

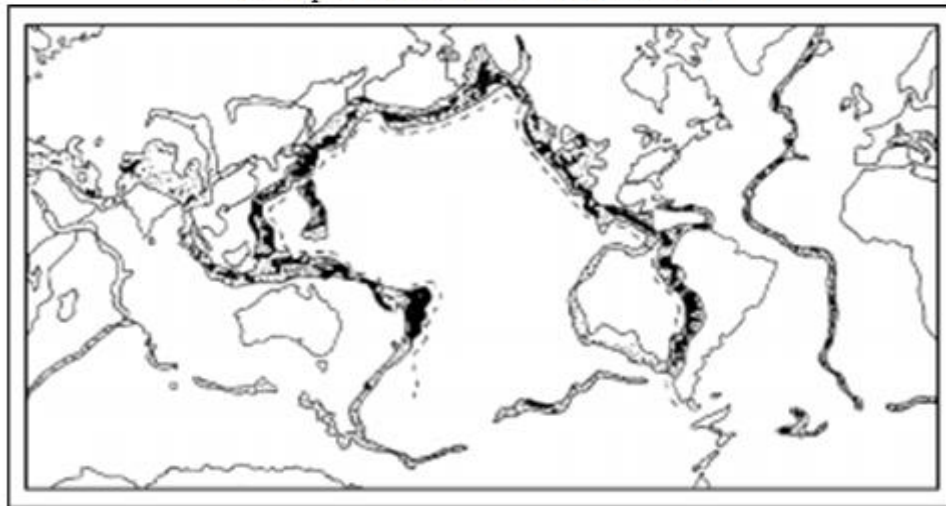
Impact of Global Warming on The Probable Earthquake in The Bengal Basin area with respect to The Global Scenario

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ABSTRACT: Each and every part of the world including South Bengal and Bangladesh is not free from earthquake. With the help of geological, geomorphological, neotectonic studies and as well as paleo-seismic studies and Global climatic change a probabilistic earthquake hazard assessment is possible. The study of major seismic zones of the world, Global climatic changes and sea level changes as well as degrading nature of important coastal cities due to construction boom has enable such prediction.

Earthquake Prone Belts of The World



I. INTRODUCTION

Earthquakes occur anywhere in the earth and mainly indicate that there is huge stored energy to form fracture along a fault plane by the processes of nucleation. The recent most earthquake of 17.09.2011 occurred 68km North West of Gangtok at a magnitude of 6.9. It is a typical diastrophic belt where Indian plate is moving towards North-East and slipping under Tibetan plate and Myanmar plate through this strike-slip fault belt at a rate of 20mm to 40mm per year. Though the soft sediment load on the Gangetic plain is likely to cause amplification of energy but as the Bengal basin is traversed by many sub-surface faults which are seismogenic in nature, have expanded the impact of earthquake over Bangladesh and South Bengal.

11th March 2011, is the another recent most event of earthquake occurred at Miame of Japan has been attached by the geo-scientists in the list of devastating earthquakes of the world. In this earthquake Pacific plate and Eurasian plate collision is the main cause, as has been explained by the geo-scientist, mainly due to the submergence of Pacific plate under Eurasian plate at the subduction zone. The epicenter of the earthquake was formed 400 km far from the main land within the ocean which has caused tremendous tsunami at the coast of northern Japan and that has resulted maximum devastation. The earthquake has destroyed lakhs of residential houses and has caused death of near about 20,000 people.

The previous earthquake of 26.12.2004 occurs in Indian Ocean mainly by the collision of Philip-pines plate and Indian plate. Those collisions indicate another major earthquake at the southern most part of the Indian plate subduction. Pacific plate on an average move 6 cm to 10 cm per year towards Eurasian plate. As a result the Eurasian, Indo-Australian and Philippines plate boundary act as the subduction zone which represent the occurrence of destructive boundary. The southern most part of Bering Trench oceanic platform also acts as the subduction zone. On the other hand the plate margin at the side of North America indicating the zone of shearing and the western coast of South America, the presence of Cocos plate and Nazca plates are also the indicator of plate subduction. Pacific Ocean is encircled by this subduction which has caused the Ring of Fire.

The most important subduction is extending through the southern part of South-East Asia and it is following Indo-Burma plate subduction and extending through the Himalayan ranges up to Mediterranean Sea.

