T1.5-P3

ASSESSMENT OF SEISMIC HAZARD POTENTIALS IN ZIMBABWE

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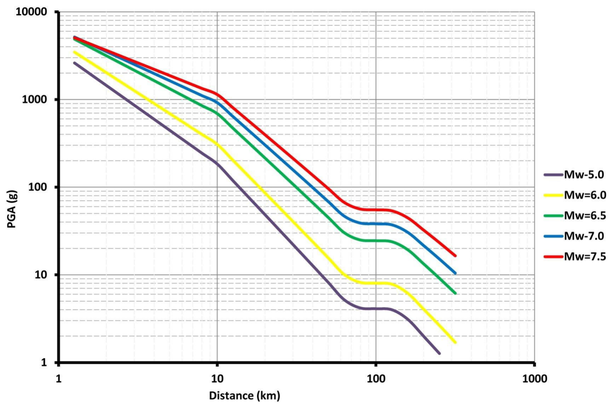
Abstract

A probabilistic seismic hazard assessment for Zimbabwe is analysed according to the data and statistics of the seismicity of Zimbabwe and sources of earthquakes around the country. Data from different sources were merged and duplicate earthquakes were removed. Data from IMS stations in Southern Africa and Zimbabwe includes contributions to the catalogue from 2003.The catalogue was unified with all magnitude types converted to Mw. The "deductive" probabilistic seismic hazard analysis (PSHA) approach was used; this integrates geological and geophysical information together with seismic event catalogues in the assessment of seismic hazard. In this study, seismic hazard maps are presented as maps showing peak ground acceleration (PGA) for Zimbabwe. The maps have a 10% probability of exceedance in a 50 year period, and are prepared using a homogenized catalogue compiled for seismic moment magnitude. The highest levels of seismic hazards in Zimbabwe are along the eastern border of the country with Mozambique, in the Lake Kariba area and in the mid Zambezi basin in the vicinity of the Save-Limpopo mobile belt

Introduction

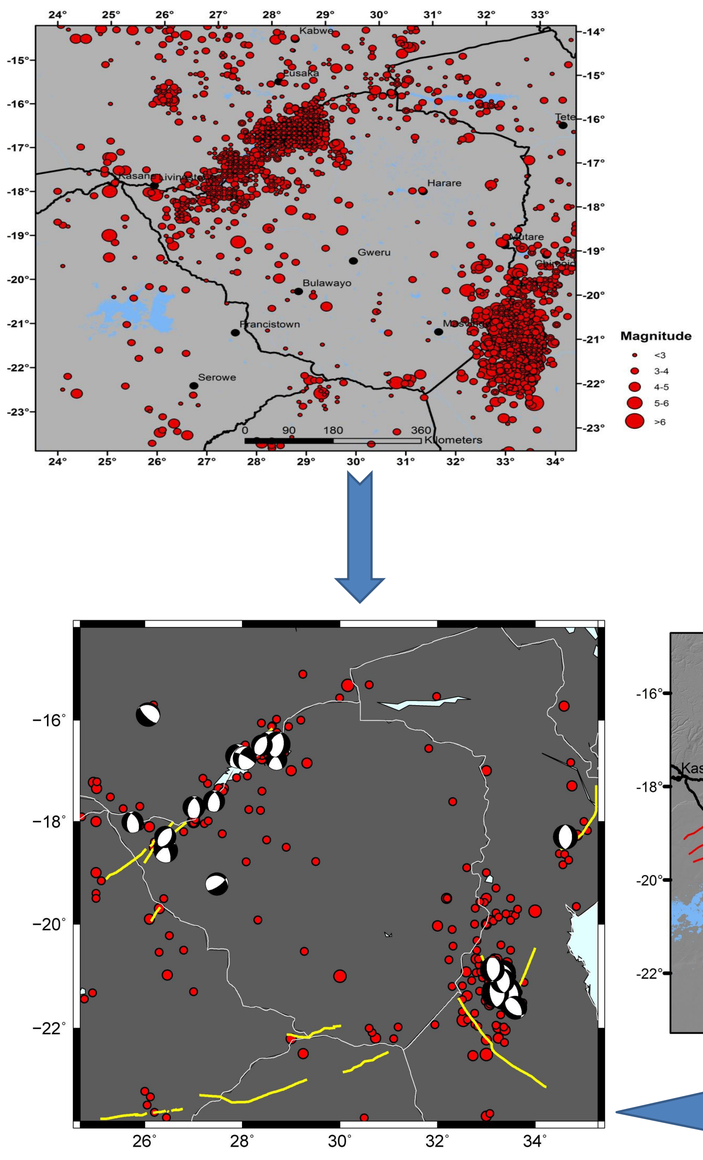
Seismic hazard analysis is an important tool in mitigating risks associated with earthquakes in an area. The method of probabilistic seismic-hazard assessment (PSHA) has been a standard input to engineering, planning, and insurance applications for several decades. It is based on Cornell's fundamental logic that hazard at a site is based on the location, recurrence behavior, and predicted ground motions of earthquakes surrounding the site (Cornell, 1968). PSHA models use estimates of earthquake recurrence derived from seismicity catalogs, active fault data, and from geodetic strain rates derived from global positioning system (GPS) data. This information is jointly used to develop a seismotectonic model.

