BRITISH GEOLOGICAL SURVEY
Natural Environment Research Council

TECHNICAL REPORT WD/91/46R

Hydrogeology Series

Technical Report WD/91/46R

KENYA RIFT VALLEY GEOTHERMAL PROJECT PHASE 3
Report on a visit 1-22 June 1991

W G Darling

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BRITISH GEOLOGICAL SURVEY

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Keyworth, Nottingham NG12 5GG
☎ Plumtree (06077) 6111 Telex 378173 BGSKEY G
Fax 06077–6602

Murchison House, West Mains Road, Edinburgh EH9 3LA
☎ 031–667 1000 Telex 727343 SEISED G
Fax 031–668 2683

London Information Office at the Geological Museum, Exhibition Road, South Kensington, London SW7 2DE
☎ 071–589 4090 Fax 071–584 8270
☎ 071–938 9056/57

19 Grange Terrace, Edinburgh EH9 2LF
☎ 031–667 1000 Telex 727343 SEISED G

St Just, 30 Pennsylvania Road, Exeter EX4 6BX
☎ Exeter (0392) 78312 Fax 0392–437505

Bryn Eithyn Hall, Llanfarian, Aberystwyth, Dyfed SY23 4BY
☎ Aberystwyth (0970) 611038 Fax 0970–624822

Windsor Court, Windsor Terrace, Newcastle upon Tyne NE2 4HB
☎ 091–281 7088 Fax 091–281 9016

Geological Survey of Northern Ireland, 20 College Gardens, Belfast BT9 6BS
☎ Belfast (0232) 666595 Fax 0232–662835

Maclean Building, Crowmarsh Gifford, Wallingford, Oxfordshire OX10 8BB
☎ Wallingford (0491) 38800 Telex 849365 HYDROL G
Fax 0491–25338

Parent Body

Natural Environment Research Council

Polaris House, North Star Avenue, Swindon, Wiltshire SN2 1EU
☎ Swindon (0793) 411500 Telex 444293 ENVRE G
Fax 0793–411501

EXECUTIVE SUMMARY

A visit to collect water, steam condensate and gas samples has been made to the northern Rift Valley in connection with the United Kingdom-Government of Kenya Geothermal Project. The three-week visit was sufficient to accomplish all the sampling necessary to complete the geochemical investigations for Phase 3 of the Project. The samples collected will be analysed in the UK and the results will appear in a research report at a later date.

1. INTRODUCTION AND PURPOSE OF VISIT

This report describes a visit undertaken by W G Darling in connection with the third phase of the UK-GOK Rift Valley Geothermal Project. The main objective of the visit was to carry out the geochemical sampling necessary to complete the Phase 3 investigations.

2. ITINERARY

1 June	Travel to Nairobi
2-3 June	Discussions with Drs Dunkley and Smith (resident team), equipment organisation and preparation.
4 June	Travel to Baringo
5 June	Set up field laboratory. Sampling boiling springs near Namarunu.
6 June	Sampling fumaroles on the Barrier. Resampling of Lorusio hot spring.
7 June	Sampling hot springs, N.E. Suguta Valley.
8 June	Sampling boiling springs, S.E. Bogoria.
9 June	Sampling fumaroles on the Barrier, wells at Parakati and Tum.
10 June	Resampling at Napeiton and Kampi Ya Samaki wells.
11 June	Sample organisation and treatment. Resampling fumarole at Loruk to demonstrate techniques to ODA visitors (A Wood, R Cadwallader).
12 June	Resampling Nginyang Polytechnic well.
13 June	Travel to Ferguson's Gulf, Lake Turkana, sampling Loyangalani warm spring en route. Sampling warm springs at Eliye in pm.
14 June	Sampling fumaroles and spring on North Island (am) and Central Island (pm). Lakewater sampled at each site.
15 June	Travel to Baringo, sampling River Kerio en route.
16 June	Sampling of Arus fumaroles and 'frying pan' springs.
17 June	Sampling Lake Baringo. Travel to Nairobi.
18 June	Sample organisation and treatment.
19 June	Travel to Olkaria, sampling in N.E. Wellfield, search for possible sinter deposits in Olkaria area. Sample Lake Naivasha.
20 June	Sampling fumarole on Suswa ring graben. Return to Nairobi.
21 June	Final discussions with resident team and packing of samples.
22 June	Return to UK.