II. OBJECTIVES

The study has been designed keeping in view the following objectives :

- 1) To study the relationship between Global Warming and Earthquake.
- 2) Probability of earthquake in Bengal delta area.
- 3) To, study the impact of the apparent movement of the sun on Earthquake.

III. METHODOLOGY

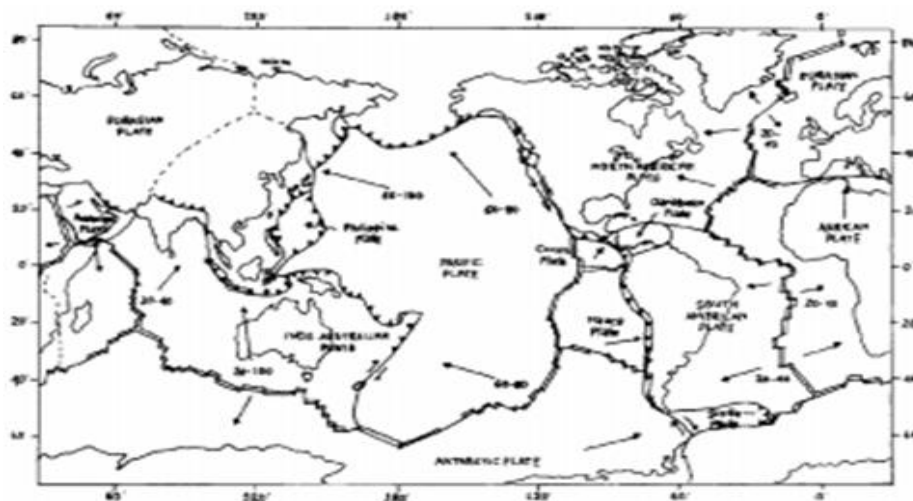
As a whole the study depends upon Secondary data. At first data have been collected from various published books, journals and various research works of the eminent researchers in this field. At the second phase, all the collected data and information has been analysed properly keeping in mind the objectives of study. At the last phase, depending on the temperature change of the earth surface due to global warming the study has tried to analyse the co-efficient of expansion of the surface due to temperature deviation which can easily correlate the impact of Global Warming on earth quake.

IV. ANALYSIS

The occurrences of the last two important earthquakes have caused not only great devastation but it indicates that in the future the major part of the earth surface will be affected by such devastations. Actually the eastern coast of Asia indicates the successive arrangement of the Aleutian Trench, Curile Trench, Ryukyu Trench, Mariana Trench and Sunda Trench and all these trenches are attached with each other (Ref. Fundamentals of the Physical Environment by David Briggs, Peter Smithson, Kenneth Addison and Ken Atkinson, Pg -32 to 37). The another most important condition is that the presence of shearing fault at the north-eastern part of the Pacific Ocean indicates that the Pacific plate is gliding down at the subduction zone and causing great tension mainly at the plate margins. So these two earthquakes directly or indirectly will change the normal oscillation of the earth around its axis and at the same time it will cause great devastation in near future because the zones of subduction are mainly fragile and changeable in nature. The another most important factor is that all the subduction zones are located over the hot spots which normally cause excessive temperature deviation, unequal radio-active decay of minerals within the earth's surface and variable energy sources of electromagnetic waves within the earth's interior.

As the Eurasian plate and Pacific plate are gliding through this typical subduction and by the tectonic activities of Pacific plates and Philippines plate, they are gliding down 6cm to 10 cm per year. It will cause severe devastation, and on the other hand, Indo-Australian in its north and north-east gliding at a rate of 2cm to 4 cm per year and on the east and south-east gliding at a rate of 2cm to 10 cm per year, is the main cause of earthquake at these subductions. The rate of subduction is not uniform, so the years which represent greater rate of subduction will surely cause a devastating earth- quake in near future

