EARTHQUAKE OF JULY 1980 IN FAR WESTERN NEPAL

Vinod Singh

Department of Mines & Geology, Lainchaur, Kathmandu

Nepal

सारांश

नेपालमा अल्पग नाभीय (Shallow focused) भूकम्प धेरै संख्यामा अनुभव भएको छ भने दिर्धंग नाभीय (Deep focused) भूकम्प थोरै मात्र अनुभव भएका छन्। भूकम्पको मान ५.६ रिक्टर स्केल भन्दा विरलै बढी भएको पाइन्छ। भूकम्प केन्द्रहरू मुख्य मध्यबर्ति प्रघात (Main Central Thrust) तथा मुख्य सिमावर्ति प्रघात (Main Boundary Thrust) विच सिमित भएको देखिन्छ।

बझाङ्ग नजिक केन्द्र रहेको ६.५ रिक्टर स्केल मान भएको सन् १९८० मा गएको भूकम्पले पश्चिम नेपालको ४०,००० वर्ग किलोमिटर क्षेत्रलाई असर पारेको थियो। पृथ्वी सतहमा देखा परेका भूकम्प जन्य चिराहरू पश्चिम-उत्तर पश्चिम तर्फ उन्मुख थिए। भूकम्पको असर बढी भएको क्षेत्र पनि झण्डै यसै दिशामा लम्बिएको थियो। नाभी सतह समाधान विधिबाट विश्लेषण गर्दा भूकम्प गएको भ्रंस सतहको स्ट्राइक १२०° तथा डीप ६०° दक्षिण–पूर्व भएको अनुमान गरिन्छ।

ABSTRACT

This paper is an attempt to study the seismicity of the Nepal Himalaya and the earth-quake of July 1980 of magnitude 6.5 in western Nepal on its regional geological framework. A new fault plane solution is botained for this earthquake from the study of P wave motion on WWSSN Seismograms at 34 stations. The solution given by Kanamori and Given is not in conformity with the observed P wave first motion. The damaged area is elongated in the azimuth of 110°-120°, which is parallel to the strike of the nodal plane obtained in this sutdy. From the study of the seismicity of Nepal region it is observed that most of the seismicity in recent years is confined in between the Main Central Thrust and the Main Boundary Thrust.

HISTORICAL BACKGROUND

The oldest record of earthquakes in Nepal dates back to 1253 AD. Since then, there has been records of big events in 1259,1407,1679,1681,1809,1823 and 1843 up to the ent of the last century (Suzuki, 1980). According to the data published by Gutenburg and Richter (1949), and Duda (1945) nine big earthquakes of magnitude 6 or larger have taken place in Nepal or in its vicinity during the period 1902-1952. Among them, the biggest three which occurred in 1916, 1934 and 1936 were located within the Nepalese territory or very close to her border. The January 1934 Bihar-Nepal earthquake (magnitude8.4 Richter), the epicentre of which was located about 150 km southeast of Nepal-India border, was the most severe one in the present century. It claimed over 10,000 lives and caused a 300 km long slump belt.

Recent data by International Seismological Centre (1964-1977) are shown in fig.1 which shows the following significant features about the seismicity in Nepal.

1. A seismic zone runs through the middle part of the country parallel to the Himalayan chain and is mainly confined between the Main Central Thrust and the Main Boundary Thrust.
2. Concentration of seismicity is seen on the farwestern part of the country near the Nepal-India-Tibet trijunction. The activity progressively decreases towards east.

