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Proterozoic Rifting in the Pranhita-Godavari Valley: Implication on India-Antarctica Linkage

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Abstract

The Pranhita-Godavari (PG) Valley, a major lineament within the South Indian cratonic province, that preserves sediment dominated deposits spanning from Mesoproterozoic to Mesozoic, appears to be a key element in supercontinent reconstruction. The sedimentary basins of the Valley include a thick succession of Early Mesoproterozoic to Late Neoproterozoic rocks, the Godavari Supergroup, which is unconformably overlain by the Late Palaeozoic-Mesozoic Gondwana sequence. The Godavari Supergroup is internally punctuated by several regional and interregional unconformities into a number of unconformity-bound sequences having group level and subgroup level status. The lithostratigraphic attributes of the succession indicate multiple events of fault controlled sedimentation marked by transgression and regression, as well as uneven rates of uplift and subsidence of the basin floor in an extensional tectonic regime. The amplitude of translation of the unconformity surfaces across the base level attests to collective role of tectonic movement and sea level changes in building the stratigraphic framework of the Valley. The stratigraphic framework and depositional systems, such as fan and fan-deltas, together with local outburst of felsic volcanism further indicate repeated rifting of the craton.

Geochronologic data indicate that the rift basin started to open in Early Mesoproterozoic, concomitantly with the breakup of the Mesoproterozoic supercontinent during which the India and East Gondwana fragments were separated. The spatial variation in the declivity of the unconformity surfaces, and the trend of thickness variation of the unconformity-bound sequences point that the basin deepened and opened towards southeast to join an ocean that developed between the South Indian craton and East Antarctica. The contractional deformation structures preserved in several lithounits were produced under NE-SW directed regional compression during Late Neoproterozoic basin inversion.

Key words: Pranhita-Godavari Valley, Godavari Supergroup, cratonic rift, Indo-Antarctic ocean, basin inversion.

Introduction

The origin of cratonic basins has been debated for decades, and none of the proposed models adequately explains the major elements of basins or their subsidence history (Sloss, 1991; Miall, 1999). Nevertheless, a close relationship of craton-interior histories with events at the craton margins and variations in the heat flow regime underneath the large continental crust is now fairly well established (Anderson, 1982; Gurnis, 1988; Sloss, 1991). Periods of formation of many cratonic basins are coincident with the fragmentation of supercontinents (Hartley and Allen, 1994), indicating genetic linkage between the two processes. In this context, the origin and evolution of the Proterozoic basins of the Indian Peninsula attain special significance in critically evaluating the relationship of the cratonic landmass of South India vis-à-vis other cratons of Proterozoic supercontinents.

The Indian Peninsula that stabilized at ca. 2500 Ma is divided by an ENE–WSW trending tectonic zone, the Central Indian Tectonic Zone (CITZ), into northern and southern cratonic provinces (Acharyya, 1997; Fig. 1). The Peninsula witnessed development of a number of large cratonic basins during the Late Palaeoproterozoic to Neoproterozoic, which are referred to as the Purana basins (Holland, 1907). The Purana basins show similarity in respect of size, sediment thickness and depositional systems, and span of the basin history with many such basins such as the Williston, Michigan or Illinois basins of North America (Sleep and Sloss, 1980; Miall, 1999), the basins on the Russian platform (Aleinikov et al., 1980), and the Australian basins. Three major Purana basins of the South Indian cratonic province, the Pranhita-Godavari (PG) Valley, Chattisgarh and Cuddapah basins developed along pre-existing lineaments, defined by Archaean granite-greenstone or granulite belt (Chaudhuri et al., 2002) (Fig. 1). Nevertheless, the Peninsula does not bear any signature of fragmentation and separation since its stabilization in the Late Archaean-Palaeoproterozoic transition, not withstanding the periodic events of rifting, remobilization, and multiple episodes of supercontinent assembly and fragmentation (Chaudhuri et al., 2002).

The PG Valley constitutes an important Purana basin in the southern part of the Indian Peninsula, and received considerable attention in recent years. Significant information is now available on the stratigraphic framework, sedimentary facies and facies association, deformation structures and volcanism from the PG Valley basin (Chaudhuri, 1985, 2003; Chaudhuri and Howard, 1985; Sreenivasa Rao, 1987; Chakraborty, 1991; Chakraborty and Chaudhuri, 1993; Saha and Chaudhuri, 2003; Deb, 2003; Patranabis Deb, 2003). In this paper, we intend to discuss the major stratigraphic, sedimentologic, and deformational attributes of the Proterozoic succession of the PG Valley, which is considered to be a key element in supercontinent reconstruction (Roy, 1999; written comm., J.J.W. Rogers, 2000). We would also make an endeavour to discuss the bearing of the Proterozoic geology of the PG Valley on the India-Antarctica linkage.

The Pranhita-Godavari (PG) Valley

Geological setting

The PG Valley is a NW-SE trending major lineament which marks the contact of the two Archaean nuclei of Dharwar and Bastar. The lineament extends from the Eastern Ghats Granulite Belt (EGGB) in the southeast to the CITZ in the NW. The basin-filling sedimentary rocks

