SEISMIC GAPS : A DISCUSSION

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1. INTRODUCTION

Most large earthquakes are preceded by lulls in seismic activity which can be identified (a posteriori, at least) as seismic gaps (Kelleher, et al., 1973; McCann et al., 1979). The question as to whether these gaps are of predictive value is of some theoretical and practical interest.

The logic according to which research on seismic gaps should be conducted is still unclear. No generally accepted conceptual model has been brought to bear on the problem of earthquake prediction in general, or of seismic gaps in particular. Sir Harold Jeffreys once aptly remarked that if some precursor were strong enough to be of predictive value, "no statistics should be required to bring it out". The following discussion is presented in the same tradition of thought.

2. HISTORICAL BACKGROUND

In 1950 Benioff predicted an earthquake of magnitude 7.5 on the Indian Ocean Ridge, by extrapolating the cumultative plot of the square roots of the energy release of earthquakes in this region. The predicted earthquake occured on December 8, 1951 (Fig. 1). It led Benioff to state that "this sequence provides convincing evidence that in a given region the accumulating strain may be relieved either by a large number of small shocks or by a small number of large shocks" (Benioff, 1955). Yet no further successful predictions of this kind were documented.

Benioff had noticed that plotting the energy directly (rather than its square root) tended to exaggerate the contribution of large events at the expense of the smaller ones. The seismic moment M_o being numerically of the same order as the energy, cumulative plots of M_o would entail the same effect, thus oversimplifying the history of seismic strain accumulation by reducing it to a very few, very large events. Unfortunately the error in the determination