Various Spreading Sites of the Major Plates of The World



At present the quick rate of global warming increases the sea level which indirectly indicates the occurrence of imbalance in the isostasy (Ref. Fundamentals of Geophysics by William Lowrie, Pg. – 179 to 186). The either pole of the earth is also shifting very slowly in respect to its actual position, as a result the west coast of North America and South America, east coast of Asia and South-East Asia and the great extension of the Himalaya is located at the most effective belt due to the location of subduction zones. The east coast of Australia also indicates such a typical subduction. All these subductions are located far from the coast line that will cause transformation of body waves in the oceanic surface and will cause tremendous earthquake and tsunamis in these coastal tracts of Japan, China, Sumatra, Borneo, Thailand and Malaysia. The impact of such tsunami will also be observed in the coastal tracts of Bay of Bengal.

simplified tectonic map of the bengal basin

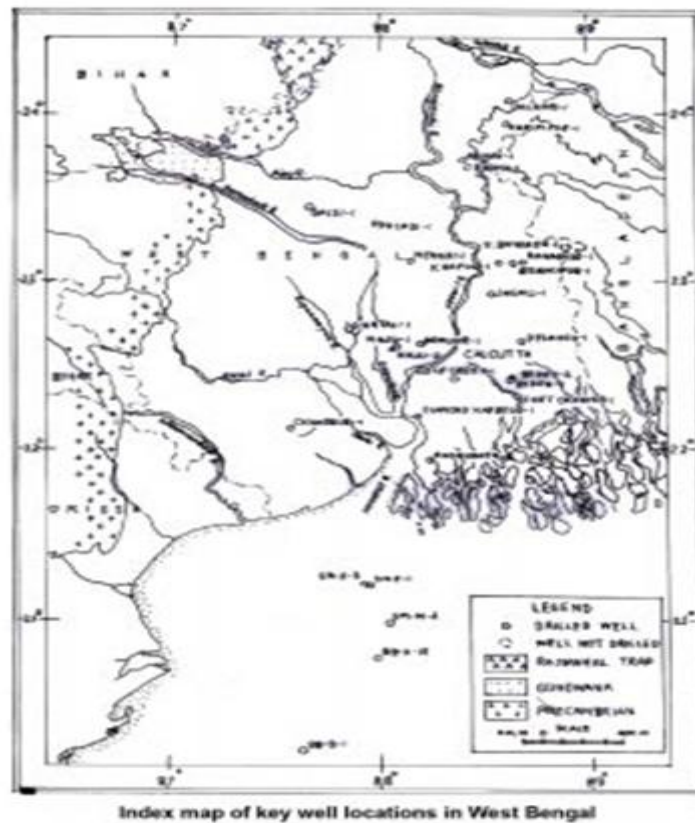


Simplified tectonic map of the northern part of the Bengal Basin

Here in this context it is very much important that north and north-eastern part of India and northern part of Arabian plate have developed a specific subduction zone that is extended through the continent. As a result any type of subduction occurs in this zone will cause tremendous earthquake in the major parts of Himalayan terrain which may be able to change the Himalayan ecosystem and will cause a great devastation in the northern part of India, Mongolia and southern part of China, southern part of Europe and in the coastal tracts of Mediterranean Sea.

At present it is an astonishing fact that various types of disaster are partly or partially under the control of the technical man but earth-quake is beyond such control. It is because the internal heat of the earth, that is not manageable till date. Present research indicates the industrially developed countries those have increased the global temperature to a greater extent by releasing excessive amount of carbon dioxide, carbon monoxide and smoke. (Ref. A change in the Weather by Michael Allaby Pg. 64, 69 to 86) Unfortunately the cool-temperate countries are the sufferer of long winters. Since last five years which have caused the major ice-falls in the localities of Eurasia and North America indirectly indicate the occurrence of little ice-age in the Northern Hemisphere ((Ref. A Chronology of weather by Michael Allaby, Pg. 68 to 81). Due to the prolonged winter, in the last five years, the landscape of Northern Hemisphere has released more heat than the water body which caused excessive temperature variation of the earth’s interior. In such a condition unequal expansion and contraction of the crust have occurred in the crustal layer. As a result the outer most part of the crust and the inner most part of the crust experience transverse wave motion and compressional wave motion mainly at the subduction zone or along the fault or rapture occurred in the plate margins, are the main causes of such devastating earthquake. If we analyse the earthquakes of last 200 years which indicate that majority of the earthquakes of Northern Hemisphere have occurred in between the months of November and March and majority of earthquakes of Southern Hemisphere occurred between May and July. Such typical nature of the quakes indicates that due to excessive variation of temperature between crust and mantle in some parts the plates become much more active and cause powerful divergence or subduction which is the main cause of such sudden quakes.

