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Scientific Technical Report STR14/12 - Data
GIPP Experiment- and Data Archive

www.gfz-potsdam.de

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Recommended citation:

Ryberg, T., Haberland, C., Weber, M., Jokat, W., Behrmann, J., Gassner, A. (2014), LISPWAL: Lithospheric structure of the Namibian continental passive margin at the intersection with the Walvis Ridge from amphibious seismic investigations; November 2010 – January 2011, Namibia. *Scientific Technical Report 14/12 - Data, GFZ German Research Centre for Geosciences*.
doi: 10.2312/GFZ.b103-14122.

Imprint

Helmholtz Centre Potsdam
GFZ German Research Centre for Geosciences

Telegrafenberg
D-14473 Potsdam

Published in Potsdam, Germany
October 2014

ISSN 1610-0956

DOI: 10.2312/GFZ.b103-14122
URN: urn:nbn:de:kobv:b103-14122

This work is published in the GFZ series
Scientific Technical Report (STR)
and electronically available at GFZ website
www.gfz-potsdam.de

LISPWAL: Lithospheric structure of the Namibian continental passive margin at the intersection with the Walvis Ridge from amphibious seismic investigations November 2010 – January 2011, Namibia

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Coordinates: -18.722 S 12.646 E
Supplementary data: 10.5880/GIPP.201019.1

Abstract

Seismic Data, including raw, MSEED and SEG-Y files, of the large-scale controlled-source survey in Northern Namibia (Kaokoveld) using combined on- and offshore experiments.

Keywords: Geophysics, controlled-source seismic survey, onshore, offshore, continental margin, Namibia

1. Introduction

Passive continental margins offer the unique opportunity to study the processes involved in continental extension and break up as well as the role of hot-spot related magmatism. We conducted combined on- and offshore seismic experiments in Northern Namibia designed to characterize the Southern African passive margin at the interaction with the Walvis Ridge, to assess the interaction of the presumed plume with continental lithosphere and to determine the deep structure of the transition from the coastal fold belt to the stable craton, where the Walvis Ridge hits the African continent. The seismic project integrated three experiments, (**A**) an onshore, coast-parallel refraction seismic profile, (**B**) two onshore-offshore wide-angle seismic transects, and (**C**) a combined on- and offshore seismic experiment to image the sub-Moho velocity (Pn tomography) at the ocean-continent transition (Fig. 1). The knowledge of the lithospheric structure of the margin together with results from other geoscientific studies (e.g., conducted within the SPP-SAMPLE, DFG Priority Program 1375, South Atlantic Margin Processes and Links with onshore Evolution) will help to address fundamental questions such as, how continental crust and plume head interact, what the extent and volumes of magmatic underplating is, and how and which inherited (continental) structures might have been involved and utilized in the break-up process.

2. Data Acquisition

2.1 Experiment design and schedule

Between November 2010 and January 2011 we conducted an extensive seismic experiment in Northern Namiba, in the Kaokoveld. Along 3 seismic lines with a total length of more than 900 km, we deployed 200 seismic sensors and data loggers (Fig. 1). The average spacing of the instruments was ~3 km along the coast-parallel line and ~6 km along the other lines, running NE-SW and SE-NW. The data loggers had been equipped with a short-period seismic sensor, recording the vertical ground motion and a battery pack, suitable for continuous data recording of >6 weeks. The instruments were placed in shallow holes and covered by sand, leaving the logger surface clear for GPS reception. At the eastern ends of the lines, the instruments were deployed in somewhat hidden places to avoid instrument damage or theft.