Recent seismicity in and around Nepal

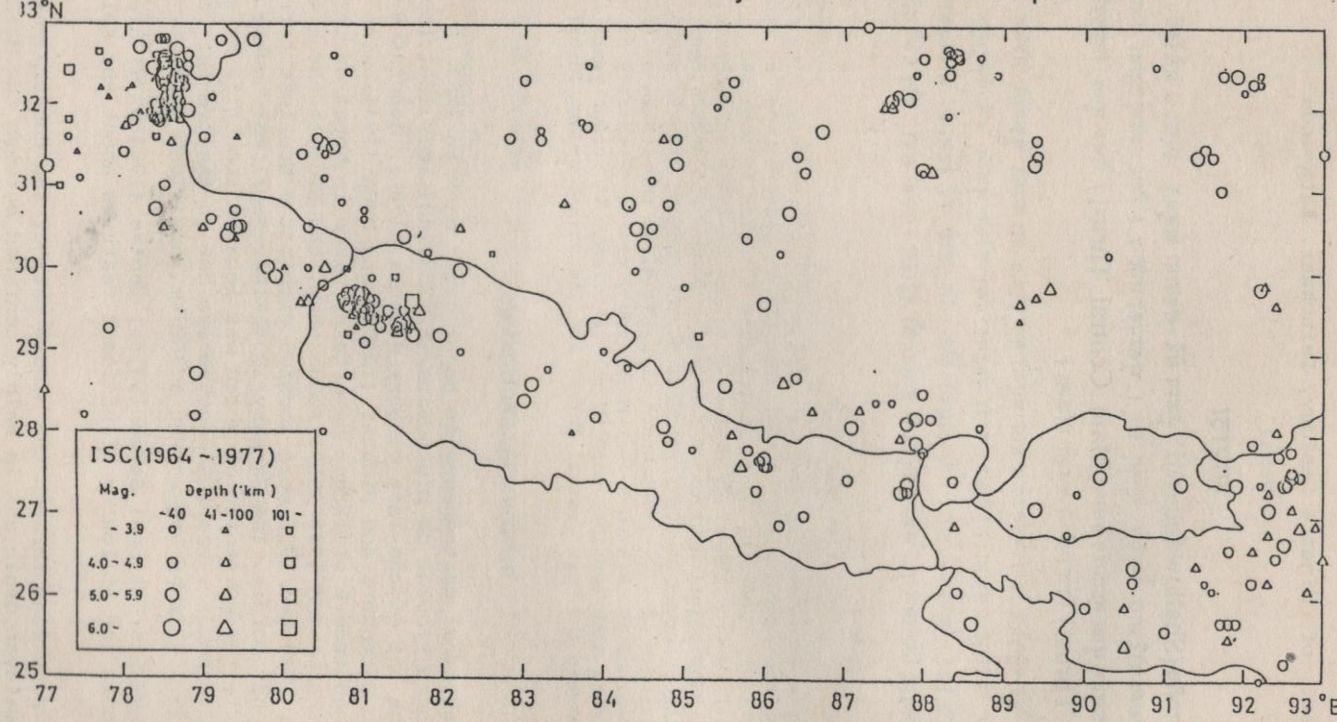

Fig-1

3. Very low seismic activity is seen in the southern Nepal and in India, whereas seismic activity has scattered distribution all over Tibet.

Fig.1 showing the seismic data of I.S.C. (1964 - 1977) and Fig. 2 showing U.S.G.S. data (1978 - 1981) suggest that there is an abundance of shallow earthquakes (less than 40 km) in Nepal having magnitude less than 5.9 on Richter Scale. Deep focus earthquakes (depth more than 100 km and in between 40-100 km) are very few and their magnitude never exceed 5.9 on the Richter scale.

JULY 1980 EARTHQUAKE

Nearly 40,000 sq.km area of western Nepal was rocked at 20.30 hrs. (Local time) on July 29, 1980 by a tremor of 15 seconds duration due to an earthquake of magnitude 6.5 Richter. It took a toll of 178 human lives and 758 cattle heads and about 40,000 houses were destroyed. Of the 19 affected districts, 4 were severely damaged. Foreshocks were felt at 18.04 hrs, two and half hours before the main event. The epicentres determined by U.S.G.S., University of colorado and Department of Mines and Geology are located in the proximity of Bajhang (fig. 3). 150 aftershocks were recorded by a protable seismometer with vertical component during 4 weeks 17th Aug to 15 sept 1980 after the event.

Part of the affected area was investigated during the clear up operations and the following table summarises the damage data (Singh and Sharma, 1980).

