CHAPTER - VII

VISUALIZATION OF
NEO-ACTIVE TECTONIC MODEL
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VISUALIZATION OF NEO–ACTIVE TECTONIC MODEL

7.1 GENERAL

As discussed in the introductory chapter–I, the Geoscientists have been using different types of geomorphic anomalies to detect and map the zones of Neo–Active tectonics. They have used lineaments, drainage fabric and geomorphic anomalies, geophysical anomalies, etc. either independently or in combinations of one or two anomalies only. Neither all the possible anomalies were analyzed together in a particular area nor the technologies like Remote Sensing which can spectacularly show various terrain anomalies and GIS which has the advanced credentials in amalgamating huge volume of geospatial data and 3D visualization feasibilities were used to their deserving limits. Hence, there remained possibilities of uncertainties in the Neo–Active tectonic models developed by them. So, the present research study was taken up to

- Utilize all possible anomalies namely the lineaments, drainage and other geomorphic anomalies
- Evaluate the possibility of utilizing some newer tools like geophysical resistivity data, groundwater modifications, etc.
- Utilize the advanced concepts of 3D GIS visualizations
- Bring out a comprehensive and a holistic model on Neo–Active tectonics
- Validate such a model and
- Finally develop suitable concepts / methodologies for Neo–Active tectonic mapping on the basis of such validation.

Hence, to evolve such a Neo–Active tectonic model, the probable Neo–Active tectonic zones deduced from lineament anomalies (Fig.2.13), fluvial geomorphic anomalies (Fig.3.21), coastal geomorphic anomalies (Fig.4.2–4.7), geophysical resistivity anomalies (Fig.5.16) and groundwater anomalies (Fig.6.6–6.7), that were all brought out as independent GIS layers in each case were integrated and a Neo–Active tectonic model was visualized for the study area.
7.2 NEO–ACTIVE TECTONIC MODEL

7.2.1 Phenomenon of Doming

The perusal of such drainage anomalies data and the integrated GIS output on such drainage anomalies, have shown three radial drainages (Fig.3.5). The occurrence of radial drainages in general and the centrifugal drainages in particular have been demonstrated to be the indicators of exposed buried structural domes or active diapirism and related doming, etc. by many workers around the world as well as in India (section–3.3.1).

Amongst these three radial drainages, one was found in sector-I and the other two in sector-II (Fig.7.1). Again, wherever such radial drainages show gullying, the same indicates the ongoing probable diapheric activities (Thornbury 1985). The radial drainage RD1 (Fig.3.4A) found in Ponnaiyar river catchment (sector–I) was observed in an active tectonic domain which has induced the phenomenon of river piracy demonstrated by Raiverman (1969). The radial drainages RD2 and RD3 (Fig.3.4A) seen in sector–II were interpreted along the misfit Araniar and Korttalaiyar rivers. These misfit rivers have been demonstrated to have occupied the left out traces of Palar / Cauvery after the river left the old course (PCI, Fig.3.6B) around 3,000 years B.p (Ramasamy et al 1992). Hence, these three radial drainages suggest diapheric or tectonic doming phenomenon of Holocene period (Fig.7.1).

Similarly, the five radial lineaments (RL1–RL5, Fig.2.10) must also indicate diapheric or tectonic doming (Fig.7.1). Ramsay (1967) has demonstrated that the clusters of domes and basins can be formed by simultaneous cross folding phenomenon during single deformation. Similar observations were made in different parts of the world by many (King 1942, Sharma 1974, Isachsen 1975, Ramasamy et al 1983, Ramasamy 1987 and many others). Hence it can be said that these radial drainages and radial lineaments are indicative of Late Holocene / ongoing tectonic activities.

