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Tittel The Tuftehavna Minralization				
Forfatter I. Hultin H. Qvale		Dato Ar 1982	Bedrift (oppdragsgiver og/eller oppdragstaker)	
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Råstoffgruppe Industrimineral	Råstofftype Skjeldne jordartselementer			
Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse To korte rapporter over mineral-undersøkelse på Nb - Apatitt mineralisering i Tuftehavna-området. Det er gjennomført optiske, kjemiske og gefysiske undersøkelser av dette Nb-holdige Apatittmineralet.				

H. Qvale

Oslo, 2/8-82

NOTE

(Kap 4c)

Apatite chemistry

Microprobe analysis have been carried out on apatites from the major rock types within the area. In addition to the routine energ.-dispersion-based full analysis, more careful individual analysis are carried out for Mg, Cl and F^- to fix these constituents' variations relative to specific industrial wants.

As is shown in Table 1 the variations are generally small. Characteristic are: CaO: 54-56 wt %

Na_2O : 0,2-0,4 wt %

P_2O_5 : 40,3-41,3 wt %

F^- : 2,5-4,0 wt %

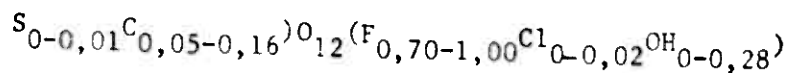
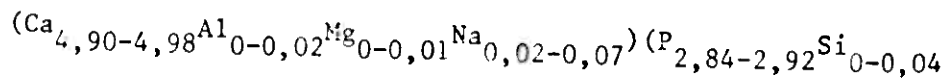
Cl^- : 0,04-0,12 wt % (Av. 0,07 %)

and $MgO < 0,10$ wt %

43.7% teorisk. P: P_2O_5 .

Contents of SiO_2 , Al_2O_3 , FeO , Ce_2O_3 and La_2O_3 are low and irregular. The only traces of chemical zoning are exhibited by Cl which is significantly enriched along grain boundaries (cf. BH 1, 9 - - - - - vz. 1D, Table 1). Whether this is a general phenomenon or is restricted to certain rocktypes, samples or structural features is not yet ascertained.

The calculated structural formulae indicate a deficiency in the P-position suggesting a significant substitution of C (in the form of $(CO_3OH)^{3-}$?) for PO_4^{3-} . Taking this, as well as the substitution of OH^- for F^- and Cl^- , into account the probable full composition of the analyzed apatites may be expressed as



The indicated content of C is comparable to CO_2 -contents between 0,4 and 1,4 wt %. This parameter, if confirmed by later direct analysis, seem to be the most critical when considering the Fen apatites as possible

source of industrial production of fertilizers. The other quality requirements outlined by Lenning (1982) are met with as far as the apatite itself is concerned. Complications arising from impurities in a concentrate are outside the scope of the discussions in this chapter.

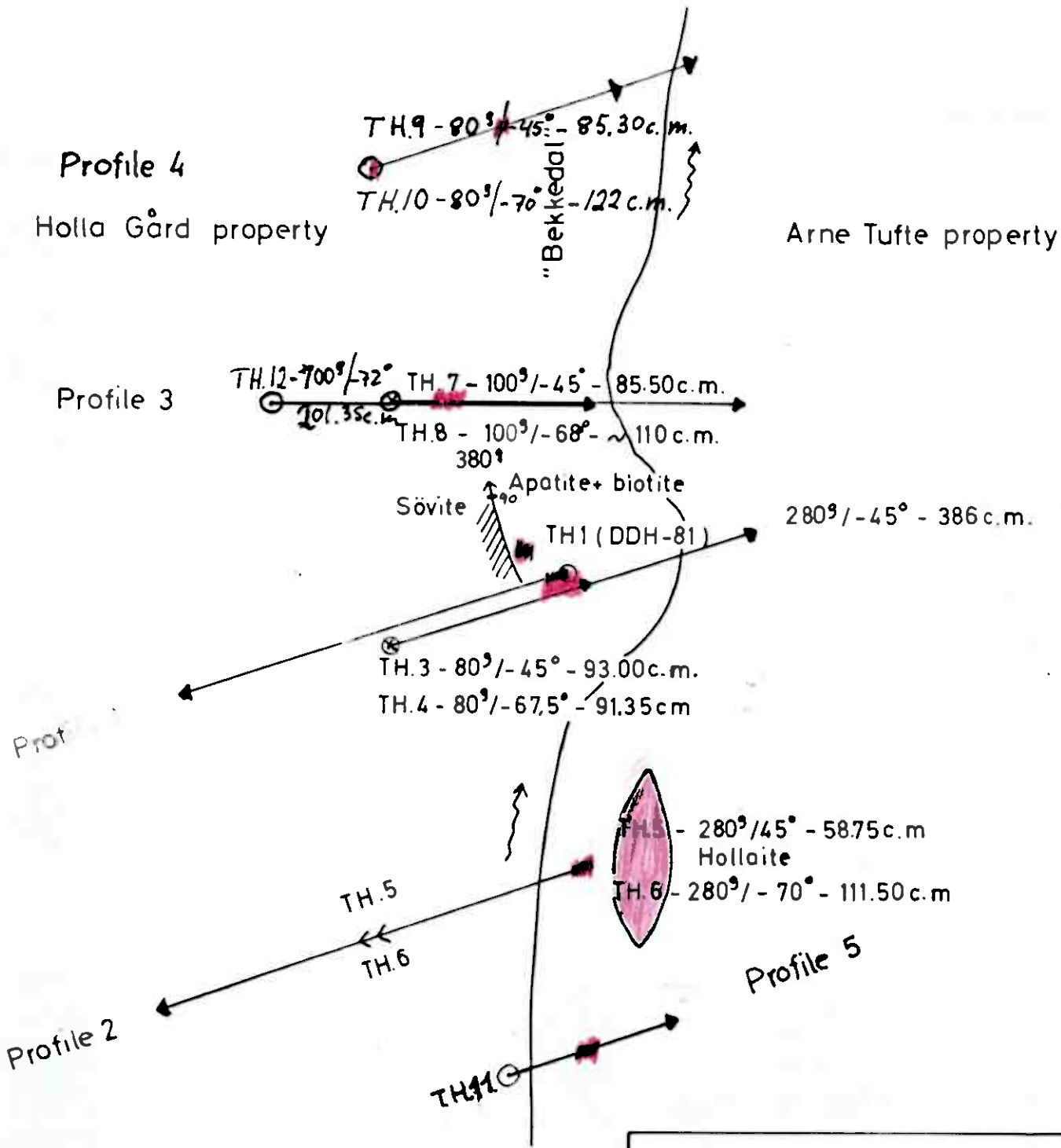
No		A N A L Y S I S																	
SAMPLE	POINT	REF	METHOD	ROCK TYPE	SiO ₂	Al ₂ O ₃	FeO	MgO	CaO	Na ₂ O	P ₂ O ₅	Y ₂ O ₃	Ce ₂ O ₃	La ₂ O ₃	SO ₄ ²⁻	F ⁻	Cl ⁻	O ₂ ¹⁾	SUM
Sh 1 3,95 m	1	25/5	EDX	Bi ap-rock	na	0	0	0	54.5	,2	39,8	na	tr	na	na	tr(2.4)	na	,9	96,0
	1	14/7	"	"	,3	tr	0	tr	55.0	,3	40,7	0	tr	0	,2	3.0	0	1,4	97,8
			spectr	"				0								3.5	,04	1,6	98,1
	2	25/5	EDX	"	na	,2	0	,2	54.6	,3	40,4	na	0	na	na	tr(1.8)	na	,8	96,7
	2	14/7	"	"	,3	,2	0	tr	55,4	,2	41,3	tr	tr	0	tr	tr(2.6)	0	1,1	98,9
			spectr	"				0								3.3	,05	1,4	99,4
	4	25/5	EDX	"	na	,2	tr	tr	na	tr	41,0	na	tr	na	na	tr(1,9)	na	,8	98,0
Sh 1 8,35 m	1	25/5	"	Bi ap-rock	na	0	0	tr	55,9	,2	40,9	na	0	na	na	tr(2.4)	na	1,8	98,4
		15/7	spectr	"				0								3.5	,05	1,5	99,1
	2	"	EDX	"	tr	tr	0	tr	55,0	,4	40,8	0	tr	tr	tr	4.3	0	1,8	98,3
			spectr	"				0								4.2	,05	1,8	98,3
Sh 1 9,60 m	1A	14/7	EDX	Bi ap-rock	,3	tr	0	0	56,4	,3	40,9	0	0	0	,3	0	,12	,1	98,2
			spectr	"				0								4.0	,12	1,8	100,5
	1B	"	EDX	"	tr	0	0	0	55,9	,2	41,3	0	tr	tr	tr	2.8	0	1,2	99,0
			spectr	"				0								2.8	,08	1,2	99,1
	1C	"	EDX	"	,4	0	0	0	56,4	,4	42,0	0	tr	tr	tr	tr(2,0)	0	,8	100,2
			spectr	"				0								3.0	,11	1,3	100,8
	1D	"	EDX	"	tr	0	0	tr	55,9	,4	41,7	0	tr	0	tr	tr(1,8)	0	,8	99,0
			spectr	"				0								3.4	,08	1,4	100,1
	3	25/5	EDX	"	na	0	0	,3	55,7	,4	41,0	na	tr	na	na	0(,9)	na	,4	97,9
Sh 1 4,40 m	1	25/5	EDX	søvite	na	tr	0	0	56,1	,3	40,8	na	0	na	na	tr(1,4)	na	,6	98,0
	1	14/7	"		,2	0	0	0	54,8	,3	40,3	0	0	0	tr	tr(2,3)	0	,9	96,9
			spectr	"				0								3.3	,07	1,4	97,6
Sh 3 12,70 m	1	15/7	EDX	Mgt-bi-ap-rock	,5	0	tr	,2	54,3	,2	40,4	0	0	0	tr	tr(2,3)	0	1,0	96,9
			spectr	"				0								3.0	,06	1,3	97,4
	2	"	EDX	"	tr	tr	tr	,2	54,0	tr	40,1	tr	0	0	tr	tr(,9)	0	,4	94,8
			spectr	"				0								2.9	,05	1,2	96,1
	3	"	EDX	"	,3	,2	0	tr	55,0	tr	40,8	0	tr	0	,4	tr(1,7)	0	,8	97,6
			spectr	"				0								3.0	,05	1,4	98,4
Sh 3 38,25	1	"	EDX	Ap-vein	tr	0	,4	,3	54,4	,4	40,6	0	0	0	tr	2.6	0	1,1	97,6
			spectr	"				0								2.6	,08	1,1	97,7
	2+3	"	EDX	"	,3	0	0	0	54,3	,2	40,4	0	tr	0	,3	3,6	tr	1,6	97,5
			spectr	"				0								3,4	,11	1,5	97,5

