Norðfjarðargöng

Jarðfræðirannsóknir

Viðauki A

Lýsingar á borkjörnum

Borholur EF-01 til EF-02 og NF-01 til NF-08

Holurnar voru boraðar 2007 og 2008

Jarðfræðistofan Ehf
JFS Geological services Ltd
Nóvember 2008
Unnið fyrir Vegagerðina

Jarðfræðistofan Ehf / JFS Geological services Ltd	Norðfjörður - Veggöng	JFS-74	Drwg. **Legend**
	Skýringar með kjarnaborholum / Legend for coreholes	Date Sept. 2012	Page **1** of **1**
Empl. VEGAGERÐIN		Design AgG/GG	Drawn AgG
	Coord. X: Y: Elev.:	Driller X	Drilled x

Elev. m a.s.l. 454,1

Depth m: 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 192, 194, 196, 198, 200

Description of corehole - name of corehole

All core was drilled with NQ triple tube core barrels
Diameter of core 44,7 - 45 mm
Hole diameter 75,7 mm

Tholeiite basalt

Olivine basalt

Porphyritic basalt

Scoria

Dyke intrusions (subvertical)

Tectonic breccia

Sedimentary interbeds (fine grained)

Sedimentary interbeds (coarse grained)

Sedimentary interbeds pyroclastic - agglomerate

Percussion drilling at top and complete core loss

NQ drilling rods with triple tube, core Ø 45 mm

Well defined boundary between rock units

Poorly defined boundary between rock units

Core loss

Jointed rock

Marks for drilling intervals

Core box number K-31 / K-32

Rock magnetisation
Normal / Reverse / Anomalous
Ⓝ/Ⓡ/Ⓐ

UCS=55 MPa (Laboratory tested Uniaxial cpmpressive strength)

TS=5,5 MPa (Laboratory tested tensile strength)

Schmidt hammer test
Number of tests 8
Average rebound hardness 12,1

Point load test
Number of tests 8
Average readout strength on PLT instrument 4,9 kN
Average calculated apparent UCS strength 51 MPa

Conversion of PLI values to Apparent uniaxial compressive strength
Apparent UCS values for Icelandic rock fit best to the formula:

$$UCS = 11 \times PLI^{1,2}$$

Apparent UCS may also be calculated as:
For PLI 1-2 = PLI x 12
For PLI 2-4 = PLI x 14
For PLI 4-6 = PLI x 16
For PLI > 6 = PLI x 18

UCS 10 MPa
Uniaxial compressive strength, laboratory test

NGI Rock classification system
Qc Q-value as evaluated on core
(not valid for measurements on blasted tunnel walls)

$$Qc = \frac{RQD}{J_n} \times \frac{J_r}{J_a} \times \frac{J_w}{SRF}$$

Joint roughness; Joint sets; Joint alteration

The joint water and SRF (stress reduction) parameters are evaluated as 1/1 in the boreholes

Depth m

Rock column

Core % — Core recovery and RQD is defined by rock units

RQD % 10 / 30 / 50 /100 — Percentage of core pieces of over 10 cm, 30 cm, 50 cm and 100 cm continuous core length, indicating block sizes, within the same rock unit

Qc — NGI Rock classification system Qc - value as evaluated on core

GWT — Ground water table

Perm. (LU) 2,5 5,0 7,5

Jarðfræðistofan Ehf / JFS Geological services Ltd	Norðfjarðargöng	JFS-74	Drwg. A-1a
	Eskifjörður	Date Feb 2008	Page **1** of **1**
Empl. VEGAGERÐIN	**Corehole EF - 01 0 - 45,3m**	Design AgG	Drawn TW / AgG
	Coord. X: 732.421,5 Y: 518.460,3 Elev.: 37,39	Driller RFS	Drilled Oct. 2007

Description of corehole EF - 01

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
37,4	0	The hole is located on a valley slope in Eskifjörður. Vertical hole. Percussion drilling and casing to 3 m	0						
	2	NQ triple tube core drilling from 3 m depth. Core diameter 44,5mm.	2						
34,4		**Tholeiite basalt** Light grey hard and strong rock. Vesicular and porous in the upper part. Approximately 10% to 15% vesicles, well-filled with zeolites. More massive, harder and denser downwards							
	4		4		100	70/0/0/0			
	6		6		100	86/65/17/0			
	8		8		100	95/67/57/57			
	10		10	R	**100**	**92/70/51/13**	***Qc = 6 - 16***		
27,4		Extreemely hard and dense tholeiite basalt with faint micropore flow banding. Some irregularly spaced joints, rough, undulating, and coated with light grey clay. 10 / 56 K-1; 10 / 25,9 kN / 155 MPa K-2			100		$Q=\frac{92}{9-10}x\frac{2-3}{2-3}x\frac{1}{1}$		
	12		12			97/86/76/0			
	14		14		100	96/78/78/0			
	16		16		100	92/56/0/0			
21,1		**Sediment** Tuffaceous siltstone - claystone, red brown very weak rock. The sediment breaks up and disintegrates during drilling and handling. Waxy surface on core — Core loss 0,35m			79	16/0/0/0			
	18		18		**85** 87	**10/0/0/0** 8/0/0/0			
18,9		**Scoriaceous basalt - Olivine basalt** Medium to dark grey, very porous moderately strong rock. Approximately 5% to 10% vesicles, half-filled with zeolites and black clay							
	20	K-2 / K-3	20		96	71/46/0/0			
	22		22	R	**98**	**76/42/0/0**	***Qc = 5 - 13***		
		9 / 5,8 kN / 33,6 MPa			100		$Q=\frac{76}{9-10}x\frac{2-3}{2-3}x\frac{1}{1}$		
	24	11 / 38	24			75/23/0/0			
12,1					100	100/100/0/0			
11,9		**Sediment** Green very weak tuffaceous sandstone, Waxy surface on core			**100**	**0/0/0/0**			
	26	**Olivine basalt** Dark grey very strong. Vesicular and porous at the top, 5% to 10% pores, all well-filled with zeolites	26		100	79/41/0/0			
	28		28		100	94/48/20/0			
	30	Massive olivine basalt with several irregularly spaced joints, rough, undulating, and coated with black clay — K-3 / K-4	30	R	**100**	**82/34/6/0**	***Qc = 5 - 14***		
	32	11 / 54; 8 / 16 kN / 94,7 MPa	32		100	79/31/0/0	$Q=\frac{82}{9-10}x\frac{2-3}{2-3}x\frac{1}{1}$		
	34	Vesicular zone, 5% to 10% vesicles, filled with zeolites	34		100	69/0/0/0			
2,4		Sharp contact, possibly weak.			**100**	**13/0/0/0**			**1,3 LU at 4,5 bar**
1,6		**Basaltic dyke** Dark grey, fine grained, welded contacts		R	100	0/0/0/0			
	36	Sharp contact, welded.	36		100	36/0/0/0			
0,2		**Olivine basalt** Dark grey, microporous, extremely strong rock		R	100	99/0/0/0			
	38	Zone of fractured rock probably caused by stress. Orange brown alteration of most joint walls down from 38 m depth, due to flow of thermal water. Alteration is up to 5 mm wide (2,5 mm from joint surfaces).	38	N	100	56/0/0/0			
-1,7		Massive microporous dark grey Olivine basalt, micropores filled with black clay — K-4 / K-5			**100**	**75/34/26/12**	***Qc = 5 - 13***		
	40		40		100		$Q=\frac{75}{9-10}x\frac{2-3}{2-3}x\frac{1}{1}$		
	42	6 / 21,5 kN / 128MPa; 13 / 60	42	N		70/37/37/37			
	44		44	R	100	90/67/42/0			
		1cm of orange sediment at base							
-7,9	46	Bottom of hole 45,3 m on 18th October 2007	46						
	48		48						
	50		50						