3. PROGRESS

The resident team of Drs Dunkley and Smith had previously identified sites of geothermal interest as far north as Loyangalani on Lake Turkana, and these were duly sampled. Also for the sake of regional completeness the volcanic centres of North and Central Islands were briefly visited. South Island was overflown but appeared to have no fumarolic activity worth sampling. This visit was therefore sufficient to carry out all the geochemical sampling necessary for the Phase 3 project area. In addition a few sites elsewhere were sampled or resampled in an attempt to answer questions which had arisen during previous work on Phases 1 and 2.

Details of all sample types collected are given in Table 1, while Figure 1 and the Appendix provide locations and other information about samples collected within the Phase 3 area.

4. PRESENT STATUS AND FUTURE WORK

Geochemical sampling for the Phase 3 area has been completed. The samples collected will be airfreighted to the UK where they will be analysed at BGS Wallingford. The results will be reported at a later date.

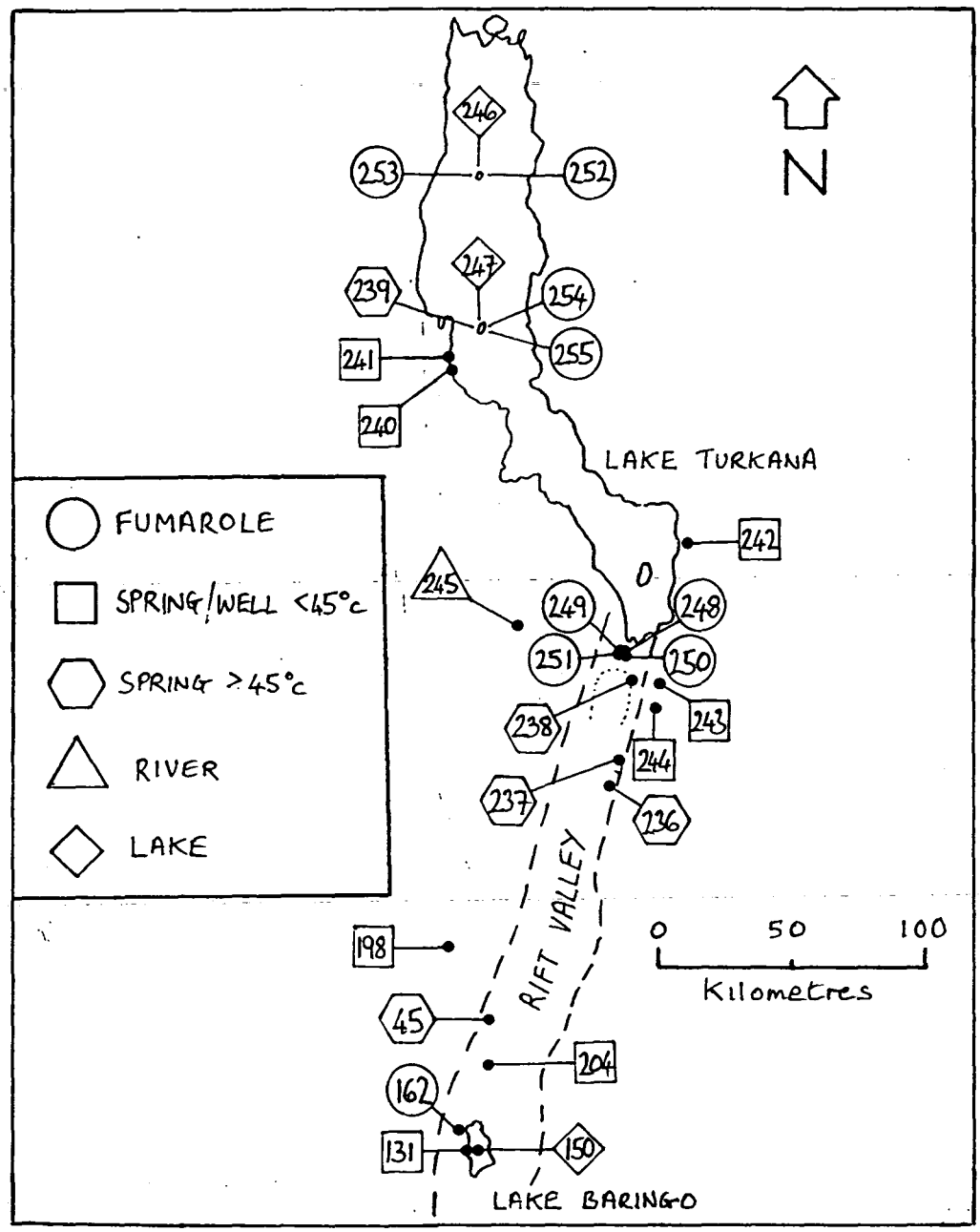


Figure 1. Map of Sampling Localities

TABLE 1: Geochemical field sampling data

Locality	Site No.	Date	Sample Type	Grid Ref	Temp C	pH	Chem	S.I.	$\delta^{13}C_{DIC}$	Gases	NaOH	$^3He/^4He$	Other
Lorusio	45	6.6.91	H	AM 788 387	81	-		✓		✓			travertine
Bogoria S.E.	62	8.6.91	H	AL 1796 6215	97.1	9.58	✓	✓	✓	✓			
Elboitong S.	236	5.6.91	H	BN 2243 2180	95.0	7.10	✓	✓	✓	✓		✓	
Elboitong N.	237	7.6.91	H	BN 2252 2204	91.8	9.00	✓	✓	✓	✓		✓	$\delta^{18}O\text{-}SO_4$
Logipi N.E.	238	7.6.91	H	BN 2314 2490	69.8	8.85	✓	✓	✓	✓		✓	$\delta^{18}O\text{-}SO_4$
