



ORKUSTOFNUN
Jarðhitadeild

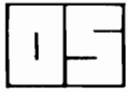
Halldór Ármannsson

LEIRÁ, BORGARFIRÐI

Efnastyrkur borholuvökva
og útfellingahætta

OS81028/JHD16

Reykjavík, desember 1981



ORKUSTOFNUN
Grensásvegi 9, 108 Reykjavík

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ÁGRIP

Í þessari skýrslu eru birtar niðurstöður þeirra efnagreininga, sem gerðar hafa verið á borholuvökva frá Leirá. Vatnið er fremur salt, kalkríkt ölkelduvatn, og efnahiti bendir til 130°C - 200°C innstreymis. Nái vatnið að sjóða verða miklar kalkútfellingar, en unnt ætti að vera að halda kísilútfellingum í skefjum, ef hitastigi er haldið yfir 80°C. Greinilegt millirennslí er milli hola L-1, L-2 og L-4, og hefur rennsli úr L-4 breytt hitastigi og efnasamsetningu rennis úr L-1. Rennsli úr L-1 hefur minnkað með árunum. Útfelling hefur fundist í aðveituæð frá L-1 og reyndist hún kalsít, en áður hafa á holutoppi og í rörum og varmaskipti tilraunastöðvar aðallega fundist aragónítútfellingar.

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1 INNGANGUR

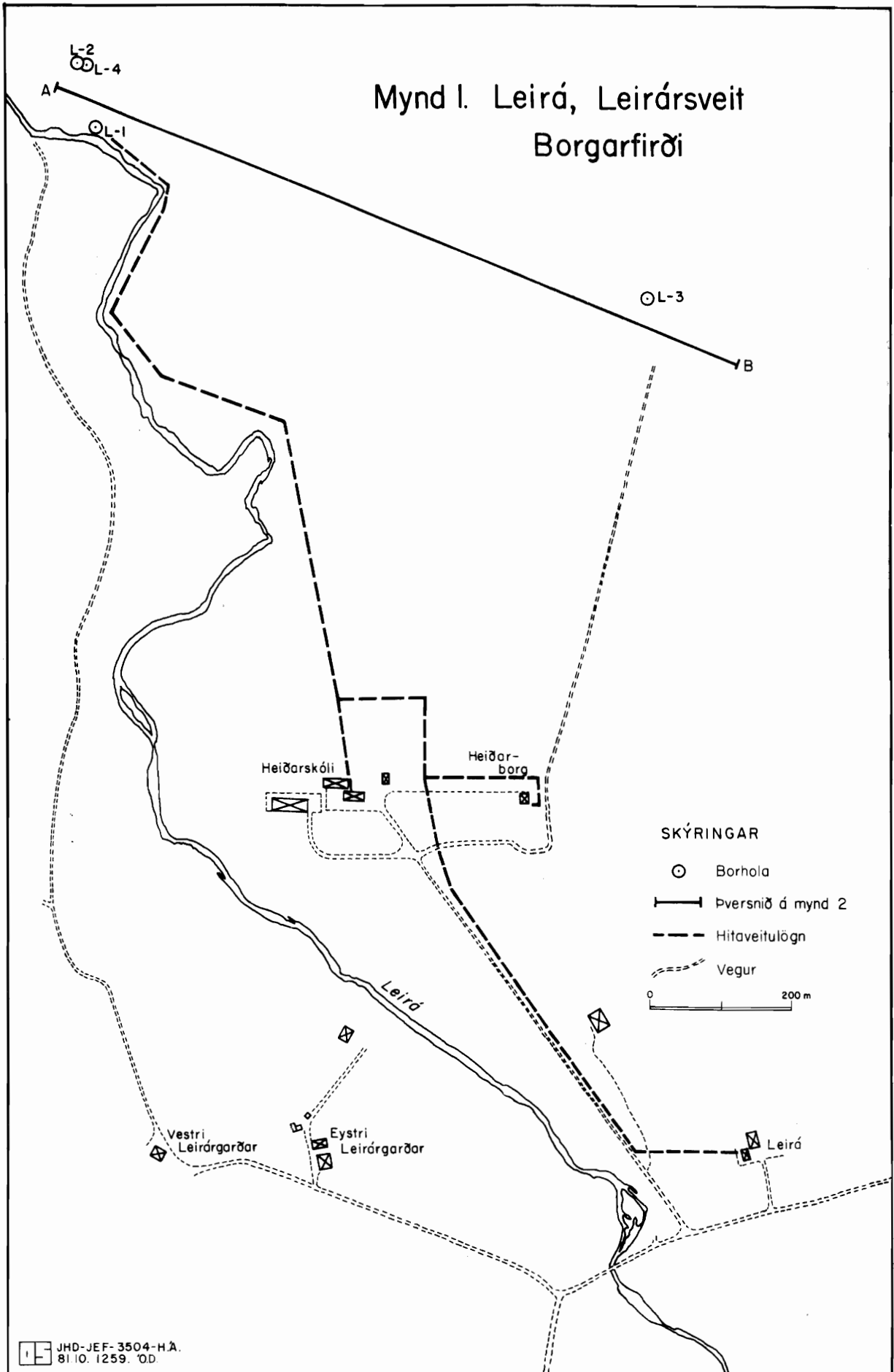
Haustið 1980 varð skortur á heitu vatni í Heiðarskóla í Leirársveit, en vatn er leitt í skólann frá holu L-1, Leirá. Einnig hafði orðið vart hitnunar vatns úr þeirri borholu. Lék grunur á, að sú hitnun væri til komin vegna tengsla holunnar við hina djúpu holu L-4, og að rennsli frá henni inn í L-1 gæti e.t.v. valdið útfellingum.

Til að kanna þetta var farin ferð að Leirá 1980.12.09 og tekin sýni af vatni úr borholunni og úr heitavatnsleiðslu við skólann. Einnig voru fengin sýni af útfellingu úr röri, rennslismælingar gerðar, og skoðaðar aðstæður á nokkrum stöðum á leiðslunni.

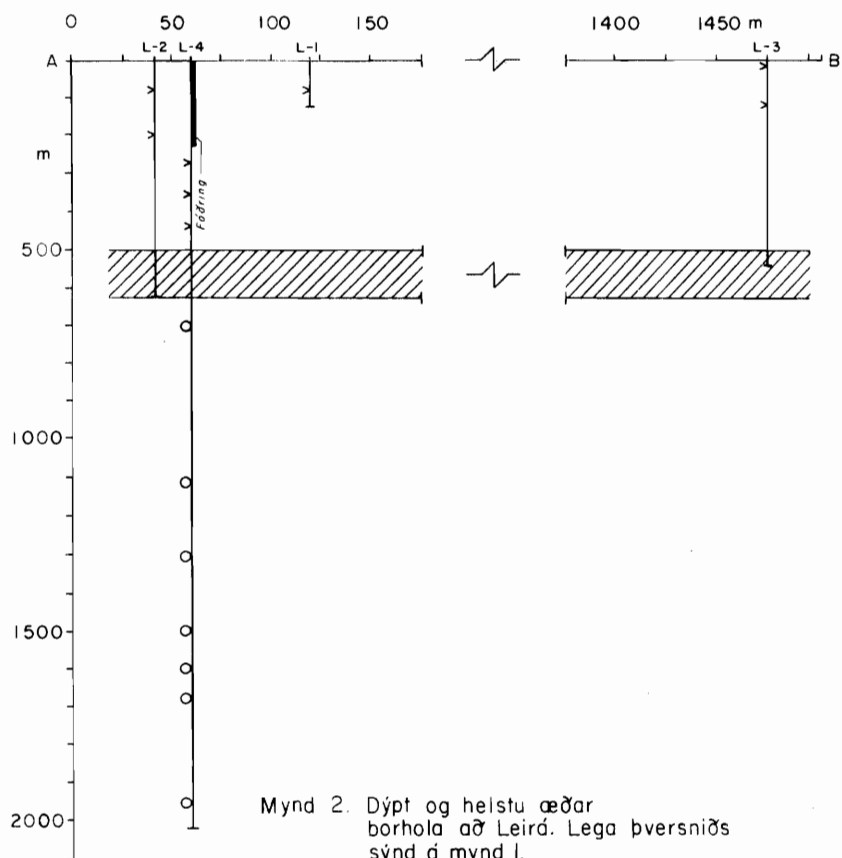
Að Leirá hafa verið boraðar 4 holur, L-1 boruð 1959-1960, L-2 og L-3 boraðar vorið 1974 og L-4 boruð vorið 1975. Lega þeirra og afstaða til helstu bæja og bygginga er sýnd á mynd 1. Þrjár síðasttöldu holurnar voru boraðar vegna könnunar á mögulegri jarðhitanytingu til hitaveitu á Akranesi. Dýpt og helstu æðar þessara hola er sýnt á mynd 2 og niðurstöður hitamælinga úr L-2, L-3 og L-4 á mynd 3. Núverandi hitaveitulögn frá L-1 að Heiðarskóla, Leirá og Heiðarborg var lögð haustið 1976, og er hún sýnd á mynd 1.

Nokkrar skýrslur hafa verið skrifaðar um rannsókn svæðisins (sjá Kristján Sæmundsson o.fl. 1974; Jens Tómasson & Hrefna Kristmannsdóttir 1975; Sverrir Þórhallsson o.fl. 1976), og haustið 1977 kom út skýrsla að nafni: "Heildarkönnun á jarðhitamöguleikum á svæðinu milli Akraness og Skarðsheiðar" (Ingvar Birgir Friðleifsson o.fl. 1977). Þó að allmörg sýni borholuvökva frá Leirá hafi verið efnagreind á Orkustofnun, eru mjög takmarkaðar upplýsingar um þær niðurstöður í skýrslum þessum. Þótti rétt að bæta úr, og verða þær niðurstöður birtar hér og að einhverju leyti fjallað um þær hér á eftir. Fram kemur, að vatnið er fremur salt, kalkríkt ölkelduvatn, sem gæti verið langstaðið og rennsli á svæðinu því tregt. Kalkfelling verður, ef vatninu er ekki haldið undir þrýstingi, en kísilfellingu ætti að vera unnt að forðast, ef hitastig fer ekki niður fyrir 80°C.

Mynd I. Leirá, Leirársveit Borgarfirði

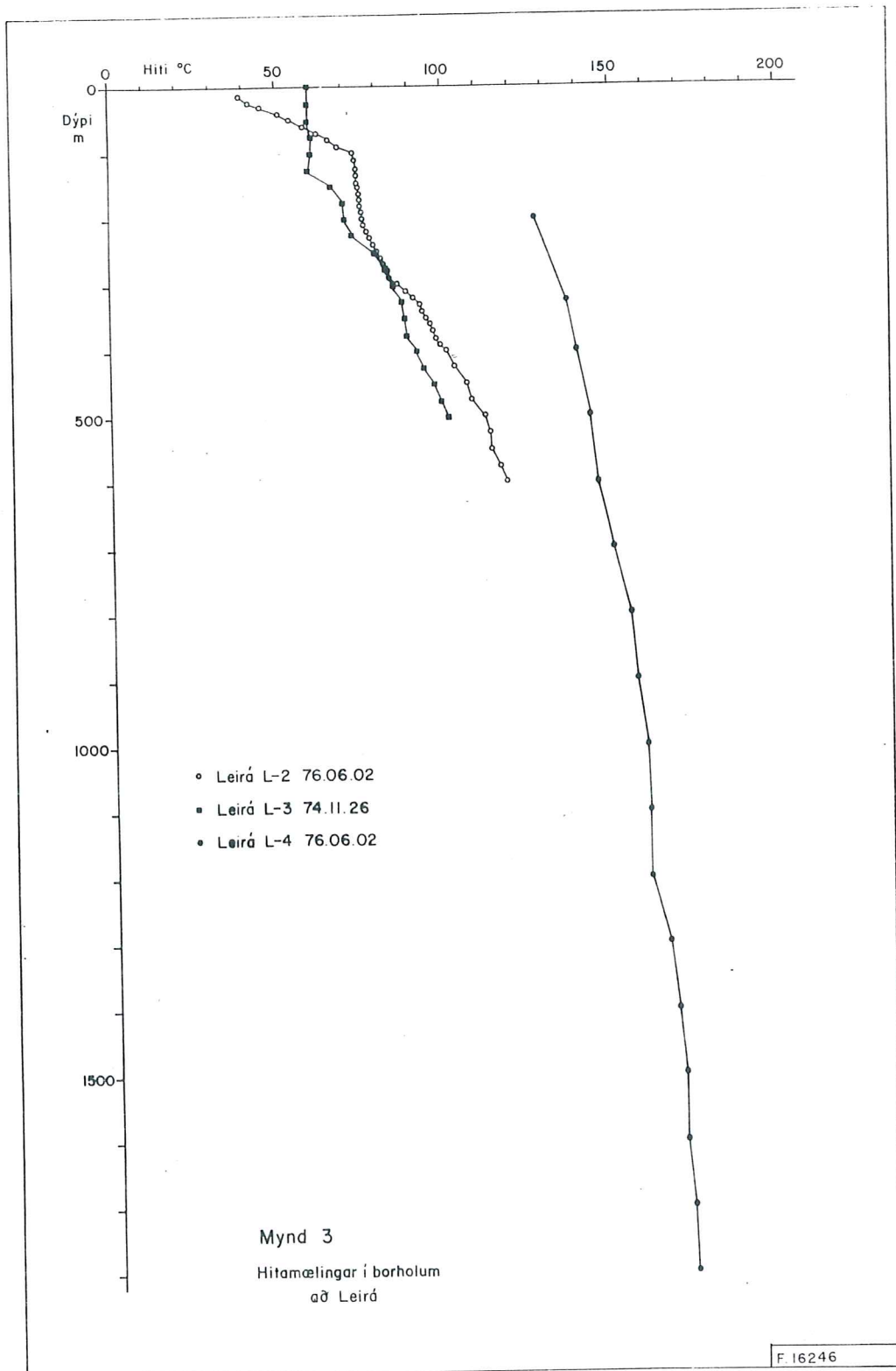


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Mynd 2. Dýpt og helstu æðar
borhola að Leirá. Lega þversniðs
sýnd á mynd 1.

- x | Æð í efra kerfi
- o | Æð í neðra kerfi
- ▨ | Áætluð skil milli efra og neðra vatnskerfis



2 AÐFERÐIR

Yfirléitt var þess gætt þegar sýnum var safnað, að halda toppþrýstingi það háum, að vatnið næði ekki að sjóða. Í þeim tilvikum, þar sem soðnum vatnsfasa var safnað við u.þ.b. 100°C, er þess sérstaklega getið í töflum um niðurstöður efnagreininga.

Hér á eftir fer lauslegt yfirlit um þær efnagreiningaraðferðir, sem beitt var.

Sýrustig, pH var mælt með leiðnimælingu með glerskauti. Hin seinni ár hefur yfirléitt verið notað Radiometer GK 2311C skaut.

Leiðni er mæld með EIL leiðnibrú.

Kísill er greindur sem gult β -mólybdat komplex í sýni, sem er þynnt til að koma í veg fyrir fjölliðun (Gunnlaugur Elísson 1969).

Natríum og kalíum eru mæld með atómisogsaðferð eftir íblöndun litíumlausnar (Halldór Ármannsson og Trausti Hauksson 1978).

Kalsíum og magníum eru mæld með atómisogsaðferð eftir íblöndun lantanlausnar (Willis 1961).

Súlfat var fyrir 1974 mælt gravímetrískt sem baríumsúlfat. Árin 1974-1976 var notuð títrun með blýníttratlausn, þar sem lokastig var ákvarðað með selektróðu. Þessi aðferð gaf ekki alltaf samhljóða niðurstöður, og ber að taka súlfattölum frá þessum árum með varúð. Eftir 1976 hefur verið notuð baríumperklórattítrun með thorin-indikator (Einar Gunnlaugsson 1978 a).

Klór er ákvarðaður með Mohr-títrun í öllum sýnum (Trausti Hauksson 1978).

Flúor er ákvarðaður með selektróðu (Einar Gunnlaugsson 1978 b).

Uppleyst steinefni eru ákvörðuð með þurreimun og vigtun.

Uppleyst gös: Koldíoxíð er ákvarðað með títrun frá pH 8,20 til pH 3,80 með aðstoð pH-glerskauts, en brennisteinsvetni með títrun með kvikasílfursasetati, þar sem dithizon er notað sem indikator (Stefán Arnórsson og Einar Gunnlaugsson 1975).

Sagt er frá samkvæmni efnagreiningaraðferða þessara í greinargerð eftir Gest Gíslason (1981).

3 NIÐURSTÖÐUR EFNAGREININGA

Niðurstöður allra efnagreininga, sem hafa verið gerðar á borholuvökva frá Leirá, þ.m.t. á sýnum frá 1980-12-09 eru skráðar í töflur 1-5.

Heildarefnasamsetning vatns, virknistuðlar, helstu spesiur, efnahiti, oxunarstig og steindajafnvægi voru reiknuð út frá niðurstöðum efnagreininga fullgreindra sýna með aðstoð tölvuforritsins WATCH 3 (Hörður Svavars-son 1981) og suða reiknuð við valin hitastig niður í 100°C með hjálp sama forrits. Útskriftir eru allar í Viðauka 1. Na/K-feldspathiti var reiknaður úr formúlunni

$$\log \text{Na/K (mól/mól)} = -10,96 + 1709/T^\circ (\text{K}) + 3,18 \log T^\circ (\text{K})$$

(Stefán Arnórsson 1979).

Reiknuð efnasamsetning vatnsins er sýnd í töflu 6, efnahiti í töflu 7 og nokkur áhugaverð efnahlutföll í töflu 8.