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	Eskifjörður	Date Sept. 2012	Page **1** of **6**
Empl. **VEGAGERÐIN**	**Corehole EF - 02 0 - 50 m**	Design AgG	Drawn AgG / TW
	Coord. X: 732.621,9 Y: 518.524,3 Elev.: 60,62	Driller RFS	Drilled Nov 2007

Description of corehole EF - 02

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
60,6	0	The hole is drilled vertically, located on steep slope near to rock outcrop. Probably red sediment (bedrock) at the top of the hole.	0						
	2	Percussion drilling with an odex bit, using 3,5" casing down to 6,0m depth, possibly surface of bedrock close to 4 m depth.	2						
	4	Core drilling, from 6,0m depth, NQ triple tube core drilling. Core diameter 44,5mm.	4						
54,6	6	**Scoriaceous vesicular basalt** Grey very strong. Vesicles up to 15% to 20%, mainly half-filled or well-filled with white zeolites, stilbite. 11 / 31 — 10 / 6,9 kN / 40 MPa. UCS=26,1 MPa	6		81	79/79/0/0			
	8		8		100	68/16/0/0			
	10	**Tholeiite basalt - Olivine basalt** Grey, very strong, microporous with faint micropore flow banding. Moderately jointed, joints irregularly spaced, rough, undulating, and coated with black and light grey stiff clay. The basalt is margnally Olivine-tholeiite basalt	10		**99**	**84/53/22/0**			
					100	91/77/48/0			
	12		12	R		***Qc = 6 - 14*** $Q=\frac{84}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$			
		11 / 53 — 11 / 22,1 kN / 132 MPa							
	14	UCS=109 MPa	14		100	91/69/30/0			
	16	K-1 / K-2	16						
					100	86/49/20/0			
	18	13 / 57 — 13 / 18,0 kN / 107 MPa	18						
		Sharp weak contact to the sediment			100	87/45/0/0			
41,1	20	**Sediment - tuffaceous claystone** Black at the top ~1m then dark red brown. Core surface is waxy. Very weak rock, breaks up into small fragments during drilling. Some green sediment at the base. Slicken sides at joints. Core loss 1,6m	20		100 57 47 18 40 22 25 78	41/0/0/0 17/0/0/0 **8/0/0/0** 0/0/0/0 0/0/0/0 0/0/0/0 0/0/0/0 0/0/0/0			
	22		22						
38,1		**Olivine basalt - compound flow** Grey and purple brown very strong rock, with 2% to 3% small Plagioclase phenocrysts. Moderately to highly jointed. 9 / 31 — 11 / 7,1 kN / 41 MPa							
	24		24	R	100	95/68/32/0			
	26	K-2 / K-3	26		100	84/32/17/0			
33,4		No weakness at contacts							
	28	**Scoria** Purple and grey, porous. Pores mostly filled with zeolites. 6 / 24 — 5 / 3,0 kN / 17 MPa	28						
		Porphyritic basalt Grey very strong, with 7% to 10% small Plagioclase phenocrysts. 13 / 42 — 10 / 8,8 kN / 51 MPa		R	100	87/34/23/0			
30,3	30	No weakness at contacts	30						
		Scoriaceous basalt red grey, and strong							
	32	**Tholeiite basalt** Grey, vesicular, very strong. About 4% to 8% vesicles, mainly coated with black clay, and some are filled with zeolites.	32		100 **100**	96/55/20/0 **91/47/24/0**	***Qc = 6 - 15*** $Q=\frac{91}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		**0,5 LU tested at 4,4 bar**
	34	14 / 54 — 13 / 13,3 kN / 78 MPa	34	R					
					100	94/89/47/0			
	36	K-3 / K-4	36		100	96/0/0/0			
22,9	38	**Sediment** Brown tuff very weak siltstone	38		**25**	**0/0/0/0**			
		Olivine basalt Dark grey, very strong, microporous, all small vesicles and micropores filled with black clay. Moderately to highly jointed. 14 / 44 — 7 / 9,7 kN / 57 MPa			99	57/0/0/0			
	40		40			55/13/0/0			
					93	**54/16/7/0**	***Qc = 3 - 8***		
	42	UCS = 41 UCS	42	R	**89**		$Q=\frac{54}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		
					99	74/47/29/0			
	44	Probably most of the water leakage at 45 m depth. Core loss 0,66m	44		54	35/0/0/0			
	46	Weak eroded contact.	46		91	24/0/0/0			
14,4		**Sediment** Brown and red brown tuffaceous claystone, very weak and erodes in the upper part. Core surface is waxy. Breaks up during drilling. Slickensides at 48 m depth, plunge ~50° Core loss 1m. 9 / 0,7 kN / 3,9 MPa — K-4 / K-5			5 **60**	0/0/0/0 **31/15/0/0**			**6,9 LU tested at 2,4 bar**
	48		48		100	56/28/0/0			
12,0					100	0/0/0/0			
	50	**Scoriaceous basalt** Dark grey, moderately strong, pores filled with white zeolites	50		100	23/0/0/0			

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	Eskifjörður	Date Sept. 2012	Page **2** of **6**
Empl. **VEGAGERÐIN**	**Corehole EF - 02 50 - 100 m**	Design AgG	Drawn AgG / TW
	Coord. X: 732.621,9 Y: 518.524,3 Elev.: 60,62	Driller RFS	Drilled Nov 2007