Ground motion prediction model



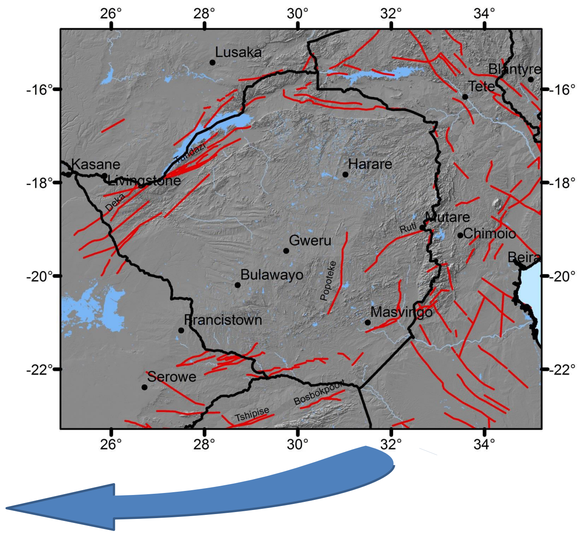
One of the most important steps in seismic hazard analysis is the selection of models to predict the ground-motion at the target region (Scherbaum *et al.*, 2009). Ground motion prediction equations developed for East and North America by Atkinson and Boore (2006) was selected since the region is of similar tectonic setting.

Seismotectonic model



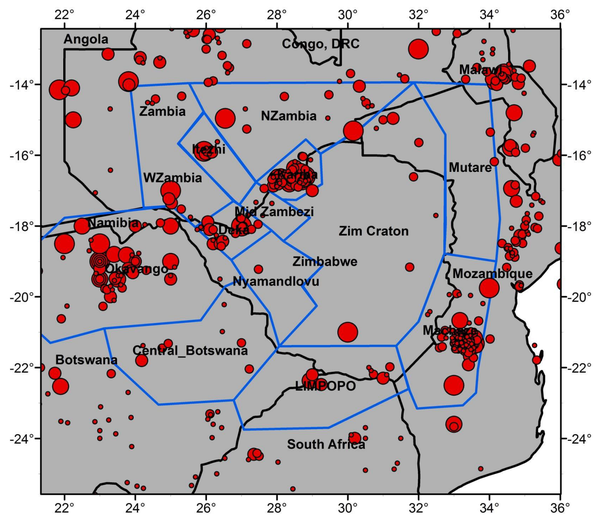
The recorded earthquakes are scattered all over the country but they are highly concentrated on our borders with Zambia on the north western side of Zimbabwe and with Mozambique on the south eastern side of the country. Some of the earthquakes are scattered throughout the country especially in the central area and some of these events are attributed to mining activities.

Seismotectonic map for Zimbabwe produced from seismological and geological data set. Faults assumed to be active are shown in yellow. This model was used to develop the seismic source zones. Focal mechanism solutions determined for some earthquakes were also used in the delineation of source zones.



Major faults identified from several sources and publications e.g. geological report, maps and scientific publications. Activity of these faults is not well known and hence they were used to develop a seismotectonic model.