7.2.2 Phenomenon of Arching

The occurrence of palaeochannels only in one bank of the rivers or the phenomenon of preferential migration has been taken as a valid evidence for the tectonic upliftment in the banks in which the palaeochannels are found or the tectonic subsidence along the banks towards which the rivers are preferentially migrating. In
Fig. 7.1 - Phenomenon of Doming

Radial Drainages
Radial Lineaments

Fig. 7.2 - Phenomenon of Arching

1, 2 and 3 - Preferential southerly migration of Proto Palar/Cauvery, Palar and Araniar rivers,
4 - Proto Palar delta, 5 - Convex coast, 6 - Beach ridges, 7 - Shrinkage of Pulicat backwater,
8 - Preferential withdrawal of creeks, 9 - Axis of arching, 10 - Shrinkage of groundwater ridge,
11 - Fracture swarms
the present study area, three conspicuous palaeochannels were found and interpreted as PCI, PC2 and PC3 (Fig.3.6), all confined only to the north of Palar river. Ramasamy et al (2006a) recently have made some specific observations on the ages of some of the palaeochannels that the palaeochannels interpreted in the present study as PCI are the old courses of river Proto Palar / Cauvery and the same are ending as two deltas to the north and south of Chennai city (1,2, Fig.3.6B & 1,Fig.7.2). They have further dated these deltas through radiocarbon tools that the northern delta is 8470±550 years old and the southern delta is 4670±90 years old and from the same inferred that the river Palar or Cauvery might have started its southerly migration from the northern delta around 8470±550 years B.p (Before present). Again Ramasamy et al (1992) have fixed up an age of 1100 years B.p to the palaeochannel belonging to river Palar near Kanchipuram which is interpreted in the present study as PC2 (Fig.3.6C & 2,Fig.7.2). This lead to the inference that the Palar river is in the process of southerly migration even during 1100 years B.p. Whereas the palaeochannels interpreted in the present study as PC3 (Fig.3.6D & 3, Fig.7.2) indicates the southerly migration of Araniar river. The Araniar river too was observed as a misfit river over the left out traces of river Palar / Cauvery (interpreted as PCI in the present study) for which Ramasamy et al (1992) earlier fixed up the upper age limit of 3000 years B.p and Ramasamy et al (2006a) have assigned an age of 8470±550 years B.p for the delta built over PCI.

However from the above observations, it can be broadly concluded that the southerly migration of river Palar / Cauvery might have been started from the PCI tract around Early–Middle Holocene (8470±550 years B.p) and continued upto 1100 years B.p as seen from the age of PC2 near Kanchipuram (2, Fig.7.2). While such persistent and preferential southerly migration of the river Palar / Cauvery suggests some tectonic upliftment in Chennai region (to the north of PC1–1, Fig.7.2), the dates of the palaeochannels suggest that such upliftment might have started atleast from Early–Middle Holocene and continued upto as late as very Late Holocene (1100 years B.p) as far as such migratory phenomenon is concerned.

The two deltas found at the terminal stage of the palaeochannels (PCI, Fig.3.6B) of Proto Palar / Cauvery are typical lobate deltas in their morphology and the same is well displayed by the northern one (Fig.4.2 & 4,Fig.7.2). Such lobate deltas have been
inferred to be concrete evidences for the constant land emergence, the consequent fall of
the sea level and the gradual progradation of the delta, lobes after lobes by many around
the world (Bates 1953, Babu 1975, Davis and Richard 1987) and in the study area too
(Ramasamy 1991, 2006a, 2006b) as discussed in section-4.2.1. Hence, the occurrence of
such lobate delta (Fig.4.2 & 4, Fig.7.2) to the north of Chennai city convincingly confirms
tectonic upliftment in the area.

The occurrence of widely developed beach ridges in general were considered to
indicate the land emergence or the regression of the sea (Babu 1975, Meijrink 1982,
Nageswara Rao et al 2003, Ramasamy 2006a) as discussed above in section-4.2.2. Whereas the convex shaped coasts with such restricted marine regressions within such convex coast along east and west coasts of India including the Chennai coast have been
demonstrated to be due to recent tectonic arching and the convex coasts are the reflections
of the structural culminations of such arches (Ramasamy 1989, Ramasamy and Balaji
1995 and Ramasamy 2006a). Ramasamy (2006a) has further observed converse
geomorphic anomalies like absence of beach ridges and concave coasts in the zones of
tectonic deepening along the Indian coasts and demarcated cymatogenic deepening along
them. Hence under such display of geomorphic anomalies, the Chennai region can be
considered as a zone of active tectonic arching during the Holocene period or cymatogenic
arching as revealed by the convex coast (5, Fig.7.2), well developed lobate deltas (4,
Fig.7.2) and restricted beach ridges (6, Fig.7.2).