Description of corehole EF - 02

Elev. m a.s.l.	Depth m	Description	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
9,1	50		100	58/41/0/0			**6,9 LU tested at 2,4 bar**
	52	**Olivine basalt** Dark grey, very strong microporous basalt. Micropores filled with black clay. Faintly flow banded. Moderately to highly jointed. Joints irregularly spaced, rough, undulating, and coated with black clay. 11 64 — 6 19,7 kN 117 MPa	100	81/34/0/0			
	54			66/23/0/0			
	56	K-5 K-6	100	**61/22/0/0**	***Qc = 4 - 11*** $Q=\frac{61}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		
	58	Slickensides between 57,0m and 59,5m, subhorizontal plunge.	**100**	48/18/0/0			
	60		100	68/39/0/0			
	62	11 56 — 9 16,8 kN 100 MPa	100	82/24/0/0			
	64		100	36/0/0/0			
		K-6	100	52/21/0/0			
-5,3	66	K-7 **Sediment** red sandstone	100	0/0/0/0			
		Olivine basalt Dark grey, strong, moderately to highly jointed, joints irregularly spaced, rough, undulating, and coated with black clay. 11 45 — 7 10,6 kN 62 MPa	**100**	**0/0/0/0**			
	68		100	48/0/0/0			
				72/22/0/0			
			100	**66/23/0/0**			
	70		**100**		***Qc = 5 - 11*** $Q=\frac{66}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		
	72		100	61/21/0/0			
-12,3			100	84/84/0/0			**0,2 LU tested at 9,4 bar**
	74	**Sediment - tuffaceous claystone** Green brown, very weak. Core loss 0,4m Slickensides at 73,4m and 75,1m, plunge ~45°. 9 1,1 kN 6,2 MPa — K-7 K-8	100	53/0/0/0			
			83	**43/15/0/0**			
			72	37/24/0/0			
-14,6	76	**Scoriaceous Olivine basalt - compound flow** Dark grey, moderately strong, very porous, but almost all pores filled with zeolites. The basalt is composed of microporous rather dense zones and highly porous scoriaceous zones. 10 20 — 10 4,0 kN 23 MPa	100	100/0/0/0			
				97/52/52/0			
			98	**89/48/34/0**			
	78	9 1,6 kN 9 MPa	**99**		***Qc = 6 - 15*** $Q=\frac{89}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		
	80	8 2,4 kN 13,7 MPa	99	79/49/18/0			
-20,7			100	78/0/0/0			
	82	**Olivine basalt** Dark grey, very strong, microporous basalt. The rock is massive, with 2% to 3% vesicles, filled with white zeolites. 12 59 — 7 23,9 kN 143 MPa	100	100/60/24/0			
	84	Slickenside at 81,9m, plunge ~45°. K-8 K-9		100/100/100/100			
				70/56/40/35			
	86		100		***Qc = 5 - 12*** $Q=\frac{70}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		
		UCS =111 MPa					
	88	14 57 — 10 17,9 kN 106 MPa	**94**				
			100	86/86/77/77			
	90	The rock is highly jointed but mostly recemented with black clay and white zeolites. Black and white thin veining					
	92	Slickensides from 90m to 92,6m, subhorizontal plunge.	100	26/0/0/0			**0,3 LU tested at 6,2 bar**
		Sharp welded contact K-9	94	48/48/0/0			
-33,1	94	**Basaltic Dyke or Sill** with thin white veins, becoming broken/ crushed rock from 94,65m. Olivine basalt, broken/brecciated with black clay and white thin veins Dyke, with white thin veins Olivine basalt, 10cm of broken rock K-10	73	33/26/0/0			
	96	Core loss 0,8m					
-35,9		**Sediment, tuffaceous siltstone - claystone** Core loss 0,37m Red brown, purple brown and green, very weak rock. UCS=25 MPa Core surface is waxy. The core shrinks during drying TS=1,5 MPa Slickensides at 97,0m, plunge subvertical (97,05m) and subhorizontal (97,15m). TS=1,5 MPa 9 0,6 kN 3,3 MPa	86	36/0/0/0			
	98		**88**	**37/0/0/0**	***Qc = 0,5 - 1,6*** $Q=\frac{37}{6\text{-}9}x\frac{1\text{-}2}{3\text{-}4}x\frac{1}{2,5}$		
-39,0	100	**Olivine basalt**	98	50/0/0/0			

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	Eskifjörður	Date Sept. 2012	Page **3** of **6**
Empl. VEGAGERÐIN	**Corehole EF - 02 100 - 150 m**	Design AgG	Drawn AgG / TW
	Coord. X: 732.621,9 Y: 518.524,3 Elev.: 60,62	Driller RFS	Drilled Nov 2007

Description of corehole EF - 02

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
-39,6	100	**Basaltic Dyke or Sill** Dark. Weak eroded upper contact. Subhorizontal, strong, lower contact. -2 / 22; 11 / 3,5 kN / 20 MPa	100		100	87/43/0/0			
	102	**Olivine basalt - compound flow** Dark grey, porous and very vesicular rock mass, about 5% to 20% vesicles, completely filled with zeolites (stilbite and scolesite). Strong and moderately strong rock.	102	N					
	104	11 / 45; 15 / 8,1 kN / 47 MPa K-10 K-11	104		100	88/88/88/46			
	106	Dark grey microporous less vesicular zone. Very strong and strong rock. About 5% to 10% vesicles, well-filled with zeolites.	106						
	108		108	N	100	90/67/24/0			
	110	7 / 27; 13 / 6,8 kN / 39 MPa	110		100	87/41/30/0			**8,7 LU tested at 4,8 bar**
-50,4	112	Vesicular red brown zone. About 10% to 20% vesicles, all well-filled with zeolites. Strong and moderately strong rock.	112						
	114	2 / 12; 15 / 6,7 kN / 39 MPa K-11 K-12	114	N	100	89/64/51/0			
	116		116		100	83/70/30/0			
-56,0	118	**Basaltic Dyke or Sill** - subhorizontal, strong, contacts. More massive dark grey zone. Very hard and strong rock. About 5% to 10%, vesicles filled with zeolites.	118	N	99	86/60/36/10	***Qc = 6 - 14*** $Q=\frac{86}{9-10}x\frac{2-3}{2-3}x\frac{1}{1}$		
	120	11 / 56; 10 / 13,4 kN / 79 MPa	120		100	74/48/37/0			
-60,4	122	Porous brown grey and grey zone. Strong and moderately strong rock Pores and vesicles, about 5% to 10%, all well-filled with zeolites. 11 / 43; 14 / 7,2 kN / 42 MPa K-12 K-13	122	N	100	85/50/21/0			
	124		124						
	126	Microporous massive zone, dark grey, with few joints.	126		92	69/25/25/0			
	128	12 / 55; 15 / 13,2 kN / 78 MPa	128	N	100	99/85/57/39			**8,4 LU tested at 2,7 bar**
-70,0	130		130						
	132	Vesicular and porous zone. About 10% to 20% pores, well-filled with zeolites. Dark grey and brown. A short part of the core breaks up during drilling. K-13 K-14	132		100	88/75/54/37			
	134	9 / 39; 11 / 9,3 kN / 54 MPa	134	N	100	78/52/19/0			
	136	Microporous massive zone with fewer vesicles	136						
	136	10 / 52; 8 / 18,0 kN / 107MPa	136	N	100	100/68/27/0			
-77,2	138	**Sediment, tuffaceous siltstone - claystone** Very weak rock. Stratified, green and brown. Core surface is waxy. Core loss 0,3m Breaks up during drilling and handling. 11 / 0,7 kN / 3,9 MPa UCS=23 MPa TS=1,3 MPa TS=1,9 MPa TS=2,1 MPa	138		88	29/0/0/0			
	140	Slickensides from 138,0 m to 144,3 m, plunge mostly ~45°. UCS=20 MPa TS=1,0 MPa TS=1,1 MPa K-14	140		91	64/11/0/0 **59/5/0/0**	***Qc = 0,7 - 3***		
	142	High anisotrophy in vertical vs horizontal strength (weakness in layering) 13 / 0,6 kN / 3,3 MPa K-15 TS=2,0 MPa	142		93		$Q=\frac{59}{6-9}x\frac{1-2}{3-4}x\frac{1}{2,5}$		
	144	TS=2,8 MPa UCS=33 MPa	144		96	66/0/0/0			
-84,2					100	0/0/0/0			
	146	**Olivine basalt - compound flow** Dark grey strong	146	N	99	95/87/40/0			**6,9 LU tested at 3,9 bar**
	148	Dark coarse grained Olivine basalt, possibly an intrusive rock welded to the neighboring basalt.	148	N	99	99/99/81/81			
	150	Dark grey vesicular Olivine basalt 12 / 40; 17 / 7,1 kN / 41 MPa	150						

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	Eskifjörður	Date Sept. 2012	Page **4** of **6**
Empl. VEGAGERÐIN	**Corehole EF - 02 150 - 200 m**	Design AgG	Drawn AgG / TW
	Coord. X: 732.621,9 Y: 518.524,3 Elev.: 60,62	Driller RFS	Drilled Nov 2007