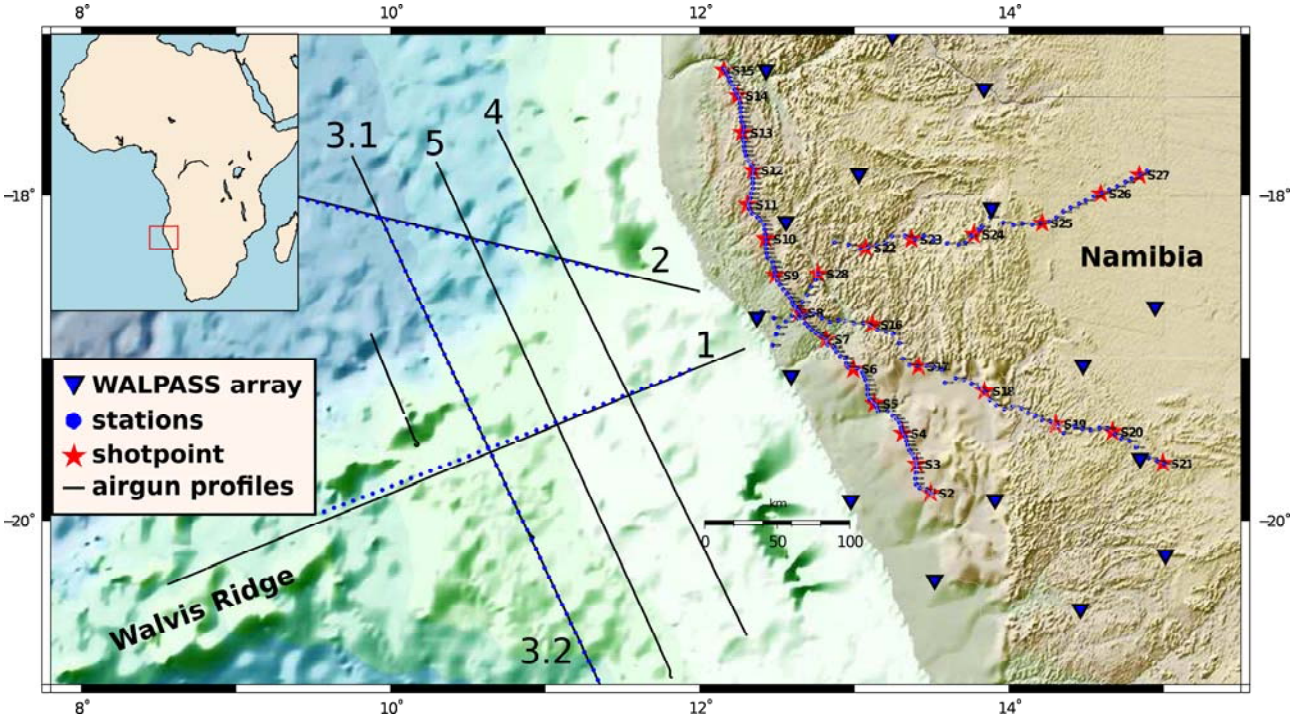

Figure 1: Map of the study region in Northern Namibia involving three seismic profiles along the coast, NE-SW and SE-NW running. Onshore shot points and stations are marked as red stars and blue dots, respectively. Additionally, the offshore airgun profiles (1, 2, 3.1, 3.2, 4 and 5) and the Ocean Bottom Seismic stations are shown. The temporary WALPASS seismic array is indicated by blue triangles.

Every shot location consisted of several (2-4) boreholes (~25m deep) which had been drilled directly along the existing tracks to minimize the environmental impact. By mid-December 2010 the drilling of the boreholes was finished.

In early December 2010 all seismic stations had been deployed, and blasting could start. By that time, the German research vessel MS Merian had deployed 40 Ocean Bottom Seismic stations (OBS) and started to shoot and record >15,000 airgun sources. These airguns were also been recorded on land (>400 km distance), to facilitate combined on- and offshore measurements, thus densely sampling the Earth's crust and upper mantle.

The charge size varied from 250 to 600kg explosives. The holes were loaded, several meters of stemming added, then blasted. The exact blasting time (important for the seismic interpretations) was measured with special equipment. After the first 14 shots, we stopped the blasting operations and conducted a service trip. The stations were left in the field to record the airgun shots from the

MS Merian. During the second period of the seismic experiment in January 2011, the remaining 13 shots were carried out with similar results.
Unfortunately, during the field work 8 of the 200 seismic stations (data loggers and sensors) were lost. In the western region (Skeleton coast and surroundings) some of the stations were damaged by animals, and some cables were destroyed (see master_landshots).

