Boundary East Dharwar Craton Strike-Slip Zone' (WBEDCSZ). This prompted us to study the structural aspects of another margin of SEDVP with basement granite near the Degloor region. The study area (Fig. 1) is located ~135 km SSW of Kaddam fault, the area from where strike-slip faults were reported from the basement granite (Sangode et al. 2013).

Basement structures affected Deccan tectonics. For example, ~N-S Dharwar trend in the basement was inherited as weak planes in Deccan trap in subsequent strike-slip faulting around Mumbai (Misra et al. 2014).

Md. Babar · C. Gurav
Department of Geology, Dnyanopasak College, Parbhani 431401
Maharashtra, India

R. D. Kaplay
School of Earth Sciences, S.R.T.M. University, Nanded 431606
Maharashtra, India

S. Mukherjee (✉) · S. Mahato
Department of Earth Sciences, Indian Institute of Technology Bombay,
Powai, Mumbai 400076, Maharashtra, India
e-mail: soumyajitm@gmail.com

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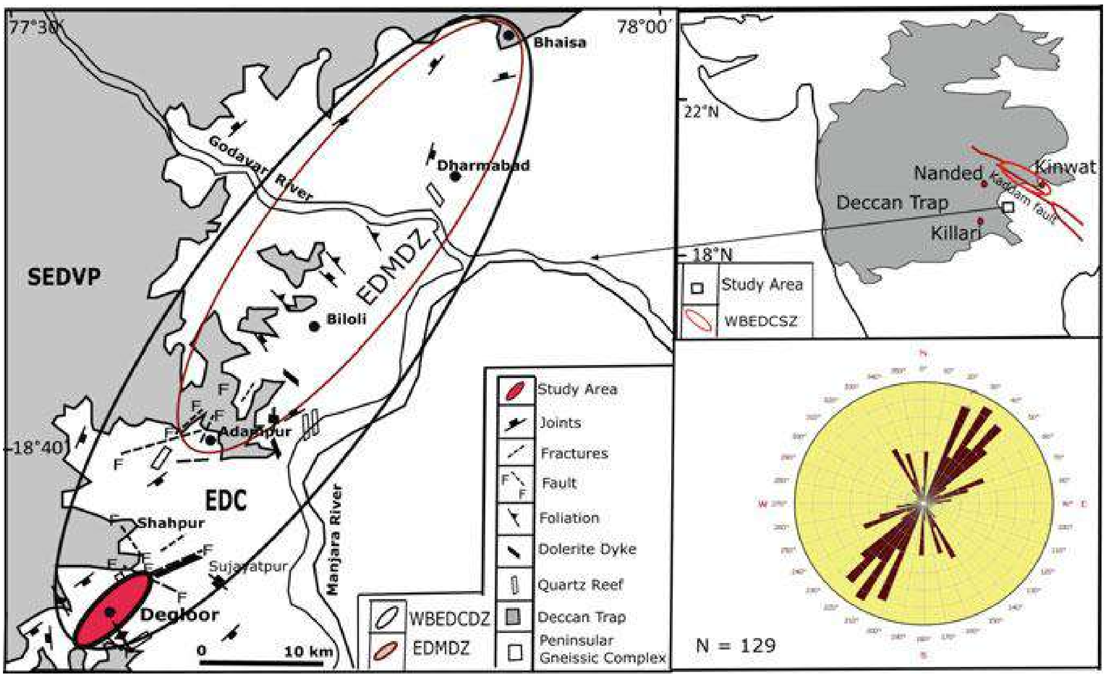

Fig. 1 Location map showing deformation zones along SEDVP contact with EDC. SEDVP: South East Deccan Volcanic Province, EDC: East Dharwar Craton, EDMDZ: East Dharwar Margin Deformation Zone, and WBEDCDZ: 'Western Boundary East Dharwar Craton Deformed Zone'. Right corner inset: Rose diagram- dominant trend of the strike-slip faults from the regions 1–5. Data population: N = 129. (Geology after Banerjee et al. 2012)

The Degloor region is characterized by westernmost part of East Dharwar Craton with basement granite. The Deccan trap exposes about ~10 km from the Degloor granite. The Degloor region consists of Palaeoproterozoic high K-granitoids (Banerjee et al. 1993; Wesankear and Patil 2000). These rocks are also referred to as the Nanded granitoids (NG) by Banerjee et al. (2012). They are the continuation of 'Peninsular Gneissic Complex' (PNG) along the Deccan Traps boundary (SEDVP) (Banerjee et al. 2012). These granites are coarse-grained pink and gray with porphyritic texture. Quartzo(-feldspathic) veins and pegmatite dykes intrude them profusely. The dark coloured basic enclaves are also commonly associated with these granites. At places WNW trending mafic dykes also exposed. The granites exposed as detached mounds/along the course of the river. These granites are part of the reactivated and remobilized EDC (GSI 1979, 2001).

Banerjee et al. (2012) report that these granitoids demonstrate well developed mostly NE and NW trending joints and local foliations. These authors also report (i) minor slip in pink feldspar bands near Sagroli- ~24 km NE of Degloor; and (ii) several minor faults close to the 'South East Deccan Volcanic Province-East Dharwar Cratorn margin, and minor folding within the EDC. However, Banerjee et al. (2012) did not present structural details. On the other hand we worked on this basement granite for detail structural geology. The methodology of the present study have been data collection through fieldwork, and their interpretation.

2 Structures Observed in Degloor—The Present Study

Reverse faults, normal faults (step faults), strike-slip faults, brittle shear along the boundary of veins, minor folds and boudins are observed in the basement rock. In Fig. 2, a thin quartz vein is faulted in normal manner at as many as 12 locations. These faults are (sub) parallel to each other and constitute a step-like array with small throw. The fault plane dips 80° due W. The slip of fault plain varies from 1.6 to 6.5 cm.

Brittle strike-slip faults are numerous in the study area. In some cases, single veins are strike-slip faulted (Fig. 3a). In Fig. 3b, a pegmatite vein is dextrally faulted. In Fig. 3c, slightly folded pegmatite vein is slipped possibly with a “reverse drag” (Mukherjee and Koyi 2009). A medium size pegmatite vein (A) in granitic country rock (B), at the contact of basic dyke (C) shows reverse slip but no drag close to the fault plane (Fig. 3d). A pegmatite vein is strike-slip sinistrally faulted twice in two directions. Sigmoid P-planes decode the former slip, and sharp offset the later one (Fig. 3e). Brittle shear fractures and fault planes were also observed; Y-planes and the fault planes in Fig. 4a–d and also in Fig. 5 trend NE, showing both sinistral and dextral slip. A thin vein, observed on a horizontal plane, is reverse dragged only at one side of the fault plane. At the other side, no drag is noted (Fig. 3f). The slip is 17 cm and fault strikes ~NE. A rather irregular basic intrusion in granitic rock shows faulting. This is a strike-slip fault (Fig. 6a).

In other cases, single veins are multiply faulted (Fig. 6b). Fault ‘A’ strikes N20° E and slips 9.0 cm; ‘B’ strikes N50°E and slips 5.0 cm; ‘C’ strikes N75°W and slips 24 cm; and ‘D’ strikes N80°E and slips 28 cm. In Fig. 6c, the quartzo-feldspathic vein is dextral faulted at three places. The en-echelon joints

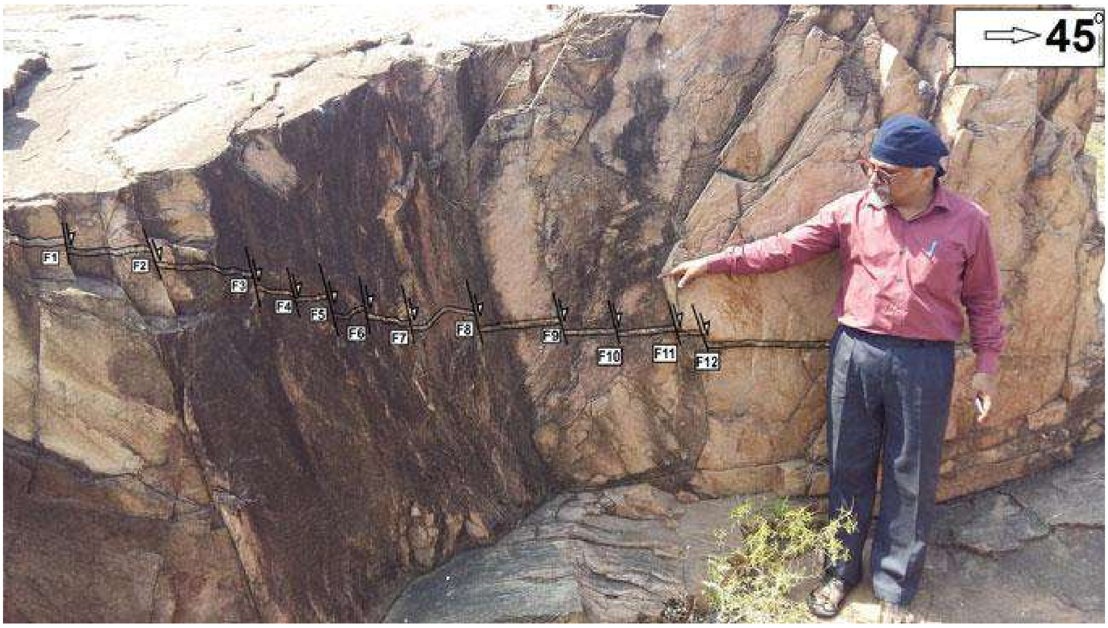

Fig. 2 Step faulting in quartz vein (12 faults in vertical section). We tend to think them as a manifestation of a major fault, since our observations repeat