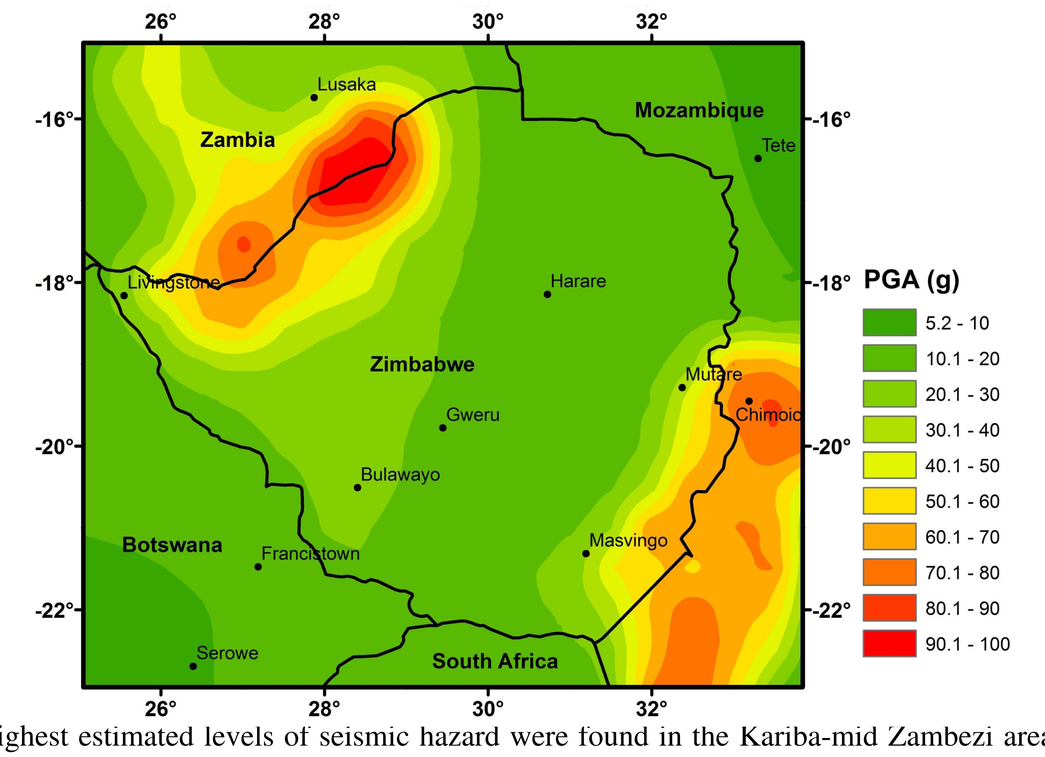
Seismic Source Characterisation



The seismotectonic model was used to delineate seismic source zones. A total of 13 seismic sources zones were identified in and around Zimbabwe. The four major sources of the earthquakes that affect Zimbabwe from the region are mostly along our border areas with Mozambique and Zambia. Recurrence parameters for each zone were calculated.

Source	b-value	β = ln(10)*b	λ(M≥5.0)	Recurrence weight	M_{obs}	M_{max}
Cbots	0.86	1.9802	0.1950	0.4	5.3	5.80
	1.18	2.7171	0.1479	0.6		
Deka	0.96	2.2105	1.1220	0.4	6.1	6.6
	1.07	2.4638	0.8913	0.6		
Itezhi	1.09	2.5098	1.0000	0.4	6.1	6.6
	1.22	2.8092	1.0000	0.6		
Kariba	1.32	3.0394	4.3652	0.5	6.5	7.0
	1.04	2.3947	4.4670	0.5		
Mid-Zambezi	1.03	2.3712	0.3890	0.7	5.0	5.5
	1.68	3.8683	0.6166	0.3		
Nyama	1.29	2.9703	0.2399	0.7	5.0	5.5
	1.03	2.3717	0.4074	0.3		
Okavango	1.22	2.8091	0.3467	0.4	6.7	7.2
	1.03	2.3716	0.4672	0.6		
Zim-Craton	1.07	3.9143	0.6166	0.4	4.6	5.10
	1.08	3.17756	1.3183	0.6		
Machaze	1.24	2.8552	7.9433	0.4	7.2	7.7
	1.02	2.3486	7.0000	0.6		
Mutare	0.93	2.7861	0.1622	0.4	5	6.0
	1.21	2.1414	0.1175	0.6		
NZambia	1.03	3.0624	0.7763	0.4	4.4	4.9
	1.02	2.9473	0.7943	0.6		
WZambia	1.09	2.5098	0.07413	0.4	4.8	5.3
	1.13	2.6019	0.0708	0.6		

Results



The highest estimated levels of seismic hazard were found in the Kariba-mid Zambezi areas and in the south eastern parts around Chipinge, where peak ground accelerations (PGA) in excess of 0.1**g** chance of exceedance in 50 years.. The main cities, Harare and Bulawayo show moderate levels of peak ground acceleration.. The central region including Harare is situated in an area with geology that is predominantly stable (granitic) continental shield and may be regarded as aseismic. In this region seismicity has been unevenly distributed.

Conclusion

A seismic hazard map for Zimbabwe was produced for a 10% probability of exceedance of the given PGA values for bedrock conditions for an exposure time of 50 years. The results presented here give preliminary seismic hazard maps for the region. Although most of the major cities lies outside the high hazard zones, Zimbabwe is still susceptible to seismic hazard.

References

- Atkinson, G.M. and D.M., Boore (2006). Earthquake ground-motion prediction equations for eastern North America, *Bulletin of the Seismological Society of America*, **96**(6), 2181–2205, doi: 10.1785/0120050245.
- Scherbaum F., E. Delavaud, and C. R. Scherbaum, 2009. Model Selection in Seismic Hazard Analysis: An Information-Theoretic Perspective, *Bulletin of the Seismological Society of America*, **99**(6), 3234–3247, doi: 10.1785/0120080347