C. Island	239	14.6.91	C	3°27'N 37°4'E	70.5	7.20	✓	✓					$\delta^{18}O\text{-}SO_4$
Arus	-	16.6.91	H	ZR 8305 0183	86.6	-		✓		✓	✓	✓	
Eliye	240	13.6.91	C	3°15'N 36°2'E	35.4	9.00	✓	✓	✓	✓		✓	
Eliye N.	241	13.6.91	C	*BB 2276 8684	37.3	8.75	✓	✓	✓				
Loyangalani	242	13.6.91	H	BP 2473 3055	39.2	7.65	✓	✓	✓	✓		✓	
Napeiton	198b	10.6.91	C	AM 1712 1862	36.8	7.80	✓	✓		✓		✓	
Kampi Y.S.	131	10.6.91	C	AL 6860 6815	amb	8.15	✓	✓	✓	✓		✓	
Nginyang Poly	204	12.6.91	C	AM 1677 1045	34.0	8.45	✓	✓	✓	✓		✓	
Parakati	243	9.6.91	C	BN 2427 2490	amb	7.50	✓	✓	✓				
Tum	244	9.6.91	S	BN 2544 2383	amb	7.55	✓	✓					
R. Kerio	245	15.6.91	S	AN 2122 1667	amb	8.65	✓	✓					
L. Baringo	150	5.6.91	S	AL 720 680	amb	-	✓	✓					
L. Baringo	150	17.6.91	S	AL 720 680	amb	9.00	✓	✓					
L. Naivasha	-	19.6.91	S	BK 203 911	amb	7.60	✓	✓					
L. Turkana N.	246	14.6.91	S	*BH 2384 9500	amb	9.45	✓	✓					
L. Turkana C.	247	14.6.91	S	3°28'N 37°3'E	amb	9.45	✓	✓					
Loruk KR34	162	11.6.91	F	AL 6790 7375	94.5	-		✓		✓	✓		
Kakorinya ridge	248	6.6.91	F	BN 2306 2562	92.8	7.50		✓		✓			
Kakorinya W.wall	249	6.6.91	F	BN 2308 2562	94.0	5.40		✓		✓	✓	✓	
Kakorinya S.S.E.	250	9.6.91	F	BN 2320 2555	94.4	6.10	✓	✓		✓	✓	✓	
Kakorinya S.W.	251	9.6.91	F	BN 2295 2557	92.9	6.55		✓		✓			
N. Island slope	252	14.6.91	F	*BH 2392 9484	95.5	4.35	✓	✓		✓	✓	✓	sulphur
N. Island summit	253	14.6.91	F	*BH 2391 9482	95.9	5.80	✓	✓		✓	✓	✓	
C. Island lower	254	14.6.91	F	3°27'N 37°4'E	97.3	5.85	✓	✓		✓	✓	✓	
C. Island upper	255	14.6.91	F	3°27'N 37°4'E	97.4	5.70	✓	✓		✓	✓	✓	
Arus	-	16.6.91	F	ZR 8305 0183	95.1	4.30	✓	✓		✓	✓		
Suswa F-12	-	20.6.91	F	BJ 041 744	94.1	4.35	✓	✓		✓	✓	✓	
Olkaria OW-715	-	19.6.91	G	BK 199 054	-	4.30	✓	✓	✓		✓	✓	

