"…. though originally proposed as a name for stratigraphical sequence, the term GONDWANA, thus, comes to connote over the years, different meanings in different contexts to different people. To a stratigrapher, it was the Gondwana Sequence comprising several thousand meters of sedimentary deposits of a certain age; to a palaeobotanist, it was the Gondwana flora of certain composition; and to a palaeogeographer it was the Gondwanaland occupying a certain land area in the geological past. More often than not, one idea was confused with the other due to ambiguity about the concept, limits and extent of the Gondwana."

B.S. VENKATACHALA and H.K. MAHESHWARI (1988)

2

REGIONAL FRAMEWORK

CHAPTER 2
REGIONAL FRAMEWORK

GENERAL

In order to understand the geological setting of the study area, it is essential to know the regional framework of the basin. In this chapter, therefore, an attempt has been made to give an overview of the lithostratigraphy and tectonic set-up of the Pranhita-Godavari (P.G.) basin. The Pranhita-Godavari valley is an intracratonic failed rift basin in the Indian peninsular shield extending in NW-SE direction, more or less parallel to the course of Godavari and Pranhita rivers. Coastal Gondwana's of Ramanamurthy, (1987) and Raja Rao, (1982) are intentionally excluded from our discussion of regional framework.

STRATIGRAPHY

King (1881) worked out the stratigraphy of the whole basin. Subsequent studies by the geologists of G.S.I. (Basumallic, 1967; Raman, 1971; Ramanamurthy, 1979, 1985, 1987, 1996; Mitra et al., 1982; Raja Rao, 1982; Rudra, 1972, 1982; Srinivasa Rao, T, 1987; Balasubramanyam, 1992; Lakshminarayana, 1996; Lakshminarayana et. al., 1990,1992), O.N.G.C. (Raiverman et al., 1985; Raju, 1986), coal companies (Ramanamurthy, 1987) and other institutions (Kutty, 1969, 1970, 1987; Sengupta, 1970; Srivastava and Jha, 1988, 1990, 1992; Dasgupta, 1993) have brought out wealth of information on the stratigraphy on one or other rock units, or the same units in one or other parts of the basin.

The major rock units of the Pranhita-Godavari basin include, the Archean basement, the Proterozoic sedimentaries, the Palaeozoic - Mesozoic Gondwana sedimentaries and the Upper Cretaceous-Tertiary Deccan Trap in the order of decreasing antiquity (Table 2.1).

The Deccan Trap Formation is restricted to the extreme north-western part of the basin, whereas the other three older units show a distinct mutual

TABLE 2.1 : GENERALISED STRATIGRAPHY OF PRANHITA-GODAVARI BASIN

Age	Supergroup	Group	Formation	Lithology
Upper Cretaceous			Deccan Trap (65 m)	Basaltic flows
				Unconformity
Early Cretaceous	GONDWANA	UPPER GONDWANA	Chikiala (300 m)	Brown, red and yellow to buff ferrugenous sandstones with conglomerates and a few clay beds.
				Unconformity
Jurrasic			Kota (675 m)	Pale brown sandstones with red clays with a few thin persistant limestone bands and local carbonaceous clays, thin coal bands and pebble beds
				Unconformity
Middle to upper Triassic			Maleri (1000 m)	Alternate sandstones and clay beds, lime pellet rocks, coarse buff sandstones with clay galls (Dharmaram). Coarse grain sandstones with clay galls and a few clay intercalations (Bhimaram). Soft red mudstones with calcareous bands (Yerrapalli).
				Sharp Contact (Conformable)
Upper Permian to Middle Triassic			Kamthi (1700 m)	Upper Member (500 m) L-M Triassic Coarse grained ferrugenous sandstones with numerous clay clasts and pebbles of cherty siltstones and secondary hematitic bands.
				Unconformity
		LOWER GONDWANA		Middle Member (1000 m) U-E Triassic Alternating sequence of medium grained, white to greenish grey sandstones.and green calcareous clays. Lower Member (200 m) U Permian Medium to coarse grianed greyish white calcareous sandstones with few coal seams and subordinate shales.
				Gradational Contact
Middle Permian			Barren Measures (500 m)	Medium to coarse grained, greenish grey to grey white feldspathic sandstones with subordinate variegated clays and siltstones and carbonaceous shales.
				Gradational Contact
Lower Permian			Barakar (300 m)	Medium to coarse grained, grey white sandstones with subordinate shales and a few workable coal seams. Lower part pebbly with few shale bands.
				Gradational Contact
Basal Permian			Talchir (350 m)	Fine grained sandstones, splintery green clays/shales, khaki coloured clays, pebble beds and diamictites.
				Unconformity
Upper Proterozoic	Sullavai Group (645 m)			Medium to coarse grained, white to brick red sandstones, at places quartzitic and mottled shales.
				Unconformity
Middle Proterozoic	Pakhal Group (3335 m)			Grey shales, phyllites, dolomites and marble and white to buff quartzites.
				Unconformity
Archean				Granites, banded gneisses, biotite gneisses, hornblende gneisses, quartz magnetite schists, biotite schists, quartz and pegmatite veins.