TAFLA 1 LEIRÁ L-1. Styrkur efna

Dags.	Nr.	T °C	pH/°C	Leiðni ohm m/°C	SiO ₂ mg/kg	Na mg/kg	K mg/kg	Ca mg/kg	Mg mg/kg	SO ₄ mg/kg	Cl mg/kg	F mg/kg	Uppl.e. mg/kg	CO ₂ mg/kg	H ₂ S mg/kg
730831	0123	75,0	7,61/20	7,80/	143,5	229,4	14,8	52,0	2,10	55,6	186,7	2,10	938	247,3	0,0
801209	0177	94,0	6,80/22	8,00/23	193,5	258,0	19,8	51,8	1,52	52,4	274,5	2,30	1010	215,9	0,0
Meðaltal		84,5			168,5	243,7	17,3	51,9	1,81	54,0	230,6	2,20	974	231,6	0,0
Staðalf. %		15,9			21,0	8,3	20,4	0,3	22,7	4,2	26,9	6,4	5,2	9,6	0,0

TAFLA 2 LEIRÁ L-2. Styrkur efna

Dags.	Nr.	T °C	pH/°C	Leiðni ohm m/°C	SiO ₂ mg/kg	Na mg/kg	K mg/kg	Ca mg/kg	Mg mg/kg	SO ₄ mg/kg	Cl mg/kg	F mg/kg	Uppl.e. mg/kg	CO ₂ mg/kg	H ₂ S mg/kg
751009	0164	65,0	7,02/21	10,30/	158,0	206,1	14,3	64,8	2,90	224,8	246,8	2,08	910	255,6	0,0

TAFLA 3 LEIRÁ L-3. Styrkur efna

Dags.	Nr.	T °C	pH/°C	Leiðni ohm m/°C	SiO ₂ mg/kg	Na mg/kg	K mg/kg	Ca mg/kg	Mg mg/kg	SO ₄ mg/kg	Cl mg/kg	F mg/kg	Uppl.e. mg/kg	CO ₂ mg/kg	H ₂ S mg/kg
740717	0062	58,0	6,90/23	6,90/	157,0	392,2	30,9	88,3	5,25	41,3	283,0	0,00	1173	0,0	0,0
751112	0174	62,0	6,64/20	6,90/	160,0	257,9	23,8	73,5	4,12	52,0	302,2	2,04	1065	489,5	0,0
751112	0175	0,0	6,70/20	6,90/	159,0	259,1	24,1	74,5	2,08	55,2	290,1	2,00	1083	463,1	0,0
Meðaltal		60,0			158,7	303,1	26,3	78,8	3,82	49,5	291,8	2,02	1107	476,3	0,0
Staðalf. %		4,7			1,0	25,5	15,3	10,5	42,1	14,7	3,3	1,4	5,2	3,9	0,0

TAFLA 4 LEIRÁ L-4. Styrkur efna

Dags.	Nr.	T°C	pH/°C	Leiðni ohm m/°C	SiO ₂ mg/kg	Na mg/kg	K mg/kg	Ca mc/kg	Mg mg/kg	SO ₄ mg/kg	Cl mg/kg	F mg/kg	Uppl.e. mg/kg	CO ₂ mg/kg	H ₂ S mg/kg
750624	0103	91,0	6,55/20	12,70/	168,0	131,5	20,9	29,6	1,10	131,6	136,5	2,05	644	200,6	0,3
750624	0104	87,0	8,10/20	13,00/	149,0	133,4	16,1	22,6	1,20	59,6	135,7	2,05	605	119,4	0,3
750624	0105	84,5	6,94/20	11,80/	149,0	138,1	12,2	37,8	1,40	52,7	139,8	2,10	649	166,3	0,8
750701	0115	99,4	7,01/22	10,30/	186,0	178,3	13,7	32,4	1,10	144,1	185,0	2,30	1128	179,0	0,8
750710	0117	104,5	6,70/22	10,00/	203,0	189,3	17,0	36,8	1,02	159,8	218,0	2,23	889	227,8	0,5
751112	0173	122,0	6,70/20	9,50/	265,0	225,2	24,7	21,6	0,12	70,5	273,0	2,45	946	171,2	5,8
1) 751112	0177	100,0	8,40/20	8,70/	270,0	270,0		25,1	1,94		286,2		1020	186,1	0,6
1) 751112	0178		7,80/20	9,50/	262,0	262,0		20,8	1,29		270,4		954	121,8	3,7
760213	0015	127,0	6,92/19	10,00/	213,0	212,9	20,6	27,4	0,37	56,5	240,3	2,34	894	186,1	0,0
1) 760213	0016	100,0	8,40/19	10,00/	211,0	199,2	21,1	21,4	0,33	56,4	246,3	2,34	889	124,5	0,0
760219	0017	128,0	6,29/20	9,10/	219,0	219,0		30,9					278,6	0,3	
1) 760219	0018	97,8	8,42/20	9,10/				14,9					118,9	0,3	
1) 760219	0019	96,2	8,67/20	9,10/				15,6					117,1	2,9	
1) 760219	0020	95,6	8,64/20	9,10/				14,4					117,7	1,7	
1) 760219	0021	100,0	8,72/20	9,00/				16,8					117,3	2,4	
790809	3055		6,94/11	8,50/20	237,2	244,2	27,6	15,4	0,66	55,3	263,8	2,97	971	156,6	5,4
Meðaltal		102,4			211,0	183,6	19,3	24,0	0,96	87,4	217,7	2,31	872	161,8	1,8
Staðalf.	%	13,5			20,2	22,7	26,1	32,5	56,3	50,6	27,0	12,2	19,3	29,31	4,8

1) Soðnum vatnsfasa safnað

TAFLA 5 HEIÐARSKÓLI HITAVEITULÖGN. Styrkur efna

Dags.	Nr.	T°C	pH/°C	Leiðni ohm m/°C	SiO ₂ mg/kg	Na mg/kg	K mg/kg	Ca mg/kg	Mg mg/kg	SO ₄ mg/kg	Cl mg/kg	F mg/kg	Uppi.e. mg/kg	CO ₂ mg/kg	H ₂ S mg/kg
801209	0176	93,0	6,70/22	7,40/23	194,4	261,0	18,1	47,2	1,40	52,2	290,0	2,20	1008	248,4	0,0

TAFLA 6 Reiknaður efnastyrkur í vatni að Leirá. (Reiknað fyrir fullgreind sýni)

Hola nr	Dags.	Sýni nr	pH	SiO ₂ mg/kg	Na mg/kg	K mg/kg	Ca mg/kg	Mg mg/kg	SO ₄ mg/kg	Cl mg/kg	F mg/kg	CO ₂ mg/kg	H ₂ S mg/kg	Uppleyst efni mg/kg
L-1	1973-08-31	0123	7,4	144	229	14,8	52,0	2,10	55,6	187	2,10	247	0,00	938
L-1	1980-12-09	0177	7,0	193	258	19,8	51,8	1,52	52,4	274	2,30	216	0,00	1010
L-2	1975-10-09	0164	7,1	158	206	14,3	64,8	2,90	225,0	247	2,08	256	0,00	910
L-3	1975-11-12	0174	6,8	160	258	23,8	73,5	4,12	52,0	302	2,04	490	0,00	1065
L-3	1975-11-12	0175	6,8	159	259	24,1	74,5	2,08	55,2	290	2,00	463	0,00	1083
L-4	1975-06-24	0103	6,7	168	132	20,9	29,6	1,10	131,6	136	2,05	201	0,35	644
L-4 ¹⁾	1975-06-24	0104	7,5	149	133	16,1	22,6	1,20	59,6	136	2,05	119	0,26	605
L-4	1975-06-24	0105	7,0	149	138	12,2	37,8	1,40	52,7	140	2,10	166	0,78	649
L-4	1975-07-01	0115	7,2	186	178	13,7	32,4	1,10	144,0	185	2,30	179	0,80	1128
L-4	1975-07-10	0117	7,0	203	189	17,0	36,8	1,02	160,0	218	2,23	228	0,48	889
L-4	1975-11-12	0173	7,2	265	225	24,7	21,6	0,12	70,5	273	2,45	171	5,80	946
L-4	1976-02-13	0015	7,1	213	213	20,6	27,4	0,37	56,5	240	2,34	186	0,00	894
L-4 ¹⁾	1976-02-13	0016	7,6	211	199	21,1	21,4	0,33	56,4	246	2,34	124	0,00	889
L-4	1979-08-09	3035	7,1	237	244	27,6	15,4	0,66	55,3	264	2,97	157	5,40	971

1) Soðnum vatnsfasa safnað

TAFLA 7 Efnahiti borholuvökva frá Leirá (Reiknaður fyrir fullgreind sýni)

Hola nr	Dags.	Sýni nr	Kísilh. °C	NaKCa hiti °C	NaK 1 hiti °C	NaK 2 hiti °C	NaK Feldspat hiti °C
L-1	1973-08-31	0123	131	155	138	145	152
L-1	1980-12-09	0177	155	166	155	161	165
L-2	1975-10-09	0164	139	93	145	151	157
L-3	1975-11-12	0174	141	172	175	179	179
L-3	1975-11-12	0175	141	172	176	180	180
L-4	1975-06-24	0103	145	198	246	244	230
L-4	1975-06-24	0104	133	185	207	209	202
L-4	1975-06-24	0105	136	95	170	175	175
L-4	1975-07-01	0115	151	163	155	161	165
L-4	1975-07-10	0117	159	171	172	176	181
L-4	1975-11-12	0173	197	190	195	198	194
L-4	1976-02-13	0015	162	180	180	184	183
L-4	1976-02-13	0016	157	186	191	191	191
L-4	1979-08-09	3055	170	197	199	201	197

TAFLA 8 Nokkur efnahlutföll borholuvökva frá Leirá

(Reiknuð fyrir fullgreind sýni)

Hola nr	Dags	Sýni nr	Na/Cl	Na/K	F/Clx10 ³
L-1	1973-08-31	0123	1,22	15,5	11,2
L-1	1980-12-09	0177	0,94	13,0	8,9
L-2	1975-10-09	0164	0,83	14,4	8,4
L-3	1975-11-12	0174	0,85	10,8	6,8
L-3	1975-11-12	0175	0,89	10,7	6,9
L-4	1975-06-24	0103	0,97	6,3	15,1
L-4	1975-06-24	0104	0,98	8,3	15,1
L-4	1975-06-24	0105	0,99	11,3	15,0
L-4	1975-07-01	0115	0,96	13,0	12,4
L-4	1975-07-10	0117	0,87	11,1	10,2
L-4	1975-11-12	0173	0,82	9,1	9,0
L-4	1976-02-13	0015	0,89	10,3	9,8
L-4	1976-02-13	0016	0,81	9,4	9,5
L-4	1979-08-09	3035	0,92	8,8	11,2

4 UPPRUNI VATNSINS

Vatnið er salt og kalkríkt ölkelduvatn. Þökkalegt samræmi er í efna-
hita, reiknuðum með mismunandi aðferðum (tafla 7), og eru þau gildi
ekki fjarri mældum hita (mynd 3). Bendir það til þess, að vatnið sé
í góðu jafnvægi við berg, geti jafnvel verið langstaðið og rennsli tregt.
Na/Cl hlutfall er áþekkt því, sem gerist í sjó. Gæti það stafað af
blöndun við sjó eða rennsli um sölt setlög. Bragi Árnason (1976) mældi
tvívetni og fékk gildið - 73,8 ⁰/100. Er það líkt og í úrkomu vestan
Langjökuls. Telur hann vatnið þaðan runnið, og seltuna úr söltum set-
lögum komna. Sé vatnið hins vegar langstaðið, hefðu jónskipti við berg
getað átt sér stað. Upprunalegur tvívetnisstyrkur hefði þá verið all-
miklu hærri en lækkað smám saman vegna jónskipta, og seltan til komin
vegna blöndunar við sjó fyrir all löngu.

5 VATNSKEPPI OG TENGL MILLI HOLA

Dælingar hafa leitt í ljós tengsl milli hola L-1, L-2 og L-4, en hola L-3 virðist vera sér á parti (Sverrir Þórhallsson o.fl. 1976). Vatnafræðilega er æðum í holu L-4 skipt í tvö kerfi, efra og neðra kerfi og eru skilin talin á 5-700 m dýpi (sjá mynd 2). Erfitt er að finna slíka skiptingu efnafræðilega séð. Þó má benda á, að vökvi holu L-3 er áberandi koldíoxíðríkastur, og fylgir einnig hærri kalsíumstyrkur en finnst í hinum holunum. Koldíoxíð er hvað minnst í holu L-4, og er eins og minna koldíoxíð komi úr "neðra kerfi" hennar en hinu "efra". Selta er hins vegar svipuð alls staðar, og breytingar efnahlutfalla ekki aðrar en reikna má með við mismunandi hita.

Greinilegur munur er á efnasamsetningu og hitastigi vökva holu L-1 1973-08-31 og 1980-12-09 (sjá töflur 1 og 6). Hitastig hafði hækkað, styrkur kísils, natríums, kalíums og klórs aukist, magníumstyrkur minnkað og sýrustig lækkað. Eru þessar breytingar á þá lund, að um verulega blöndun við vökva úr holu L-4 getur verið að ræða. Hola L-4 stóð undir þrýstingi 1980-12-09 en þá rann vatn úr L-1, og er eðlilegt, að við slíkar aðstæður renni frá L-4 í L-1, þar sem greinilegt rennsli varð úr L-1 í L-4 við dælingu úr L-4 (Sverrir Þórhallsson o.fl. 1976).

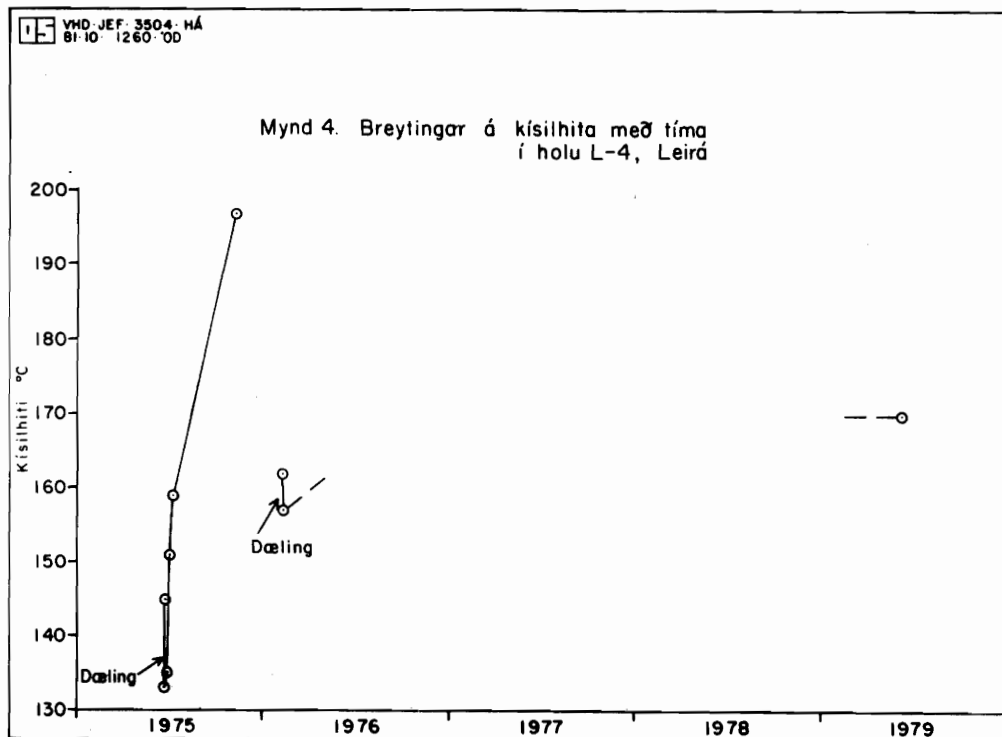
6 ÁHRIF DÆLINGAR Á EFNASTYRK VÖKVA L-4

Sé litið á mynd 4, virðist kísilhiti lækka við dælingu. Rennir það stoðum undir þá kenningu, að rennsli úr efra (kaldara) kerfinu hafi verið örvað meira við dælingu en rennsli úr því neðra (og heitara). Aðrar breytingar á styrk efna samræmast og þeirri hugmynd.

Rétt er þó að benda á, að í september 1979 er kísilhiti lægri en í desember 1976, og styrkur annarra efna bendir til þess að hlutur neðri æða í heildarrennsli holunnar hafi minnkað á þessu tímabili. Hér skal bent á tvær hugsanlegar ástæður:

- 1) Dælingin í febrúar 1976 hefði getað haft varanleg áhrif á afstaðan hlut efri og neðri æða í heildarrennsli.
- 2) Neðri æðar hafa e.t.v. stíflast meira af völdum útfellinga en þær efri.

Úr þessu fengist e.t.v. skorið með rennslismælingum.



7 RENNSLI ÚR HOLU L-1

Skv. fyrri heimildum var rennsli úr holu L-1 8 kg/s eftir borun (sjá Kristján Sæmundsson o.fl. 1974). Gerðar voru rennslismælingar á þeim stöðum 1980-12-09, sem frárennsli er (sjá mynd 1) og eru niðurstöður þeirra sýndar í töflu 9. Samanlagt rennsli reyndist þá um 3,4 kg/s og er það greinileg minnkun, einkum ef tekið er tillit til þess, að við hefur best millirennsli frá holu L-4.

Vegna ákveðinna vandkvæða hefur ekki reynst unnt að mæla heildarrennsli eftir að sigti með útfellingum (sjá nánar í 8 kafla) var fjarlægt, en gera má ráð fyrir, að við það hafi orðið rennslisaukning.

TAFLA 9 Rennsli og hitastig vökva frá holu L-1, Leirá, 1980-12-09

Staður	Op	Rennsli kg/s	Hitastig		Prýstingur bar
			Inn	Út	
Hola L-1	Útrennsli framhjá hitaveitulögn	1,02	(≈100)	94	
Heiðarskóli	Inntak hitaveitu	0,98	93	62	0,45
Heiðarborg	- " -	0,63	94	74	
Leirá	Hús Frárennsli	0,15		53	
- " -	Fjós Frárennsli	0,18		64,5	
- " -	Gróðurhús Frárennsli	0,43			
Samtals		3,39			

8 ÚTFELLINGAR

Á mynd 5 er sýndur mettnarferill kalsíts (Helgeson 1969), og reiknuð kalsíumkarbónatljónamargfeldi (frá kísilhita niður í 100°C), og má sjá, að vökvi úr öllum Leirárholum er mjög yfirmettaður með tilliti til kalks, og má búast við kalkútfellingum í þeim. Útfellingar hafa fundist í ríkum mæli í sambandi við dælingarprófanir og rekstur tilraunastöðvar til athugunar á nýtingu vatnsins í varmaskiptum (Sverrir Þórhallsson o.fl. 1976). Þær útfellingar voru að miklu leyti aragónít, og sýni af hrúðri við holutopp L-1, sem tekið var sumarið 1980 reyndist hreint aragónít.

Í ágúst 1981 var tekið sýni af útfellingu í röri heitavatnslagnar frá holu L-1, um það bil 5 m frá holutoppi L-1 (sjá mynd 1) eða þar sem reiknað var með suðuborði. Reyndist felling ekki ýkja mikil, þverskurðarflatarmál sýnisins var 335 mm², en heildarþverskurðarflatarmál innan í röri er 5156 mm². Skv því myndi taka 77 ár að stífla rörið á þessum stað með sama fellingarhraða, en fremur má búast við að dragi úr honum en hitt, vegna minnkandi fellingaryfirborðs. Sams konar útfellingar varð vart í sigti, sem sett hafði verið í rörið við holutopp. Reyndar var það stíflað af útfellingunni, og skýrir sú stíflun væntanlega þann vatnsskort, sem orðið hefur vart við í Heiðarskóla. Útfellingin í rörinu var röntgengreind og brá nú svo við, að um hreint kalsít var að ræða. Sennilega ráða aðstæður fellingar gerð útfellingar. Ellis og Mahon (1977, bls. 300-301) lýsa t.d. útfellingum úr borholum á Kizildersvæðinu í Tyrklandi þannig, að við fyrsta suðuborð og í minni mæli ofar í fóðringu myndaðist kalsít, en mikil yfirmettun af völdum gufutaps varð til þess, að mikið aragóníthrúður myndaðist í yfirborðsleiðslum og tækjum. Koma má í veg fyrir kalsíumkarbónatfellingu með því að halda þrýstingi uppi og forðast þannig suðu. Þannig varð óveruleg kalkfelling meðan á þriggja mánaða varmaskiptatilraun stóð á Leirá sumarið 1976. Notað var vatn úr holu L-4, og náði það hvergi að sjóða í kerfinu (Ingvar Birgir Friðleifsson o.fl. 1977).