Table 1. Microprobe analysis of apatite from Tuftehavna, Fen.
EDX= Energy-dispersive measurements; Spectr.: "Wave-length-despersive" measurements made on separate manual spectrometers,
tr= traces; na= not analyzed; O₂¹⁾ (F⁻+Cl⁻+SO₄²⁻).

Table 1 c td.

Structural formula, based on 25 O + 2 (OH, F, Cl)

[illegible]



Holla Gård property



Arne Tufte property

TH.3 - 80°/-45° - 93.00 c.m.

TH.4 80°/- 67,5° -
91.35 c.m.

TH.1 - 280°/-45° - 386.00 c.m.

stream

c.m.

Nb₂O₅
%P₂O₅
%Ta₂O₅
ppmU₃O₈
ppm235 - 3
4
5
6
7
8
9
10
11
12

429

6.15
3.86
4.00
3.43
5.43
4.43
6.29
4.72
2.00
1.43

15,7

622
280
317
97
390
329
525
488
488
268319
248
165
83
236
177
319
319
260
20130 - 31
32
33
34
35
36
37
38
39
40
41

218

0.2
0.05
1.5
4.8
7.6
5.5
2.9
0.3
0.05
0.2
0.96.1
6.1
10.1
14.5
18.4
20.8
13.0
8.5
7.1
8.2
12.0170
150
340
640
830
330
190
50
50
80
28070
240
110
1006 - 7
8
9
16-170.8
0.5
0.3
1.47.2
5.2
5.4
11.3190
140
130
80-
-
-
-

52-53

0.6

7.3

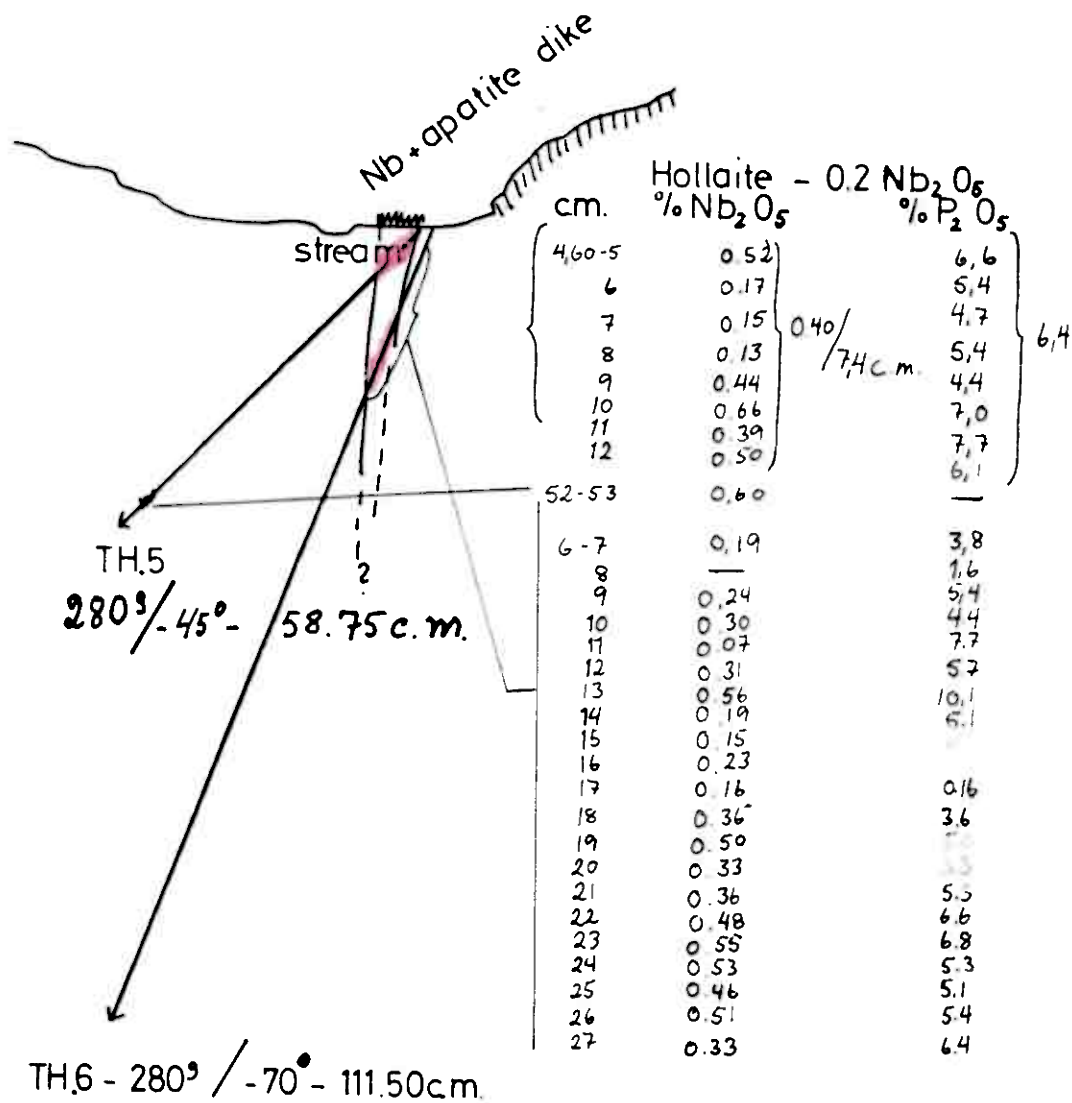
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-