From RAJA RAO (1982) and LAKSHMINARAYANA (1996)

an intervening strip of the younger unit- the Gondwanas.

BASEMENT ROCKS

The Archean basement rocks exposed on the flanks of the graben comprise of gneisses, schists and charnockites.

The crystalline basement is overlain unconformably by the rocks of Proterozoic age on both sides of the graben. The lower Pakhal Group consists of basal arkosic conglomerate, arkose, followed by shales, limestones, silicious limestones, cherty limestones, bedded chert, shales and quartzites. The upper Sullavai Group is a monotonous coarse clastic sequence comprising of conglomerates, arkosic sandstones and sandstones occurring mostly as linear patches on the basin margins.

Various workers have worked on the stratigraphic succession of the Proterozoic sediments of the Godavari valley. Table 2.2 furnishes the Proterozoic sequence of P.G. basin proposed by various workers.

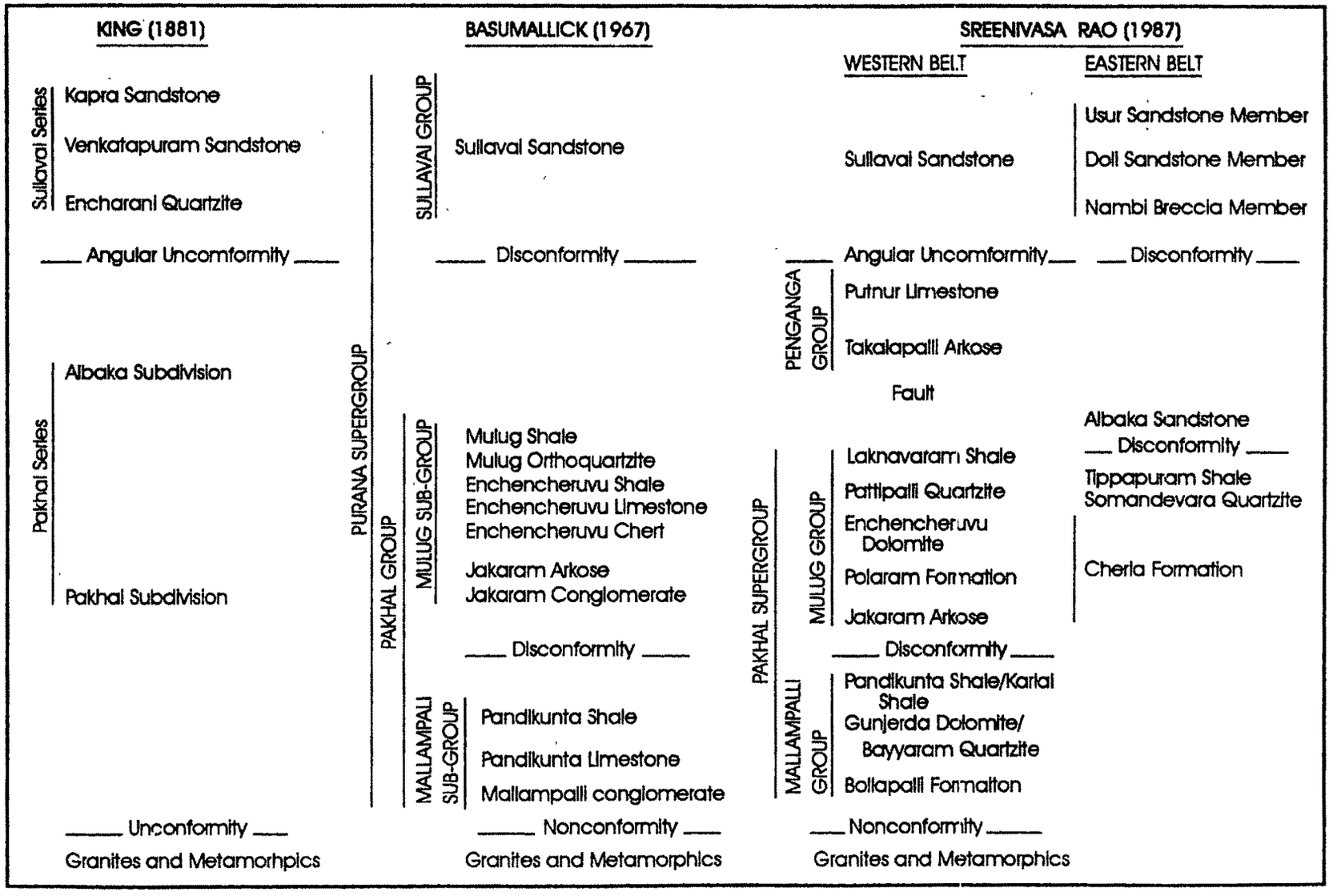