The shrinkages of backwaters in coastal zones were observed to indicate tectonic
emergence in many global coasts (Vaz and Banerjee 1997, Brunetti et al 1998,
Kontopoulus and Avramidis 2003, Teatini et al 2005, Ramasamy 2006a, etc.) as discussed
in section-4.2.3. The major Pulicat backwater (Fig.4.4) located along Chennai coast has
indicated evidences of shrinkage during the last 70–80 years in the present study (7,
Fig.7.2). Hence this also confirms such tectonic upliftment or cymatogenic arching.

The multi dated satellite data and the topographic sheets indicated again the
shrinkage of Ennore and Kovalam creeks during the last 70–80 years (Fig.4.5). Strikingly,
the southern tongue of the Ennore creek and northern tongue of the Kovalam creek which
are respectively located to the north and south of Chennai city showed preferential withdrawal (Fig.4.5). From this, it was inferred in the present study (section-4.2.4), that there is a possibility of tectonic arching or buckling in between the northern Ennore and the southern Kovalam creeks. The occurrence of Ennore and Kovalam creeks along such cymatogenic arching not only confirm such arching but such selective withdrawal of the southern tongue of northern Ennore creek and the northern tongue of the southern Kovalam creek (8, Fig.7.2) clearly suggests that the axis of such cymatogenic arch may lie in E–W direction in between both the creeks (1, Fig.4.5A & 9, Fig.7.2).

The emerging coasts are characterized by the conspicuous development of bay mouth bars along the river mouths (Ramesh 1999). The bay mouth bars developed in the rivers like Cooum, Adyar and Palar (Fig.4.7) are debouching the Bay of Bengal in Chennai region as discussed in section-4.2.6 indicate the emerging nature of the coast from their point of view.

Similarly, cliffed coast and the benched coasts are proven testimonies for the emerging coasts and the Chennai coast (Fig.4.6) conspicuously displays the same as elaborated in section-4.2.5.

Again, the GIS based visualization of 10m water levels for the years 1975, 1980, 1985, 1990 and 1995 revealed the shrinkage of a groundwater dome (Fig.6.7). As, such phenomenon of groundwater modifications were proved to have direct bearing over active tectonics (Kafri 1970, Kresic 1995, Fu – qiong Huang et al 1999, Gudmundsson 1999, Chang et al 2004, etc.) as discussed in section-6.1, the present phenomenon, that too along the axis of probable arching (10, Fig.7.2) too corroborates such tectonic upliftment.

The lineament anomalies have revealed the occurrence of well defined fracture swarms with the general E–W orientation (Fig.2.6). From the occurrence of such prolifically dyke filled fracture swarms in a restricted domain in the study area along the crest of such tectonic arch (11, Fig.7.2), these can be concluded as crestline fractures related to cymatogenic arching on the basis of its similarities with other active tectonic provinces of India (Ghosh 1976, Das and Ray 1977, Sood et al 1982, Sychanthavong 1985, Ramasamy 1995 and many others) as spelt in section-2.3.1.
Thus all these tectonic, geomorphic and geohydrologic anomalies observed in the study area show the following

1. Palaeochannels suggesting preferential southerly migration from Chennai ➔ Suggest tectonic upliftment in Chennai region

2. Conspicuously developed palaeo lobate delta seen at the terminal stage of palaeochannel PCI ➔ Indicates persistent land emergence and its tutored constant sea level regression and the resultant delta progradation in Chennai area

3. Convex shaped Chennai coast with well developed wide beach ridges confined in such convex coast of Chennai ➔ Indicates the structural culmination of cymatogenic arching in Chennai area

4. Shrinkage of Pulicat backwater during the last 70 – 80 years ➔ Convincingly indicates the land emergence and the consequent withdrawal of sea

5. Withdrawal of preferential tongues of Ennore and Kovalam creeks ➔ Indicates definite land arching along Chennai

6. Benched beaches and the bay mouth bars along Chennai coast ➔ Signify the emerging coast

7. The shrinkage of groundwater dome in the study area ➔ Indicates the land upliftment and the groundwater level fall

8. The occurrence of E–W aligned well developed fracture swarms to a breath of 40–50 km with dyke swarms and its confinement along the axial region of the land upliftment ➔ Indicates that these are crestline fractures related to cymatogenic arching and the axis of which is aligned in E–W direction

All these clearly indicate a clear E – W trending Middle – Late Holocene – still ongoing land arching along Vaniyambadi – Chennai.