- Sövite w/ rauhaugite
 Hollaite
 Nb + Apatite dike

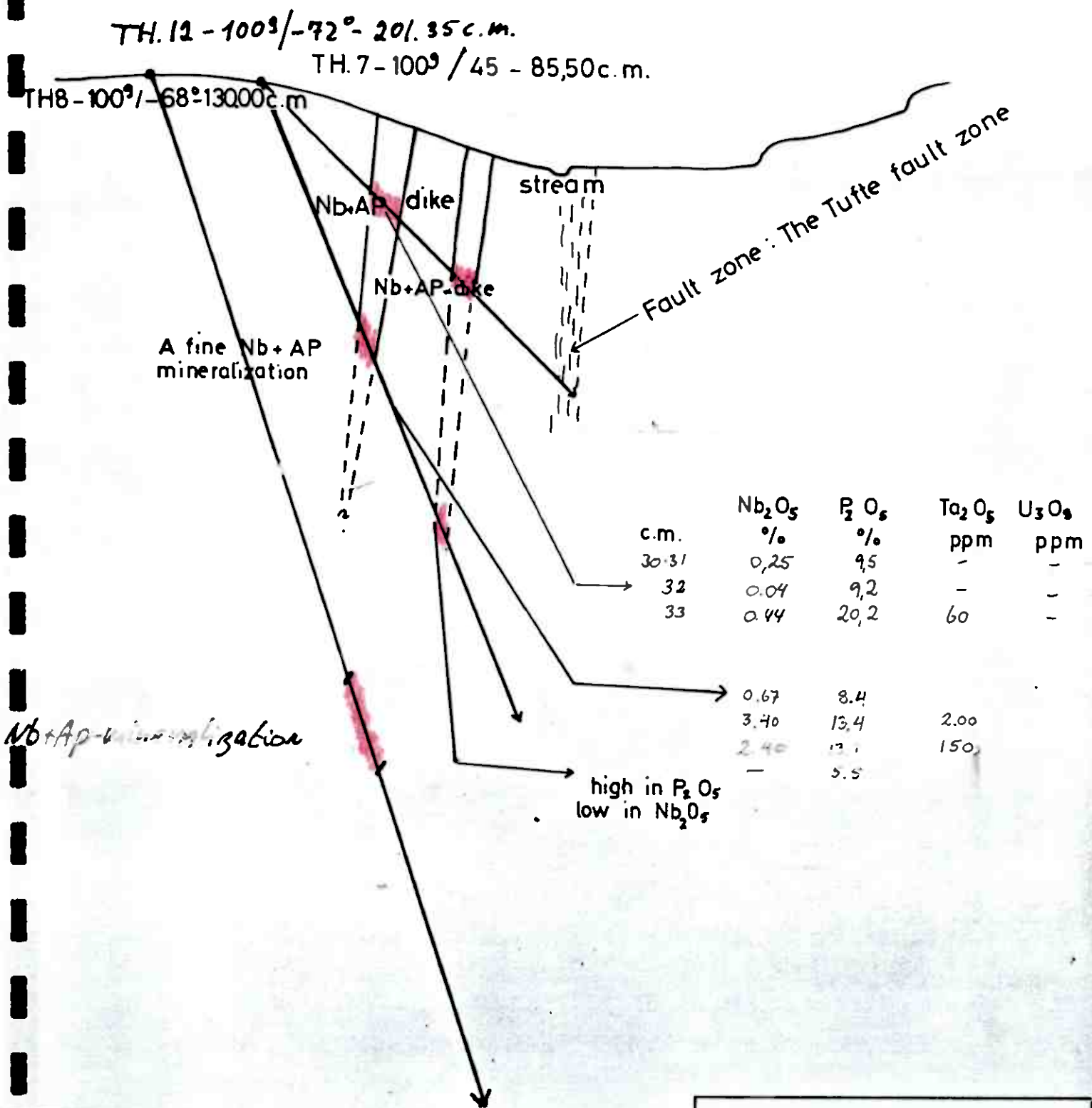
A/S Fenco
 Tuftehavna mineralization
 Bekkedal (Stream Valley)
 Profile 1
 Scale 1:1000
 I. H. June - 82

Holla Gård property —*— Arne Tufte property



- Sövite w/rauhaugite
- Hollaite
- Nb+ Apatite dike

A/S Fenco
Tuftehavna mineralization
Bekkedal (Stream Valley)
Profile 2
Scale 1:1000
I. H. June - 82



- Søvite w/ rauhaugite
- Hollaite
- Nb+ Apatite dike

A/S Fenco
 Tuftehavna mineralization
 Bekkedal (Stream Valley)
 Profile 3
 Scale 1:1000
 I.H. June - 82

Holla Gård property



Arne Tufte property

active zone

T.H.9 - 80° / - 45° - 85.90 c.m.

T.H.10 - 80° / - 70° - 122 c.m.

stream

Nb + Ap - dike

lamprophyre

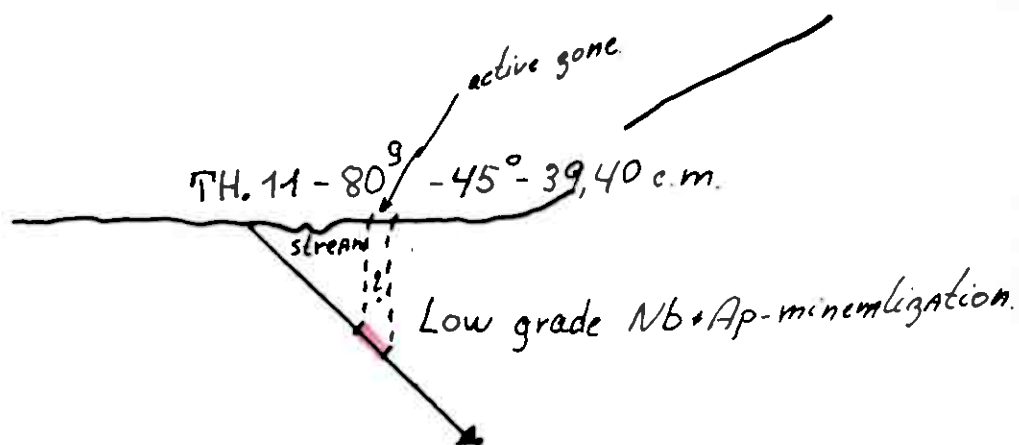
	Nb ₂ O ₅ %	P ₂ O ₅ %	Ta ₂ O ₅ ppm	U ₃ O ₈ ppm
83-84 c.m.	-	2.2	-	-
85 m	0.17	2.4	12	-
85.3 m	0.33	4.7	14	-
2.5-3.0 c.m.	-	19.6	-	150
4.0 m	-	17.0	-	150
5.0 m	-	15.9	80	150

-  Sövite w/ rauhaugite
-  Hollaite
-  Nb + Apatite dike

A/S Fenco
Tuftehavna mineralization
Bekkedal (Stream Valley)
Profile 4
Scale 1:1000
I. H. June - 82

Bilag 6

Holla Gård property → | ← Arne Tufte property



- ☐ Sövite w/rauhaugite
- ☐ Hollaite
- ☒ Nb + Apatite dike

A/S Fenco
 Tuftehavna mineralization
 Bekkedal (Stream Valley)
 Profile 5
 Scale 1:1000
 I.H. June -82

The Tuftehavna Mineralization

As mentioned in the Preliminary report of 19.03.82 some optical-, chemical- and geophysical investigations have been carried out on Nb- apatite mineralization in DDH1-81 at Tuftehavna.

Mineralogy

It seems that the Nb is concentrated i two oxides; pyrochlore which is very often zoned and inhomogeneous.

This pyrochlore is similar to those from Hydro Gangen described by A. N. Mariano, 1980.

The other mineral is, in reflected light grey to dark grey, in transmitted light - dark grey to black as magnetite. It is isometric, and some times inhomogeneous, see appendix nr. 1 & 2.

Three aggregates have been run for analytical researches at the Microprobe at Tøyen. These results indicate about: 15-17 % CaO, 75-78 % Nb_2O_5 with minor amounts of FeO, Ta_2O_5 and U_3O_8 , see appendix nr. 3.

This chemistry correspondes to the pyrochlorevariant ellsworthite - $\text{CaNb}_2\text{O}_6 \cdot 2\text{H}_2\text{O}$.



