

A COMPARATIVE STUDY OF 1819,1844 AND 2001 EARTHQUAKES IN GUJARAT.

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ABSTRACT

The Rann of Kachchh in Gujarat in the Western part of India is seismically the most active area outside Himalayan Belt. Several severe earthquakes of which the 1819 Rann of Kachchh and 2001 Bhuj Earthquakes are the severest recorded have rocked the region. This paper is an attempt to make a comparative study of the 1819,1844 and 2001 earthquakes. The study of 1819 and 1944 earthquakes is based on secondary accounts while 2001 Bhuj earthquake is based on remote Sensing. From a comparative study of the three earthquakes many interesting conclusions can be drawn. These earthquakes have been the result of accumulation of stress caused due to the collision of Indian Plate with the Eurasian Plate, which is continuously moving northwards. The earthquakes have been felt over large part of the Indian Sub-continent. These have resulted in creation of several faults that have activated periodically. Prominent of them are the Allah Bund Fault, Manfara Fault and Budharmora Fault. These are strike slip faults that get periodically activated. In future too these faults are going to be the most vulnerable to any seismic activity with the probability of high intensity earthquakes occurring along them in future too.

KEYWORDS: Allah Bund, Bhuj, Budharmora, Earthquake, Eurasia, Faults, Kachchh, Manfara, Seismic, Sindi

STUDY AREA

The present study area lies between 20°30' North to 24°30' North latitude and 69°E to 73°E longitudes. Rann of Kachchh flanks the region in the North, Gulf of Kachchh in the Southwest and the Little Rann of Kachchh in the East. It extends for approximately 250 Kms from East to West and 150 Kms. from North to South. Nagar Parkar Fault in the North and Kathiawar Fault in the South flank it.

GEOLOGY & GEOMORPHIC STRUCTURE OF KACHCHH:

A brief insight into the geology and geomorphic structure of Kachchh region will not be out of place here. This region lies within 400 Kms of the active plate boundary zone between the Indian subcontinent and the Asian Plate along Indo-Pakistan border. Structurally the features here include east trending faults and folds.

The Kachchh region is seismically one of the most active region outside Himalayan belt in the Indian Sub-continent and is placed in the Zone V of seismic zonation map. It extends for approximately 250 Kms (E-W) and 150 Kms(N-S). Nagar Parkar Fault in the North and Kathiawar Fault in the South (Malik 2000) flank it. Several Faults viz. Katrol Fault, Kachchh Mainland fault, Banni Fault etc. abound the region.

From the available seismic data of the region and the Peleoseismic evidences it is amply clear that there has been continued tectonism from the Quaternary Times. According to J.N. Malik the ancient Harappan Settlement that flourished at Dholavira on the Khadir Island 4500-5000 B.C. might have ruined due to continued Seismic activity along East West trending Faults in the Rann area.

In the more recent past i.e. past 200 years several earthquakes have rocked this region. This includes the 1819&1844 Earthquakes of the Rann of Kachchh, earthquakes of 1856,1857,1940,1956,1970 and the

recent 2001 Bhuj Earthquake. The present Paper is an attempt to make a comparative study of the earthquakes of 1819, 1844 and 2001 that rocked this area. This is done to understand the forces responsible, structural changes that have occurred, extent of damage caused and future implications.

THE 1819 RANN OF KACHCHH EARTHQUAKE.

A severe earthquake measuring approximately $M= 7.7$ + or - 2 hit Rann of Kachchh on 16th June 1819 at 7 p.m. The earthquake was felt all over India. The shocks were felt as far as Calcutta in the East, Baluchistan Hills in Pakistan in the West, Pondicherry in the South and Kathmandu in the North. The radius of impact was approximately 1600 Kms with maximum impact being felt in the radius of 70 Kms around the epicenter. According to J.M. Murdo the then British Resident in Bhuj and Anjar approximately 1500 to 2000 people were killed and around 1500 houses were completely damaged mostly around Bhuj and Anjar.