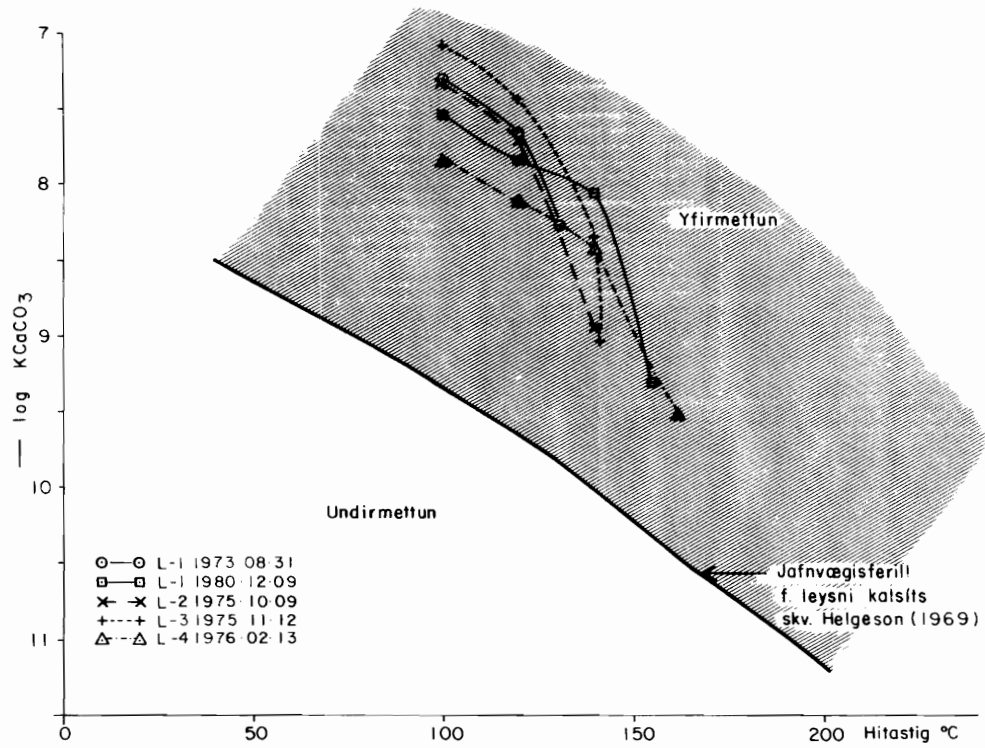
Þar sem innstreymi er allheitt og kísilstyrkur borholuvökva því mikill, þótti ástæða til að kanna hættu á kísilfellingu. Ópalmettunarhitastig við þrenns konar aðstæður í holu L-4 (kísilstyrkur er minni í hinum

holunum) eru sýnd í töflu 10. Er það aldrei hærra en 70°C. Sé hitastigi haldið vel ofan við það (t.d. alltaf > 80°C) ætti ekki að vera hætt á ópalfellingu. Þar sem mikil selta flýttir fyrir slíkri fellingu gæti hún orðið hröð, ef hitastig færi niður fyrir 50-70°C. Í varmaskiptatilraun eil könnunar fellingarhættu við notkun vatns úr holu L-4 í varmaskiptum reyndist kísilfelling óveruleg, þó svo að vatnið væri kælt niður í 20-30°C (Ingvar Birgir Friðleifsson o.fl. 1977).

TAFLA 10 Ópalmettunarhitastig rennis holu L-4, Leirá á þremur mismunandi tímum

Dags.	Ópalmettunar- mörk, °C	Aðstæður
1975-11-12	64	Sjálfrennsli
1976-02-13 - 19	44	Dæling
1979-08-09	54	Sjálfrennsli

VHD-JEF 3504 HA
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Mynd 5. Mettunarferlar kalsíts í borholuvökva frá Leirá
(Reikað frá kísilhita, og suða reiknuð
við 140°C, 120°C, og 100°C).

HEIMILDASKRÁ

Bragi Árnason 1976: Groundwater systems in Iceland traced by deuterium.
Vísindafélag Íslendinga, XLII, 236 s.

Einar Gunnlaugsson 1978 a: Greining á sulfati. Orkustofnun, OSJHD 7818,
11 s.

Einar Gunnlaugsson 1978 b: Fluormæling. Orkustofnun, OSJHD 7817, 8 s.

Ellis, A.J. & Mahon, W.A.J. 1977: Chemistry and Geothermal Systems,
New York, Academic Press, 392 s.

Gestur Gíslason 1981: Athugun á samkvæmni efnagreininga. Orkustofnun,
greinargerð GG-81/01, 4 s.

Gunnlaugur Elísson 1969: Athugun á kísil í hveravatni á nokkrum háhita-
svæðum. Raunvísindastofnun Háskólans, 30 s.

Halldór Ármannsson og Trausti Hauksson 1978: Um natriúmakvörðun. Orku-
stofnun, OSJHD 7815, 8 s.

Helgeson, H.C. 1969: Thermodynamics of hydrothermal systems at elevated
temperatures. Am.J.Sci, 267, 729-804.

Hörður Svavarsson 1981: Forritin "WATCH 1" og "WATCH 3". Hjálpartæki
til túlkunar efnagreininga á jarðhitavatni. Leiðbeiningar fyrir
notendur. Orkustofnun, OS81007/JHD03, 70 s.

Ingvar Birgir Friðleifsson, Lúðvík Georgsson og Hjalti Franzson 1977:
Heildarkönnun á jarðhitamöguleikum á svæðinu milli Akraness og
Skarðsheiðar. Orkustofnun, OSJHD 7714, 41 s + myndir.

Jens Tómasson og Hrefna Kristmannsdóttir 1975: Leirá hola 4. Orkustofnun,
OSJHD 7551, 13 s + töflur og myndir.

Kristján Sæmundsson, Stefán Arnórsson, Valgarður Stefánsson, Guðmundur Sigurósson og Sigurður Benediktsson 1974: Skýrsla um jarðhitarannsóknir við Leirá í Leirársveit. Orkustofnun, OSJHD 7402, 10 s + myndir.

Stefán Arnórsson 1979: Hydrochemistry in geothermal investigations in Iceland. Techniques and applications. Nordic Hydrology, 191-224.

Stefán Arnórsson og Einar Gunnlaugsson 1975: Leiðbeiningar um söfnun vatns- og gassýna. Orkustofnun, OSJHD 7522, 27 s + viðaukar og myndir.

Sverrir Þórhallsson, Þorsteinn Thorsteinsson & Gestur Gíslason 1976: Framvinduskýrsla um rannsóknir að Leirá. Orkustofnun, OSJHD 7617, 12 s + töflur og myndir.

Trausti Hauksson 1978: Greining klórs í jarðhitavatni. Orkustofnun, OSJHD 7816, 10 s.

Willis, J.B. 1961: Determination of calcium and magnesium in urine by atomic absorption spectroscopy. Anal. Chem., 33, 556-559.

VIÐAUKI

Reikningar á efnastyrk djúprennis og breytingum hans
frá kísilhita niður í 100°C.
Valin hitastig.

GROUNDWATER
191-01-23

PROGRAM WATERZ.

3504 400 101 75- 8-31 123

LEINA 1-1

LETIMR- DE HELMAR. BORGAS-ARANSYSLA SA

WATER SAMPLE (PPM)

Table with columns: PARAMETER, VALUE, UNIT, and COMMENTS. Includes parameters like PPM/REG-C, S102, MA, K, CA, MG, S04, HCS, CL, F, AL, FE, NH3, S, and Z.

LITERS GAS PER KG

Table with columns: PARAMETER, VALUE, UNIT, and COMMENTS. Includes parameters like CONDENSATE/REG-C, CONDENSATE (PPM), and CONDENSATE WITH MAH3 (PPM).

MEASURED BOWENHOLE TEMP. / FLUID INFLOW

Table with columns: PARAMETER, VALUE, UNIT, and COMMENTS. Includes parameters like MEASURED BOWENHOLE TEMP. and FLUID INFLOW.

IONIC BALANCE :

Table with columns: IONIC BALANCE, VALUE, UNIT, and COMMENTS. Includes parameters like IONIC BALANCE and ANIONS (MOL. EQ. 10.017005).

DEEP WATER (PPM)

Table with columns: PARAMETER, VALUE, UNIT, and COMMENTS. Includes parameters like S102, MA, K, CA, MG, S04, CL, F, DIS.S., AL, B, FE, H2O, and BOILING PORTION.

ACTIVITY COEFFICIENTS IN DEEP WATER

Table with columns: ION, VALUE, and UNIT. Lists activity coefficients for various ions like NH4+, KSO4-, F-, Cl-, NH3, etc.

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLE)

Table with columns: ION, VALUE, and UNIT. Lists chemical components and their concentrations in PPM and LOG MOLE.

IONIC BALANCE :

Table with columns: IONIC BALANCE, VALUE, UNIT, and COMMENTS. Includes parameters like IONIC BALANCE and CATIONS (MOL. EQ. 10.0129225).

CHEMICAL GEOTHERMOMETERS DEGREES C

Table with columns: TEMPERATURE, VALUE, and UNIT. Lists chemical geothermometer temperatures in degrees Celsius.

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

Table with columns: MINERAL, LOG SOLUBILITY PRODUCT, and COMMENTS. Lists log solubility products for various minerals.

ACTIVITY COEFFICIENTS IN DEEP WATER

Table with columns: ION, VALUE, and UNIT. Lists activity coefficients for various ions like NH4+, KSO4-, F-, Cl-, NH3, etc.

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLE)

Table with columns: ION, VALUE, and UNIT. Lists chemical components and their concentrations in PPM and LOG MOLE.

IONIC BALANCE :

Table with columns: IONIC BALANCE, VALUE, UNIT, and COMMENTS. Includes parameters like IONIC BALANCE and CATIONS (MOL. EQ. 10.0129225).

CHEMICAL GEOTHERMOMETERS DEGREES C

Table with columns: TEMPERATURE, VALUE, and UNIT. Lists chemical geothermometer temperatures in degrees Celsius.

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

Table with columns: MINERAL, LOG SOLUBILITY PRODUCT, and COMMENTS. Lists log solubility products for various minerals.

ORONISTOPAN
1981-09-23

DEEP WATER BOILED AT 120.0 DEGREES C.
1981-09-23

LOG DISTRIBUTION COEFFICIENTS CO2 = 3.52 H2S = 3.04 GAS SOLUBILITY MULTIPLYING FACTOR 1.00

DEEP WATER (PPM) DEEP STEAM (PPM) GAS PRESSURES (MMHG ABS.)

SiO2	144.59	CO2	4030.39	CO2	0.237E+02
H	234.31	H2S	0.00	H2S	0.00E+00
K	15.12	H2	0.00	H2	0.00E+00
Ca	53.11	O2	0.00	O2	0.00E+00
Na	2.14	CH4	0.00	CH4	0.00E+00
SO4	56.79	H2	0.00	H2	0.00E+00
CL	170.68	H2S	0.00	H2S	0.00E+00
DIS.S.	2.15	H2O	0.00	H2O	0.199E+01
A	0.0000	ROLLING FRICTION	2.10	TOTAL	0.199E+01
B	0.0000		0.02		

ACTIVITY COEFFICIENTS IN DEEP WATER

H+	0.802	HSO4-	0.849	FEH+	0.579	FECL+	0.863
OH-	0.841	F-	0.841	FEH+	0.326	ALH++	0.326
K2SiO4	0.843	CL-	0.859	FEDH+	0.847	ALOH+	0.372
HSiO4-	0.572	NA+	0.843	FE(OH)3-	0.847	AL(OH)2+	0.869
H3BO3-	0.854	K+	0.859	FE(OH)4--	0.568	AL(OH)4-	0.865
HCO3-	0.843	CAH+	0.579	FEDH+	0.568	ALSOH+	0.865
CO3--	0.543	MSH+	0.598	FE(OH)2+	0.849	AL(SO4)2-	0.865
HS-	0.841	CaHCO3+	0.571	FE(OH)4-	0.849	ALFH+	0.572
S--	0.548	MSHCO3+	0.843	FESOH+	0.847	ALF2+	0.869
HSO4-	0.845	CaOH+	0.871	FECL+	0.568	ALFA-	0.865
SO4--	0.557	MSOH+	0.873	FECL2-	0.847	ALFS--	0.543
MSO4-	0.849	MMH+	0.854	FECL4-	0.843	ALF3---	0.275

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MMOL)

H+	(ACT.)	0.00	-8.481	MSH+	1.33	-1.254	FE(OH)3	0.00	0.000
OH-	6.35	-3.478	NaCl	0.74	-4.875	FE(OH)4-	0.00	0.000	
HSiO4-	152.65	-2.799	KCl	0.01	-6.751	FECL+	0.00	0.000	
MSiO4-	73.54	-3.112	MSO4-	1.84	-4.867	FECL2	0.00	0.000	
MSiO4--	0.38	-5.371	KSO4	0.38	-5.350	FECL+	0.00	0.000	
MSiO4-	8.74	-4.131	CaSO4	7.17	-4.278	FECL2	0.00	0.000	
MSO3-	0.00	0.000	MSO4	1.96	-4.788	FECL3	0.00	0.000	
MSO3-	0.00	0.000	CaCO3	38.44	-3.413	FECL4-	0.00	0.000	
MSO3-	1.73	-4.525	MSO3	0.63	-5.129	FESO4	0.00	0.000	
MSO3-	188.78	-2.510	MSHCO3+	16.89	-3.777	FESOH+	0.00	0.000	
CO3--	5.61	-4.029	MSHCO3+	0.22	-5.379	ALH++	0.00	0.000	
MS-	0.00	0.000	MSH+	0.42	-5.130	AL(OH)2+	0.00	0.000	
MS-	0.00	0.000	MSOH+	0.25	-5.210	AL(OH)3	0.00	0.000	
MS-	0.00	0.000	MSOH+	0.00	0.000	AL(OH)4-	0.00	0.000	
MSO4	0.00	-8.946	MMH+	0.00	0.000	ALSOH+	0.00	0.000	
MSO4-	48.40	-3.278	FEH+	0.00	0.000	AL(SO4)2-	0.00	0.000	
HF	0.00	-8.461	FEDH+	0.00	0.000	ALFH+	0.00	0.000	
F-	2.15	-3.947	FE(OH)2+	0.00	0.000	ALF2+	0.00	0.000	
CL-	196.22	-2.270	FE(OH)3-	0.00	0.000	ALF3---	0.00	0.000	
MSH+	231.96	-1.976	FE(OH)4--	0.00	0.000	ALFA-	0.00	0.000	
K+	15.00	-3.416	FE(OH)4-	0.00	0.000	ALFS--	0.00	0.000	
CAH+	28.54	-3.148	FE(OH)2+	0.00	0.000	ALF3---	0.00	0.000	

IONIC BALANCE : CATIONS (MMOL) = 0.01293 ANIONS (MMOL) = 0.01293
DIFFERENCE (MMOL) = 0.00000

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

ANHALSIA	TEOR.	99.999	ALBITE LOW	TEOR.	99.999
AMPHIBOLE	TEOR.	-14.117	ALBITE	TEOR.	-15.144
ANALCITE	TEOR.	-5.889	ALUNITE	TEOR.	-9.444
MC-CALCITE	TEOR.	-79.144	CELESTINE	TEOR.	-10.537
LAPOPHITE	TEOR.	-25.588	MC-CALCITE	TEOR.	-17.377
CA-MONTROK	TEOR.	-74.584	MC-MONTROK	TEOR.	-37.279
MA-MONTROK	TEOR.	-37.100	MC-SIDERITE	TEOR.	-19.144
PHYRROPHITE	TEOR.	1.126	MC-SIDERITE	TEOR.	-40.785
MALACHITE	TEOR.	-23.519	MC-SIDERITE	TEOR.	9.729
EPIDOTE	TEOR.	99.999	MALACONITE	TEOR.	10.777

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER (CONT.)

ANHALSIA	TEOR.	99.999	ALBITE LOW	TEOR.	99.999
AMPHIBOLE	TEOR.	-14.117	ALBITE	TEOR.	-15.144
ANALCITE	TEOR.	-5.889	ALUNITE	TEOR.	-9.444
MC-CALCITE	TEOR.	-79.144	CELESTINE	TEOR.	-10.537
LAPOPHITE	TEOR.	-25.588	MC-CALCITE	TEOR.	-17.377
CA-MONTROK	TEOR.	-74.584	MC-MONTROK	TEOR.	-37.279
MA-MONTROK	TEOR.	-37.100	MC-SIDERITE	TEOR.	-19.144
PHYRROPHITE	TEOR.	1.126	MC-SIDERITE	TEOR.	-40.785
MALACHITE	TEOR.	-23.519	MC-SIDERITE	TEOR.	9.729
EPIDOTE	TEOR.	99.999	MALACONITE	TEOR.	10.777

ORIGINATION
191-49-23
DEEP WATER BOILED AT 100.0 DEGREES C.

LOG DISTRIBUTION COEFFICIENTS CO2 = -2.74 H2S = -3.27 GAS SOLUBILITY MULTIPLYING FACTOR 1.00

Table with columns for species (AQUARIA, AMMONIUM, etc.), TEMP., CALC., EN 100- 99.999, EN 100- 99.999, EN 100- 99.999, EN 100- 99.999, EN 100- 99.999. Rows list various chemical species and their associated thermodynamic data.

DEEP WATER (PPM) DEEP STEAM (PPM) GAS PRESSURES (MMG ABS.)

Table showing distribution coefficients for species like CO2, H2S, CH4, H2O, and various iron species (FE14, FE24, FE34, etc.) under deep water and steam conditions.

ACTIVITY COEFFICIENTS IN DEEP WATER

Table of activity coefficients for various chemical species, including H+ (ACT.), NH4+, H3SiO4, H2SiO4, HSiO3, HCO3-, CO3--.

IONIC BALANCE

Table showing ion balance for various chemical species, including Na+, K+, NH4+, Ca++, Mg++, Fe3+, Fe2+, Fe1+, HCO3-, CO3--.