7.2.3 Phenomenon of N–S / NNE–SSW Faulting

The analysis of the lineament system shows that the lineament density maxima and lineament number maxima fell predominantly in N–S direction (Fig.2.11, 2.12). As far as the deflected drainages are concerned, the N–S lineaments have significantly deflected the drainages both in sector–I and II. In sector–II, these deflecting lineaments were straight
and had longer strike extension and even the major rivers like Palar has been deflected to 90° (DD27, Fig.3.12E). In between these sectors too, the Ponnai river again was sharply deflected by a N–S lineament (DD18, Fig.3.11D). The Palar river is a misfit river occupying the left out traces of Cauvery river which had abandoned this tract around 3000 years B.p (Ramasamy et al 1992) (section-3.3.2). Hence, this N–S deflection of Palar river and the lineament which deflected it must be of Late Holocene in age (Fig.7.3).

Amongst the eyed drainages interpreted in 13 locations (ED1–ED13, Fig.3.17) which signify the recent land subsidence (Thombury 1985, Smith et al 1997, Ramasamy and Karthikeyan 1998, Ramasamy and Kumanan 2000 and many others), 8 eyed drainages were related to N–S to NNE–SSW faults / lineaments indicating the probable land subsidence along these lineaments. Even amongst these 8 eyed drainages, three of them (ED4, ED5 and ED11, Fig.3.17) showed ‘S’ shaped dragging pattern in the drainages from which possible sinistral transverse tectonic movements have been visualized along them (Fig.7.3).

The resistivity lows and breaks identified at multiple depths have revealed N–S oriented major anomalies and of course more in the western half of the area and in a little fragmented pattern in eastern half of the area (Fig.5.16). These have also almost coincided with the N–S lineaments / faults identified from lineament density maxima, lineament number maxima, deflected drainages and eyed drainages (Fig.7.3).

Radhakrishna (1992) and Valdiya (1998) have observed active Holocene tectonism respectively in the western Biligirirangan hill ranges (south of Bangarapet) and Bangalore area. Ramasamy and Balaji (1995), Ramasamy et al (1998b) and Ramasamy (2006a) have observed many major faults of Post-Mio-Pliocene to Holocene period in parts of Tamil Nadu.

All these indicate that the N–S anomalies demonstrated in the form of lineament density maxima, lineament number maxima, drainage deflections, resistivity breaks and lows (Fig.5.16) must be the Holocene block faults (Fig.7.3).

7.2.4 Phenomenon of NE–SW Transverse Faulting

The compressed meanders were interpreted in the present study in 15 locations (CM1–CM15, Fig.3.20) confining within two sub parallel lineaments. Amongst these, the NE–SW lineaments showed conspicuous ‘S’ shaped flow (for example CM9, Fig.3.19B)
Fig. 7.3 - Phenomenon of N-S / NNE-SSW faulting

- Lineaments deduced from deflected drainages
- Lineaments deduced from Resistivity lows
- Lineament Density Maxima
- Lineaments deduced from Resistivity breaks
- Lineament Number Maxima

Fig. 7.4 - Phenomenon of NE-SW faulting

- Lineaments deduced from Deflected drainages
- Lineaments deduced from Eyed drainages
- Lineaments deduced from Resistivity breaks
- Lineaments deduced from Compressed meanders
- Lineaments deduced from Resistivity lows
and hence, as discussed earlier (section-3.3.6), sinistral strike slip fault movements has been visualized along these NE–SW faults. Similarly amongst 13 eyed drainages, the major eyed drainage found in Palar River (ED8, Fig.3.16D) in Kanchipuram area too was confined within two sub parallel lineaments and this eyed drainage showed ‘S’ shaped drags also. So, similar sinistral fault movements has been visualized along these NE–SW lineaments / faults (Fig.7.4). These NE–SW lineaments were also well reflected by the drainage deflections and spectacularly documented by the resistivity breaks (Fig.5.16).

