

EAGLE

Ethiopia – Afar Geoscientific Lithospheric Experiment

EAGLE phase II: Rift Valley Array
October 2002 – February 2003

Huddle Test and Deployment Report

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A project in collaboration with Addis Ababa University and University of Leeds

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1) Introduction

EAGLE (Ethiopia Afar Geoscientific Lithospheric Experiment) is a three-part project designed to probe lithospheric structure beneath an active rift zone. The Main Ethiopian Rift displays transition from continental to oceanic style rifting, a characteristic that makes the region a perfect laboratory for the study of continental break-up and ocean formation. British participation within EAGLE includes the Universities of Leeds, Leicester and Royal Holloway. Stanford University and University of Texas – El Paso are the American participants. The University of Addis Ababa and Geological Survey of Ethiopia are the local institutions also involved in the project. The experiment is permissioned by the Ethiopian Science and Technology Commission.

1.1) EAGLE phase II

The second experiment within EAGLE, referred to as the Rift Valley Experiment, involved the deployment of fifty Guralp 6TD seismometers over an area within the rift valley from Shashamene in the south to Melka Werer in the north (Fig.1). The Rift Valley array lies within the broader EAGLEI array, which itself lies within the Penn State array deployed in 2000-2002, thereby providing a telescoping view of breakup processes (Fig.2). The specific aims of EAGLEII are 1) to assess the seismic and volcanic hazards of the region; 2) to assess the relationship between the magmatic segmentation observed at the surface and crust and/or upper mantle thickness variations, allowing us to differentiate between current models for breakup; 3) evaluate the distribution of strain across and along the rift zone, and its variation with depth; 4) to evaluate the kinematics of the Main Ethiopian rift and southernmost Red Sea rift intersection.

The Rift Valley array was designed to a) provide good areal coverage of the volcanically active central rift valley for a Pn tomography study, to be integrated with the Leeds teleseismic tomography study; b) provide adequate coverage of local earthquake swarms detected in 2001 by the Leeds array (EAGLEI); and c) to provide longer-term monitoring needed for anisotropy studies along the across- and along-rift refraction profiles (EAGLEIII). The Rift Valley array remained in place until late February 2003.

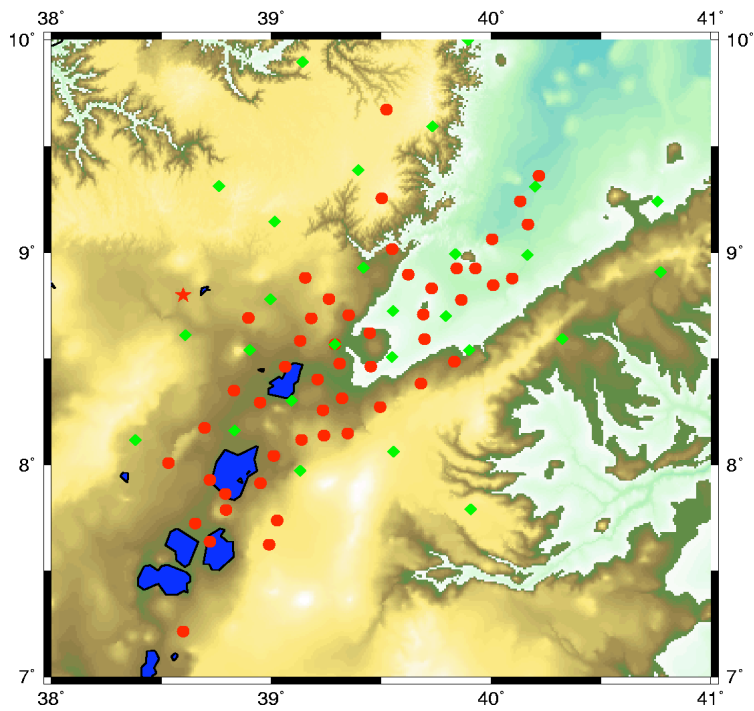
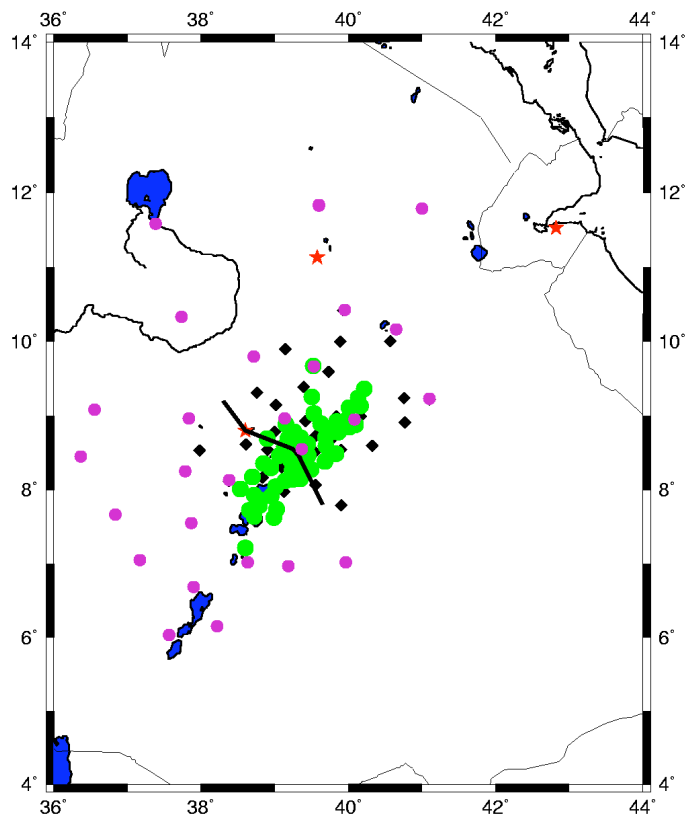


