EXPECTED MAXIMUM MAGNITUDE, INTENSITY AND PEAK HORIZONTAL GROUND ACCELERATION MAPS OF THE HIMALAYAN REGION

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The seismic zoning maps depicting expected maximum magnitude (M_{max}), Intensity (I_{max}) and peak horizontal ground acceleration (a_H) are prepared for the Himalayan region. These maps are prepared using A values corresponding to 0.5^o by 0.5^o grid averages computed on the basis of Kaila and Narain (1971) method. The A values on the cumulative regression curve log N=A - bM normalized to a 0.5^o by 0.5^o grid area as at the equator and 22 years earthquake observation period (1954-1975) have been determined using the relations

$$A = 6.36b - 2.008 \qquad \text{Eq.1}$$

and

$$A = 3.40 + 2.69 \frac{\log N(det)}{D} \qquad \text{Eq.2}$$

where N(det) is the number of earthquakes actually detected in 0.5^o by 0.5^o grid area and D is the detectability level of that region.

The observed body wave maximum magnitude (M_{max}) of the earthquakes occurred in the Himalayan region during the period 1816-1975 and the corresponding A-values normalized to 0.5^o by 0.5^o grid area are found to be related by the empirical relation given by

$$M_{max} = (0.31 \pm 0.04)A + (5.75 \pm 0.18) \qquad \text{Eq.3}$$

In order to obtain the relation between M_{max} and A, if only surface wave magnitudes were available for some earthquakes, the corresponding bodywave magnitudes were computed using the relation $m_b = 0.63\ M_s + 2.5$ (Gutenberg and Richter, 1956).

The observed maximum intensity (I_{max}) of about 31 earthquakes including Great Assam (1897), Kangra (1905), Bihar-Nepal (1934), Assam (1950), Kinnaur (1975) and their corresponding magnitudes were found to be related by the following equation

$$I_{max} = (1.66 \pm 0.19)M - (2.68 \pm 1.22) \qquad \text{Eq.4}$$

It is assumed that the maximum magnitude and the highest intensity experienced in the past may also be reached by future earthquakes. Based on this criterion the expected maximum magnitude and Intensity values are computed from equations 2, 3 and 4 using A values for every 0.5^o by 0.5^o grid and the same are plotted at their centres. The contour maps are drawn for equal M_{max} and I_{max} values which are shown in Figures 1 and 2 respectively.

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The peak horizontal ground acceleration map of the Himalayan region (Figure 3) has been also drawn by making use of the world wide relation given by Murphy and O'Brien (1977) between peak horizontal ground acceleration (a_H) and the Modified Mercalli intensity (I_{MM}) which is given by

$$\log a_H = 0.25\ I_{MM} + 0.25 \qquad \text{Eq.5}$$

The antilog of the standard errors of the estimates and the slopes were given by them as 2.29 and 0.02.

All the three maps (Figures 1, 2 and 3) show the most probable values of expected maximum magnitude, intensity and horizontal ground acceleration which may be expected due to future earthquakes in the Himalayan region.

These maps besides giving M_{max}, I_{max} and a_H values at any place in the Himalaya, have also brought out a number of high seismic activity zones such as Srinagar high, the Jammu-Peshawar high, the Kedarnath-Askot high, the Pokhara high, the Khatmandu-Everest high, the Taplejung-Kangchenjunga high, the Timphu-Dhubri high, the Tawang-Kangdu high and the Abor-Mishmi high. It is interesting to note that the high seismicity zones northwest of Everest are aligned parallel to the Himalaya, whereas the seismicity highs on its east are aligned almost transversely to the Himalayan structural trend. The transversely aligned high seismicity zones such as Khatmandu-Everest high, Kangchenjunga-Taplejung high, NW-SE trending Timphu-Dhubri high and Tawang-Kangdu high may be probably related to the transverse folds and faults (Valdiya, 1973) like Arun anticline of eastern Nepal, Kangchenjunga-Dharanbazar syncline, Madhupur fault and NW-SE trending fault between Kangdu and Takpashiri in the region of Kemeng and adjoining Bhutan respectively (Abdel-Gawad, 1971).

