Pull-apart origin of the Satpura Gondwana basin, central India

Chandan Chakraborty* and Sanjoy Kumar Ghosh

Geological Studies Unit, Indian Statistical Institute, 203, B.T. Road, Kolkata 700 108, India.
**e-mail: chandan@isical.ac.in*

The Gondwana basins of peninsular India are traditionally considered as extensional-rift basins due to the overwhelming evidence of fault-controlled synsedimentary subsidence. These basins indeed originated under a bulk extensional tectonic regime, due to failure of the attenuated crust along pre-existing zones of weakness inherited from Precambrian structural fabrics. However, disposition of the basins and their structural architecture indicate that the kinematics of all the basins cannot be extensional. To maintain kinematic compatibility with other basins as well as the bulk lateral extension, some basins ought to be of strike-slip origin. The disposition, shape and structural architecture of the Satpura basin, central India suggest that the basin could be a pull-apart basin that developed above a releasing jog of a left-stepping strike-slip fault system defined by the Son–Narmada south fault and Tapti north fault in consequence to sinistral displacement along WSW–ENE. Development of a sedimentary basin under the above-mentioned kinematic condition was simulated in model experiments with sandpack. The shape, relative size, stratigraphic and structural architecture of the experimental basin tally with that of the Satpura basin. The experimental results also provide insights into the tectono-sedimentary evolution of the Satpura basin in particular and pull-apart basins in general.

1. Introduction

The Satpura basin is the westernmost Gondwana basin exposed in the peninsular region (figure 1; cf. Robinson 1967). It is unique among all the Indian Gondwana basins by having the longest range of stratigraphic record spanning from Permian to Cretaceous (Crookshank 1936; table 1). Recently, it has been demonstrated that the Gondwana basins of peninsular India developed under a bulk extensional regime but the kinematics of the individual basins were variable ranging between extensional and pull-apart (Chakraborty *et al* 2003a). The study revealed that the Satpura basin is of pull-apart origin. The purpose of this paper is to understand the progressive tectono-sedimentary evolution of this basin with the help of analog model experiments and corroborative field data.

2. Tectonic framework of the Gondwana basins of peninsular India

The major significance of the Indian Gondwana strata is that they mark initiation of sedimentation in peninsular India in the Permo-Carboniferous time after a long depositional hiatus beginning at the end of Proterozoic. The successions are similar to the time-equivalent strata of South America, South Africa, Australia and Antarctica – the constituents of the southern hemispheric part (Gondwanaland) of the Paleozoic supercontinent Pangea. All these successions, in general, start with basal diamictite and glacial outwash deposits, followed successively by coal-bearing siliciclastics with *Glossopteris* and Triassic red beds with calcretes, and contain similar fossil assemblages (Hobday 1987).

The Gondwana basin-fills of peninsular India are unmetamorphosed and the original basin

Keywords. Basin tectonics; strike-slip basin; transcurrent zone; step-over; subsidence.

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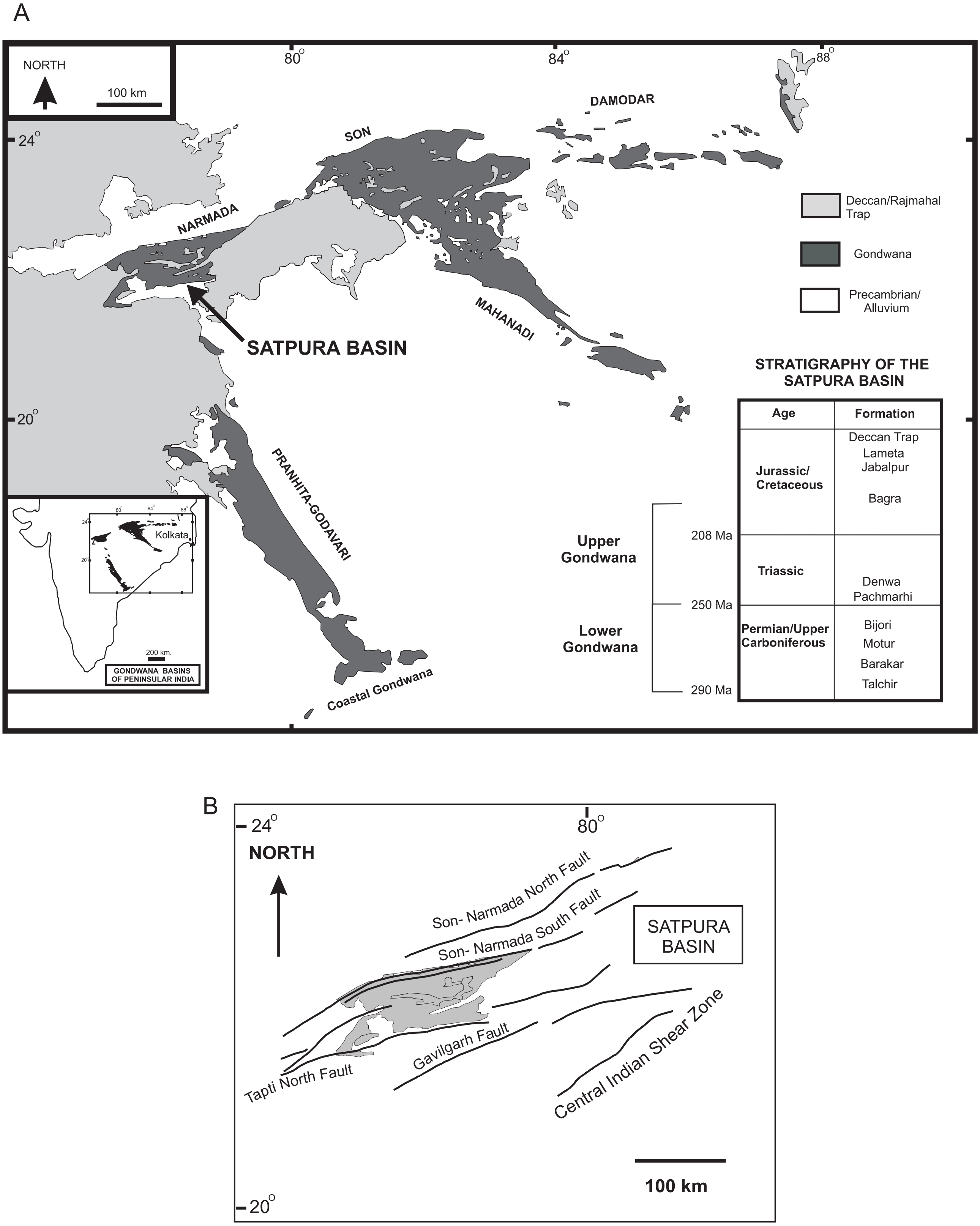


STRATIGRAPHY OF THE SATPURA BASIN

Age	Formation
Jurassic/ Cretaceous	Deccan Trap Lameta Jabalpur Bagra
Triassic	Denwa Pachmarhi
Permian/Upper Carboniferous	Bijori Motur Barakar Talchir

Figure 1. **(A)** Outcrops of the Gondwana basins in peninsular India. Note their occurrence along three distinct belts following the present day valleys of Narmada–Son–Damodar, Pranhita–Godavari and Mahanadi rivers. The present study is confined to the Satpura basin. Stratigraphy of the Satpura basin-fill is also shown. Inset shows the Indian peninsula. **(B)** Major boundary faults of the Satpura basin (based on Narula *et al* 2000). Shaded area represents the outcrop of the basin.