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

Table of log solubility products for minerals such as AQUARIA, AMMONIUM, ANHYDRITE, BARYTE, CHOLESTRITE, CHROMITE, CUMMINGTON, DALMANITE, HALMITE, HEMATITE, HEPHREITE, KANTHALITE, KINOSHITSE, KYANITE, LABRADORITE, LEUCITE, LILYITE, MARGARITE, MONTMORILLONITE, NACRITE, NITRINE, PLAGIOCLASE, PYROXENE, QUARTZ, SODALITE, STROBILANITE, TALC, TERNITE, TRONTOBIASITE, VERMONTITE, WOLLASTONITE.

DIFFERENCE (S) 11.04

OKWJDTUPFM
1981-09-23

PROGRAM WATCHZ.

3504 400 101 BP-12- 9 177

LETRA L-1

WATER SAMPLE (PPH)

PH/DEG-C 6.50/22.0 GAS (VOL-%) 0.0 (TS102)
 SID 193.50 CO2 0.00
 NA 256.00 HCS 0.00
 A 17.80 HZ 0.00
 CA 1530.00 CHA 0.00
 CO2 215.90 HZ 0.00
 S 52.40 HZ 0.00
 SO4 274.50 HZ 0.00
 CL 274.50 HZ 0.00
 F 2.30 LITERS GAS PER KG 0.00
 AL 0.0000 CONDENSATE/DEG-C / FLUID INFLOW 0.00
 P 0.0000 CONDENSATE (PPH) DEPTH (METERS)
 FE 0.0000 PH/DEG-C / 0.00
 NHZ 0.0000 HCS 0.00
 # HCS 0.00
 # NH 0.00
 # CONDENSATE WITH MOH (PPH) 0.00
 CO2 0.00
 HCS 0.00

IONIC BALANCE : CATIONS (MOLES/10.0137304)
 ANIONS (MOLES/10.0137304)
 DIFFERENCE (Z) - 13.83

DEEP WATER (PPH) BEEP STEAM (PPH) GAS PRESSURES (MM HG ABS.)

S102	193.52	CO2	215.90	CO2	0.00	CO2	0.102E+00
NA	256.00	HCS	0.00	HCS	0.00	HCS	0.000E+00
A	17.80	HZ	0.00	HZ	0.00	HZ	0.000E+00
CA	31.80	CHA	0.00	CHA	0.00	CHA	0.000E+00
CH	1530.00	CHH	0.00	CHH	0.00	CHH	0.000E+00
SO4	52.40	SO4H	0.00	SO4H	0.00	SO4H	0.000E+00
CL	274.46	CLH	0.00	CLH	0.00	CLH	0.000E+00
F	2.30	F	2.30	F	2.30	F	0.359E+01
DISS.S.	1010.00	H2O	0.00	H2O	0.00	TOTAL	0.359E+01
B	0.0000	ROLLING PORTION	0.00				
FE	0.0000						

ACTIVITY COEFFICIENTS IN DEEP WATER

HA	0.848	FEH	0.579	FECL4	0.847
HB	0.848	FEH4	0.283	ALH4+	0.283
HST04-	0.847	FEH4	0.851	ALOH4	0.532
HST04	0.841	FEOH4-	0.851	ALOH4-	0.853
HOB4-	0.839	FEOH4-	0.528	ALSOH4	0.849
HOB4	0.847	FEOH4-	0.528	ALSOH4-	0.849
HCO3-	0.522	FEOH4-	0.853	ALSOH42-	0.532
CO3-	0.844	FEOH4-	0.851	ALF7+	0.849
HS-	0.528	FEOH4-	0.851	ALF7+	0.853
S-	0.849	FEOH4-	0.528	ALF7+	0.849
SO4-	0.516	FECL2+	0.851	ALF5--	0.532
SO4	0.853	FECL2+	0.847	ALF5--	0.232
MSO4-	0.853	FECL2+			

CHEMICAL COMPONENTS IN DEEP WATER (PPH AND LOG MOLE)

HA (ACT.)	0.00	-7.000	PH+	1.02	-4.376	FE(OH)3	0.00	0.000
HB	0.32	-4.516	MKL	1.72	-4.532	FE(OH)4-	0.00	0.000
HST04	302.81	-2.302	KCL	0.04	-6.263	FECL	0.00	0.000
HST04-	6.03	-4.178	MSO4-	2.47	-4.683	FECL2	0.00	0.000
HOB4-	0.00	-7.944	MSO4	0.63	-5.330	FECL2+	0.00	0.000
HOB4	0.80	-5.168	CASO4	11.30	-4.081	FECL3	0.00	0.000
HCO3-	0.00	0.000	MSO4	2.04	-4.771	FECL4	0.00	0.000
CO3-	86.92	-2.853	CASO3	2.71	-4.508	FECL4	0.00	0.000
HS-	186.54	-2.310	MSO3H+	38.68	-5.417	FEOH4	0.00	0.000
S-	0.13	-5.659	MSO3H+	3.23	-5.978	ALFH	0.00	0.000
SO4-	0.00	0.000	MSO4H	0.06	-5.976	ALOH4	0.00	0.000
SO4	0.00	0.000	MSO4H	0.03	-6.218	ALOH4-	0.00	0.000
MSO4-	0.00	0.000	MSO4	0.00	0.000	ALOH4	0.00	0.000
MSO4	0.00	-5.257	MSO4	0.00	0.000	ALSOH4	0.00	0.000
MSO4-	40.34	-3.377	FEH4	0.00	0.000	ALSOH42-	0.00	0.000
MSO4	2.30	-3.918	FE(OH)2	0.00	0.000	ALF7+	0.00	0.000
CL-	273.42	-2.113	FE(OH)3	0.00	0.000	ALF7+	0.00	0.000
NA	256.49	-1.952	FE(OH)4-	0.00	0.000	ALF5--	0.00	0.000
KA	19.59	-3.300	FE(OH)4-	0.00	0.000	ALF5--	0.00	0.000
CAH	32.01	-3.098	FE(OH)2+	0.00	0.000	ALF5--	0.00	0.000

IONIC BALANCE : CATIONS (MOLES/10.0137304)
 ANIONS (MOLES/10.0137304)
 DIFFERENCE (Z) 14.64

CHEMICAL GEOTHERMOMETERS DEGREES C 1000/T DEGREES KELVIN = 2.34

SILICA TEMPERATURE 154.8

MKA 1 165.6
 MKA 2 160.9

IONIZATION POTENTIAL (VOLTS) : EN HCS= 99.999 EN CH4= 99.999 EN H2= 99.999 EN NH3= 99.999

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

ARAGONITE	-14.70	99.999	ALBITE LOW	-14.176	99.999	ANALCIME	-11.253	99.999
AMORPHITE	-6.43	-7.030	FLUORITE	-10.329	-9.307	CALCEDONY	-2.498	-2.502
MC-CALCITE	-78.541	99.999	FLUORITE	-10.975	-11.389	CHERTITE	-3.633	99.999
LABRADORITE	-23.733	99.999	HYDROCLINE	-15.837	99.999	MONNETITE	-23.771	99.999
CA-MONNETITE	-45.842	99.999	K-MONNETITE	-31.431	99.999	MC-MONNETITE	-46.406	99.999
MC-MONNETITE	-31.368	99.999	PERITE	-37.238	99.999	QUARTZ	-2.143	-2.502
PERITE	-37.238	99.999	ROLLESTONITE	8.894	8.133	ZONITE	-33.316	99.999
ROLLESTONITE	-23.331	99.999						
ZONITE	99.999	99.999						

ORIGINATION
1981-09-23

DEEP WATER BOILED AT 140.0 DEGREES C.

LOG DISTRIBUTION COEFFICIENTS CO2 -3.30 H2S -2.42 GAS SOLUBILITY MULTIPLYING FACTOR 1.00
DEEP WATER (PPM) DEEP STEAM (PPM) GAS PRESSURES (MMNS ABS.)

SI02	199.47	CO2	194.69	CO2	0.554E+02
N02	265.94	H2S	0.00	H2S	0.000E+00
K	20.41	H2	0.00	H2	0.000E+00
Ca	53.39	O2	0.00	O2	0.000E+00
Mg	1.57	CH4	0.00	CH4	0.000E+00
SO4	54.01	H2	0.00	H2	0.000E+00
Cl	262.93	H2S	0.00	H2S	0.000E+00
F	2.37	F	0.00	F	0.000E+00
DIS.S.S.	1041.10	TOTAL	0.542E+01	TOTAL	0.542E+01
AL	0.0000	H2O (L)	2.99		
B	0.0000	BOILING PORTION	0.03		
FE	0.0000				

ACTIVITY COEFFICIENTS IN DEEP WATER

H+	0.872	CSM-	0.857	FEH-	0.550	FEH+	0.851
OH-	0.898	C-	0.848	FEH2-	0.295	ALPH+	0.295
HSO4-	0.851	CL-	0.846	FEH20-	0.856	ALOH1+	0.243
H2SO4-	0.843	CL-	0.846	FEH22-	0.857	ALOH2+	0.857
HCO3-	0.851	CAH+	0.850	FEH24-	0.853	ALOH4-	0.853
CO3--	0.852	CH4	0.851	FEH26-	0.857	ALSOH4-	0.853
H2CO3	0.848	CMH3+	0.849	FEH28-	0.857	ALSOH2-	0.853
S--	0.838	CMH3+	0.851	FEH30-	0.854	ALFH+	0.857
H2S04-	0.853	CMH1+	0.849	FEH32-	0.854	ALFH2+	0.853
SO4--	0.854	CMH1+	0.849	FEH34-	0.854	ALFH4-	0.853
MSO4-	0.857	MH4+	0.843	FEH36-	0.851	ALFH6-	0.243

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLES)

H+	1.01	H2O	1.01	FE(OH)3	0.00
OH-	0.197	MSA-	1.58	FE(OH)4-	0.00
MSO4-	5.78	MSA-	1.58	FE(OH)6-	0.00
H2SO4	239.45	KCL	0.03	FECL+	0.00
H2SO4-	70.92	MSO4-	2.79	FECL2	0.00
MSO4-	0.20	MSO4-	0.58	FECL4	0.00
MSO4-	9.32	CASO4	10.04	FECL6	0.00
MH2CO3	0.00	MH2CO3	1.72	FECL8	0.00
MH2CO3-	2.68	MSO4-	21.35	FECL10	0.00
MH2CO3-	116.45	MH2CO3	18.79	FECL12	0.00
CO3--	1.53	MH2CO3+	0.12	FECL14	0.00
H2S	0.00	MSO4-	0.57	FECL16	0.00
S--	0.00	MH4H	0.22	FECL18	0.00
MSO4-	0.00	MH4H	0.00	FECL20	0.00
MSO4-	0.00	MH4H	0.00	FECL22	0.00
MSO4-	0.00	MH4H	0.00	FECL24	0.00
MSO4-	0.00	MH4H	0.00	FECL26	0.00
MSO4-	0.00	MH4H	0.00	FECL28	0.00
MSO4-	0.00	MH4H	0.00	FECL30	0.00
MSO4-	0.00	MH4H	0.00	FECL32	0.00
MSO4-	0.00	MH4H	0.00	FECL34	0.00
MSO4-	0.00	MH4H	0.00	FECL36	0.00
MSO4-	0.00	MH4H	0.00	FECL38	0.00
MSO4-	0.00	MH4H	0.00	FECL40	0.00
MSO4-	0.00	MH4H	0.00	FECL42	0.00
MSO4-	0.00	MH4H	0.00	FECL44	0.00
MSO4-	0.00	MH4H	0.00	FECL46	0.00
MSO4-	0.00	MH4H	0.00	FECL48	0.00
MSO4-	0.00	MH4H	0.00	FECL50	0.00
MSO4-	0.00	MH4H	0.00	FECL52	0.00
MSO4-	0.00	MH4H	0.00	FECL54	0.00
MSO4-	0.00	MH4H	0.00	FECL56	0.00
MSO4-	0.00	MH4H	0.00	FECL58	0.00
MSO4-	0.00	MH4H	0.00	FECL60	0.00
MSO4-	0.00	MH4H	0.00	FECL62	0.00
MSO4-	0.00	MH4H	0.00	FECL64	0.00
MSO4-	0.00	MH4H	0.00	FECL66	0.00
MSO4-	0.00	MH4H	0.00	FECL68	0.00
MSO4-	0.00	MH4H	0.00	FECL70	0.00
MSO4-	0.00	MH4H	0.00	FECL72	0.00
MSO4-	0.00	MH4H	0.00	FECL74	0.00
MSO4-	0.00	MH4H	0.00	FECL76	0.00
MSO4-	0.00	MH4H	0.00	FECL78	0.00
MSO4-	0.00	MH4H	0.00	FECL80	0.00
MSO4-	0.00	MH4H	0.00	FECL82	0.00
MSO4-	0.00	MH4H	0.00	FECL84	0.00
MSO4-	0.00	MH4H	0.00	FECL86	0.00
MSO4-	0.00	MH4H	0.00	FECL88	0.00
MSO4-	0.00	MH4H	0.00	FECL90	0.00
MSO4-	0.00	MH4H	0.00	FECL92	0.00
MSO4-	0.00	MH4H	0.00	FECL94	0.00
MSO4-	0.00	MH4H	0.00	FECL96	0.00
MSO4-	0.00	MH4H	0.00	FECL98	0.00
MSO4-	0.00	MH4H	0.00	FECL100	0.00

IONIC BALANCE : CATIONS (MOL.FEED/0.01394324)

ANIONS (MOL.FEED/0.01262997) DIFFERENCE (L) 14.74

ORIGINATION POTENTIAL (VOLTS) : EN H2S= 99.999 EN CH4= 99.999 EN H2O= 99.999 EN H2O2= 99.999

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER	TERM.	CALC.
ANALABRITA	-15.311	99.999
AMPHIBITE	-4.206	-6.953
MS-CHLORITE	-78.723	99.999
LAURDOLITE	-24.492	99.999
CA-NORTON.	-70.307	99.999
MS-NORTON.	-33.846	99.999
PIRROBTITE	1.021	99.999
MARINKITE	-25.799	99.999
EPIDOTI	99.999	99.999

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER	TERM.	CALC.
ALBITE LOW	-14.693	99.999
FLUORITE	-10.032	-8.197
MICROCLINE	-10.542	-11.281
HEMIMORPH.	-16.441	99.999
KA-NORTON.	-33.976	99.999
MUSCOVITE	-17.722	99.999
PIPRITE	-38.675	99.999
MOLLASTONITE	9.231	10.460

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER	TERM.	CALC.
ANALABRITA	-11.644	99.999
AMPHIBITE	-2.985	-2.604
MS-CHLORITE	-4.291	99.999
LAURDOLITE	-24.754	99.999
CA-NORTON.	-71.108	99.999
MS-NORTON.	-34.774	99.999
PIRROBTITE	-2.744	-2.604
MARINKITE	-33.853	99.999

GROUNDWATER
1981-09-23
DEEP WATER BOILED AT 126.0 DEGREES C.

LOG DISTRIBUTION COEFFICIENTS CO2 = 3.32 H2S = 3.04 GAS SOLUBILITY MULTIPLYING FACTOR 1.00
DEEP STEAM (PPM) GAS PRESSURES (BARs ABS.)

OXIDATION POTENTIAL (VOLTS): EN H2S= 99.999 EN CH4= 99.999 EN H2O= 99.999 EN H2O2= 99.999
LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER
ADULARIA -16.117 99.999 ALBITE LOW -15.444 99.999
AMPHIBOLE -5.899 -6.851 CALCITE -9.661 -7.844
... (many other minerals listed)

ACTIVITY DEFICIENCIES IN DEEP WATER
H+ 0.677 KSO4- 0.863
OH- 0.654 F- 0.854
... (many other ions listed)

BOILING POINT
H2O (2) 6.81

CATIONS (MOL/EL/10.0L) ANIONS (MOL/EL/10.0L)
Ca++ 38.07 3.022 SO4-- 0.960 0.000
Mg++ 21.08 3.268 NH4+ 0.000 0.000
... (many other ions listed)

IONIC BALANCE: CATIONS (MOL/EL/10.0L) 61.65317
ANIONS (MOL/EL/10.0L) 61.65317
DIFFERENCE (2) 14.87

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLES)
H+ (ACT.) 0.00 -8.488 H2O 11.11 -4.340
OH- 4.52 -1.487 NaCl 1.33 -4.483
... (many other components listed)

DEEP WATER (PPM) H2O 87.27 CO2 1977.02
K 276.84 H2S 0.00
Na 21.25 H2 0.00
... (many other components listed)

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER
ADULARIA -16.117 99.999 ALBITE LOW -15.444 99.999
AMPHIBOLE -5.899 -6.851 CALCITE -9.661 -7.844
... (many other minerals listed)

OXIDATION POTENTIAL (VOLTS): EN H2S= 99.999 EN CH4= 99.999 EN H2O= 99.999 EN H2O2= 99.999
LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER
ADULARIA -16.117 99.999 ALBITE LOW -15.444 99.999
AMPHIBOLE -5.899 -6.851 CALCITE -9.661 -7.844
... (many other minerals listed)

DEEP WATER BOILED AT 100.0 DEGREES C.

ORNL/STP/NUM
1981-09-23

LOG DISTRIBUTION COEFFICIENTS COZ =-3.74 HOS =-3.27 GAS SOLUBILITY MULTIPLYING FACTOR: 1.00

DEEP WATER (PPM) GAS PRESSURES (MMMS ABS.)