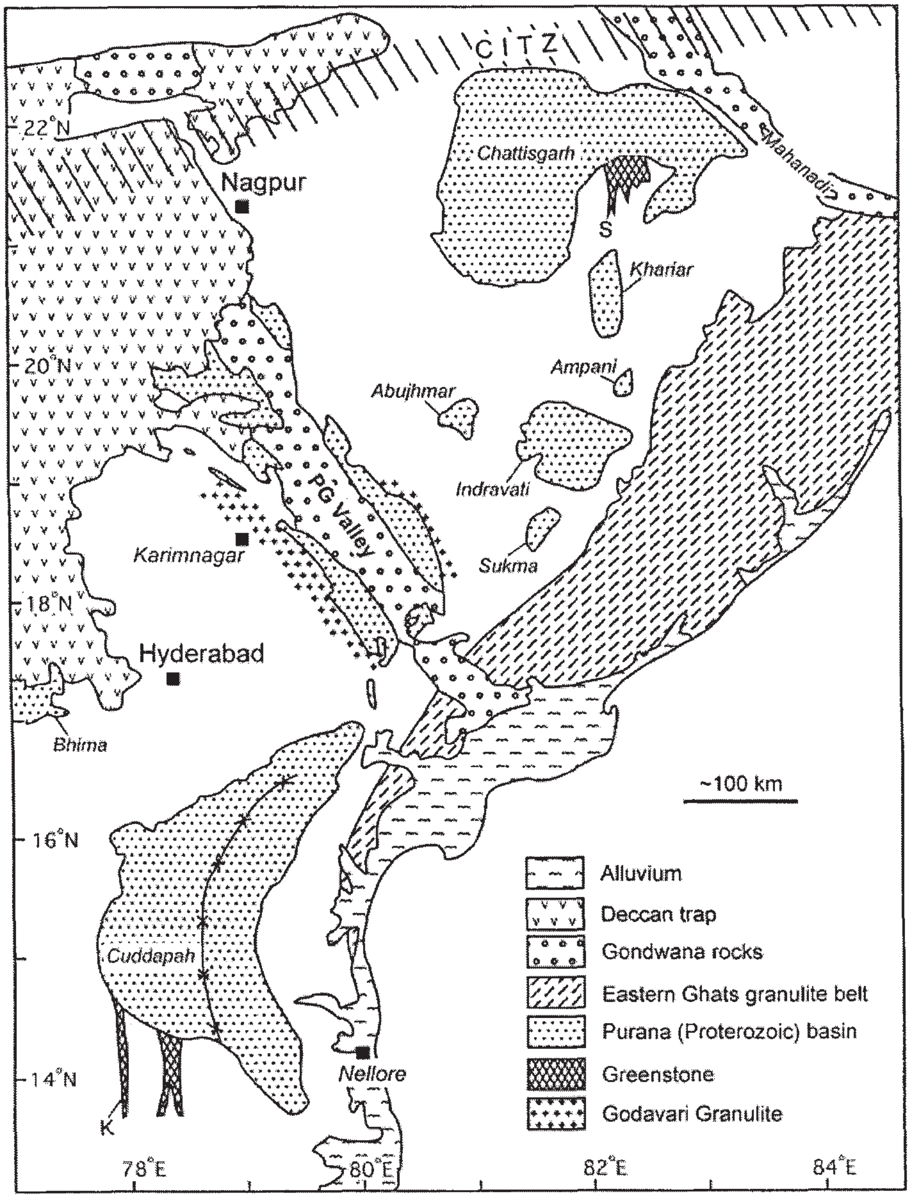

Fig. 1. The Purana (Proterozoic) intracratonic basins of Peninsular India, south of the Central Indian Tectonic Zone (CITZ). The Eastern Ghats granulite belt and granulites flanking the PG Valley and some of the greenstone remnants are also shown. S–Sonakhan greenstone belt, K–Kadiri schist belt (greenstone) (after Chaudhuri et al., 2002).

are exposed along a stretch of about 450 km in the southeastern part of the basin. The northwestern part of the basin extends under the cover of the Deccan volcanics (Cretaceous) for about 400 km till it meets the CITZ (Biswas, 2003). The average width of the exposed rock succession of the PG Valley is about 110 km (Fig. 1).

The Proterozoic sedimentary rocks crop out in two linear belts along the southwestern and northeastern margins of the Valley (subsequently referred to as the western and eastern belts respectively) separated by a linear belt of younger Gondwana rocks (220–65 Ma; Robinson, 1971). The Proterozoic belts are flanked on their outer margins by Archaean granulites (>2500 Ma, Rajesham et al., 1993) and gneisses of the basement complex (Fig. 1). In the western belt, the sedimentary rock succession unconformably overlies the granulites and gneisses, whereas in the eastern belt the former is separated from the basement by a boundary fault. The depositional contacts among individual lithological units and between the Proterozoic succession and the basement are broadly linear and follow the trend of the Valley. The PG Valley has been referred to as a rift basin on the basis of geophysical investigations (Qureshy et al., 1968; Naqvi et al., 1974), stratigraphic framework and facies association (Chaudhuri et al., 2002; Chaudhuri, 2003), and repeated felsic volcanism (Patranabis Deb, 2003).

Stratigraphy

The Proterozoic succession of the Valley, defined as the Godavari Supergroup (Chaudhuri and Chanda, 1991), is characterized by widely variable lithofacies association attesting to multiple events of transgression and regression, as well as uneven rates of basin uplift and subsidence in space and in time. The lithologic assemblages exhibit signatures of deposition in continental to deep marine environments. The correlation of the formations or groups on a regional scale has been attained through mapping the regional unconformities and by correlating the unconformity-bound sequences (cf. Sloss, 1991).

The Godavari Supergroup is bounded by two interregional unconformities (*sensu* Sloss, 1984) that demarcate it from the underlying Archaean-Palaeoproterozoic basement complex and the overlying Gondwana Supergroup. Several other regional unconformities divide the succession into six unconformity-bound sequences having the stratigraphic status of group and subgroup. The lithostratigraphic successions in central and southern parts of the western outcrop belt are given in table 1. The Pakhal and Penganga Groups of the western belt and the Somanpalli Group of the eastern belt are made up of mixed carbonate-siliciclastic assemblages. The Sullavai and Albaka Groups, by contrast, comprise only siliciclastics.