architecture is more or less preserved. The strata crop out along three distinct linear belts are defined by the present day river valleys of **(1)** Narmada–Son–Damodar (NSD), **(2)** Pranhita–Godavari (PG), and **(3)** Mahanadi (M) (figure 1). The basin-belts are flanked by regionally persistent dislocation zones of antiquity (Narula *et al* 2000). The basin-fills in some cases are asymmetric with an overall increase in thickness towards one of the boundary faults indicating that the basin bounding faults were active during sedimentation inducing subsidence and creating space for stratigraphic preservation of sediments. The basin-fill strata are also affected by intrabasinal gravity faults reflecting synsedimentary downward displacements that generated accommodation space for sediment accumulation throughout the history of basin evolution (Basu and Shrivastava 1980; Raja Rao 1982, 1983, 1987). The Bouguer gravity anomaly contours, as well as drill hole data again indicate significant thickness of subsurface Gondwana strata in all the basins implying synsedimentary tectonic subsidence (Veevers and Tewari 1995; Mishra *et al* 1999). The northern boundaries of many of the Gondwana basins occurring along the NSD valley are marked by the Son–Narmada lineament (figure 1B). This lineament is considered to have formed in the Precambrian, re-activated many times subsequently and is still a zone of seismicity (Naqvi *et al* 1974; Crawford 1978; Das and Patel 1984; Kaila 1986). The Son–Narmada lineament has been demonstrated as a trans-continental wrench system that in the Gondwanaland assembly extended from Madagaskar up to Australia through the Indian subcontinent (Crawford 1978; Harris and Beeson 1993). The development of the Gondwana basins was related to a regional ENE–WSW bulk extension of the rigid basement containing pre-existing weak zones (Chakraborty *et al* 2003a). The ENE–WSW bulk extension of the crust gave rise to the Pranhita–Godavari and Mahanadi basins, and the bulk extensional regime was terminated in the north by strike-slip zones along the ENE–WSW trending Son–Narmada lineament to maintain displacement compatibility with the tectonics of the Pranhita–Godavari and Mahanadi basins as well as the bulk ENE–WSW lateral extension (cf. Biswas 1999, 2003; Chakraborty *et al* 2003a).

3. Structural framework of the Satpura basin

The Satpura basin is the westernmost of the series of basins occurring along the Narmada–Son–Damodar valley, which also marks the junction of the Pranhita–Godavari valley and Narmada–Son–Damodar valley (figure 1). The basin is filled with around 5 km thick siliciclastic succession. The sedimentological attributes of the succession are summarised in table 1.

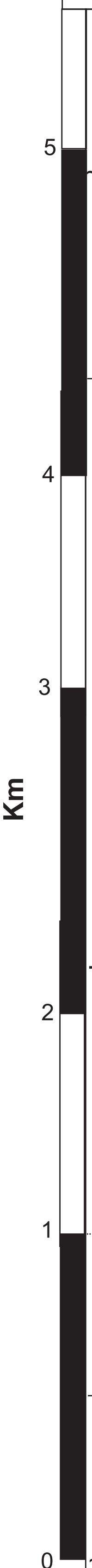
The Satpura basin (~ 200 km long, ~ 60 km wide) is rhomb-shaped, relatively long in the ENE–WSW direction and its longer sides are marked by the ENE–WSW trending Son–Narmada south fault and Tapti north fault in the north and south respectively (figure 2A). These faults are subvertical near the surface and show evidence of strike-slip movements (Crawford 1978; Das and Patel 1984; Biswas 1999, 2003). The western margin of the basin is also marked by a fault trending NE–SW and linking the strike-slip margins (figure 2A).

The regional strike of the basin-fill strata is NE–SW, and the regional dip ($\sim 5°$) is northerly. There are numerous faults affecting the basin-fill strata (figure 2C). These faults are intrabasinal in the sense that they are confined within the basin and do not transgress the basin bounding faults mentioned earlier. That many of these faults are synsedimentary is reflected in the thickening of hangingwall strata towards the fault plane, as well as from the fact that the frequency of intrabasinal faults decreases towards younger formations (cf. Raja Rao 1983). The Talchir and Barakar Formations are affected by faults more than the other formations. The intrabasinal faults are normal in nature. The dominant set trends along ENE–WSW, making positive acute angles of around 10°–20° with the northern and southern boundary faults (figure 2C). There are also faults making negative acute angles (10°–20°) with the boundary faults. A subordinate set of faults trends along NW–SE, making high angles ($\sim 70°$) with the basin bounding faults (figure 2C). Some of the faults branch out and rejoin resembling a braided pattern.

Subsurface mapping of the coal seams of the Barakar Formation also revealed the presence of synsedimentary normal faults (figure 3A). These faults show a similar pattern of arrangement as discussed above. There are two sets of faults: **(1)** a set trending parallel to the northern and southern basin margin faults, and **(2)** a set of NE–SW trending cross faults linking the first set of faults (figure 3A). The cross-sectional profile reveals asymmetric half-graben configuration with thickening of hangingwall strata towards northerly occurring and southerly dipping faults indicating synsedimentary, fault-controlled subsidence (figure 3B).

The rhombohedral shape of the Satpura basin bounded by fault lineaments merging with left-stepping strike-slip zones (figure 2A), and the presence of intrabasinal cross-faults making positive acute angles with the boundary faults (figure 2C)

Table 1. *Sedimentary attributes and thicknesses of different stratigraphic units of the Satpura basin.*



Jabalpur	Sandy braided rivers with muddy flood plain
Bagra Gravelly conglomerate, pebbly sandstone alternating with pedogenically modified red mudstone. Coarser clastics define channel-like bodies, macroform bars and are thoroughly cross-stratified. Dinosaur bone fragments.	High-gradient, piedmont rivers with braided morphology. Alluvial tracts were separated in space by muddy plains. Subordinate mass flow deposits (Casshyap *et al 1993)*
Unconformity	
Denwa *Upper part:* Mixed sandstone and mudstone. Sediment bodies characterized by laterally accreting heterolithic strata alternate with pedogenically modified red mudstone. *Lower part:* Sheet-like, multistoreyed, cross-stratified sandstone bodies alternating with red mudstone. Downcurrent dipping macroform stratification common with a few laterally accreting strata sets. Amphibian skulls.	Network of laterally migrating mixed-load channel belts separated in space by muddy plains (Maulik *et al* 2000) Braided, bedload channel belts separated in space by muddy plains (Maulik *et al* 2000)
Pachmarhi Pebbly sandstone. Sandstone bodies define laterally extensive sheets that are superimposed upon one another. Thoroughly cross-stratified. Downcurrent dipping macroform stratification common. At places pedogenically modified red mudstones may occur between sandstone bodies. Sandstone bodies separated by thick mudstones occur in the eastern part.	Braided, bedload channels (Maulik *et al* 2000)
Unconformity	
Bijori Sandstone, carbonaceous shale. Two types of sandstone bodies: 1) unidirectionally cross-stratified coarse sandstone, 2) medium sandstone with hummocky cross-stratification. Pedoturbation is common and hydromorphic paleosols are present within the carbonaceous shales. Shaly units show flaser, lenticular and wavy bedding. Rootlets and wood fossils are common.	Delta plain, delta front (Chakraborty and Sarkar, this volume)
Motur *Upper part:* Multistoreyed, cross-stratified, coarse-grained sandstone. *Lower part:* Channel-form, sandstone bodies alternating with pedogenically modified red mudstone (present only in the eastern part). Wood fossils are common.	Braided, bedload channels Anastomosed channels (Ray and Chakraborty 2002)
Unconformity?	
Barakar Alternation of sandstone, sandstone-shale heterolith and carbonaceous shale/peat/coal. Two types of sandstone bodies: 1) coarse sandstone characterized by unidirectional cross-sets, 2) medium sandstone characterized by hummocky cross-stratification, tidal bundles. Sandstone-shale heteroliths show flaser, lenticular and wavy bedding. Rootlets, plant litters.	Delta plain, delta front (Chakraborty *et al* 2003)
Talchir Alternation of conglomerate, sandstone and shale. Dropstone, striation, faceted and bullet-shaped boulders are common. Two types of sandstone bodies: 1) unidirectionally cross-stratified and 2) parallel and wave-ripple stratified. Bivalves are present.	Glacial outwash, subaqueous flow-till, shoreface and offshore shelf (Casshyap and Qidwai 1974)
Unconformity	
Precambrian Basement	