Description of corehole EF - 02

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
-89,9	150	**Basaltic Dyke or Sill** Subhorizontal contacts. Weak upper contact	150						
		Olivine basalt K-15 K-16							
	152	Dark grey, strong rock, very vesicular. About 10% to 20% vesicles, all well-filled with zeolites. Some joints, rough, undulating, and with thin grey clay coatings.	152	N	99	97/97/97/43			
	154	14 8,1 kN 47 MPa; 10 29	154		99	**95/83/66/28**	***Qc = 6 - 16***		
		Dyke (0,2 m)			100	$Q=\frac{95}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$			
	156		156			100/78/59/42			
		Broken and crushed rock at 156,5 m			67	0/0/0/0			
	158		158	N	100	100/95/78/0			
	160	13 5,3 kN 31 MPa; 11 33; K-16 K-17	160						
					100	90/58/47/0			
	162	Strong, welded contact	162						
-101,9		**Basaltic Sill** Dark grey, very strong, sheet-like.			**100**	**54/38/0/0**			
-102,8	164	**Sediment** 11 1,4 kN 7,9 MPa	164		93	70/0/0/0			
		Dark brown and green brown, very weak rock. The core surface is waxy. The core breaks into stumps during drilling and handling. Slickensides at 165 m, plunge ~40°. Core loss 0,3m			**85**	**45/0/0/0**			**7,6 LU tested at 3,2 bar**
					83	32/0/0/0			
-105,0					50	0/0/0/0			
	166	**Basaltic Sill** Dark grey, very strong. Rather coarse grained dolerite with small pores and vesicles that are well-filled with zeolites. Some inclusions of Olivine basalt.	166		100	83/50/22/0			
	168	Most probably a Sill, with wide joint spacing.	168			57/37/19/0			
						79/55/34/0			
	170	K-17 K-18	170		98		***Qc = 5 - 14***		
	172	2 42; 13 51; 12 12,0 kN 71 MPa	172	N	**99**		$Q=\frac{79}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		
					100	99/74/47/0			
	174		174						
	176		176		98	77/59/48/0			
-116,7					100	100/0/0/0			
	178	**Sediment,** tuffaceous sandstone-siltstone, dark brown and green grey, stratified, very weak and clayeous, breaks during drilling and handling. Slickensides, with ~40° to ~45° plunge. 13 1,1 kN 6,2 MPa	178		**100**	**74/0/0/0**			
-118,2					100	70/0/0/0			**2,1 LU tested at 3,9 bar**
		Basaltic Sill K-18 K-19							
	180	Dark grey, rather coarse grained basalt, with some inclusions of Olivine basalt.	180		98	75/38/38/0			
		The rock is slightly stratified by concentration of pore zones.				75/63/21/0			
						72/56/18/0			
	182	15 14,6 kN 86 MPa; 11 51	182	N	98		***Qc = 5 - 12***		
					99		$Q=\frac{72}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		
	184		184						
					100	67/60/0/0			
-125,4	186		186						
		Scoriaceous basalt Red grey, strong rock, porous, but all pores well-filled with zeolites. 8 19; 12 5,6 kN 32 MPa		R	100	26/0/0/0			
	188	Diffuse boundary	188		100	83/56/20/0			
		Olivine basalt K-19 K-20			**100**	**84/62/38/0**			
		Dark grey, very strong, about 5% to 8% pores and vesicles, filled with black clay and zeolites		R			***Qc = 5 - 18***		
	190		190				$Q=\frac{82}{9\text{-}10}x\frac{2\text{-}4}{2\text{-}3}x\frac{1}{1}$		
-130,1		Plagioclase crystals are abundant in the lower 1 m 9 59; 10 17,4 kN 103 MPa		R	100	100/85/71/0			
-131,1	192	**Sediment - sandstone** Dark red brown, moderately strong. 10 5,1 kN 29 MPa; 10 34	192		**100**	**100/0/0/0**			
		Scoriaceous Porphyritic basalt		R	100	98/98/98/0			
		Brown strong competent rock			100	99/99/99/0			
-132,6		**Basaltic Dyke** Dark grey, strong, welded margins,		N	100	78/52/0/0			
	194	**Porphyritic basalt**	194		100	100/89/89/89			
		Pink grey near top, then grey, very strong, with few joints. Scattered small pores filled with black clay. 7 11,0 kN 65 MPa; 11 51				96/87/75/0			
	196		196			**91/69/57/22**			
		Porphyritic basalt			100				
		Grey, very strong, about 2% to 4% pores, mainly filled with black clay. About 7% to 10% small Plagioclase phenocrysts. 8 20,9 kN 125 MPa; 13 60; K-20 K-21; 13 58; 8 22,3 kN 133 MPa					***Qc = 6 - 15***		**0,6 LU tested at 11,7 bar**
	198	Some joints, rough, undulating, and coated with black clay.	198	R					
	200		200		**100**				

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	Eskifjörður	Date Sept. 2012	Page **5** of **6**
Empl. **VEGAGERÐIN**	**Corehole EF- 02 200 - 250 m**	Design AgG	Drawn AgG / TW
	Coord. X: 732.621,9 Y: 518.524,3 Elev.: 60,62	Driller RFS	Drilled Nov 2007