GONDWANA SUPER GROUP

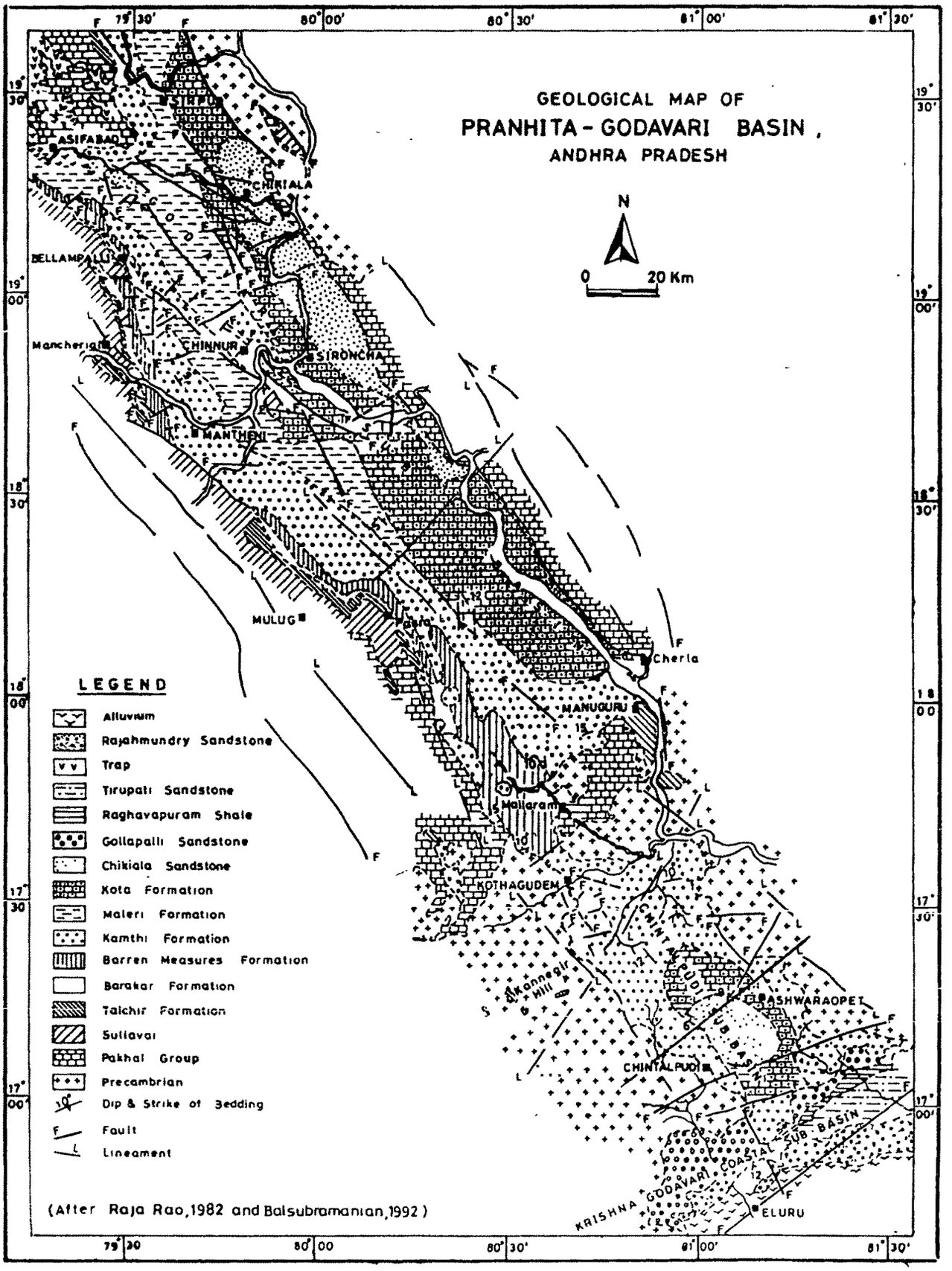
The rocks of Gondwana Super Group are divided into two groups - lower and upper. The lower Gondwana is further sub-divided into Talchir, Barakar, Barren Measures and Kamthi formations, while the upper Gondwana comprises Maleri, Kota and Chikiala formations in ascending order (Raja Rao, 1982). The entire succession is exposed in the central part of the basin (Fig. 2.1); whereas on either side of the basin (north as well as south) some of the units are missing.

Lower Gondwana Group (Palaeozoic sediments)

The basal unit of the Gondwana, represented by Talchir Formation (derived from the type locality in Orissa) crops out as a narrow elongated strips along the western margin of the basin resting either unconformably on the Proterozoic sediments or at places with original faults. On account of various transverse faults the exposures are offsetted at number of places. Isolated outcrops are also seen in the areas around Manuguru and Sirpur on the eastern