This mineral was earlier found in Tuftestollen in connection to an active zone of 1-2 m by H. Bjørlykke, see Landreth's report of 1979, p. 19.

Miss B. Nilsen, Geologish Museum, has worked a lot with pyrochlore earlier, is of that opinion that this mineral has properties similar to fernschmidt $\text{CaO} \cdot \text{Nb}_2\text{O}_5$, which she syntezised in the middle of 1950.

Two samples from Tuftehavna were run on the Guiniercamera at Tøyen. Both aggregates are metamict.

Geology

The biotite- lamprophyre crops out about 10 m north of DDH1-81, a small outcrop. The main strike seems to be 380°. The dip is difficult to decide, but it seems to be very steep, see appendix nr. 4.

According to S. Svinndal, pers.com., an apatite-rich dike with about 3 % Nb_2O_5 was registrated in the inner part of Tuftestollen, at end of the producing of the Mine. Because of that there was no possibility to follow up their registration at that time.

According to the investigations up to this day, it seems that this Nb-apatite mineralization are late magmatic or hydrothermal. The oxides have crystallized around - and along the cleavage - plane of the biotite, and as inclusions in the apatite.

Geophysics

The biotite - lamprophyre is poor in magnetite, almost magnetite-free. Being due to this property Ø. Logn and C.W. Carstens proposed more detailed mag. surfasemeasurements in Tuftehavna-area in an attempt to map the dip, strike and size (shape) of the lamprophyre-body. under the overburdens.

The preliminary results indicate a low anomaly close to DDH1-81 with a strike towards south coinciding with the direction of γ -activity anomaly, see appendix nr. 5.

Towards north there is no correlation between the two parameters. The low mag. -anomaly strikes towards NE, while the γ -activity anomaly strikes more towards north, see appendix nr. 5.

References:

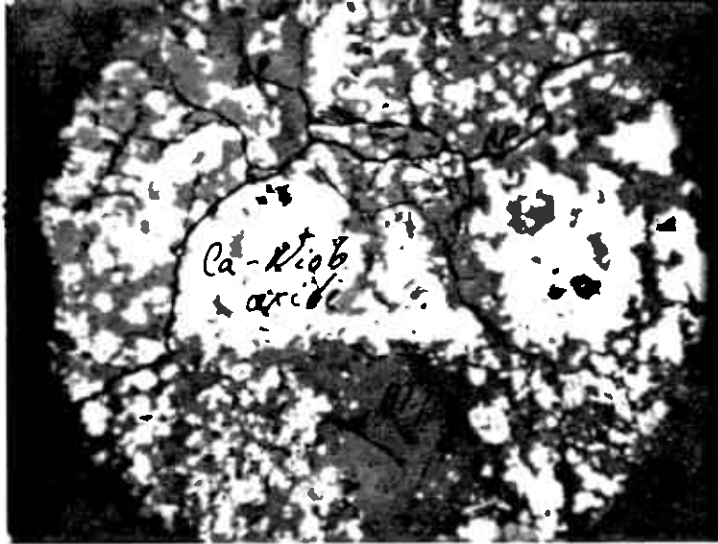
- J.O. Landreth, 1979: Mineral potensial of the Fen alkaline Complex, Ulefoss Norway.
- A.N. Mariano, 1980: Pyroclorite and columbite at the Fen, Ulefoss Norway.

Stabekk, 26. april 1982

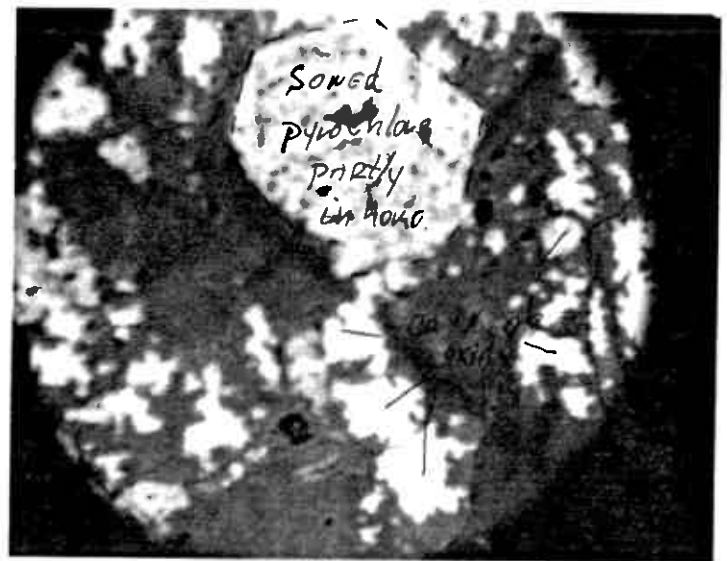


Ivar Hultin

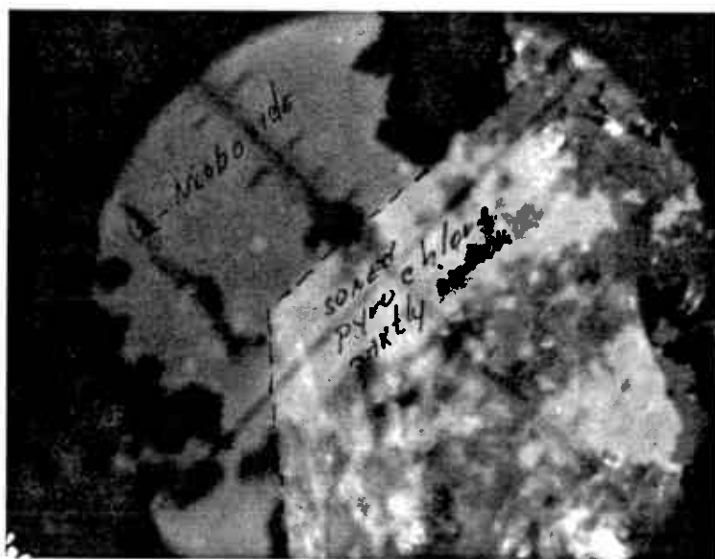
Tuffe haunt.



x 8 air



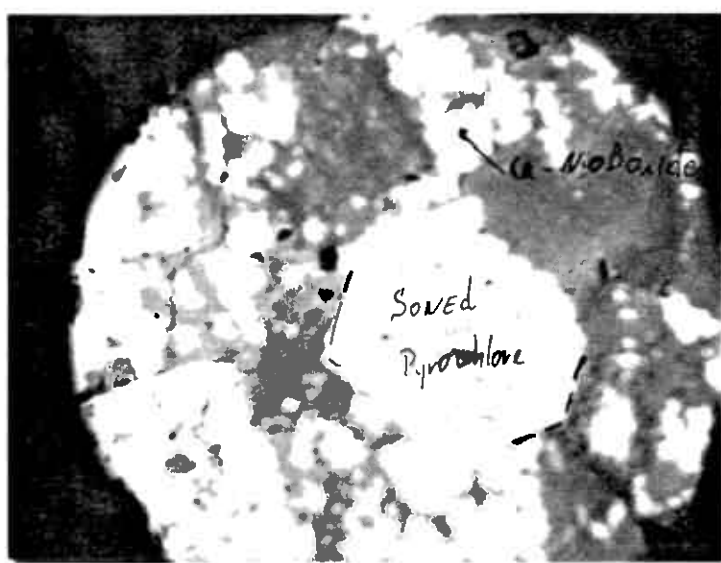
x 16 air



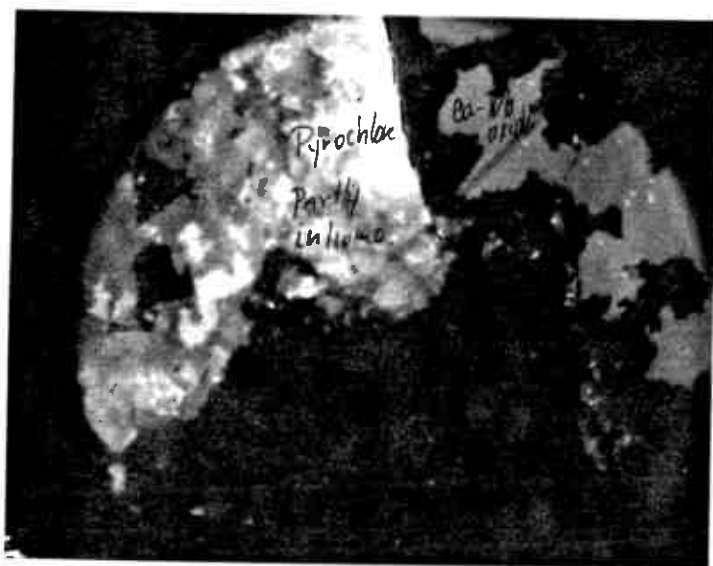
x 60 air

Appendix IV. 1.
Fig. 1.

