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RIFT VALLEY GAS GEOTHERMOMETRY PROJECT
Report on a Visit to Ethiopia and Djibouti 1-21 December 1990

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1. INTRODUCTION AND PURPOSE OF VISIT

This report describes a visit undertaken to the Rift System in Ethiopia and Djibouti for the purpose of gas sample collection. It is intended that the data obtained from these samples will be combined with data previously obtained from Kenya to give a comprehensive review of gas geothermometry in geothermal fields of the East African Rift.

2. ITINERARY

1 December	Depart for Addis Ababa.
2 December	Arrive Addis Ababa.
3 December	Meeting and discussions with Ato Berhanu Gizaw and Ato Negussie Mekuria (geochemists) of the Ethiopian Institute of Geological Surveys (EIGS) Geothermal Project. Equipment preparation.
4 December	Register at British Embassy. Further discussions and equipment preparation at EIGS.
5 December	Equipment preparation. Travel to EIGS Langano Camp with Ato Berhanu Gizaw.
6 December	Reagent preparation. Spring sampling, Langano area.
7 December	Geothermal well and fumarole sampling, Langano area.
8 December	Fumarole sampling, Langano area. Travel to Awasa.
9 December	Fumarole sampling, Corbetti area.
10 December	Spring and fumarole sampling, Abaya.
11 December	Spring sampling at Wondo Genet and Lake Shalla. Travel to Nazret.
12 December	Fumarole sampling at Boku. Travel to Sodere, sample spring.
13 December	Travel to Addis Ababa. Commence packing of samples.
14 December	Complete packing of samples, deliver to British Embassy for forwarding. Discussions with Dr Abebaw Endeshaw, Geothermal Project Director EIGS, and Ato Berhanu Gizaw.
15 December	Deliver lecture at EIGS on 'The Uses of Geochemistry in Geothermal Prospecting in the Kenya Rift'. Final preparation for departure.
16 December	Travel to Djibouti City. Commence equipment preparation.
17 December	Meeting with M. Anis Abdallah (Director), M. Jama Khabar (geologist) and M. Houdart Xavier (chemist) of the Institut Superieur d'Etudes et des Recherches Scientifiques et Techniques (ISERST). Complete equipment preparations, travel to Assal.

18 December	Fumarole and spring sampling at Assal.
19 December	Travel to Lake Abbé. Sample fumarole at Garrabayis, spring at Abbé.
20 December	Spring sampling at Abbé. Travel to Djibouti City. Prepare for departure.
21 December	Return to UK via Addis Ababa.

3. PROGRESS

The object of the visit was to complete fieldwork for the gas geothermometry R & D project already begun in Kenya. Deep geothermal wells in all three countries (Olkaria, Kenya; Langano, Ethiopia; Assal, Djibouti) provide unique opportunities for comparing surface gas and steam samples with those at depth.

Good cooperation was received from both the EIGS in Ethiopia (part of the Ministry of Mines and Energy) and ISERST in Djibouti, with both organisations providing transport and field assistance. The main objective, sampling in the drilled areas, was achieved in both countries together with more limited sampling in other thermal areas for the purposes of comparison. Sample localities are shown in Figure 1 (Ethiopia) and Figure 2 (Djibouti), while Table 1 gives a list of samples collected. Details of sampling localities are provided in the Appendix.

4. FUTURE WORK

When laboratory analysis of the samples has been completed, the results from Kenya, Ethiopia and Djibouti will be presented together with an interpretation in the form of a technical report. It is intended that this should be followed eventually by the publication of a research paper on gas geothermometry in the East African Rift System.