Figure 1. Topography of the northern Main Ethiopian rift with rift valley lakes displayed in blue. Red circles are the positions of Rift Valley Experiment (EAGLE phase II) seismic stations. Green diamonds show distribution of the EAGLE phase I array. The red star represents the location of the FURI seismic station near Addis Ababa.

East Africa stations

Figure 2. Locations of permanent (red stars), Penn State (purple dots), Leeds (black), and Rift Valley (green) broadband seismic stations operative in NE Africa during the period 2000-2003. The bold black line is the UK refraction profile shot in 2003. An along-axis profile (not shown) was also shot in 2003.



2) Site Permissioning

The locations of Rift Valley Experiment array seismic stations were initially determined during the preparation and deployment of EAGLE phase I, late 2001. Advice was sought from Addis Ababa University and the Geological Survey of Ethiopia. Fenced and guarded compounds such as schools, plantations, farms, national parks and private residences (Fig.3) were targeted. Single sites also included a clinic, a radio repeater station, a geothermal power plant, construction company road camp and a Geological Survey of Ethiopia storage facility. Dr. Graham Stuart and Prof. Cynthia Ebinger officially acquired the relevant permission documentation for the Rift Valley Experiment array sites from Federal, Regional, District and Farming Association (Kebele) offices in September 2002. Addis Ababa University also compiled letters to schools directors, plantation and farm managers, clinic doctors and landowners. Dr Graeme MacKenzie permissioned four sites that were positioned along profile 1 of EAGLE phase III. The site permissioning process was completed in three weeks, with field assistance from Ms Yodit Teferi, Ashanafi Tesfaye, and Dr Dereje Ayalew. Dr Laike Asfaw, Dr Atalay Ayele and Mrs Asnakech Estifanos of the Geophysical Observatory, Addis Ababa University, provided essential technical and logistical assistance.

3) Huddle Test I

3.1) Procedure

The first consignment of seismic equipment was cleared through customs in Addis Ababa over a period of two weeks in late September. The first group of 30 seismometers, solar panels, GPS modules and Sun Blade 1000 computer with accessories shipped by Guralp were delivered to the Science and Technology Equipment Centre on 30 September 2002.

Dr. A. Brisbane directed the first Huddle Test. Cindy Ebinger, Derek Keir, Ian Bastow, Jon Pollatos and Sarah Swindley also participated. All seismometers were unpacked, levelled and cables with batteries, GPS modules appropriately connected. Palm pilots that ran SHOUT software were used to check seismometer mass positions, software setup parameters, recorded signal and GPS fix (Table B1). A GPS antenna was positioned on the Science and Technology Equipment Centre roof, with GPS repeater inside the Huddle Test room. Seismometers were arranged in a semi-circle about the repeater. All instruments were set to sample at 100 and 5 s/s

and to seek a GPS fix every hour. Guralp firmware version of all seismometers was set to v.128. The instruments recorded overnight 30 September – 1 October and the data downloaded onto portable disks and analysed on the Sun Blade. All firewire cables (used to extract data from seismometer to portable disk) were tested during data extraction. Details of the huddle test were recorded (Appendix A). The first shipment had a failure rate of 6.7% (**T6184, T6207**).