In the central part of the western outcrop belt, the Pakhal Group is unconformably overlain successively by the Penganga Group and the Sullavai Group (Fig. 2). In the northern part, the Penganga Group unconformably rests on the basement, and is unconformably overlain by the Sullavai Group. In the southern part, on the other hand, the Pakhal Group is unconformably overlain successively by the Albaka Group and the Sullavai Group (Fig. 2). In the eastern belt, the Proterozoic rock succession is bounded by two major faults, one against the Gondwana succession to the southwest and the other against the basement to the northeast. In the northern part, the succession is made up of the mixed carbonate-siliciclastics of the Somanpalli Group (Chaudhuri and Chanda, 1991; Saha and Ghosh, 1998), whereas in the southern part it comprises of the Albaka Group. The Sullavai Group unconformably overlies both the Somanpalli and Albaka Groups. The relationship between the Somanpalli Group and other mixed carbonate-siliciclastic assemblages, viz., the Pakhal and Penganga Groups of the western belt is still not unequivocally constrained.

The problems that still plague the stratigraphy of the valley have been attributed to differential subsidence and up-arching in different parts of the basin, uplift of large fault blocks by over 1000 m, and complete removal of thick successions by erosion during the time spans represented by the hiatuses (Chaudhuri, 2003).

Depositional motif

The lithologic assemblage of different unconformity-bound sequences are given in table 1. The Mallampalli Subgroup comprises quartzose sandstone and dolomitic limestone with profuse algal stromatolites, and minor conglomerates (Fig. 3; Chaudhuri, 1985). The sequence is comparable with the 'carbonate-orthoquartzite' association of Sloss (1963). Deposition of both the Mulug Subgroup and the Penganga Group started with thick succession of conglomerate and coarse-grained arkose in coastal fan and fan-deltas, attesting to major episodes of fault-controlled sedimentation. The coarse siliciclastics, in both the instances, were followed by deposition of thick succession of limestone and dolomitic limestone (Fig. 3). In the Mulug Subgroup, the carbonate depositional system is represented by myriad of coastal marine environments, such as tidal flats, lagoons and banks with evidence of intermittent exposure (Chaudhuri and Howard, 1985). In the Penganga Group, the carbonate depositional system is represented by a thick deep-water ramp sequence deposited in a rapidly subsiding basin, which developed through intermittent faulting, subsidence and extension (Mukhopadhyay and Chaudhuri, 2003). The sequences of the Mulug Subgroup and the Penganga Group, thus,

Table 1. Stratigraphic succession, lithology and depositional setting of the Godavari Supergroup in central and southern parts of the PG Valley.

	Mancherial-Ramgundam (central part of the Valley)		Mallampalli-Pakhal Lake (southern part of the Valley)		
	Lithologic unit			Lithologic assemblage	Depositional setting
	Gondwana Supergroup				
	~~ U ~~~ U ~~~ U ~~~ U ~~~ U ~~~ U ~~~				
GODAVARI SUPERGROUP	Sullavai Group		Sullavai Group (1375 m)	Conglomerate, feldspathic and quartzose sands (red bed)	Fault-controlled, unstable: Fan-fluvial complex and erg deposits
			~~ U ~~~ U ~~~		
			Albaka Group (3255 m)	Quartzose sandstone and shale	Wide stable shelf: shallow marine environments
	~~ U ~~~ U ~~~				
	Penganga Group (1225 m)			Shale Limestone Conglomerate and feldspathic sandstone Rb-Sr date: 775±30 Ma 790±30 Ma	Fault controlled, unstable: fan and fan delta; rapidly subsiding shelf, slope, base of slope
	~~ U ~~~ U ~~~ U ~~~ U ~~~ U ~~~				
	PAKHAL GROUP	Mulug Subgroup (945 m)	Mulug Subgroup (713 m)	Dolomitic limestone, calcareous shale and subordinate chert Conglomerate and feldspathic sandstone	Fault-controlled unstable: coastal fan, fan delta and carbonate shelf
		~~ U ~~~ U ~~~ U ~~~ U ~~~			
		Mallampalli Subgroup (390 m)	Mallampalli Subgroup (1420 m)	Quartzose sandstone and calcareous shale Dolomitic limestone and minor conglomerate K-Ar date: 1330±53 Ma	Wide stable shelf: shallow marine environments
~~ U ~~~ U ~~~ U ~~~ U ~~~ U ~~~ U ~~~					
	Archaean Basement				

developed in two major transgressive events separated by a major hiatus, now represented by the Pakhal-Penganga unconformity.

The Somanpalli Group consists of a complex array of lithologies indicating highly unstable basin condition and abruptly changing bathymetry of the depositional interface. It comprises shoreface sandstone as well as deep-water sequence of graywacke, black shale, black chert (Saha and Ghosh, 1998), and thick ash-flow tuff attesting to generation of steep slopes and deep basinal conditions and concomitant volcanism.

The Albaka Group, on the other hand, comprises thick, blanket-type deposits of quartzarenite and shale with innumerable lenses of dolomitic limestone, deposited in shoreface and inner shelf environments with open marine circulation (Sreenivasa Rao, 1987). The sequence represents a very stable tectonic regime, with a finely tuned balance between the rate of sand input and basin subsidence. The Sullavai Group consists of a thick succession of red sandstone. The lower part of the succession was deposited in braided-streams, whereas the upper part was deposited in an extensive erg environment (Chakraborty, 1991; Chakraborty and Chaudhuri, 1993).

Palaeogeography

The unconformity-bound sequences in the central and southern parts of the western outcrop belt exhibit well defined and systematic changes in thickness along the lengthwise profile of the Valley (Fig. 3). Figure 4 exhibits the unconformity profile that depicts the behavior of the unconformity surfaces as well as their interrelationship.