H - spring, >50°C; C - borehole or well <50°C; S - surface water; F - fumarole; G - geothermal well
All grid references to UTM except * which denotes EA grid

APPENDIX: Geochemical Sampling Site Details

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 236
   Date : 5.6.91
   Sample type: SPRING
   Temperature: 95°C

2. Place name : ELBOITONG S.
   Grid Ref. : BN 2243 2180 1:50,000 No.:
   Altitude (m):
   Access notes: HELICOPTER

3. Description of springs

   Area of discharge S. END OF SEVERAL KM OF DISHARGE AT FOOT OF E. RIFT WALL
   Number of springs
   Flow rates (liters/second)
   Temperature (Max) 100°C (SLIGHT SUPERHEATING)
   Temperature (Range) 85 - 100°C
   Conductivity (μmhos)
   pH 7.10
   Gas (amount and constancy) LARGE AMOUNT CO_2
   Smell
   Type of encrustation/alteration CARBONATE DEPOSITS
   Photograph ✓
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

7. Description of geological setting

   Faulting (field evidence, photo interpretation)
   HOT FLUIDS PROBABLY UPWELLING ALONG FAULT LINE
   Volcanism (age and type of associated activity)
   OPPOSITE NAMARUNU – SEVERAL KM FROM LATE QUATERNARY BASALTS
   Hydrothermal alteration (general description, ?sample)

Other notes SAMPLED CHEMISTRY, STABLE ISOTOPES, $\delta^{13}C$, GASES, HELIUM ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 237
   Date : 7.6.91
   Sample type: HOT SPRING
   Temperature: 91.8°C

2. Place name : ELBOITONG N.
   Grid Ref. : BN 2252 2204 1:50,000 No.:
   Altitude (m):
   Access notes: HELICOPTER

3. Description of springs

   Area of discharge SEE DESCRIPTION FOR 236
   Number of springs
   Flow rates (liters/second)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH 9.00
   Gas (amount and constancy) LESS CO_2 THAN 236
   Smell
   Type of encrustation/alteration
   Photograph ✓
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph —
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   AS 236

   Volcanism (age and type of associated activity)

   Hydrothermal alteration (general description, ?sample)

   Other notes SAMPLED CHEMISTRY, STABLE ISOTOPES, $\delta^{13}C$, GASES, HELIUM ISOTOPES AND $\delta^{18}O \cdot SO_4$

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 238
   Date : 7.6.91
   Sample type: HOT SPRING
   Temperature: 69.8°c

2. Place name : LOGIPI N.E.
   Grid Ref. : BN 2514 2490 1:50,000 No.:
   Altitude (m):
   Access notes: HELICOPTER

3. Description of springs

   Area of discharge SPRING AT N.E. CORNER OF L. LOGIPI
   Number of springs 1
   Flow rates (liters/second) ≪ 1
   Temperature (Max) 69.8°C
   Temperature (Range)
   Conductivity (μmhos)
   pH 8.85
   Gas (amount and constancy) NONE
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)
   S.E. FLANK OF BARRIER

   Hydrothermal alteration (general description, ?sample)

   Other notes SAMPLED CHEMISTRY, STABLE ISOTOPES, $\delta^{13}C$, GASES, HELIUM ISOTOPES AND $\delta^{18}O - SO_4$

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 239
   Date : 14.6.91
   Sample type: HOT SPRING
   Temperature: 70.5°c

2. Place name : CENTRAL ISLAND GREEN LAKE
   Grid Ref. : 3°27'N 37°4'E 1:50,000 No.:
   Altitude (m):
   Access notes: HELICOPTER (OR BOAT)

3. Description of springs

   Area of discharge SEEPAGES ROUND E. SIDE OF CRATER LAKE
   Number of springs NUMEROUS BUT V. SMALL (SOME UNDER WATER)
   Flow rates (liters/second) SEE SKETCH MAP FOR 254
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH 7.20
   Gas (amount and constancy) NOT OBVIOUS
   Smell
   Type of encrustation/alteration
   Photograph ✓
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

