A Study on Tectonic stress in and around the Chennai region, Tamil Nadu, India

Thamizhchelvan R [a], Francis Lawrence J[b],Annapoorani D[c] and Sivakarun N [d]

[a] *Indian Meteorological Department, Chennai,Tamil Nadu, India,* [b]*Department. of Geology, Presidency College,Chennai,Tamil Nadu,India,* [c]*Department of Statistics S.D.N.B Vaishnav college for Women,Chennai,Tamlnadu,India.*[d]*Annamalai University,Tamilnadu,India.*

ABSTRACT

To understand the occurrence status of earthquake events in and around the Chennai city, geology, tectonic setup, and epicenter data are collected for the decade from the year 2000 to 2010 respectively. Origin of the earthquake events, pressure building, and its very executions are mostly taking place at the deeper level. Surface events like monsoon depressions, cyclonic storm, forest fires, and dust and sand storms are all cause factors that have a good number of clues and hints to trace the formation and development and forecast well in advance. Thus, a lot of life and property have been saved. But, earthquake events cannot be traced or noticeable from the surface observations, and the parameters for their observation too not fully specified. An earthquake is formed by a collective expression of pressure developed under feasible geological conditions. Typically, it needs vast land mass, a conducive geological setup for pressure building, and a suitable point for releasing of gained pressure. To understand the seismic wave flow of Chennai city and its surroundings, epicenter data covering more than 500 km is collected and statistically analyzed.

Keywords: Earthquake, Tectonic, Epicenter

INTRODUCTION

Chennai city has an area of 1177 sq.km. It is sprawling as a city increasingly invites people from various parts of the country daily for employment and business purposes. The Government of Tamilnadu also expands its jurisdiction frequently as demand is pressing. Chennai has a population of around 10 million, and the floating population is more because it is a state capital and high-ranked business city. To accommodate the residents and the floaters, city buildings are raising taller too many folded compared to last two decades.

Earlier, the LIC building was the one standing tallest in the city. Now, from recent IT companies are taller and each one is a multistoried structure and race of such buildings one can see very

Author for Correspondence: Thamizhchelvan R [a] Email: gracebrother24@gmail.com

well. To meet the water requirement, deep bore wells are dug in larger numbers. One can easily see a minimum of half a dozen earthmovers moving slowly in the hectic traffic to attend various projects from metro train, storm project to handle the heavy rainfall-induced impact on the ground, underground sewage and metro water pipeline works. All these projects are done in a larger scale by the earthmovers, and the land is excavated wider and deeper to do them from start to the end.

Compactness is the hardness index, Chennai's top lithology is under full utility. Tenacious strata are the guarding parameter that holds the city intact. In this situation, the city undergoes more pressure change by removing overburden, adding concrete structures, and over-exploitation of groundwater. From surface level, exertion and removal of stress are going on, and for searching groundwater by using high-powered motors to meet the multistoried buildings. The drastic change in the sub-surface by hydrostatic pressure occurs in the underground by pumping of water; from the top pressure is exerted, and from underground pressure is withdrawn. Under this scenario, studying the more important epicenters close to Chennai was recognized.

Significant events felt by Chennai Population

Chennai people felt several shocks from the event (e.g.,) Latur, and Osmanabad event in 1993,Bhuj event in 2001, the tsunami event in 2004, and the Java Sumatra event in 2012. The mass of people felt all the above above-mentioned events and people rushed and found safety to save their life. Though the above events had taken place at far off Chennai, the above events had taken place far off Chennai, it was good enough energetic to create feared tremors. In media, it was telecasted widely, and experts were thrown light on the event. Epicenter means a place or location on the surface where released energy is realized as tremors and damage from the depth below if the magnitude is sufficient to make it so, whatever may be the intensity recorded. Objective one is to find the many alarming epicenters to Chennai city.

STUDY AREA

Chennai is located between WikiMiniAtlas13°02′N 80°10′E and 3.04°N 80.17°E / 13.04; 80.17 on the southeast coast of India and in the northeastern corner of Tamil Nadu. It is located on a

flat coastal plain known as the Eastern coastal plains. The city has an average elevation of 6 meters (20 ft), its highest point being 60 meters (200 ft). Almost plain surface with local undulations to meet the terrain evenness is commonly seen except around the hillock areas in Pallavaram, St.Thomas Mount, Thiruneermalai, and Tambaram.