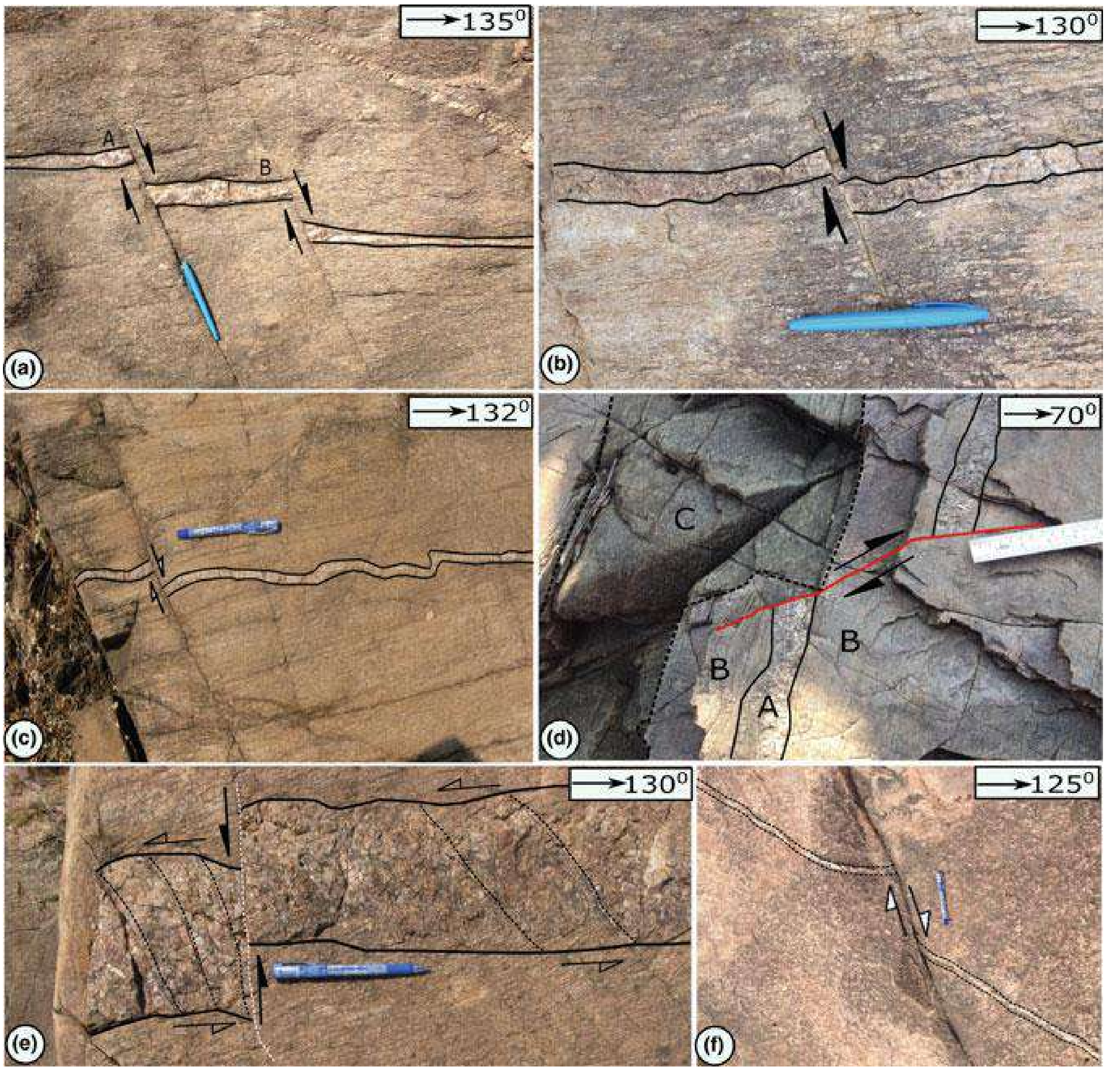

Fig. 3 **a** Normal step faults exposed on steeply inclined exposure, at ‘A’ and ‘B’ dip towards E at 25°. Net slip: 5.5 cm both at ‘A’ and ‘B’. **b** Dextral sheared pegmatite vein, 2.1 cm net slip along NE trending fault plane. **c** Joints acted locally as brittle-ductile fault planes (strike N20°E, 3.2 cm slip), at horizontal outcrop. **d** Dextral brittle slip. Net slip 12 cm; N45°E (horizontal exposure). **e** Sinstral shear (at horizontal outcrop). Strike of the fault is N20°E; net slip is 5.0 cm. **f** A thin vein shows bending before it is deformed in an brittle manner (horizontal exposure)

locally acted as fault planes. In Fig. 6d as well, the quartzo-feldspathic vein faulted along joint planes at three places both dextrally and sinsitrally.

In Fig. 7a, the vein is faulted at four places. At ‘A’ the sense of movement is sinistral, while at ‘B’, ‘C’ and ‘D’ the sense is dextral. At ‘B’ the vein has not lost the continuity indicating local ductile deformation. At ‘A’, the vein is bent close to the fault plane indicating drag.

A quartz vein (Fig. 7b) slips at three places along parallel set of N6°W-S6°E trending faults. The displacement at ‘A’ is 7 cm, at ‘B’ it is 4.2 cm and at ‘C’ it is 4 cm. In Fig. 7c, curved joints act as fault planes slipping the vein at five places. One more slip is noted at ‘F’. Some of these fault planes are curved. In some of the cases, one of the veins is strike-slip faulted (Fig. 7d) while the other parallel vein is

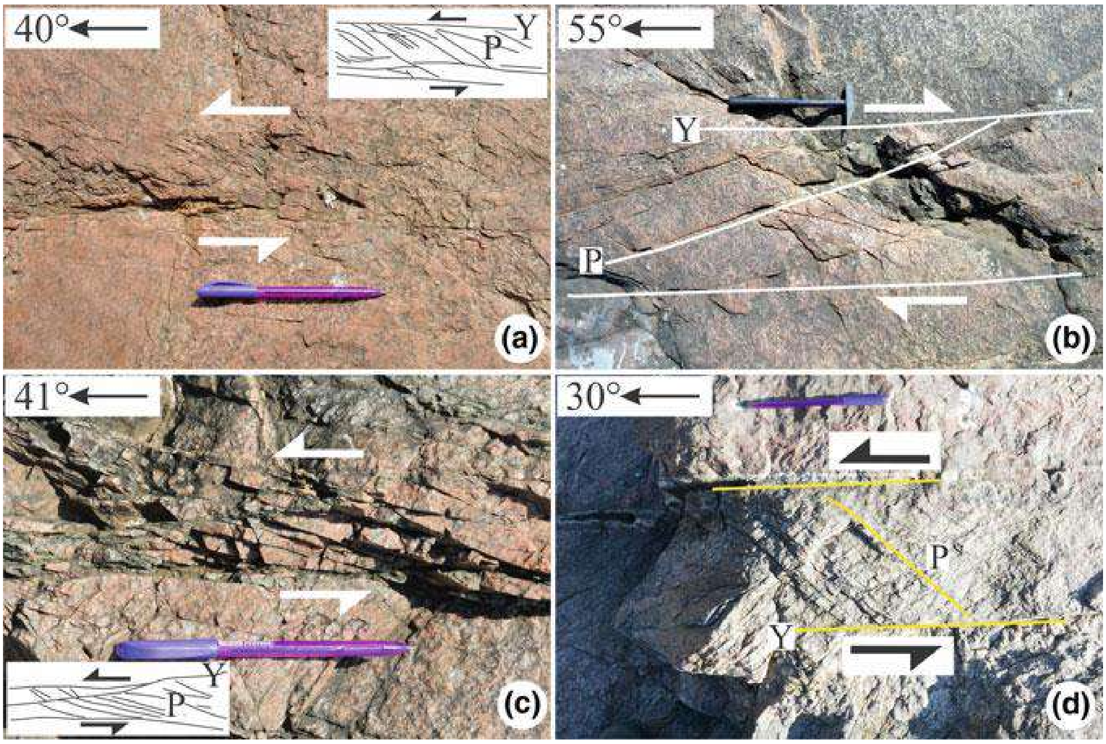

Fig. 4 Brittle strike slip shear observed on horizontal exposures. Y-plane trends ∼ NE. **a**, **c**, **d** Sinistral slip. **b** Dextral slip. Additionally: **d** secondary quartz along Y-plane

