

South African National Seismograph Network (SANSN) FDSN Report 2005

Ian Saunders
Council for Geoscience
ians@geoscience.org.za

Seismicity of South Africa

The seismicity, in general, of Southern Africa is moderate, of shallow nature and in most cases difficult to correlate with geologic features. This scatter of seismic foci is similar to the diffuse pattern observed for intraplate regions around the world.

The historical record of seismicity in South Africa is restricted in both time and the distribution of the population. This statement is qualified when considering that the first mention of an earthquake in the region is made in 1620. Figure 1 presents a map of the seismicity of South Africa for the period 1620 to 1900. It is worth noting that no seismic events were reported in the Gauteng province where the gold mines are situated (North-eastern quarter of South Africa).

A unique aspect of South African seismicity is that the vast majority of seismic events are associated with the deep gold mining areas (See Figure 2). The high concentrations of seismic activity in and around the deep gold mines led to the development of seismic networks for the mining industry that are presently deployed in many of the deep mines or mining areas to monitor activity around the mine tunnels. These networks now focus on assessing risk to mining operations and miners, and on evaluating methods of mine design.

Earthquakes of magnitude greater than 5.0 have occurred in the Klerksdorp and Welkom gold mining areas, where more extensive faulting occurs than in other gold mining areas.

There are concentrations of natural seismic activity extending from the Koffiefontein area of the Free State through Lesotho and northeast through KwaZulu Natal to the Mozambique Channel, in Namaqualand, and also in the Ceres area of the Western Cape, where the largest earthquake in South Africa's history (magnitude 6.3) occurred on September 29, 1969. Table 1 lists all earthquakes equal to magnitude 5 and larger since 1969 in South Africa.

Network

The South African National Network (SANSN) is operated by the Council for Geoscience and consists of 21 seismological stations located throughout South Africa (See Figure 3). A modernization of the SANSN was undertaken during the period 2001 to 2004 through a capital placement programme from funds acquired through the Innovation Fund. The majority of the

SANSN is presently equipped with extended short-period seismometers (Guralp CMG-40T) and also has five broadband sensors (Geotech KS-2000). Table 2 presents details of the equipment and geological conditions at the stations comprising the SANSN.

Table 1: Earthquakes of magnitude 5.0 and larger since 1960.

DATE	LOCATION	MAGNITUDE
1963/08/27	Worcester Area	5.0
1964/06/09	Luckhoff Area	5.0
1966/06/18	Mokhotlong (Lesotho)	5.0
1969/09/11	Heidelberg Area (Cape Province)	5.2
1969/09/29	Tulbagh Area	6.3
1969/10/05	Tulbagh Area	5.1
1969/11/05	Tulbagh Area	5.4
1969/11/10	Tulbagh Area	5.1
1970/04/14	Cape Province	5.7
1976/07/01	Free State Province	5.9
1976/12/08	Free State Gold Mines	5.1
1977/03/02	Cape Province	5.3
1977/04/07	Klerksdorp Gold Mines	5.2
1977/06/07	Cape Province	5.4
1984/01/28	Klerksdorp Gold Mines	5.0
1985/05/08	Free State Province	5.2
1986/10/05	Lesotho	5.1
1989/09/29	Lesotho	5.0
1993/03/11	Bushmanland Area	5.2
1994/12/31	Bushmanland Area	5.1
1996/09/15	Bushmanland Area	5.7
1999/04/22	Free State Gold Mines	5.1
1999/04/22	Bushmanland Area	5.2
2001/07/31	Klerksdorp Gold Mines	5.0
2005/03/09	Klerksdorp Gold Mines	5.3

Table 2.

Stations of the South African National Seismograph Network.