3.2) Problem Summary

The following problems were identified from palm pilot tests and analysis of extracted data. Seismometers **T6184** and **T6207** had anomalously high mass positions MA. **T6184** was unable to record motion in the N-S horizontal direction. The instrument's auto-centre functions was thus disabled and the seismometer utilised as a vertical motion recorder. A number of stations exhibited discontinuous GPS locks. The offending instruments were set to seek a continuous GPS fix upon deployment. The air bubble within the spirit level of seismometer **T6168** was oversized and it enlarged during the course of the experiment.

4) Huddle Test II

4.1) Procedure

The second consignment of seismic equipment was delivered to the Science and Technology Equipment Centre on 8th October 2002. Cindy. Ebinger, Alex Brisbane, Derek Keir and Sarah Swindley participated in the second huddle test. All seismometers were connected to batteries and GPS modules on 9th October 2002. The seismometers were initially checked while still packed. This setup did not allow the instruments to be sufficiently levelled and the seismometers were thus subsequently unpacked and levelled on the huddle test room floor. As before, the instruments were arranged in close proximity to the GPS repeater. The seismometers recorded overnight and the data analysed the following day on the Sun Blade. Unfortunately, details of the second huddle test were not all entered into the spreadsheet by S.Swindley, and no further details could be discovered after she terminated her studentship.

4.2) Problem Summary

Seismometer **T6194** had an anomalously high mass position M8 and was unable to record vertical motion at the huddle test. This station operated when deployed at E63: Dawero. Seismometer

T6204 was unable to record motion in the N-S horizontal direction. Sarah Swindley did not check that all instruments ran firmware version v.128. Three instruments were found to run the wrong software upon deployment.

5) Deployment

5.1) Personnel

The following geoscientists were directly involved in the deployment of Rift Valley Experiment seismic stations:

Mr Derek Keir, Royal Holloway University of London

Miss Sarah Swindley, Royal Holloway University of London

Dr Alex Brisbourne, SEIS-UK, University of Leicester

Mr Ian Bastow, University of Leeds

Mr Jon Pollatos, University of Leeds

Mr Ewenet Gashaw-Beza, Southern States Council Water and Mines Department

Mr Ashanafi Tesfaye, Addis Ababa University

5.2) Equipment

The materials required to deploy the Rift Valley Experiment seismic stations were acquired from various sources. The following items required to deploy for each station were loaned from SEIS-UK:

Guralp CMG-6TD seismometer

Guralp breakout boxes

Guralp GPS modules

BP Solar solar panel

Sonnenschein 12V/10Ah Dryfit500 battery

Seismic station cables

Tools: spanners, wire-cutters, hammers and spade

Consumables: electrical tape, cable ties, plastic bin liners, nails, AAA battery

Palm pilot

In addition, various materials were purchased in Ethiopia:

5cm diameter wood poles for fence and solar panel posts

4cm diameter plastic conduit

Chicken and barbed wire

Further equipment was also required:

Compass

Garmin GPS 2

Deployment sheets and writing instrument

Laptop computer with Scream 3.1

5.3) Procedure

Upon arrival at a chosen site a 50cm diameter, 70cm deep pit were created to house the seismometer. A thin layer of loose soil covered the base of the hole. The seismometer was prepared for deployment on the back seat of the Toyota Landcruiser. The sensor feet were fully retracted and locked, the firewire cable connected and the instrument placed within a plastic bin liner. The associated breakout box, battery and firewire cable were placed in a separate plastic liner. The seismometer was placed within its host excavation, aligned with magnetic north and levelled. At this stage soil was compressed around the lower 20cm of the seismometer.

A second pit of 40 cm diameter and 10 cm depth was created in close proximity to the seismometer. The breakout box, battery and firewire cable (all covered by a single plastic bin liner) were positioned within the excavation. A 10cm diameter, 30 cm deep pit was required to support the solar panel and GPS pole. This was positioned approximately 1m north of the seismometer. The solar panel surface dipped south and its associated cables led to the breakout box within a length of plastic conduit. The GPS module and associated cable was attached to the pole. The breakout box to seismometer cable and firewire cable were buried under a moderate depth of soil.

The seismometer mass positions, software setup and recorded signal were checked via the data port of the breakout box using a palm pilot that ran SHOUT software. Once the station was fully operational the buried equipment was fully covered with local soil. The position of the seismic station was recorded in UTM and Cartesian co-ordinates using the Adindan and WGS-84 datum respectively. The SEIS-UK 6TD deployment sheet was duly completed. The majority of Rift Valley Experiment seismic stations were protected by chicken wire fence. Barbed wire was also utilised on occasion and several sites were chosen within fenced weather stations. Where available, acacia branches were placed amongst the fence for added protection. Unfenced sites were deemed adequately guarded upon deployment.