Biological group 710
Tuftehauna.



x 80 air



x 80 oil



x 80 oil

Appendix nr. 1
Fig. 2.

FIT INDEX= .94

FLMT	APP.CONC	ERROR (WT%)
FE	.185	.174* < 2 SIGMA*
MN	.008	.130* < 2 SIGMA*
CA	12.197	.150
TI	2.175	.111
NB	53.237	.367
TA	.215	.119* < 2 SIGMA*
U	.261	.143* < 2 SIGMA*
SN	.085	.193* < 2 SIGMA*

NO. OF O ATOMS=6 [1 2 ZAF'S]

15.00 KV TILT= .00 ELEV=55.00 AZIM= .00 CC

SPECTRUM: KORN 1

LAST ELMT BY STOICHIOMETRY

ELMT	ZAF	%ELMT	%OXIDE	FORMULA
FE	1.052	.176	.226	.010
MN	.921	.008	.011	.000
CA	1.029	11.850	16.580	.945
TI	.905	2.402	4.007	.160
NB	.975	54.630	78.150	1.879
TA	.846	.254	.310	.004
U	.667	.391	.444	.005
SN	.799	.106	.135	.003
O	.156	30.045	.000	6.000
TOTAL		99.862	99.862	

FLMT	APP.CONC	ERROR (WT%)
FE	.146	.175* < 2 SIGMA*
MN	.029	.133* < 2 SIGMA*
CA	11.636	.148
TI	2.117	.114
NB	50.862	.362
TA	.158	.117* < 2 SIGMA*
U	.401	.149
SN	.038	.193* < 2 SIGMA*

NO. OF O ATOMS=7 [1 2 ZAF'S]

15.00 KV TILT= .00 ELEV=55.00 AZIM= .00

SPECTRUM: KORN 3

LAST ELMT BY STOICHIOMETRY

ELMT	ZAF	%ELMT	%OXIDE	FORMULA
FE	1.053	.139	.179	.010
MN	.922	.031	.040	.002
CA	1.029	11.307	15.820	1.095
TI	.906	2.338	3.899	.189
NB	.975	52.468	75.057	2.193
TA	.846	.187	.228	.004
U	.668	.600	.680	.010
SN	.799	.048	.061	.002
O	.156	28.848	.000	7.000
TOTAL		95.965	95.965	

FIT INDEX= .79

FLMT	APP.CONC	ERROR (WT%)
FE	.307	.172* < 2 SIGMA*
MN	.176	.129* < 2 SIGMA*
CA	12.746	.152
TI	1.574	.103
NB	53.225	.370
TA	.277	.120
U	.047	.140* < 2 SIGMA*
SN	.179	.193* < 2 SIGMA*

NO. OF O ATOMS=6 [1 2 ZAF'S]

15.00 KV TILT= .00 ELEV=55.00 AZIM= .00 C

SPECTRUM: Korn 1

LAST ELMT BY STOICHIOMETRY

ELMT	ZAF	%ELMT	%OXIDE	FORMULA
FE	1.052	.292	.376	.017
MN	.921	.191	.247	.011
CA	1.028	12.395	17.343	.994
TI	.904	1.741	2.904	.117
NB	.974	54.693	78.240	1.891
TA	.846	.328	.400	.006
U	.666	.070	.079	.001
SN	.797	.000	.000	.000
O	.157	29.879	.000	6.000
TOTAL		99.588	99.588	

NEXT ELT= .00

FLMT	APP.CONC	ERROR (WT%)
FE	.100	.169* < 2 SIGMA*
MN	.045	.134* < 2 SIGMA*
CA	11.734	.148
TI	2.137	.113
NB	51.387	.364
TA	.197	.117* < 2 SIGMA*
U	.405	.152
SN	.096	.192* < 2 SIGMA*

NO. OF O ATOMS=6 [1 2 ZAF'S]

15.00 KV TILT= .00 ELEV=55.00 AZIM= .00 COSINE=1.000

SPECTRUM: 8

LAST ELMT BY STOICHIOMETRY

ELMT	ZAF	%ELMT	%OXIDE	FORMULA
FE	1.053	.000	.000	.000
MN	.922	.049	.064	.003
CA	1.030	11.400	15.951	.938
TI	.906	2.360	3.936	.183
NB	.975	52.942	75.734	1.880
TA	.846	.233	.284	.004
U	.668	.607	.688	.008
SN	.799	.120	.152	.003
O	.156	29.100	.000	6.000
TOTAL		96.810	96.810	

PEAK AT 1.24 KEV OMITTED

FIT INDEX= 1.76

FLMT	APP.CONC	ERROR (WT%)
FE	.198	.170* < 2 SIGMA*
MN	.036	.125* < 2 SIGMA*
CA	12.351	.150
TI	1.199	.103
NB	53.069	.367
TA	1.022	.124
U	.191	.139* < 2 SIGMA*
SN	.047	.191* < 2 SIGMA*

NO. OF O ATOMS=6 [1 2 ZAF'S]