District	No. of Affected Panchayat*	No. of Houses Collapsed	No. of Houses Cracked	No. of Houses Cracked (Minor)	Death	Wounded (human)
1. Darchula	26	4135	2743	x	24	x
2. Baitadi	41	1257	1949	x	22	236
3. Dandeldhura	x	x	120	x	x	x
4. Bajhang	35	6137	6380	2200	x	x
5. Bajura	19	419	654	1199	x	x
6. Achham	46	781	1227	1583	x	x
7. Doti	30	82	225	1395	x	x
Total	197	12817	13298	6377	46	236

* Small politico - administrative unit.

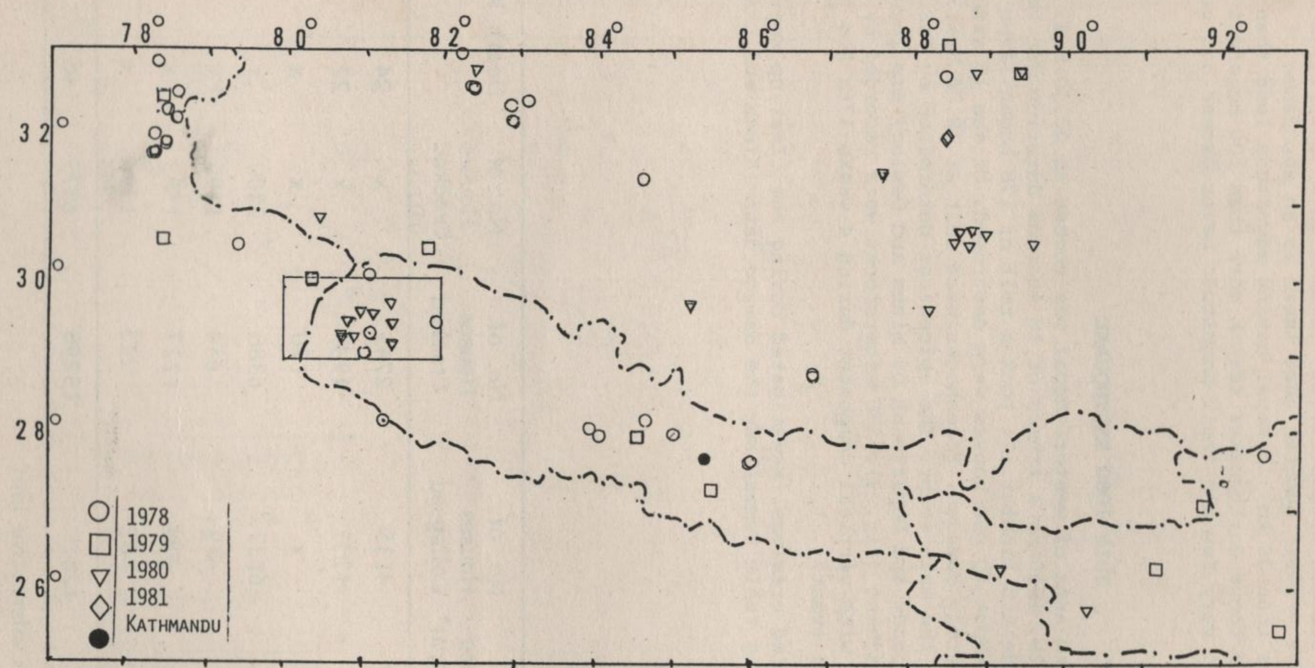

Fig.2. Seismicity in and around Nepal based on P.D.E. data (1978-1981).