Many earlier workers (Jacob and Narayanaswami 1954, Nair 1987 and Nair and Subramanian 1989, Ramasamy 1995c, Ramasamy and Balaji 1995 and Ramasamy 2006a) have made a lot of inferences on these NE–SW aligned faults in parts of South India; some of them observed that the NE–SW faults of Tamil Nadu take a swing in west southwesterly direction, sinistrally shifted the west coast of Kerala, continue upto Laccadives and Maldives and again sinistrally shifted these coral islands too; some observed clear evidences for recent tectonic movements along the west coast of Kerala; etc. Ramasamy and Ramesh (1999), Ramasamy and Kumanan (2000) and Ramasamy et al (2006b) have observed that these sinistral faults causing the eyed, dragged eyed and ‘S’ shaped drainages are of very Late Holocene age ranging from 3000 years B.p to till date.

So such NE–SW lineaments / faults interpreted in the present study area can be concluded as sinistral faults of Late Holocene period (Fig.7.4).

7.2.5 Phenomenon of NW–SE Transverse Faulting

Again amongst the 15 compressed meanders, two major compressed meanders were found to fall within NW–SE trending sub parallel lineaments. Amongst these, the compressed meander CM10 (Fig.3.19C) found in river Korttalaiyar displayed a very characteristic ‘Z’ shaped compressed flow of the drainage within these faults. While Ramasamy and Balaji (1995) have observed such well defined compressed meanders with ‘Z’ shaped flow in Coleroon river east of Tiruchirappalli at the crossing point of NW–SE lineament and assigned dextral strike slip geometry to this fault, Ramasamy et al (2006b) again interpreted such compressed meanders along with ‘Z’ shaped drainages in a number of places in South India and from the same inferred that these confining faults are active
dextral strike slip faults in nature. Similar dextral strike slip fault movements were observed by many on the basis of ‘Z’ shaped meanders and the one inferred in Kyoto river, Japan by Maruyama and Lin (2002) exactly resembles the Coleroon compressed meanders, besides many. Ramasamy et al (1992) observed that the Cauvery river has reached the Coleroon river stage in the processes of it’s anticlockwise rotational migration around 750 years B.p. Hence, obviously such NW–SE fault causing such a compressed meanders (Fig.3.19C) should be younger to it.

The parallel drainages interpreted in the study have shown well defined parallel lineaments. While the same found southwest of Vaniyambadi is found to fall in a domain of active tectonics (PD1, Fig.3.8B), where major river capturing was inferred in Ponnaiyar river (Raiverman 1969), similar parallel drainages in Araniar river (PD2, Fig.3.8C) in the north and Palar river (PD4, Fig.3.8E) in the south were demonstrated to be Late Holocene faults as discussed in the section-3.3.3. Amongst 32 deflected drainages and the related lineaments, the maximum of over ‘17’ NW–SE lineaments were related to drainage deflection (Table-3.1). The GIS based visualization of multi depth resistivity data also indicated prominent anomalies along NW–SE directions (Fig.5.16).

All these indicate that the NW–SE lineaments are mostly of Late Holocene faults or Late Holocene reactivation with dextral geometry. While many earlier workers observed that NW–SE to WNW–ESE faults were inferred to control the major rivers like Palar, Ponnaiyar, Cauvery in parts, Vaigai, etc. in parts of Tamil Nadu (Vemban et al 1977), Ramasamy (2006a) have observed similar dextral strike slip movements along NW–SE lineaments / faults in Precambrian rocks and the same was found to continue upto the Tamil Nadu coast too. Hence, these NW–SE lineaments of the study area by and large can be considered as dextral faults of Late Holocene parentage or reactivation (Fig.7.5).

7.3 VISUALIZATION OF NEO–ACTIVE TECTONIC MODEL (Fig.7.6)

The various anomalies interpreted from the lineament systems, drainages and the fluvial geomorphic anomalies, coastal geomorphic anomalies and the geophysical resistivity anomalies thus indicate a E–W to ENE–WSW oriented land arching in the study area along Vaniyambadi–Chennai. The radiocarbon and other dates of the palaeochecknals
Fig. 7.5 - Phenomenon of NW - SE faulting

- Lineaments deduced from Compressed meanders
- Lineaments deduced from parallel drainages
- Lineaments deduced from deflected drainages
- Lineaments deduced from resistivity breaks
- Lineaments deduced from resistivity lows

Fig. 7.6 - Visualization of Neo - Active tectonic model

- Cymatogenic arching
- N - S faulting
- NE - SW faulting
- NW - SE faulting
- Barnch off lineaments
- Curvilinear lineaments
- Shrinkage of groundwater ridge
of Proto Palar (8470±550 years B.P) and Araniar (<3000 years B.P) in Chennai region, the Palar (1100 years B.P - Archaeological and Tamil Literature dates) in Kanchipuram area and their southerly migrations, convex coast with restricted marine regression, the shrinkage in Pulicat backwater during 1915–1992, the preferential withdrawal of creeks during 1915–1992 and the squeezing and shrinkage of groundwater dome in this area during 1975–1995, etc. indicate that such land arching is going on even today.