15.00 KV TILT= .00 ELEV=55.00 AZIM= .00 C

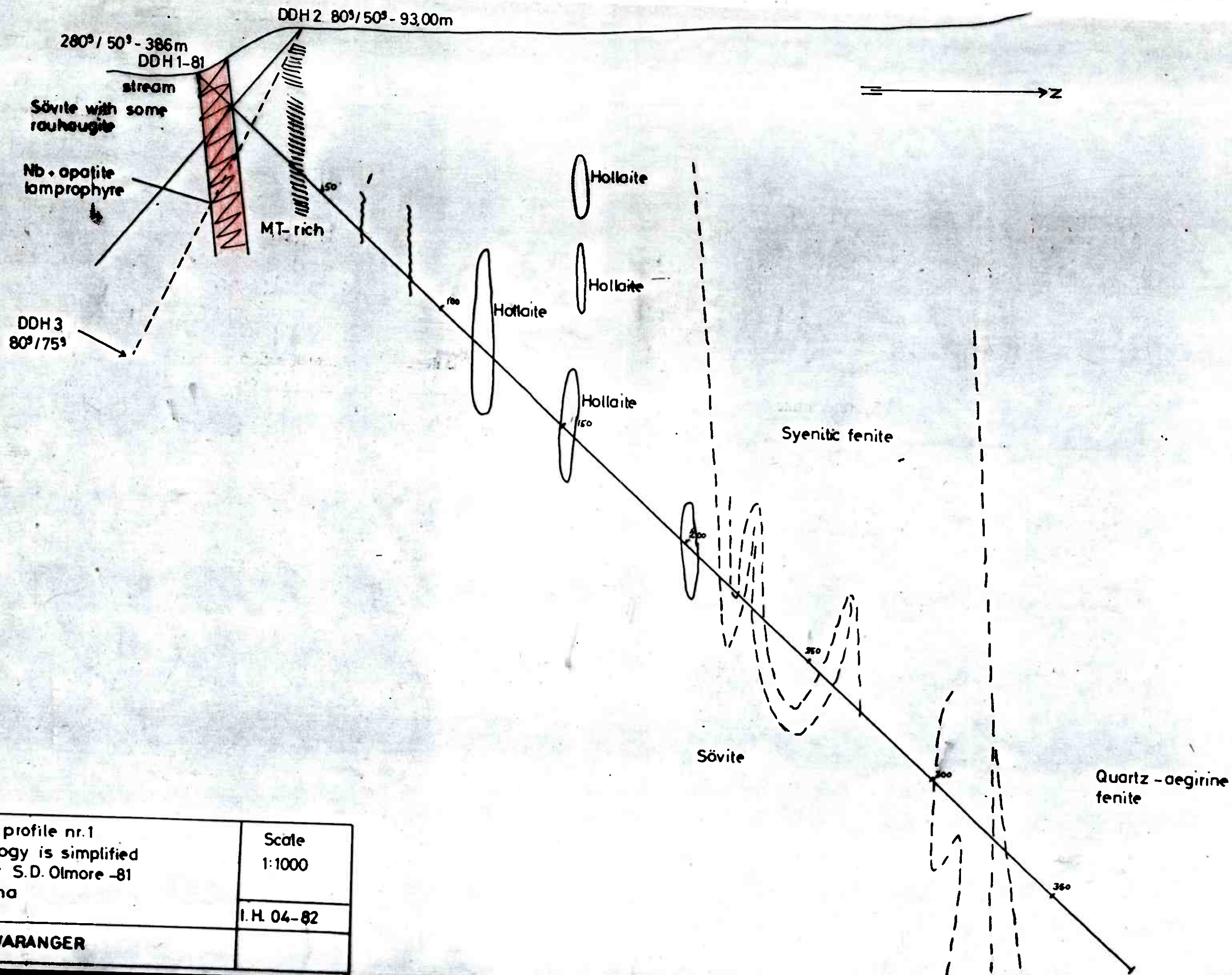
SPECTRUM: KORN 2

LAST ELMT BY STOICHIOMETRY

FLMT	ZAF	%ELMT	%OXIDE	FORMULA
FE	1.056	.187	.241	.011
MN	.924	.039	.050	.002
CA	1.029	12.003	16.795	.971
TI	.906	1.323	2.207	.090
NB	.971	54.678	78.218	1.909
TA	.848	1.205	1.472	.022
U	.667	.286	.325	.004
SN	.798	.058	.074	.002
O	.158	29.602	.000	6.000
TOTAL		99.382	99.382	

I. HULTIN 18/3 82

Appendix m. 1
Fig. 3.



Drilling profile nr.1
The geology is simplified
after S.D. Olmore -81
Tuftehavna
PEN

Scale
1:1000

I.H. 04-82

A/S SYDVARANGER

	Nb	Y	Th	CE	TA	U
2.35 - 3.00	4.3	0.011	0.022	0.16	0.051	0.027
3.00 - 4.00	2.7	0.012	0.012	0.13	0.023	0.021
4.00 - 5.00	2.8	0.008	-	0.090	0.026	0.014
5.00 - 6.00	2.4	0.009	-	0.10	0.008	0.007
6.00 - 7.00	3.8	0.009	0.006	0.13	0.032	0.020
7.00 - 8.00	3.1	0.009	-	0.13	0.027	0.015
8.00 - 9.00	4.4	0.008	0.030	0.14	0.043	0.027
9.00 - 10.00	3.3	0.013	0.036	0.14	0.040	0.027
10.00 - 11.00	1.4	0.012	0.048	0.082	0.040	0.022
11.00 - 12.00	1.0	0.016	0.025	0.11	0.022	0.017
12.00 - 13.00	0.11	0.010	0.014	0.063	0.013	0.005
13.00 - 14.00	0.13	0.011	0.020	0.064	0.007	-
14.00 - 15.00	0.28	0.012	0.033	0.060	0.010	-
15.00 - 16.00	-	0.009	-	0.055	0.003	-
16.00 - 17.00	0.032	0.013	0.022	0.088	-	-
17.00 - 18.00	0.01	0.010	0.006	0.060	-	-
18.00 - 19.00	0.023	0.009	-	0.055	-	-
19.00 - 20.00	0.016	0.009	0.005	0.047	0.003	-
20.00 - 21.00	-	0.010	0.008	0.052	-	-
21.00 - 22.00	-	0.008	-	0.066	-	-
22.00 - 23.00	-	0.008	-	0.064	-	-
23.00 - 24.00	-	0.010	-	0.062	-	-
24.00 - 25.00	-	0.009	-	0.067	-	-
25.00 - 26.00	-	0.008	-	0.065	-	-
26.00 - 27.00	0.015	0.009	0.007	0.064	-	-
27.00 - 28.00	-	0.010	-	0.065	-	-
28.00 - 29.00	0.016	0.009	-	0.063	-	-
29.00 - 30.00	-	0.011	0.006	0.063	-	-
30.00 - 31.00	-	0.009	-	0.066	-	-
31.00 - 32.00	-	0.009	0.006	0.066	-	-
32.00 - 33.00	0.010	0.014	0.008	0.064	-	-
33.00 - 34.00	0.090	0.009	0.011	0.071	0.007	-
34.00 - 35.00	0.13	0.010	0.015	0.066	0.005	-
35.00 - 36.00	0.23	0.010	0.028	0.083	0.012	-
36.00 - 37.00	0.41	0.009	0.041	0.063	0.016	-
37.00 - 38.00	0.16	0.009	0.016	0.063	0.004	-
38.00 - 39.00	0.049	0.009	0.007	0.062	0.004	-
39.00 - 40.00	0.19	0.009	0.020	0.069	0.007	-

	Nb	Y	Th	CE	TA	U
40.00 - 41.00	0.15	0.009	0.014	0.066	0.004	-
41.00 - 42.00	0.34	0.009	0.033	0.068	0.011	-
42.00 - 43.00	0.11	0.010	0.011	0.060	-	-
43.00 - 44.00	0.19	0.008	0.014	0.066	0.003	-
44.00 - 45.00	0.29	0.008	0.026	0.074	0.012	-
45.00 - 46.00	0.11	0.010	0.010	0.066	-	-
46.00 - 47.00	0.15	0.009	0.019	0.067	0.006	-
47.00 - 48.00	0.072	0.011	0.013	0.067	0.006	0.006
48.00 - 49.00	0.077	0.009	0.013	0.057	0.005	-
49.00 - 50.00	0.12	0.009	0.017	0.069	0.007	0.006
50.00 - 51.00	0.055	0.017	0.042	0.081	-	-
51.00 - 52.00	0.024	0.014	0.014	0.066	-	0.008
52.00 - 53.00	0.10	0.011	0.022	0.069	0.008	0.011
53.00 - 54.00	0.062	0.009	0.008	0.058	0.003	0.003
54.00 - 55.00	0.10	0.007	0.010	0.052	0.004	-
55.00 - 56.00	0.014	0.009	-	0.066	-	-
56.00 - 57.00	0.035	0.010	0.008	0.067	0.003	0.004
57.00 - 58.00	0.020	0.011	-	0.071	-	0.002
58.00 - 59.00	0.020	0.009	-	0.063	-	-
59.00 - 60.00	0.020	0.012	0.010	0.062	-	-
60.00 - 61.00	-	0.010	0.007	0.069	-	-
61.00 - 62.00	-	0.010	-	0.067	-	-
62.00 - 63.00	-	0.009	-	0.066	-	-
63.00 - 64.00	-	0.010	-	0.066	-	-
64.00 - 65.00	-	0.010	-	0.066	-	-
65.00 - 66.00	-	0.009	-	0.063	-	-
66.00 - 67.00	-	0.010	-	0.064	-	-
67.00 - 68.00	-	0.009	-	0.067	-	-
68.00 - 69.00	0.010	0.013	0.015	0.061	-	-
69.00 - 70.00	0.019	0.009	0.015	0.051	-	-
70.00 - 71.00	0.010	0.011	-	0.066	-	-
71.00 - 72.00	-	0.010	-	0.068	-	-
72.00 - 73.00	0.014	0.010	0.006	0.15	-	-
73.00 - 74.00	0.033	0.014	0.015	0.28	-	0.005
74.00 - 75.00	-	0.009	-	0.069	-	-
75.00 - 76.00	-	0.009	0.007	0.074	-	-
76.00 - 77.00	-	0.010	0.006	0.070	-	-
77.00 - 78.00	-	0.009	-	0.066	-	-
78.00 - 79.00	-	0.010	0.008	0.074	-	-
79.00 - 80.00	-	0.013	-	0.067	-	-