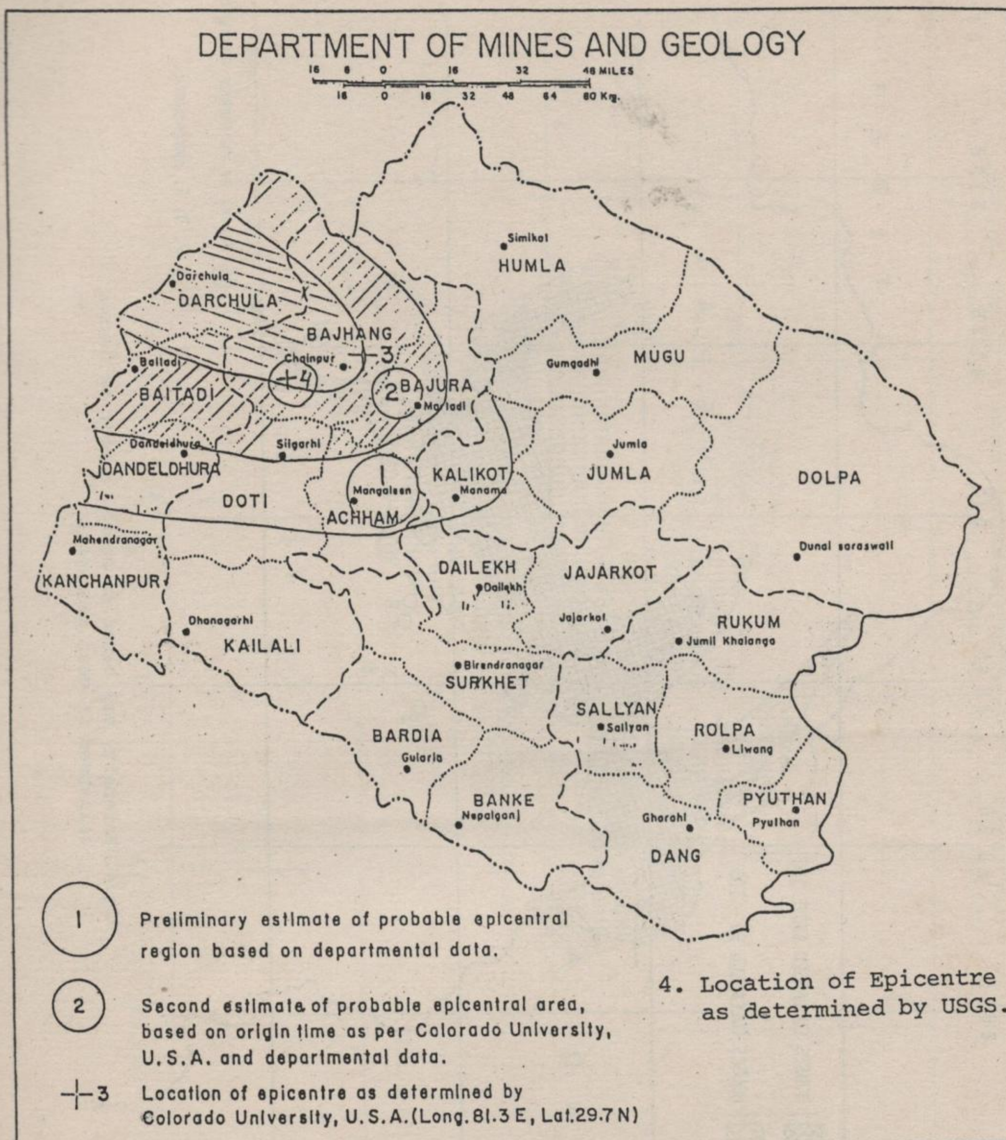

Fig.3. Area affected by the 1980 Nepal Earthquake.