Description of corehole EF - 02

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
	200	**Porphyritic basalt** Grey, very strong, about 2% to 4% pores, mainly filled with black clay. About 7% to 10% small Plagioclase phenocrysts.	200		100	82/63/53/53			
	202		202		100	86/46/46/0			
-142,4									
	204	**Basaltic Sill or Dyke** Dark grey, very strong, moderately jointed. Subhorizontal contacts.	204	N	100	77/60/60/0			
		Porphyritic basalt Dark grey, very strong.			100	90/0/0/0			
		Basaltic Dyke			100	99/50/0/0			
	206	Scoriaceous Porphyritic basalt 9 8,9 kN 52 MPa	206	R					
		Sediment - sandstone Brown, moderately strong.			**100**	**80/0/0/0**			
		Scoriaceous Porphyritic basalt Brown, very strong, porous and vesicular. ~10% vesicles, filled with zeolites and black clay. 9 33 8 5,5 kN 32 MPa K-21		R	100	100/100/53/0			
	208	Basaltic Dyke K-22	208						
		Scoriaceous Porphyritic basalt Brown, strong, porous and vesicular. About half of the vesicles are filled with zeolites.		R	100	96/79/31/0			
	210		210						
		11 7,2 kN 42 MPa							
	212	**Olivine basalt** Part of the scoriaceous basalt. More jointed and broken than the scoriaceous part	212	R	99	57/44/19/0			
		Sample UCS							
	214	**Scoriaceous Porphyritic basalt** Red brown, porous, strong and competent rock. 14 40 7 5,5 kN 58 MPa	214	R		98/38/0/0			
		Diffuse boundary, no weakness				**85/61/36/14**			
		Porphyritic basalt Dark grey, strong rock. Several joints, rough, undulating, coated with black clay. Small pores bout 2% to 5%, well-filled with black clay. Only occasional Plagioclase laths at the top of the layer.			100				
	216	6 58 8 20,6 kN 123 MPa K-22 K-23	216		**100**	***Qc = 6 - 14***			**0,1 LU tested at 11,4 bar**
				N		$Q = \frac{85}{9\text{-}10} x \frac{2\text{-}3}{2\text{-}3} x \frac{1}{1}$			
	218		218		99	72/37/22/0			
		Welded contact, no weakness							
-159,0					100	0/0/0/0			
	220	**Basaltic Sill or Dyke** Dark grey, very strong, welded contacts.	220	N	100	97/75/75/0			
		Scoriaceous Porphyritic basalt Red brown, strong competent rock.		R	100	100/81/81/81			
	222	Porous and vesicular, about 10% vesicles, filled with zeolites. 14 21 11 4,6 kN 27 MPa	222						
		Diffuse boundary, no weakness							
		Porphyritic basalt Dark grey, very strong. Several steeply inclined joints, rough, undulating, and coated with black clay.		R	100	81/63/39/0			
	224	12 59 14 19,2 kN 114 MPa	224						
		Diffuse boundary, no weakness							
	226	**Scoriaceous Porphyritic basalt** Light red brown, strong rock. Porous, about 10% vesicles and vugs, filled with zeolites. 15 42 12 6,8 kN 40 MPa K-23 K-24	226	R	100	87/63/63/46			
	228	No weakness at contact	228		100	100/100/0/0			
-168,3									
	230	**Porphyritic basalt** Dark grey, about 10% Plagioclase phenocrysts up to 7 mm long. Core loss 0,75m	230	N	70	27/0/0/0			
		Zone of fractured and partly brecciated rock. Possibly a tectonic fault zone, the rock is highly jointed. Joints mainly rough, undulating, coated and sometimes healed with black clay. Several slickensided fractures.				61/27/0/0 **53/25/5/0**			
	232		232		95	***Qc = 4 - 9***			
	234		234		**90**	$Q = \frac{53}{9\text{-}10} x \frac{2\text{-}3}{2\text{-}3} x \frac{1}{1}$			
					87	19/0/0/0			**0,0 LU tested at 12,4 bar**
	236		236		97	60/37/0/0			
		K-24 K-25		N					
	238	Slickensides	238		92	51/0/0/0			
		9 21,4 kN 128 MPa							
		Vesicular near the base. About 10% vesicles, filled with black clay. 10 58							
	240		240		98	89/68/29/0			
-180,0		Sharp contact Slickenside, plunge about 45° 14 3,4 kN 20 MPa			100	0/0/0/0			
-180,8		**Sediment - siltstone** Brown, very weak rock.			**100**	**90/77/77/0**			
	242	Slickensided contact, plunge about 45°. **Olivine basalt** Dark grey, strong, porous basalt. Vugs and vesicles about 10%, mainly filled with black clay.	242	R	100	97/97/63/63			
-182,7									
	244	**Scoriaceous Olivine basalt** Dark grey. 11 21 9 3,7 kN 21 MPa	244	R	**100**	**98/96/84/62**			
		Sharp, welded, contact				***Qc = 7 - 17***			
		Olivine basalt Dark grey, very strong. About 5% to 10% pores and vugs, filled with black clay. UCS = 18,6			100	$Q = \frac{98}{9\text{-}10} x \frac{2\text{-}3}{2\text{-}3} x \frac{1}{1}$			
	248	K-25 K-26	246	R		99/99/99/78			
		No weakness at contact 13 41 7 5,8 kN 34 MPa			100	100/84/84/0			
-186,7									
	248	**Scoriaceous Porphyritic basalt** Brown, strong, porous rock. About 10% vugs, well-filled with zeolites. 13 29 10 4,4 kN 25 MPa	248	R	100	90/87/52/52			
		No weakness at contact							
	250	**Porphyritic basalt** Dark grey, very strong rock. About 5% vesicles, well-filled with black clay. 0,3 m of scoriaceous broken rock at 249 m.	250						

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	Eskifjörður	Date Sept. 2012	Page **6** of **6**
Empl. **VEGAGERÐIN**	**Corehole EF - 02 250 - 300 m**	Design AgG	Drawn AgG / TW
	Coord. X: 732.621,9 Y: 518.524,3 Elev.: 60,62	Driller RFS	Drilled Nov 2007

Description of corehole EF - 02

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
	250	**Porphyritic basalt** Dark grey, very strong, vesicles about 5% to 10%, well-filled with black clay. Plagioclase phenocrysts about 15%, up to 8 mm long.	250	R	100	100/89/78/49			
	252	12 58 — 11 20,0 kN 119 MPa	252		**100**	**97/91/76/54**			
		Vesicles about 5%, well-filled with black clay.					***Qc = 6 - 21*** $Q=\frac{97}{9\text{-}10}x\frac{2\text{-}4}{2\text{-}3}x\frac{1}{1}$		
	254		254		100	99/95/95/64			
-194,4		Sharp contact							
		Sediment - tuff Clayeous. Dark green top, afterwards brown, with layers of green tuff, very weak rock.			92	68/0/0/0			
	256	K-26 K-27 — 13 — 0,9 kN 5 MPa — UCS=47 MPa	256		100	76/0/0/0			**0,0 LU tested at 11,5 bar**
		15 slickensides between 255m and 260m, i.e. 3/m. Plunge typically about 45°.			96	88/88/0/0			
		Basaltic Sill or Dyke			84	46/0/0/0			
	258	**Sediment - tuff** Clayeous. Green, bedded, very weak rock. Core surface is waxy — 9 — 0,5 kN 2,8 MPa	258		**94**	**58/16/0/0**	***Qc = 0,7 - 2,9*** $Q=\frac{58}{6\text{-}9}x\frac{1\text{-}2}{3\text{-}4}x\frac{1}{2,5}$		
		Core loss 0,3m							
		Brown claystone layer (15cm) Slickensided contact to Olivine basalt.			100	44/24/0/0			
-199,4	260	**Olivine basalt** Dark grey, strong, vesicular. About 5% to 10% vesicles, filled with zeolites or black clay. — 12 — 6,8 kN 40 MPa — 13 — 31	260	R	100	99/89/89/89	**2**		
-200,9		Slickensided contact.			100	100/0/0/0			
	262	**Sediment - tuff** Clayeous. Green and brown, very weak. Core surface is waxy Slickensided contact — 12 — 1,1 kN 6,2 MPa	262		95	73/0/0/0			
					95	**44/0/0/0**			
					94	0/0/0/0			
		Sediment - Lapili tuff			96	66/34/33/0			
	264	Lapili, and occasional bombs, of pumice and brown grey scoria, in a light grey green tuff matrix. Acidic dacite or rhyolite in origin. TS=3,9 MPa UCS=22 MPa TS=2,7 MPa — 12 44 — 10 4,9 kN 28 MPa — K-27	264		**98**	**87/75/43/0**	***Qc = 2 - 10*** $Q=\frac{87}{6\text{-}9}x\frac{1\text{-}2}{3\text{-}4}x\frac{1}{1}$		
	266	16 slickensides between 261,5 m and 264,5 m, i.e. 5/m. Plunge typically about 45°. — 9 26 — 13 5,6 kN 32 MPa — K-28 UCS=24 MPa UCS=17 MPa TS=1,4 MPa	266						
					100	100/100/57/0			
-207,5	268	Diffuse boundary — 9 — 17,8 kN 106 MPa	268		97	81/60/0/0			
		Ignimbrite - Pyroclastic flow — 11 59			100	87/66/47/47			
	270	Light grey (light pink grey top), very strong and extremely strong, very well welded grey mass, with inclusions of various origin.	270						
		The rock mass resembles fine-grained acidic crystalline rock, but contains widely abundant inclusions of different rock fragments welded into the rock mass.							
	272		272	R	100	82/48/17/0			
	274	K-28 K-29	274		100	94/55/55/0			
					100	**88/62/36/7**			
		2 57 — 11 63 — 6 22,8 kN 136 MPa					***Qc = 4 - 10*** $Q=\frac{88}{9\text{-}10}x\frac{2\text{-}3}{3\text{-}4}x\frac{1}{1}$		
-215,5	276	Scoriaceous Tholeiite basalt inclusion, welded into the Ignimbrite	276						**0,0 LU tested at 11,8 bar**
		Light grey, very well welded Ignimbrite, with welded inclusions of pumice and basalt fragments. — 7 — 27,0 kN 162 MPa							
	278		278		100	77/65/49/0			
	280		280						
					100	91/72/23/0			
	282	10 62 — 6 23,5 kN 140 MPa — K-29	282						
	284	K-30	284		100	96/68/23/0			
-224,5		**Scoriaceous Ignimbrite** Clastic and welded.							
		Sediment - Tuff Brown and green, very weak, clayeous, with layers of green tuff, occasional layers with fine gravel sized fragments. Core surface is waxy. UCS=25 MPa UCS=37 MPa UCS=21 MPa TS=9,2 MPa TS=1,7 MPa			77	35/0/0/0			
	286		286		75	23/0/0/0			
					81	**27/0/0/0**	***Qc = 0,3 - 1,2*** $Q=\frac{27}{6\text{-}9}x\frac{1\text{-}2}{3\text{-}4}x\frac{1}{2,5}$		
	288	Core loss 0,85m — 9 — 0,8 kN 4,5 MPa	288						
		TS=1,1 MPa			96	34/0/0/0			
-229,2	290	**Tholeiite basalt** Scoriaceous at the top, medium - dark grey, very strong, but porous basalt. Vesicles about 1% to 2%, well-filled with black clay and white zeolites. — 10 49 — 9 15,1 kN 89 MPa	290		94	90/78/78/0			
						90/69/60/0			
	292		292		**95**		***Qc = 6 - 20*** $Q=\frac{90}{9\text{-}10}x\frac{2\text{-}4}{2\text{-}3}x\frac{1}{1}$		
					96	90/63/48/0			
	294	**Scoriaceous Tholeiite basalt** At the base K-30	294		**100**	**100/0/0/0**			
-233,6		**Sediment - sandstone** Brown, very weak. K-31 — 9 — 9,7 kN 57 MPa			100	100/100/0/0			
		Tholeiite basalt Scoriaceous at the top, medium dark grey, very strong, with several joints, rough, undulating, and coated with black clay. — 10 48				**79/63/15/0**			
	296		296		**97**		***Qc = 5 - 18*** $Q=\frac{79}{9\text{-}10}x\frac{2\text{-}4}{2\text{-}3}x\frac{1}{1}$		
					97	77/59/17/0			
-236,9	298	Bottom of the hole 297,53m on 13th November 2007.	298						
	300		300						

