THE SEISMIC PERCEPTIBILITY IN DETERMINING SOME FOCAL PARAMETERS OF HISTORICAL EARTHQUAKES IN CHILE

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RESUMEN : Sobre la base de algunas expresiones obtenidas por diferentes autores y tomando en consideración la ubicación geográfica de Chile, se propone utilizar la distancia de máxima perceptibilidad para estimar el tamaño de los terremoros históricos.

KEY WORDS : Size, Historical, Earthquakes, Regression, Parameters, Perceptibility

INTRODUCTION

In Chile we have had many earthquakes of great magnitude such as M_s = 7.5 to M_s = 8.6. The ones that have happened after the year 1906 have been determined with the use of instruments. For this reason, some of their focal parameters as seismic magnitude, length of rupture, seismic moment, etc. are fairly well estimated.

Although, the earthquakes that have happened before 1906 (or historical) have been estimated through some indirect parameters, that we will call "Macroseismic Parameters". Some of them are, duration of the main earthquakes, distance of maximum perceptibility, duration of aftershocs, etc.

One of the macrosismic parameters most frequently, quoted in the historical documents, it is the distance of maximum perceptibility (L^*), which is the distance between, the epicentral zone and the zone where the earthquake was felt by a normal watcher who declares "to have perceived the earthquake".

The reason why this is one of the best registered parameters is due to the geographical shape of the Chilean territory, which is a long and narrow zone located in geographical North - South direction so that the rupture zones go in the same direction (parallel) to the coast line.

So, the differents isoseismic lines in the graphic of a great isoseismic lines in the graphic of a earthquakes have an elliptical form whose largest diameter is approximately oriented to N.S. direction (See Fig. 1). So it is often probable that the limit of any isoseismal reachs, a city, town or village in our country.

For the earthquakes that have happened after 1906 (contemporany) it has been determined with fair accuracy the area involved by the isoseismal of levels VII and VIII (M.M.), and up although, this has not been possible for the isoseismal of levels IV, III (M.M.) and inferior, because their largest dimension involve as the Pacific Ocean, so the Andean mountains, so that for this levels of seismic intensity the lenght of the major semiaxis, represents with higher precision the level of seismic perceptibility.

GEOLOGICAL SETTING

Richter, (1958) proposed some data that connected the maximum intensity of a seism (I_{max}) to his seismic magnitude (M) and the distance of maximum perceptibility (L^*) starting from this data Ramírez (1988), obtained an empirical relation that linked L^* to M. The same way Barrientos (1980), obtained some relations of attenuation for a group of 73 Chilean earthquakes in which this three parameters connected themselves in a consistent way.

Asuming that for a normal watcher whose level of perceptibility, is equivalent to that of a witness present in a historical earthquakes, the limit of the seismic perceptibility approaches to the extreme value of the isoseismal III (M.M.) Ramírez (1988), it is feasible to deduct from the formula of attenuation, an empirical relation that link L^* and M for big earthquakes with epicenters inferior to 100 (Km) depth.

Also S.K. Singh et al. (1980), obtained some empirical relations that linked the areas delimited by the contours of the isoseimal IV, V, VI to the seismic magnitude of some earthquakes, which occurred in Mexico. As a consequence, it is extremely possible to derive empirical relations between the lenght of the major semiaxis of that areas with the seismic magnitude so that it will become similar to the

On the basis of this antecedents we have selected a group of great Chilean earthquakes after the year 1900 of magnitude M_s 7.0 (Table 1) such that their distance of maximum perceptibility has been determined in a equivalent way of the one registered by a witness present in some historical earthquake. Kausel y Ramirez (1993). Using the methods of regression by minimum squares, starting from the data indicated in Table 1, we can get the following equations of empirical character :

$$\log L^* = 0.23 + 0.35\ M_s \quad (1)$$
$$\log L^* = 0.44 + 0.32\ M_w \quad (2)$$
$$\log L^* = 1.97 + 0.48 \log L \quad (3)$$

The distribution and correlation of the points can be seen in figures 2, 3 y 4 respectively.