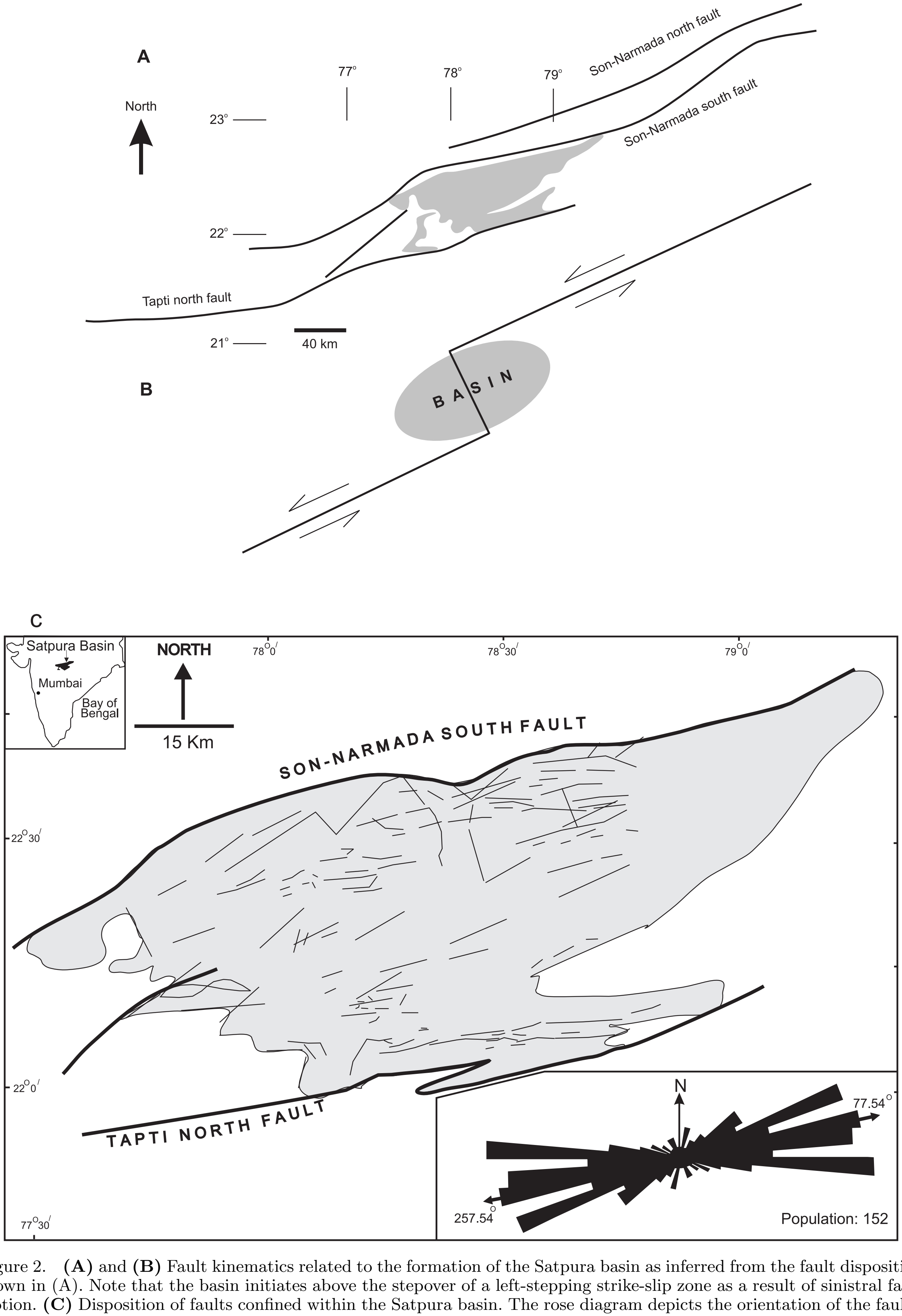


Figure 2. **(A)** and **(B)** Fault kinematics related to the formation of the Satpura basin as inferred from the fault disposition shown in (A). Note that the basin initiates above the stepover of a left-stepping strike-slip zone as a result of sinistral fault motion. **(C)** Disposition of faults confined within the Satpura basin. The rose diagram depicts the orientation of the faults. See text for details. Based on Raja Rao (1983), Peters and Singh (2001), Chakraborty *et al* (2003a) and new data from this study.