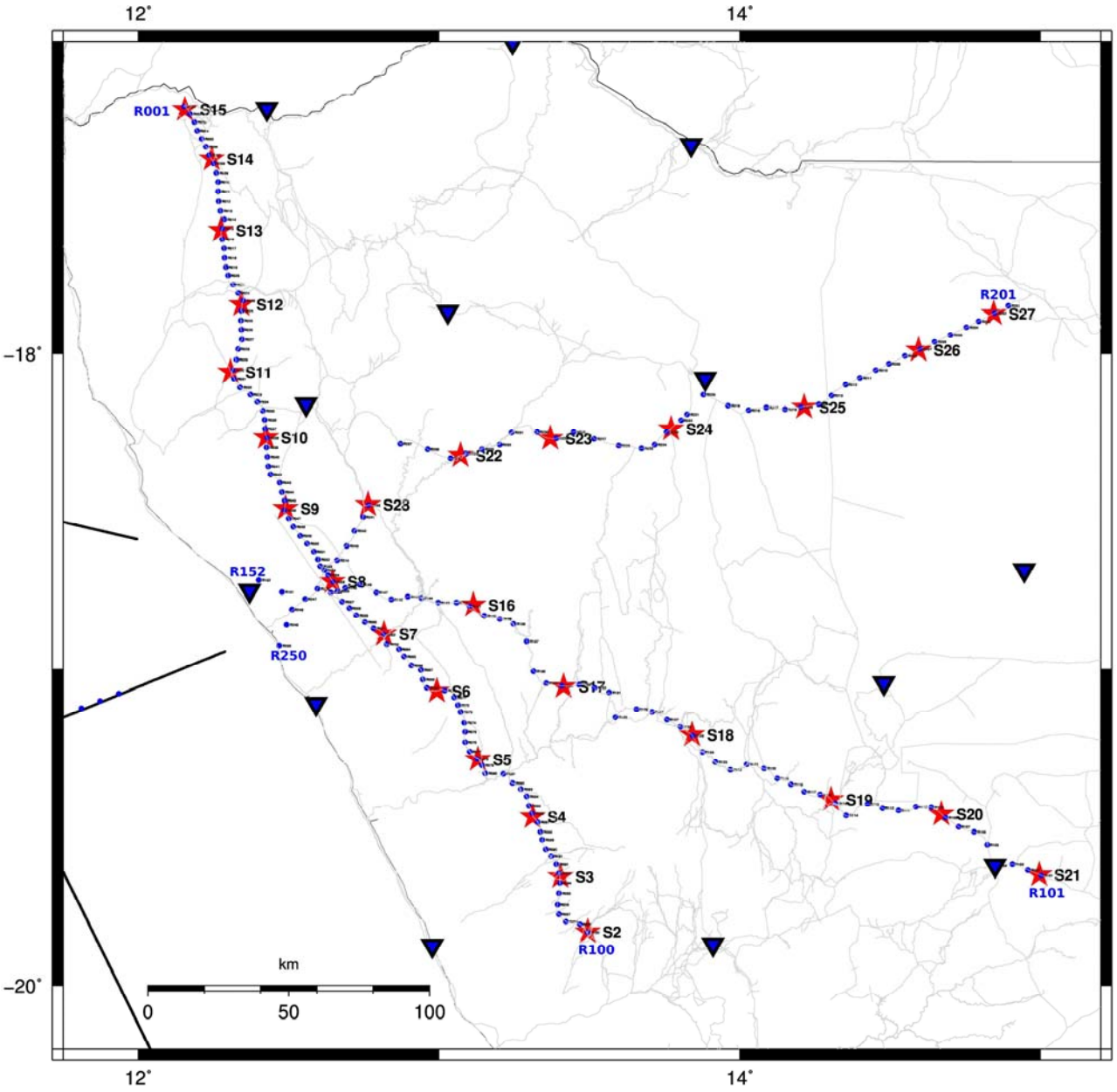

Figure 2: Location of the onshore shots shown as red stars. Stations are marked as blue dots and the start and end shots of each line are denoted, respectively. The WALPASS array is indicated by blue triangles.

2.2 *Geometry/Location*

The shot coordinates and charging sizes are listed below. The location information of the 200 onshore stations can be find in file master_landshots.dat.