TABLE 2.2 : DIFFERENT VERSIONS OF THE PROTEROZOIC STRATIGRAPHY OF THE GODAVARI VALLEY.




GEOLOGICAL MAP OF
PRANHITA - GODAVARI BASIN ,
ANDHRA PRADESH
N
0 20 Km
SIRPUR
ASIFABAD
CHIRIALA
BELLAMPALLI
Mancherial
CHINNUR
STRONCHA
MANTHNI
MULUG
Cherla
MANUGURU
Mallaram
KOTHAGUDEM
Konnegir Hill
BHADRACHALAM
CHINTALPUDI
ELURU
GODAVARI COASTAL SUB BASIN
KRISHNA
LEGEND
Alluvium
Rajahmundry Sandstone
Trap
Tirupati Sandstone
Raghavapuram Shale
Gollapalli Sandstone
Chikiala Sandstone
Kota Formation
Maleri Formation
Kamthi Formation
Barren Measures Formation
Barakar Formation
Talchir Formation
Sullavai
Pakhal Group
Precambrian
Dip & Strike of Bedding
Fault
Lineament
(After Raja Rao, 1982 and Balsubramanian, 1992)

part of the basin. It consists of diamictites, fine grained sandstones, splintary green clays, shales, and chocolate coloured clays.