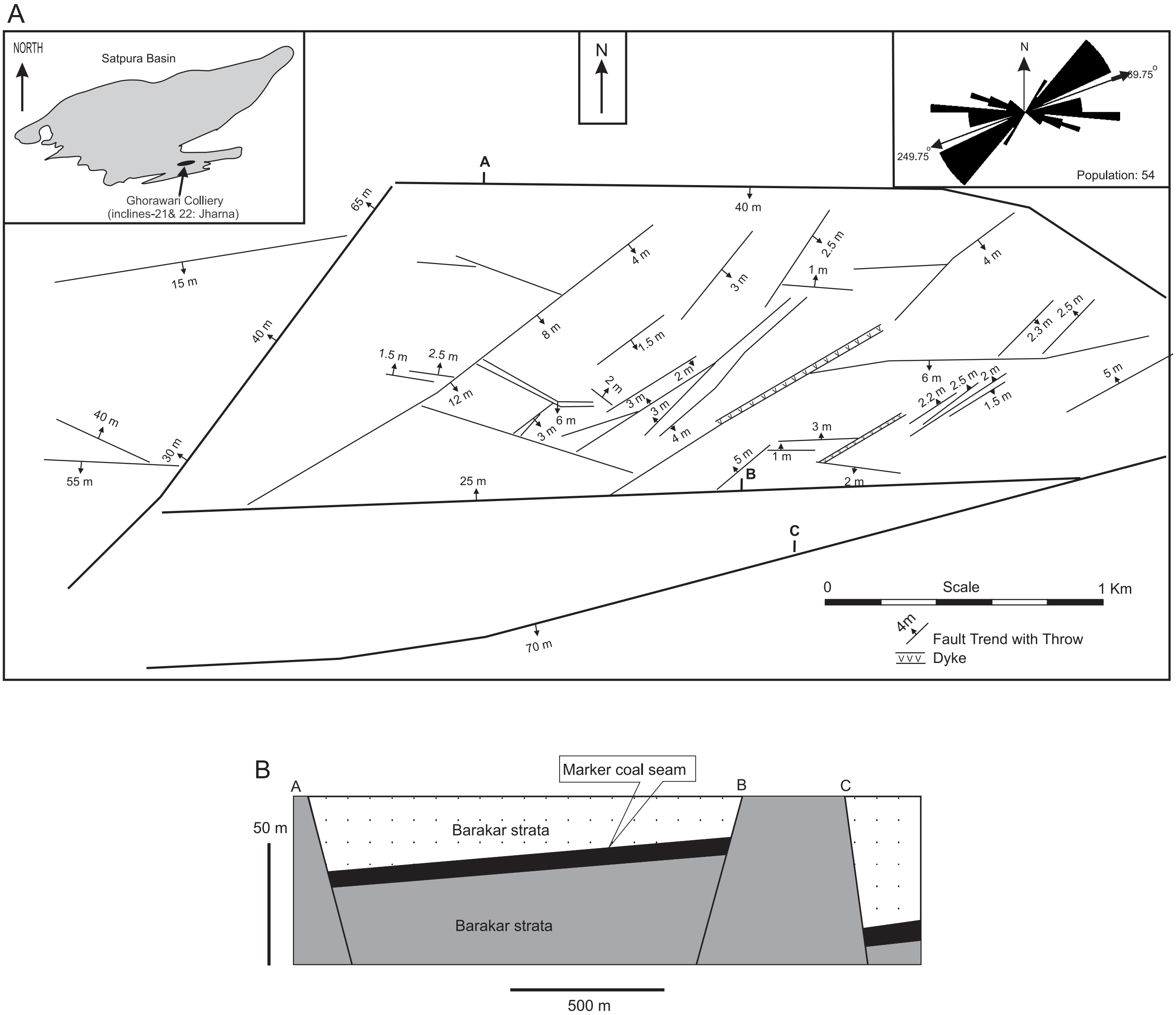


Figure 3. **(A)** Disposition of faults within the Barakar Formation of the Satpura basin as revealed from sub-surface mapping within a coal mine of the Pench-Kanhan valley, M.P. Note two sets of faults at angles with each other. Rose diagram depicts the orientation of the faults. Data source: Western Coalfields Limited. **(B)** Structural profile through the Barakar Formation constructed on the basis of data shown in A. Faults are marked by A, B, C which are also shown in the map in (A). Note graben-like configuration, asymmetric nature of the basin-fill and thickening of the hangingwall sediment fill (white, stippled) towards the fault A indicating synsedimentary nature of the faults.

are reflective of pull-apart basins developing in response to sinistral motion (Crowell 1974; Aydin and Nur 1985; Christie-Blick and Biddle 1985; Ingersoll and Busby 1995). It appears that this basin developed on a releasing jog along an ENE–WNW trending intracontinental transcurrent zone with side steps due to sinistral strike-slip motion (figure 2B).

We performed analog model experiments with sandbox to understand

- its progressive evolution, and
- predict the architecture of the basin-fill, as outlined in the following sections.

4. Experimental simulation

4.1 *Experimental set-up*

A series of sandbox model experiments were performed to understand the tectono-sedimentary evolution of the Satpura basin. Experimentalists generally use two different set-ups for simulation of pull-apart basins. In one set-up, the sandpack rests over a basal plate containing side-stepping discontinuities with a stepover that divides the plate into two segments which are displaced laterally (figure 4I; cf. Dooley and McClay 1997). This method has one disadvantage that after a

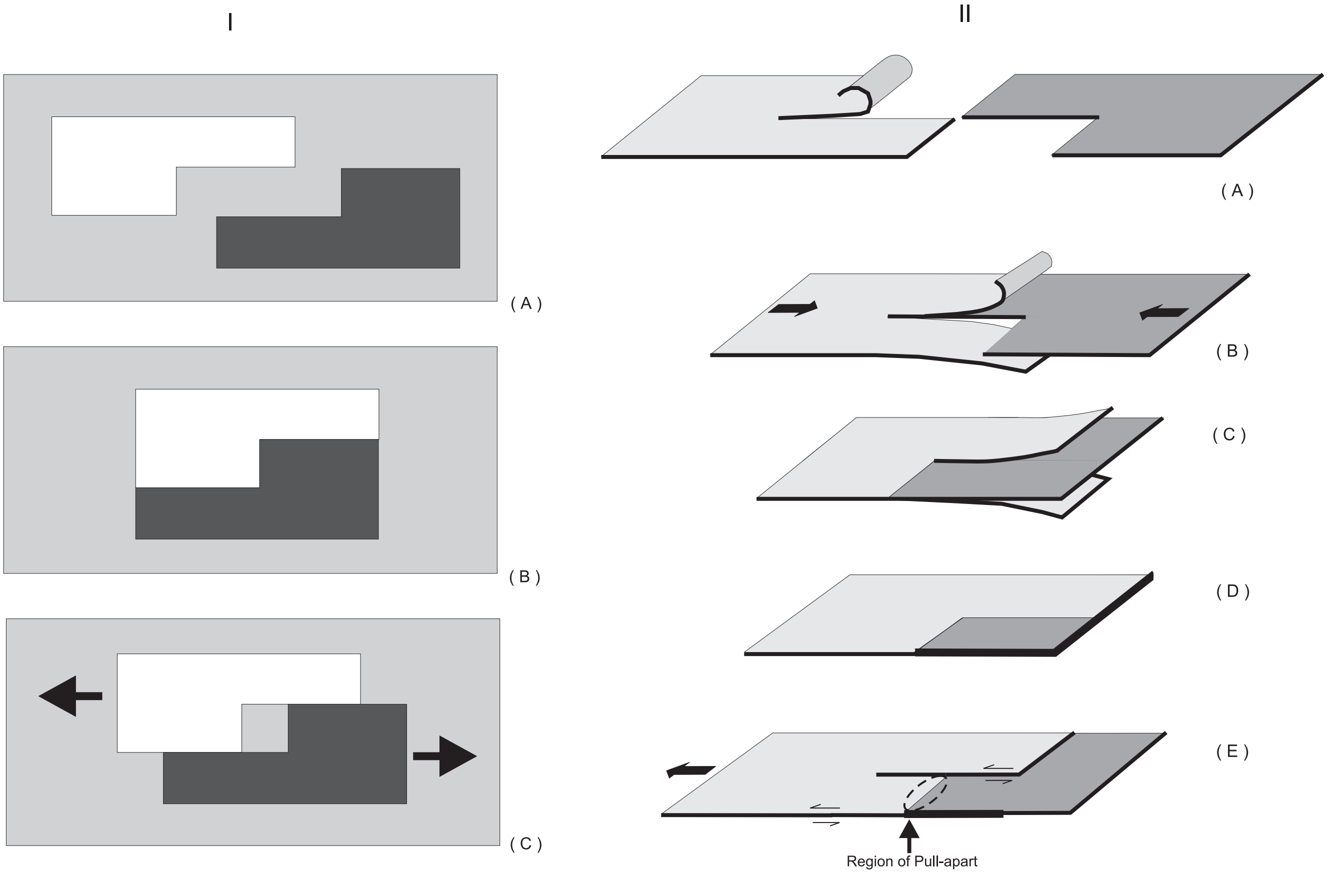


Figure 4. **(I)** Schematic representation of the progressive stages of arrangement of basal plates in the experimental set up for pull-apart basins **(A, B)**. Note in **(C)** that following displacement of the basal plates the overlying sand-pack (not shown here) would be out of contact of the basal plates in the region of stepover. **(II)** Schematic representation of the progressive stages of arrangement of basal plates in the experimental set up devised in this study for pull-apart basins **(A, B, C, D)**. Note in **(E)** that during displacement of the basal plates the overlying sand-pack (not shown here) would always remain in contact with the underlying plates in the region of stepover.

finite displacement the sandpack in the region of the stepover does not remain in contact with the basal plate, as a result the stresses due to movement of the plates are not transmitted to the sandpack (figure 4I). To overcome this limitation, an alternative experimental method is formulated, keeping a ductile layer between the sandpack and the basal plate (Basile and Brun 1999; Sims *et al* 1999). We have, however, designed a fairly simple, convenient but effective set-up without any ductile layer (figure 4II) in which the sandpack in the region of the stepover always remains in contact with the basal plate and suffers stress at all stages of displacement. In the experiments, the brittle crust was simulated by a layer of dry, quartz sand that undergoes failure according to Coulomb–Navier criterion (Horsefield 1977). Synkinematic sediments (dry sand) were added to the depressions at finite intervals to study progressive development of the basin and synsedimentary intrabasinal faults. The experimental results are reproducible and described below as observed in plan (figures 5 and 6).