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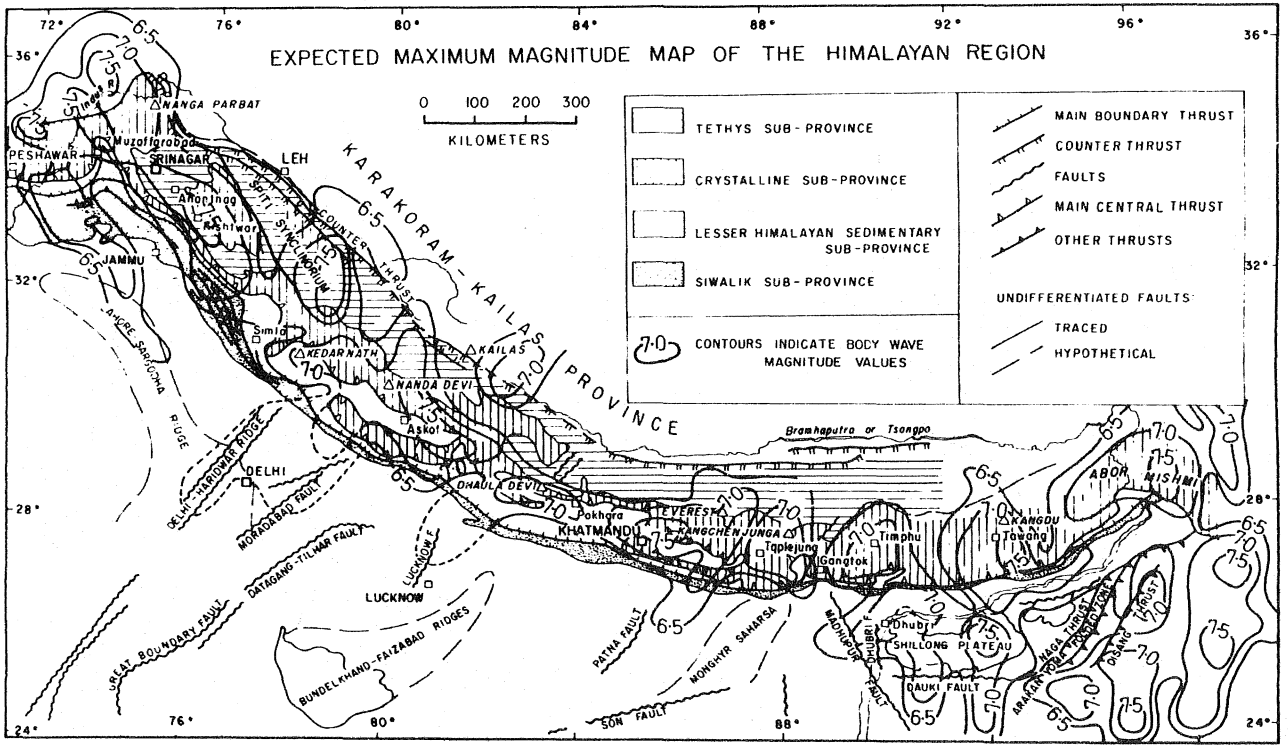

Fig.1 Expected maximum magnitude (M_{max}) map of the Himalayan region. The tectonic features in the Himalaya and the Ganga basin are after Valdiya (1973). The undifferentiated faults are reproduced from the 'Tectonic map of Eurasia' edited by Acad. A.L. Yanshin, Geological Institute of the Academy of Sciences, USSR, Moscow, 1966.

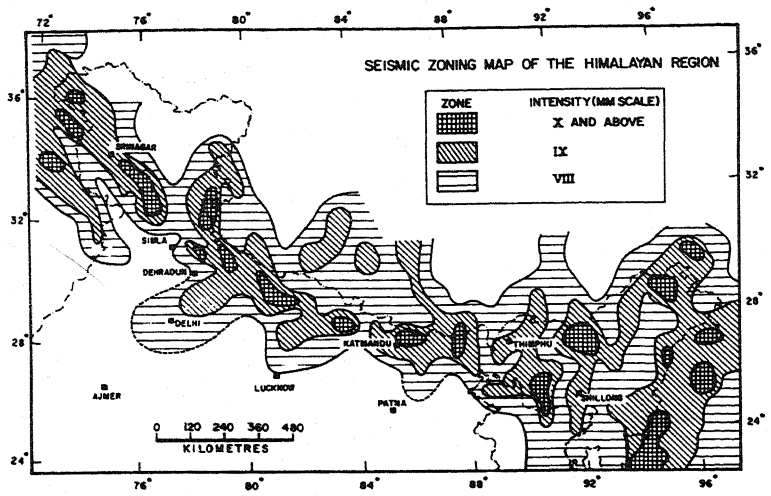

Fig.2 The seismic zoning map of the Himalayan region showing the expected maximum intensity (I_{max}) values. Intensities of future earthquakes on Modified Mercalli scale associated with the seismic zones are X and above, IX and VIII respectively.

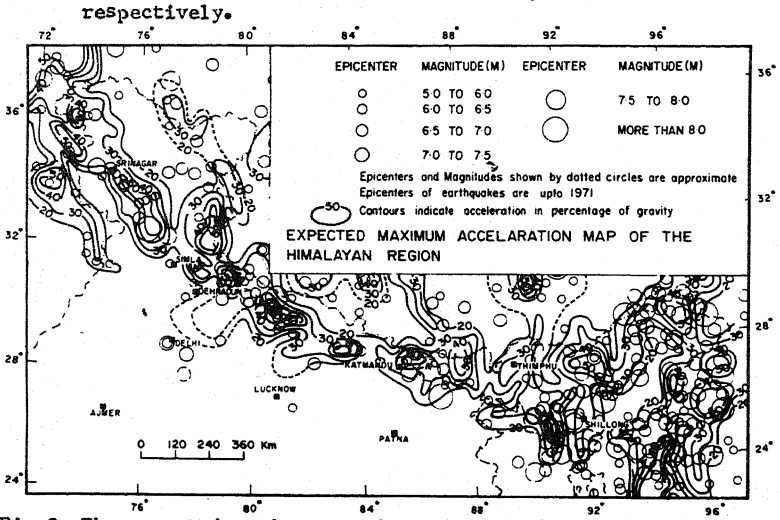

Fig.3 The expected maximum acceleration map of the Himalayan region showing the peak horizontal ground acceleration values expressed as percentage of gravity. Earthquake epicentres plotted are from historic times to 1971 after Tandon and Chaudhury (1966) and Tandon and Srivastava(1974).