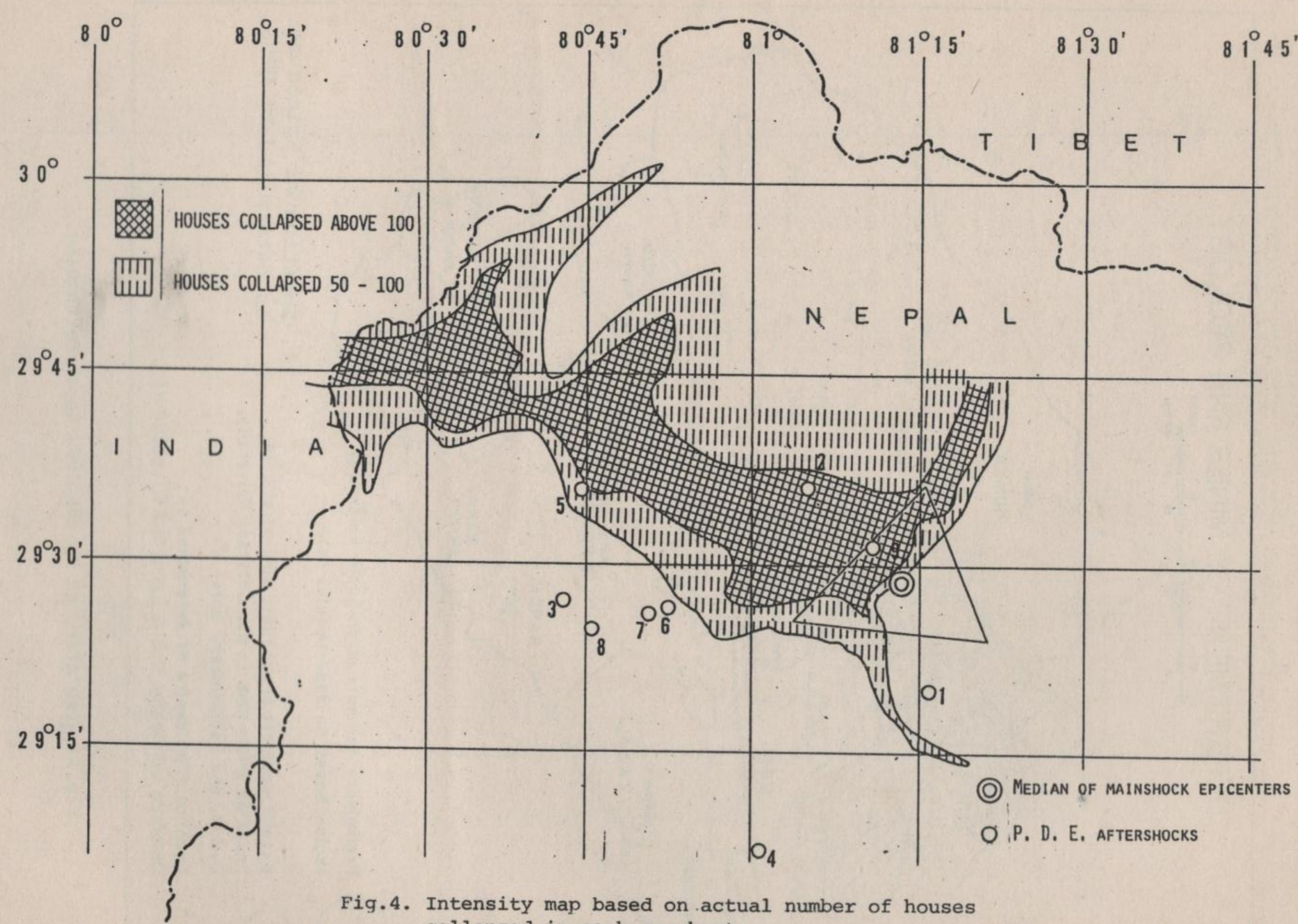

Fig.4. Intensity map based on actual number of houses collapsed in each panchyat.

