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Earthquake recurrence parameters for KwaZulu-Natal Province

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Introduction

The accurate evaluation of earthquake recurrence parameters is a critical step in seismic hazard analysis and is also used in the engineering and insurance industries. The initial step before the evaluation of recurrence parameters is the delineation of seismic source zones. A seismo-tectonic model that is based on a multi-disciplinary geo-database has already been developed for KwaZulu- Natal (KZN) and is shown in Figure 1 below. Data used for the formulation of this seismo-tectonic model is inclusive of geology, tectonics, palaeo-seismology, regional geophysical anomalies, historical and instrumental seismicity.

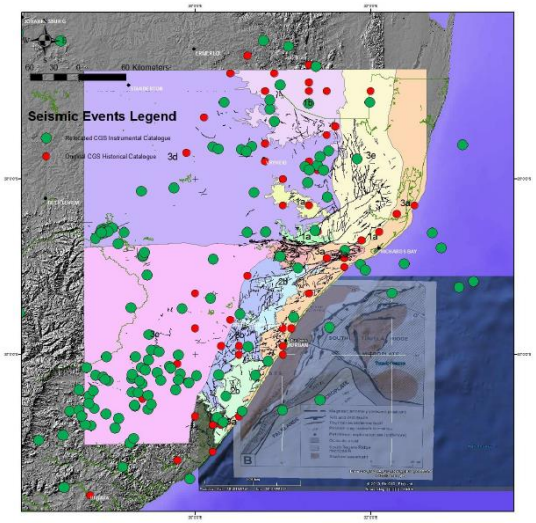

Figure 1: KwaZulu-Natal seismic zones

The Gutenberg-Richter relationship

The Gutenberg-Richter relationship [1] is the most frequently used model of earthquake magnitude recurrence. The relationship is:

$$\log(n) = a - bm \qquad (1)$$

where *n* is the number of earthquakes with a magnitude *m* whereas *a* and *b* are parameters. The earthquake magnitude lies within the domain $<m_{min}, m_{max}>$, where m_{min} is the level of completeness of the earthquake catalogue and m_{max} is the maximum possible earthquake magnitude. The parameter *a* depicts the measure of the level of seismicity while *b* is the ratio between small and large events such that a high *b*-value indicates a larger fraction of small earthquakes and vice versa.

Method and results

The KZN catalogue had 233 events and the one with the highest magnitude was $M_L = 6.5$. Only Zones 3c and 3d as shown in figure 1 had sufficient data to reliably evaluate maximum magnitude. The level of completeness of the KZN catalogue was found to be $M_L = 5$ and was calculated using ZMAP[2]. The theoretical background of the method applied in this study can be found in [3] . This is a maximum likelihood procedure, based on past seismicity that takes into account the various levels of completeness in the earthquake catalogue.

Conclusions

The maximum observed earthquake magnitudes (m_{max}^{obs}) for Zones 3c and 3d were $M_L = 5.6$ and $M_L = 4.4$ respectively. This is important as estimates of m_{max} are expected to be to be close to m_{max}^{obs}. Similar previous studies such as [4] yielded values of m_{max} that are different to the ones obtained in this study This is because this value is largely dependent on the m_{max}^{obs} in the region and their studies were on a regional scale.