SEISMIC PRONE LINEAMENTS OF TAMIL NADU, INDIA AND ITS IMPACT ON ENVIRONMENT – AN ANALYSIS THROUGH REMOTE SENSING

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ABSTRACT

The Peninsular shield of India was thought as a aseismic region but the frequent earth tremors, at many places, of late, suggest that it is also seismic prone. The violent earthquake in 1994 at Latur, Maharastra state has justified the fact. The Latur catastrophic event not only devastated the whole of Latur village but also claimed many precious lives. The tectonics of a region plays a crucial role in many of the major earthquakes around the world. The Tamil Nadu state in South India is no exception to the onslaught of this event. Several earth tremors have been recorded right from 1823 till date in various parts of the state. The seismological and remote sensing analysis has shown that most of the earth tremors are falling along Precambrian faults/lineaments reactivated in Quaternary times and Pleistocene faults/lineaments. The occurrence of earth tremors in South India may be attributed to the reactivation of lineaments/faults, which are trending in NE-SW, NW-SE and N-S directions and the reactivation of lineaments/faults may be ascribed to the movement of the Indian plate towards Tibetan plate. In seismological analysis, the satellite Remote Sensing gives a clear picture of regional lineaments/faults of tectonic importance and thus plays a vital role in seismic concepts.

1.INTRODUCTION

The Southern India which is otherwise called as Peninsular shield was hitherto regarded as a stable zone free from seismicity but the recent earth tremor which occurred in Latur, Maharastra state in 1994 and the earth quake of 1900 in Coimbatore to a magnitude of 6.5 (Richter scale) have broken the conviction of the geoscientists as it no longer to be so. The frequent earth tremors which have been triggering on and off in various parts of Tamil Nadu state too justify the same and the faults/lineaments play a vital role for the cause of the earth tremors in South India which dissipate the accumulated strain in the form of earth tremors. These lineaments/faults of tectonic importance are well manifested in satellite imagery. Hence, in order to understand the role of lineaments/faults and Remote Sensing in seismicity, this study has been taken up.

2.METHODOLOGY

The regional lineament/fracture pattern of Tamil Nadu was prepared using Landsat and IRS 1 series on black and white and FCC satellite imagery on 1:250,000 scale on various indivudual bands and scenes and subsequently they were transformed into a 1:100,000 planimetrically controlled map.

The seismic earth tremors recorded by Gauribidanur seismic station and the data from available literature (Sharma and Verghese 1979) were collected and they were analysed with the lineament/fracture network for the possible relationship and Pleistocene tectonism. Various geomorphic anomalies have also been analysed for establishing the Pleistocene tectonism, which caused many earth tremors in South India.

3.REGIONAL GEOLOGY

The Sothern Indian Peninsula exposes olden Archaean crust and supracrustals which comprise of Khondalites, Charnockites, Migmatites, Sargurs, Peninsular gneiss and schists. In Tamil Nadu, the major hills are Kolli, Pachai, Shevroy, Chitteri, Kalrayan of Eastern Ghats hill ranges which are all composed of Charnockitic rocks.

Apart from Charnockite rock, most of the region is covered by Gneissic rocks. The Eastern part of Tamil Nadu is represented by Cretaceous, Tertiary rocks and Alluviam (Anon, 1969 and Balaji 1995). The Northern part of Tamil Nadu is criss crossed by E-W trending doleritic dykes (Ramasamy and Balaji 1995).

4.REGIONAL LINEAMENT/FRACTURE NETWORK OF TAMIL NADU

Using Landsat and IRS 1A and 1B satellite imagery, the major fractures/lineaments were interpreted on individual scenes and bands and they were subsequently mosaiced to get a regional picture (Fig.1). The lineaments were interpreted on the basis of tonal linearities, straightness of drainages, vegetational alignments, soil tonal contrast etc. The fractures /lineaments are regional in extent which cover 600 km in lengthwise at some places traversing various geological terrains which controls minerals, ground water and ultrabasics and thus, they are of tectonic importance. The fractures thus interpreted were trending in four azimuthal frequencies viz NE-SW, NW-SE, N-S and E-W directions. The NE-SW lineament shows signatures of dextral movements, NW-SE lineament shows sinistral movements and the E-W lineament shows release geometry (Ramasamy and Balaji 1993). The fractures/lineaments, which show signs of Pleistocene tectonic movements in the form of geomorphic anomalies and earth tremors, were grouped into reactivated lineaments/faults of Pleistocene age (Fig.2). The reactivated lineaments/faults
of Pleistocene age were trending in three azimuthal frequencies viz NE-SW, NW-SE, and N-S directions. These lineaments/faults are of importance in the seismic analyses of South India.