Shot number	Latitude	Longitude	Elevation (m)	Date	UTC Time	Charge size (kg)
S2	-19.830248	13.4938507	692	2011-01-10	11:43:04.524	600
S3	-19.654799	13.4026431	674	2011-01-10	14:27:29.074	500
S4	-19.465472	13.3108952	623	2011-01-10	16:25:55.639	600
S5	-19.28491	13.12886	379	2010-12-05	07:24:35.863	300
S6	-19.06842	12.99265	681	2010-12-05	09:48:10.059	250
S7	-18.88929	12.81621	221	2010-12-05	12:46:47.959	250
S8	-18.722718	12.6459953	455	2011-01-09	14:30:45.651	400
S9	-18.4895	12.48895	416	2010-12-05	15:59:04.652	250
S10	-18.26631	12.42424	593	2010-12-06	06:05:16.798	250
S11	-18.05751	12.30596	670	2010-12-06	08:37:01.700	250
S12	-17.84202	12.34204	777	2010-12-06	10:25:03.638	300
S13	-17.60607	12.27479	900	2010-12-06	12:47:36.608	375
S14	-17.3798	12.24401	635	2010-12-06	14:39:11.545	400
S15	-17.21856	12.1539	349	2010-12-07	06:18:02.203	500
S16	-18.796039	13.1132593	419	2011-01-08	14:17:58.441	350
S17	-19.054125	13.4132802	583	2011-01-08	11:28:12.253	300
S18	-19.20714	13.84091	670	2011-01-08	08:27:58.661	375
S19	-19.411087	14.3027136	1025	2011-01-07	12:52:46.253	375
S20	-19.457196	14.6698252	1317	2011-01-07	10:13:24.973	375
S21	-19.649233	14.9952239	1246	2011-01-07	07:49:58.942	375
S22	-18.32195	13.07126	639	2010-12-07	15:51:02.821	250
S23	-18.26827	13.36916	848	2010-12-08	11:01:12.404	250
S24	-18.23873	13.77067	1401	2010-12-08	13:24:39.068	300
S25	-18.16939	14.21317	1246	2010-12-08	17:11:16.912	300
S26	-17.98748	14.59379	1138	2010-12-09	11:05:59.600	300
S27	-17.87123	14.84399	1113	2010-12-09	13:56:25.651	375
S28	-18.479114	12.7638736	610	2011-01-09	10:14:14.475	350

2.3 Instrumentation

We used 200 seismic dataloggers (CUBEs, see http://www.gfz-potsdam.de/en/research/organizational-units/departments/department-2/geophysical-deep-sounding/servicesinfrastructure/geophysical-instrument-pool-potsdam-gipp/instruments/seismic-pool/recorder-dss-cube/ or http://www.omnirecs.de/) with a vertical component geophone having a eigenfrequency of 4.5 Hz. The dataloggers recorded continuously at 100 samples per second.

2.4 Acquisition parameters

Parameter	Value
Number of onshore profiles	3
Length of each onshore profile	Along the coast: ~320 km NE-SW: ~280 km NW-SE: ~290 km
Sensor spacing	Along the coast: ~3 km Other lines: ~6 km
Shot spacing	~20-40 km
Sampling rate	100 Hz
Acquisition length	Continuous recordings
Number of offshore profiles	6
Length of each offshore profile	>400 km

3. Data Pre-Processing

The data set was preprocessed at the GFZ in Potsdam. Time series for the 27 shots and >15,000 airgun shots were cut out from the continuously recorded data stream of the data loggers, and consequently converted to the commonly used data format SEGY. Beside the raw data, continuous MSEED data are also provided and can be found in MSEED.

4. Data Description

For each seismic line, one SEG-Y file contains the recordings of all receivers and all sources along the respective line, where land and airgun shots are separated.

4.1 File formats

We provide three file formats: raw, SEG-Y and MSEED data**.** Only minimal information is set in the SEG-Y headers:

All SEG-Y files have a length of 120 sec, starting at -10 sec and are time reduced by V_{red} = 8 km/s. For the airgun recordings, the SEG-Y files have a length of 25 sec, starting at time 0 and are also time reduced by V_{red} = 8 km/s.