5.4) Timetable

The majority of Rift Valley Experiment seismic stations (Table.1) were deployed in early October 2002, during which each of two to three teams deployed ~4 stations per day. Two stations were added to the array in mid-November 2002.

Table 1. Deployment Details and Station Locations

DEPLOYMENT DETAILS

SITE No	SITE NAME	SERIAL No	LAT N		LONG E	ELEV	START DATE	GRID N	GRID E	COMMENTS
			WGS84							
					Meters	Adindan				
E31	ABADIR FARM	T6182	8.77735	39.86439	1009	04/10/2002	0594978	0970138		
E32	NATIONAL PARK HQ	T6191	8.84591	40.00907	976	04/10/2002	0610870	0977849		
E33	FENTALE SOUTH	T6193	8.92552	39.92904	979	05/10/2002	0602044	0986539	Continuous gps	
E34	SHASHEMENE	T6201	7.21431	38.59894	1934	16/10/2002	0455631	0797253		
E35	AWASH ARBA	T6177	9.13363	40.16815	846	04/10/2002	0628264	1009628	Cntsgps , repeat flush	
E36	HOT SPRINGS	T6199	9.06275	40.00486	770	05/10/2002	0611276	1006703	Continuous gps	
E37	MUKIA SCHOOL	T6063	8.17437	38.69635	1799	17/10/2002	0466460	0903379		
E38	ELALA CLINIC	T6181	8.92527	39.84319	1011	08/10/2002	0592608	0986492	Continuous gps	
E39	MELKA SEDI	T6198	9.24151	40.13336	770	04/10/2002	0624397	1021543	Continuous gps	
E40	MELKA WERER	T6167	9.36161	40.21721	743	04/10/2002	0633571	1034855	Continuous gps	
E41	KOSHE	T6224	8.00959	38.53251	1905	16/10/2002	0448392	0885177	Broken E	
E42	KEREYOU LODGE	T6189	8.87904	40.09608	1057	04/10/2002	0620428	0981448		
E43	ILEKASE	T6159	9.25490	39.50255	3294	11/10/2002	0555076	1022864	autoC off, v.123	
E44	DEBRE BIRHAN	T6211	9.67218	39.52489	2058	10/10/2002	0557583	1069214		
E45	ALUTO	T6220	7.78810	38.79476	1932	16/10/2002	0477279	0860670		
E46	MEKI DELA	T6179	8.70903	39.69090	1242	05/10/2002	0575909	0962547	Continuous gps	
E47	BOFA	T6212	8.46487	39.45321	1448	07/10/2002	0549795	0935514		
E48	EGO	T6160	7.62393	38.99066	2613	22/10/2002	0498878	0842516	v.123	
E49	DERA	T6170	8.31443	39.32120	1711	09/10/2002	0535275	0918867		
E50	SIRE	T6169	8.27388	39.49581	2074	09/10/2002	0554511	0914398		
E51	HURUTA	T6197	8.14852	39.34777	2080	15/10/2002	0538217	0900529		
E52	ITEYA	T6207	8.13799	39.24048	2200	09/10/2002	0526399	0899354	Broken N	
E53	OGOLCHA	T6079	8.04329	39.01137	1704	17/10/2002	0501160	0888876		
E54	DANISA	T6200	8.11816	39.13849	2084	15/10/2002	0515165	0897159		
E55	ALEM TENA	T6222	8.29503	38.94925	1683	18/10/2002	0494318	0916707	Broken N	
E56	EJERSA	T6012	8.46218	39.06369	1637	15/10/2002	0506912	0935189		
E57	MOJO	T6188	8.58484	39.13200	1823	07/10/2002	0514434	0948736		
E58	GOGLI	T6162	8.69088	39.18257	2057	09/10/2002	0519989	0960473		
E59	WEST WOLENCHITI	T6195	8.70586	39.35161	1680	05/10/2002	0538585	0962144		
E60	NE BOSETTI TRACK	T6166	8.62155	39.44879	1626	09/10/2002	0549287	0952836		
E61	MELKA JILO	T6176	8.89741	39.62286	1155	05/10/2002	0568384	0983360	Continuous gps	
E62	KONE	T6186	8.83132	39.73014	1443	8/10/2002	0580197	0976076		
E63	DAWERO	T6194	8.25883	39.23508	1781	14/10/2002	0526891	0912837		
E64	NAZRET	T6196	8.56798	39.29068	1753	07/10/2002	0531891	0946894		
E65	WONJI SHOA FARM	T6165	8.40305	39.21144	1550	10/10/2002	0523184	0928654		
E66	AROGI MINJAR	T6088	9.03260	39.52997	1727	26/11/2002	0558154	0998292		
E67	ARBOYE I	T6168	8.38443	39.68104	2144	08/10/2002	0574887	0926656	Bubble level	
E68	EJERE	T6161	8.78207	39.26278	2290	09/10/2002	0528909	0970766	Continuous gps	
E69	ZIWAY	T6037	7.92965	38.72161	1675	15/10/2002	0469220	0876332		
E70	TULU DIMTU	T6097	8.88227	39.15440	2227	18/10/2002	0516885	0981636	Continuous gps	
E71	DIRE	T6164	8.69351	38.89554	1980	10/10/2002	0488416	0960763		
E72	ABOMSA	T6185	8.48714	39.83294	1577	08/10/2002	0591584	0938040	Continuous gps	
E73	LOLEE-ABOSERA	T6163	7.73750	39.02616	2496	22/10/2002	0502792	0855072		
E74	KILE DOYO	T6155	8.35644	38.84563	1724	27/11/2002	0482910	0923498	v.110, no flush	
E75	KIYENSHO SCHOOL	T6192	7.91412	38.95121	1745	21/10/2002	0494525	0874591		
E76	BULBULA	T6217	7.72455	38.65370	1674	16/10/2002	0461718	0853651		
E77	CHEFE JILA	T6202	7.86426	38.79136	1668	17/10/2002	0476908	0869091		
E78	MERTI	T6178	8.59315	39.69765	1220	07/10/2002	0576671	0949737	Continuous gps	
E79	LANGANO	T6204	7.63839	38.72161	1673	16/10/2002	0469315	0876450		
E80	ADULALA KOSHE	T6184	8.47814	39.31056	1655	07/10/2002	0534088	0936953	Broken N	