	Nb	Y	Th	CE	TA	U
80.00 - 81.00	-	0.008	-	0.074	-	-
81.00 - 82.00	-	0.009	-	0.069	-	-
82.00 - 83.00	-	0.009	-	0.069	-	-
83.00 - 84.00	-	0.010	0.005	0.065	-	-
84.00 - 85.00	-	0.009	-	0.067	-	-
85.00 - 86.00	-	0.011	0.010	0.073	-	-
86.00 - 87.00	-	0.009	0.005	0.064	-	-
87.00 - 88.00	-	0.009	-	0.067	-	-
88.00 - 89.00	-	0.009	-	0.060	-	-
89.00 - 90.00	-	0.010	0.007	0.063	-	-
90.00 - 91.00	-	0.009	-	0.044	-	-
91.00 - 92.00	-	0.010	-	0.055	-	-
92.00 - 93.00	-	0.008	-	0.060	-	-
93.00 - 94.00	0.014	0.009	-	0.066	-	-
94.00 - 95.00	-	0.008	-	0.057	-	-
95.00 - 96.00	-	0.010	-	0.061	-	-
96.00 - 97.00	-	0.008	-	0.056	-	-
97.00 - 98.00	0.012	0.010	0.006	0.052	-	-
98.00 - 99.00	0.010	0.010	-	0.056	-	-
99.00 - 100.00	0.010	0.010	-	0.043	-	-
100.00 - 101.00	0.043	0.030	0.042	0.10		
101.00 - 102.00	0.039	0.019	0.016	0.042		
102.00 - 103.00	0.015	0.008	0.005	0.059		
103.00 - 104.00	0.005	0.008	-	0.081		
104.00 - 105.00	0.031	0.009	-	0.053		
105.00 - 106.00	0.020	0.008	-	0.053		
106.00 - 107.00	0.065	0.008	0.010	0.053		
107.00 - 108.00	0.078	0.009	0.007	0.061		
108.00 - 109.00	0.16	0.010	0.010	0.059	0.010	≤ 0.002
109.00 - 110.00	0.16	0.012	0.007	0.061	0.005	"
110.00 - 111.00	0.17	0.010	0.009	0.048	≤ 0.003	"
111.00 - 112.00	0.036	0.007	0.005	0.054		
112.00 - 113.00	0.023	0.006	0.005	0.046		
113.00 - 114.00	0.057	0.007	-	0.039		
114.00 - 115.00	0.080	0.007	0.008	0.10		
115.00 - 116.00	0.073	0.010	0.011	0.064		
116.00 - 117.00	0.053	0.011	0.008	0.033		
117.00 - 118.00	0.11	0.008	0.010	0.029		
118.00 - 119.00	0.053	0.007	-	0.050		
119.00 - 120.00	0.047	0.005	-	0.024		

	Nb	Y	Th	CE	TA	U
120.00 -121.00	0.076	0.005	-	0.033		
121.00 -122.00	0.070	0.009	-	0.047		
122.00 -123.00	0.070	0.005	0.005	0.026		
123.00 -124.00	0.069	0.005	-	0.036		
124.00 -125.00	0.065	0.009	-	0.056		
125.00 -126.00	0.24	0.010	0.015	0.068	0.021	0.002
126.00 -127.00	0.13	0.011	0.011	0.067	0.012	≤ 0.002
127.00 -128.00	0.077	0.010	0.006	0.070	0.008	"
128.00 -129.00	0.11	0.010	0.009	0.073	0.013	"
129.00 -130.00	0.10	0.009	0.006	0.067	0.010	"
130.00 -131.00	0.12	0.011	0.010	0.076	0.011	"
131.00 -132.00	0.10	0.010	0.005	0.073	0.016	0.003
132.00 -133.00	0.24	0.011	0.013	0.061	0.028	0.006
133.00 -134.00	0.065	0.010	0.005	0.059		
134.00 -135.00	0.073	0.011	0.005	0.061		
135.00 -136.00	0.050	0.010	-	0.079		
136.00 -137.00	0.12	0.010	-	0.076		
137.00 -138.00	0.084	0.010	-	0.070		
138.00 -139.00	0.072	0.010	0.005	0.067		
139.00 -140.00	0.055	0.016	0.035	0.110		
140.00 -141.00	0.038	0.011	0.005	0.068		
141.00 -142.00	0.080	0.009	-	0.075		
142.00 -143.00	0.13	0.011	0.012	0.064	0.011	≤ 0.002
143.00 -144.00	0.094	0.012	0.016	0.11	0.007	"
144.00 -145.00	0.14	0.011	0.007	0.071	0.013	0.002
145.00 -146.00	0.12	0.011	0.008	0.14	0.012	0.015 ≤ 0.002
146.00 -147.00	0.11	0.008	0.008	0.10	0.021	0.006
147.00 -148.00	0.076	0.010	-	0.075	0.007	≤ 0.002
148.00 -149.00	0.031	0.010	-	0.050	≤ 0.003	"
149.00 -150.00	0.12	0.006	0.019	0.046	0.007	"
150.00 -151.00	0.074	0.009	-	0.028	≤ 0.003	"
151.00 -152.00	0.12	0.009	0.005	0.061	0.007	"
152.00 -153.00	0.41	0.010	0.019	0.061	0.013	"
153.00 -154.00	0.14	0.009	0.005	0.048	0.006	"
154.00 -155.00	0.061	0.016	0.016	0.056	≤ 0.003	"
155.00 -156.00	0.21	0.016	0.022	0.050	"	"
156.00 -157.00	0.52	0.011	0.016	0.061	0.016	"
157.00 -158.00	0.10	0.011	0.005	0.073	0.004	"
158.00 -159.00	0.27	0.011	0.011	0.079	0.015	0.015 "

	Nb	Y	Th	CE	TA	U
159.00 -160.00	0.45	0.011	0.020	0.064	0.030	0.006
160.00 -161.00	0.18	0.007	0.007	0.048	0.012	≤ 0.002
161.00 -162.00	0.059	0.011	0.005	0.062	≤ 0.003	"
162.00 -163.00	0.22	0.011	0.015	0.060	0.016	0.009
163.00 -164.00	0.14	0.013	0.017	0.069	0.021	0.011
164.00 -165.00	0.10	0.013	0.015	0.058	0.014	0.007
165.00 -166.00	0.11	0.005	0.005	0.056	0.020	0.009
166.00 -167.00	0.10	0.006	0.006	0.073	0.018	0.010
167.00 -168.00	0.070	0.020	0.020	0.27	0.013	0.005
168.00 -169.00	0.12	0.018	0.018	0.082	0.014	0.007
169.00 -170.00	0.085	0.005	0.005	0.067		
170.00 -171.00	0.080	-	-	0.075		
171.00 -172.00	0.14	0.014	0.014	0.081		
172.00 -173.00	0.090	0.005	0.005	0.079		
173.00 -174.00	0.072	0.006	0.006	0.087		
174.00 -175.00	0.13	0.010	-	0.073		
175.00 -176.00	0.048	0.008	-	0.060	0.004	
176.00 -177.00	0.13	0.011	0.015	0.074	0.003	
177.00 -178.00	0.14	0.010	0.007	0.057	-	
178.00 -179.00	0.14	0.006	-	0.053	0.003	
179.00 -180.00	0.30	0.011	0.009	0.071	0.004	
180.00 -181.00	0.25	0.011	0.013	0.080	-	
181.00 -182.00	0.28	0.010	0.010	0.069	-	
182.00 -183.00	0.23	0.010	0.009	0.058	-	
183.00 -184.00	0.16	0.010	-	0.068	-	
184.00 -185.00	0.19	0.012	0.015	0.067	-	
185.00 -186.00	0.14	0.009	0.014	0.039	-	0.004
186.00 -187.00	0.18	0.014	0.015	0.056	-	0.006
187.00 -188.00	0.077	0.006	-	0.027	-	0.006
188.00 -189.00	0.096	0.010	0.007	0.041	-	
189.00 -190.00	0.065	0.007	-	0.050	-	
190.00 -191.00	0.094	0.005	-	0.045		
191.00 -192.00	0.084	0.006	0.007	0.026	0.003	
192.00 -193.00	0.078	0.008	-	0.046	-	
193.00 -194.00	0.091	0.013	-	0.045	-	
194.00 -195.00	0.074	0.007	0.013	0.074	-	
195.00 -196.00	0.07	0.016	0.064	0.093	-	
196.00 -197.00	0.054	0.011	0.040	0.058	-	
197.00 -198.00	0.066	0.011	0.022	0.066	-	