7. Description of geological setting

   Faulting (field evidence, photo interpretation)
   SPRINGS FEEDING ALKALINE CRATER LAKE, ON SAME SIDE AS FUMAROLIC ACTIVITY
   Volcanism (age and type of associated activity)
   LATE QUATERNARY (VERY RECENT)

   Hydrothermal alteration (general description, ?sample)

   Other notes
   SAMPLED CHEMISTRY AND STABLE ISOTOPES + $\delta^{18}O - SO_4$

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 240
   Date : 13.6.91
   Sample type: SPRING
   Temperature: 35.4°C

2. Place name : ELIYE SPRINGS
   Grid Ref. : 3°15'N 36°2'E 1:50,000 No.:
   Altitude (m):
   Access notes: POSSIBLE BY ROAD

3. Description of springs

   Area of discharge SPRINGS DISCHARGING IN AND AROUND SMALL LAKE IMPOUNDED BY DAM
   Number of springs
   Flow rates (liters/second) 20 (TOTAL)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH 9.00
   Gas (amount and constancy) SOME GAS BUBBLES
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   Hydrothermal alteration (general description, ?sample)

Other notes ON W. EDGE OF L. TURKANA - BELT OF SMALL DISCHARGES AND SEEPAGES STRETCHING N. FOR SEVERAL KM. SAMPLED CHEMISTRY, STABLE ISOTOPES, $\delta^{13}C$, GASES, HELIUM ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 241
   Date : 13.6.91
   Sample type: SPRING
   Temperature: 37.3°C

2. Place name : ELIYE NORTH
   Grid Ref. : BB 2276 8684 1:50,000 No.: EA GRID
   Altitude (m):
   Access notes: POSSIBLE BY VEHICLE

3. Description of springs

   Area of discharge SEE REMARKS FOR SITE 140
   Number of springs
   Flow rates (liters/second) 10
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH 8.75
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   Hydrothermal alteration (general description, ?sample)

   Other notes SEE REMARKS FOR SITE 140.
   SAMPLED CHEMISTRY, STABLE ISOTOPES AND $\delta^{13}C$

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WRD -- Sample No: 242
   Date : 13·6·91
   Sample type: SPRING
   Temperature: 39.2°C
2. Place name : LOYANGALANI
   Grid Ref. : BP 2473 3055 1:50,000 No.:
   Altitude (m):
   Access notes: POSSIBLE BY ROAD

3. Description of springs

   Area of discharge A FEW SQ METRES
   Number of springs SEVERAL
   Flow rates (liters/second) TOTAL 20
   Temperature (Max)
   Temperature (Range)
   Conductivity (µmhos)
   pH 7·65
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (µmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (µmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   Hydrothermal alteration (general description, ?sample)

   Other notes

SPRING IN CENTRE OF LOYANGALANI NEAR POLICE POST. WATER APPEARS TO BE TYPICAL RIFT-WALL TYPE (NON-VOLCANIC). SAMPLED FOR CHEMISTRY, STABLE ISOTOPES, GASES, $\delta^{13}C$ AND HELIUM ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 243
   Date : 9.6.91
   Sample type: WELL
   Temperature: AMBIENT

2. Place name : PARAKATI MISSION SCHOOL
   Grid Ref. : BN 2427 2490 1:50,000 No.:
   Altitude (m):
   Access notes: POSSIBLE BY VEHICLE

3. Description of springs

   Area of discharge
   Number of springs
   Flow rates (liters/second)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth SURFACE
   Discharge rate UNKNOWN
   pH 7.50
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes WELL NEAR SPRING (OUTPUT $\ll$ 1 l/s)

6. Descriptive notes of other samples (rainwater, lakewater)

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   Hydrothermal alteration (general description, ?sample)

   Other notes WELL SITUATED ON VOLCANIC PRE-RIFT BASEMENT ON RIFT SIDE E. OF LAKE LOGIPI. SAMPLED FOR CHEMISTRY, STABLE ISOTOPES AND $\delta^{13}C$

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 244
   Date : 9.6.91
   Sample type: STREAM
   Temperature: AMBIENT

2. Place name : TUM
   Grid Ref. : BN 2544 2383 1:50,000 No.:
   Altitude (m):
   Access notes: POSSIBLE BY VEHICLE

3. Description of springs

   Area of discharge
   Number of springs
   Flow rates (liters/second)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH 7.55
   Photograph
   Notes SAMPLE COLLECTED FROM PIPE FEEDING RESERVOIR. INTAKE SEVERAL HUNDRED METRES HIGHER ON E. RIFT WALL.