Figure 3. Station E58: Gogli was within a private residence compound

5.5) Problems

As noted at the huddle tests, seismometer **T6184** (E80: Adulala Koshe) was unable to record N-S component horizontal motion. Seismometer **T6207** (E52: Iteya) had an anomolous MA mass position at both huddle test and in the field. In addition, the N-S component of this instrument did not function in the field. Upon deployment **T6222** (E55: Alem Tena) was also unable to record N-S motion and **T6224** (E41: Koshe) unable to record E-W motion. These two seismometers were fully operational at huddle test II. Seismometer **T6204** could not record N-S motion at huddle test II but was fully operational upon deployment. Similarly, **T6194** could not record N-S motion at the huddle test but operated once deployed. In the field, **T6183** had a broken vertical component and was not deployed. The instrument was exchanged for **T6088** from EAGLE phase III. Instruments unable to record horizontal motion were installed to provide coverage required for the tomography study. They were placed in close proximity to EAGLE phase III stations.

Seismometers **T6159** (E43: Ilecase) and **T6160** (E48: Ego) ran firmware version v.123. Seismometer **T6155** (E74: Kile Doyo) ran version v.110. All three instruments were not adequately checked during huddle test II. The firmware version of **T6155** was duly changed to v.128 during a service run.

During service runs it was noted that two power regulators did not remain adhered to their solar panels. The solar panel deployed at E72: Abomsa had a faulty regulator and the panel was thus replaced. At deployment, seismometer **T6224** (E41: Koshe) was aligned north using a Garmin GPS. This technique was used due to the loss of the deployment team member's compass.

Numerous plastic bags that housed seismometers, batteries and breakout boxes suffered from water penetration. Seismometers deployed in black cotton soil suffered destabilisation after saturation from heavy rain. Station E36: Hot Springs suffered sulfurous water penetration of the break out box and battery, both of which were damaged.

A goat knocked over the solar panel at E67: Arboye, disconnecting the cable from the GPS module. The GPS cable connectors then corroded. Exposed cable connections to regulators and GPS modules were generally solid, the only exceptions being the disconnection of the solar panel to breakout box at E49: Dera and GPS cable to GPS module at E52: Iteya.

Seismometer **T6181** (E38: Elala clinic), with accompanying solar panel, GPS module, battery, breakout box and cables were stolen by Kereyou nomads in the Metehara area. Seismometer **T6186** and associated equipment was also removed from station E62: Kone. The seismometer (fully functional) and breakout box (broken) were recovered from Metahara police station in January 2002. Despite **T6186** suffering no apparent damage, it should be checked by Guralp upon return to the U.K. In summary, two solar panels, two batteries, one breakout box, two GPS modules and numerous cables were not recovered from the deployed Rift Valley Experiment array.