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	Fannardalur	Date Sept. 2012	Page **1** of **3**
Empl. VEGAGERÐIN	**Corehole NF - 01 0 - 50 m**	Design AgG	Drawn AgG / EO
	Coord. X: 736.243,31 Y: 523.630,73 Elev.: 224,6	Driller RFS	Drilled Aug 2007

Description of corehole NF - 01

224,6 m a.s.l. — 0 m

The hole is drilled vertically, located in a moderately steep slope of glacial debris. The surface is covered with moss and heather.

Percussion drilling with odex drill bit, 3,5" steel casing down to 15 m depth.

Bedrock is probably at 14 m depth.
The hole was cemented with concrete down to 21,1 m depth owing to drilling difficulties. Most of the cement was lost out of the hole.

Probably bedrock at approx 14,5 m depth. Core drilling with NQ triple tube drilling rods from 15,0 m depth.

GWT at 63 m hole depth

209,6 m

Tholeiite basalt, K-1

Medium grey, very hard and strong with few scattered vesicles. The basalt is highly jointed, joints are rough, undulating and coated with black clay.

Additionally the core contains scattered black veins of joints, healed with black clay.

GWT at 85 m hole depth

The hole was cemented when bottom was at 21,1 depth

K-1 / K-2

Tholeiite basalt / Scoriaceous basalt, medium grey, strong, very porous and vesicular rock. About 10-20% vesicles, coated with black clay and partly filled with zeolites.

195,5 m

Scoria Scoriaceous basalt, mixed with red siltstone, about 20% silt.

194,4 m

Tholeiite basalt / Scoriaceous basalt

Medium and dark grey, moderately strong very porous and vesicular basalt. About 20% vesicles, mainly empty or coated with green and black clay. Some vesicles filled with zeolites.

K-2 / K-3

Tholeiite basalt, medium grey, more massive than higher up but highly jointed and crushed.

Scoriaceous basalt, very porous, moderately strong, about 20% pores, partly filled with zeolites and partly empty.

Tholeiite basalt hard and crystallined at 39-40,5 m depth.

Scoria Scoriaceous basalt, dark grey, moderately strong, very porous, pores filled with soft zeolites

14 / 15 — 7 — 3,8 kN — 22 MPa

Scoriaceous and vesicular basalt with about 15% vesicles half filled with black and green clay. Unclear boundary

Tholeiite basalt, medium gray, hard and strong basalt K-3 / K-4

Scoria Scoriaceous basalt, grey purple grey, well compressed and consolidated strong rock. Thin, 5 cm, red bed at 47,7 m depth

11 — 4,7 kN — 27 MPa

174,6 m

Depth m	Core %	RQD % 10 / 30 / 50 /100	Qc
16	100	62/0/0/0	
	100	49/0/0/0	
		45/30/0/0	
18	97		***Qc = 1,5 - 4***
			$Q=\frac{24}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$
	66	0/0/0/0	
20	**86**	**24/9/0/0**	
	40	0/0/0/0	
	0	0/0/0/0	
22	79	0/0/0/0	
	100	37/0/0/0	
24	100	0/0/0/0	
	100	13/0/0/0	
26	93	21/0/0/0	
28	100	49/26/0/0	
30	64	18/0/0/0	
32			
34	100	34/24/0/0	
36	100	76/27/0/0	
	100	24/0/0/0	
38	93	71/71/0/0	
	100	23/0/0/0	
40	72	15/0/0/0	
42	100	91/87/34/0	
	100	57/27/0/0	
44	97	53/40/40/0	
	92	**42/22/9/0**	***Qc = 3 - 8***
	100		$Q=\frac{42}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$
		32/0/0/0	
48	95	29/0/0/0	
50	100	92/83/83/0	

10-14 LU at 3,7 bar

Problem with packing and overflow

Jarðfræðistofan Ehf / JFS Geological services Ltd	Norðfjarðargöng	JFS-74	Drwg. A-3b
	Fannardalur	Date Sept. 2012	Page **2** of **3**
Empl. VEGAGERÐIN	**Corehole NF - 01 50 - 100 m**	Design AgG	Drawn AgG / EO
	Coord. X: 736.243,31 Y: 523.630,73 Elev.: 224,6	Driller RFS	Drilled Aug 2007