The unconformities point to episodic uplift and depression of the depositional interface; and the unconformity profile indicates higher rate of movement in the southeastern part of the Valley than in the central part. The central part behaved as a positive area, whereas the southeastern part behaved as a negative area during the pre-Sullavai time. Higher subsidence in the negative area created accommodation space for accumulation of thicker sequences in the southeast.

The stratigraphic trends indicate that the southeastern part of the PG Valley basin was deepening and widening at a greater rate during the deposition of the pre-Sullavai sequences, viz., the Pakhal Group and the Albaka Group. The depositional width of the basin was much larger in the southeastern part than that indicated by the present day outcrop width (Chaudhuri et al., 2002) (Fig. 5). The reconstructed palaeogeography suggests that during Pakhal and Albaka times, the PG basin opened to a major marine basin that existed to the eastern side of the present day eastern seaboard of the Peninsula.

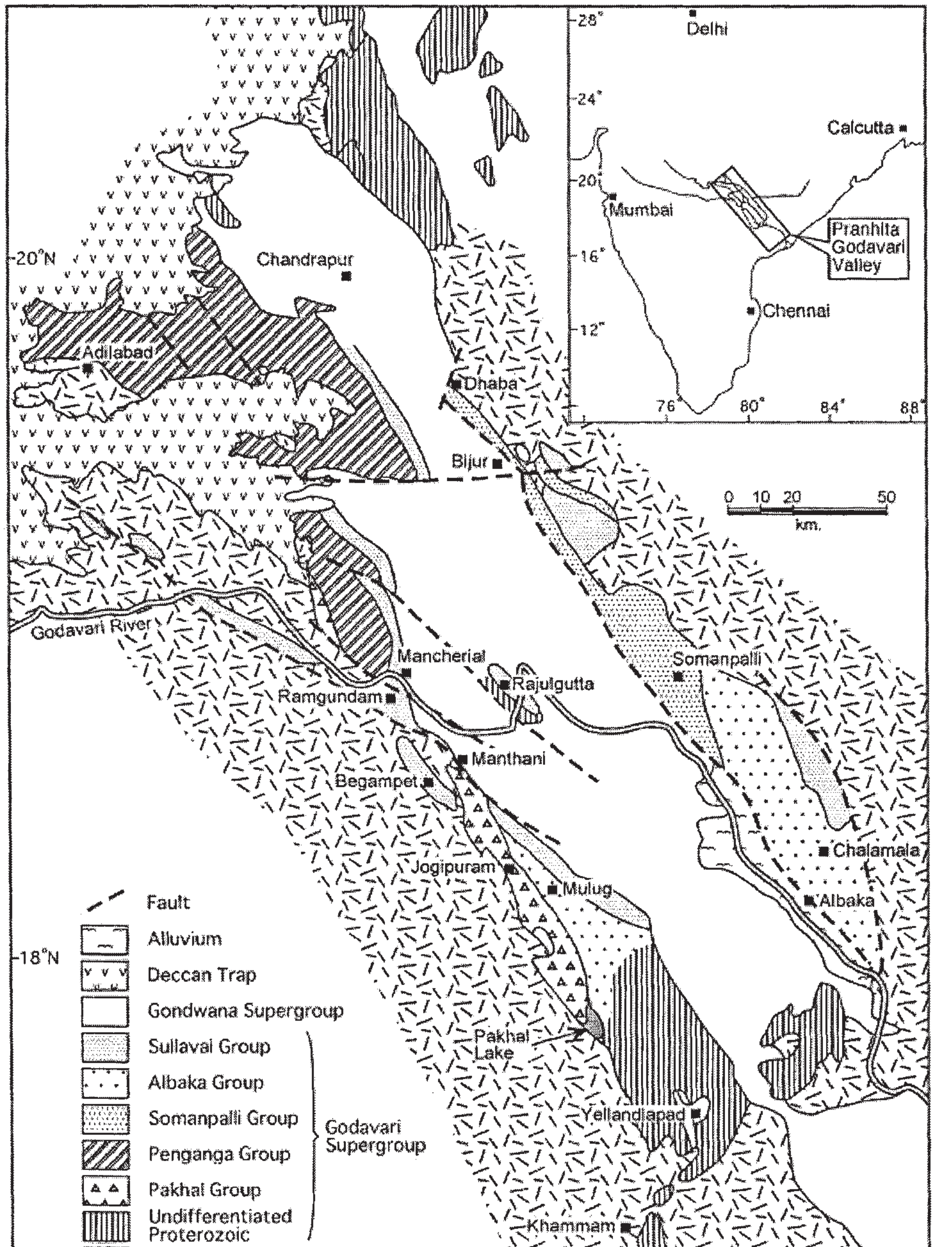

Fig. 2. Geological map of the PG Valley showing distribution of Proterozoic sedimentary rocks (modified after Chaudhuri, 2003).