The N–S lineaments deduced from the present study and also by the earlier workers indicate active tectonics along these lineaments. The eyed drainages and the compressed meanders in the present study suggest that these must be the block faults and active even now. Ramasamy et al (2006c) have observed that the N–S lineaments found in Pattukottai–Mannargudi–Vedaranniyam area are the expressions of Middle–Late Holocene hinge faults with their hinge located near Neyveli in the north on the basis of the rapid sandbar building seen in IRS-1B satellite imagery encircling the Tiruthuraipoondi – Vedaranniyam beach ridges. Ramasamy and Ravikumar (2002) have earlier observed that the Mio–Pliocene Sandstone of the Pattukottai–Mannargudi area is undergoing upliftment along two N–S trending sub parallel faults atleast since 6000 years. The active tectonics along such faults of Cauvery delta were also observed by Agarwal and Mitra (1991), Raiverman (1966), Babu (1991) and many others.

The NE–SW spectrum of faults / lineaments deciphered in the present study shows a lot of evidences for the sinistral strike slip movements corroborating with earlier observations of different workers (Jacob and Narayanaswami 1954, Prabhakar Rao et al 1985, Nair 1987, Nair and Subramanian 1989, Ramasamy 1995c, Ramasamy and Balaji 1995 and Ramasamy 2006a). In contrast, the NW–SE dextral faults observed to be active in the present study area again regionally corroborate with the observations made by the earlier workers. Again E–W dyke filled fracture swarms and their coincidence with the active E–W arching deciphered along Vaniyambadi–Chennai indicate that these E–W tectonic grains are related to such arching.

So such Neo–Active tectonic signatures brought out in the present study indicate general E–W arching along Vaniyambadi–Chennai and the N–S oriented block faulting along with frequent dextral and sinistral movements, NE–SW sinistral and NW–SE dextral
strike slip faults. Hence, a possible compressive force of Holocene period can be visualized in N–S orientation (Anderson 1951 and Moody and Hill 1956). Under this environment, the NE–SW faults can be referred to left lateral wrench faults and the NW–SE faults to right lateral wrench faults. Under this stress distribution system prevalent during Holocene period, the E–W fracture swarms conspicuously coinciding along the crest of the Vaniyambadi – Chennai arch, can be referred as release fractures related to this arching as found in most of the cymatogenic arches (Ghosh 1976).

The present study has also brought out curvilinear lineaments (section-2.3.2) in 9 locations (CL1–CL9, Fig.2.7A) and amongst which most of the lineaments fall in N–S orientation except CL5 (Fig.2.8B) which has a general E–W orientation with convexity towards north. Such curvilinear lineaments of this part of South India have been reported to be the reflection of post drift kinematics by Prabaharan et al (1995). Hence, the occurrences of curvilinear lineaments with N–S orientation are attributed to the progressive northerly compression. The E–W curvilinear lineament (CL5, Fig.2.8B) may be also related to such northerly compressive force. However its southerly convexity / curvilinearity may be due to the strong rigid landform in the north. Valdiya (2001), on the basis of geomorphic anomalies and Qureshy (1964) on the basis of deep gravity anomalies have inferred a number of peripheral / curvilinear E–W faults in Tamil Nadu and the rise of the southern Anamalai–Palani hills and the northern Nilgiri hills with intervening grabening along the central Palghat region (Fig.7.6).

Again, in the present study, some branch off lineaments (section-2.3.3) have been interpreted in six locations (BL1–BL6, Fig.2.9). Such branch off lineaments or the converging lineaments were interpreted as “Tear faults” aligned orthogonally to the folds by Mueller and Talling (1997) along the Wheeler ridge of southwestern California. Hence, as the branch off lineaments interpreted in six locations, as all are aligned near orthogonal to the Vaniyambadi–Chennai arch, these could be related to active tectonics and hence seismogenic (Fig.7.6).