TABLE 1. DETAILS OF SAMPLES COLLECTED IN ETHIOPIA AND DJIBOUTI

SITE NO.	SITE NAME	SAMPLE SOURCE	DATE	LAT/LONG	SAMPLES COLLECTED				
					Gases	NaOH cond.	He	Chemistry	Isotopes
ETH 01	Langano LA-3	Geoth. well	7.12.90	7°48'N, 38°48'E	x	x	x	x(v)	x(v)
								x(l)	x(l)
ETH 02	Langano LA-6	Geoth. well	7.12.90	7°48'N, 38°48'E	x	x	x	x(v)	x(v)
								x(l)	x(l)
ETH 03	Langano LA-8*	Geoth. well	1.9.88	7°48'N, 38°47'E		x			
								x(l)	x(l)
ETH 04	Bobessa	Fumarole	7.12.90	7°47'N, 38°51'E	x	x	x	x	x
ETH 05	Gebiba	Fumarole	8.12.90	7°45'N, 38°48'E	x	x	x	x	x
ETH 06	Auto	Fumarole	8.12.90	7°48'N, 38°44'E	x	x	x	x	x
ETH 07	Chebicha	Fumarole	9.12.90	7°14.5'N, 38°20.2'E	x	x	x	x	x
ETH 08	Danshe	Fumarole	9.12.90	7°14.0'N, 38°23.6'E	x	x	x	x	x
ETH 09	Koka	Fumarole	9.12.90	7°17.7'N, 38°23.5'E	x	x	x	x	x
ETH 10	Boku	Fumarole	12.12.90	8°30'N, 39°18'E	x		x		x
ETH 11	Langano	Hot spring	6.12.90	7°42'N, 38°47'E				x	x
ETH 12	Abaya	Hot spring	10.12.90	6°37'N, 37°54'E				x	x
ETH 13	Abaya	Hot spring	10.12.90	6°37'N, 37°54'E	x	x	x	x	x
ETH 14	Wondo Genet	Hot spring	11.12.90	7°08'N, 38°38'E				x	x
ETH 15	Shalla	Hot spring	11.12.90	7°30'N, 38°37'E	x		x	x	x
ETH 16	Sodere	Hot spring	12.12.90	8°27'N, 39°26'E	x		x	x	x
ETH 17	Langano	Lake	8.12.90	7°38'N, 38°42'E				x	x
ETH 18	Awasa	Lake	10.12.90	7°07'N, 38°28'E				x	x
ETH 19	Awash	River	13.12.90	8°27'N, 39°26'E					x
DJI 01	Assal 3**	Geoth. well	11.1.90	11°38'N, 42°23'E	x		x		
DJI 02	Assal 5	Fumarole	18.12.90	11°37'N, 42°27'E	x	x	x	x	x
DJI 03	N. Ghoubet	Fumarole	18.12.90	11°39'N, 42°32'E	x	x	x	x	x
DJI 04	Garrabayis	Fumarole	19.12.90	11°22'N, 42°11'E	x	x	x	x	x
DJI 05	Korilli**	Hot spring	8.12.89	11°40'N, 42°20'E			x	x	x
DJI 06	Abbé	Hot spring	19.12.90	11°17'N, 41°53'E			x	x	x
DJI 07	Abbé	Hot spring	20.12.90	11°17'N, 41°53'E	x		x	x	x
DJI 08	Ghoubet	Seawater	18.12.90	11°35'N, 42°31'E					x

Gases = Free gases; NaOH cond. = gases condensed into NaOH; He = Sample for $^3He/^4He$ analysis;
Isotopes = δ^2H and $\delta^{18}O$; l = liquid phase; v = vapour phase

* Sample previously collected by B Gizaw
** Sample previously collected by H Armannsson

