Distribution Of Earthquakes And Their Relations To Major Lineaments In Mizoram and its Vicinity

Saitluanga
Department of Geology, Pachhunga University College, Aizawl, India

Abstract : The most important components pertaining to the seismotectonic study are wide but these primarily and mainly relates to the better estimation of hypocentral parameters. Best estimated hypocentral parameters are the prime input to the Seismotectonic study of any region. The study begins with the prediction of seismicity map which ascertains comparatively high and low seismically active region. A regional seismicity map for Surma valley and the adjoining region, covering the area bounded by longitudes 90° to 95°E and latitude 22°N to 26°N has been prepared by plotting the earthquake data for the period from 1969- 2010 (source: ISC) over the generalized tectonic maps of the region.

I. INTRODUCTION

Mizoram, a part of Surma valley, lies in a highly seismic zone of NER in which about 10 large earthquakes (M ≥ 7.0) have occurred during the last 100 years.The high seismicity in the region is attributed to the collision tectonics between the Indian plate and the Eurasian plate in the north and subduction tectonics along the Indo-Burma region (IBR) in the east (Dewey and Bird, 1970; Kayal, 1996, 1998; Molnar and Tapponnier, 1975, 1977). In order to have a comprehensive idea of geologic and tectonic settings, it is essential to prepare a tectonic map based on geological field observations. Some parts of the study area are inaccessible and it is difficult to conduct geological field surveys in these places. With the advancement of technology and information available, high quality imageries are available under certain terms and conditions for personal use and research purposes. The high resolution satellite imageries are generated using sophisticated instruments and advanced techniques which make them very reliable and précise and can endure extreme close-up. Earthquakes generally occur within well defined areas of the world, on which there is a striking pattern of continuous belts of activity (Selby, 1985). Geological, tectonic, geophysical, seismotectonic and G.I.S. studies of the region are studied in order to provide a context for the subsequent analysis and bring out the complexities of the area which are also reflected by the seismicity and kinematics of plate motion of the Surma valley and its surrounding.

II. METHODOLOGY AND DATA PROCESSING

Present study comprises the re-look into the seismic activity of the region apart from the inferences made through seismicity parameters. Continuous monitoring of earthquakes during the last couple of years in Surma Basin with seismic stations of Agartala, Manipur, Shillong including a Broadband seismograph in Aizawl, the Capital city of Mizoram- has improved the knowledge about the present day seismic activity and seismo tectonics of the region. The seismic activities are studied on the basis of data collected during 1969 to 2009. However most of the events are relocated during the period 1982 to 2009. These data are the hypocenter data file compiled jointly by RRL-Jorhat and NGRI-Hyderabad complemented by phase data from IMD-Shillong, IIG-Shillong, Manipur University, Gauhati University and Mizoram University (Figure 1). A close comparison with EHB location (www.isc.ac.uk/EHB) has been made for some moderate to large earthquakes. For these earthquakes the difference of hypocentral parameters is about 2-3 kms between these two datasets.