SIUC	215.89	COZ	80.40	CO2	1387.66	CO2	0.575E-03
MA	281.84	HOS	0.00	HOS	0.00	HOS	0.000E+00
K	22.09	HC	0.00	HC	0.00	HC	0.000E+00
LA	37.79	CHA	0.00	CHA	0.00	CHA	0.000E+00
LO	58.44	HC	0.00	HC	0.00	HC	0.000E+00
SOA	306.22	WH3	0.00	WH3	0.00	WH3	0.000E+00
F		CL	0.00	CL	0.00	CL	0.101E+01
DISS.S.	1126.80						TOTAL 0.101E+01
R	0.0000						
FE	0.0000						

ACTIVITY COEFFICIENTS IN DEEP WATER

OH-	0.881	ASO4-	0.866	FE++	0.377	Fe++	0.482
OH-	0.859	F-	0.859	FE++	0.375	AL++	0.375
H2SIO4--	0.862	CL-	0.862	FE(III)	0.866	AL(OH)4-	0.570
H2SIO4--	0.570	NAH	0.862	FE(III)	0.866	AL(OH)3	0.868
HCO3-	0.854	AL	0.857	FE(OH)2-	0.565	AL(OH)4-	0.864
HCO3-	0.862	CAH	0.577	FE(OH)2-	0.868	AL(OH)2-	0.864
CO3--	0.560	MGH	0.577	FE(OH)2-	0.868	AL(OH)2-	0.864
CO3--	0.859	CAH	0.870	FE(OH)2-	0.868	AL(OH)2-	0.868
S--	0.565	MSO4--	0.862	FE(OH)2-	0.868	AL(OH)2-	0.868
HSO4-	0.844	CAOH	0.870	FE(OH)2-	0.868	AL(OH)2-	0.868
SO4--	0.254	ROOH	0.872	FE(OH)2-	0.868	AL(OH)2-	0.868
MSO4--	0.868	MH4	0.854	FE(OH)2-	0.862	AL(OH)2-	0.271

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLE)

OH (ACT.)	0.00	-8.722	MH4	1.23	-4.295	FE(OH)3	0.00
OH-	3.75	-3.471	MCL	1.01	-4.783	FE(OH)4-	0.00
H2SIO4	198.67	-2.685	MCL	1.02	-6.311	FE(OH)4-	0.00
H2SIO4--	179.17	-2.867	MSO4-	1.82	-4.883	FE(OH)4-	0.00
H2SIO4--	1.44	-4.736	CAOH	7.54	-4.287	FE(OH)4-	0.26
H2SIO4--	0.49	-3.825	CAOH	1.72	-4.993	FE(OH)4-	0.00
HCO3-	0.00	0.000	MSO4	27.31	-1.584	FE(OH)4-	0.00
HCO3-	0.34	-5.239	MSO4	0.25	-5.384	FE(OH)4-	0.00
HCO3-	84.56	-2.854	MSO4	6.81	-4.171	FE(OH)4-	0.00
CO3--	5.01	-4.079	MSO4	0.08	-6.048	FE(OH)4-	0.00
CO3--	0.60	0.000	MSO4	0.43	-5.120	FE(OH)4-	0.00
HS-	0.00	0.000	MSO4	0.16	-5.407	FE(OH)4-	0.00
S--	0.00	0.000	MSO4	0.00	0.000	FE(OH)4-	0.00
HSO4-	0.00	-19.915	MH4	0.00	0.000	FE(OH)4-	0.00
HSO4-	0.00	-9.207	FE++	0.00	0.000	FE(OH)4-	0.00
SO4--	30.38	-3.290	FE(III)	0.00	0.000	FE(OH)4-	0.00
SO4--	0.00	-8.820	FE(III)	0.00	0.000	FE(OH)4-	0.00
HF	2.57	-3.849	FE(OH)2-	0.00	0.000	FE(OH)4-	0.00
F-	305.60	-2.044	FE(OH)2-	0.00	0.000	FE(OH)4-	0.00
CL-	283.49	-1.999	FE(OH)2-	0.00	0.000	FE(OH)4-	0.00
MH4	21.95	-3.251	FE(OH)2-	0.00	0.000	FE(OH)4-	0.00
CAH	41.63	-2.894	FE(OH)2-	0.00	0.000	FE(OH)4-	0.00

IONIC STRENGTH = 0.01982 IONIC BALANCE : CATIONS (MOL-ED.10.01515048)
ANIONS (MOL-ED.10.0198238)
DIFFERENCE (Z) 14.65

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

MINERAL	LOG SOLUBILITY PRODUCT	TEMP.	CALC.	TEMP.	CALC.
ANGLART	-16.994	99.999	-16.225	99.999	-12.917
ANHYDRITE	-5.407	-6.760	CACTITE	-9.326	-7.583
MS-CHLORITE	-79.791	99.999	FLURITE	-10.337	-11.093
LAURONITE	-26.765	99.999	MICROCLINE	-18.377	99.999
LA-MONTMO.	-83.666	99.999	K-MONTMO.	-40.708	99.999
NA-MONTMO.	-40.444	99.999	MUSCOVITE	-20.624	99.999
PHYSPHOSITE	-1.257	99.999	PHILITE	-43.113	99.999
WATERITE	-24.285	99.999	MELLASTONITE	10.282	11.537
FT200E	99.999	99.999			

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

MINERAL	LOG SOLUBILITY PRODUCT	TEMP.	CALC.	TEMP.	CALC.
ANGLART	-16.994	99.999	-16.225	99.999	-12.917
ANHYDRITE	-5.407	-6.760	CACTITE	-9.326	-7.583
MS-CHLORITE	-79.791	99.999	FLURITE	-10.337	-11.093
LAURONITE	-26.765	99.999	MICROCLINE	-18.377	99.999
LA-MONTMO.	-83.666	99.999	K-MONTMO.	-40.708	99.999
NA-MONTMO.	-40.444	99.999	MUSCOVITE	-20.624	99.999
PHYSPHOSITE	-1.257	99.999	PHILITE	-43.113	99.999
WATERITE	-24.285	99.999	MELLASTONITE	10.282	11.537
FT200E	99.999	99.999			

ORUSTOFUM
1981-09-23

DEEP WATER MOILED AT 120.0 DEGREES C.

LOG DISTRIBUTION COEFFICIENTS CO2 = -3.52 H2S = -3.04 GAS SOLUBILITY MULTIPLYING FACTOR 1.00

DEEP WATER (PPM)	CO2	H2S	DEEP STEAM (PPM)	GAS PRESSURES (MMHG ABS.)
SI02	144.22	CO2	3192.10	0.2076-02
Al	114.10	H2S	0.00	0.000E+00
Ca	67.35	O2	0.00	0.000E+00
CH4	3.01	CH4	0.00	0.000E+00
SO4	233.43	H2	0.00	0.000E+00
CL	254.48	NK3	0.00	0.000E+00
F	2.16	H2O	0.179E+01	0.179E+01
DIS.S.	945.77	TOTAL	0.179E+01	0.179E+01
AL	0.0000	H2O (G)	3.78	
B	0.0000	MOILING PORTION	0.04	
FE	0.0000			

ACTIVITY COEFFICIENTS IN DEEP WATER

OH-	0.872	FS04-	0.857	FEH	0.549	FECL1	0.850
H+	0.847	F-	0.847	FEH+	0.276	ALH1+	0.276
HS104-	0.850	CL-	0.845	FEH2	0.853	ALOH1+	0.542
HS104--	0.542	NA+	0.850	FE(OH)3-	0.853	ALOH12+	0.857
H2BO3-	0.842	K+	0.845	FE(OH)4--	0.338	ALOH14-	0.853
HCO3-	0.850	CAH+	0.549	FE(OH)4-	0.338	ALSOH+	0.853
CO3--	0.531	MGH+	0.531	FE(OH)2+	0.857	ALSOH12-	0.853
HS-	0.847	CMCO3H	0.860	FE(OH)4-	0.857	ALF1+	0.857
S--	0.538	HCO3H	0.850	FE(OH)4-	0.855	ALF2+	0.857
HSO4-	0.853	CAOH+	0.860	FECL1+	0.858	ALF3-	0.853
SO4--	0.525	H2BOH+	0.862	FECL2+	0.855	ALF5-	0.531
HSO4-	0.857	MAH+	0.842	FECL3-	0.850	ALF6--	0.242

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLES)

NA (MOL)	0.0	8.489	MEH	1.29	-4.274	FE(OH)3	0.00	0.000
AL(OH)3	4.52	-3.412	MECL	0.88	-4.822	FE(OH)4-	0.00	0.000
AL(OH)4-	145.25	-2.754	KCL	0.02	-6.453	FECL1	0.00	0.000
ALSO4-	84.58	-1.051	MSO4-	6.51	-4.242	FECL2	0.00	0.000
ALSO4--	0.47	-5.305	KS04-	1.42	-4.780	FECL3	0.00	0.000
MAHS104-	6.87	-4.125	CAO4	32.91	-3.617	FECL4	0.00	0.000
MAHS104-	0.00	0.000	MSO4	6.91	-4.241	FECL5	0.00	0.000
MAHS104-	0.00	0.000	CAO3	37.75	-3.423	FECL6	0.00	0.000
H2O3	1.37	-4.656	CAO3	0.47	-5.253	FES04	0.00	0.000
HCO3-	154.68	-2.576	CMCO3H	16.39	-3.770	FES04	0.00	0.000
CO3--	4.89	-4.089	MSKCO3H	0.17	-5.705	ALH1+	0.00	0.000
HS-	0.00	0.000	CAOH+	0.52	-5.041	ALOH1+	0.00	0.000
HS-	0.00	0.000	MAH+	0.24	-5.236	ALOH12+	0.00	0.000
S--	0.00	0.000	MAH+	0.00	0.000	ALOH13	0.00	0.000
HSO4-	0.00	-8.110	FEH+	0.00	0.000	ALOH14-	0.00	0.000
HSO4-	0.00	-8.110	FEH+	0.00	0.000	ALSOH+	0.00	0.000
SO4--	198.43	-2.684	FEH2	0.00	0.000	ALSOH12-	0.00	0.000
HF	0.00	-8.473	FEH3	0.00	0.000	ALF1+	0.00	0.000
F-	2.16	-3.944	FEH4	0.00	0.000	ALF2+	0.00	0.000
CL-	255.94	-2.141	FE(OH)3-	0.00	0.000	ALF3-	0.00	0.000
MA+	210.87	-2.038	FE(OH)4-	0.00	0.000	ALF4-	0.00	0.000
K+	14.44	-3.433	FE(OH)4-	0.00	0.000	ALF5-	0.00	0.000
CAH+	35.68	-3.051	FE(OH)2+	0.00	0.000	ALF6--	0.00	0.000

IONIC BALANCE = 0.01643
CUSTOMS (MOL PER MOL ORUSTOFUM)
DIFFERENCE (G) = -28.42

OXIDATION POTENTIAL (VOLTS) : EN H2S= 99.999 EN O4= 99.999 EN H2= 99.999 EN H2O2= 99.999

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

TEMR.	CALC.	TEMR.	CALC.		
ANALABIA	-16.117	99.999	ALBITE LM	-15.444	99.999
AMPHIBOLE	-5.899	-4.275	CALCITE	-9.461	-7.674
MG-CALCITE	-79.144	99.999	FLUORITE	-10.537	-11.342
LAURDOLITE	-25.389	99.999	HYDROCLINE	-17.377	99.999
CA-HYDROTHER.	-74.304	99.999	K-HYDROTHER.	-37.279	99.999
PHOSPHORITE	-37.100	99.999	ARSDOLITE	-39.164	99.999
MAHROCKITE	-23.519	99.999	WOLLASTONITE	-40.785	99.999
EPIDOTE	99.999	99.999	ZONITE	9.729	10.914

TEMR.	CALC.	TEMR.	CALC.		
ANALABIA	-12.285	99.999	ANALABIA	-12.285	99.999
AMPHIBOLE	-2.713	-2.754	AMPHIBOLE	-2.713	-2.754
MG-CALCITE	-5.150	99.999	MG-CALCITE	-5.150	99.999
LAURDOLITE	-26.498	99.999	LAURDOLITE	-26.498	99.999
CA-HYDROTHER.	-77.514	99.999	CA-HYDROTHER.	-77.514	99.999
PHOSPHORITE	-25.544	99.999	PHOSPHORITE	-25.544	99.999
MAHROCKITE	-2.900	-2.754	MAHROCKITE	-2.900	-2.754
EPIDOTE	-34.838	99.999	EPIDOTE	-34.838	99.999

DEEP WATER BOILED AT 100.0 DEGREES C.

1981-09-23

LOG DISTRIBUTION COEFFICIENTS CO2 = 3.74 H2S = 3.27 GAS SOLUBILITY MULTIPLYING FACTOR 1.00

DEEP WATER (PPM) REEP STEAM (PPM) GAS PRESSURES (MMHG ABS.)

SI02	170.64	CO2	126.98	CO2	1862.19	CO2	0.776-03
NA	222.60	H2S	0.00	H2S	0.00	H2S	0.006E+00
K	15.44	H2	0.00	H2	0.00	H2	0.006E+00
Ca	49.99	O2	0.00	O2	0.00	O2	0.006E+00
Mg	3.13	CH4	0.00	CH4	0.00	CH4	0.006E+00
SO4	242.79	H2	0.00	H2	0.00	H2	0.006E+00
CL	246.54	MH3	0.00	MH3	0.00	MH3	0.006E+00
F	2.25						
DISS.S.	982.84						
AL	0.0000						
B	0.0000						
FE	0.0000						

H2O (Z) 7.41
BOILING POINT 0.07

ACTIVITY COEFFICIENTS IN DEEP WATER

HI	0.877	HS04-	0.842	FEH+	0.563	FEL+	0.854
OH-	0.853	F-	0.853	FEH+	0.312	ALH+	0.312
HS104-	0.856	CL-	0.850	FE0H1-	0.860	AL0H1-	0.556
HS104--	0.856	MH	0.856	FE0H13-	0.860	AL0H12-	0.862
HS03-	0.848	SI	0.850	FE0H14--	0.351	AL3OH+	0.858
HS03--	0.856	CAH	0.563	FE0H1+	0.351	AL3OH+	0.858
HS-	0.545	MH+	0.395	FE0H2+	0.862	AL3OH12-	0.858
S--	0.351	CAH03H	0.865	FE0H2+	0.862	ALF1+	0.356
HS04-	0.858	CAH03H	0.865	FE0H4-	0.860	ALF2+	0.862
SO4--	0.539	CAH0H+	0.867	FELH+	0.351	ALF4-	0.858
HS04-	0.862	MH+	0.860	FELH-	0.860	ALF5--	0.345
				FELH-	0.858	ALF6--	0.756
				TOTAL	0.101E+01		

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLES)

Na (ACT.)	4.68	-8.374	1.52	-4.204	FE0H13	0.00	0.000
HS104-	149.44	-3.811	0.42	-4.942	FE0H14-	0.00	0.000
HS104--	112.14	-2.928	0.01	-4.741	FEL+	0.00	0.000
HS03-	1.04	-4.949	5.77	-3.315	FEL2+	0.00	0.000
HS03--	0.00	0.000	1.23	-5.042	FEL2+	0.00	0.000
HS-	0.00	0.000	26.54	-3.679	FEL3	0.00	0.000
S--	0.00	0.000	44.95	-3.348	FEL4-	0.00	0.000
HS04-	0.00	0.000	9.79	-5.053	FES04	0.00	0.000
SO4--	0.00	0.000	0.14	-5.774	ALH+	0.00	0.000
Na	0.00	0.000	0.23	-5.260	AL0H12+	0.00	0.000
OH-	0.00	0.000	0.00	0.000	AL0H13	0.00	0.000
HS04-	0.00	-19.425	0.00	0.000	AL0H14-	0.00	0.000
SO4--	0.00	-8.453	0.00	0.000	AL3OH+	0.00	0.000
HF	212.30	-2.458	0.00	0.000	AL3OH12-	0.00	0.000
F-	0.00	-8.942	0.00	0.000	ALF1+	0.00	0.000
CL-	2.25	-3.927	0.00	0.000	ALF2+	0.00	0.000
M+	246.13	-2.125	0.00	0.000	ALF3	0.00	0.000
K+	218.85	-2.021	0.00	0.000	ALF4-	0.00	0.000
CAH	15.08	-3.414	0.00	0.000	ALF5--	0.00	0.000
CAH+	39.38	-3.008	0.00	0.000	ALF6--	0.00	0.000

IONIC BALANCE : CATIONS (MOL.ER.10.01E009)
ANIONS (MOL.ER.10.01E010)
DIFFERENCE (Z) -29.39

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

ANALCIMA	-16.974	99.999	TEOR.	CALC.	TEOR.	CALC.
AMALCLINE	-5.607	-4.181	AMALCLINE	-12.917	99.999	-2.855
ANHYDRITE	-79.791	99.999	CHALCEDONY	-2.855	-2.811	99.999
CA-MONITOR.	-21.765	99.999	DOYERITE	-5.978	99.999	-5.978
CA-MONITOR.	-83.066	99.999	MAGNETITE	-26.012	99.999	-26.012
CA-MONITOR.	-40.444	99.999	MG-MONITOR.	-84.033	99.999	-84.033
PIRRITE	1.257	99.999	PREWITE	-36.410	99.999	-36.410
WOLLASTONITE	-24.285	99.999	QUARTZ	-3.075	-2.811	99.999
EPITOTE	99.999	99.999	ZOLSITE	-35.479	99.999	-35.479

EN H2S= 99.999 EN H2O= 99.999 EN H2S= 99.999

EN H2S= 99.999 EN H2O= 99.999

EN H2S= 99.999 EN H2O= 99.999

EN H2S= 99.999 EN H2O= 99.999

ORIGINATION
1981-09-23
DEEP WATER BOILED AT 140.0 DEGREES C.

LOS SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER. Table with columns for mineral name, TEOR, CALC, and values for EN H2O, EN CH4, EN H2, EN H2O-99.999, EN H2O-99.999, EN H2O-99.999.

LOS DISTRIBUTION COEFFICIENTS. Table with columns for mineral name, CO2, H2S, and values for CO2, H2S, H2O (C), H2O (O), BOILING PARTITION, and activity coefficients.

TOTAL 0.376491

ACTIVITY COEFFICIENTS IN DEEP WATER. Table listing activity coefficients for various ions like H+, OH-, H2S, HS-, S--, Fe, etc.

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOS MOLE). Table listing chemical components and their concentrations in PPM and LOS MOLE.

IONIC BALANCE : CATIONS (MOL. LB.) 10.0142342 ANIONS (MOL. LB.) 10.0139451 DIFFERENCE (2) -8.02 IONIC STRENGTH = 0.01675

DEEP WATER BOILED AT 120.0 DEGREES C.

ORIGINATION
1981-09-23

LOG DISTRIBUTION COEFFICIENTS CO2 = -3.52 H2S = -3.04 GAS SOLUBILITY MULTIPLYING FACTOR 1.00
DEEP STEAM (PPM) GAS PRESSURES (MMAS ABS.)