At station pick up a number of problems were encountered. **T6177** (E35:Awash Arba) required repeat flushes before data was successfully transferred to portable disk. Seismometers **T6169** (E50: Sire) and **T6063** (E37: Mukia) displayed the instrument name as Guralp CMG600 when communicated with using SHOUT. The gcf files extracted to Sun Blade 1000 scapa from these instruments were misnamed with the station serial number replaced by "GURALP". **T6155** (E74: Kile Doyo) could not be accessed using the palm pilot or laptop running Scream 3.1. The data from this seismometer could not be extracted in the field.

6) Equipment Problem Summary

6.1) Seismometers

The following seismometers suffered malfunctions at various stages of the Rift Valley Experiment.

Huddle Test:

T6184: MA 8 million, broken N

T6207: MA 8million

T6168: broken bubble level

T6194: M8 8.4million

Deployment and Service 2:

T6184: MA 9 million, broken N

T6207: MA 8million, broken N

T6222: MA 8.4million at deployment, broken N

T6224: M9 8.4million at deployment, broken E

T6183: broken V – not deployed

T6181: stolen

T6186: stolen

Service 3:

T6184: MA at 9million, broken N

T6207: MA at 5million, broken N

T6222: broken N

T6224: broken E

T6177: required repeat downloads for successful data extraction

T6155: ran v.110, changed to v.128 for successful flush

T6186: recovered and redeployed, must be checked by Guralp

Pick up:

T6169: reverted to GURALP CMG600

T6063: reverted to GURALP CMG600

T6155: could not access instrument or download data

T6177: required repeat downloads for successful data extraction

6.2) GPS Modules

The following GPS modules malfunctioned at the huddle tests but worked when deployed. G3033, G3008, G3007, G3009, G3025, G3006.

G3012 and G3007 were stolen from E62: Kone and E38: Elala clinic respectively.

Seismometer T6165: could not acquire a GPS fix despite the use of numerous modules, cables and breakout boxes

6.3) Solar Panels

Two panels suffered detached regulator boxes, one had a faulty regulator and were stolen with the two missing GPS modules.

6.4) Breakout Boxes

One breakout box was corroded, one broken and one stolen.

6.5) Batteries

Two batteries were stolen from E62 and E38

7) Recommendations

7.1) Huddle Test

A completed huddle test would have identified the three instruments that ran the incorrect firmware version.

7.2) Equipment

Barbed wire and acacia branches proved to be the most effective fence material. Plastic bin liners suffered water infiltration whereas heavyweight rubble sacks proved extremely effective in insulating buried equipment at stations with damp conditions. Black cotton soil was prone to

dramatic changes in texture when damp or dry. The use of sand may have improved station stability at such locations. Use of an equipment check sheet at the start of a deployment day may have identified the missing compass prior to arrival at site E41.

7.3) Deployment

Seismometer pits were generally excavated such that the top of the seismometer was 10-30cm below ground level. An increased depth of deployment may have prevented rainwater infiltration and reduced noise levels.

Acknowledgements

The EAGLE phase II experiment formed part of a much larger project that involved most geoscientific institutions in Ethiopia. The work was permissioned by the Science and Technology Commission and overseen by an advisory committee. Below are some of the large number of people that assisted in planning and implementation of this project:

Dr Laike Mariam Asfaw, Dr Atalay Ayele, Dr Bekele Abebe, Dr Dereje Ayalew, Dr Gezahegn Yirgu, Dr Tesfaye Korme, Dr Tesfaye Kidane, Ashanafi Tesfaye, Ewenet Gashaw-Beza, Dr Graeme Mackenzie, and Prof Peter Maguire.

Dr Christel Tiberi, Andy Page and Prof. Cynthia Ebinger participated in service runs. Eve Daly and Ian Bastow assisted in station pickup.

Toyota Landcruisers were rented from Addis Ababa University and Ethio-Der tour and Travel. Ethio-Der drivers involved in EAGLE phase II were Fitsum, Solomon, Eyaya, Jaffar, Berhanu and Alex. AAU drivers were Ato Mellassa, Ato Legessa, Mangasha, Hailu and Brahamu. Their assistance in station deployment and pickup was crucial.