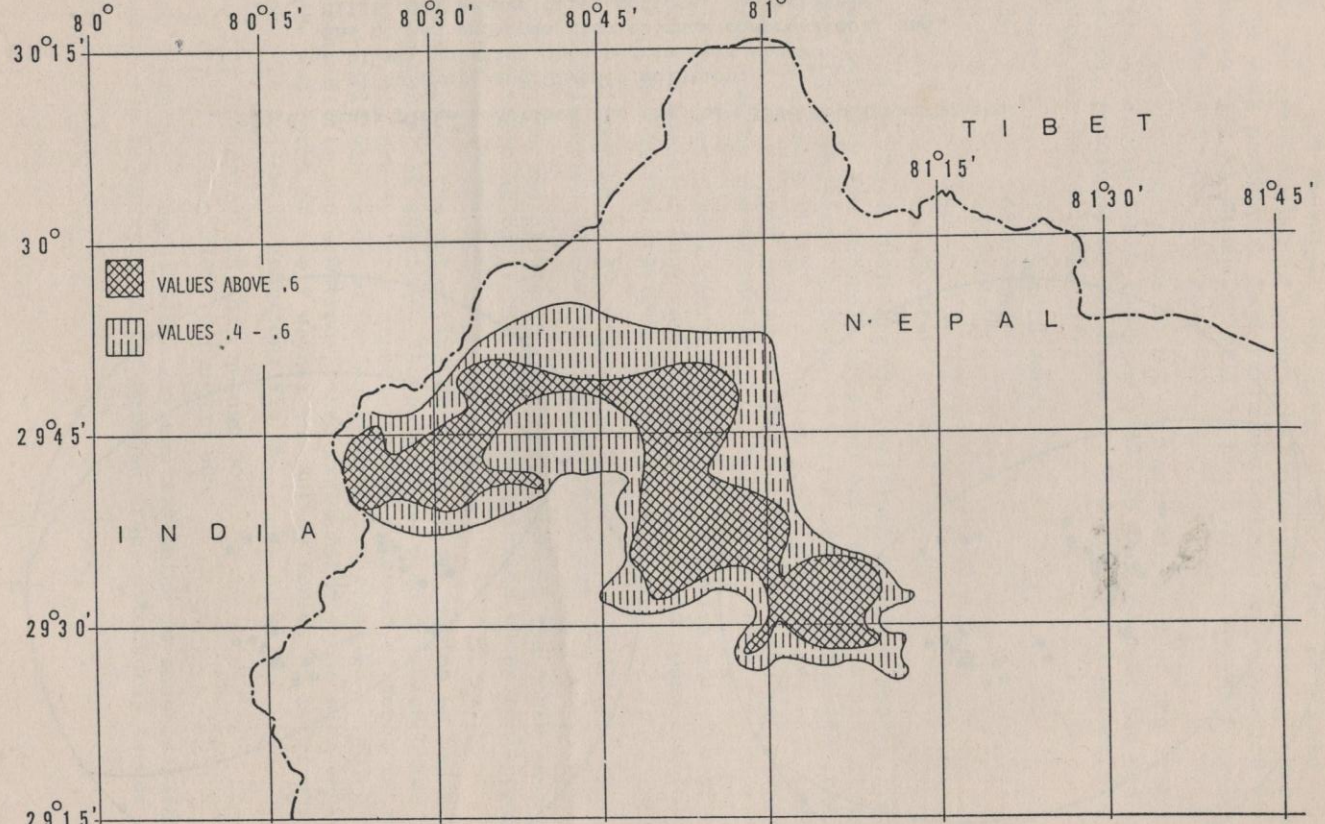

Fig.5. Intensity map based on ratio of numbers of houses collapsed over number of houses collapsed plus number of houses cracked.