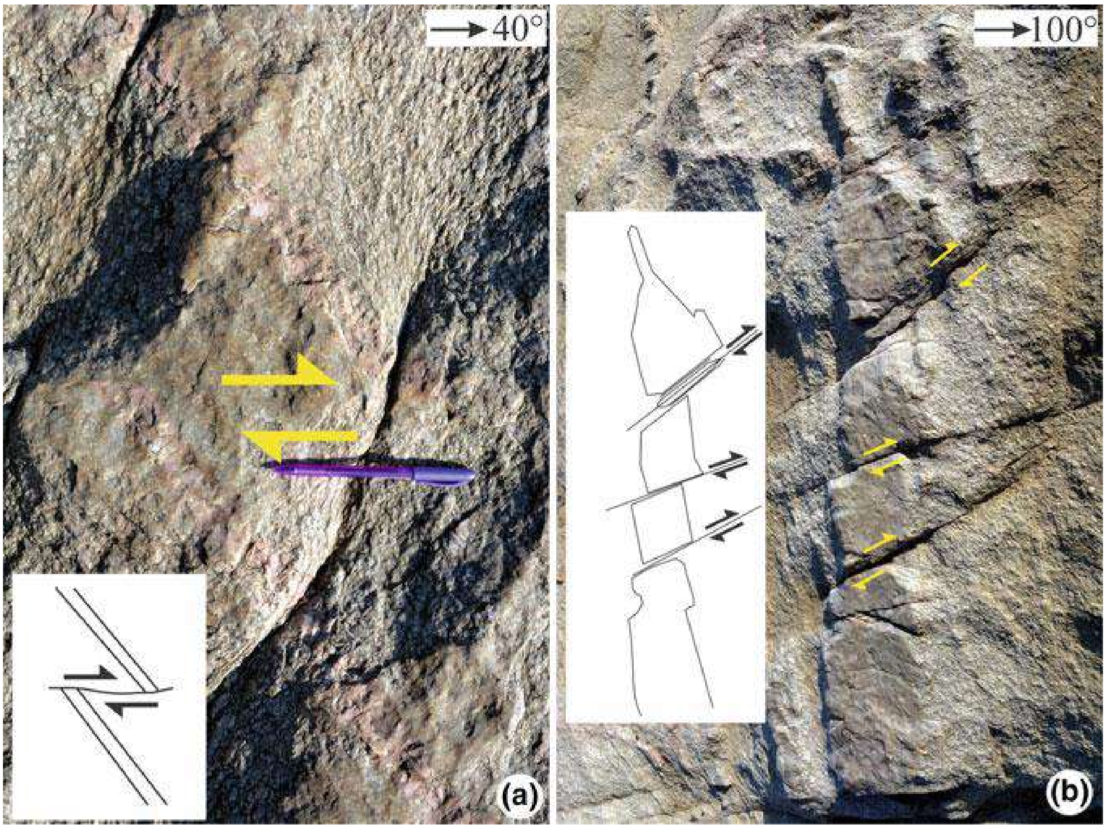

Fig. 5 **a** Quartzo-feldspathic vein dextral slipped along N40°E striking fault. **b** Three fault planes marked on the diagram are vertical, striking N69°E, N85°E and N54°E from bottom to top of the image also show dextral slip

soumyajitm@gmail.com

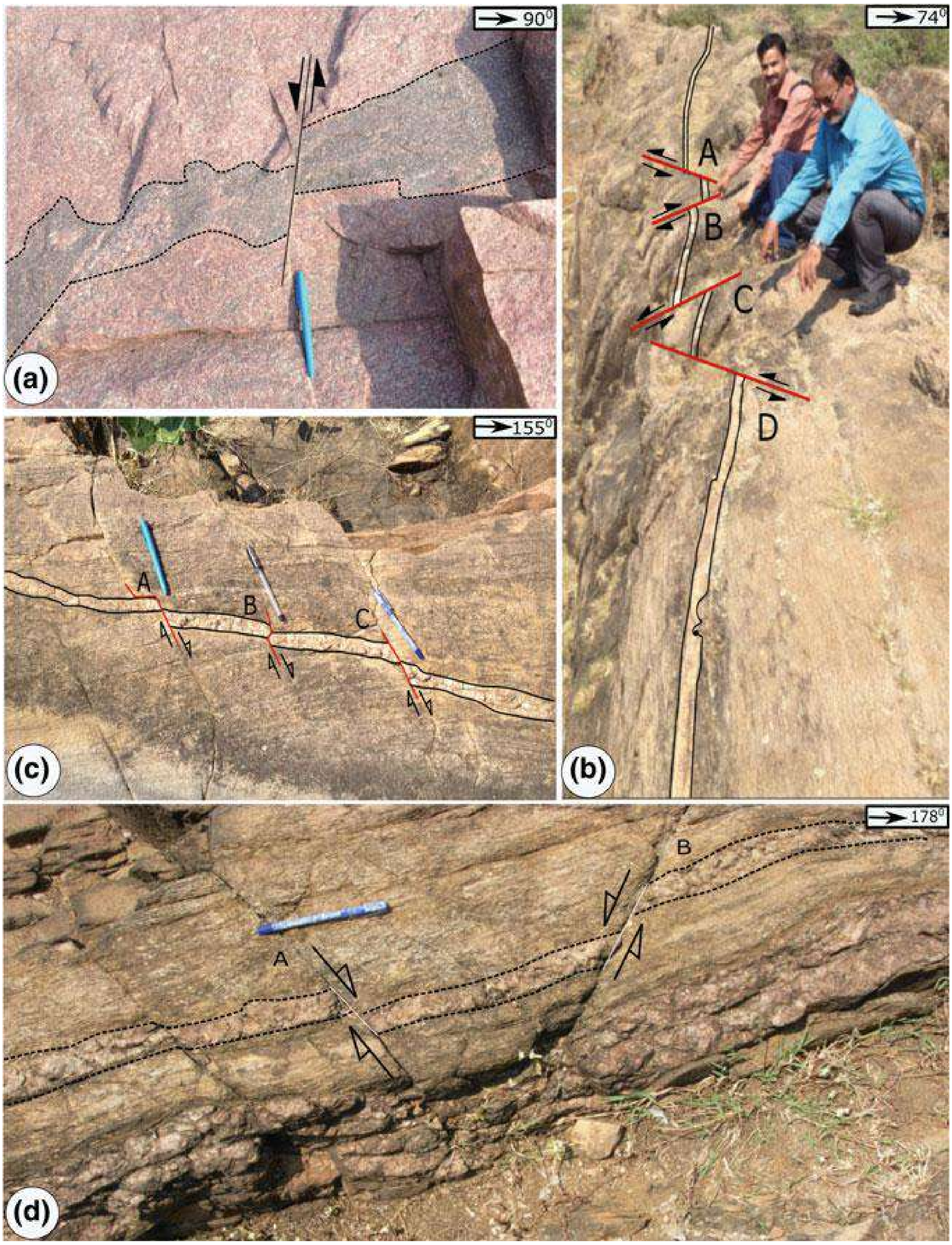

Fig. 6 **a** Basic intrusion faulted with 2.2 cm slip. Fault strikes NE. **b** Multiple faults (at horizontal outcrop). **c** Joints acting as fault planes, at horizontal outcrop. Fault strikes N65°E at 'A' with 3 cm slip, at 'B': strike: N65°E, slip: 2.0 cm; at 'C', strike: N65°E, slip: 3.5 cm. **d** 'A' and 'B' are the joints which acted as fault planes in displacing pegmatite vein (horizontal outcrop). At 'A' the fault strikes N48°E, with 4.0 cm slip, at 'C', strike: N78°W, slip: 9.0 cm