The basal unit is conformably succeeded by rocks of Barakar Formation (derived from type location Damodar Valley) which is often transected by faults, thus disrupting the continuity of the outcrops. Barakar Formation comprises coarse-grained sandstones with subordinate shales/clays and coal seams.

Conformably, overlying the Barakar's are the rocks of the Barren Measures Formation (absence of coal bearing strata), which are exposed all along the western belt from south of Asifabad to north of Kothagudem. It comprises medium to coarse grained greenish white compact sandstones with subordinate clays and siltstone.

The Kamthi Formation (named after Kamptee 79° 11' E - 21° 14' N) outcrops uninterruptedly almost in all sub-basins. It is divided into lower, middle and upper members. The lower member is correlatable with the Raniganj Formation of Damodar basin based on the presence of coal seam and similarity in lithology, while the middle and upper members broadly resemble with that of Panchet and Mahadeva formation (Ramanamurthy, 1987). Between the Middle and Upper member an unconformity exists and this marks a significant break in the sedimentation.

Upper Gondwana Group (Mesozoic sediments)

The Maleri Formation (named after the village Marweli) occurs in the central part of the basin from Sirpur (79° 39' E - 19° 30' N) to Eturnagaoram (79° 22' E - 18° 20' N). It contains dominantly of vermillion coloured silty clays with bands of arkosic sandstones, siltstones and calcareous pelleted rocks.

The Kota Formation (named after the village Kota 79° 58' E - 18° 54' N) rests unconformably on the Maleris, which occurs as a linear tract, extending from Wardha to Cherla, along the eastern margin. It consists of pale brown sandstones with red and green clays with a few thin persistent limestone bands. The presence of calcareous bands distinguishes this formation from the rest.

Fossil fishes, insect remains and dinosaurian remains are reported from this unit (Jain et al., 1962).

The Chikaila Formation forms the youngest unit, occupies the low hill ranges in the northeastern margin of the basin from Sirpur to Chandruptala. It comprises brown, red and yellow to buff coloured ferrugenous sandstones with conglomerates and few clay bands.

DECCAN TRAP

The Deccan Traps with intervening inter-trappeans occur over vast areas in the northwest beyond Asifabad.

TECTONIC SETUP

The Pranhita-Godavari basin exhibits two major structural linear trends in NW-SE and NE-SW directions. These correspond to Dharwarian and Eastern Ghat grains of the orogeny respectively (Agarwal and Bansal, 1986). The NW-SE lineaments paralleling the basin axis are represented by boundary faults related to taphrogenesis and rifting, while the NE-SW lineaments transverse to the basin, represent faults responsible for segmentation of the basin into various blocks (Agarwal and Bansal, Op. cited) or into various sub-basins (Ramanamurthy, 1988). Figure 2.2 depicts the tectonic framework of the basin.

LONGITUDINAL FAULTS

The north-eastern margin of the basin is defined by two prominent fault systems; (i) The Ahiri-Tipapuram or Ahiri-Cherla fault (F_1 F_1) which juxtaposes the Proterozoic sediments against the Archean basement, (ii) The Godavari fault (F_2 F_2) which demarcates the boundary between Gondwana sediments and Proterozoic/Archean rocks.

The left flank of the basin is marked by a set of faults arranged en-echelon which impart an irregular shape to the southwest margin. The westernmost fault, Mallampalli fault (F_3 F_3) demarcates the boundary between Pakhal sediments and Archean basement. The Mulug fault (F_4 F_4) juxtaposes the Pakhal Group against the Sullavai Group.