<i>LOCALITY AND STATION CODE</i>	<i>LATITUDE (DEG MIN)</i>	<i>LONGITUDE (DEG MIN)</i>	<i>ELEVATION ABOVE SEA LEVEL (METERS)</i>	<i>GEOLOGICAL FOUNDATION</i>	<i>INSTRUMENTS</i>
Belfast (BFT)	25°41.20'S	30°02.60'E	1868	Gabbro	Stand Alone Quake Seismometer (SAQS) with a Guralp CMG-40T broadband seismometer
Calvinia (CVNA)	31°27.00'S	19°45.70'E	1050	Dolerite	EARS Delta 24 bit Digital dial-up event recorder with a Geotech Instruments KS2000 broadband seismometer.
Ceres (CER)	33°21.70'S	19°17.60'E	472	Quartzite	EARS Delta 24 bit Digital dial-up event recorder with a Guralp CMG-40T broadband seismometer
Elim (ELM)	34°35.80'S	19°44.70'E	126	Sandstone	Stand Alone Quake Seismometer (SAQS) with a Mark Products L4-3D three-component short period seismometer.
Grahamstown (GRM)	33°18.80'S	26°30.50'E	610	Witteberg Quartzite	EARS Delta 24 bit Digital dial-up event recorder with a Geotech Instruments KS2000 broadband seismometer.
Gariep Dam (HVD)	30°36.30'S	25°29.80'E	1433	Dolerite	Stand Alone Quake Seismometer (SAQS) with a Guralp CMG-40T broadband seismometer
Komaggas (KOMG)	24°47.94'S	17°29.02'E	299	Gneiss	Stand Alone Quake Seismometer (SAQS) with a Mark Products L4-3D three-component short-period seismometer.
Kokstad (KSD)	30°32.46'S	29°25.00'E	1350	Dolerite	No instruments installed.
Koster (KSR)	25°51.10'S	26°53.83'E	1623	Sandstone	EARS Omega 18 bit Digital dial-up event recorder with Geotech Instruments S-13 three-component short period seismometers.

Table 2. Stations of the South African National Seismograph Network (Continued).

LOCALITY AND STATION CODE	LATITUDE (DEG MIN)	LONGITUDE (DEG MIN)	ELEVATION ABOVE SEA LEVEL (METERS)	GEOLOGICAL FOUNDATION	INSTRUMENTS
Lephalale (LEP)	23°38.98'S	27°44.81'E	840	Sandstone, siltstone and mudstone	Stand Alone Quake Seismometer (SAQS) with a Guralp CMG-40T broadband seismometer
Mussina (MSNA)	22°20.71'S	30°01.39'E	600	Quartzite	EARS Omega 18 bit Digital dial-up event recorder with a Guralp CMG-40T broadband seismometer
Mopani (MOPA)	23°31.04'S	31°23.86'E	362	Granite	Stand Alone Quake Seismometer (SAQS) with a Guralp CMG-40T broadband seismometer
Newcastle (NWL)	27°43.24'S	29°57.19'E	1332	Dolerite	EARS Omega 18 bit Digital dial-up event recorder with a Mark Products L4-C, vertical component short period seismometer.
Parys (PRYS)	26°55.52'S	27°21.59'E	1403	Granite	EARS Omega 18 bit Digital dial-up event recorder with Geotech Instruments S-13 three- component short period seismometers.
Pongola (POG)	27°22.19'S	31°36.70'E	290	Sandstone	No instruments installed.
Prieska (PKA)	29°40.20'S	22°45.40'E	960	Alluvium, calcrete	EARS Omega 18 bit Digital dial-up event recorder with a Guralp CMG-40T broadband seismometer
Silverton (SLR)	25°44.10'S	28°16.90'E	1348	Quartzite	EARS Omega 18 bit Digital dial-up event recorder with a Mark Products L4-3D short period seismometer.
Senekal (SEK)	28°19.40'S	27°37.50'E	1486	Sandstone	Stand Alone Quake Seismometer (SAQS) with a Guralp CMG-40T broadband seismometer
Somerset-East (SOE)	32°42.70'S	25°33.70'E	820	Mudstone sandstone	No instruments installed.
Schweizer-Reneke(SWZ)	27°10.94'S	25°19.90'E	1342	Sandstone	No instruments installed.
Uppington (UPI)	28°21.72'S	21°15.16'E	845	Calcrete	EARS Delta 24 bit Digital dial-up event recorder with a Geotech Instruments KS2000 broadband seismometer.