Seismic Unix Header	Byte Position	Byte Length	SEG-Y	Comment
fldr	009-012	4	Shot point number	2-28 for the land shots and 1-2011 for profile airguns_line01, etc. of the airgun shots
tracf	013-016	4	Station numbers	1-152,201-250 for the onshore stations
offset	037-040	4	Source-receiver distance	
gelev	041-044	4	Receiver elevation	
selev	045-048	4	Source elevation	For the airgun shots, this is the water depth

4.2 Data content and structure:

File name	Shots	Size	Acquisition date	Comment
SEGY/Onshore/landshots.segy	2-27	338MB	26.11. - 04.12.2010	all lines
Airgun shot files are sorted by land receivers (see Fig. 2)				
SEGY/Offshore/l01_1-49.segy	2011	911MB	08.-10.1.2011	Line 1
… /l01_50-100.segy		943MB		
… /l01_101-152.segy		840MB		
… /l01_201-250.segy		806MB		
SEGY/Offshore/l02_1-49.segy	2702	1.3GB	16.-18.12.2010	Line 2
… /l02_50-100.segy		1.3GB		
… /l02_101-152.segy		1.3GB		
… /l02_201-250.segy		1.1GB		
SEGY/Offshore/l31_1-49.segy	2697	1.2GB	05.-08.12.2010	Line 3.1
… /l31_50-100.segy		1.3GB		
… /l31_101-152.segy		1.2GB		
… /l31_201-250.segy		1.2GB		
SEGY/Offshore/l32_1-49.segy	2464	761MB	10.-12.12.2010	Line 3.2
… /l32_50-100.segy		1.1GB		
… /l32_101-152.segy		1.1GB		
… /l32_201-250.segy		919MB		
SEGY/Offshore/l04_1-49.segy	3126	1.5GB	25.-27.12.2010	Line 4
… /l04_50-100.segy		1.5GB		

… /l04_101-152.segy		1.4GB		
… /l04_201-250.segy		1.3GB		
SEGY/Offshore/l05_1-49.segy	2487	1.2GB	13.-15.12.2010	Line 5
… /l05_50-100.segy		1.2GB		
… /l05_101-152.segy		1.2GB		
… /l05_201-250.segy		1.1GB		
Raw data sorted by cube number (see INFO/Onshore/master_landshots.dat)				
RAW/cube-xxx				
MSEED data not sorted, but contain all on/offshore shots				
MSEED/xxx.pri0				
INFO/Onshore/master_landshots.dat				Station geometry
INFO/Offshore/airguns_line01				Shot geometry line 1
INFO/Offshore/airguns_line02				Shot geometry line 2
INFO/Offshore/airguns_line31				Shot geometry line 3.1
INFO/Offshore/airguns_line32				Shot geometry line 3.2
INFO/Offshore/airguns_line04				Shot geometry line 4
INFO/Offshore/airguns_line05				Shot geometry line 5

5. Data Quality/Accuracy

Generally, the data quality (Signal-to-Noise ratio) and the GPS timing of the data is good.
All blasting operations went smoothly, except for the three north-eastern most shot locations, no blowouts occurred. In addition to our controlled-source events, we recorded many local tectonic events.

6. Data Availability/Access

Data is archived at the *GIPP Experiment and Data Archive* where it is freely available for further use. The DOI number of the supplementary data is: 10.5880/GIPP.201019.1 When using the data, please give reference to this data publication as:

> Ryberg, T. , Haberland, Ch, Weber, M.H., Jokat, W. , Behrmann J. and Gassner, A. (2014) LISPWAL: Lithospheric structure of the Namibian continental passive margin at the intersection with the Walvis Ridge from amphibious seismic investigations, November 2010 – January 2011, Namibia, Scientific Technical Report STR Data 14/12, DOI: 10.2312/GFZ.b103-14122; Potsdam.

Acknowledgments
We thank the Geological Survey of Namibia for their support of this experiment. Thanks to the GSN, the temporary importation of the seismic equipment and the actual field work could be carried out without any problems, especially due to the permits provided by the Geological Survey. The drill contractor Daniel van Rhyn and blasting contractor Enid Lee also conducted an excellent and job. Funding was provided by the DFG and GFZ. Instruments were provided by GIPP.

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ISSN 1610-0956