5.SEISMICITY IN TAMIL NADU, SOUTH INDIA

Seismic tremors occur in South India at frequent intervals. The earth tremors are mostly of tectonic in nature and at some places the impounding water in reservoir also causes earth tremors. In Tamil Nadu, in 1900, an earthquake of magnitude 6.5 of Feb.8 occurred at a depth of 70 km in the fault striking NNW-SSE (Rajendran and Rajendran 1996). According to him, the Coimbatore event is due to active faults of shear zones. A tectonic map of Eurasia published in 1968 show a submerged volcano in the Bay of Bengal, North of Madras. This volcano is located along NE-SW trending faults, which caused many earth tremors in and around Madras and Pondicherry (Grady 1971). Grady (1971) has observed that out of 38 earth quakes in southern part of Peninsular shield between 1823 and 1968, 19 occurred within 20 miles of carbonatite bearing N45E faults/lineaments. Six occurred on or near Archaean-Cretaceous boundary fault. Singh andVenketesh Raghavan (1989) observed that the earthquake centered 30 km to the North of Trivandrum on 2 September 1988 falls in proximity of NNW-SSE to NE-SW trending faults. Ramasamy and Balaji (1993) observed that the earth tremors in Tamil Nadu

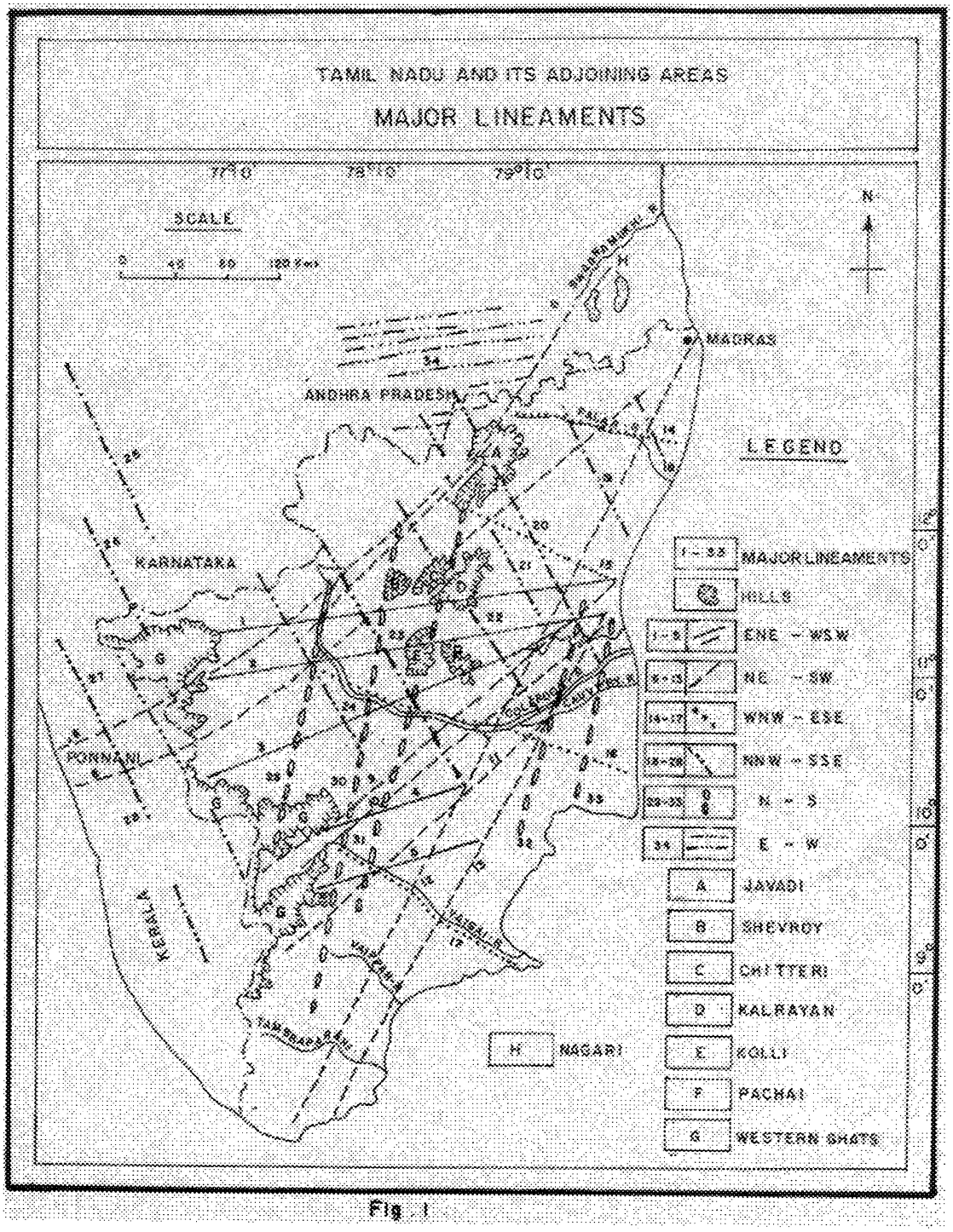
TAMIL NADU AND ITS ADJOINING AREAS
MAJOR LINEAMENTS
77°0'
78°0'
79°0'
SCALE
N
MADRAS
ANDHRA PRADESH
KARNATAKA
PONNANI
KERALA
LEGEND
MAJOR LINEAMENTS
HILLS
ENE - WSW
NE - SW
WNW - ESE
NNW - SSE
N - S
E - W
A JAVADI
B SHEVROY
C CHITTERI
D KALRAYAN
E KOLLI
F PACHAI
G WESTERN GHATS
H NAGARI