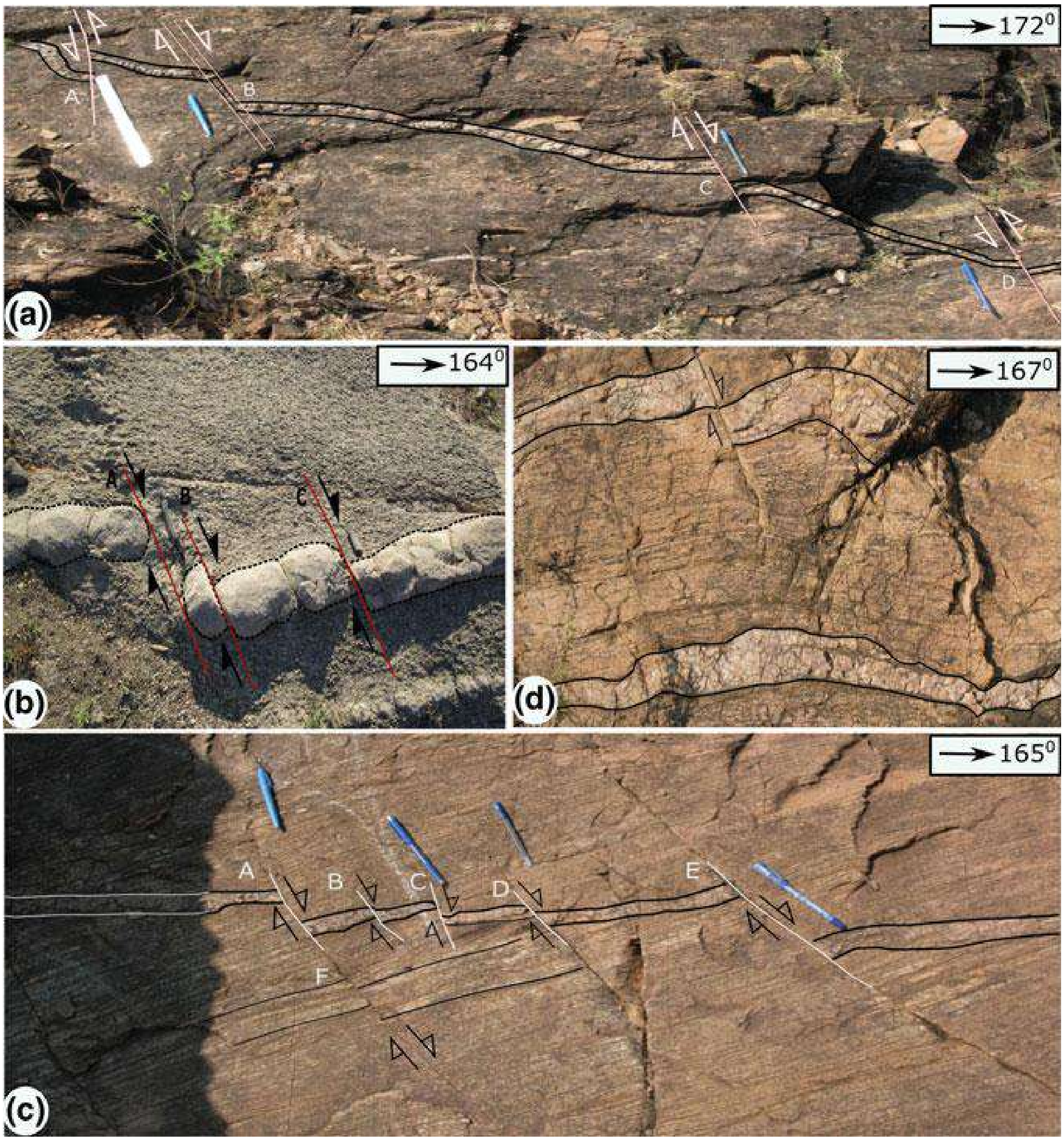

Fig. 7 **a** Vein displaced at four places, at horizontal outcrop. Strike of the fault at ‘A’: N30°E, slip: 7.0 cm, at ‘B’ strike: N30°E, slip: 10 cm, at ‘C’ strike: N65°E, slip: 6.5 cm; at ‘D’ strike: N50°E, slip: 13 cm. **b** Quartz vein faulted at three places: ‘A’, ‘B’ and ‘C’. Sense of slip: dextral. **c** Curvilinear en-echelon joints acting as fault planes, at horizontal outcrop. Slip at ‘A’ is 8.0 cm, at ‘B’ 0.2 cm, at ‘C’ 4 cm, at ‘D’ 2 cm, at ‘E’ 14 cm; and at ‘F’: 3.8 cm. The strike all these small faults is N35°E. **d** At ‘A’ the vein shows deformation with 8 cm strike slip. Fault strikes N60°E. At ‘B’ the vein is unaffected by faulting and is open folded (at horizontal outcrop)

undeformed. In other words, in meso-scale one can see termination of fault planes. In Fig. 8a, the topmost vein (A) faults at four places (locations ‘D’ to ‘G’) along parallel en-echelon joints while the lower vein (‘B’) is not. The host rock (‘C’) above and below the vein ‘A’ is also faulted. In some other cases, parallel veins faulted (Fig. 8b). Here, left vein shears sinistrally and the right vein oppositely and dextrally. In Fig. 8c, however, both the veins shear dextrally.

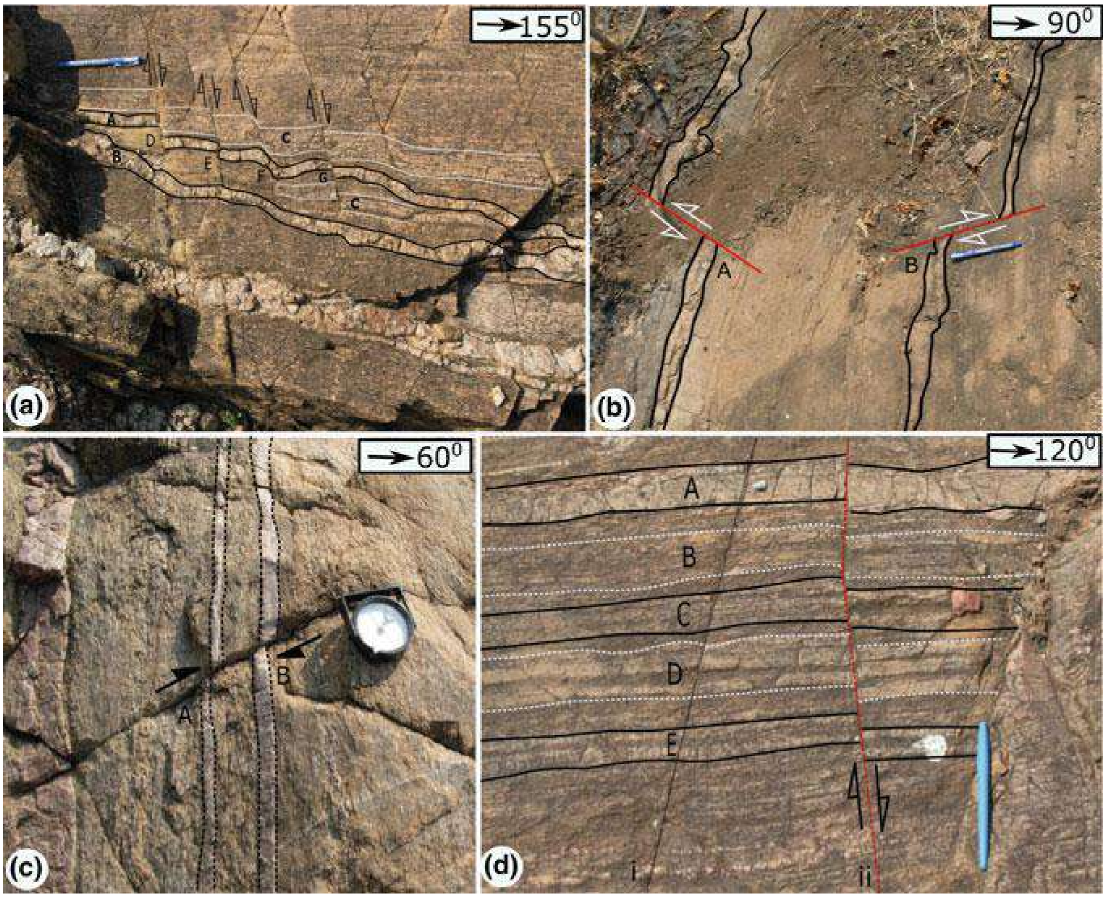

Fig. 8 **a** En-echelon joints (marked as 'D', 'E', 'F' and 'G') displaced the vein in brittle and ductile-brittle manner (at horizontal outcrop). At 'D' slip: 2.0 cm, at 'E': 0.6 cm, at 'F' the vein is ductile deformed, at 'G' slip is 0.5 cm. These faults strike ~NE. **b** brittle deformation (at horizontal outcrop). Strike of the fault at 'A' is N40°W with 26 cm slip; at 'B' strike: N70°E, slip 14.0 cm. **c** Two parallel veins brittle deformed. At 'a' 2 cm strike slip, at 'B' 1.5 cm slip. Fault strikes N40°E. **d** Multilayered faulting

Several layers in the rock got faulted (Fig. 8d). Two conjugate joints, i and ii, cut through the layers. Joint i does not slip the layer, however, joint ii does dextrally. Therefore joint ii can be called more accurately a fault. The strike of the fault is N30°E. The displacement for layer 'A' is 0.8 cm, for 'B' 0.9 cm, for 'C' 1.1 cm, for 'D' 1.2 cm, and for 'E' 1.4 cm. Slip increases locally towards SW. Commonly fault planes demonstrate maximum slip near their central part and at the margins minimum or zero (review in Mukherjee 2014a). Figure 8d is an exception.