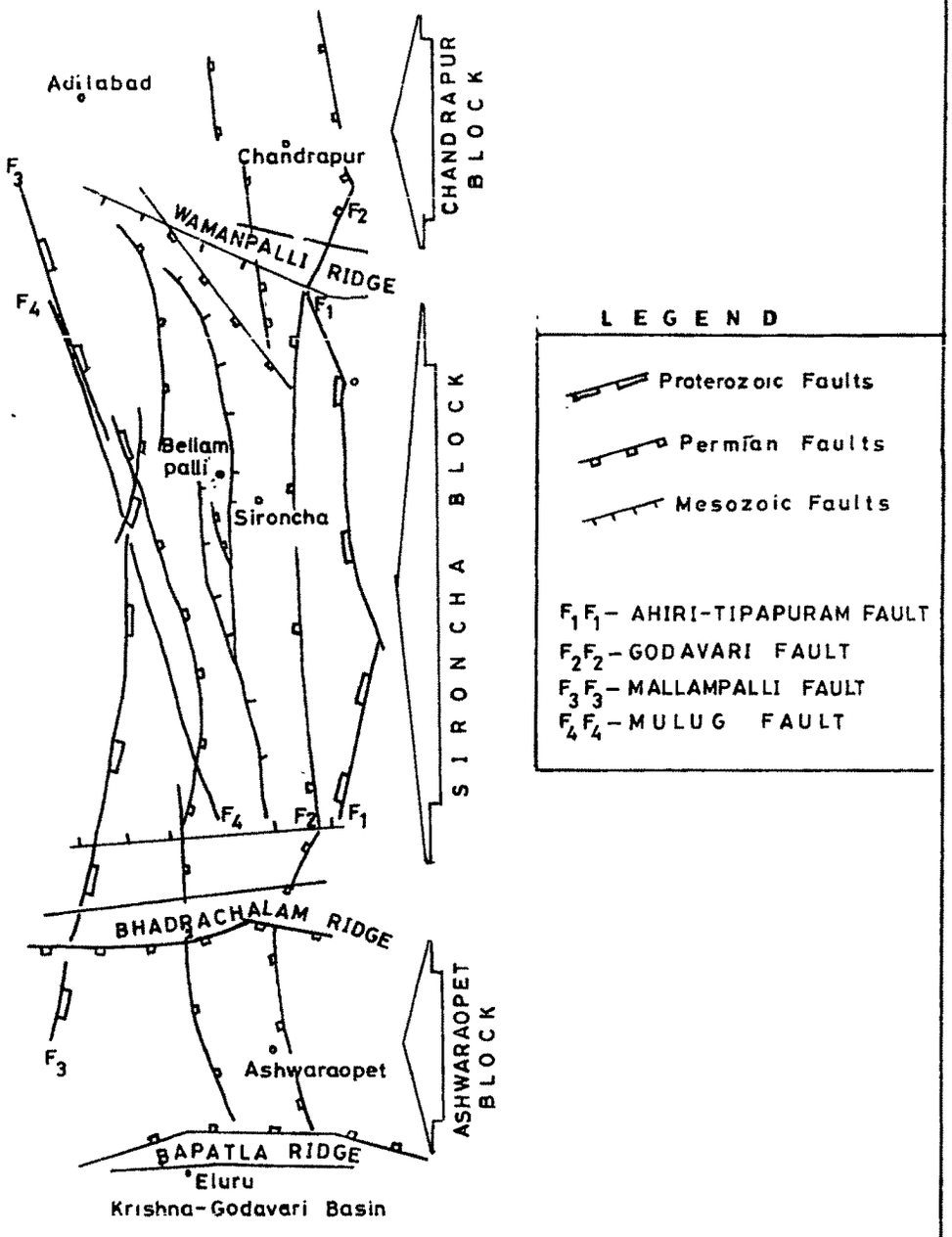


Fig. 2.2: Tectonic Framework of Pranhita-Godavari Basin

(After Agarawal and Bansal 1986)

Besides these four major basin-margin faults, numerous other longitudinal faults are running discontinuously within the basin bringing the lower Gondwana sediments at various places, in contact with different Pre-Cambrian formations. The most notable among them occur near (i) Chinnur, where a basement inlier and older Gondwana rocks were brought up against the Maleri Formation, (ii) Mantheni, where Barakar, Barren Measures and Kamthi rocks are lying juxtaposed against Pre-Cambrian and Sullavai rocks, (iii) Eturnagaram, where a NW-SE trending antiformal structure was formed.