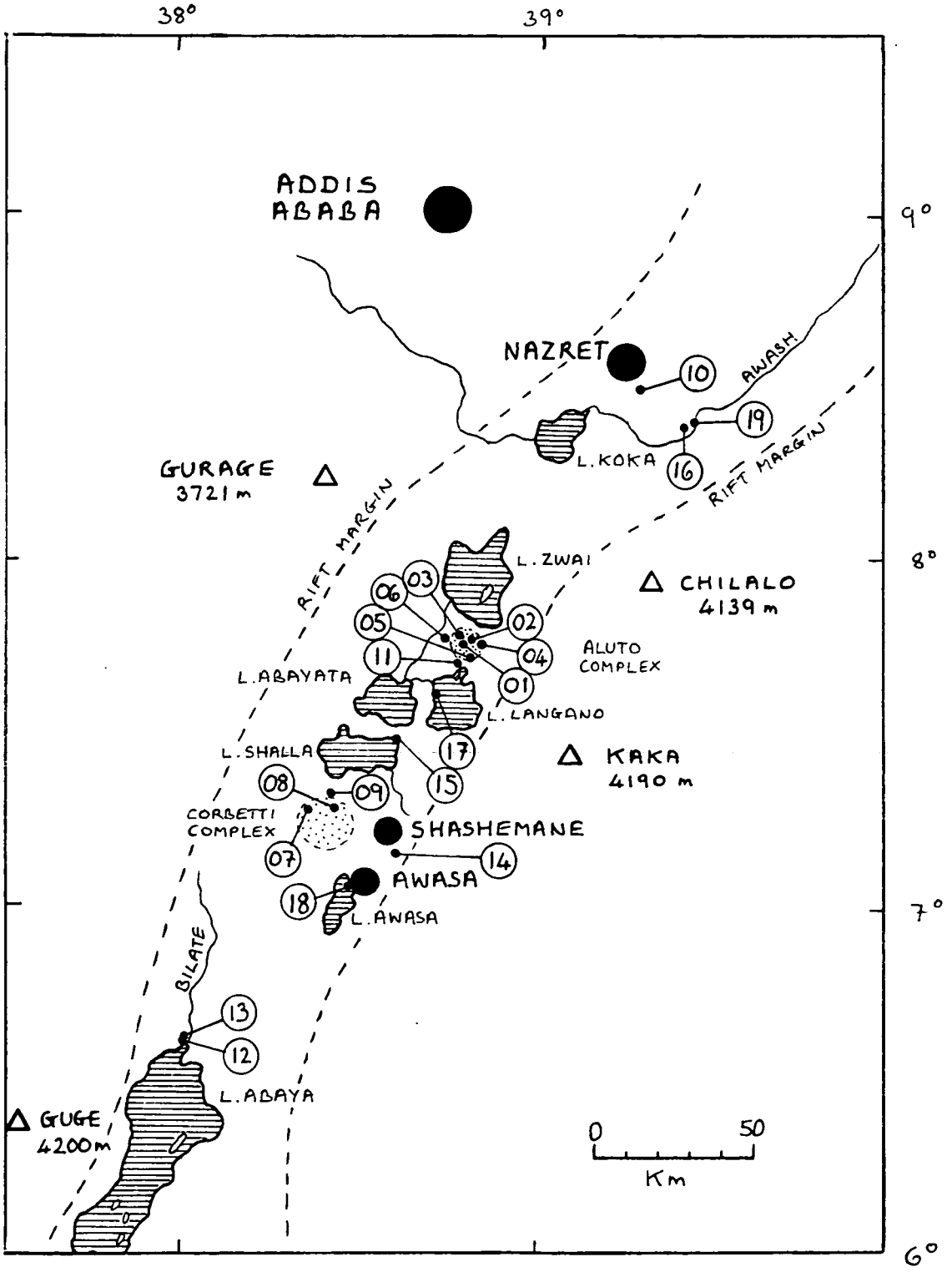

Figure 1 Sampling locations in Ethiopia.