Index Map of The Location of Wells



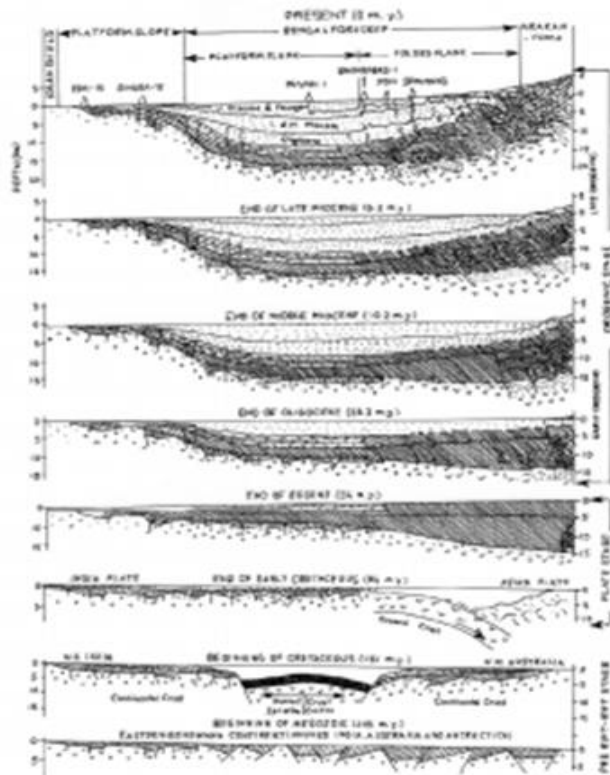
So it is obvious that the added heat to the global temperature caused by Global Warming changing the volume of the interval material by increasing the Kinetic energy of the molecules. Such an increase of the kinetic energy normally causes unequal expansion and contraction which may not only cause faults or fractures but also may hamper the stability of the plates. The change of volume co-efficient of expansion may be calculated by an equation which has given in the discussion part of this paper.

In each and every subduction or spreading sites of the plate the presence of faults and hinges represent the imbalanced condition of the plates. So, to undertake any constructional work at the margin of such plates, intensive survey is necessary mainly to understand the structure and alignment of the internal strata and rock bodies and the rock forming minerals because Global Warming is destroying their stability

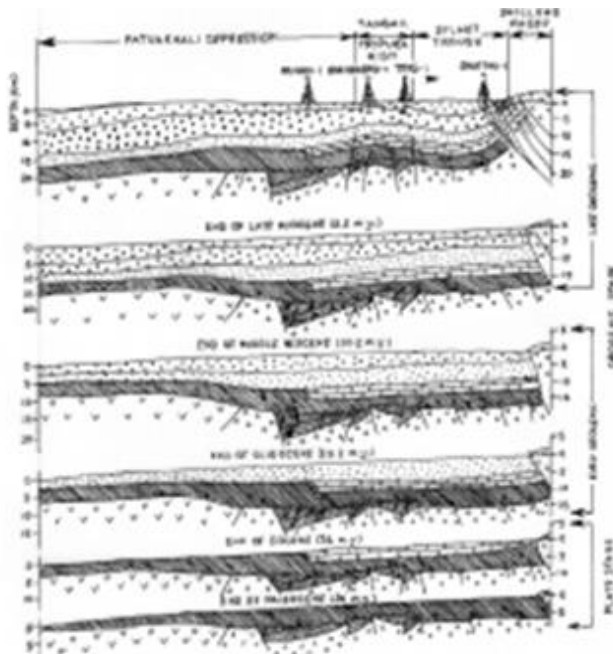
Paleotectonic evolution of Bengal Basin and Bengal fore deep indicate there are sequential changes in the structural condition from Cretaceous to Miocene. Such a long tectonic history not only had modified shape of the basin but also had caused the occurrence of the successive faults in the basin platform.

Though the basin is saucer shaped, its rolling plain topographical condition indicates the variation of the depth of sediment. As the Asian plate has formed a typical junction by the underlying gamma cells, the frontal part of the Indian plate becomes submerged which have to be developed into a polygenetic and polycyclic basin. The occurrence of such subduction at the north-eastern part and the formation of the series of fault have made the basin platform much more fragile. That's why any type of subduction, shearing or transformation may cause powerful earthquake. Presently the rate of global warming is increasing its fragile nature.