TRANSVERSE FAULTS

Based on gravity data, Agarwal and Bansal (1986) have divided the basin into three transverse blocks (Fig. 2.2) along NE-SW trend. These blocks are (i) Chandrapur block, (ii) Sironcha block and (iii) Ashwaraopet block. These blocks are separated from each other by two prominent transverse ridges viz. Wamanapalli ridge and Bhadrachalam ridge. However, the Ashwaraopet block is terminated in the south by the sub-surface Bapatla ridge. According to Mani et al., (1991) these ridges were formed during the Mesozoic after the deposition of Lower Gondwana sediments. According to them, the Sironcha block continued experiencing negative movements during the Mesozoic while the other two blocks remained stable or underwent positive movement resulting in erosion of earlier deposited sediments.

Besides these basement ridges numerous other NE-SW faults extend from one margin to another cutting across almost all the formations of the Gondwana. Prominent transverse faults are located at Pasra, Paloncha, Kothagudem, Sattupalli, Chintalpudi and Elluru. More number of NE-SW faults towards the SE part of the basin can be attributed to the prominent upliftment of the Eastern Ghat at the beginning of Cretaceous when Indian plate started breaking away from Gondwanaland.

Based on the nature of lithic fills and structural setting, Ramanamurthy (1985) divided the basin transversely into four sub-basins (i) Godavari sub-basin, (ii) Kothagudem sub-basin, (iii) Chintalpudi sub-basin and (iv) Krishna-Godavari coastal sub-basin. The Godavari sub-basin corresponds to Agarwal and Bansal's (1986) Sironcha block while Ashwaraopet block encompasses both Kothagudem and Chintalpudi sub-basins. Since Ramanamurthy (Op. cited) had

considered the Chandrapur area within the Wardha Valley, he had not included it within the framework of Pranhita Godavari basin.

NATURE OF THE BASIN

According to Ramanamurthy (1985), the Krishna-Godavari coastal sub-basin which consists of Gollapalli, Raghavapuram and Tirupati formations of Juro-Cretaceous age cannot be included with the context of Permo-Triassic Gondwana sedimentations; because of, (i) a significant change in basin geometry and (ii) complete reversal of palaeodrainage during that time. However, subsurface occurrence of Barakar and Kamthi formations in the coastal sub-basin has been recorded (Mani et al., 1991).

In the Sironcha and Chandrapur blocks, the Proterozoic sediments form the basement rocks for Gondwana sediments whereas in the Ashwaraopet block, the Archean gneisses, granites and schists form the basement for the Gondwana (Agarwal and Bansal, 1986). Another difference in the structural set up of the central and the southern blocks is that while the Sironcha block exhibits the structural set-up of a half graben, the Ashwaraopet block displays a true character of a graben as both margins are defined by faults. Lakshminarayana (1996) has attributed development of such graben and half graben to inhomogeneities in the lithology of basement rock.

According to Qureshy (1968), the Pranhita-Godavari basin marks the rift nature, however Ahmed and Ahmed (1979) and Krishnan (1968) have refuted the same. The later workers have broadly stated their opinions without restricting themselves to any particular basin. After critical study on various works, explanation found to be most logical to the present author is that the Godavari rift had developed along a NW trending zone of weakness inherited from the Archean (Dharwarian) orogenesis (Qureshy 1968) due to the extension caused by asthenospheric upwelling and subsequent cooling causing subsidence (Mishra et al., 1987).