Conjugate strike-slip faults at ~30° are observed in this study at places (Figs. 6d, 9a, b and 10). Fault 'A' strikes N50°E and slips 7 cm. Fault 'B' strikes N80°E and slips 6 cm. Spectacular conjugate multilayer strike-slip faulting is observed in the ancient granitoid rock (Fig. 10). On a ~N striking fault, brittle-ductile slip of 3 cm is noted at 'A', 5 cm at 'B', and 1.2 cm at 'C'. On a

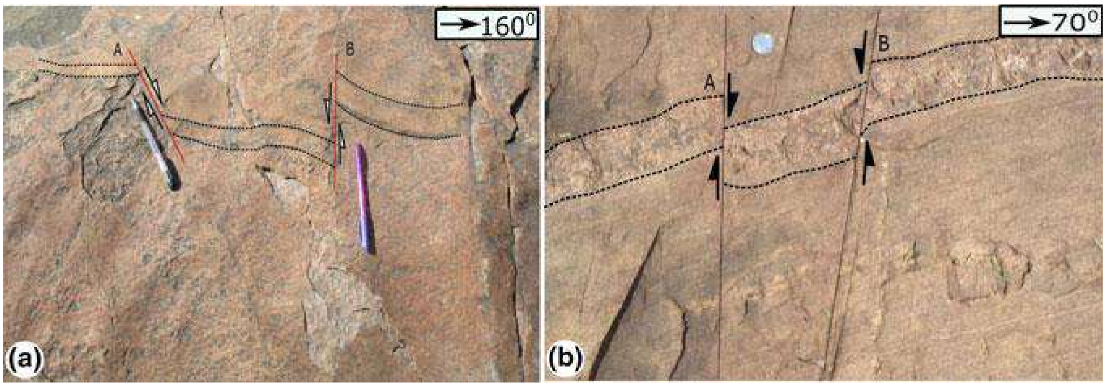

Fig. 9 **a**, **b** Conjugate strike-slip faults

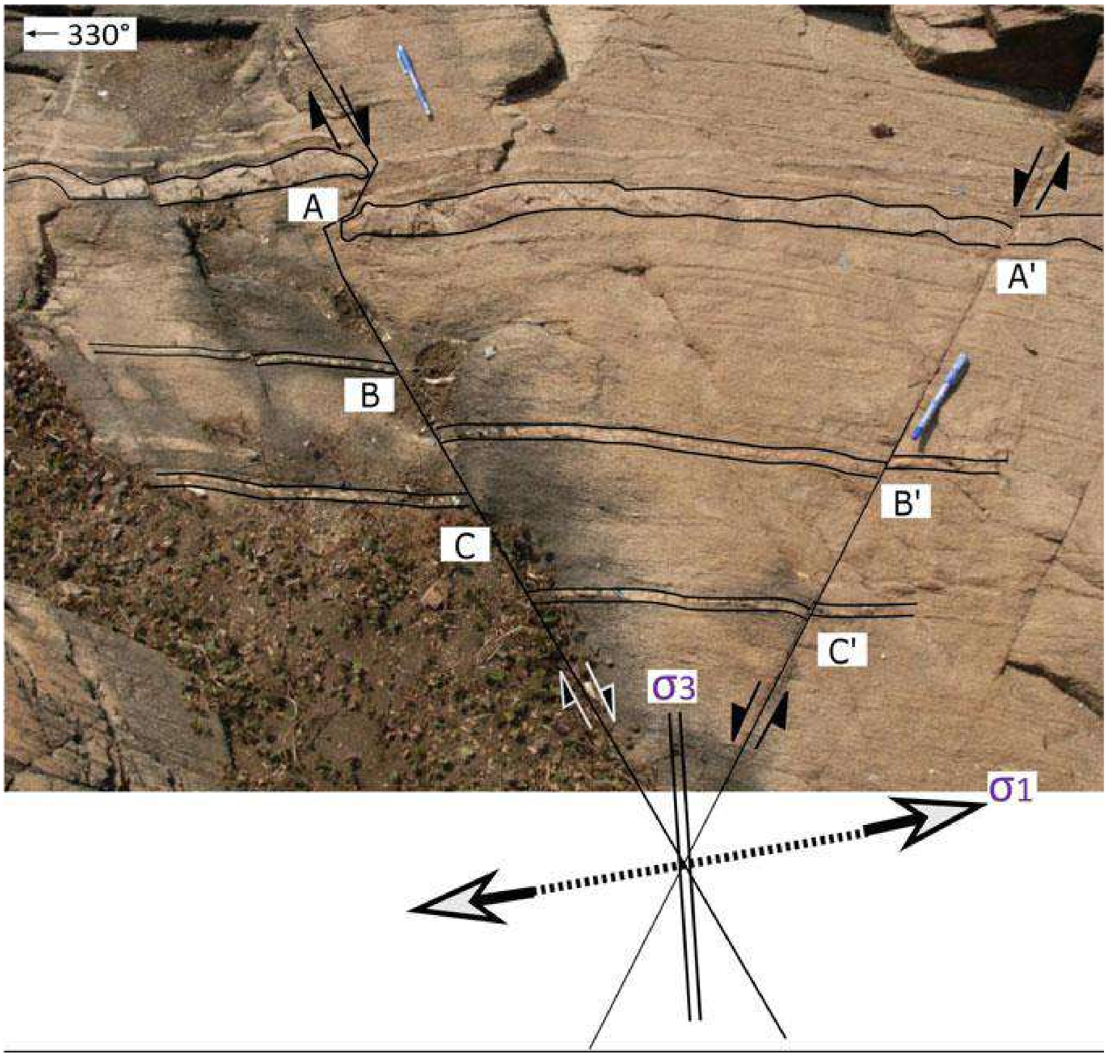

Fig. 10 Multilayer strike-slip faults (at horizontal outcrop)

N30°E striking plane, slip at ‘A$^{/}$’ is 1 cm, at ‘B$^{/}$’ is 1.1 cm, and at ‘C$^{/}$’ is 1 cm. The thickest pegmatite layer is sheared sinistrally. Note fracture patterns inside the vein. That shear acted prior to the conjugate faulting. The left hand side geographic direction in this snap is N30°W/330°. A pegmatite vein faults along two sub-parallel planes. Since the angle between the two fault planes is rather low, they are not conjugate faults. Fault ‘A’ strikes N25°W and slips 2 cm. Fault ‘B’ strikes N6°W and slips 4 cm.

‘Intrusion-in-intrusion’ feature is ductile sheared (Fig. 11). Basic intrusion (B), with quartz vein (C) within, inside host granitic rock (A), is ductile sheared along N20°W-S20°E. Both the basic intrusion and the quartz vein thin significantly inside the shear zone (Fig. 11). Outside and inside the shear zone, ‘B’ is 22 and 6 cm thick, respectively. Likewise, ‘C’ is 6 and 1 cm thick.

Though major/regional folds are absent, small (ptygmatic) folds are found in vertical and horizontal sections. Synclinal type of fold is observed at one place (Fig. 12a). The axial plane is slightly inclined. A folded structure, at the horizontal outcrop, is exposed in granitic gneiss (Fig. 12b).

Folding in quartzo-feldspathic vein/pegmatite veins is also a common feature observed in the study area (Fig. 12c). At many places, pegmatite veins intruded in host granitoids is ptygmatic folded (Fig. 12d; also see Mukherjee et al. 2015). Drawing tectonic inferences from ptygmatic folding would be difficult because of their irregular and sometimes inconsistent geometries. ‘S’ and M-type folding in

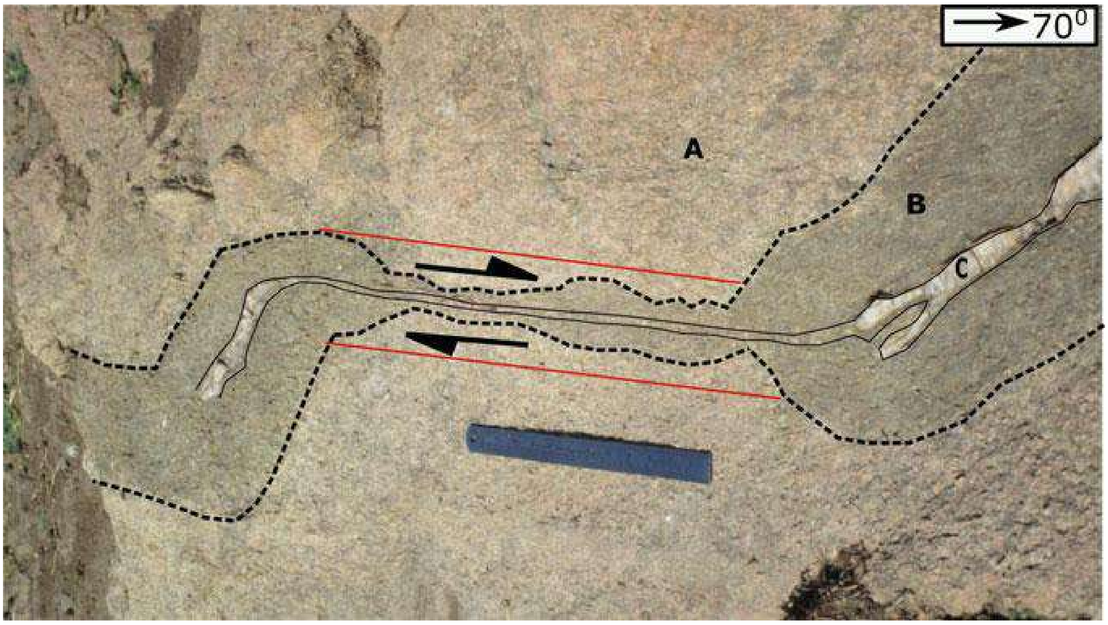

Fig. 11 Quartz vein (C) within basic intrusion (B) in host granitoid (A) ductile deformed. Shear zone is marked by red lines (at horizontal outcrop)