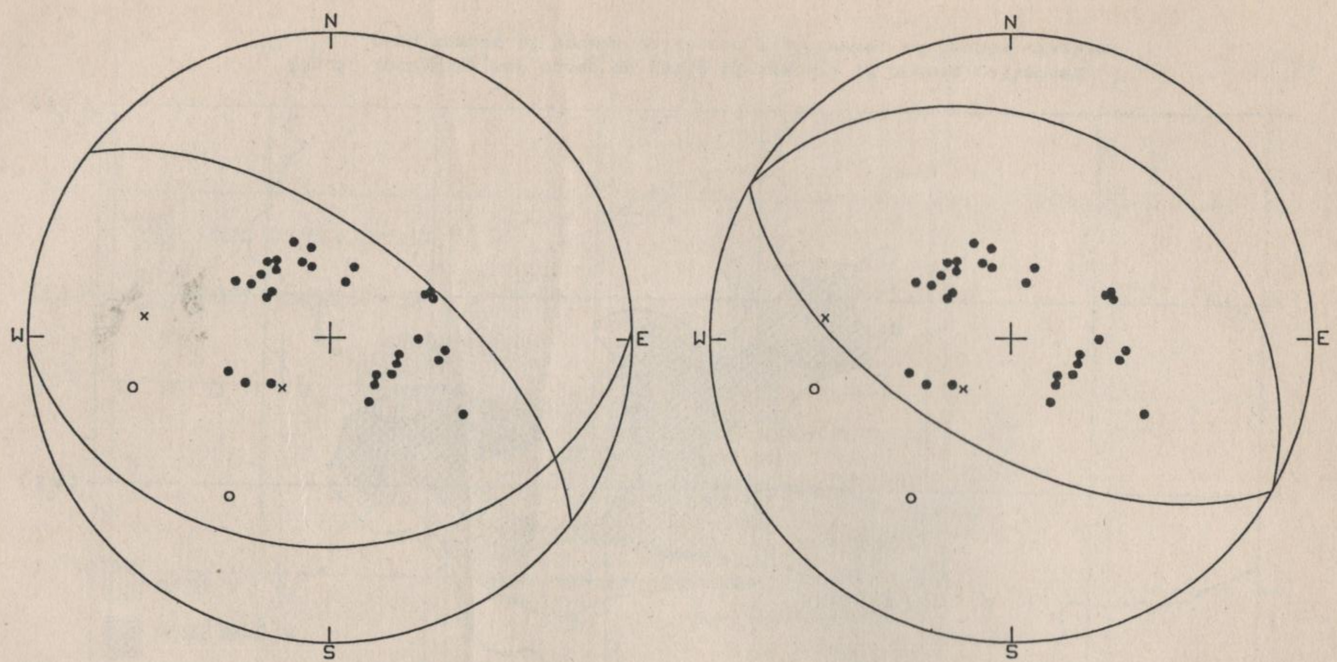

Fig.6. Fault plane solutions for the July 1980 Nepal Earthquake.

6 a) Kanamori and Given's solution.
6 b) New solution obtained in this study.
The closed and open circles show compressional and dilational P-wave first motions, respectively.
The crosses indicate stations showing nodal character.
The lower focal hemisphere is shown by equal area projection.

Fissures developed due to earthquake in the affected area trend in WNW-ESE direction. Countless number of landslides and gound subsidence were also observed in the area. The earthquake intensity map (fig 4) shows that most of the severe damages were confined in the districts of Darchula and Bajhang. For these two districts, the ratio of the number of houses collapsed to the total number of houses collapsed plus houses cracked was calculated for each panchayat. This ratio was used as an indication of the degree of damage (fig 5) Intensity VIII of the Modified Mercalli scale roughly corresponds to the ratio of 0.5.

Epicentres of the shocks lie in the southeastern part of the damaged area (fig. 4). An active fault (Nakata, 1982) is located near the median of the epicentre. According to P.D.E. by U.S.G.S. the focal parameters of this earthquake are as follows:

Origin time	14:58:40.8 (GMT)
Longitude	81.092°E
Latitude	29.598°N
Depth	18 km.
Magnitude	6.5 Richter.

Points 1 to 9 in fig 4. indicate the positions of after shocks listed in P.D.E. Geologically the severely affected area consists mostly of calcareous rocks like limestone, dolomite and quartzite. The damaged area is elongated in the azimuth of 110°-120° which roughly coincides with the structural trend (?) of this region as well as with the trend of the newly developed fractures by the earthquake.

Kanamori and Given (1982) carried out focal mechanism solution of the earthquake on the basis of long period surface waves and found the following possible planes of rupture:(Fig 6a).

Plane 1 Dip direction 36.8°, dip amount 62.2°
Plane 2 Dip direction 178.0°, dip amount 31.7° (?)

The second of the two planes is of thrust type. If the north eastward dipping plane is taken as the fault plane the solution shows small component of right lateral strike-slip.

The author studied the polarities of P wave first motion on WWSSN long period seismograms at 34 stations. The polarities read on seismograms at New Delhi and Poona are not consistent with the solution of Konomori and Given (1982). So it was tried to get an alternative solution which should not only fit to the observed P wave first motion, but also explain the amplitude and forms of the P waves. The author found, by trial and error method, the following solution:(Fig 6b).

Plane 1 Dip direction 30°, dip amount 30°
Plane 2 Dip direction 210°, dip amount 60°

The west dipping (?) nodal plane strikes 120° which is roughly parallel to the trend of the major axis of the damaged area, structural trends and