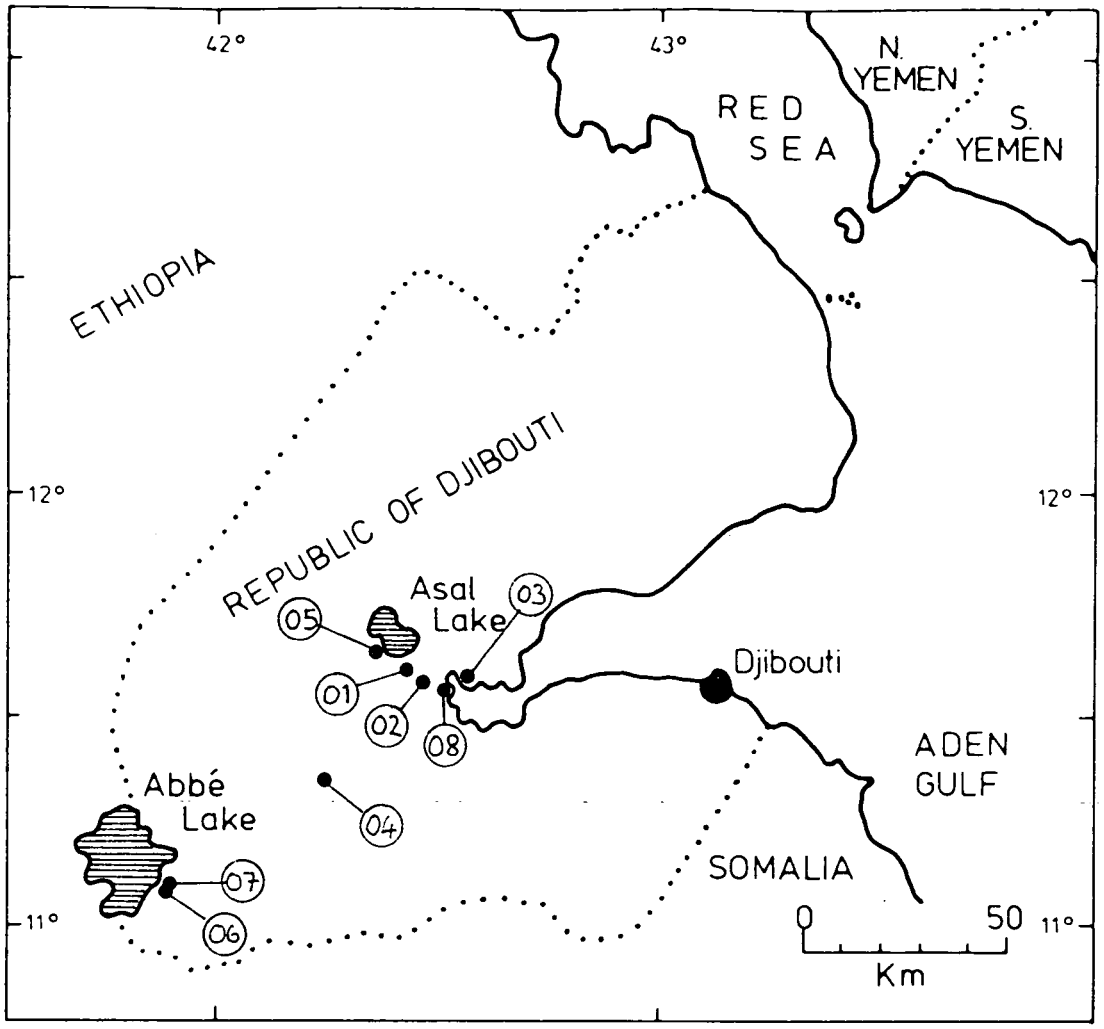

Figure 2 Sampling locations in the Republic of Djibouti.

APPENDIX

Details of Sample Locations

ETH 01-03 Geothermal wells sampled via a Webre separator producing a liquid phase and a gas-steam phase. All wells are situated in the Aluto 'caldera' part of the Langano geothermal field.

ETH 04 Low-CO_2 fumarole, rather weak flow, issuing from slightly altered rock to the E of Aluto summit at Bobessa.

ETH 05 Medium-CO_2 fumarole, medium flow, issuing from SW wall of gully at Gebiba. T = 93°C.