Fig. 1

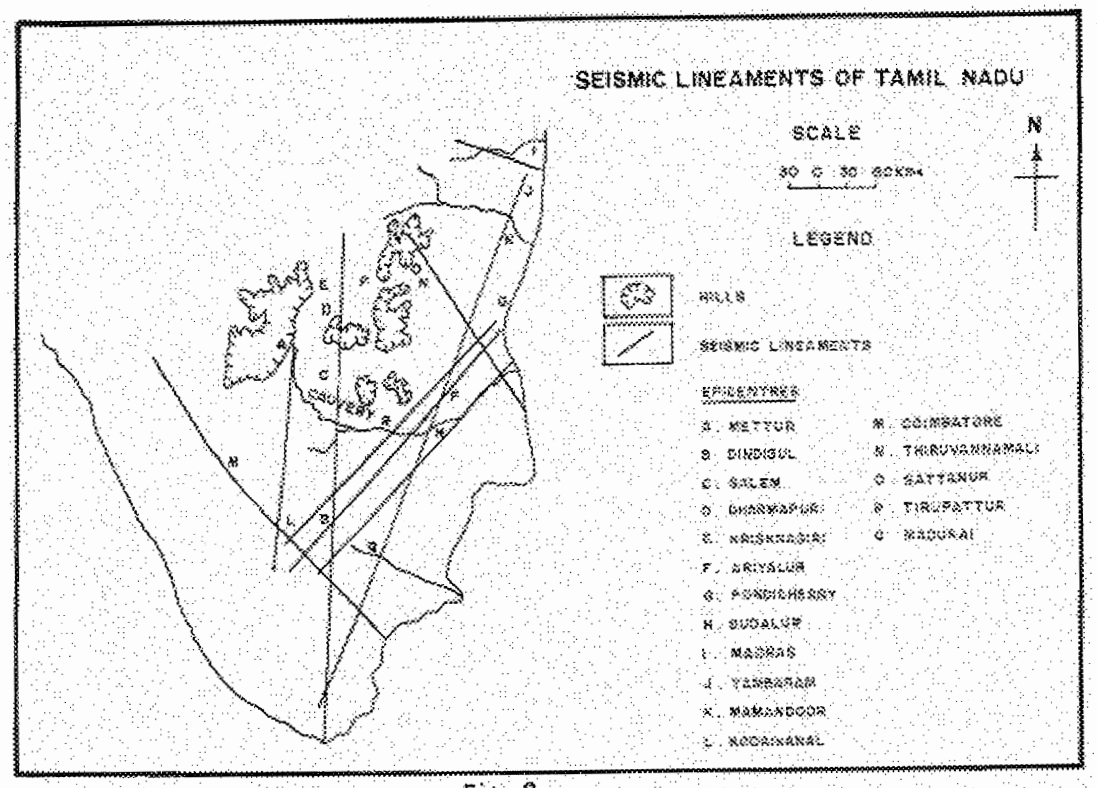

Fig. 2

fall along major NE-SW trending dextral and NW-SE trending sinistral faults/lineaments. Valdiya (1994) has observed that seismicity very mild and sparse of Peninsular shield is restricted to NW-SE and E-W trending faults and fractures of strike-slip nature. Ramasamy and Balaji (1995) have also observed that the neotectonism/Pleistocene tectonism played a role in earth tremors in Tamil Nadu.

All these facts suggest that the South Indian Peninsular shield is not stable and the neotectonics played a role in seismicity in South India. These neotectonism or Pleistocene tectonism at many places in Tamil Nadu caused migration of rivers, vertical upliftment of beds and drainage reversals etc. (Ramasamy and Balaji 1995).

6.PLEISTOCENE TECTONISM AND SEISMICITY IN TAMIL NADU

The seismic data recorded by Gauribidanur seismic station and the data collected from available literature (Sharma and Verghese 1979) were integrated with lineament/fracture network of Tamil Nadu. There is good relationship exists between earth tremors and regional faults/lineaments. The analysis has shown that most of the earth tremors falls on Precambrian lineaments/faults reactivated in Quaternary times and Pleistocene younger fractures/lineaments (Ramasamy and Balaji 1995). These fractures/lineaments are trending in NE-SW, NW-SE and N-S directions, which cause earth tremors at many places in Tamil Nadu as shown in Fig.2. Along N-S trending Mettur –Tevaram lineament earth tremors occurred 4 times at Mettur (A,.Fig.2) and one time at Kodaikanal (L, Fig.2). Earth tremors occurred along N-S trending Dharmapuri-Cape Comorin lineament at Krishnagiri (19 times), Dharmapuri (4 times) and Salem (1 time) (E, D and C in Fig.2). Along NE-SW trending Madras-Cape Comorin lineament earth tremors occurred at Madras (7 times), Tambaram (1 