4.2 *Experimental results*

After a lateral basal plate-displacement of 0.5 cm, a pair of parallel faults developed on the sandpack on either side of the underlying stepover defining the sidewall boundary faults of the experimental basin (figures 5a and 6a). The faults make positive acute angles of ∼ 35° with the shear direction verging opposite to the shear sense (sinistral). The fault lines were confined between the side-stepping, transcurrent discontinuities of the basal plate and were spaced at a distance of 6 cm along the shear direction defining the boundaries of the infantile basin. The faults dip towards each other and the displacement along them were oblique-slip in nature. The strike-slip component of the fault movement was synthetic to the bulk shear sense. The net vertical fall was very small (a few

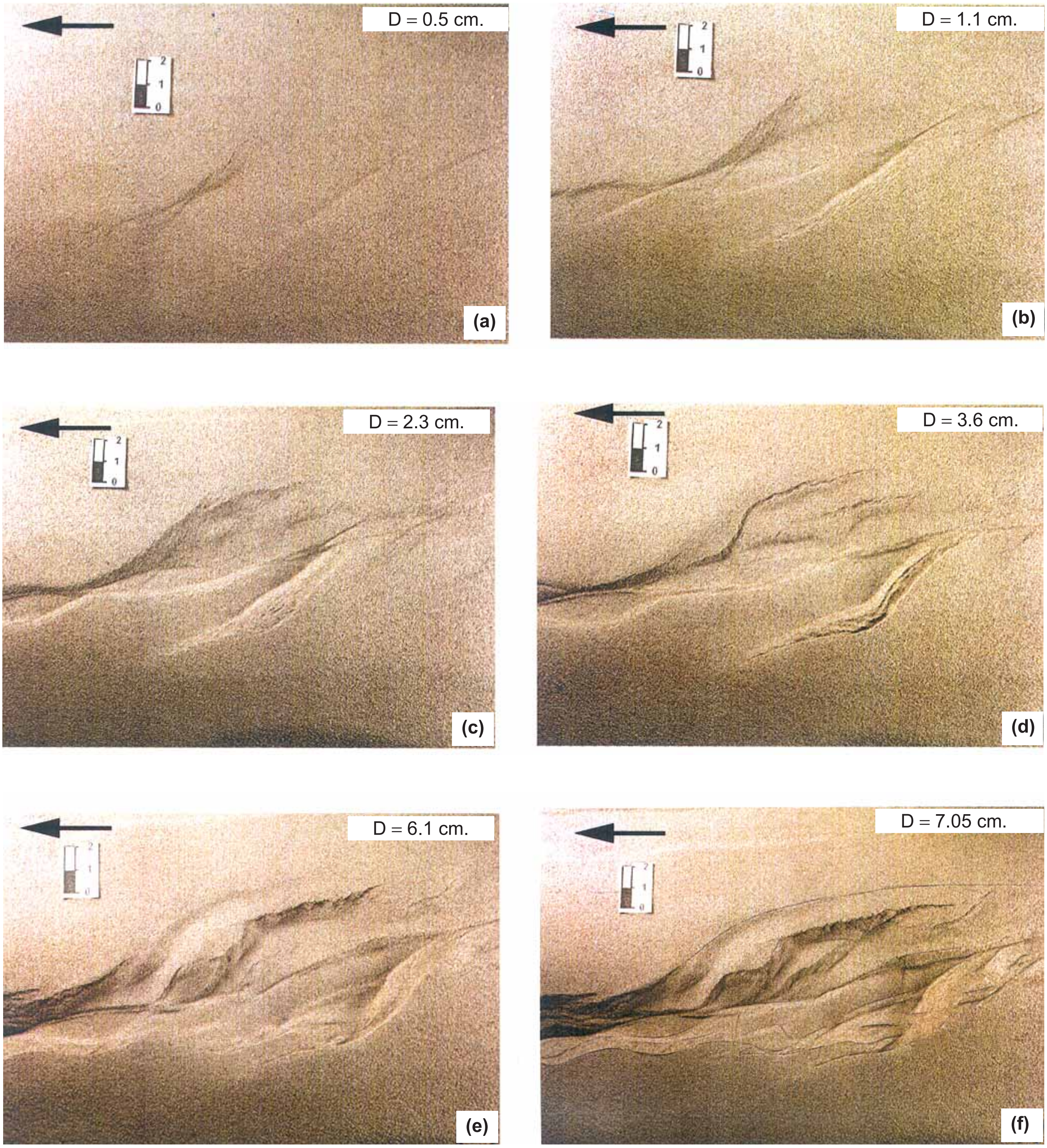


Figure 5. Plan views of successive stages of development of a pull-apart basin in sandbox model experiments above a left-stepping, transcurrent discontinuity due to sinistral strike-slip displacement of the basal plates. Displacement direction is marked by arrow and net displacement of the plate at each stage is shown at the top-right corners of the photographs. See text for details.

mm) and was higher along the fault at the left margin. These faults resemble Riedel fracture system except that they are disposed at higher angles with the shear direction (cf. Dooley and McClay 1997).

After a lateral basal plate-displacement of 1.1 cm, the sidewall faults lengthened and propagated progressively lowering their angle with the shear direction resulting in a finite sigmoidal geometry (figures 5b and 6b). New faults also