ETH 06 Low-CO_2 fumarole, weak flow, issuing from largely unaltered rock at Aluto. T = 90°C.

ETH 07 Low-CO_2 fumarole, very weak flow, issuing from S wall of gully on W side of Corbetti complex at Chebicha. T = 80°C.

ETH 08 Low-CO_2 fumarole, fairly weak flow individually but collectively a large flow from both sides of a NW-trending gully at Danshe on the northern edge of the Corbetti complex. T ~ 90°C.

ETH 09 High gas and steam flow fumarole at base of N-facing slope a few km north of Corbetti complex. Hole-in-the-ground type fumarole, tending toward mudpot status. T = 94°C.

ETH 10 Extremely weak fumarole with very low gas content issuing from a S-trending fault scarp at Boku. T = 73°C.

ETH 11 Hot spring (Langano Spring #2 in UN report of 1973). Low flow from cracks in the rock. T = 65°C.

ETH 12 Abaya boiling spring (Abaya Spring #6 in UN report of 1973, ET-72 of Craig et al., 1977). Very large and noisy boiling spring situated at base of SE-facing fault scarp. Not possible to obtain a good sample of gases boiling off the water. T ~ 96°C.

ETH 13 Hot spring, shallow 'frying-pan' type, perched above level of ETH 12 (Abaya Spring #7 of UN report of 1973, ET-73 of Craig et al., 1977). Large amount of gas in water, probably representing gas given off by the boiling spring nearby. T ~ 88°C.

ETH 14 Hot spring, Wondo Genet (ET-47 of Craig et al., 1977). Set of springs on E Rift flank, water sampled above thermal pools. T ~ 65°C.

ETH 15 Boiling spring issuing from mudstone near edge of Lake Shalla, NE corner (Shalla Spring #30 of UN report of 1973, ET-30 of Craig et al., 1977). Some gas bubbles. T ~ 96°C.

ETH 16 Hot spring complex at Sodere, issuing from the foot of a large scarp-like feature which may be part of an old caldera structure. Southwesternmost spring of complex was sampled. No gas bubbles seen, small flow, but flow from some of the other springs sufficient to supply large thermal pool complex. T ~ 65°C.

ETH 17 Lake Langano, sampled from the breakwater at the Wabe Shebelle Hotel.

ETH 18 Lake Awasa, sampled from the jetty at the Wabe Shebelle Hotel, Awasa.

ETH 19 River Awash, sampled at Sodere.

DJI 01 Assal geothermal well No. 3, sampled during testing in January 1990.

DJI 02 Weak, low-CO_2 fumarole near Assal No. 5 well, near base of NE-facing fault scarp. pH = 5.35.

DJI 03 Fumarole on summit of a small ridge at the NW end. Medium gas and flow, altered ground. pH = 5.25.

DJI 04 Fumarole in small, highly-altered gully in basalt. High flow of steam, some gas. pH = 5.65.

DJI 05 Hot saline spring near the edge of Lake Assal. T = 35.8°C, pH = 6.43. Sampled in December 1989.

DJI 06 Hot spring issuing from the base of the Big Chimney mound spring on the SE shore of Lake Abbé. T ~ 75°C, pH = 8.70.

DJI 07 Hot spring among the Northern Chimneys on the SE shore of Lake Abbé. Plentiful gas bubbles. T ~ 90°C, pH = 6.05.

DJI 08 Seawater from Plage du Ghoubet.

References in Appendix:

Craig H, Lupton J E and Horowitz R M (1977) Isotopic geochemistry and hydrology of geothermal waters in the Ethiopian rift valley. Scripps Institute of Oceanography Report 77-14.

United Nations Development Programme (1973) Investigation of geothermal resources for power development: Geology, geochemistry and hydrology of hot springs of the East African Rift System within Ethiopia. UNDP Technical Report DP/SF/UN/116.