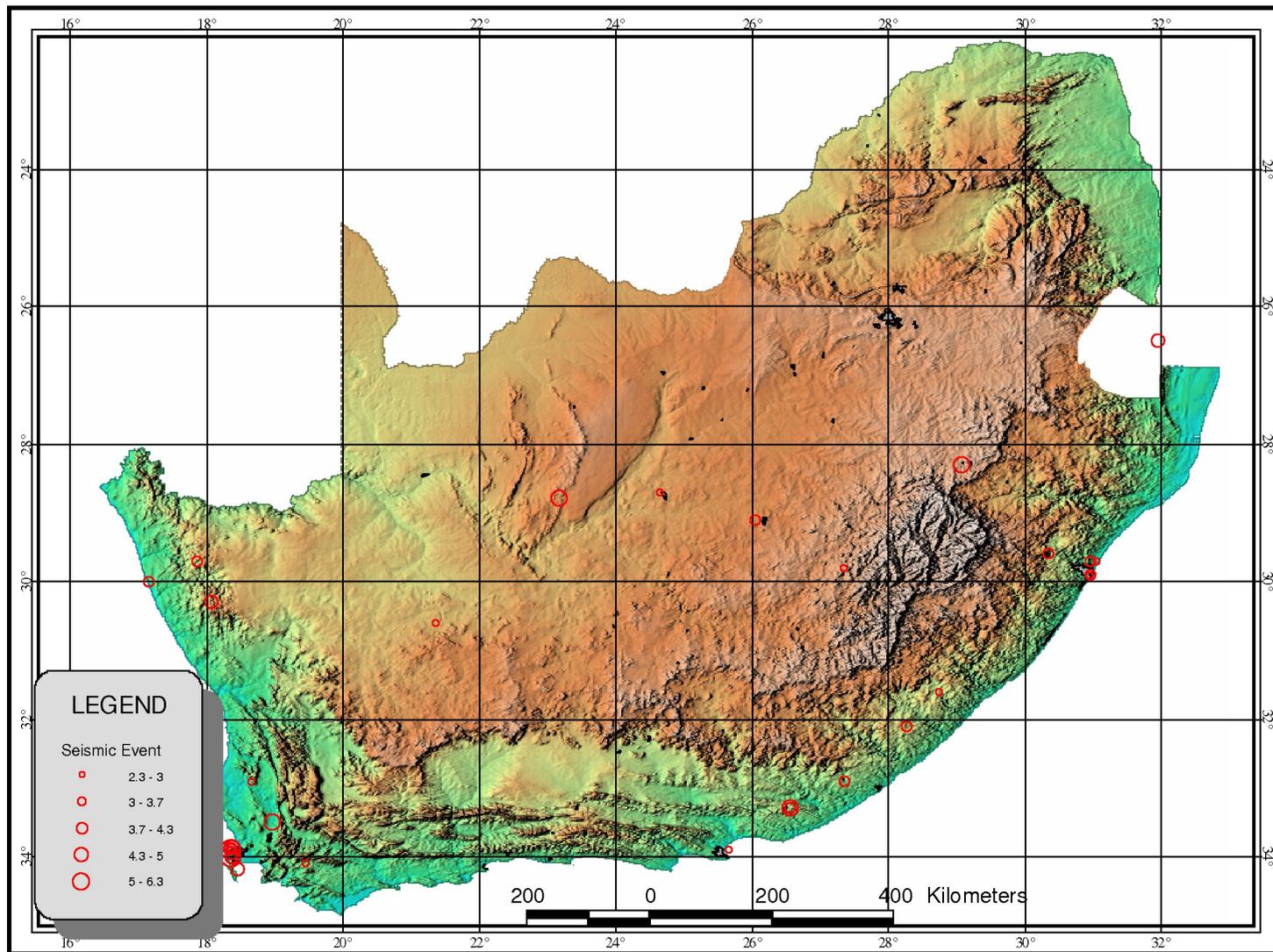


Figure 1: Map showing the distribution of historic seismicity for South Africa.