SI02	144.94	CO2	247.07	CO2	6490.34
HA	249.04	H2S	0.00	H2S	0.000000
K	24.83	H2	0.00	H2	0.000000
CA	74.68	O2	0.00	O2	0.000000
MG	44.30	CHA	0.00	CHA	0.000000
S04	54.25	W2	0.00	W2	0.000000
CL	315.25	W3	0.00	W3	0.000000
F	2.13	TOTAL			0.199E+01
DISS.S.	1111.10				
AL	0.0000	H2O (G)	4.15		
B	0.0000	ROLLING POSITION	0.04		
FE	0.0000				

ACTIVITY COEFFICIENTS IN DEEP WATER

H+	0.870	HSO4-	0.854	FEH	0.543	FEH2	0.847
OH-	0.844	F-	0.844	FEH3	0.290	AL+++	0.270
HS1D4-	0.817	CL-	0.842	FEH4	0.852	ALDH12+	0.536
HS1D4--	0.839	W+	0.847	FE(OH)2-	0.854	AL(OH)2+	0.854
HS2D3-	0.839	H+	0.842	FE(OH)4--	0.531	AL(OH)4-	0.850
HS3D-	0.817	CAH	0.543	FEH5+	0.531	ALSO4+	0.850
CO3--	0.525	W2H	0.566	FE(OH)2H	0.854	ALSO4H2-	0.850
HS-	0.844	CMH2G3+	0.857	FE(OH)4-	0.854	AL+++	0.536
HSO4-	0.850	CMH3+	0.847	FE(OH)4-	0.852	AL7+	0.854
S04--	0.518	CMH+	0.860	FEH2+	0.531	AL74-	0.850
MS04--	0.854	W2H+	0.859	FEH4-	0.852	AL7S--	0.525
						AL7S---	0.235

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLES)

HA	0.00	HS04-	2.74	-3.949	FE(OH)3	0.00
HS1D4-	4.10	CL-	1.34	-4.324	FE(OH)4-	0.00
HS1D4--	175.81	W+	0.63	-4.324	FEH2	0.00
HS2D3-	81.25	CAH	1.82	-5.816	FEH3	0.00
HS3D-	0.42	W2H	0.53	-5.816	FEH4	0.00
CAH	10.67	W2H+	7.48	-4.240	FEH5+	0.00
CO3--	0.00	CMH2G3+	3.20	-4.575	FEH2H	0.00
CO3-	2.61	CMH3+	63.12	-3.200	FEH4-	0.00
HS-	8.07	CMH+	1.60	-4.721	FEH4-	0.00
HSO4-	0.00	W2H2G3+	29.77	-3.531	FEH4H	0.00
S04--	0.00	CMH2H	0.42	-5.134	AL+++	0.00
MS04--	0.00	CMH3H	0.49	-5.043	ALDH12+	0.00
		W2H2H	0.47	-4.948	AL(OH)2+	0.00
		W2H3H	0.00	0.000	AL(OH)3	0.00
		W2H4H	0.00	0.000	AL(OH)4-	0.00
		W2H5H	0.00	0.000	ALSO4+	0.00
		W2H6H	0.00	0.000	ALSO4H2-	0.00
		W2H7H	0.00	0.000	AL+++	0.00
		W2H8H	0.00	0.000	AL7+	0.00
		W2H9H	0.00	0.000	AL74-	0.00
		W2H10H	0.00	0.000	AL7S--	0.00
		W2H11H	0.00	0.000	AL7S---	0.00
		W2H12H	0.00	0.000	AL7S---	0.00

IONIC BALANCE : CATIONS (MOL/LEN) 0.0146014
ANIONS (MOL/LEN) 0.0150922
DIFFERENCE (G) -0.43

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER
TEOR. CALC. EN H2S= 99.999 EN CH4= 99.999 EN H2O= 99.999 EN H2S= 99.999 EN H2O= 99.999

ANALAKIA	-16.117	99.999	ALBITE LOW	-15.444	99.999	TEOR.	CALC.
AMPHIBOLE	-5.899	-6.918	CALCITE	-9.461	-7.451	ANALAKIA	-12.265
MG-CALCITE	-79.144	99.999	FLUORITE	-10.337	-11.347	CHALCOPRYTE	-2.713
LAURDOLITE	-25.589	99.999	HYDROLINE	-17.337	99.999	DOBSONITE	-5.150
CA-MONTROD.	-76.284	99.999	K-MONTROD.	-37.279	99.999	MONTROD.	-26.498
MA-MONTROD.	-37.100	99.999	MUSCOVITE	-19.164	99.999	PREHNITE	-25.544
PROPHONITE	-23.519	99.999	PIRITE	-60.785	99.999	QUARTZ	-2.900
WOLLASTONITE	99.999	99.999	WOLLASTONITE	9.729	10.872	ZINBLITE	-34.638
EPIDOTE	99.999	99.999					

DRAUGHTSMAN
1981-09-23
DEEP WATER BOILED AT 140.0 DEGREES C.

LOG DISTRIBUTION COEFFICIENTS CO2 -3.30 H2S -2.82 GAS SOLUBILITY MULTIPLYING FACTOR 1.00
DEEP WATER (PPM) DEEP STEAM (PPM) GAS PRESSURES (MMG AMS.)

SI02	222.81	CO2	80.24	CO2	2487.41	CO2	0.348E-02
W	222.68	H2S	0.00	H2S	0.00	H2S	0.000E+00
HA	21.55	H2	0.00	H2	0.00	H2	0.000E+00
NA	28.66	CH4	0.00	CH4	0.00	CH4	0.000E+00
SO4	58.37	NO	0.00	NO	0.00	NO	0.000E+00
C	251.32	NI3	0.00	NI3	0.00	NI3	0.000E+00
DISS.S.S. 935.09							
AL	0.0000	TOTAL 0.348E+01					
B	0.0000	H2O (2) 4.39					
FE	0.0000	BOILING POINT 0.04					

ACTIVITY COEFFICIENTS IN DEEP WATER

H+	0.879	HSO4-	0.846	FE++	0.571	FE(L)-	0.860
OH-	0.858	F-	0.858	FE+++	0.317	AL+++	0.317
HSO4O-	0.860	CL-	0.860	FE(OH)3-	0.865	AL(OH)+	0.565
HSO4O--	0.865	HA+	0.860	FE(OH)4-	0.561	AL(OH)2+	0.864
H2SO3-	0.854	K+	0.854	FE(OH)4-	0.561	AL(OH)4-	0.863
HC03-	0.860	CA++	0.860	FE(OH)2+	0.866	ALSOH+	0.863
CO3--	0.856	MBH+	0.869	FE(OH)2+	0.866	AL(SOH)2-	0.863
HS-	0.858	CMKCO3H	0.860	FE(OH)4-	0.866	ALF++	0.565
S--	0.861	MSKCO3H	0.860	FE(OH)4-	0.865	ALF+	0.866
HSO4-	0.843	CAMH	0.869	FE(L)-	0.561	ALF2+	0.863
SO4--	0.850	MSOH	0.870	FE(L)-	0.865	ALF3--	0.856
MSO4-	0.856	MMH+	0.854	FE(L)-	0.860	ALF6--	0.867

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLE)

H+	0.00	HSO4-	0.23	Fe(OH)3	0.00	0.000
OH-	1.27	F-	0.00	Fe(OH)4-	0.00	0.000
HSO4O-	22.29	CL-	1.20	Fe(L)-	0.00	0.000
HSO4O--	94.01	HA+	0.00	Fe(L)-	0.00	0.000
HSO4O-	0.33	MSO4-	2.38	Fe(L)-	0.00	0.000
H2SO3-	0.00	CMKCO3H	0.75	Fe(L)-	0.00	0.000
H2CO3-	0.00	MSKCO3H	0.86	Fe(L)-	0.00	0.000
HCO3-	1.24	MSOH	0.00	Fe(L)-	0.00	0.000
CO3--	95.28	MMH+	0.44	Fe(L)-	0.00	0.000
HS-	1.54	MSOH	0.39	Al+++	0.00	0.000
S--	0.00	MSOH	0.06	Al(OH)2+	0.00	0.000
HSO4-	0.00	MSOH	0.00	Al(OH)3	0.00	0.000
SO4--	0.00	MSOH	0.00	Al(OH)4-	0.00	0.000
S04--	51.40	MSOH	0.00	ALSOH+	0.00	0.000
HS-	0.00	MSOH	0.00	AL(SOH)2-	0.00	0.000
F-	2.45	MSOH	0.00	ALF++	0.00	0.000
CL-	250.38	MSOH	0.00	ALF+	0.00	0.000
HA+	219.66	MSOH	0.00	ALF2+	0.00	0.000
K+	21.31	MSOH	0.00	ALF3--	0.00	0.000
CA++	18.66	MSOH	0.00	ALF6--	0.00	0.000

IONIC BALANCE : CATIONS (MOL.EQ.10.01111147)
ANIONS (MOL.EQ.10.01130312)
DIFFERENCE (2) -1.71

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER
OXYGEN POTENTIAL (VOLTS) : EN H2O= 99.999 EN CH4= 99.999 EN H2S= 99.999

AQUARIANA	-15.311	99.999	99.999	99.999	99.999	99.999	99.999
AMPHIBOLE	-4.204	-7.120	-10.432	-8.134	99.999	99.999	99.999
ANALCIME	-78.273	99.999	-10.432	-11.502	99.999	99.999	99.999
ANALCIME	-70.492	99.999	-16.461	-11.502	99.999	99.999	99.999
ANALCIME	-70.207	99.999	-33.974	99.999	99.999	99.999	99.999
ANALCIME	-33.864	99.999	-17.222	99.999	99.999	99.999	99.999
ANALCIME	1.021	99.999	-38.675	99.999	99.999	99.999	99.999
ANALCIME	-22.799	99.999	9.231	10.433	99.999	99.999	99.999
ANALCIME	99.999	99.999	99.999	99.999	99.999	99.999	99.999

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER
OXYGEN POTENTIAL (VOLTS) : EN H2O= 99.999 EN CH4= 99.999 EN H2S= 99.999

ANALCIME	-11.644	99.999	99.999	99.999	99.999	99.999	99.999
ANALCIME	-2.585	-2.581	99.999	99.999	99.999	99.999	99.999
ANALCIME	-24.954	99.999	99.999	99.999	99.999	99.999	99.999
ANALCIME	-71.180	99.999	99.999	99.999	99.999	99.999	99.999
ANALCIME	-34.275	99.999	99.999	99.999	99.999	99.999	99.999
ANALCIME	-2.744	-2.381	99.999	99.999	99.999	99.999	99.999
ANALCIME	-33.853	99.999	99.999	99.999	99.999	99.999	99.999

ORANSTROM 1981-09-23

DEEP WATER BOILED AT 120.0 DEGREES C.

LOG DISTRIBUTION COEFFICIENTS CO2 = -3.32 H2O = -3.04 GAS SOLUBILITY MULTIPLYING FACTOR: 1.00

Table with columns: DEEP WATER (PPH), DEEP STEAM (PPH), GAS PRESSURES (MMSE ABS.), GAS SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER, and LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER.

Table with columns: ACTIVITY COEFFICIENTS IN DEEP WATER and ROLLING PORTION.

Table with columns: CATIONIC COMPONENTS IN DEEP WATER (PPH AND LOG MOLE), CATIONIC BALANCE, IONIC STRENGTH, and DIFFERENCE (Z).

Table with columns: DEEP WATER (PPH), DEEP STEAM (PPH), GAS PRESSURES (MMSE ABS.), GAS SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER, and LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER.

Table with columns: ACTIVITY COEFFICIENTS IN DEEP WATER and ROLLING PORTION.

Table with columns: CATIONIC COMPONENTS IN DEEP WATER (PPH AND LOG MOLE), CATIONIC BALANCE, IONIC STRENGTH, and DIFFERENCE (Z).

OROSTROMAN
1981-09-23
DEEP WATER BOILED AT 100.0 DEGREES C.

LOG DISTRIBUTION COEFFICIENTS CO2 = -3.74 H2S = -3.27 GAS SOLUBILITY MULTIPLYING FACTOR: 1.00

DEEP WATER (PPM)	CO2	H2S	CH4	HCN	PH3	SiO2	CO2	H2S	CH4	HCN	PH3	SiO2	CO2	H2S	CH4	HCN	PH3	SiO2
SiO2	244.25						1116.02						0.45E-03					
Al	244.12						0.00						0.00E+00					
Na	31.31						0.00						0.00E+00					
Ca	31.03						0.00						0.00E+00					
Mg	63.99						0.00						0.00E+00					
SO4	272.12						0.00						0.00E+00					
Cl	2.65						0.00						0.00E+00					
F	1012.48						0.00						0.00E+00					
DISS.S.	0.0000						0.00						0.00E+00					
AL	0.0000						0.00						0.00E+00					
B	0.0000						0.00						0.00E+00					
FE	0.0000						0.00						0.00E+00					

ACTIVITY COEFFICIENTS IN DEEP WATER	H2O (X3)	BOILING PARTION	H2O (X3)	BOILING PARTION
H+	0.888	0.876	FEH	0.598
OH-	0.869	0.849	FEH+	0.448
HS-	0.871	0.846	FEH2	0.875
H2S(aq)	0.871	0.871	FE(OH)3-	0.875
H2S(aq)	0.884	0.866	FE(OH)4--	0.587
HCO3-	0.871	0.598	FE(OH)4-	0.587
CO3--	0.582	0.616	FE(OH)2-	0.876
HS-	0.869	0.878	FE(OH)4-	0.876
S--	0.587	0.871	FE(OH)4-	0.875
SO4--	0.873	0.878	FE(OH)4-	0.587
SO4--	0.577	0.880	FE(L)2+	0.875
HSO4-	0.876	0.884	FE(L)4-	0.871

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLE)	ACTIVITY	LOG MOLE	ACTIVITY	LOG MOLE
H+	0.00	-8.749	FE(OH)3	0.00
OH-	0.00	-8.749	FE(OH)4-	0.00
HS-	0.00	-8.749	FE(L)2+	0.00
H2S(aq)	0.00	-8.749	FE(L)4-	0.00
HCO3-	0.00	-8.749	FE(L)3	0.00
CO3--	0.00	-8.749	FE(L)4-	0.00
HS-	0.00	-8.749	FE(L)5-	0.00
S--	0.00	-8.749	FE(L)6-	0.00
SO4--	0.00	-8.749	FE(L)7-	0.00
HSO4-	0.00	-8.749	FE(L)8-	0.00
HSO4-	0.00	-8.749	FE(L)9-	0.00
HSO4-	0.00	-8.749	FE(L)10-	0.00
HSO4-	0.00	-8.749	FE(L)11-	0.00
HSO4-	0.00	-8.749	FE(L)12-	0.00
HSO4-	0.00	-8.749	FE(L)13-	0.00
HSO4-	0.00	-8.749	FE(L)14-	0.00
HSO4-	0.00	-8.749	FE(L)15-	0.00
HSO4-	0.00	-8.749	FE(L)16-	0.00
HSO4-	0.00	-8.749	FE(L)17-	0.00
HSO4-	0.00	-8.749	FE(L)18-	0.00
HSO4-	0.00	-8.749	FE(L)19-	0.00
HSO4-	0.00	-8.749	FE(L)20-	0.00

IONIC BALANCE : CATIONS (MOL-EN-10-01298149)
ANIONS (MOL-EN-10-01298149)
DIFFERENCE (X) -1.75

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

MINERAL	EN 102= 99,999	EN 102= 99,999	EN 102= 99,999	EN 102= 99,999
ANALCIMA	-16.974	99.999	99.999	99.999
AMMONIUM	-5.607	-6.931	99.999	99.999
MG-CHLORITE	-79.791	99.999	99.999	99.999
LAURDORITE	-26.745	99.999	99.999	99.999
CA-MONTMOR.	-83.066	99.999	99.999	99.999
NA-MONTMOR.	-40.444	99.999	99.999	99.999
PYRROPHITE	1.257	99.999	99.999	99.999
MALMSTRATE	-24.285	99.999	99.999	99.999
EPIHOTE	99.999	99.999	99.999	99.999

MINERAL	EN 102= 99,999	EN 102= 99,999	EN 102= 99,999	EN 102= 99,999
ANALCIMA	-16.974	99.999	99.999	99.999
AMMONIUM	-5.607	-6.931	99.999	99.999
MG-CHLORITE	-79.791	99.999	99.999	99.999
LAURDORITE	-26.745	99.999	99.999	99.999
CA-MONTMOR.	-83.066	99.999	99.999	99.999
NA-MONTMOR.	-40.444	99.999	99.999	99.999
PYRROPHITE	1.257	99.999	99.999	99.999
MALMSTRATE	-24.285	99.999	99.999	99.999
EPIHOTE	99.999	99.999	99.999	99.999

MINERAL	EN 102= 99,999	EN 102= 99,999	EN 102= 99,999	EN 102= 99,999
ANALCIMA	-16.974	99.999	99.999	99.999
AMMONIUM	-5.607	-6.931	99.999	99.999
MG-CHLORITE	-79.791	99.999	99.999	99.999
LAURDORITE	-26.745	99.999	99.999	99.999
CA-MONTMOR.	-83.066	99.999	99.999	99.999
NA-MONTMOR.	-40.444	99.999	99.999	99.999
PYRROPHITE	1.257	99.999	99.999	99.999
MALMSTRATE	-24.285	99.999	99.999	99.999
EPIHOTE	99.999	99.999	99.999	99.999

MINERAL	EN 102= 99,999	EN 102= 99,999	EN 102= 99,999	EN 102= 99,999
ANALCIMA	-16.974	99.999	99.999	99.999
AMMONIUM	-5.607	-6.931	99.999	99.999
MG-CHLORITE	-79.791	99.999	99.999	99.999
LAURDORITE	-26.745	99.999	99.999	99.999
CA-MONTMOR.	-83.066	99.999	99.999	99.999
NA-MONTMOR.	-40.444	99.999	99.999	99.999
PYRROPHITE	1.257	99.999	99.999	99.999
MALMSTRATE	-24.285	99.999	99.999	99.999
EPIHOTE	99.999	99.999	99.999	99.999

DOUGSTON AND
1981-09-22 06

LETHA L-4

LETHA L-4

LETHA-08 WELLSPEPPU BORGANE JAGANSTYLA J17/08

PROGRAM WATERZ.