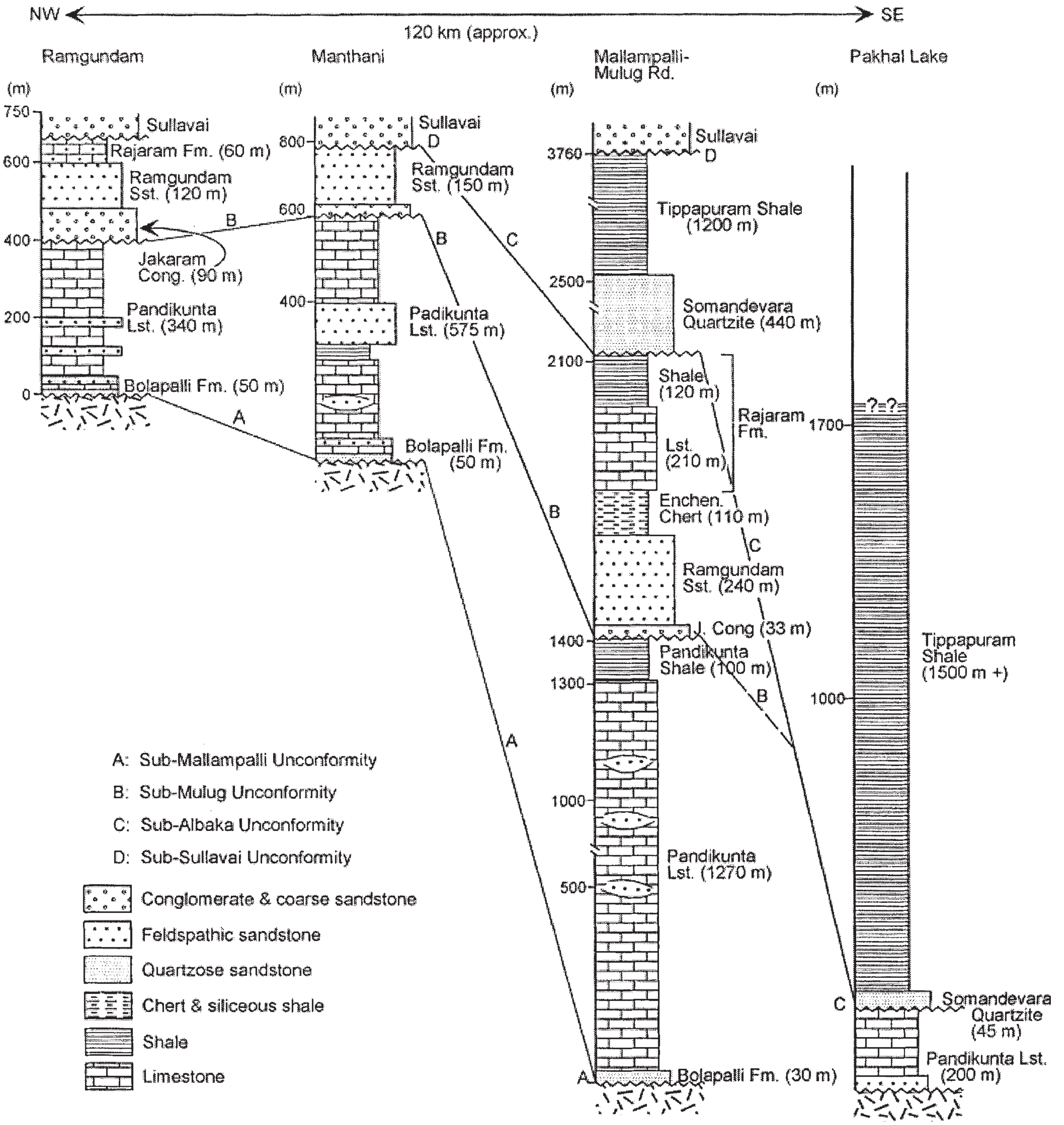

Fig. 3. Stratigraphic profiles of the Proterozoic successions along the southwestern belt, between Ramgundam and Pakhal Lake (modified after Chaudhuri, 2003).

Deformation structures

The PG Valley is marked by a set of steeply dipping to subvertical NW-SE trending faults that can be traced for several hundred metres to more than 100 kilometre. The faults are parallel to subparallel to the depositional strike of the rocks. A few faults, however, transgress the lithounits at places. Many of the faults exhibit displacement to the tune of several hundred metres to more than several kilometres. Movement along one such fault uplifted a slice of basement granite and Proterozoic sequence through the Gondwana succession in the central part of the Valley (Fig. 2).

In the central part of the western belt where the Pakhal, Penganga and Sullavai Groups occur in a succession, the Pakhal and Penganga Groups are co-folded into a series of NW-SE trending anticlines and synclines. The unconformably overlying Sullavai Group does not exhibit any evidence of contractional deformation.

In the eastern belt, the Somanpalli sequence records successively developed NW-SE trending map-scale folds, imbricate thrust faults and related shear zones, and E–W strike-slip faults (Saha, 1990, 1992; Ghosh and Saha, 2003). Major thrust faults are traceable for tens of kilometres, and are characterized by either northeasterly or southwesterly sense of transport (Ghosh and Saha, 2003).

In the vicinity of the Eastern Ghats outcrops, the Proterozoic rocks of the PG Valley record strong deformation and high grade (andalusite-sillimanite grade) metamorphism. The rocks have been folded into a series of northerly plunging synclines and anticlines. The axial direction of the folds, in places, show a swing from NW–SE, the typical trend of the structures developed in other parts of the Valley, to NE-SW, the general strike of the Eastern Ghats structural grains. The fold limbs are affected by thrust faults with northwesterly sense of movement (Ramamohana Rao, 1964, 1969).

The Proterozoic succession of the PG Valley is thus characterized by NW–SE trending outcrops and map-scale faults and folds. The overall trend of fabrics in the Godavari Granulite Belt is also NW–SE. Development of contractional structures, such as imbricate thrust faults and tight asymmetric folds, at places, along the major faults indicate that the faults were apparently reactivated basin opening faults that acted under strong compression during basin inversion (Deb, 2003). Along the contact with the EGGB, an imprint of deformation under NW–SE compression had been superposed on the NW–SE trending folds of the PG Valley. The NE–SW trending structures are parallel to the overall trend of the fabrics of the EGGB (Ramamohana Rao, 1969), and may reflect the deformation caused during amalgamation of the EGGB with the South Indian craton. The age of the amalgamation event, however, is not yet very well constrained.