Description of corehole NF - 01

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Q	GWT	Perm. (LU) 2,5 5,0 7,5
	50	**Tholeiite basalt,** light grey, very hard, highly jointed and additionally with thin black veins of joints healed with black clay. Joints, irregularly spaced, rough and undulating. 14 / 29	50	R	98	38/18/0/0			
	52		52		85	19/0/0/0			
	54	**Scoriaceous basalt,** dark red grey, strong rock porous and vesicular. K-4 / K-5	54	R	100	0/0/0/0			
					97	57/0/0/0			
					100	100/100/0/0			**10-14 LU at 3,7 bar**
	56	**Tholeiite basalt,** light grey, very hard and strong basalt, highly jointed, joints irregularly spaced, rough, undulating and coated with black clay.	56	R	97	0/0/0/0			
					100	83/19/0/0			
	58		58	R A	94	50/25/0/0			
	60	**Scoriaceous basalt,** red grey, moderately strong, porous and vesicular, pores varying from 10 to 25%. Pores empty or coated with thin black clay. 6 / 4,2 kN / 24 MPa	60	R	100	85/53/0/0			
					85	42/42/42/0			
	62	**Tholeiite basalt,** medium grey, very hard and strong, intensely jointed, joints irregularly spaced, rough, undulating and coated with black clay. K-5	62	R	90	26/0/0/0			
					96				
	64	K-6	64		100	82/0/0/0			
					94	0/0/0/0			
					100	50/0/0/0			
	66	**Scoriaceous basalt,** grey and red grey, strong, very porous and vesicular	66	R	81	41/0/0/0			
					100	100/100/0/0			
						48/28/0/0			
	68		68		100	**50/20/6/0**			
		Tholeiite basalt, medium grey, extremely strong and hard basalt, moderately jointed, joints irregularly spaced, rough, undulating and coated with light green clay. 16 / 54				***Qc = 4 - 8***			
	70		70	R A		$Q = \frac{50}{9\text{-}10} \times \frac{2\text{-}3}{2\text{-}3} \times \frac{1}{1}$			
		6 / 24,4 kN / 146 MPa			100	54/26/17/0			
	72	K-6 / K-7	72						
		Scoriaceous basalt, 0,2 m			100	63/0/0/0			
151,3		**Sediment, sandstone,** Dark green at top green tuffaceous sediment in the lower part			86	30/0/0/0			
	74		74		100	49/35/0/0			
		Tholeiit basalt, grey, very hard and strong, highly jointed, joints rough, undulating and coated with black clay.							
	76		76	R	100	11/0/0/0			
147,6		Sharp contact scoria 5 cm Weak boundary			30	0/0/0/0			
	78	**Sediment,** green sandstone at top 0,3 m	78		96	70/26/0/0			
					100	50/17/0/0			
		Sandstone conglomerate, green sandy matrix and angular to sub rounded fragments of basalt up to 3 cm. The matrix is very well cemented forming moderately strong rock mass. 9 / 4,8 kN / 28 MPa 15 / 29				***Qc = 0,6 - 1,4***			
	80		80	R		$Q = \frac{53}{6\text{-}9} \times \frac{1\text{-}2}{3\text{-}4} \times \frac{1}{2,5}$			
		K-7 / K-8			86	24/0/0/0			
		The sediment is most probably welded pyroclastic tuff. Light grey green sandstone conglomerate. Relatively strong rock mass and probably most of the sediment is favourable tunnelling rock				91/91/80/0			
	82		82		100	**53/31/21/0**			
						Qc = 1,5 - 3,5			
		15 / 33 9 / 5,5 kN / 32 MPa			**96**				
	84		84	R					
					100	0/0/0/0			
	86	Lower margin of welded phyroclastics	86		91	36/0/0/0			**8-10 LU**
		Sandstone, claystone, dark green waxy very week rock, probably claystone			91	37/0/0/0			
136,7	88	**Scoria Scoriaceous basalt,** basalt, dark grey, very porous moderately strong rock	88	R					
		Tholeiite basalt, medium, dark grey, very strong, vesicular, about 15 to 20% large irregular vesicles, coated with black clay. K-8 / K-9			100	80/47/47/47			
	90		90	R	100	76/70/57/0			
						47/29/23/0			
		6 / 18,5 kN / 109 MPa 4 / 60				***Qc = 3 - 8***			
	92	Thin irregular veins of joints, loaded with black clay.	92		**86**	$Q = \frac{47}{9\text{-}10} \times \frac{2\text{-}3}{2\text{-}3} \times \frac{1}{1}$			
		Scoria - Scoriaceous basalt			77	35/0/0/0			
		Sediment, 5-10 cm dark red siltstone, mixed in scoria							
	94	**Tholeiite basalt,** medium grey, very strong, porous in the upper part, flow banded in the lower part.	94		95	42/28/28/0			
	96	The basalt is intensely jointed in addition to an irregular network of thin black veins of joints, healed with black clay. Also frequent inclined flow banding	96		70	21/0/0/0			
					100	54/29/0/0			
	98	**Scoria Scoriaceous basalt,** weak rock, core loss, probably of layer contact	98		100	0/0/0/0			
					25	0/0/0/0			
	100	Tholeiite basalt, medium grey highly jointed	100	R	95	16/0/0/0			

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	Fannardalur	Date Sept. 2012	Page **3** of **3**
Empl. VEGAGERÐIN	**Corehole NF - 01 100 - 150 m**	Design AgG	Drawn AgG / EO
	Coord. X: 736.243,31 Y: 523.630,73 Elev.: 224,6	Driller RFS	Drilled Aug 2007

Description of corehole NF - 01

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
124	100	Tholeiite basalt, medium gray highly jointed	100						
	102	Sediment Breccia, green grey strong rock, angular fragments of pebble size of various size and various grain well cemented in green sandy matrix grain supported. K-9, K-10	102		75	37/0/0/0			
		Sandstone - Siltstone, dark green-brown tuff 0,6 m. Weak rock			100	100/52/0/0			
	104	Sandstone - Breccia, pyroclastic flow. Very well cemented green and grey rock, small angular fragments of various origin welded in a sandy matrix	104		100	39/0/0/0			
	106	Open joint at 104 m to105 m depth. The GWT in the hole lowered below 50 m depth when the hole crossed the joint. Few original joints in the rock mass.	106		100	87/87/73/53			
	108	The coarse grained particles, decrease downwards (more fine grained). Relatively uniform welded sediment. 19 / 46	108				**Qc = 2,6 - 8** $Q=\frac{70}{6-9}x\frac{1-2}{2-3}x\frac{1}{1}$		The GWT dropped below some depth after crossing an open joint at 104 m depth
	110	14, 7,5 kN, 44 MPa. Several steeply inclined joints rough, undulating and coated with thin black clay. K-10, K-11	110		100	89/74/74/74			**8-10 LU**
	112		112		100	75/75/75/75			
	114		114		100	15/0/0/0			
					95	50/38/38/0			
	116	Claystone, dark grey green and brown tuffaceous sandstone claystone of very low strength. Core surface vaxy.	116		100	50/50/0/0			
		Conglomerate - agglomerate, fragments of pebble size of various origin cemented in tuffaceous matrix. Moderately strong rock. 11 / 35, 7, 1,7 kN, 9,6 MPa			100	81/56/0/0			
	118	K-11	118		100	66/43/24/16	**Qc = 0,7 - 1,8** $Q=\frac{66}{6-9}x\frac{1-2}{3-4}x\frac{1}{2,5}$		
		11, 4,0 kN, 23 MPa. K-12			100	71/41/18/0			
	120	Claystone, with lenses of small fragments of pebble size. Tuffaceous and pumice rich argillaceous rock of very low strength. The sediment shrinks during drying.	120		100	0/0/0/0			
					100	100/0/0/0			
	122	Fragments of pebble size in tuffaceous matrix	122		100	63/31/0/0			
		Claystone, dark purple grey, weak rock, core with waxy surface.			100	26/0/0/0			
100,4	124	Scoriaceous basalt, dark purple grey strong, porous rock. 3-10% pores, mainly empty.	124	N					
	126	11 / 22, 8, 6,6 kN, 38 MPa	126	N	98	87/80/80/80			
97					48	48/48/48/0			
	128	Bottom of hole at 127,6 m depth, August 2007	128						
	130		130						
	132		132						
	134		134						
	136		136						
	138		138						
	140		140						
	142		142						
	144		144						
	146		146						
	148		148						
	150		150						