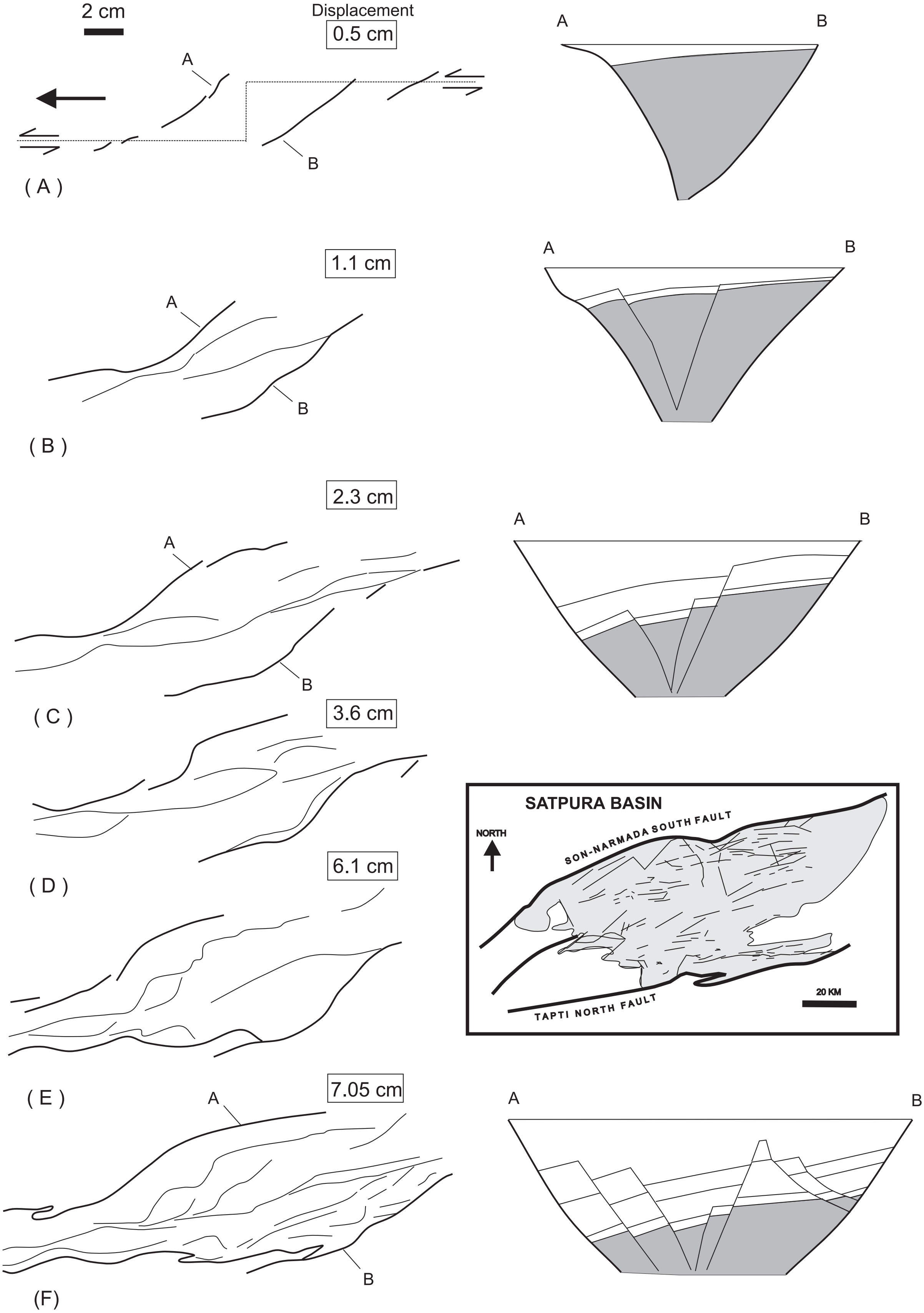


Figure 6. Line drawings of the plan views of the experimental model showing progressive developments of faults during formation of a pull-apart basin as shown in figure 5. Thick lines represent boundary faults and the thin lines are intrabasinal faults. Dotted line in (A) marks the basal discontinuity. Schematic profiles along A–B at each stage of experiment are shown at the right. Compare the fault pattern of the Satpura basin (in the inset) with that of the last stage of the experimental model. See text for details.

developed making positive acute angles of ∼ 15° with the shear direction. The spacing between the older sidewall boundary faults along the shear direction increased to 7.5 cm. The new faults dip towards each other, were confined between and appeared to terminate against the relatively older faults. The nature of displacement along all the faults was oblique-slip with synthetic strike-slip components. The newer faults appear to represent synthetic Riedel shears. Net vertical fall along the faults increased and was larger along faults occurring leftward of the model.

After a displacement of 2.3 cm, the older sidewall faults extended in length, attained a conspicuous sigmoidal geometry and defined a rhombohedral basin with a length of 10 cm along the shear direction (figures 5c and 6c). The relatively newer faults extended and joined to form a through-going lineament along the diagonal of the rhomb that makes positive acute angle with the shear direction, linking the boundary faults. The faults dip towards left of the model. The vertical fall along the faults increased, the higher fall being along faults occurring towards left, but maximum subsidence appeared to have taken place slightly away from the leftward sidewall fault. At this stage of experiment, the depression was filled with dry quartz sand and leveled before further displacement.

Following sediment filling, the basal plate was further displaced, and when the finite displacement was about 3.6 cm several faults appeared in the newly added sediment pile. The previous boundary faults vertically penetrated into the new sediment pile and again defined a rhombohedral basin, but the sigmoidal boundary faults appeared to be kinked (figures 5d and 6d). New faults developed within the basin mostly following the through-going fault observed at the previous stage and a few parallel to that trend. With further basal plate-displacements three principal changes were noticed:

- The length of the basin along the shear direction progressively increased and attained a length of 16 cm and width of 7.5 cm when the finite plate-displacement was 7.05 cm.
- The kink of the boundary faults gradually flattened to become perfectly sigmoidal.
- Several sets of intrabasinal faults developed trending: (a) along and parallel to the antithetic diagonal of the rhombic basin, (b) antithetically at angles 15°–20° with the diagonal and (c) antithetically at angles 30°–40° with the shear direction (figures 5e, f, and 6e, f).

The faults along the antithetic diagonal of the rhombic basin defined a prominent lineament, which appeared to have divided the basin into two discrete grabens separated by an intrabasinal horst (figures 5c to f and 6c to f). The experiments revealed that following the development of the through-going lineament, dominant subsidence took place in the graben occurring to the left of the lineament. Moreover, within the rapidly subsiding graben the subsidence rate varied spatially due to differential vertical falls along intra-graben faults. The faults at places branch out and rejoin resembling braids.

5. Discussion

Tallying the architecture of the experimental basin at the last stage with that of the Satpura basin (figures 5 and 6) reveals several corresponding features:

- The overall shape and the length-width ratio of the experimental basin resembles that of the Satpura basin,
- the intrabasinal fault pattern of the Satpura basin closely matches that of the experimental basin.

Combining the experimental observations with the structural and stratigraphic data of the Satpura basin (Raja Rao 1983) we have erected a structural profile of the basin (figure 7). The profile reveals that:

- The bulk of the Satpura succession was deposited in a mega half-graben bounded by basin margin faults represented by the Son–Narmada south lineament and Tapti north fault. The half-graben geometry is also reflected in the profile of the Barakar Formation prepared from subsurface data (figure 3B).
- The subsidence rate varied across the basin resulting in an asymmetric basin-fill with the thickness increasing towards north.
- The basin-fill is transected by several synsedimentary gravity faults dipping northerly as well as southerly (figures 2 and 3A).
- The Pachmarhi Formation defines a monocline with its anticlinal bend underlain by a blind, subsurface gravity fault (figure 7) that follows the through-going cross-basin fault lineament linking the boundary faults and defining the axis of the basin.

6. Tectonosedimentary evolution

The Satpura succession is characterised by three major unconformities between **(1)** Basement and