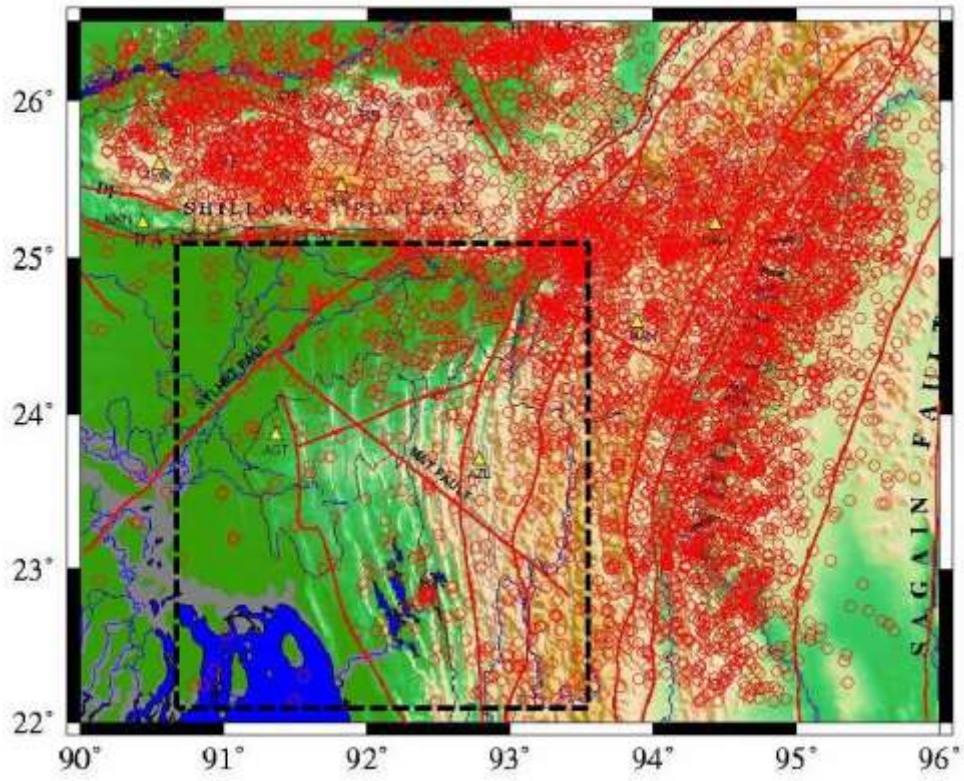

Fig.1: Seismicity plot of Surma valley and its vicinity

This study deals with the present trend of seismicity activity in the region. The study covers an area between 90ºE and 95ºE longitudes and 22ºN and 26ºN latitudes in the Surma valley and its vicinity. Recomputation of hypocentral parameters of all the earthquakes in the study region is done using HYPOCENTER (Lienert et al.,1986).

The faults and lineaments present in Figure 2(a) are digitized separately using GIS software. For digitization it is essential to define the position of geographical objects relative to a standard reference grid, which is called Geo-coding. Since the tectonic map is well demarcated by geographical coordinates (Latitudes and Longitudes), it is easier to Geo-code the map. After Geo-coding minimum 4 reference points, accurate information regarding geographical coordinates of all the ungeocoded parts of the maps can be obtained. After the process of Geo-coding any desired fault and lineaments can be extracted into a file having ASCII format. All the digitized faults and lineaments are combined into a single layer in the software and superimposed onto the base map as shown in Figure 2(a), thereby obtaining the modified tectonic map (Fig. 2(b)) of the region.The linear and curvilinear lineaments shown on (Fig. 2(b)) can be interpreted using relatively standard photogeologic or geomorphic analysis such as has been done for many years in interpreting data from aerial photographs (Lillesand and Kiefer, 1994).

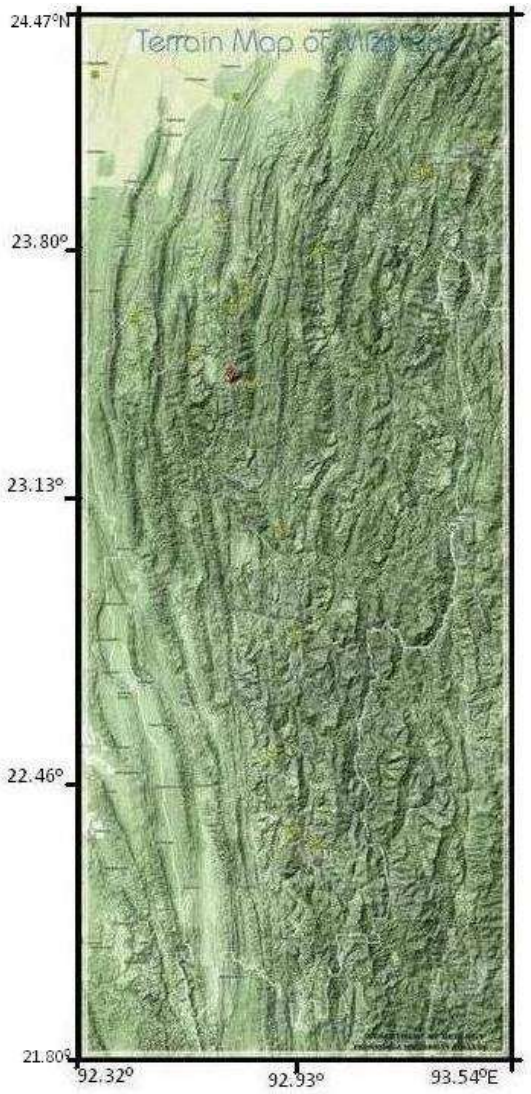

Fig.2(a): Tectonic Map of Mizoram showing Mat fault and other lineaments.