TABLE N°1

DATE	LAT.	LONG.	PROF.	M_s	M_w	L(km)	L^*(km)
17.08.06	33.0	72.0	25.0F	8.4	8.2	250	1600
11.11.22	28.5	70.0	25.0F	8.4	8.5	390	1500
01.12.28	35.0	72.0	25.0F	8.0	7.6	90	1300
25.01.39	36.3	72.3	---	8.3	---	200	1600
06.04.43	30.8	72.0	---	7.9	8.2	200	1000
02.08.46	26.5	70.5	50.0G	7.9	7.9*	110	950
20.04.49	38.0	73.5	70.0E	7.3	7.3*	---	660
17.12.49	54.0	71.0	---	7.8	7.8*	---	1000
09.12.50	23.5	67.5	100.0F	8.0	---	120	1200

This is consistent with the condition that the magnitude Mw is determined in relation to periods higher than 100 (sec.), as by definition M_w is proportional to the logarithm of the seismic moment (M_o) and this is measured in cero frecuency. The length of rupture L shows a similar behaviors to the magnitude M_w in front to Log L^*, as theoretically both parameters appear linked each other, Geller and Kanamori (1977).

Due to that logarithm L^* is proportional to M_s is possible expect that the empiric relation of the form log $L^* = A + B\ M_s$ with $M_s > 8.0$ shows a excellent correlation.

The determination of L^* for a historical earthquakes has to start by an exhaustive test of the historical antecedents available, allowing an estimation of no more than 10% of the measure of L^* of uncertainty.

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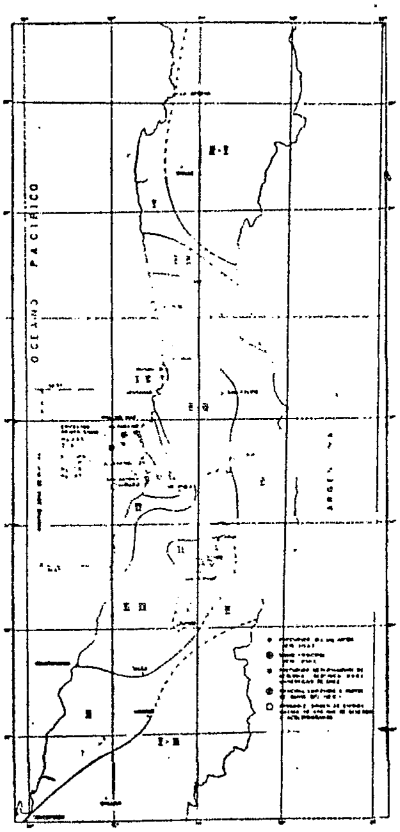

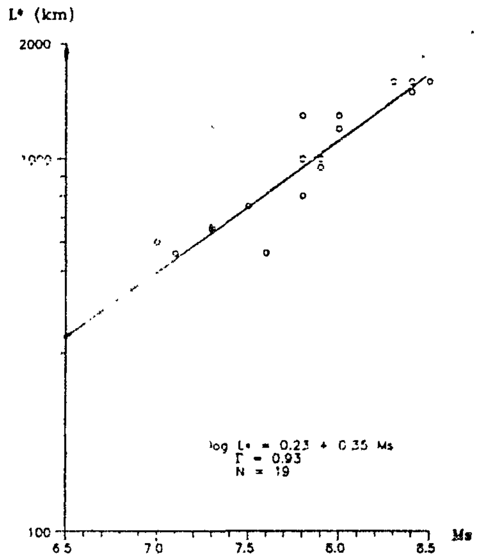

Relacion entre la Distancia de Maxima Perceptibilidad (L*) y la Magnitud Richter (Ms)

FIG. 2