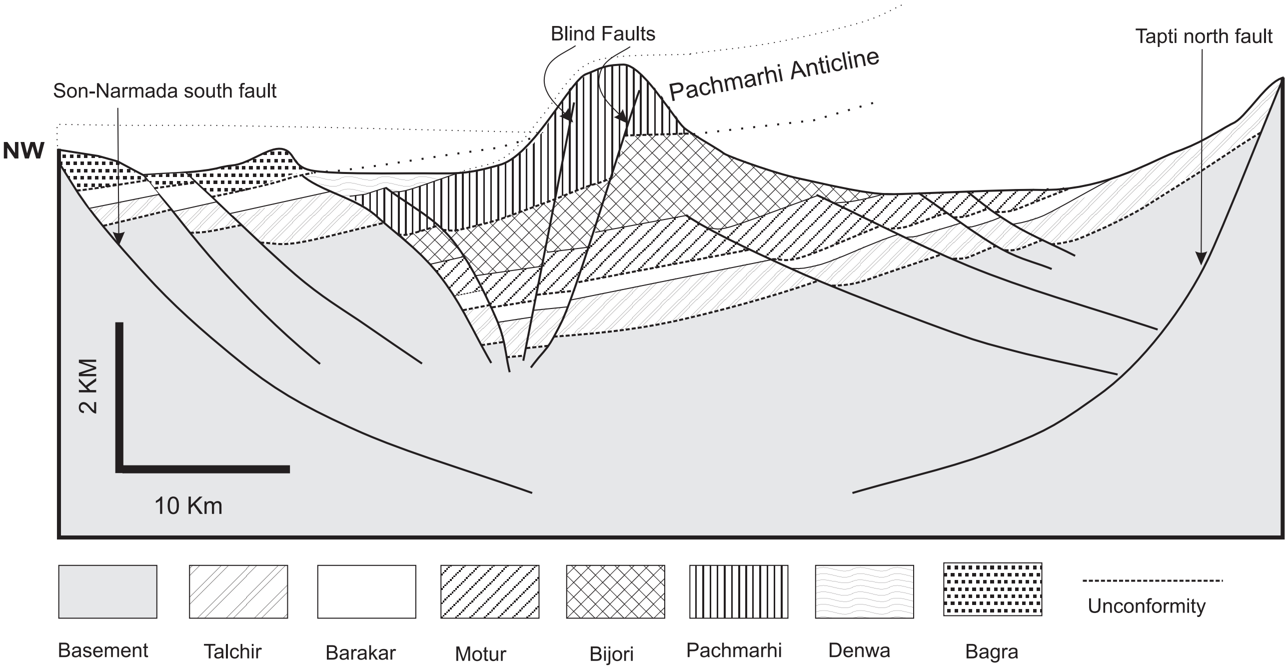


Figure 7. Cross-sectional profile of the Satpura basin as inferred from the experimental and field data (modified from Chakraborty *et al* 2003a). See text for details. Note half-graben configuration. Boundary faults are shown by heavy lines.

Barakar, **(2)** Bijori and Pachmarhi, and **(3)** Denwa and Bagra (Crookshank 1936; Casshyap *et al* 1993; Casshyap and Khan 2000; Chakraborty and Sarkar, this volume). The Barakar-Motur contact is sharp and the transition apparently represents a climatic shift towards aridity (Ray and Chakraborty 2002). Moreover, in the western part, the sandy Motur strata of braided fluvial origin sharply overlie the coal-bearing deltaic succession of the Barakar Formation (Chakraborty *et al* 2003b; Ghosh *et al* 2004). A sharp change from warm-humid deltaic to arid, fluvial condition suggests that the upper boundary of the Barakar Formation may also be an unconformity. These unconformities divide the Satpura succession into four distinct packages: **(a)** Talchir–Barakar, **(b)** Motur–Bijori, **(c)** Pachmarhi–Denwa and **(d)** Bagra–Jabalpur. It is thus inferred that accumulation of the Satpura succession took place at least under four different fault-controlled subsidence regimes with intervening tectonically static periods as schematically shown in figure 8. The termination of each faulting regime was followed by the development of unconformities.

Barring the Talchir Formation that comprises glacio-marine deposits, the rest of the Satpura Gondwana succession largely represents a variety of fluvial depositional systems with some records of fluvio-deltaic regime (table 1). Paleocurrent data from the fluvial and glacial outwash strata (figure 9) reveal the following:

- Both transverse and axial sediment dispersal systems prevailed in the Satpura basin.
- Three distinct patterns of fluvial sediment transport can be recognized:

  (a) Dominance of southerly-fed transverse systems manifested in the Talchir, Barakar, Motur and sandy Pachmarhi strata,
  (b) comparable dominance of southerly-fed transverse systems and easterly-fed axial systems with relatively feeble southerly dispersal as represented in the Bijori, muddy Pachmarhi, Denwa and Bagra strata,
  (c) dominantly easterly-fed axial systems with subordinate northerly-fed transverse systems as manifested in the Jabalpur strata.

It may be noted that transverse sediment transport prevailed till the accumulation of Motur strata, and axial sediment transport began to take place along with transverse transport since accumulation of the Bijori strata and continued thereafter. It is inferred that transverse sediment transport took place when active subsidence in the basin was controlled by faults oriented at high angles to the shear direction. Following nucleation of faults making low angle with the boundary faults and defining through-going lineament in the basin axial sediment transport set in.

The Bagra Formation of alluvial origin reveals a polymodal paleocurrent rose spanning the whole

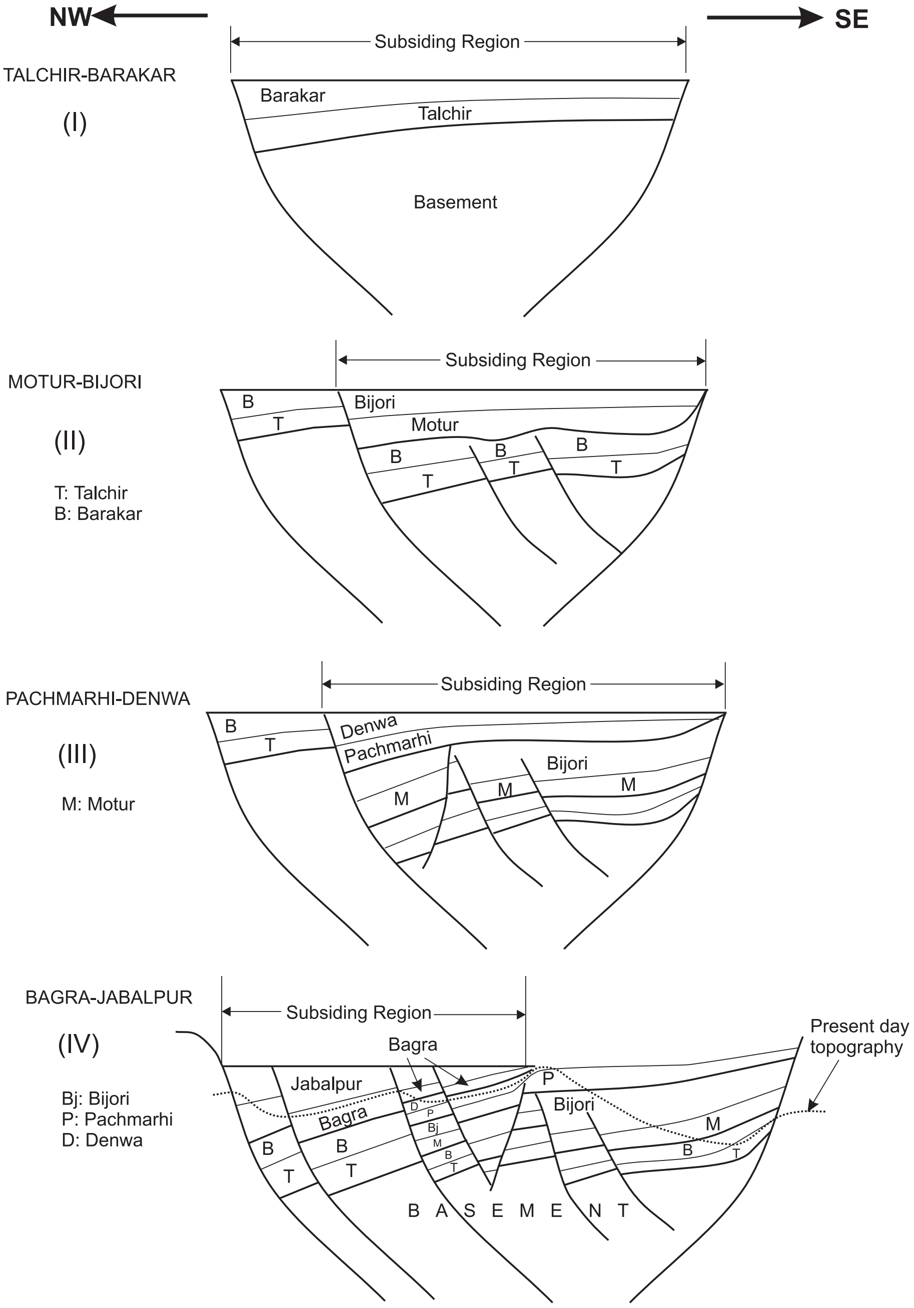


Figure 8. Four stages of development of the Satpura basin as inferred from the present study. See text for details. Unconformities are marked by thick lines.