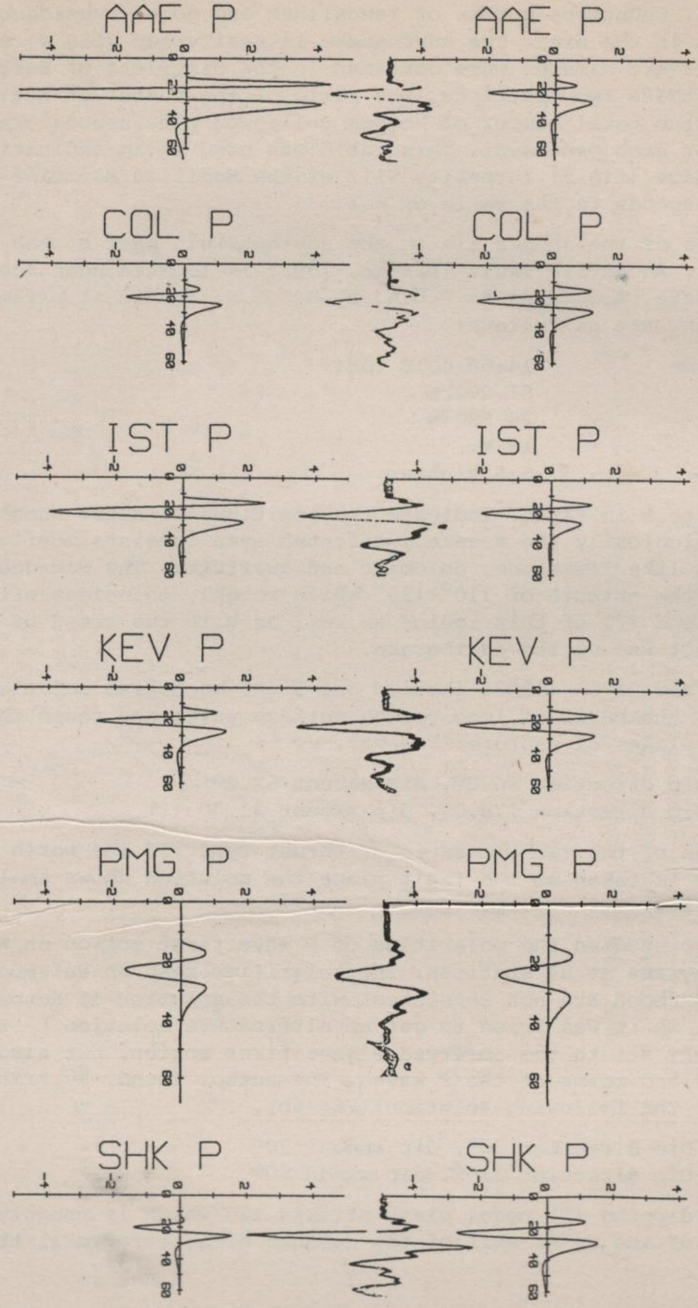

Fig.7. A comparison of synthetic with observed P-wave forms at representative stations. Synthetic waves are calculated by using formula in Kanamori and Stewart (1976). The numerals in the abscissa show time in seconds.

a) Synthetics based on the new solution obtained in this study.

b) Observed waveforms.

c) Synthetics based on Kanamori and Given's solution.

strike of fissures and fractures. The strike of the active fault reconized by Nakata (1982) also coincides with the strike of this nodal plane. Moreever, Nakata (1982) observed accumulated downward movement on the northeastern side of the active fault which is in consistance with our solution.

By a comparison of the observed and theortical P wave amplitude, the author determined the seismic moment to be 4.5×10^{25} dyne/cm(fig-7) This is roughly half of the value estimated by Kanamori and Given !1982). However, their estimation of the seismic moment on the basis of long period surface waves appears to be more reliable, because the P wave forms indicate that this earthquake was a multiple event.

In this area of concentrated seismic activity, it was attempted to see whether there was any change in seismic activity prior to the main event of 1980. A comparison between the two different time periods (figs. 1 and 2) show not significant chage in seismicity prior to the event. In the area enclosed between 80°-82° E meridians and 29°-30° N parallels, 3 events occured in 1978, 1 in 1979 while there were 28 events during the last 14 years (1964-1977).

CONCLUSIONS

1. Most of the Seismic activities in Nepal is confined between the Main Central Thrust and The Main Boundary Thurst.
2. The likely rupture plane for the july 1980 event is a 120° dip 60°SE plane; strikes of the fissures, fractures and that of the active fault coincide with this trend.

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