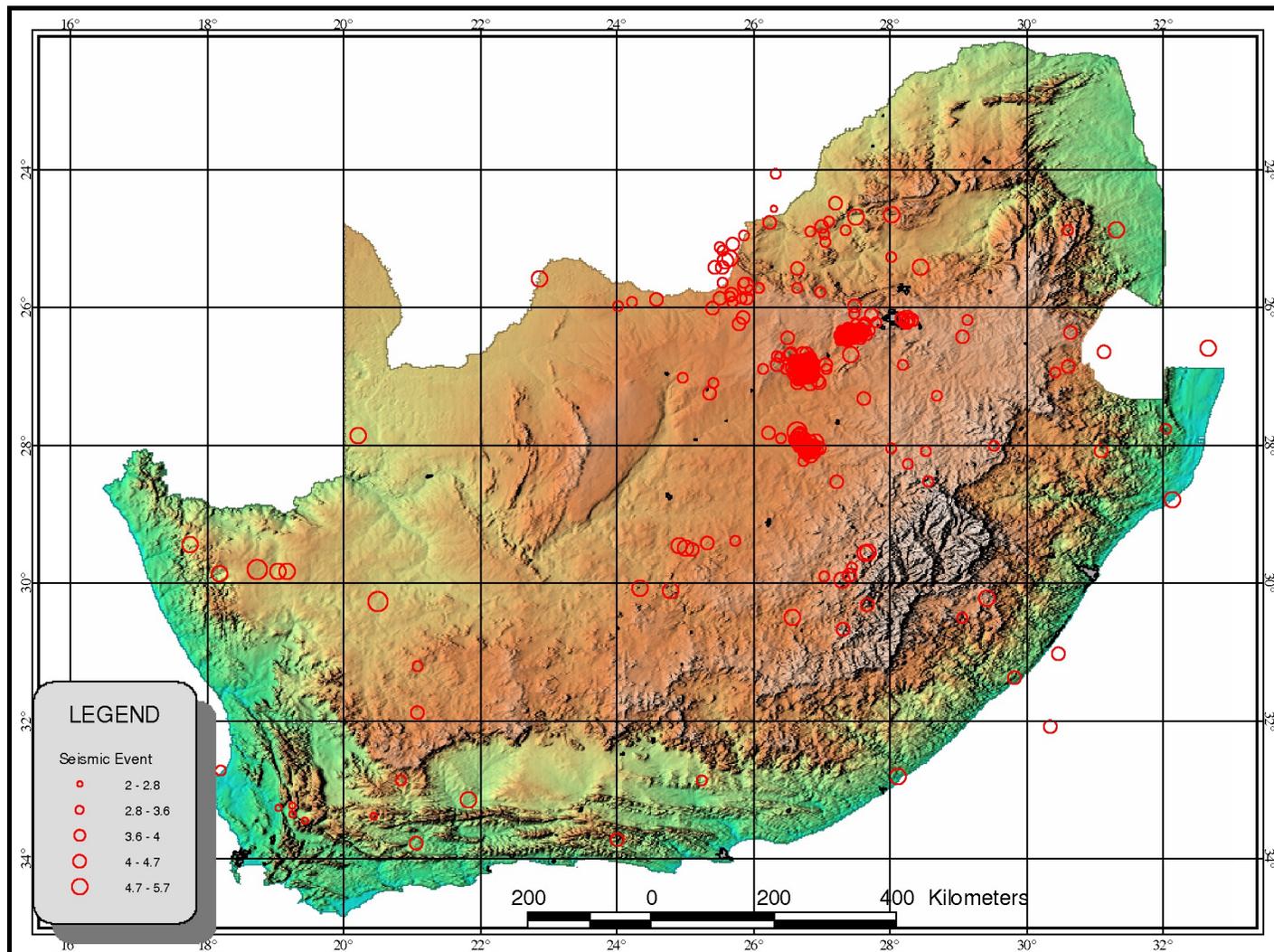


Figure 2: Seismicity of South Africa for the period January 1990 to March 2005 indicating all seismic events of local Richter magnitude equal to 3.5 and greater.