Geochronology

The age of the rock succession of the Godavari Supergroup is not well constrained by radiometric dating. Paucity of geochronologic data is the major constraint in ascertaining a time frame for the basin filling events, and in attempting a correlation of these events with those in the adjoining EGGB. The available age data from the gneissic basement rocks adjoining the two margins of the Valley, the EGGB, the Godavari Granulite Belt, and the Proterozoic sedimentary rocks, and their systematics are given in table 2.

The EGGB records four tectonothermal events at 1900 Ma (compressional), 1600–1400 Ma (extensional), 1150–950 Ma (compressional) and 540±20 Ma (compressional) respectively (Table 2). The gneissic

Table 2. Geochronologic dates from rocks in and around the PG Valley and the Eastern Ghats Granulite Belt.

Location	Rock type	Method	Age (Ma)	Reference
Gondwanas, PG Valley	Sandstone, shale, limestone	Biostratigraphy	220–65	Robinson (1971)
Middle part of Penganga Group	Glauconitic sandstone	Rb–Sr	775±30 and 790±30	Chaudhuri et al. (1989)
Mallampalli Subgroup, lower division of Pakhal Group	Glauconitic sandstone	K–Ar	1330±53	Vinogradov et al. (1964)
Karimnagar, Godavari Granulite Belt	Younger intrusive granite	Rb–Sr	2286±100	Rajesham et al. (1993)
Karimnagar, Godavari Granulite Belt	Granulites	Rb–Sr	≥2500	Rajesham et al. (1993)
East Dharwar and Bastar craton	Granite gneiss	Nd–Sr	2550–2520	Jayananda et al. (2000)
Eastern Ghats Granulite Belt	Tectonothermal Event 4	U–Pb	540±20	Aftalion et al. (2000)
	Event 3	Sm–Nd, U–Pb	1150–950	Grew and Manton (1986); Shaw et al. (1997); Mezger and Cosca (1999)
	Event 2	Sm–Nd, U–Pb	1600–1400	Shaw et al. (1997); Mezger and Cosca (1999)
	Event 1	Sm–Nd, U–Pb	~1900	Shaw et al. (1997); Kovach et al. (1998)

basement rocks from the Bastar and Dharwar nuclei yield ages of 2550–2520 Ma. The charnockites of the Godavari granulite belt yield an age greater than 2500 Ma, whereas the granite intrusions within the granulite belt yield ages of 2200–2300 Ma. Authigenic glauconitic minerals from the Mallampalli Subgroup, about 200 m above the basement-sediment contact, yield an age of 1330±53 Ma (Table 2). Considering the authigenic origin of the minerals, possible loss of Ar on deep burial, and position of the samples in the sequence, an age between 1600 and 1500 Ma would be a reasonable estimate for the initiation of Mallampalli sedimentation. The glauconitic minerals from the lower part of the Penganga limestone indicate an Early Neoproterozoic age (775±30 Ma and 790±30; Table 2) for the Penganga sedimentation.

Discussion

Basin tectonics

The regional unconformities punctuating the Proterozoic succession clearly attest to episodic excursion of the depositional interface across the base level, either by eustatic sea level change, or by tectonic uplift and subsidence. The unconformity profile exhibits that the major unconformity surfaces experienced uplift and subsidence of the order of a kilometre or more (Fig. 4). The amplitude of translation of the unconformity surfaces point to tectonically controlled movement of the depositional interface. Most dramatic uplift and erosion of about 4000 m occurred during the sub-Albaka hiatus. The unconformity profile further indicates that different parts of the basin had different responses to the applied tectonic stress. The southeastern part of the basin moved up and down more vigorously than the central part. The tectonic behaviour of the basin was 'oscillatory', and the basin-filling processes were marked by abrupt changes in the depositional mode induced by rapid uplift of the basin floor along high angle faults, that propagated from the basement to the overlying sedimentary rocks (cf. Sloss, 1984). The oscillatory behaviour of the depositional interface along a narrow linear zone, accompanied by large number of subparallel high angle faults are the manifestations of a rift basin. The development of vast amount of coarse arkosic detritus heralding new phase of deposition as fan, fan-delta or braided fluvial deposits above several major unconformity surfaces attests to repeated rifting, extension and uplift of the cratonic hinterland. The felsic welded tuffs in different stratigraphic levels also indicate extensive partial melting at lower crustal level leading to localized stretching and rifting (Patranabis Deb, 2003).