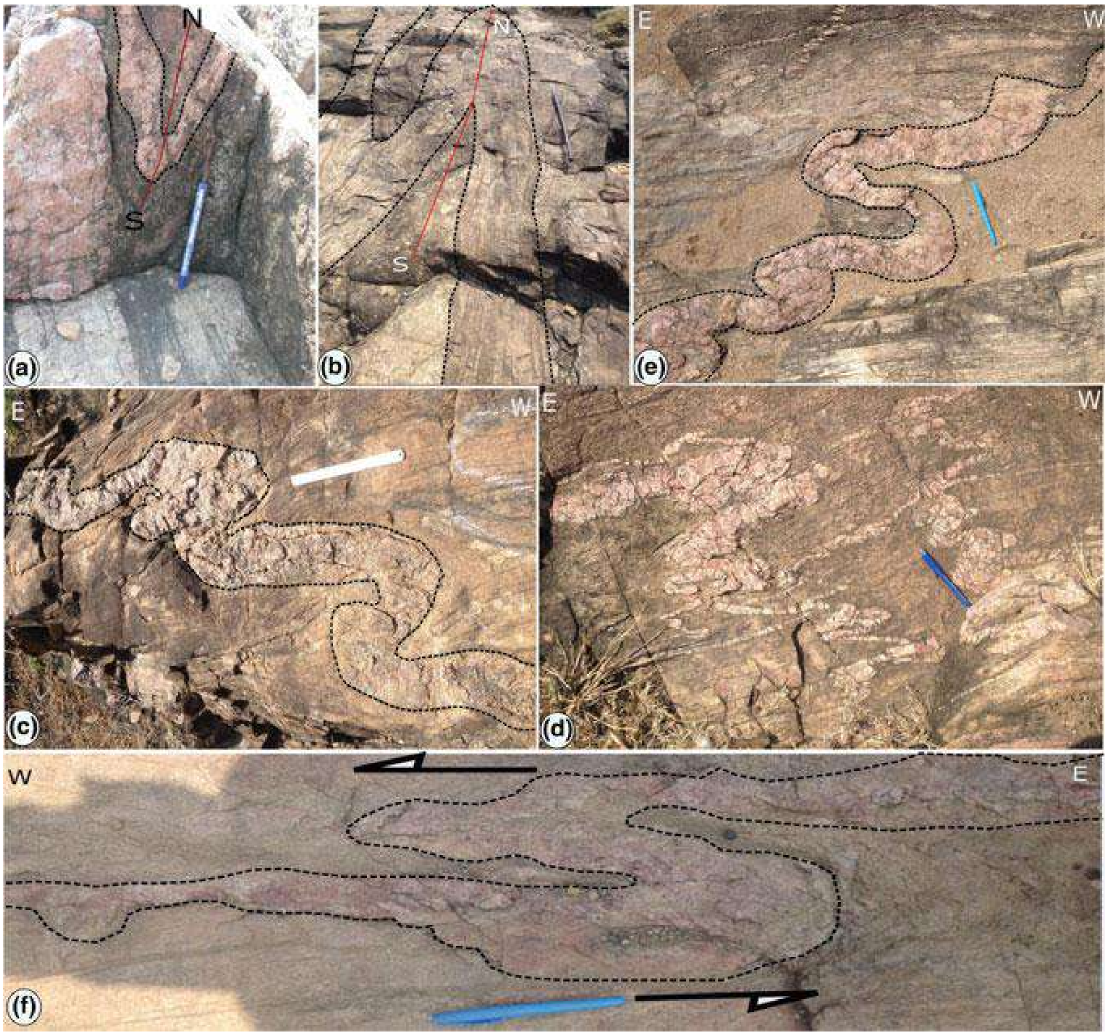

Fig. 12 **a** Asymmetric folds at vertical outcrop. **b** Folding in granitic gneiss (horizontal outcrop). Axial plane trends N. **c** Folding in pegmatite vein (horizontal outcrop). **d** Ptygmyatic folding. (E-W trending photo). **e** Pegmatite vein folded (W-E trending photo). **f** Folding in pegmatite vein (horizontal outcrop)

pegmatite dyke in granitoid (Figs. 12e, f and 13a, b) do exist though we do not decipher any regional folding. ‘Z’-type tight fold with hinge thicker than the limbs is observed in one of the pegmatite veins. Multiple (faint) faults also occur in the close vicinity (Fig. 13c). Pinch and swell structures of pegmatite layer indicates local brittle-ductile NW-SE extension. Not all swells resemble geometrically, while few are sub-elliptical.

There are two major trends of vertical joint planes observed. Trend-1 varies N10° to 340°NW and trend-2 260°SW to 280°NW (Fig. 14).

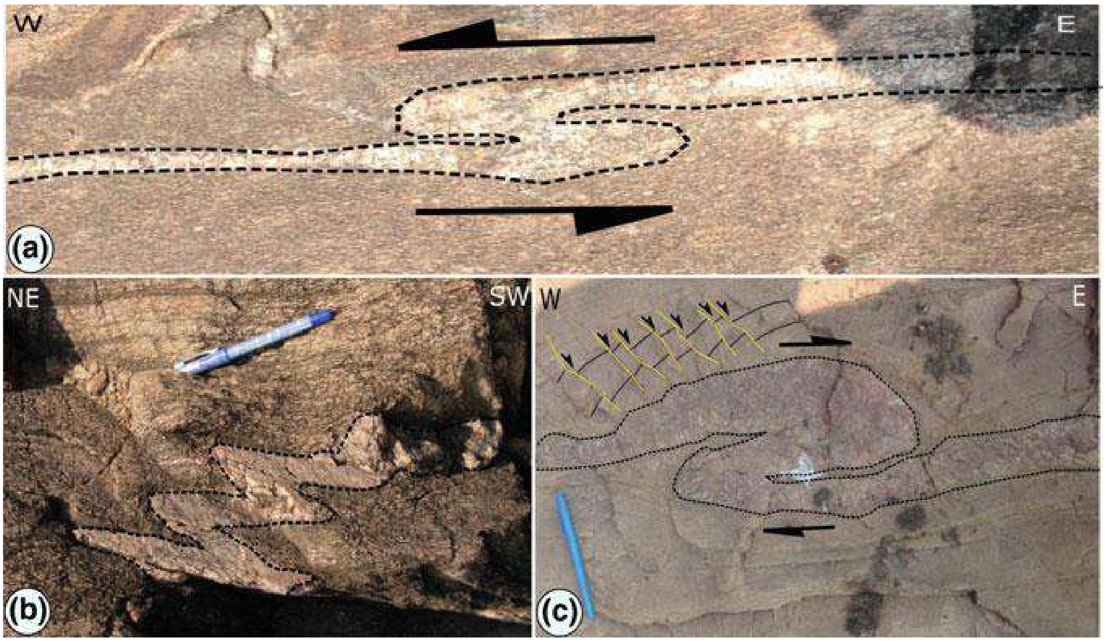

Fig. 13 **a** Folding in pegmatite vein. **b** 'M' type of folded pegmatite vein. **c** 'Z' type folding with multiple faulting in its close vicinity (W-E trending photo)