Geological Sections of Bengal Basin



Paleotectonic evolution of the Bengal Basin. Cross section A-A'

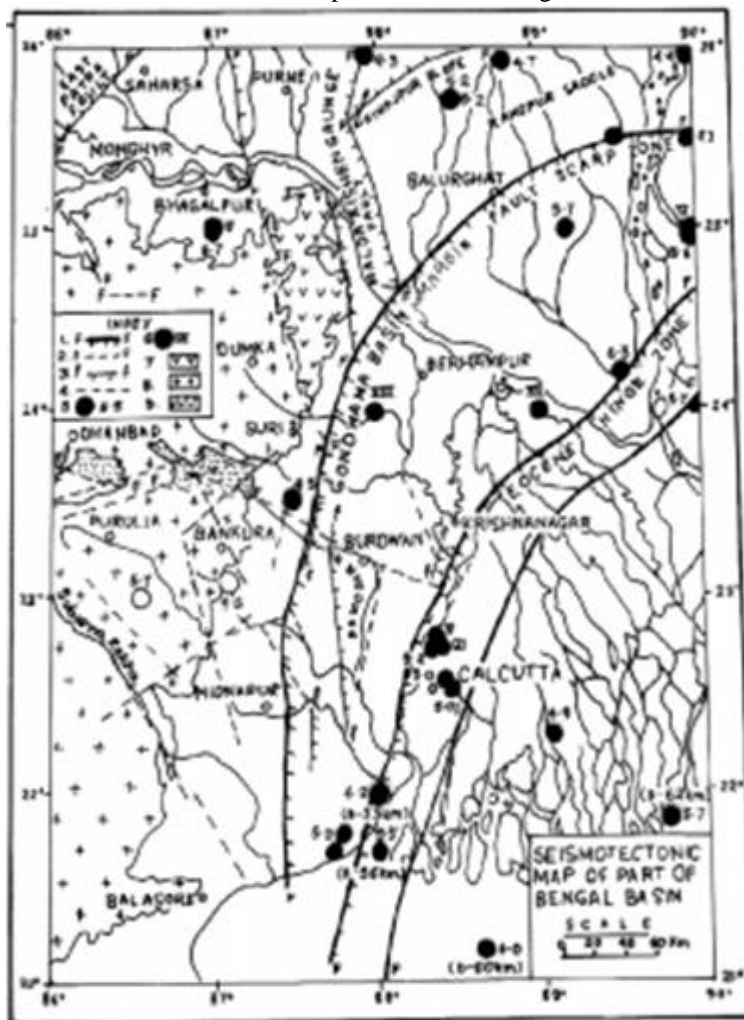


Paleotectonic evolution of central part of the Bengal foredeep. Cross section B-B'

The developmental work like the gigantic structural boom of Kolkata Metro Railway, so many Malls and skyscraper building mainly at the coastal tracts indicates the unplanned constructions which indirectly hamper the isostatic adjustments of the coastal tracts and in the same time the high speedy under-way rail tracts of Japan is also hampering the isostatic adjustment of the surface in such typical subduction zone.

Such imbalanced isostatic condition and increase in global temperature may also change the volume of co-efficient of expansion. So, any type of further development should be managed. Such imbalanced isostatic condition and increase in global temperature may also change the volume of coefficient of expansion. So, present study of the Plate Tectonics and Plate Subduction indicate that within 2 to 3 years there may be another earthquake at the north-eastern and north-western part of India. In this quake southern Bengal, Bangladesh, Myanmar and north-eastern states of India may be mostly affected. Such an earthquake may cause excessive faults, landslide, rock fall, mudflow, solifluction and as well as flashflood. In such earthquake Dauki fault and Kolkata hinge may be mostly effected and Probably that will cause devastation to Kolkata. Within 1 to 2 years another earthquake may occur at the southern part of south-east Asia mainly at the margin of the Sunda Trench. In this quake south-east Asian Islands and Andaman and Nicobar Islands may be mostly affected. In this earthquake tsunami may occur and may cause great damage at the eastern coastal tracts of India. Within 2 to 3 years, the collision of the Philippines and Pacific plates may cause tremendous earthquakes at the coast of China and in this quake East Asia and western coast of North America may be affected by tsunami. Within 1 to 2years Japan may also face another great devastation and as well as western coast of North America may experience tremendous earthquake in between 2 to 3 years due to plate divergence. These continuous processes of plate motion in various parts of Globe may also cause typical lava eruption in various parts. These Lava eruption mainly at the margin of the Pacific Ring of Fire may also cause the drastic increase of the Global temperature.