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   Hydrothermal alteration (general description, ?sample)

   Other notes TYPICAL RIFT WALL WATER. SAMPLED FOR CHEMISTRY AND STABLE ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT .

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 245
Date : 15.6.91
Sample type: RIVER
Temperature: AMBIENT

2. Place name : R. KERIO AT LOKORI
Grid Ref. : AN 2122 1667 1:50,000 No.:
Altitude (m):
Access notes: ROAD BRIDGE

3. Description of springs

Area of discharge
Number of springs
Flow rates (liters/second)
Temperature (Max)
Temperature (Range)
Conductivity (μmhos)
pH
Gas (amount and constancy)
Smell
Type of encrustation/alteration
Photograph
Notes

4. Description of streams

Approx. flow rate (liter/second) LARGE RIVER (AMOUNT UNCERTAIN)
Conductivity (μmhos)
pH 8.65
Photograph ✓
Notes COPIOUS AMOUNTS OF SEDIMENT IN SUSPENSION

5. Description of borehole sample

Sample depth
Discharge rate
pH
Conductivity (μmhos)
Stratigraphy/lithology
Notes

6. Descriptive notes of other samples (rainwater, lakewater)

7. Description of geological setting

Faulting (field evidence, photo interpretation)

Volcanism (age and type of associated activity)

Hydrothermal alteration (general description, ?sample)

Other notes SAMPLED FOR CHEMISTRY AND STABLE ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 246
   Date : 14.6.91
   Sample type: LAKEWATER
   Temperature: AMBIENT

2. Place name : NORTH ISLAND
   Grid Ref. : BH 2384 9500 1:50,000 No.: E.A. GRID
   Altitude (m):
   Access notes: HELICOPTER OR BOAT

3. Description of springs

   Area of discharge
   Number of springs
   Flow rates (liters/second)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

   SAMPLE OF L. TURKANA COLLECTED ON THE WESTERN SIDE OF NORTH ISLAND PH 9.45. SEE SKETCH MAP FOR SITE 252.

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   Hydrothermal alteration (general description, ?sample)

   Other notes SAMPLED FOR CHEMISTRY AND STABLE ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 247
Date : 14.6.91
Sample type: LAKEWATER
Temperature: AMBIENT

2. Place name : CENTRAL ISLAND
Grid Ref. : 3°28'N 37°3'E 1:50,000 No.:
Altitude (m):
Access notes: HELICOPTER OR BOAT. SEE SKETCH MAP FOR SITE 254

3. Description of springs

Area of discharge
Number of springs
Flow rates (liters/second)
Temperature (Max)
Temperature (Range)
Conductivity (μmhos)
pH
Gas (amount and constancy)
Smell
Type of encrustation/alteration
Photograph
Notes

4. Description of streams

Approx. flow rate (liter/second)
Conductivity (μmhos)
pH
Photograph
Notes

5. Description of borehole sample

Sample depth
Discharge rate
pH
Conductivity (μmhos)
Stratigraphy/lithology
Notes

6. Descriptive notes of other samples (rainwater, lakewater)

SAMPLE OF LAKE TURKANA COLLECTED ON THE NORTH SIDE OF CENTRAL ISLAND. LESS SUSPENDED MATTER THAN FOR N. ISLAND. pH 9.45

7. Description of geological setting

Faulting (field evidence, photo interpretation)

Volcanism (age and type of associated activity)

Hydrothermal alteration (general description, ?sample)

Other notes SAMPLED FOR CHEMISTRY AND STABLE ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 249
   Date : 6.6.91
   Sample type: FUMAROLE
   Temperature: 92.8°C

2. Place name : KAKORINYA RIDGE
   Grid Ref. : BN 2306 2562 1:50,000 No.:
   Altitude (m):
   Access notes: HELICOPTER

3. Description of springs

   Area of discharge
   Number of springs
   Flow rates (liters/second)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

   WEAK FUMAROLE . pH 7.5 . LOW GAS .