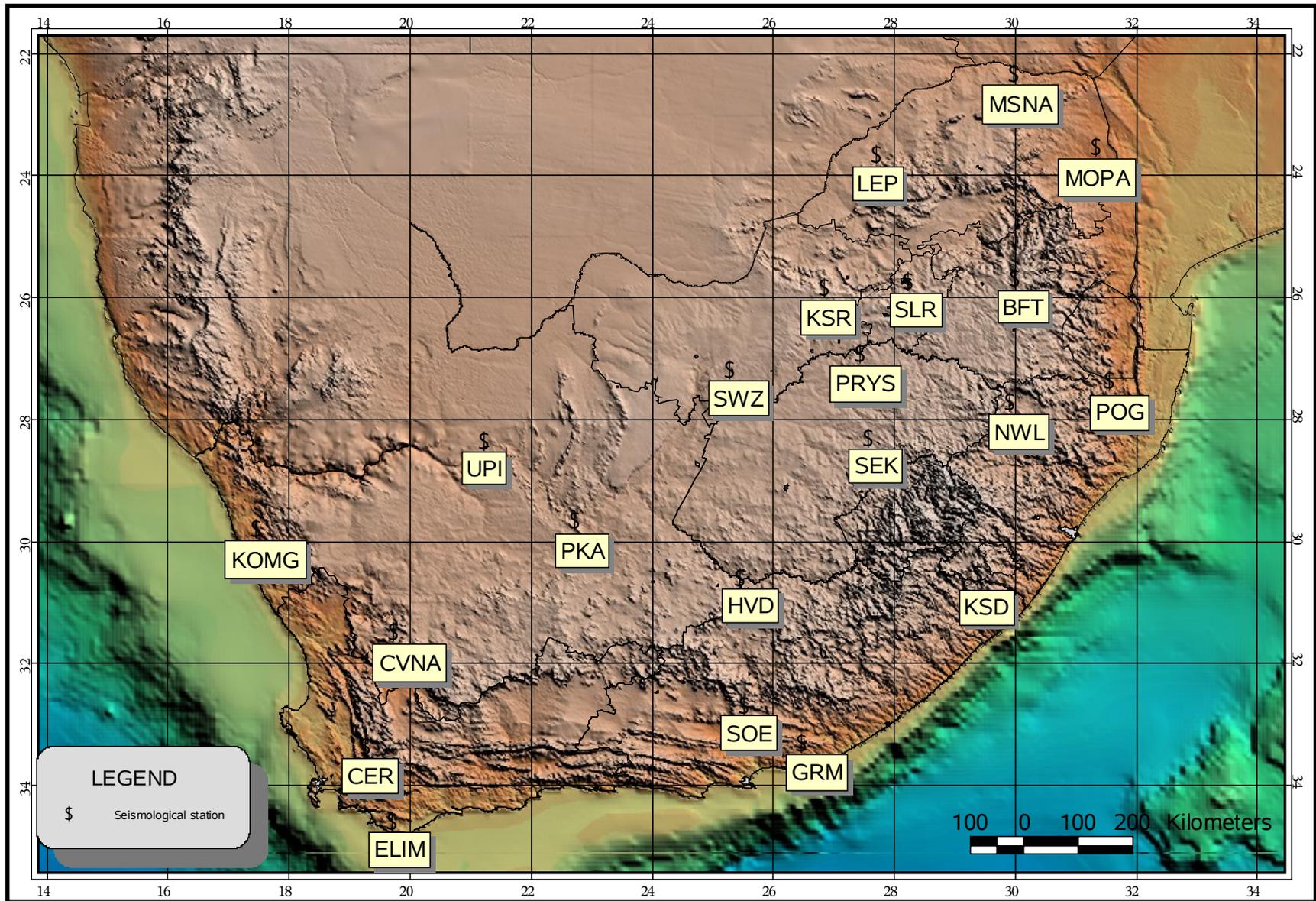


Figure 3: Map showing the layout of the South African National Seismological Network.