Seismotectonic Map Of A Part Of Bengal Basin



V. DISCUSSION OF FINDINGS

It is indicated in the paper that (i) Earthquake is partially regulated by the apparent movement of the sun. (ii) Presently increasing temperature of the atmosphere and Global Warming also are increasing sismicity and probability of earthquake and (iii) the temperature deviation at the plate margin mainly at the spreading sites and subduction zones are causing such earthquake

The added heat caused by global temperature change fractional change of volume normally occurs, but it is not uniform for every material. As the volume co-efficient of expansion α is defined by the equation

$$\alpha = 1/V (dv / dT) \text{ here } \alpha = \text{coefficient of expansion, } V = \text{Volume of the material, } T = \text{Temperature \& } P = \text{Energy Potential}$$

When such thermal energy added to the internal structure of the earth, it normally increases the kinetic energy of the molecules that cause expands part of the earth surface by changing the volume.

In most of the cases volume expansion coefficient in the range of $15\text{-}33 \times 10^{-6}$ per degree celsius is observed in normal condition. So, it normally depends on temperature change. Quartz rich rocks are of higher value because of the higher volume expansion of quartz. Here we may consider the chart of the volume expansion of rocks.

<u>Rock Types</u>	<u>Volume Expansion Coefficient in $10^{-6} / ^\circ\text{C}$</u>
Granite and Rhyolite	8 ± 3
Andesite and Diorite	7 ± 3
Basalt, Gabbro and Diabse	5.4 ± 1
Sandstone	10 ± 2
Limestone	8 ± 4
Marbel	7 ± 2
Slate	9 ± 1

In this process thermal conduction takes place while temperature moving through the earth's crust and causes transfer of kinetic energy between molecules and atoms. Hence with the help of quantum theory or band theory of solids we may explain it as the transfer of heat through conduction of electrons. The thermal convection and the transportation of material and heat through thermal convection current normally occur within the earth's crust.

When energy flows from inner part of the earth i.e. from an excited state to the lower energy state towards the surface it is normally undergone a transition and forms powerful electromagnetic wave. These transitions and geothermal flux normally cause powerful heat transfer from lower part to the upper part of the crust. That is why the increasing heat of the earth surface also increases emitted radioactive heat production, that normally may be the cause of powerful earthquake which have been occurred in various parts of the globe.

The various hinge prevailing under the Bengal fan and the parallel faults present over various parts of Bengal delta indicate that these zones are not a stable area in the tectonic history of the earth. The Kolkata hinge is also connected with the dauki fault at the north eastern part of India and that fault line is well connected with the Indo-Burma subduction zone. It is the probable area where the future earthquake will originate and will cause a great devastation over the deltaic Bengal, India. The another investigation regarding the eastern coastal tracts of Asia and south east Asia also indicates the occurrence of various types of faults and raptures over the subduction zone and as well as at the coastal tracts of the continents. As these areas are already demarcated by the study that any kind of heavy construction will hamper the balance of the surface and will increase the probability of earthquake and at the same will also increase the intensity of the earthquake

Conclusion and Recommendation :



Areal variation of paleoseismic lines through time in West Bengal

So it is normal that each and every country which is located at the margin of such typical subduction should be much more sensitive in this context. International consciousness should be developed by the UNO to control these effective zones. It is a beam of hope that the eastern coastal tracts of Asia and India mostly indicate the occurrence of sedimentary deposits by the major river systems. The huge load of such sediments somehow managing the imbalanced isostatic condition in some parts. So any type of constructional work should be restricted and digging should not exceed 40 to 50 m. in these zones. Such a deep cutting will naturally decrease the rock body strain and the hinges and faults become more powerful by such release in pressure and will cause powerful earthquake

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