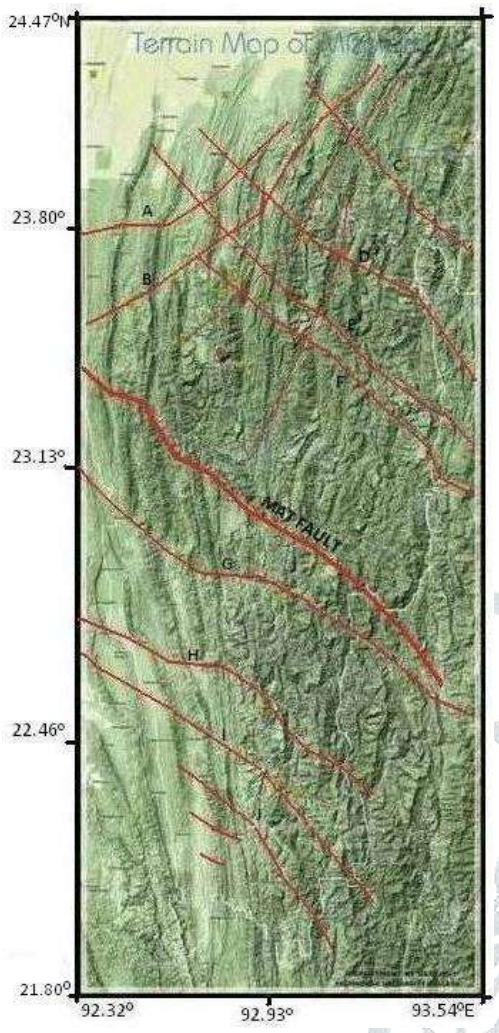

Fig.2(b): Delineation of Mat fault and other lineaments and faults (A-J) over the tectonic map.

III. RESULT AND CONCLUSION

The seismological data of the ISC and USGS, the microearthquake analog data and that of digital data from permanent network have been useful to a great extent to understand the earthquake source processes and the active faults in Mizoram and its vicinity. Simultaneously the study carried out by the relocation of the events not only improved the locations but also helped in better resolution to explain the seismotectonics of the study area.

Examination of the data shows that most of the events fallsunder the tectonic domains of the Indo-Burmese Range, Meghalaya Plateau and Mikir Hills, Eastern Himalaya and Assam shelf. Surma and Bengal basins have relatively low seismicity compared to the other regions (Fig.1). The region is dominated by shallow focal depth i.e., <70km events except for the Indo-Burmese Range where deeper focus earthquakes scattered along the range where seismicity is more intense and defines the westerly convex broadly N-S subduction zone of the Indian plate. The earthquake events in these tectonic domains occur in diffused pattern having post-collisional intracratonic characteristics. On the other hand, most of the earthquake events falling in the Indo-Myanmar (Burmese) tectogenes have focal depths varying from 70-200 km where seismicity is more intense and defines the westerly convex broadly N-S subduction zone of the Indian plate. Filtering of other events to project the earthquakes that occur along Mat and Sylhet faults bears witness to the activeness of both the faults, although almost all the events are shallow focused and having magnitudes of less than 5.0.

Most of the major lineaments observed are undoubtedly related to the geodynamic situation arising from the progression of continual plate collision between Indian and Burmese plates. This plate boundary has been subjected to a complex pattern of regional compression, extension and transcurrent displacements.Detailed comparisons of the earthquakes with major and minor lineaments in the study area does not show any significant relationships. However, this should not overrule that the lineaments, both major and minor, can induce large and damaging earthquakes in the area and its vicinity.

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