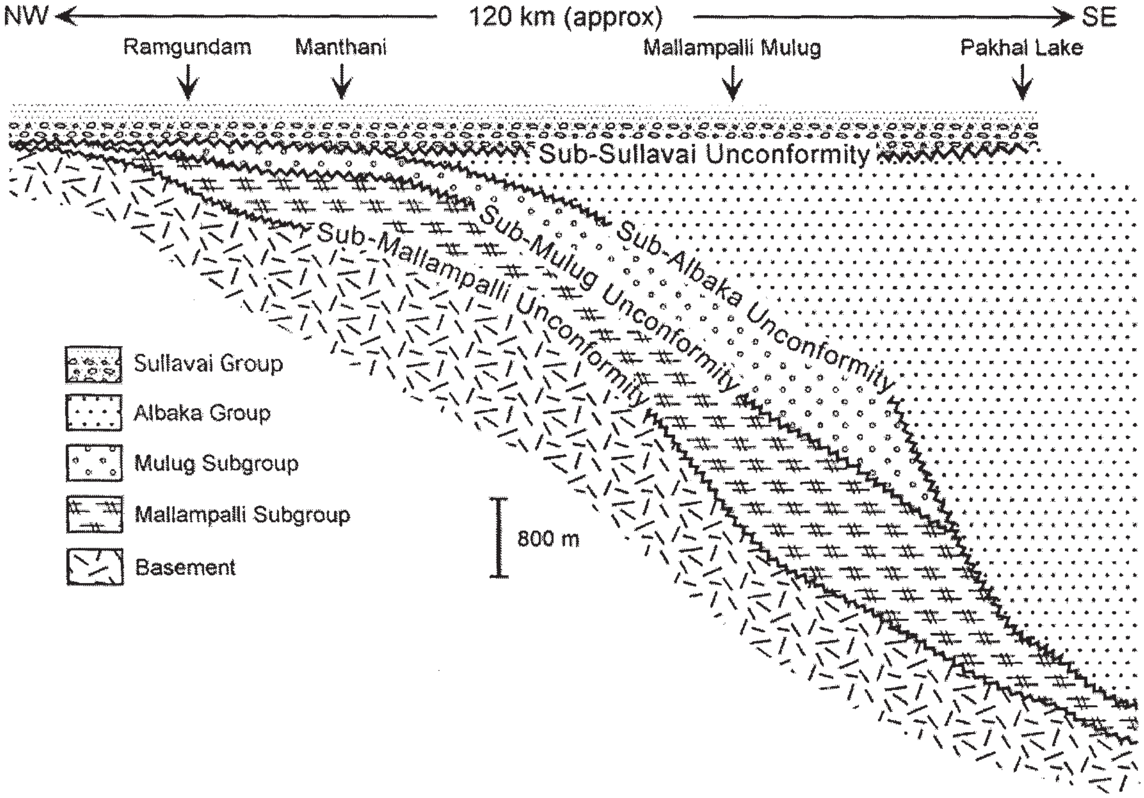

Fig. 4. Correlation of regional unconformities along the southwestern Proterozoic belt of the PG Valley (modified after Chaudhuri, 2003).

Rifting in the PG Basin: its bearing on India-Antarctica linkage

Evidence is accumulating fast to the effect that widely separated cratons tend to exhibit a degree of synchronism in their episodes of uplift and subsidence, warranting a globally effective phenomena to account for the origin of cratonic basins. It seems to be quite well established that the secular variation in radial heat flow and changes in the thermal budget of the earth related to supercontinental cycles may provide the basis for formation of cratonic basins on a global scale (see, Sloss, 1984; Gurnis, 1988; Miall, 1999). The causal relationship between the supercontinental cycles and origin of cratonic basins further dictates that tectonics of the craton is strongly influenced by the events at the continental margin. The dramatic examples of plate convergence such as continent-continent collision at the Ouachita-Marathan margin during Pennsylvanian–Early Permian time is concurrent with the creation of mountainous blocks deep inside the craton. By contrast, when more than one margin of a craton is in a state of divergence, such as during the Late Proterozoic–Cambrian breakup of a supercontinent, extensional forces may penetrate deep within the craton, and generate aulacogenic rift systems (Sloss, 1984).

The evidence of continent-continent collision at ca. 1900 Ma along the EGGB (Takano and Arima, 1999), and development of fold belts and shear zones during the inversion of the Mahakoshal basin in the CITZ at ca. 1800 Ma (Roy and Devarajan, 2000) are the possible signatures of amalgamation of the northern Indian cratonic province, southern Indian cratonic province and East Antarctica craton into a cratonic landmass of supercontinental dimension. The Mesoproterozoic supercontinent existed between ca. 1550–1850 Ma (Rogers and Santosh, 2002). The fragmentation of this supercontinent at ca. 1500 Ma is broadly synchronous with the origin of the PG Valley rift at about 1500 Ma. The rifting event is broadly coeval with the time of emplacement of sub-alkalic basalt in the Eastern Ghats at ca. 1450 Ma (Shaw et al., 1997) and of alkali syenite near Khariar in the Bastar nuclei at ca. 1500 Ma (Aftalion et al., 2000). The rifting in the South Indian craton is also synchronous with the events of melting of the crust in Enderby Land of East Antarctica at ca. 1400–1500 Ma (Black et al., 1987; Grew et al., 1991). The synchrony of events attests to an