3504 400 104 75- 6-24 103

WATER SAMPLE (PPH) STEAM SAMPLE

PH/RES.C	SI/DZ	WA	CA	MG	CDZ	SO4	CL	F	FE	NI3	NI	AL	B	FE	NI3	NI	AL	B	
4.52/20.0	148.00	131.50	20.90	1.1000	200.60	131.60	0.35	2.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
SI/DZ	CO2	H2S	CH4	W2	PH/RES.C	PH/RES.C	PH/RES.C	PH/RES.C	PH/RES.C	PH/RES.C	PH/RES.C	PH/RES.C	PH/RES.C	PH/RES.C	PH/RES.C	PH/RES.C	PH/RES.C	PH/RES.C	PH/RES.C
148.00	131.50	20.90	1.1000	200.60	131.60	0.35	2.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

IONIC STRENGTH = 0.01056
CATIONS (MOL-LE/10.0003332)
ANIONS (MOL-LE/10.0003332)
DIFFERENCE (C) -19.05

KEEP STEAM (PPH)

SI/DZ	WA	CA	MG	CDZ	SO4	CL	F	FE	NI3	NI	AL	B	FE	NI3	NI	AL	B	
148.01	131.56	20.90	1.10	131.60	136.49	2.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

IONIC STRENGTH = 0.01056
CATIONS (MOL-LE/10.00770991)
ANIONS (MOL-LE/10.0093332)
DIFFERENCE (C) -19.05

KEEP STEAM (PPH)

SI/DZ	WA	CA	MG	CDZ	SO4	CL	F	FE	NI3	NI	AL	B	FE	NI3	NI	AL	B
148.01	131.56	20.90	1.10	131.60	136.49	2.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

IONIC STRENGTH = 0.01056
CATIONS (MOL-LE/10.00770991)
ANIONS (MOL-LE/10.0093332)
DIFFERENCE (C) -19.05

KEEP STEAM (PPH)

ACTIVITY COEFFICIENTS IN DEEP WATER

WH	OH	HS10H	HS20H	HS30H	HS40H	HS50H	HS60H	HS70H	HS80H	HS90H	HS100H
0.877	0.870	0.871	0.866	0.871	0.866	0.871	0.866	0.871	0.866	0.871	0.866

CHEMICAL COMPONENTS IN DEEP WATER (PPH AND LOG MOLE)

WH (ACT.)	OH	HS10H	HS20H	HS30H	HS40H	HS50H	HS60H	HS70H	HS80H	HS90H	HS100H
0.00	-6.733	0.22	-4.872	2.70	-4.547	0.00	-8.578	0.19	-5.793	0.00	0.000

IONIC STRENGTH = 0.00972 IONIC BALANCE :

WH (ACT.)	OH	HS10H	HS20H	HS30H	HS40H	HS50H	HS60H	HS70H	HS80H	HS90H	HS100H
0.00	-4.690	0.42	-5.143	3.47	-4.535	0.00	-4.879	1.79	-3.881	0.00	0.000

CHEMICAL GEOTHERMETERS DEGREES C

WH (ACT.)	OH	HS10H	HS20H	HS30H	HS40H	HS50H	HS60H	HS70H	HS80H	HS90H	HS100H
0.00	-4.690	0.42	-5.143	3.47	-4.535	0.00	-4.879	1.79	-3.881	0.00	0.000

SILICA TEMPERATURE 145.0

WH (ACT.)	OH	HS10H	HS20H	HS30H	HS40H	HS50H	HS60H	HS70H	HS80H	HS90H	HS100H
0.00	-4.690	0.42	-5.143	3.47	-4.535	0.00	-4.879	1.79	-3.881	0.00	0.000

OXIDATION POTENTIAL (VOLTS) :

WH (ACT.)	OH	HS10H	HS20H	HS30H	HS40H	HS50H	HS60H	HS70H	HS80H	HS90H	HS100H
0.00	-4.690	0.42	-5.143	3.47	-4.535	0.00	-4.879	1.79	-3.881	0.00	0.000

ACTIVITY COEFFICIENTS IN DEEP WATER

WH	OH	HS10H	HS20H	HS30H	HS40H	HS50H	HS60H	HS70H	HS80H	HS90H	HS100H
0.877	0.870	0.871	0.866	0.871	0.866	0.871	0.866	0.871	0.866	0.871	0.866

CHEMICAL COMPONENTS IN DEEP WATER (PPH AND LOG MOLE)

WH (ACT.)	OH	HS10H	HS20H	HS30H	HS40H	HS50H	HS60H	HS70H	HS80H	HS90H	HS100H
0.00	-6.733	0.22	-4.872	2.70	-4.547	0.00	-8.578	0.19	-5.793	0.00	0.000

IONIC STRENGTH = 0.00972 IONIC BALANCE :

WH (ACT.)	OH	HS10H	HS20H	HS30H	HS40H	HS50H	HS60H	HS70H	HS80H	HS90H	HS100H
0.00	-4.690	0.42	-5.143	3.47	-4.535	0.00	-4.879	1.79	-3.881	0.00	0.000

CHEMICAL GEOTHERMETERS DEGREES C

WH (ACT.)	OH	HS10H	HS20H	HS30H	HS40H	HS50H	HS60H	HS70H	HS80H	HS90H	HS100H
0.00	-4.690	0.42	-5.143	3.47	-4.535	0.00	-4.879	1.79	-3.881	0.00	0.000

SILICA TEMPERATURE 145.0

WH (ACT.)	OH	HS10H	HS20H	HS30H	HS40H	HS50H	HS60H	HS70H	HS80H	HS90H	HS100H
0.00	-4.690	0.42	-5.143	3.47	-4.535	0.00	-4.879	1.79	-3.881	0.00	0.000

OXIDATION POTENTIAL (VOLTS) :

WH (ACT.)	OH	HS10H	HS20H	HS30H	HS40H	HS50H	HS60H	HS70H	HS80H	HS90H	HS100H
0.00	-4.690	0.42	-5.143	3.47	-4.535	0.00	-4.879	1.79	-3.881	0.00	0.000

ORLUSTON MM #10
18N-09-22 65
LEIRA L-4

PROGRAM WATCH2.
3504 400 104 75 6-24 104
LEIRA L-4
LEIRAR-06 RELAKREPU BORGAFJARDARSTYLA JI/0H
STEAM SAMPLE
WATER SAMPLE (PPM)
PH/REG.C 8-10/20.0 GAS (VOL.%) REFERENCE TEMP. DEGREES C 0.0 (SILO2)
SILO2 149.00 CO2 0.00
WA 133.40 H2S 0.00
K 16.10 H2 0.00
CA 22.60 CH4 0.00
MG 1-2000 CH4 0.00
SDA 119.40 H2 0.00
H2S 59.60 H2S 0.00
CL 135.70 H2S 0.00
DISS.SOLIDS 2.45
AL 0.0000
P 0.0000
FE 0.0000
MNS 0.0000

CONDENSATE (PPM) / FLUID IN/LEUW DEPTH (METERS)
CONDENSATE (PPM) / PH/REG.C /
CO2 0.00
H2S 0.00
NA 0.00
CONDENSATE WITH MASH (PPM)
CO2 0.00
H2S 0.00

IONIC STRENGTH = 0.00880 IONIC BALANCE : CATIONS (MOL.EQ./10.0073727)
ANIONS (MOL.EQ./10.0073728)
DIFFERENCE (%) -6.04

DEEP WATER (PPM) BEEP STEAM (PPM) GAS PRESSURES (MMHG ABS.)
SILO2 149.01 CO2 119.40 CO2 0.00
WA 133.40 H2S 0.26 H2S 0.00
K 16.10 H2 0.00 H2 0.00
CA 22.60 CH4 0.00 CH4 0.00
MG 1.20 CH4 0.00 CH4 0.00
SDA 59.60 H2 0.00 H2 0.00
CL 135.69 H2S 0.00 H2S 0.00
DISS.S. 2.05 H2O 0.293E+01
AL 0.0000 H2O (L) 0.00
P 0.0000 BOILING PORTION 0.00
FE 0.0000

ACTIVITY COEFFICIENTS IN DEEP WATER
NA 0.897 K2SO4 0.888
NH4 0.882 F- 0.860
OH- 0.883 CL- 0.860
MgSO4 0.883 NH4 0.883
MgSO4 0.879 K+ 0.880
MgSO4 0.883 Ca++ 0.427
CO3-- 0.615 NH4+ 0.442
HS- 0.882 CaHCO3+ 0.889
S-- 0.619 MgHCO3+ 0.883
MgSO4 0.885 CaOH+ 0.889
SO4-- 0.611 MgSO4 0.891
MgSO4 0.888 NH4+ 0.879

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLE)
H+ (ACT.) 0.00 -7.532 NH4+ 0.777 -4.498
OH- 1.00 -4.231 NaCl 0.38 -5.186
MgSO4 224.20 -2.632 KCl 0.01 -6.766
MgSO4 13.24 -3.856 NH4OH 1.48 -4.966
MgSO4-- 0.01 -7.100 K2SO4 0.57 -5.372
MgSO4 0.96 -5.091 CaSO4 6.36 -4.331
MgSO4 0.00 0.000 NH4OH 1.81 -4.823
MgSO4 0.00 0.000 CaCO3 2.64 -4.578
MgSO4 14.22 -3.640 MgCO3 0.04 -6.342
MgSO4 143.26 -2.629 CaHCO3+ 10.23 -3.975
CO3-- 0.40 -5.179 CaHCO3+ 0.12 -5.838
H2S 0.52 -6.143 CO3-- 0.03 -6.146
H2S 0.52 -6.143 NH4OH 0.03 -6.146
H2S 0.52 -6.143 NH4OH 0.03 -6.146
MgSO4 0.00 -14.444 NH4+ 0.00 0.000
MgSO4 52.64 -3.266 NH4+ 0.00 0.000
SO4-- 0.00 -2.497 FeH+ 0.00 0.000
MgSO4 52.64 -3.266 FeH+ 0.00 0.000
F- 2.05 -2.394 FeH+ 0.00 0.000
CL- 135.45 -2.418 Fe(OH)2 0.00 0.000
MgSO4 132.78 -2.238 Fe(OH)3-- 0.00 0.000
K+ 15.93 -3.390 Fe(OH)4-- 0.00 0.000
Ca++ 15.58 -3.410 Fe(OH)2+ 0.00 0.000

IONIC STRENGTH = 0.00832 IONIC BALANCE : CATIONS (MOL.EQ./10.0071289)
ANIONS (MOL.EQ./10.0073782)
DIFFERENCE (%) -6.13
1000/T DEGREES KELVIN = 2.46

CHEMICAL GEOTHERMETERS DEGREES C
SILICA TEMPERATURE 132.8
MKA 185.2
MKA 1 207.2
MKA 2 206.9

DURATION POTENTIAL (VOLTS) : EP H2S= -0.440 EH CH4= 99.999 EH H2S= 99.999 EH H2S= 99.999
LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER
MgSO4 -15.594 99.999 ALBITE LOW -14.956 99.999
MgSO4 -15.594 99.999 ALBITE HIGH -14.956 99.999
MgSO4 -15.594 99.999 CALCITE -14.956 99.999
MgSO4 -15.594 99.999 DOLOMITE -14.956 99.999
MgSO4 -15.594 99.999 HALITE -14.956 99.999
MgSO4 -15.594 99.999 KALSHOFITE -14.956 99.999
MgSO4 -15.594 99.999 MASHONITE -14.956 99.999
MgSO4 -15.594 99.999 SIDERITE -14.956 99.999
MgSO4 -15.594 99.999 ZINCOBLITE -14.956 99.999

LETRA L-4

ORUSTUPHAIN JD
1981-09-22 BS

PROGRAM WATCHES.

3204 400 104 75-6-24 US

LETRA L-4

LETRA-08 NELAHEPU BORGARFJANASTEILA JT/GR

WATER SAMPLE (PPM)

PH/DEG.C	6.94/20.0	GAS (VOL.%)		DEGREES C	0.0 (TS102)
SI02	149.00	H2S		REFERENCE TEMP.	
WA	138.10	H2		SAMPLING PRESSURE	BARIS ABS.
K	12.20	H2		DISCHARGE ENTHALPY	N.JUL/KG
CA	37.80	O2		DISCHARGE	KG/SEC.
WA	1.4000	CH4		MEASURED TEMPERATURE DEGREES C	84.5
CO2	166.30	CO2		RESISTIVITY/TEMP.	OHM/DEG.C 11.8/ 0.0
SO4	52.70	H2		EN/TEMP.	0.000/ 0.0
CL	0.78				
FE	139.80				
F	2.10	LITERS GAS PER KG			
AL	649.00	COMBUSTANT/DEG.C			
B	0.0000				
FE	0.0000	CONCENTRATE (PPM)			
WA3	0.0000	CO2			
£		H2S			
£		CONCENTRATE WITH MOCH (PPM)			
£		CO2			
£		H2S			

IONIC STRENGTH = 0.00944 IONIC BALANCE : CATIONS (MOL.ED.10.00828917
ANIONS (MOL.ED.10.00807143
DIFFERENCE (Z) -2.18

DEEP WATER (PPM)	GAS PRESSURES (BARIS ABS.)	CO2	166.30	CO2	0.00
		H2S	0.78	H2S	0.00
SI02		K	12.20	H2	0.00
WA		CA	37.80	O2	0.00
K		WA	1.4000	CH4	0.00
CA		SO4	52.70	H2	0.00
WA		CL	0.78	H2S	0.00
CO2		F	2.10	H2O	0.320E+01
SO4		AL	649.00	TOTAL	0.331E+01
CL		B	0.0000	H2O (Z)	0.00
FE		FE	0.0000	BOILING PORTION	0.00

ACTIVITY COEFFICIENTS IN DEEP WATER

HA	0.891	FEA	0.881	FEA	0.879
HA	0.877	FEH	0.877	FEH	0.877
H2O	0.877	FEH2O	0.877	FEH2O	0.877
H2SO4	0.877	FEH2SO4	0.877	FEH2SO4	0.877
CL	0.877	FEHCL	0.877	FEHCL	0.877
NA	0.877	FEHNA	0.877	FEHNA	0.877
K	0.877	FEHK	0.877	FEHK	0.877
CA	0.877	FEHCA	0.877	FEHCA	0.877
CO3	0.877	FEHCO3	0.877	FEHCO3	0.877
OH	0.877	FEHOH	0.877	FEHOH	0.877
HS	0.877	FEHHS	0.877	FEHHS	0.877
S	0.877	FEHS	0.877	FEHS	0.877
SO3	0.877	FEHSO3	0.877	FEHSO3	0.877
SO4	0.877	FEHSO4	0.877	FEHSO4	0.877
MSO4	0.877	FEHMSO4	0.877	FEHMSO4	0.877

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLE)

HA	0.00	7.017	MSH	0.76	-4.405	FE(OH)3	0.00	0.000
HA	0.33	-4.711	MCL	0.42	-5.147	FE(OH)4	0.00	0.000
H2SO4	231.74	-2.414	KCL	0.01	-6.859	FECL	0.00	0.000
H2SO4	4.32	-4.343	MSO4	1.30	-4.563	FECL2	0.00	0.000
H2SO4	0.00	-8.096	K2SO4	0.37	-5.562	FECLH	0.00	0.000
MSO4	0.32	-5.565	CSO4	9.11	-4.175	FECL2H	0.00	0.000
H2SO3	0.00	0.000	MSO4	1.90	-4.802	FECL3	0.00	0.000
H2SO3	0.00	0.000	CAO3	1.61	-4.794	FECL4	0.00	0.000
H2SO3	54.97	-3.052	MSO3	0.02	-6.707	FEH4	0.00	0.000
H2SO3	162.83	-2.574	MSO3H	20.38	-3.691	FEH4H	0.00	0.000
H2SO3	0.14	-4.446	MSO3H	0.17	-5.705	AL(H)	0.00	0.000
H2SO3	0.74	-4.446	MSO3H	0.63	-6.323	AL(OH)2	0.00	0.000
H2SO3	0.54	-4.746	MSO3H	0.00	0.000	AL(OH)3	0.00	0.000
H2SO4	0.00	-13.326	MSO3H	0.00	0.000	AL(OH)4	0.00	0.000
H2SO4	0.00	-13.450	MSO4	0.00	0.000	AL(SO4)2	0.00	0.000
H2SO4	0.01	-7.025	FEH	0.00	0.000	AL(SO4)2-	0.00	0.000
H2SO4	43.44	-3.345	FEH2	0.00	0.000	AL(F)2	0.00	0.000
H2SO4	0.00	-6.842	FEH3	0.00	0.000	AL(F)3	0.00	0.000
H2SO4	2.10	-3.957	FEH4	0.00	0.000	AL(F)4	0.00	0.000
H2SO4	139.53	-2.405	FE(OH)2	0.00	0.000	AL(F)5	0.00	0.000
H2SO4	137.62	-2.223	FE(OH)3	0.00	0.000	AL(F)6	0.00	0.000
H2SO4	12.09	-3.510	FE(OH)4	0.00	0.000	AL(F)7	0.00	0.000
H2SO4	26.30	-3.183	FE(OH)5	0.00	0.000	AL(F)8	0.00	0.000

IONIC STRENGTH = 0.00895 IONIC BALANCE : CATIONS (MOL.ED.10.0079249
ANIONS (MOL.ED.10.0079255
DIFFERENCE (Z) 2.40

CHEMICAL GEOTHERMOMETERS DEGREES C 1000/T DEGREES KELVIN = 2.45

SILICA TEMPERATURE 135.7

NAKKA 95.4

NAK 1 170.1

NAK 2 174.7

OXIDATION POTENTIAL (VOLTS) : EH H2S = -0.403 EH CH4 = 99.999 EH H2 = 99.999 EH H2S = 99.999

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

ADULMITE	-13.08	99.999	ALBITE	-14.849	99.999	ANALCITE	-11.789	99.999
ANALCITE	-6.137	99.999	ANALCITE	-9.750	99.999	ANALCITE	-2.411	99.999
ANALCITE	-7.962	99.999	ANALCITE	-10.325	99.999	ANALCITE	-25.290	99.999
ANALCITE	-74.720	99.999	ANALCITE	-14.671	99.999	ANALCITE	-34.833	99.999
ANALCITE	-71.633	99.999	ANALCITE	-18.025	99.999	ANALCITE	-39.110	99.999
ANALCITE	-74.550	99.999	ANALCITE	-22.950	99.999	ANALCITE	-34.814	99.999
ANALCITE	-1.042	99.999	ANALCITE	9.324	8.024	ANALCITE	-34.814	99.999
ANALCITE	-22.950	99.999	ANALCITE			ANALCITE		
ANALCITE	99.999	99.999	ANALCITE			ANALCITE		

ORIGINATION NO
191-49-22 86

LEINA L-4

PROGRAM WATCH:

3304 400 104 75- 7- 1 115

LEINA L-4

LEINA-05 RELAREPPI BURGAS JAGARSTVLA JI/08

WATER SAMPLE (PPM)

PH/REG.C 7.01/22.0
SI02 184.00
WA 178.30
K 13.70
CA 32.40
Mg 1.1000
CH4
CO2 179.00
S04 144.10
HCS 0.80
CL 185.00
2-30
DISS.SOLIDS 1128.00

LITERS GAS PER KG
COMBUSTIVE/REG.C /

COMBUSTIVE (PPM) /
PH/REG.C /
CO2
H2
NH

COMBUSTIVE WITH NASH (PPM)
CO2
H2
NH

IONIC BALANCE : CATIONS (INCL.ED.10.00154813
ANIONS (INCL.ED.10.01154813
DIFFERENCE (Z) -17.59

DEEP WATER (PPM)

SI02 184.02
WA 178.30
K 13.70
CA 32.40
Mg 1.10
S04 144.10
CL 184.98
F 2.30
DISS.S. 1128.00
AL 0.0000
P 0.0000

DEEP STEAM (PPM)

CO2 179.00
HCS 0.80
H2 0.00
CH4 0.00
H2 0.00
HCS 0.000E+00
H2O 0.491E+01
TOTAL 0.503E+01

H2O (Z) 0.00
BOILING POSITION 0.00

ACTIVITY COEFFICIENTS IN DEEP WATER

OH	0.877	FS04-	0.864	FEH+	0.546	FECL+	0.858
H+	0.856	F-	0.854	FEH+	0.310	ALH+	0.310
HS104	0.858	CL-	0.854	FE0H+	0.862	AL(OH)2+	0.560
HS104-	0.540	M+	0.858	FE(OH)3-	0.862	AL(OH)2+	0.864
HS03-	0.851	K+	0.854	FE(OH)4-	0.555	AL(OH)4-	0.860
HS03-	0.858	CAH+	0.566	FE(OH)4-	0.555	AL(OH)4-	0.860
CO3--	0.550	MH+	0.585	FE(OH)2+	0.864	AL(SO4)2-	0.860
HS-	0.856	CMCO3H	0.866	FE(OH)2+	0.864	ALF7+	0.864
HS04-	0.860	CMCO3H	0.866	FE0H+	0.555	ALF7+	0.864
S04--	0.545	MS04H	0.868	FECL2+	0.862	ALF5--	0.550
MS04-	0.864	MH+	0.851	FECL4-	0.858	ALF5--	0.261