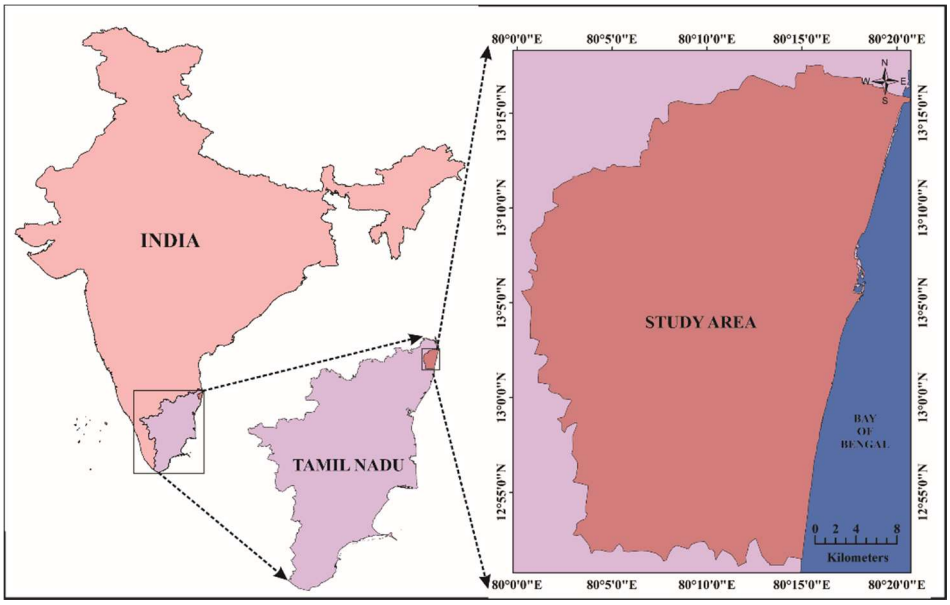

Fig.1. Location map of the Study area.

The geology of Chennai comprises mainly of clay, shale, and sandstone. The city is classified into three regions based on geology: sandy, clayey and hard-rock. Sandy areas are found along the river banks, and the coasts, and the clayey regions are covered a major portion of the study area. The hard rocks are found in the areas of Guindy, Velachery, Adambakkam, and a part of Saidapet, respectively. In sandy areas, such as Thiruvanmiyur, Adyar, Kottivakkam, Santhome, George Town, Thondiarpet, and the rest of coastal Chennai, rainwater run-off and percolates rapidly into the ground. In clayey and hard rock areas, rainwater percolates slowly, but it is held by the soil for a longer time. The city's clayey areas include T. Nagar, West Mambalam, Anna Nagar, Perambur, and Virugambakkam..

For administrative purposes, Chennai is divided into five taluks: Egmore-Nungambakam, Fort Tondiarpet, Mambalam-Guindy, Mylapore-Triplicane, and Perambur-Purasawalkkam. The Chennai Metropolitan area consists of three districts, namely Chennai city and the districts of

Kanchipuram and Thiruvallur. The metropolitan area covers 1,177 sq.km(455 sq miles), and the study area covers an area of about 476 sq.km (184 sq.miles).

: An earthquake is an event executed or enacted after a long process of stress building underneath, and the stored stress gets released at the appropriate point well below the crust or at the mantle, or at the junction of mantle and core is known as Focus. A place or location immediately above the Focus on the earth's surface is called as the epicenter. From the beginning to the end, the whole process has taken place at a greater depth and no one can observe on theearth's surface. Its domain starts from a kilometer of depth and goes to a very deeper scale till the mantle meets the core.

To understand the response to the shock waves and how the Chennai city was surrounded by different energy-throwing points that is epicenters are identified from 16N to 5S 66E and 84E covering up to Sri Lanka. Earthquake data was collected during the period from 01-01-2000 to 31-12-2010(source).Earthquake is not a small scale phenomenon to easily get the event's details. To fix three epicenters,, at least three stations data are required to study and understand the conditions. The Chennai city epicenters are collected in all possible directions covering more than 500 km distance. The event from the portion of peninsular part of India was depicted in Fig.2.