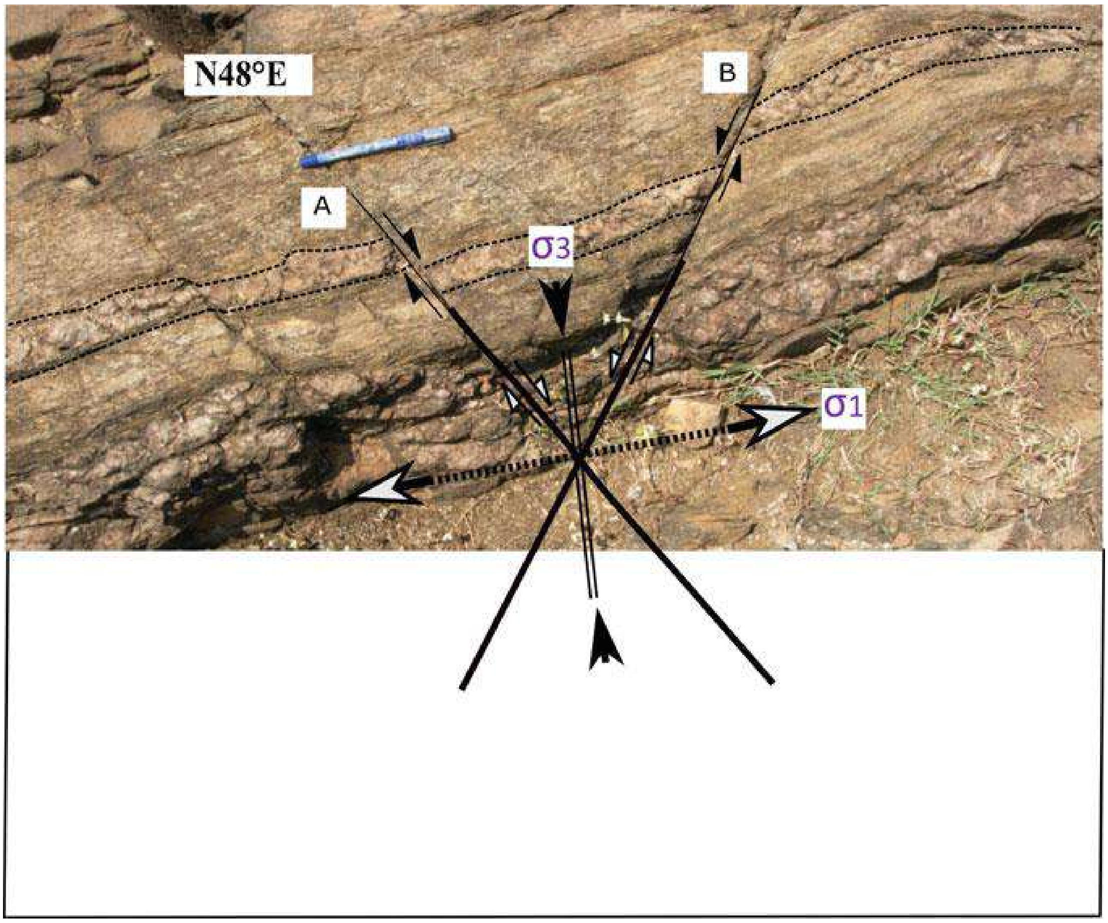

Fig. 14 Mechanism of strike-slip conjugate faulting. Strike of the fault is N50°E. Red dash lines: actual fault lines, black solid lines intersecting shear axes. σ_1: short solid black arrow, σ3, compressive stress axis: open arrow

3 Discussions

The faults/fractures/shear zones, in the Degloor region, are represented by a number of N to NNE, NE, NE and E bound lineaments (Banerjee et al. 2008). One NE trending fault is reported in between Shahapur and Sujayatpur, 9 km NE to the present study area and a shear zone near Madnoor. However, there has been no report of faults from the study area by the previous workers.

We document 129 small faults (Table 1) out of which 116 (~90%) are strike-slip, 12 (~9%) are normal faults, and only one (1%) is a reverse fault from the study area (Fig. 1). From these faults, 72% are of the strike-slip faults trend NE. 80% of the total strike-slip faults shear dextrally. Net slip of all the strike slip faults, where decipherable, varies 0.5–82 cm.

Conjugate or 'X' type joints at ~30°, devoid of any slip along them, is also observed. Conjugate joins were not observed in earlier studies from (other parts of) Deccan Traps such as Devey and Lightfoot (1986), Mitchell and Widdowson (1991), Babar et al. (2017), Bhave et al (2017), Kaplay et al. (2017a, b), Misra and Mukherjee (Misra and Mukherjee 2017) and Mukherjee et al. (2017). Most prominent sets of joints strike N50°E at 'A' and N80°E. These trends mostly match with the conjugate faults reported in Fig. 6d (N48°E), Fig. 9a (N50°E), Fig. 9b (N50°E), and Fig. 10 (N30°E). These joints played crucial role in displacing the veins in the region in a strike-slip manner. Similar types of joints have displaced various veins at other outcrops (Figs. 9a, b and 10). The angle between these two joints is 30°.

This work finds that the deformation style observed in the basement granite near Degloor, close to the contact of SEDVP with E Dharwar Craton, is dominantly strike-slip. This suggests that the region belongs to a tectonic regime with intermediate stress axis σ_2 vertical (in the past). Fault planes most dominantly trends NE.

Numerous conjugate strike-slip faults exist in the study area (Figs. 6b, d, 8b, 9a, b and 10). At some places, conjugate shear develop within the strike slip fault system (Fig. 14). The state of stress in such type of faulting consists of two horizontal principal stresses that are compressional push (σ_1; Fig. 14) in one direction and tensional pull (σ_3) in the perpendicular direction. The σ_1 direction bisects the acute angle, and the σ_3 the obtuse angle between the two fault planes that constitute the single conjugate set. The mechanism of faulting is shown in Fig. 14.

We refer the study area as the 'Degloor Strike-slip Shear Zone'. Note that strike-slip shear is reported from the basement granite nearer to the margin of SEDVP with Dharwar Craton at Kinwat (Kaplay et al. 2017a, b), which is ~135 km NNE of the present study area. The strike-slip faults, with movement parallel to the NE trend of Kaddam fault, are also reported close to Kaddam lineament (Sangode et al. 2013). Thus the Kinwat-Degloor-Kaddam triangular zone, so far explored, shows strike-slip tectonics. However, the deformation style, ~NE-SW at Degloor, does not match with the trend of those at northern margin of SEDVP with Dharwar craton near Kinwat (~E-W) and at Kaddam (~NW-SE),

Table 1 Deformation types and characters

Structure No.	Deformation regime	Fault type	Shear sense	Fault trend	Net slip (cm)
F1	Brittle	Strike slip	Dextral	N43°E	3.5
F2	Brittle	Strike slip	Dextral	N56°E	3.0
F3	Brittle	Strike slip	Dextral	N70° E	4.0
F4	Brittle	Strike slip	Dextral	N48°E	3.5
F5	Brittle	Strike slip	Dextral	N25°E	3.2
F6	Brittle	Strike slip	Dextral	N20°W	2.5
F7	Brittle	Strike slip	Dextral	N20°W	2.4
F8	Brittle	Strike slip	Dextral	N20°W	1.0
F9	Brittle	Strike slip	Dextral	N20°W	0.7
F10	Brittle	Strike slip	Dextral	N26°W	0.5
F11	Brittle	Strike slip	Dextral	N25°W	1.3
F12	Brittle	Strike slip	Dextral	N25°W	0.4
F13	Brittle	Strike slip	Dextral	N27°W	0.7
F14	Brittle	Strike slip	Sinistral	N25°W	1.6
F15	Brittle	Strike slip	Dextral	N26°W	0.7
F16	Brittle	Strike slip	Dextral	N28°W	1.8
F17	Brittle	Strike slip	Dextral	N28°W	1.7
F18	Brittle	Strike slip	Dextral	N28°W	1.5
F19	Brittle	Strike slip	Dextral	N28°W	2.2
F20	Brittle	Strike slip	Dextral	N25°E	2.0
F21	Brittle	Strike slip	Dextral	N43°E	3.5
F22	Brittle	Strike slip	Dextral	N41°E	3.0
F23	Brittle	Strike slip	Dextral	N10°W	3.4
F24	Brittle	Strike slip	Dextral	N14°W	0.8
F25	Brittle	Strike slip	Dextral	N65°E	4.0
F26	Brittle	Strike slip	Sinistral	E-W	2.7
F27	Ductile/Brittle	Strike slip	Dextral	N47°E	0.6
F28	Ductile/Brittle	Strike slip	Sinistral	E-W	2.8
F29	Brittle	Strike slip	Dextral	N78°E	1.8
F30	Brittle	Strike slip	Dextral	N55°W	4.0
F31	Brittle	Strike slip	Dextral	N28°E	13
F32	Brittle	Strike slip	Dextral	N26°E	1.1
F33	Brittle	Strike slip	Dextral	N45°E	12
F34	Brittle	Strike slip	Dextral	N24°E	07
F35	Brittle	Strike slip	Dextral	N05°W	05
F36	Brittle	Strike slip	Dextral	N65°E	26
F37	Brittle	Strike slip	Dextral	N65°E	28
F38	Brittle	Strike slip	Dextral	N23°E	03
F39	Brittle	Strike slip	Dextral	N23°E	03
F40	Brittle	Strike slip	Sinistral	N70°E	5.7

(continued)

Table 1 (continued)