	Nb	Y	Th	CE	TA	U
198.00 -199.00	0.038	0.012	0.030	0.074	-	0.005
199.00 -200.00	0.098	0.016	0.011	0.035	0.010	0.013
200.00 -201.00 ?			0.023		-	
201.00 -202.00	0.023	0.013	0.012	0.046	-	
202.00 -203.00	0.17	0.008	0.006	0.043	-	
203.00 -204.00	0.16	0.008	0.011	0.034	-	
204.00 -205.00	0.054	0.006	0.011	0.024	-	
205.00 -206.00	0.10	0.007	0.005	0.024	-	
206.00 -207.00	0.13	0.011	0.014	0.063	0.019	0.009
207.00 -208.00	0.11	0.010	0.005	0.081	0.020	0.013
208.00 -209.00	0.14	0.011	0.007	0.080	0.015	0.006
209.00 -210.00	0.16	0.011	0.006	0.085	0.015	0.004
210.00 -211.00	0.10	0.015	0.013	0.077	0.018	0.025
211.00 -212.00	0.031	0.008	0.006	0.056	-	-
212.00 -213.00	0.091	0.010	-	0.082	0.012	0.004
213.00 -214.00	0.083	0.011	-	0.10	0.008	-
214.00 -215.00	0.083	0.008	-	0.059	0.004	-
215.00 -216.00	0.037	-	-	0.023	-	-
216.00 -217.00	0.087	0.009	0.007	0.044	0.009	0.006
217.00 -218.00	0.19	0.008	0.011	0.045	-	0.004
218.00 -219.00	0.10	-	-	0.040	0.003	0.004
219.00 -220.00	0.069	-	-	0.025	-	0.004
220.00 -221.00	0.10	0.005	-	0.026	-	-
221.00 -222.00	0.087	0.010	0.014	0.024	-	0.005
222.00 -223.00	0.21	0.009	0.012	0.063	0.003	0.003
223.00 -224.00	0.20	0.011	0.016	0.13	0.014	0.015
224.00 -225.00	0.092	0.012	0.006	0.078	0.012	0.007
225.00 -226.00	0.048	0.009	-	0.078	-	-
226.00 -227.00	0.072	0.009	-	0.079	0.006	-
227.00 -228.00	0.12	0.010	0.006	0.082	0.015	0.005
228.00 -229.00	0.087	0.011	0.005	0.049	0.008	0.004
229.00 -230.00	0.14	0.007	0.006	0.045	0.008	0.006
230.00 -231.00	0.005	0.007	0.008	0.044	-	-
231.00 -232.00	0.053	0.009	-	0.064		
232.00 -233.00	0.078	0.006	-	0.050		
233.00 -234.00	0.14	0.007	-	0.067		
234.00 -235.00	0.092	0.005	-	0.040		
235.00 -236.00	0.041	0.005	-	0.039		

IH/bs

		Nb	Y	Th	Ce	TA	U
236.00	-237.00	0.065	-	-	0.032		
237.00	-238.00	0.056	0.007	-	0.043		
238.00	-239.00	0.053	0.009	0.006	0.043		
239.00	-240.00	0.071	0.010	0.007	0.056		
240.00	-241.00	0.065	0.008	0.008	0.080		
241.00	-242.00	0.042	-	-	0.030		
242.00	-243.00	0.024	-	-	0.026		
243.00	-244.00	0.022	-	-	0.011		
244.00	-245.00	0.028	0.007	0.011	0.043		
245.00	-246.00	0.034	0.006	-	0.039		
246.00	-247.00	0.031	-	-	-		
247.00	-248.00	0.023	-	-	0.030		
248.00	-249.00	0.020	-	-	0.025		
249.00	-250.00	0.041	0.006	-	0.030		
250.00	-251.00	0.061	0.006	-	0.033		
251.00	-252.00	0.046	0.006	-	0.033		
252.00	-253.00	0.058	0.006	-	0.042		
253.00	-254.00	0.049	0.007	0.006	0.060		
254.00	-255.00	0.032	-	-	0.045		
255.00	-256.00	0.035	0.006	-	0.044		
256.00	-257.00	0.035	-	-	0.027		
257.00	-258.00	0.027	-	-	0.016		

Nb - : ≤ 0.005

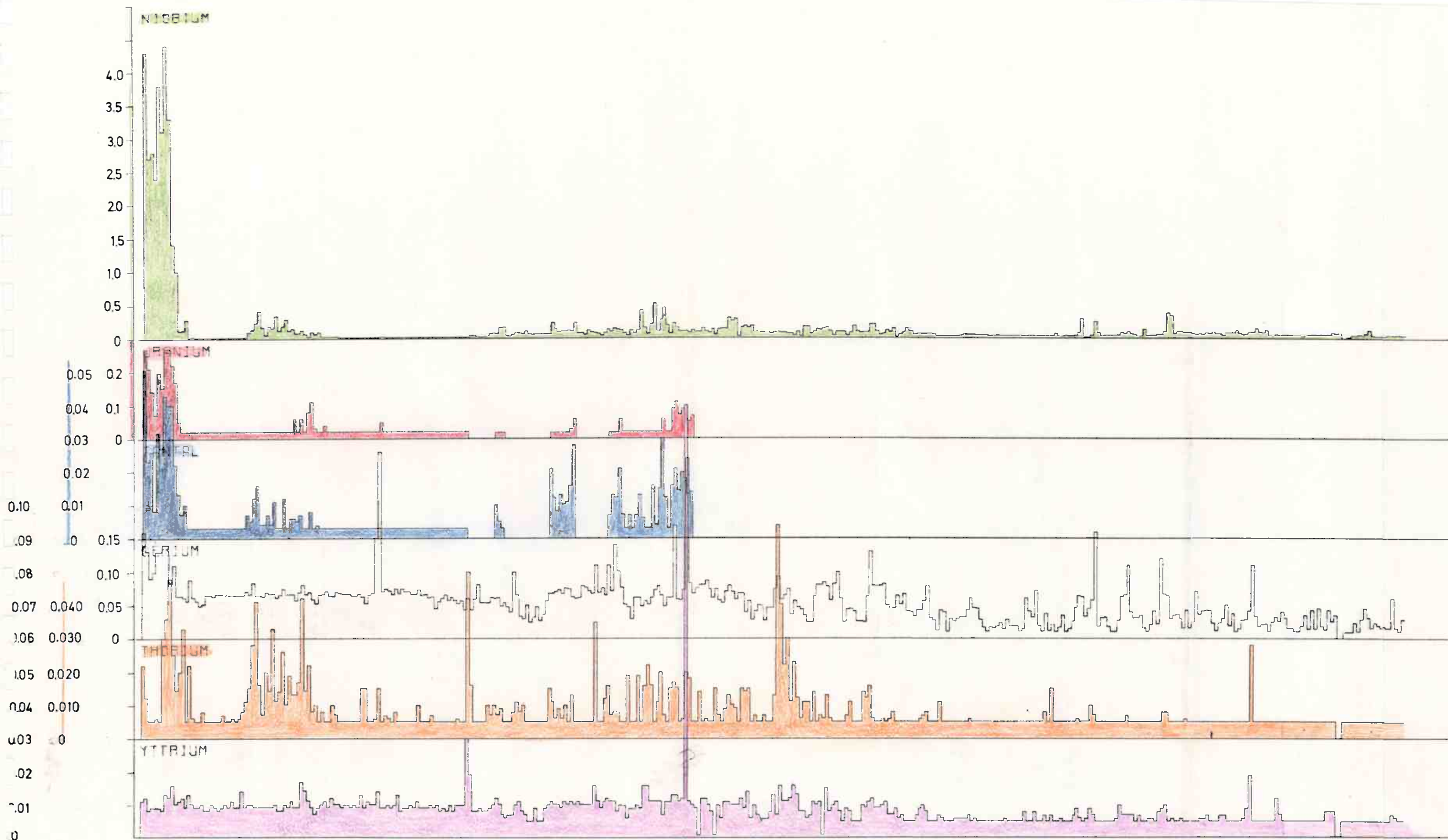
TA - : < 0.003

Y - : < 0.005

Th - : < 0.005

Ce - : < 0.01

U - : < 0.005



DOWNHOLE CHEMISTRY • DRILLHOLE NO 1/1981 LOC.: EAST OF HOLLA FARM