The forts at Anjar and Sindri were completely damaged.. Several surficial deformities also accompanied the earthquake. Ground fissures of various dimensions ranging from a width from 1" to 1foot and depth between 10 and 20 feet were observed. At several places these were accompanied by outpour of gravely soil and Black Soil.(Mac Murdo). A Tsunami from Arabian Sea struck the coast of Rann. Sand venting which caused enormous flooding in the Rann followed it. The most significant ground deformity was the creation of a natural dam (alluvial scrap), 80 Kms long, 6-9meters high-called Allah Bund or Mound of God near Sindri. This uplifted feature truncated the flow of Nara River a Southeast flowing tributary of Indus. A lake 30 Kms in diameter called Sindri Lake was created to the South of Allah Bund. This lake which is now partially filled with sediments has become a rainfed depression which accumulates water in the monsoon season.

1844 EARTHQUAKE

Another earthquake rocked the region in 1844. The epicenter of the earthquake lay near the epicenter of the 1819 Earthquake. According to the available accounts this earthquake it affected Lakhput and Sindri regions profoundly. It resulted in the widening of the Allah Bund by 7.5 Kms and an additional uplift of Sindri region by 1 meter.

2001 BHUJ EARTHQUAKE

On 26th January 2001 a massive earthquake rocked the entire state whose impact was felt not only in India but adjoining Pakistan in the West, Nepal in the North and Bhutan in the Northeast. According to U.S.G.S. the intensity of the earthquake was 7.9 on the Richter Scale. Its epicenter was located at 23^o36' N latitude and 70^o34'E longitude approximately 100 Kms NNE of Jamnagar in India and 290 Kms South East of Hyderabad in Pakistan. The event occurred in a diffuse zone of historical seismicity lying south of what is generally considered as main boundary between India and Eurasian plate. It lies 50 Kms. South East of the 1819 Kachchh Earthquake. The earthquake affected 21 districts and a population of 1.58 crores. It caused approximately 30,000 deaths and injured 166000 people.

The earthquake has resulted in enormous surficial and subsurficial changes in the form of faults, cracks, liquefaction, and temporary water surges, lateral spreading etc. A fault rupture 8 Kms in length trending Northwest has been observed close to and northeast of U.S.G.S. epicenter. It passes through the small town of Manfara. It is a right-lateral strike-slip fault. Another similar surface deformation has been detected at Budharmora that appears as a linear fault. It runs along the Kachchh mainland fault near the epicenter. Liquefaction has been recorded on an extensive scale in several parts of the state. It has been profusely recorded in the little Rann of Kutch, Rann of Kutch as well as the coastal areas of the Gulf near Gandhidam, Kandla and between Malya and Samakhiali. The Killer earthquake was accompanied by large-scale changes on the surface and coastal features. The high revisit capabilities of IRS WiFS images have been helpful in the study of these changes. One IRS image prior to the earthquake has been analyzed along with post earthquake images of the area to arrive at meaningful conclusions, regarding surficial changes in the Bhuj-Kachchh and Kathiawar-Saurashtra regions. The intense shaking has brought significant changes in the ocean and land surface and sub-surface. At numerous places in Kachchh, emergence of water on the earth's surface was observed. Near Rapar after earthquake crater-like structure developed. Near these craters, 500-meter long cracks with Eastwest, Northwest and Southwest orientation were seen. The images of earthquake show drastic changes in the cracks in the Gulf of Kachchh, little Rann, and near Nal Lake.

COMPARATIVE ANALYSIS

A comparative analysis of the earthquake of 1819, 1844 and 2001 bring to light interesting facts. All these earthquakes have been the result of the accumulated stress due to the collision of Indian Plate with the Eurasian Plate as a result of its continued northward movement. The 1819 earthquake resulted in the creation of a strike-slip Fault called the Allah Bund that is now a site of major seismic activity. The 2001 Bhuj earthquake resulted in the creation of similar strike slip faults - Manfara and Budharmora Faults. The shocks of the 1819 and 2001 Bhuj earthquake were felt over entire sub continent whereas the 1844 earthquake was of local nature. Another interesting feature about the 1819 and 2001 earthquakes have been that severe damage has been caused to the West of the epicenter that shows that the Western part is experiencing greater deformation as compared to the east.

RESULTS AND CONCLUSIONS

From the discussion above it is amply clear that the Kachchh Region is seismically a proactive region with several earthquakes of varying intensities occurring periodically. Most of these earthquakes have been the result of the activation of different faults that are found in this region. In future too a region is likely to experience continued seismic activity. Consequently a regular monitoring of the activity along the faults needs to be done. These must be taken into account while planning the development of any settlements and the construction material should be such so that it is able to bear the earthquake shocks.

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