Structure No.	Deformation regime	Fault type	Shear sense	Fault trend	Net slip (cm)
F41	Brittle	Strike slip	Sinistral	N70°E	1.1
F42	Brittle	Strike slip	Sinistral	N60°E	08
F43	Brittle	Strike slip	Dextral	N65°E	03
F44	Brittle	Strike slip	Dextral	N65°E	02
F45	Brittle	Strike slip	Dextral	N65°E	3.5
F46	Brittle	Strike slip	Dextral	N45°E	09
F47	Brittle	Strike slip	Dextral	N85°E	3.0
F48	Brittle	Strike slip	Dextral	N85°E	3.5
F49	Brittle	Strike slip	Dextral	N20°E	7.5
F50	Brittle	Strike slip	Sinistral	N35°W	03
F51	Brittle	Strike slip	Sinistral	N40°E	04
F52	Brittle	Strike slip	Dextral	N20°E	3.2
F53	Brittle	Strike slip	Dextral	N47°E	02
F54	Brittle	Strike slip	Dextral	N48°E	04
F55	Brittle	Strike slip	Sinistral	N80°W	09
F56	Brittle	Strike slip	Dextral	N30°E	07
F57	Brittle	Strike slip	Dextral	N30°E	10
F58	Brittle	Strike slip	Dextral	N65°E	6.5
F59	Brittle	Strike slip	Dextral	N50°E	13
F60	Brittle	Strike slip	Dextral	N45°E	14
F61	Brittle	Strike slip	Dextral	N70°E	26
F62	Brittle	Strike slip	Sinistral	N40°W	09
F63	Brittle	Normal	–	–	12.5
F64	Brittle	Strike slip	Dextral	N20°E	02
F65	Brittle	Strike slip	Dextral	N50°E	02
F66	Brittle	Strike slip	Dextral	N50°E	05
F67	Brittle	Strike slip	Sinistral	N75°W	24
F68	Brittle	Strike slip	Sinistral	N80°E	28
F69	Brittle	Strike slip	Sinistral	N39°E	02
F70	Brittle	Strike slip	Dextral	N37°E	05
F71	Brittle	Strike slip	Dextral	N40°E	2.2
F72	Brittle	Strike slip	Dextral	N40°E	6.0
F73	Brittle	Strike slip	Sinistral	N40°E	1.0
F74	Brittle	Strike slip	Sinistral	N40°E	1.5
F75	Brittle	Strike slip	Dextral	N20°E	18
F76	Brittle	Strike slip	Dextral	N45°E	11
F77	Brittle	Strike slip	Dextral	N45°E	08
F78	Brittle	Strike slip	Dextral	N43°E	6.5
F79	Brittle	Normal	–	–	4.5
F80	Brittle	Normal	–	–	1.6

(continued)

Table 1 (continued)

Structure No.	Deformation regime	Fault type	Shear sense	Fault trend	Net slip (cm)
F81	Brittle	Normal	–	–	2.0
F82	Brittle	Normal	–	–	6.5
F83	Brittle	Normal	–	–	3.0
F84	Brittle	Normal	–	–	6.0
F85	Brittle	Normal	–	–	4.0
F86	Brittle	Normal	–	–	1.6
F87	Brittle	Normal	–	–	2.0
F88	Brittle	Normal	–	–	4.0
F89	Brittle	Normal	–	–	3.5
F90	Brittle	Strike slip	Dextral	N35°E	08
F91	Brittle	Strike slip	Dextral	N35°E	04
F92	Brittle	Strike slip	Dextral	N35°E	02
F93	Brittle	Strike slip	Dextral	N35°E	14
F94	Brittle	Strike slip	Sinistral	N80°E	12
F95	Brittle	Strike slip	Sinistral	N80°E	19
F96	Brittle	Strike slip	Sinistral	N20°E	15
F97	Brittle	Strike slip	Sinistral	N20°E	22
F98	Brittle	Strike slip	Dextral	N20°E	22
F99	Brittle	Strike slip	Dextral	N24°E	04
F100	Brittle	Strike slip	Dextral	N24°E	04
F101	Brittle	Strike slip	Dextral	N30°E	12
F102	Brittle	Strike slip	Dextral	N30°E	11
F103	Brittle	Strike slip	Dextral	N30°E	06
F104	Brittle	Strike slip	Sinistral	E-W	07
F105	Brittle	Strike slip	Dextral	N35°E	6.5
F106	Brittle	Strike slip	Dextral	N35°E	09
F107	Brittle	Strike slip	Dextral	N26°E	05
F108	Brittle	Strike slip	Sinistral	N20°E	05
F109	Brittle	Thrust	–	–	13
F110	Brittle	Strike slip	Dextral	N40°E	1.5
F111	Brittle	Strike slip	Dextral	N40°E	2.0
F112	Brittle	Strike slip	Dextral	N05°W	10
F113	Brittle	Strike slip	Dextral	N20°W	1.0
F114	Brittle	Strike slip	Dextral	N60°E	07
F115	Brittle	Strike slip	Sinistral	N30°E	06
F116	Brittle	Strike slip	Sinistral	N20°W	82
F117	Brittle	Strike slip	Dextral	N40°W	10
F118	Brittle	Strike slip	Dextral	E-W	05
F119	Brittle	Strike slip	Dextral	E-W	05
F120	Brittle	Strike slip	Dextral	E-W	03

(continued)

Table 1 (continued)

Structure No.	Deformation regime	Fault type	Shear sense	Fault trend	Net slip (cm)
F121	Brittle	Strike slip	Dextral	N25°E	04
F122	Brittle	Strike slip	Dextral	N40°E	05
F123	Brittle	Strike slip	Dextral	N30°E	2.5
F124	Brittle	Strike slip	Dextral	N30°E	07
F125	Brittle	Strike slip	Dextral	N30°E	4.0
F126	Brittle	Strike slip	Dextral	N30°E	2.0
F127	Brittle	Strike slip	Dextral	N30°E	1.5
F128	Brittle	Strike slip	Dextral	N30°E	1.0
F129	Brittle	Strike slip	Dextral	N30°E	3.5

which is located along the SE of Kinwat region. This NE-SW trend of strike-slip faults from Dharwar Craton near Degloor mismatches with the trend of the N-S trending strike-slip faults near Mumbai reported by Misra et al (2014) (also see Misra and Mukherjee 2015). The easternmost fault reported at Malshej Ghat (Misra et al. 2014) is ~500 km west of Degloor. These faults cannot be related with the study area presumably because they are far away from the study area.

The Degloor region is bound at SW by seismically active Killari region, NW by the present day microseismically active Nanded and NE by seismic event nearer to Kaddam fault/lineament reported in 2015 (Kaplay et al. 2017a, b). The study area locates exactly at the edge of one of the side of a seismically active triangle i.e., Killari-Kaddam-Nanded. Killari seismically activated since 1993, Nanded since 2006 and a small-scale seismicity is reported recently in 2015 nearer to Kaddam fault/lineament (Kaplay et al. 2017a, b). So far no (micro)seismic events are reported from Degloor. The region Killari and Nanded in Maharashtra and Kaddam in the Indian state Telangana lies in the zone III of Indian map of seismic zonation (Subhadra et al. 2015). Killari is a typical example of intracratonic seismicity and a ‘slow-deforming non-rifted zone’ (Rajendran 2016). Nanded and Kaddam too exemplify intracratonic microseismicity. The studies in Killari region suggested that Killari had experienced similar earthquakes in past (Rajendran et al. 1996). The Nanded region also experienced earthquakes in 1942 (review in Valdiya 2015). Killari and Nanded seismicity occurred in the SEDVP, which was previously considered tectonically stable. The Kaddam event occurred in granitic province.

The E-W strike-slip deformation zone is reported at the SEDVP contact around Kinwat (Kaplay et al. 2017a). A stretch of 60 km (Adampur-Bhaisa) SW of Kinwat along SEDVP contact has been recently designated as the “East Dharwar Margin Deformation Zone” (EDMDZ; (Kaplay et al., submitted). The reporting of strike-slip faults from Degloor, 15 km SW of Adampur-Bhaisa stretch, is marked as the EDMDZ in Fig. 1 confirms that the stretch EDMDZ continued further SW up to Degloor and hence this zone is designated as ‘Western Boundary East Dharwar Craton Deformed Zone’(WBEDCDZ) which includes entire EDMDZ. The zone might continue SW right down up to Killari and also towards NE from Bhisa to Kinwat, but is to be checked by fieldwork. The study area is bound towards SE by seismically active Killari, towards NW by microseismically active Nanded and towards NE by recently reported microseismic event near Kaddam.

4 Conclusions

A. Deformation style, ~NE-SW structures, at Degloor does not match with those at the South East Deccan Volcanic Province (SEDVP), with Dharwar craton at Kinwat with ~E-W trend and the NW-SE strike-slip faults at Kaddam. Therefore, the stretch of ~105 km from Degloor to Bhainsa is designated separately as the 'Western Boundary East Dharwar Craton Deformed Zone' (WBEDCDZ).

B. Orientation of stress axes deciphered from this study: Fig. 6d: σ_3 (N83°E), σ_1 (N8°W/352°). Figure 9a: σ_3 (N65°E), σ_1 (N25°W/335°). Figure 9b: σ_3 (N20° W/340°), σ_1 (N66°E/66°). Figure 10: σ_3 (N°55E/°), σ_1 (N40°W/320°). This shows the extent of local variation of stress regime. This work presents the first detail information on orientation of stress axes from the remobilized EDC. Future structural geological works in the same line can provide comparison of how stress pattern had varied in the past. A statistical model highlighting the probability of earthquake occurrence can better justify the suggestion of installing a seismic network along the SEDVP.

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