Seismotectonics of Hindukush

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Summary - Elastic strain rebound increments for the Hindukush region has been studied which revealed a cyclic pattern of strain release in this area where the rate of strain release decreases with time. The spatial distribution of earthquakes clearly defines the Pamir knot where most of the shocks are concentrated. The dip of the deep seated fault which produces the earthquakes so frequently comes out to be 54° dipping in the northwest direction. This fault is best developed between 70 to 300 kilometers and perhaps both these levels represent tectonic discontinuities.

1. Introduction

Most of the large Hindukush earthquakes with their depth of foci lying between 210 to 250 kilometres had their origin in the same area lying between the parallels of latitude 36°N and 37°N and longitude 70°E and 71°E. This is precisely the area which comes under the Pamir knot with its special geological feature and an area where conspicuous negative gravity anomalies prevail [1] 2). The presistence of occurrence of earthquakes in this region at very nearly the same depths and very close to each other suggest operative causes which are similar in nature and which repeat themselves almost once every year. The shocks of this area have been recorded at various seismological observatories and most of the observatories show perfectly identical records traced by the same instrument which in turn suggest the same coordinates of the earthquakes. Some of these shocks are strong enough to cause damage such as the shock of November 21, 1939. This earthquake has been described by Mukherjee and Pillai [2] as a great earthquake of the Hindukush region. According to them strong shocks occur generally in winter and weak ones in all seasons. The frequency of occurrence in both the classes is two per year.

2. Geological setting of the area

The western end of the Himalayas shows a syntaxial structure because of which the geological formations turn round and can ultimately be followed south into the Baluchistan arc [3]. The Punjab-Kashmir wedge which is believed to have produced

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2) Numbers in brackets refer to References, pages 117/118.
this structure must be of large enough dimensions to have pushed back the structures so far to the north. The well marked bend in the course of other mountains of Central Asia such as the Hindukush, Karakoram etc. should be attributed to this wedge. These ranges are gathered up in the Pamirs from which they appear to diverge in the east and west. Each of the mountain system is separated by major faults (some of them are transcurrent in nature) parallel to their trend as shown in Fig. 1. These faults are believed to be deep and connected with basic and acid intrusions as in Karakoram.

3. Strain rebound increments of the Hindukush sequence

Following BENIOFF [4, 5, 6, 7] the elastic strain rebound accompanying an earthquake can be calculated from the seismic energy $J$, released in an earthquake of RICHTER magnitude $M$ using the relation given by RICHTER [8].

$$\log J = 11.4 + 1.5 M.$$  \hspace{1cm} (1)

Further, assuming the conversion efficiency of strain into seismic waves as unity or neglecting the frictional losses, BENIOFF [4] has shown that the relation between $J^{1/2}$ and the strain rebounds $\varepsilon$ is

$$J^{1/2} = C \varepsilon$$  \hspace{1cm} (2)

where $C$ is a constant which depends upon the volume $V$ and the rigidity $\mu$ of the volume of rock involved in an earthquake and is equal to

$$C = \left(\frac{1}{2} \mu V\right)^{1/2}$$ \hspace{1cm} (3)

which may be assumed to be a constant for a given earthquake sequence as in the present case. Thus, the square root of the earthquake energy is proportional to the