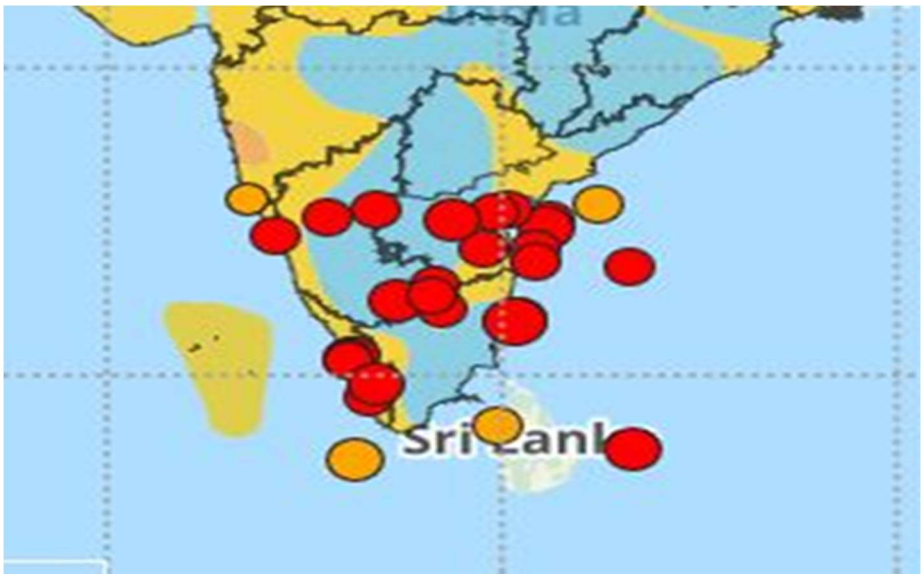

Fig.2.Epicenters in the study area.

The above figure shows the red plot indicates the epicenters which have released energy from the depth up to 30 km and yellow one is from the depth between 31km and 70km. Epicenter has an origin shallow level that is significant during the study period compared to the deeper source. The closest epicenter was recorded from Chennai at a depth of 102 km.

METHODOLOGY

Suitable data was collected for a period of a decade from 2000 to 2010 was taken for study and correlated with the statistical parameters adopted for illustration. That the graph and bar diagram depicts the depth and intensity of an earthquake were explained. For convenience, the data is divided into two sets from 2000 to 2005 and 2006 to 2010 for easier and more accurate results and illustrates set 1 has more events than set 2.

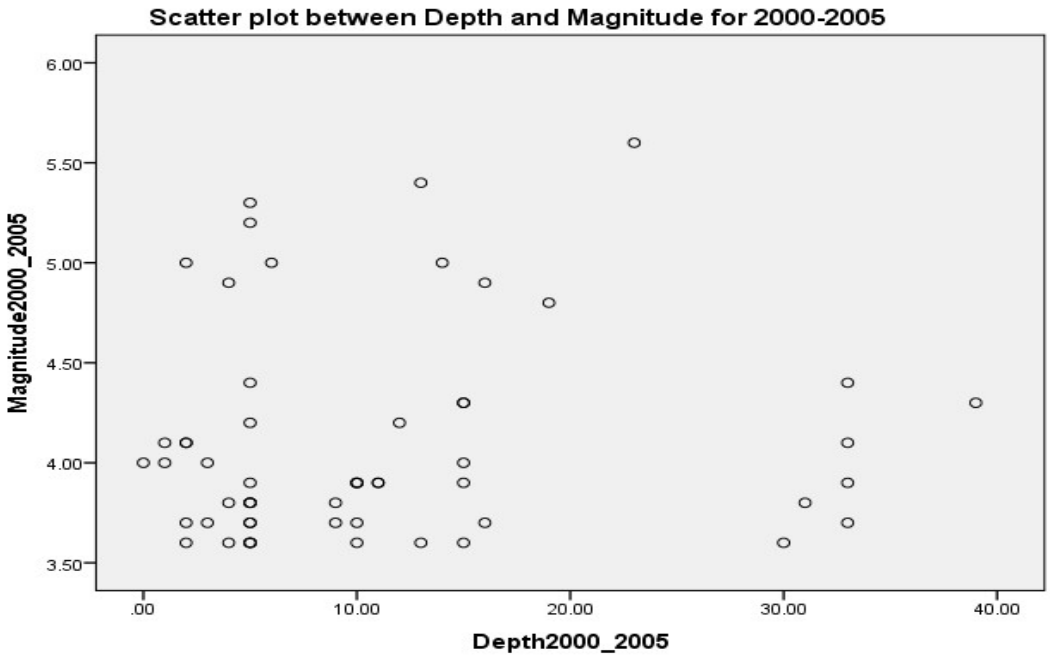

Fig.3. Graph of epicenters occurred in the study area from 2000 to 2005.