The analysis of groundwater anomalies (Fig.6.1–6.6) in the study area has brought out an E–W trending groundwater ridge (shallow groundwater) and valleys (deep groundwater). The conspicuous alignment of such groundwater valleys and the ridge with
a general E–W alignment resembling a wave pattern or mega ripples indicates that it must be the reflection of the above visualized northerly compressive force similar to “seismic seiche” observed in different parts of the world (Leroy et al 2002, XinJian Chen 2005 and many others). Further, the integration of such groundwater ridges and valleys of 1975–1995 indicated that the rectilinear groundwater valleys of 1975 getting transformed into hour-glass shape during 1990–1995. This again confirms that the northerly directed compressive stress is prevalent in the study area. The transformation of rectilinear southern groundwater valley into curvilinear pattern with northerly convexity could be explained to the northerly compression related to post collision tectonics. The gradual conversion of rectilinear northern groundwater valley into arcuate shape with southerly bending during 1975–1995 could probably indicate the sub surface rigidity / obstructions provided from the north.

The modifications of groundwater ridge / cone (Fig.6.7) indicating the squeezing effect and the gradual shrinkage of the same in between 1975 and 1995 also indicate the probable tectonic upliftment. Such reflections in groundwater systems have also been observed by many in active tectonic and seismic provinces of the world (Kafri 1970, Kresic 1995, Fu – qiong Huang et al 1999, Gudmundsson 1999, Chang et al 2004, etc). However, further detailed studies on the groundwater behavior could provide more confirmative ideas on how such groundwater anomalies can be effectively utilized not only for such Neo–Active tectonic mapping but also as a precursor for disastrous earthquakes.

Thus, the present research study using multivariate anomalies viz: lineaments, drainages / fluvial and coastal geomorphic, geophysical resistivity and groundwater anomalies have lead to the detection of E–W cymatogenic arching with N–S block faulting, NE–SW sinistral and NW–SE dextral strike slip faulting and E–W fracture swarms in the area (Fig.7.6).

This model also gains support from various earlier workers:

➔ While Ramasamy et al (1987) have visualized the feasibility of a tectonic arch in Chennai area, Subrahmanya (1994), on the basis of coastal geomorphic anomalies, inferred similar arching in Mangalore region of the west coast of India and visualized the possibility of Mangalore arch to continue upto Chennai in the east.
Qureshy (1964) and Valdiya (2001) have inferred central E–W graben along Palghat gap flanked by the northern uplifted block in Nilgiris and the southern uplifted block in Anamalai–Palani hills.

Ramasamy (1999) has inferred a cymatogenic arch with E–W orientation along Vengurla of Kerala coast correlatable with similar arch brought out by geophysical investigations (Biswas 1989).

Ghosh (1976) and Sood et al. (1982) have inferred similar cymatogenic arching along Saurashtra Peninsula and further observed that is Post Trappean arch is related to post collision tectonics and the same has created E–W fracture swarms with prolific intrusion of dykes. Similar to one observed along Vaniyambadi – Chennai arch.

Similar N–S compression and E–W to ENE–WSW trending cymatogenic arching was demonstrated by Power and Patil (1980) in Deccan volcanic province to the north of the present study area.


Singh et al. (1996) have deduced the northerly compressive force in Indo–Gangetic plains from the NNE–SSW sinistral and NW–SE dextral strike slip faults of Holocene period from the drainage anomalies.

Ramasamy et al. (1991), on the basis of the migratory pattern of the West Indian rivers, have inferred ENE–WSW trending cymatogenic arch along Siwana–Ajmer–Delhi with a graben along its axis. This graben was also inferred to coincide with Post Tertiary graben established by Das et al. (1990).

In contrast, Ramasamy and Balaji (1995) have visualized that whole Indian plate is whirling like a worm with alternate arches and deeps from Cape Comorin in the south to Himalayas in the north.

7.4 SYNTHESIS

Thus, the present study of developing of concepts and methodologies for Neo–Active tectonic mapping using various anomalies on lineaments, geomorphology, geophysics and groundwater have lead to the deduction of an unique tectonic model with E–W ongoing land arching, N–S block faulting, NE–SW sinistral and NW–SE dextral faulting and E–W release fracture swarms.