compass indicating a contrasting basin morphology which received sediments from all sides implying the existence of transverse systems from both the margins as well as an axial system dominantly from the north–east (figure 9). The Bagra sediments are restricted along the northern margin of the half-graben and are observed to unconformably overlie Denwa, Pachmarhi, Bijori and Talchir Formations at different places (Casshyap *et al* 1993; Maulik *et al* 2000). The infra-Bagra formations possibly suffered exposure and denudation before initiation of Bagra sedimentation. This perhaps implies that during Bagra period the active fault marking the southern limit of sedimentation was located within the basin far northward of the Tapti north fault defining the southern boundary of the Satpura basin. It has recently been documented from active, intracontinental transcurrent zones that development of pull-apart basin above the stepover of side-stepping discontinuities is followed by a tectonic regime when basin subsidence ceases to be controlled by the stepover between separate segments of principal displacement zone, but active subsidence is accommodated by oblique extension

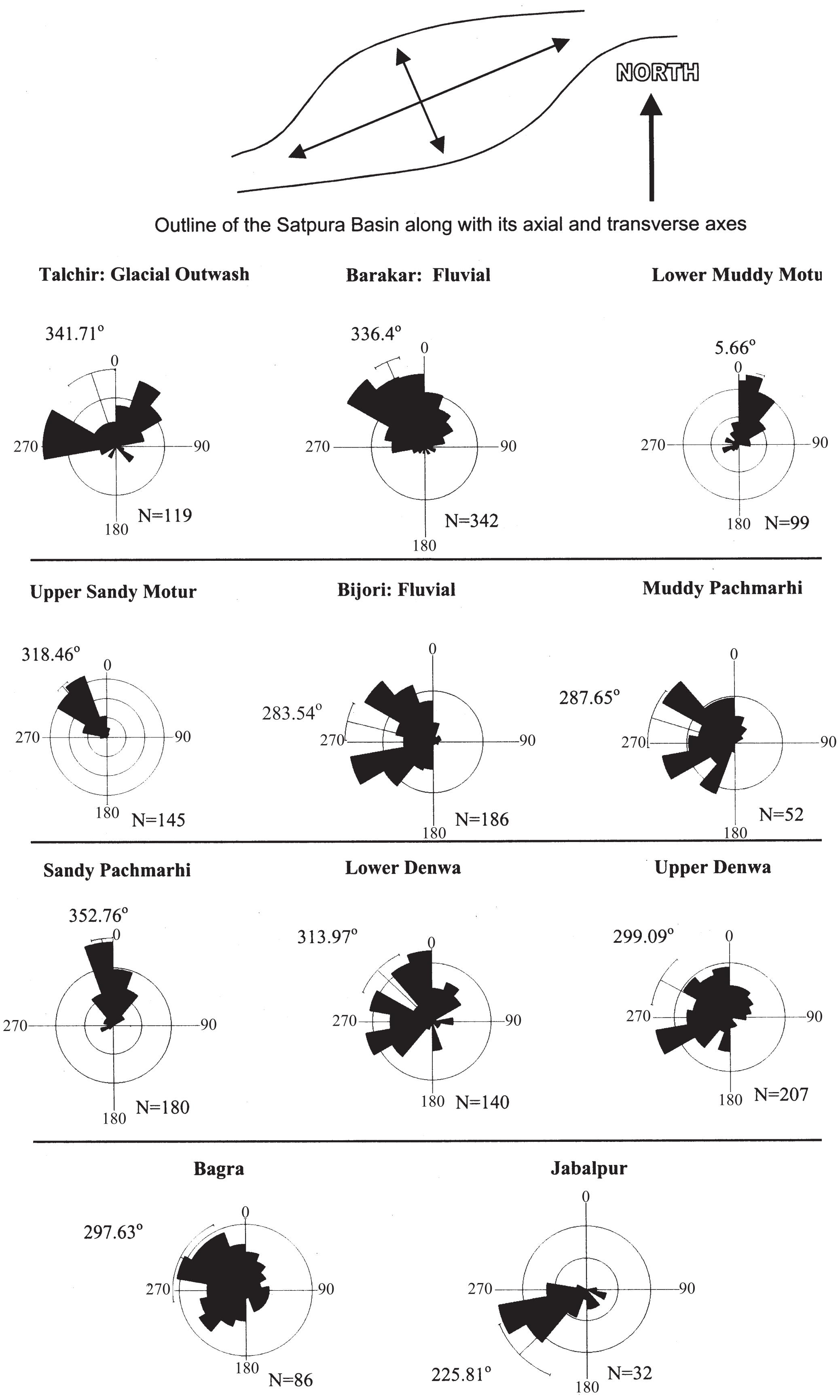


Figure 9. Paleocurrent rose diagrams of the glacial outwash and fluvial strata of the Satpura basin. Note progressive variation of the paleocurrent pattern with time attributable to different tectonic stages of basin evolution as shown in figure 8 (see text for details).

on a through-going intrabasinal fault that developed at a stage during pull-apart regime (Barnes *et al* 2001). It appears that Bagra-Jabalpur strata represent such a tectonic stage of the Satpura basin when the southern half of the basin (with respect to the through-going fault lineament) was being relatively uplifted and the northern half was accumulating sediments (figure 8IV).

7. Conclusions

The principal outcome of the present study can be summarized as follows:

- The Satpura Gondwana basin of central India represents a pull-apart basin that developed above a releasing jog of a pre-existing transcurrent zone as a result of sinistral displacement. Rhombic shape of the basin and intrabasinal fault pattern support this contention.
- The subsidence of the Satpura basin was principally related to movement along two sets of faults, one making ∼ 35° and the other ∼ 15° positive angles with the direction of transcurrent movement.
- The overall basin architecture is that of a half-graben which at a finite stage of tectonism was divided into two discrete segments by a through-going intrabasinal horst along the axis of the basin.
- The basin was filled by glacio-marine, glacio-fluvial, fluvio-deltaic and fluvial depositional systems. Periods of maximum subsidence are indicated by fluvio-deltaic regimes that prevailed during Talchir, Barakar and Bijori sedimentation. Following Bijori sedimentation, accumulation in the Satpura basin took place under the alluvial regime indicating decrease in the rate of basin subsidence. Three distinct patterns of fluvial sediment transport can be recognized:

  (a) Dominance of southerly-fed transverse systems,
  (b) comparable dominance of southerly-fed transverse systems and easterly-fed axial systems,
  (c) dominantly easterly-fed axial systems.

  Axial sediment transport began following nucleation of faults making low angles to the basin margin and defining through-going lineament along the basin axis.
- At the terminal stage, sedimentation in the Satpura basin was confined to the northern half of the basin.

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