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND LOG MOLE)

OH (ACT.)	0.00	-7.138	NH+	0.47	-4.716	FE(OH)3	0.00	0.000
H+	0.68	-4.398	NaCl	0.79	-4.867	FE(OH)4-	0.00	0.000
HS104	286.75	-2.322	AL	0.02	-6.814	FECL+	0.00	0.000
HS104-	0.09	-4.070	MS04-	3.22	-4.328	FECL-	0.00	0.000
HS03-	0.26	-5.187	MS04	19.31	-3.824	FECL2+	0.00	0.000
MS03-	0.76	-5.185	CaSO4	19.31	-3.824	FECL2+	0.00	0.000
MS03-	0.00	0.000	MS04	2.93	-4.614	FECL3	0.00	0.000
HS03-	0.00	0.000	CaCO3	2.84	-4.627	FECL4-	0.00	0.000
HS03-	55.02	-3.052	MS03	0.01	-6.815	FES04	0.00	0.000
CO3--	180.44	-2.529	CMCO3H	20.00	-3.204	FES04	0.00	0.000
HS-	0.18	-5.514	MS03H	0.10	-5.935	ALH+	0.00	0.000
HS-	0.61	-4.734	MS04H	0.84	-6.133	AL(OH)2+	0.00	0.000
S--	0.00	-12.990	MH0H	0.00	0.000	AL(OH)3	0.00	0.000
MS04	0.03	-6.516	MH+	0.00	0.000	AL(OH)4-	0.00	0.000
MS04-	122.68	-2.894	FEH+	0.00	0.000	AL(SO4)2-	0.00	0.000
HF	0.00	-6.798	FE0H+	0.00	0.000	ALF7+	0.00	0.000
F-	2.30	-3.918	FE(OH)2	0.00	0.000	ALF7+	0.00	0.000
CL-	184.49	-2.284	FE(OH)3-	0.00	0.000	ALF3	0.00	0.000
NH	174.83	-2.114	FE(OH)4-	0.00	0.000	ALF4-	0.00	0.000
K+	13.31	-3.468	FE(OH)4-	0.00	0.000	ALF5--	0.00	0.000
CAH+	17.82	-3.352	FE(OH)2+	0.00	0.000	ALF6--	0.00	0.000

IONIC BALANCE : CATIONS (INCL.ED.10.00154813
ANIONS (INCL.ED.10.01087859
DIFFERENCE (Z) -18.14

1000/7 DEGREES KELVIN = 2.36

CHEMICAL GEOTHERMOMETERS DEGREES C

SILICA TEMPERATURE 151.1
MNA 183.4
MNA 1 155.3
MNA 2 181.0

Oxidation Potential (VOLTS) : EN HCS= -0.439 EN CH4= 99.999 EN H2= 99.999 EN H2S= 99.999

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

ADULARIA	-14.892	99.999	ALBITE LHM	99.999	ANALCIME	99.999	TEBR.	CALC.
AMPHIBOLE	-6.384	-6.257	CALCITE	-10.254	-8.373	CHALCEDONY	-2.519	-2.522
NE-CALCITE	-78.574	99.999	FLUORITE	-16.526	-11.520	SIENITE	-3.797	99.999
LAURDOLITE	-23.915	99.999	MICROCLINE	-15.986	99.999	MAGNETITE	-24.080	99.999
CA-MONTMOR.	-66.922	99.999	K-MONTMOR.	-32.138	99.999	MG-MONTMOR.	-47.742	99.999
MA-MONTMOR.	-32.138	99.999	MUSCOVITE	-16.950	99.999	PREHNITE	-34.289	99.999
PHYRROPHILITE	0.973	99.999	PYRITE	-37.582	99.999	QUARTZ	-2.668	-2.522
WATANKITE	-22.422	99.999	MOLLAUSTONITE	8.975	8.195	ZOISITE	-33.443	99.999
EPIDOTE	99.999	99.999						

LETRA L-4

OROSTOFUM AND
1981-09-22 BR

PROGRAM INTEREX.

3504 400 104 75- 7-10 117

LETRA -HOLA L-4

LETRA-06 HELMAREPPO BORGAFJAMMARETELA JT/0H

STEAM SAMPLE

PH/REG-C	6-70/22.0	GAS (VOL. %)	REFERENCE TEMP.	DEGREES C	0.0 (TSID2)
SI02	283.50	CO2	SAMPLING PRESSURE	MMHG ABS.	
NA	157.50	H2S	DISCHARGE ENTHALPY	KJUL/KG	
CA	34.80	O2	DISCHARGE	KG/SEC.	1.2
HA	1.0000	CH4	MEASURED TEMPERATURE DEGREES C	104.5	
SO4	227.80	H2	RESISTIVITY/TEMP.	OHM/REG-C	10.0/ 0.0
CL	159.80		EN/TEMP.	MV/REG-C	0.000/ 0.0
F	0.48				
AL	218.00				
FE	2.23				
DISS-SOLIDS	889.00	LITERS GAS PER KG	MEASURED DOWNSIDE TEMP.	FLUID INFLOW	
B	0.0000	CONCENTRATE/REG-C	DEGREES C/METERS	DEPTH (METERS)	
NA	0.0000				
FE	0.0000				
HK3	0.0000				
#					
#					
#					

IONIC STRENGTH = 0.01420

IONIC BALANCE : CATIONS (MOL.EQ./10.01302451)
ANIONS (MOL.EQ./10.01301199)
DIFFERENCE (%) -21.99

DEEP WATER (PPM)

	203.00	203.00	CO2	227.80	CO2	0.00	0.2346400
NA	157.50	H2S	0.48	H2S	0.00	K2S	0.119E-03
CA	34.80	H2	0.00	H2	0.00	H2	0.000E+00
HA	1.02	O2	0.00	O2	0.00	CH4	0.000E+00
SO4	159.80	CH4	0.00	CH4	0.00	H2	0.000E+00
CL	217.98	H2	0.00	H2	0.00	H2S	0.000E+00
F	2.23	H2S	0.00	H2S	0.00	K2O	0.299E+01
DISS.S.	889.00					TOTAL	0.421E+01
AL	0.0000					H2O (Z)	0.00
B	0.0000					BOILING POINT	0.00
FE	0.0000						

ACTIVITY COEFFICIENTS IN DEEP WATER

NA	0.870	ES04-	0.854	FEH+	0.547	FECL4	0.850
OH-	0.948	F-	0.848	FEH+	0.790	ALH+	0.290
HS04-	0.850	CL-	0.845	FEH+	0.855	ALOH+	0.540
HS04--	0.540	NA+	0.850	FE(OH)3-	0.855	AL(OH)2+	0.854
HCO3-	0.842	K+	0.845	FE(OH)4--	0.536	AL(OH)4-	0.852
CO3--	0.850	CAH+	0.547	FEH+	0.854	AL(SO4)2-	0.852
HS-	0.530	MGH+	0.859	FE(OH)2+	0.856	ALFH+	0.540
S--	0.848	CAKOH3+	0.859	FE(OH)4-	0.855	ALFH+	0.854
HS04-	0.852	CAOH+	0.859	FEH+	0.854	ALFH+	0.852
SH4--	0.524	NOH+	0.841	FECL2+	0.855	ALF5--	0.530
MS04-	0.856	MMH+	0.842	FECL4-	0.850	ALF6---	0.240

CHEMICAL COMPONENTS IN DEEP WATER (PPM AND MOL)

NA (ACT.)	0.00	-0.950	MGH+	0.40	-4.785	FE(OH)3	0.00	0.000
OH-	0.51	-4.523	NACL	1.04	-4.750	FE(OH)4-	0.00	0.003
HS104	318.44	-2.480	KCL	0.03	-6.409	FECL+	0.00	0.009
HS104--	5.78	-4.216	MS04-	6.40	-4.270	FECL2	0.00	0.000
HS104--	0.00	-8.015	HS04-	1.89	-4.854	FECL+	0.00	0.000
MS104--	0.57	-5.316	CAH04	24.40	-3.747	FECL2+	0.00	0.000
HCO3-	0.00	0.000	MS04	2.90	-4.618	FECL3	0.00	0.000
HCO3-	104.11	-2.787	CAH33	1.63	-4.787	FECL4-	0.00	0.000
CO3--	194.71	-2.496	CAKOH3+	25.78	-3.953	FEH04	0.00	0.000
CO3--	0.12	-5.315	CAKOH3+	0.10	-5.350	FEH04	0.00	0.000
HS-	0.32	-5.128	CAH04	0.14	-4.260	ALOH+	0.00	0.000
S-	0.00	-11.397	MS04-	0.01	-4.599	ALOH+	0.00	0.000
HS04	0.00	-14.354	MMH+	0.00	0.000	AL(OH)2+	0.00	0.000
HS04-	0.06	-4.179	FEH+	0.00	0.000	AL(OH)4-	0.00	0.000
SO4--	133.70	-2.854	FEH+	0.00	0.000	AL(SO4)2-	0.00	0.000
FE	0.91	-3.931	FEH+	0.00	0.000	ALFH+	0.00	0.000
CL-	217.34	-2.212	FE(OH)2-	0.00	0.000	ALFH+	0.00	0.000
NA+	187.54	-2.068	FE(OH)4--	0.00	0.000	ALF3	0.00	0.000
K+	16.44	-3.376	FE(OH)4--	0.00	0.000	ALF4-	0.00	0.000
CAH+	18.72	-3.331	FE(OH)2+	0.00	0.000	ALF5--	0.00	0.000

IONIC STRENGTH = 0.01294 IONIC BALANCE : CATIONS (MOL.EQ./10.00901812)
ANIONS (MOL.EQ./10.01232473)
DIFFERENCE (%) -22.82

CHEMICAL GEOTHERMETERS DEGREES C

1000/T DEGREES KELVIN = 2.32

SILICA TEMPERATURE 158.7

NAKA 171.3
NAK 1 171.9
NAK 2 176.4

OCCUPATION POTENTIAL (VOLTS) :

EH H2S = -0.429 EH CH4 = 99.999 EH H2 = 99.999 EH H2S = 99.999

LOG SOLUBILITY PRODUCTS OF MINERALS IN DEEP WATER

MINERAL	TEMP.	CALC.	TEMP.	CALC.	TEMP.	CALC.		
ANALABITE	-4.420	99.999	ALBITE LOW	-14.04	99.999	ANALABITE	99.999	
ANALABITE	-4.420	99.999	ALBITE	-10.410	-2.584	CHALCOPHY	-2.474	-2.480
ANALABITE	-4.420	99.999	FLUORITE	-10.465	-11.600	GEHLENITE	-31.455	99.999
ANALABITE	-4.420	99.999	MICROCLINE	-15.678	99.999	MICROCLINE	-23.478	99.999
ANALABITE	-4.420	99.999	K-MONTROCK	-31.624	99.999	K-MONTROCK	-65.520	99.999
ANALABITE	-4.420	99.999	MUSCOVITE	-16.441	99.999	MUSCOVITE	-34.145	99.999
ANALABITE	-4.420	99.999	PIRIT	-36.873	99.999	PIRIT	-2.418	-2.480
ANALABITE	-4.420	99.999	WOLLASTONITE	8.809	7.846	WOLLASTONITE	-33.180	99.999
ANALABITE	-4.420	99.999						

CHRISTOPHER J AND
1981-09-22 06

LETRA L-4

PROGRAM MATCHES:

ZS04 400 104 75-11-12 173

LETRA - BORDOLA 4

LETRA- DE HELMREPP BORGARFJARGARSTELA SA/MN

STEAM SAMPLE

WATER SAMPLE (PPM)	GAS (VOL.%)	REFERENCE TEMP.	DEGREES C	0.0 (TS102)
PA/REG.C	4.70/20.0			
SI02	245.00			
CO2	225.30			
H2	24.70			
CH4	21.60			
HC2	0.1200			
HC4	171.20			
HC6	70.50			
HC8	5.80			
CL	273.00			

LITERS GAS PER KG CONDENSATE/REG.C	MEASURED DOWHOLE TEMP. DEGREES C/METERS	FLUID INFLOW DEPTH (METERS)
AL	0.0	0.0
FE	0.0	0.0
HC2	0.0	0.0
HC4	0.0	0.0
HC6	0.0	0.0
HC8	0.0	0.0
MA	0.0	0.0
SI02	0.0	0.0
CO2	0.0	0.0
H2	0.0	0.0
CH4	0.0	0.0
HC2	0.0	0.0
HC4	0.0	0.0
HC6	0.0	0.0
HC8	0.0	0.0
MA	0.0	0.0

CONDENSATE WITH MINN (PPM)

CO2	0.0
H2	0.0
CH4	0.0
HC2	0.0
HC4	0.0
HC6	0.0
HC8	0.0
MA	0.0

IONIC BALANCE : CATIONS (MOL.EG.10.0114551)
ANIONS (MOL.EG.10.0114561)
DIFFERENCE (Z) -4.121

KEEP WATER (PPM)

KEEP WATER (PPM)	DEEP STEAM (PPM)	GAS PRESSURES (BARX ABS.)
SI02	171.20	CO2 0.210E+00
MA	5.80	H2S 0.238E-02
K	0.00	H2 0.000E+00
CA	0.00	O2 0.000E+00
HC	0.00	CH4 0.000E+00
SO4	0.00	H2 0.000E+00
CL	0.00	H2O 0.145E+02
F	2.45	TOTAL 0.147E+02
BISS.S.	944.00	
B	0.0000	
FE	0.0000	

KOH (Z) 0.00

BOILING FORTION 0.00

ACTIVITY COEFFICIENTS IN KEEP WATER

WT	0.860	KSM-	0.845	FE++	0.519	FECL2	0.828
OH-	0.826	F-	0.826	FE+++	0.260	AL+++	0.000
HS104-	0.828	CL-	0.823	FE0H+	0.843	AL0H+	0.512
HS104--	0.820	MA+	0.823	FE(OH)2-	0.843	AL(OH)2+	0.845
HS203-	0.820	K+	0.823	FE(OH)4--	0.507	AL(OH)4-	0.841
HS203--	0.820	CA++	0.519	FE0H++	0.845	AL(SO4)2-	0.841
HS-	0.826	HE+	0.540	FE(OH)2+	0.845	ALF++	0.512
HS--	0.507	CMCO3+	0.848	FE(OH)4-	0.843	ALF2+	0.845
HS04-	0.841	CA0H+	0.848	FE0H+	0.507	ALF4-	0.841
HS04--	0.494	MS0H+	0.850	FECL2+	0.843	ALF5--	0.502
MS04-	0.845	MM+	0.830	FECL4-	0.838	ALF6---	0.212

CHEMICAL COMPONENTS IN KEEP WATER (PPM AND LOG MOLE)

WT (ACT.)	0.00	-7.165	MS04-	0.05	-5.652	FE(OH)3	0.00	0.000
OH-	1.38	-4.032	MACL	2.08	-4.448	FE(OH)4-	0.00	0.000
HS104-	411.83	-2.348	KCL	0.10	-5.890	FECL2	0.00	0.000
HS104--	10.87	-3.942	MS04-	5.08	-4.370	FECL4	0.00	0.000
HS203-	0.09	-7.856	HS04-	2.02	-4.822	FECL+	0.00	0.000
HS203--	1.29	-4.938	CH3A	10.93	-4.995	FECL2+	0.00	0.000
HS-	0.00	0.000	MS04	0.28	-5.825	FECL3	0.00	0.000
HS--	0.00	0.000	CA03	0.00	-4.795	FECL4-	0.00	0.000
HS04-	94.48	-2.817	MS03	0.00	-7.728	FE0H+	0.00	0.000
HS04--	131.43	-2.814	MS03A	19.28	-3.770	FE0H2+	0.00	0.000
HS-	0.07	-5.849	MS03B	0.01	-4.825	AL+++	0.00	0.000
HS--	1.84	-4.244	CA0H+	0.10	-5.749	AL0H+	0.00	0.000
HS04-	3.83	-3.937	MS0H+	0.01	-6.653	AL(OH)2+	0.00	0.000
HS04--	0.00	-11.871	MS0H-	0.00	0.000	AL(OH)3	0.00	0.000
HS-	0.00	0.000	MM+	0.00	0.000	AL(OH)4-	0.00	0.000
HS--	0.06	-6.183	MS04	0.00	0.000	AL(SO4)2-	0.00	0.000
HS04-	56.97	-3.227	FE++	0.00	0.000	ALF++	0.00	0.000
HS04--	0.01	-6.313	FE0H+	0.00	0.000	ALF2+	0.00	0.000
HS-	2.44	-3.871	FE(OH)2-	0.00	0.000	ALF3	0.00	0.000
HS--	271.67	-2.116	FE(OH)3-	0.00	0.000	ALF4-	0.00	0.000
HS04-	223.13	-2.013	FE(OH)4--	0.00	0.000	ALF5--	0.00	0.000
HS04--	24.06	-3.211	FE(OH)2+	0.00	0.000	ALF6---	0.00	0.000
HS-	9.76	-3.604	FE(OH)3+	0.00	0.000	ALF6---	0.00	0.000

IONIC STRENGTH = 0.01208 IONIC BALANCE :
CATIONS (MOL.EG.10.0114556)
ANIONS (MOL.EG.10.0114603)
DIFFERENCE (Z) -3.96

CHEMICAL GEOTHERMOMETERS DEGREES C

SILICA TEMPERATURE	196.4	1000/T DEGREES KELVIN = 2.13
MMCA	190.1	
MMK 1	195.2	
MMK 2	197.9	

Oxidation Potential (VOLTS) : EN H2S- -0.350 EN CH4- 99.999 EN H2- 99.999 EN H2O- 99.999

LOG SOLUBILITY PRODUCTS OF MINERALS IN KEEP WATER

MINERAL	TEOR.	CALC.	TEOR.	CALC.	
ANALABIA	-13.468	99.999	ANALABIA	-10.242	99.999
AMPHIBITE	-7.144	-7.422	AMPHIBITE	-2.286	-2.348
MS-2ALABITE	-78.514	99.999	MS-2ALABITE	-1.441	99.999
LAURDOLITE	-21.852	99.999	LAURDOLITE	-20.348	99.999
CA-MONTMOR.	-54.299	99.999	CA-MONTMOR.	-35.045	99.999
MA-MONTMOR.	-25.599	99.999	MA-MONTMOR.	-23.150	99.999
PERMONTMOR.	0.841	99.999	PERMONTMOR.	-2.389	-2.348
MILKASITE	-21.094	99.999	MILKASITE	-32.659	99.999
EPIDOTE	99.999	99.999	EPIDOTE		