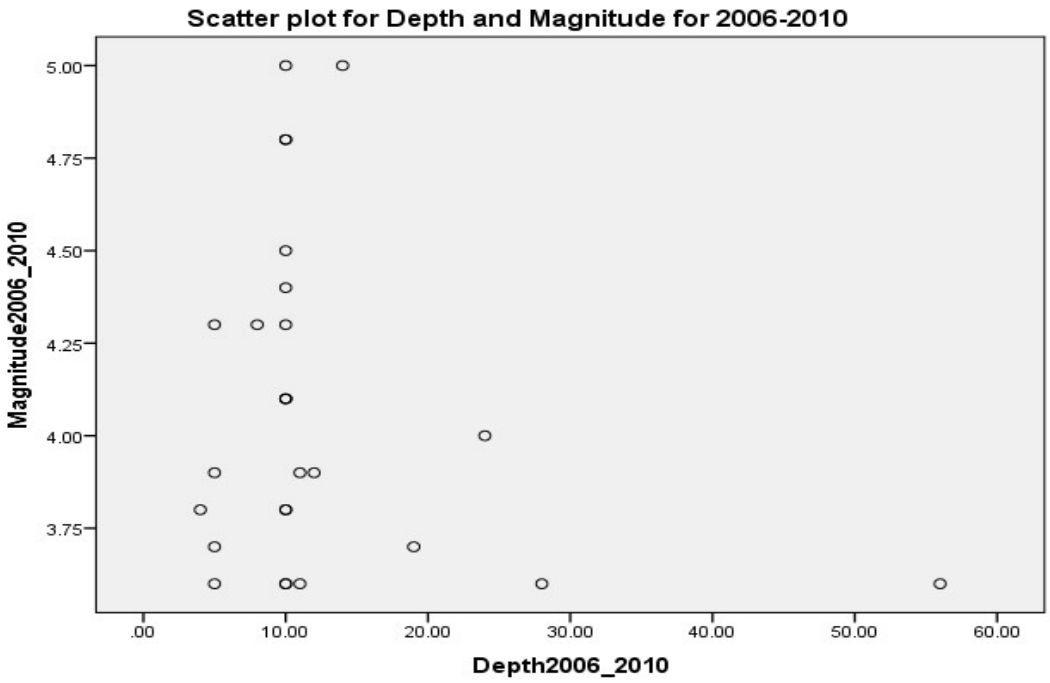

Fig.4. Graph of epicenters that occurred in the study area from 2006 to 2010.