Appendix A

1. SEIS-UK HUDDLE TEST

- Title of Project:** EAGLE phase II: Rift Valley Experiment
- Funding Agency:** Natural Environment Research Council (NERC)
- Personnel:** Alex Brisbourne¹, Cynthia Ebinger², Derek Keir², Sarah Swindley², Ian Bastow³, Jon Pollatos³ (Test 1, only)
- Affiliation:** ¹SEIS-UK, University of Leicester; ²Department of Geology, Royal Holloway University of London; ³School of Earth Sciences, University of Leeds
- Date of Tests:** Test 1: October 1, 2002 (30 instruments)
Test 2: October 9, 2002 (20 instruments)
- Location of Test:** National Scientific Equipment Centre, CMC Road, Addis Ababa, Ethiopia
- Huddle Test details recorded at the Equipment centre:** Tables B1, B2, B3
- | | | | |
|---------------------|-----------|-----------|-----------|
| Test 1: Start Time: | 14:11 EAT | End Time: | 09:47 EAT |
| Test 2: Start Time: | 12:30 | End Time: | 09:00 |
- Comments:** Seismometers on concrete floor of conference room. SEIS-UK GPS repeater used. Mass positions taken at start of deployment with seismometer levelled. 13V batteries fully charged; 5 seismometers powered by one battery. Second Huddle Test spreadsheet incomplete (Table B3). S. Swindley did not continue to record data after C. Ebinger departed the equipment centre for a meeting. S.Swindley is no longer involved in the project.
- GPS:** All instrument clocks synchronised at the start; but problems with reception on several GPS receivers occurred. Problem GPS modules set to continuous mode to obtain clock sync. All GPS modules directed towards the repeater antenna.
- Mass Positions:** Mass positions noted at start of test. Instrument with anomalously mass values were deployed with the auto-centre set to 0% (off)

TABLE B1. Huddle Test 1 Equipment Check

EAGLEII Rift Valley 6TD

NERC

Alex Brisbane, Cindy Ebinger, Sarah Swindley, Derek Keir, Ian Bastow, Jon Pollatos

01/10/02

Science Equipment Centre,
Addis Ababa

Day 274 Oct1
Start 14:11
Day 275 Oct2
End 6:47

Serial No	100 s/s	5 s/s	G60min	Z	E	N	M8	M9	MA	1920 0	GPS	Other Comments / clock sync time
T6161	x	x	x	x	x	x	892924	-763292	-509173	x	x	file disabled - file test MD to restart; - 14:14:29 - run filetest fixed error
T6162	x	x	x	x	x	x	68985	1070414	199590	x	x	13:38:57
T6164	x	x	x	x	x	x	159375	314431	271955	x	x	13:42
T6165	x	x	x	x	x	x	696711	951541	-368516	x	x	13:38:56
T6166	x	x	x	x	x	x	731216	2288679	371708	x	x	13:38:16
T6167	x	x	x	x	x	x	15574	875292	-341935	x	x	13:43:20
T6168	x	x	x	x	x	x	-229657	2515440	460845	x	x	13:38:57
T6169	x	x	x	x	x	x	-1200361	1667533	-152599	x	x	clock synch 1 Oct 13:12:44
T6170	x	x	x	x	x	x	1010882	108823	19983	x	x	clock synch 1 Oct 13:20:09
T6176	x	x	x	x	x	x	-236323	-548368	1027327	x	x	clock synch 1 Oct 13:28:25
T6177	x	x	x	x	x	x	1099331	1595129	-7803	x	x	13:44:57
T6178	x	x	x	x	x	x	306060	2819557	-538389	x	x	13:54:32
T6179	x	x	x	x	x	x	645589	532038	230575	x	x	14:15:00
T6181	x	x	x	x	x	x	949587	288461	1203634	x	x	14:13:00
T6182	x	x	x	x	x	x	787986	-633612	298616	x	x	13:52:00
T6183	x	x	x	x	x	x	1023097	-1130534	478083	x	x	14:16:00
T6184	x	x	x	x	x	x	637959	181372	-8388608	x	x	N component broken 14:26:32
T6185	x	x	x	x	x	x	-202678	52262	109348	x	x	14:16:42
T6186	x	x	x	x	x	x	883627	347716	263175	x	x	13:51:01
T6188	x	x	x	x	x	x	-1485000	1906108	889703	x	x	13:39:56
T6189	x	x	x	x	x	x	823372	-499052	-120447	x	x	clock synch 1 Oct 13:25:23
T6191	x	x	x	x	x	x	1321215	2825041	83951	x	x	clock sync 1 Oct 13:38:58
T6193	x	x	x	x	x	x	575815	-1287114	373460	x	x	clock synch 1 Oct 13:19:15
T6195	x	x	x	x	x	x	204847	1774583	529904	x	x	clock synch 1 Oct 13:13:04
T6196	x	x	x	x	x	x	553735	-399026	640410	x	x	clock synch 1 Oct 13:08:14
T6198	x	x	x	x	x	x	1106136	3307867	-275480	x		13:41:17
T6199	x	x	x	x	x	x	1004524	2917633	103074	x		13:43:02
T6207	x	x	x	x	x	x	733302	93428	6644080	x		13:41:57
T6211	x	x	x	x	x	x	351070	2512036	-406361	x	x	13:47:03
T6212	x	x	x	x	x	x	-759765	3638511	-173622	x	x	