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)
   KAKORINYA IS THE MAIN RECENT BARRIER VOLCANO (TELEKI AND ANDREWS TO THE N. and S. RESPECTIVELY)
   Hydrothermal alteration (general description, ?sample)

   Other notes

   SAMPLED FOR CHEMISTRY & STABLE ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 249
   Date : 6.6.91
   Sample type: FUMAROLE
   Temperature: 94.0°C

2. Place name : KAKORINYA WEST WALL
   Grid Ref. : BN 2308 2562 1:50,000 No.:
   Altitude (m):
   Access notes: HELICOPTER

3. Description of springs

   Area of discharge
   Number of springs
   Flow rates (liters/second)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

   MEDIUM TO WEAK FUMAROLE, SOME CO_2 DETECTABLE. pH 5.40

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   SEE 248

   Hydrothermal alteration (general description, ?sample)

   Other notes

   SAMPLED FOR CHEMISTRY, ISOTOPES, GASES, HELIUM ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 250
   Date : 9.6.91
   Sample type: FUMAROLE
   Temperature: 94.4°C

2. Place name : KAKORINYA S.S.E.
   Grid Ref. : BN 2320 2555 1:50,000 No.:
   Altitude (m):
   Access notes: HELICOPTER

3. Description of springs

   Area of discharge
   Number of springs
   Flow rates (liters/second)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

   FUMAROLES ON ROCKY MOUND. LOW CO_2.
   pH 6.10

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   SEE 248

   Hydrothermal alteration (general description, ?sample)

   Other notes

   SAMPLED FOR CHEMISTRY, STABLE ISOTOPES, GASES AND HELIUM ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : LTGD Sample No: 251
   Date : 9.6.91
   Sample type: FUMAROLE
   Temperature: 92.9°C

2. Place name : KAKORINYA S.W.
   Grid Ref. : BN 2295 2557 1:50,000 No.:
   Altitude (m):
   Access notes: HELICOPTER

3. Description of springs

   Area of discharge
   Number of springs
   Flow rates (liters/second)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

   FAIR AMOUNT OF STEAM BUT V. LITTLE GAS.
   pH 6.55

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   SEE 248

   Hydrothermal alteration (general description, ?sample)

   Other notes

   SAMPLED FOR CHEMISTRY AND STABLE ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT

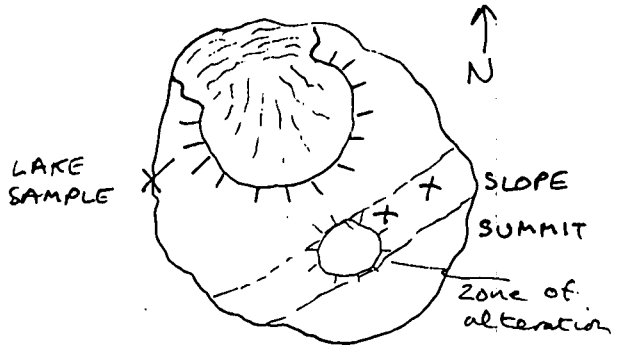
BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGTD Sample No: 252
   Date : 14·6·91
   Sample type: FUMAROLE
   Temperature: 95·5°C

2. Place name : NORTH ISLAND - SLOPE
   Grid Ref. : BH 2392 9484 1:50,000 No.: E.A. GRID
   Altitude (m):
   Access notes: HELICOPTER OR BOAT

3. Description of springs

   Area of discharge
   Number of springs
   Flow rates (liters/second)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes



NORTH ISLAND, LAKE TURKANA approx 1 km diameter

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

   FAIRLY VIGOROUS, GASSY FUMAROLE DEPOSITING NATIVE SULPHUR. pH = 4·35. SULPHUROUS SMELL.

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   Hydrothermal alteration (general description, ?sample)

   Other notes

   SAMPLED FOR CHEMISTRY, STABLE ISOTOPES, GASES, HELIUM ISOTOPES AND SULPHUR

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 253
   Date : 14.6.91
   Sample type: FUMAROLE
   Temperature: 95.9°C

2. Place name : CENTRAL ISLAND - SUMMIT
   Grid Ref. : BH 2391 9482 1:50,000 No.:
   Altitude (m):
   Access notes: HELICOPTER OR BOAT

3. Description of springs

   Area of discharge
   Number of springs
   Flow rates (liters/second)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

   FAIRLY VIGOROUS, GAISY FUMAROLE, SULPHUROUS SMELL. pH = 5.80 HIGHER WATER/GAS RATIO THAN 252

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   Hydrothermal alteration (general description, ?sample)