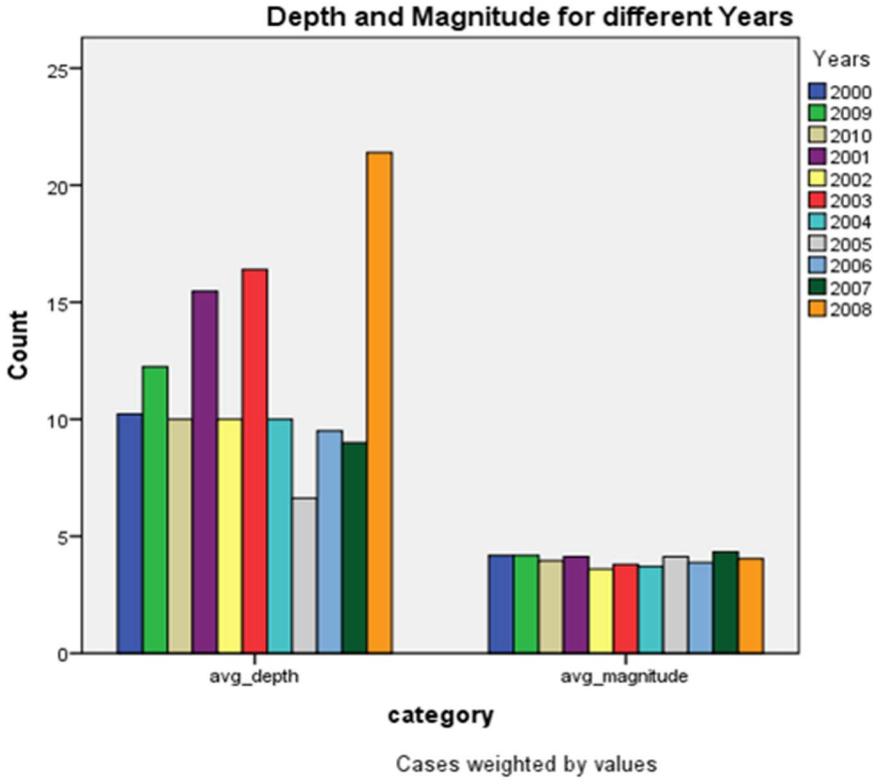

Fig.5. Bar diagram with average depth and magnitude.

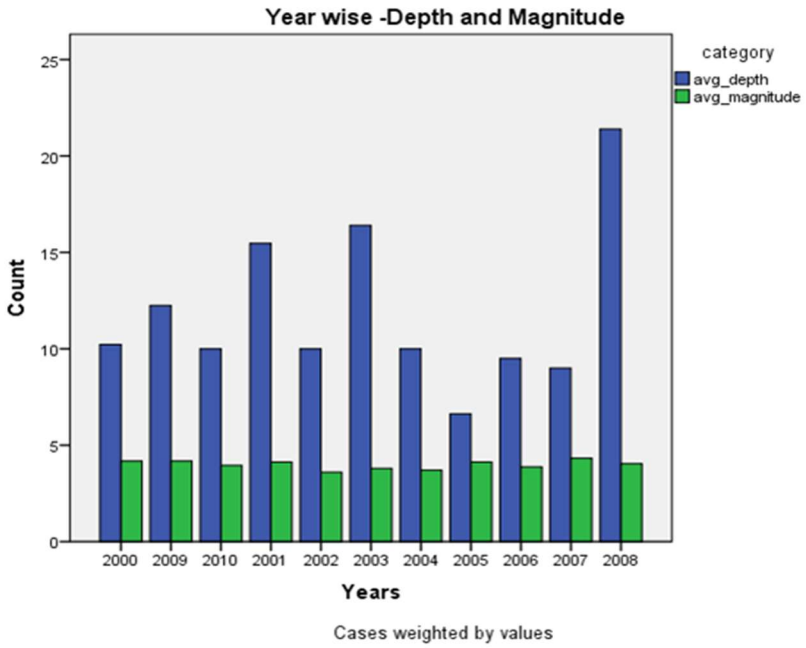

Fig.6. Bar diagram of occurrence with depth and magnitude.

These two sets of data were analysed by Pearson correlation method and the graph shows the relationship by occurrence. In the first set (2000 -2005), most events have taken place within 20 km depth. Each year has a considerable number of events.

Set 2 has less number of events, and it is observed that even though it has less number of events than the first set of the period, and behaves like the first set in the relationship of magnitude and depth.

Bar diagram has been drawn between the year in the X- axis and the magnitude on the Y-axis and it shows that the average magnitude is below 5(M) irrespective of the depth from where it got triggered.

DISCUSSION AND CONCLUSION

The nature of geology and tectonic setup holds the land mass intact and permits adjusting with the endogenetic change happening imperceptibly at far deeper part locally and yet seismically shallow.Throughout study in a decade, every year occurred at a mean depth of 10 km. The lithostatic pressure seems homogenous, and the epicenter's spread is almost at the same depth.

By the studies, the entire regional epicenter data for a decade from 2000 to 2010, the study area has got the potential to release the energy of around M (5) as mean value. The majority of the epicenter clearly matches the fault line and lineaments. It shows that, the entire region fault line, lineament, and shear zones are remarkably active in the study area. Adjustment and aligning of landmass at a deeper level induces energy triggering and felt as events with varied magnitude in scale.

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