Table B2. Huddle Test 1, Data Quality Control

October 1, 2002 Quality Control

Science Equipment Centre, Addis Ababa

Cindy Ebinger, Sarah Swindley,
Alex Brisbourne, Derek Keir

Start Time Day 274 14:11 1-Oct
End Time Day 275 6:47 2-Oct

Serial No	M8	M9	MA	GPS	Z	N	E	GPS serial No
T6161	x	x	x	x	x	x	x	G2991
T6162	x	x	x	x	x	x	x	G2992
T6164	x	x	x	x	x	x	x	G2993
T6165	x	x	x	x	x	x	x	G2995
T6166	x	x	x	x	x	x	x	G2996
T6167	x	x	x	lost GPS overnight	x	x	x	G2997
T6168	x	x	x	x	x	x	x	G2998
T6169	x	x	x	x	x	x	x	G3001
T6170	x	x	x	x	x	x	x	G3002
T6176	x	x	x	GPS no fix	x	x	x	G3003
T6177	x	x	x	lost GPS overnight	x	x	x	G3004
T6178	x	x	x	lost GPS overnight	x	x	x	G3005
T6179	x	x	x	lost GPS overnight	x	x	x	G3033
T6181	x	x	x	lost GPS overnight	x	x	x	G3008
T6182	x	x	x	lost GPS overnight	x	x	x	G3007
T6183	x	x	x	lost GPS overnight	x	x	x	G3009
T6184	x	x	8million	x	x	x	x	G3010
T6185	x	x	x	x, GPS offset near 8000usec	x	x	x	G3011
T6186	x	x	x	x	x	x	x	G3012
T6188	x	x	x	x	x	x	x	G3013
T6189	x	x	x	x	x	x	x	G3014
T6191	x	x	x	x	x	x	x	G3017
T6193	x	x	x	Problems?	x	x	x	G3032
T6195	x	x	x	x	x	x	x	G3020
T6196	x	x	x	x	x	x	x	G3021
T6198	x	x	x	x	x	x	x	G3036
T6199	x	x	x	lost GPS overnight	x	x	x	G3025
T6207	x	x	6million	x	x	x	x	G3028
T6211	x	x	x	x	x	x	x	G3035
T6212	x	x	x	lost GPS overnight	x	x	x	G3006

Table B3. Huddle Test 2, Equipment Check

Huddle Test 2: Rift Valley Experiment

Science Centre, Addis Abeba, Ethiopia

09/10/02

Start time: 12:30 local time (09:30 GMT)

End time: 9:00 local

Sarah Swindley, Cindy Ebinger, Alex Brisbane, Derek Keir

Instrument No	19200	60s	100 s/s	5 s/s	M8	M9	MA	Vel E	Vel N	Vel Z	GPS sync
T6197	x	x	x	x	738711	-676421	-1487595	x	x	x	10/9/02 11:32
T6194	x	x	x	x	8388607	-1098205	186292	x	x		10/9/02 11:25
T6200	x	x	x	x	1006595	-1209975	-489624	x	x	x	10/9/02 11:35
T6201	x	x	x	x	-74562	-56900	-927708	x	x	x	10/9/02 11:38
T6202	x	x	x	x	826770	23939	-1690054	x	x	x	10/9/02 11:41
T6204	x	x	x	x	-262436	-499971	-778778	x		x	10/9/02 11:47
T6217	x	x	x	x	851568	1534312	-570752	x	x	x	10/9/02 11:50
T6220	x	x	x	x	466615	119541	-347750	x	x	x	10/9/02 11:52
T6222	x	x	x	x	643730	1909939	-944043	x	x	x	10/9/02 11:55
T6224	x	x	x	x	823956	1656041	314023	x	x	x	10/9/02 11:59
T6192	x	x	x	x	224994	1007385	1614299	x	x	x	
T6163	x	x	x	x	391123	733284	906600	x	x	x	10/9/02 11:38
T6160	x	x	x	x	2822311	1108122	179453	x	x	x	