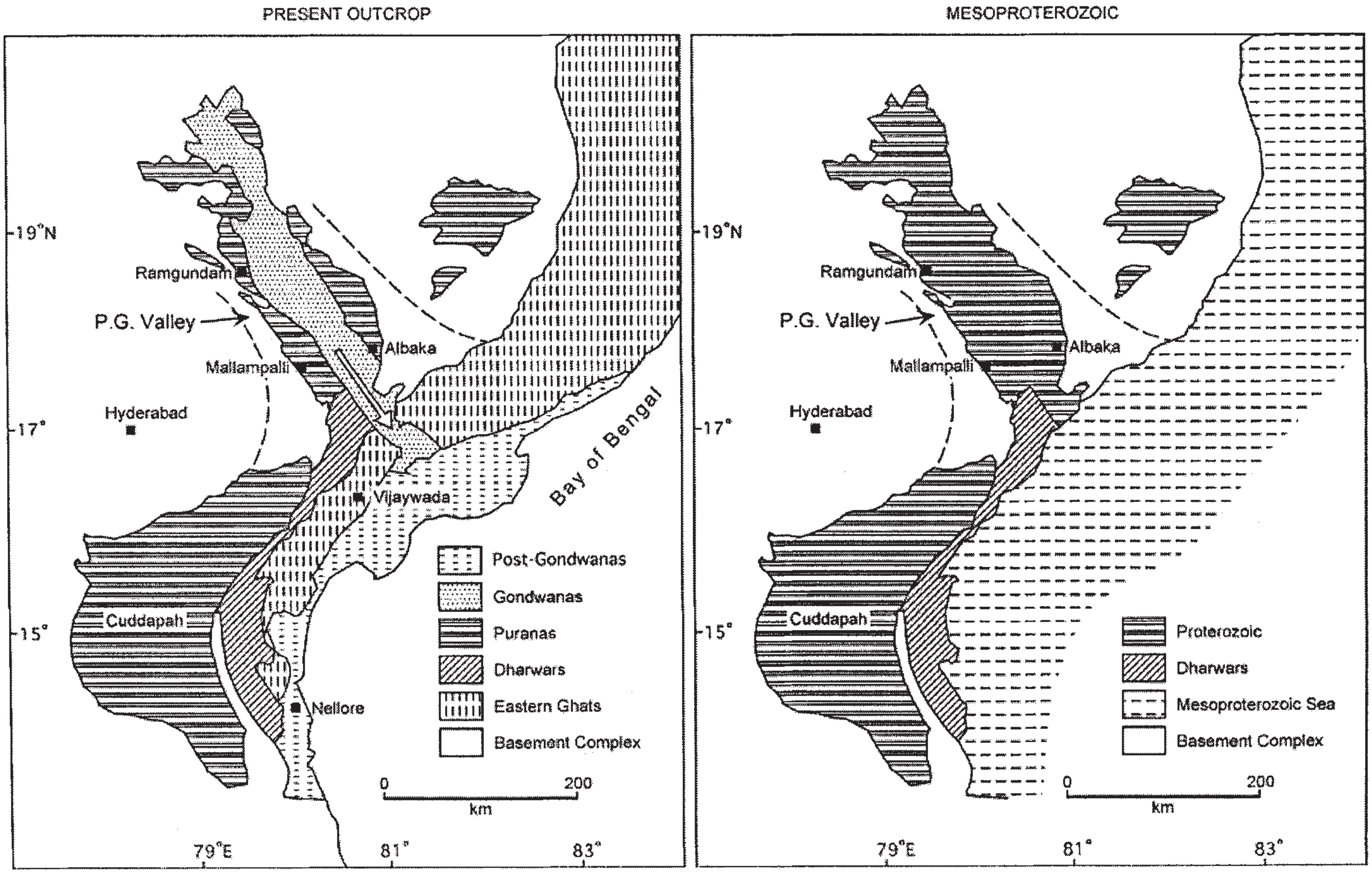

Fig. 5. Proterozoic palaeogeography (schematic) of the PG basin.

Early Mesoproterozoic phase of widespread cratonic rifting and basin opening, and points to a common tectonic history in the South Indian craton, EGGB and the Enderby Land during the rifting (Yoshida et al., 2000) and before rifting. The stratigraphic-sedimentologic signatures in the unconformity-bound sequences in the PG Valley indicate that the southeastern part of the Valley developed as a southeasterly sloping embayment, which was the pathway for marine transgression and open marine circulation. The PG basin was connected to a major marine basin on the eastern side of the Indian craton (Fig. 5), and the marine basin may be related to the fragmentation of the Mesoproterozoic supercontinent. The ca. 1500 Ma rifting along the eastern margin of the South Indian craton, along the line of the EGGB separated India and East Antarctica.

The major contractional deformation in the Valley affected the rocks of the Pakhal and Penganga Groups and their equivalents, and there is no evidence of pre-Penganga compression in the basin. The Rb–Sr age of sedimentation for the lower part of the Penganga Group (775±30 to 790±30 Ma) indicates a Middle to Late Neoproterozoic age for contractional deformation of the Penganga and the underlying Pakhal rocks. The deformation could have heralded the collapse of the ocean intervening East Antarctica and India (cf. Burke and Dewey, 1973), and amalgamation of the two cratonic blocks.

There is no definite evidence of contractional deformation in the PG valley that can be related to the ca. 1000 Ma Grenvillian orogeny or to the assembly of Rodinia and collapse of the Indo-Antarctica ocean during the Late Mesoproterozoic or the Early Neoproterozoic. The absence of any correlatable Mesoproterozoic history between the northern Eastern Ghats and Rayner Complex (Black et al., 1987) supports the view. The exact reconstruction of India-Antarctica assembly, however, may require reliable dating of rifting and inversion events in the PG Valley and other Proterozoic basins in the South Indian craton, such as Chattisgarh and Cuddapah.

Conclusions

The NW–SE trending Pranhita-Godavari (PG) Valley joins the EGGB in the SE and the CITZ in the NW. The Valley preserves a thick succession of Mesoproterozoic to Neoproterozoic rocks, which unconformably overlies the Archaean-Palaeoproterozoic basement. The PG Valley basin formed along a tectonic join between the Dharwar and Bastar Archaean nuclei.

The Proterozoic sedimentary succession of the Valley, the Godavari Supergroup, consists of several unconformity-bound sequences that bear sedimentary, stratigraphic and structural features attributable to an evolving intracratonic rift. The sequences attest to repeated rifting in the Valley, from Early Mesoproterozoic (ca. 1500 Ma) to Late Neoproterozoic. The behaviour of the unconformity surfaces in space, and trend of thickness variation of the sequences point to southeasterly deepening of the basin that opened to a major ocean basin on the eastern side of the Indian craton.

The initial rifting and opening of the basin at ca. 1500 Ma coincides with other extensional events in the EGGB, Bastar craton and East Antarctica, broadly coeval with the fragmentation of the Early Mesoproterozoic supercontinent. The Indian craton was separated from the East Antarctica with the opening of an ocean basin between the two. The ocean basin may be designated as Indo-Antarctic ocean. The Mesoproterozoic and Early Neoproterozoic stratigraphic units, respectively the Pakhal and Penganga Groups, were subjected to NE–SW directed compression. The deformation is pre-Sullavai, and may be related to a Middle to Late Neoproterozoic compression.

Paucity of radiometric ages is a major constraint in reconstructing the chronometry of events within the craton and craton margin. Reconstruction of the events of India-Antarctica linkage would require larger number of isotopic dates from the PG Valley to determine the chronology of different events of sedimentation, hiatuses and deformation.

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