time) and Mamandoor (1 time) (I, J and K, Fig.2). Another NE-SW trending Pondicherry-Kambam lineament caused earth tremors at Pondicherry (12 times), Dindigul (2 times) and Kodaikanal (1 time) (G,B and L, Fig.2). Along NW-SE trending lineaments earth tremors occurred in Sattanur and Tiruvannamalai (O and N, Fig.2). So all the N-Sof Vaigai river in Cochin-Rameshwaram cymatogenic arch (Ramasamy and Balaji 1995). This fault/lineament also cause vertical upliftment of beds in Mannargudi-Pattukottai area attributing Pleistocene tectonic activity. In addition, because of regurgent tectonism in Quaternary times, the N-S segmented faults gave rise to linear and isolated hillocks in Karnataka state (Valdiya 1998). He further observed that reactivation of faults caused

ponding of streams in Moyar-Bhavani valley (Valdiya 1998) and thus suggesting the role of Quaternary tectonism in South India. All these facts, suggest the region is not stable and getting adjusted at irregular intervals through Pleistocene tectonic events.

7.CONCLUSION

The region in between Biligirirangan hills and Javadi hills, earth tremors are more frequent and also in and around Pondicherry coast and Madras, off the coast, earth tremors are more frequent. These earth tremors fall on N-S, NE-SW and NW-SE trending faults/lineaments. Care also should be taken in constructing dams and reservoirs and industries in seismic prone regions. Thus, the present study has thrown light on how the faults/lineaments played its role in seismic activities.The Remote Sensing brings out clearly the regional lineaments/fractures of tectonic and seismic importance A detailed study involving gravity and aeromagnetic methods are suggested to find out the extension of the seismic prone lineaments/faults at depth in areas where earth tremors are frequent.

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