   Other notes
   SAMPLED FOR CHEMISTRY, STABLE ISOTOPES, GAS AND HELIUM ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 254
   Date : 14.6.91
   Sample type: FUMAROLE
   Temperature: 97.3°C

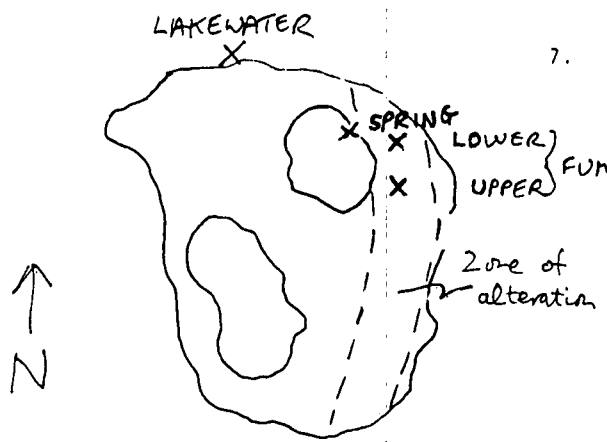
2. Place name : CENTRAL ISLAND - LOWER
   Grid Ref. : 3°27'N 37°4'E 1:50,000 No.:
   Altitude (m):
   Access notes: HELICOPTER OR BOAT

3. Description of springs

   Area of discharge
   Number of springs
   Flow rates (liters/second)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes



CENTRAL ISLAND, LAKE TURKANA
Approx 1.5 km diameter

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

   FAIRLY VIGOROUS, GASSY FUMAROLE IN ZONE OF INTENSE ALTERATION. SULPHUROUS SMELL, NATIVE SULPHUR. pH = 5.85

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   Hydrothermal alteration (general description, ?sample)

Other notes

SAMPLED FOR CHEMISTRY, STABLE ISOTOPES, GASES, HELIUM ISOTOPES

KENYA RIFT VALLEY GEOTHERMAL PROJECT

BGS/GOK, MERD DATASHEET FOR WATER SAMPLES

1. Sampled by : WGD Sample No: 255
   Date : 14.6.91
   Sample type: FUMAROLE
   Temperature: 97·4°C

2. Place name : CENTRAL ISLAND - UPPER
   Grid Ref. : 3°27'N 37°4'E 1:50,000 No.:
   Altitude (m):
   Access notes: HELICOPTER OR BOAT

3. Description of springs

   Area of discharge
   Number of springs
   Flow rates (liters/second)
   Temperature (Max)
   Temperature (Range)
   Conductivity (μmhos)
   pH
   Gas (amount and constancy)
   Smell
   Type of encrustation/alteration
   Photograph
   Notes

4. Description of streams

   Approx. flow rate (liter/second)
   Conductivity (μmhos)
   pH
   Photograph
   Notes

5. Description of borehole sample

   Sample depth
   Discharge rate
   pH
   Conductivity (μmhos)
   Stratigraphy/lithology
   Notes

6. Descriptive notes of other samples (rainwater, lakewater)

   EXTREMELY VIGOROUS FUMAROLE, ABLE TO LIFT SMALL PIECES OF CLAY OR ROCK. HIGH WATER/GAS RATIO. SULPHUROUS SMELL. pH = 5.70

7. Description of geological setting

   Faulting (field evidence, photo interpretation)

   Volcanism (age and type of associated activity)

   Hydrothermal alteration (general description, ?sample)

   Other notes

   SAMPLED FOR CHEMISTRY, ISOTOPES, GASES, HELIUM ISOTOPES.

MONITORING REPORT: ACTION SUMMARY SHEET

NB This sheet should be kept prominently on file until all recommended action taken or otherwise dealt with Then to be filed with Monitoring Report as Key Document

Project / Programme	KENYA RIFT VALLEY GEOTHERMAL PROJECT PHASE 3
Name(s) of Monitor(s)	MR W G DARLING
Date of Monitoring Visit	1-22 JUNE 1991

SUMMARY OF RECOMMENDED ACTION IN ORDER OF IMPORTANCE

Recommended Action	Recommended Timing	Action to be Initiated by	Recommendation considered: approved action (if any) taken (initials and date)	See Item
NO ACTION REQUIRED				