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	Fannardalur	Date Aug 2007	Page **1** of **7**
Empl. **VEGAGERÐIN**	**Corehole NF - 02 0 - 50 m**	Design AgG	Drawn AgG /EO
	Coord. X: 735.781,0 Y: 523.298,7 Elev.: 361,4	Driller RFS	Drilled Aug 2007

Description of corehole NF - 02

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
361,4	0	The hole is located on a rock outcrop on a terrace in the south slope of Fannardalur. Vertical hole. Percussion drilled with an ODEX bit, 3,5" casing down to 3 m depth. Core drilling with NQ triple tube core barrel. Diameter of core 44,5 mm	0						
	2		2						
358,4	4	**Scoriaceous basalt,** grey and brown grey, moderately strong, very porous and vesicular, 15% to 20% vesicles, mainly filled with white zeolites, but about 30% of the vesicles are empty. K-1	4		100 100	60/0/0/0 26/0/0/0		GWT at 153 m hole depth	
	6	Part of the scoriaceous basalt is brecciated but the fragments are recemented with zeolites.	6	R A	86 **93**	53/33/33/0 **44/25/7/0** ***Qc = 3 - 10*** $Q=\frac{44}{9-10}x\frac{2-4}{2-3}x\frac{1}{1}$			
	8	Over all average tunnelling rock.	8		91	57/49/0/0			
	10		10	R	100 95	25/0/0/0 17/0/0/0			
350,4	12	**Basaltic dyke,** dark grey, hard and extremely strong rock but highly jointed in addition to thin veins of joints, healed with zeolites. 11 / 50 6 19,7 kN 117 MPa K-1 K-2	12	R	100 **100** 100	24/0/0/0 **42/13/0/0** 69/31/0/0		GWT at 250m hole depth	
347,9	14	**Dacite,** intermediate acidic crystalline rock medium-dark grey, hard and extremely strong and brittle rock.	14	R	74 79	0/0/0/0 8/0/0/0			
	16	Intensely jointed, most rock lumps <10 cm, few longer core stumps. The joints are mostly rough, undulating but some joints seem to be smooth. Planar. All joint planes coated with black clay.	16		60 0	0/0/0/0 0/0/0/0			
	18		18			0/0/0/0			
	20	The rock is unfavourable tunnelling rock, highly jointed and crushed rock mass.	20		13 **58**	**7/0/0/0** ***Qc = 0,2 - 1*** $Q=\frac{10}{9-15}x\frac{1-2}{3-6}x\frac{1}{1}$			
	22	6 / 48	22	R A	100	30/0/0/0			
	24		24		100 100 96 53 100 100	0/0/0/0 19/0/0/0 0/0/0/0 0/0/0/0 0/0/0/0 0/0/0/0			
	26	**Dacite,** intermediate acidic crystalline rock medium grey, very hard and brittle, extremely strong but flow banded with subhorizontal platy cleavage. 6 25,1 kN 150 MPa K-2 K-3	26		88 100	27/0/0/0 0/0/0/0			
	28		28		100	25/0/0/0			
	30	Vesicular in the lowest 0,5-1 m.	30	R					
	32	**Scoria and scoriaceous basalt,** mixed with sediment, purple brown rock of medium-low strength.	32		46	0/0/0/0			
	34	Considerable core loss with sediment and scoria eroding.	34		31	7/0/0/0			
325,1	36		36						
	38	**Dacite,** grey, very hard and brittle. The intact rock is extremely strong . Vesicles 2-5% coated with black clay.	38	R	98 **99** 100	31/17/0/0 **36/21/0/0** 46/28/0/0			
321,9	40	**Sediment,** dark purple brown, weak rock, clayous, core loss.	40		51	27/27/0/0			
		Scoriaceous basalt.							
	42	22 / 38 K-3 **Basalt-Andesite,** intermediate rock, light grey, hard and strong rock. Intensely jointed with crushed zones, joints rough, undulating, coated with black clay. 7 12,1 kN 71MPa K-4	42	R	100 100	92/92/72/0 28/0/0/0		GWT at 288m hole depth	
	44	6 22,8 kN 136 MPa	44		**90**	**42/31/21/0** ***Qc = 3 - 8*** $Q=\frac{42}{9-10}x\frac{2-3}{2-3}x\frac{1}{1}$			
	46	Scattered vesicles 2-4% coated with black clay.	46		100 100 100	37/37/37/0 0/0/0/0 36/0/0/0			
314,3	48	**Sediment,** variable colour, stratified light red, dark red and green clayous weak tuff. Very low strength.	48		68 63	0/0/0/0 24/0/0/0			
313,0	50	**Scoria-Scoriaceous basalt,** dark grey, moderately strong, vesicular, vesicles half filled with zeolites.	50	R	100	52/29/0/0			

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	Fannardalur	Date Aug 2007	Page **2** of **7**
	Corehole NF - 02 50 - 100 m	Design AgG	Drawn AgG /EO
Empl. VG	Coord. X: 735.781,0 Y: 523.298,7 Elev.: 361,4	Driller RFS	Drilled Aug 2007

Description of corehole NF - 02

Elev. m a.s.l.	Depth m	Description	Samples	Rock column
	50–54	Tholeiite basalt, grey, very hard and brittle. Intensely jointed rock fragments frequently less than 5 cm in size Joints rough, undulating and coated with clay.	K-4 / K-5	R
307,7 / 306,9	54	Basaltic dyke, dark grey, strong, welded contacts.		
	54–56	Tholeiite basalt, grey, hard and brittle intensely jointed.		R
	56–60	Scoria - Scoriaceous basalt, dark grey, porous, moderately strong rock. Most vesicles half filled with zeolites. Better tunnelling rock than the overlying Tholeiite basalt.	18/22; 6, 4,0 kN, 23 MPa; K-5 / K-6	
299,2	60–62	Brown scoriaceous basalt very well compressed and consolidated.		R
	62–72	Tholeiite basalt, grey, very hard and strong but intensely jointed with additional irregular net of thin black veins of joints, healed with black clay. Joint planes rough, undulating, coated with black clay.	K-6 / K-7	R
	72–78	Scoriaceous basalt, dark grey porous, moderately strong rock (favourable tunnelling rock, compared to the crystalline basalt). More favourable tunnelling rock than the crystalline basalt.		R
	78–81	The colour of the scoriaceous basalt turns from grey to red brown. Well compressed and consolidated. Porous rock with some open pores.	18/15; 6, 4,6 kN, 26,5 MPa; K-7 / K-8	
	81–87	Tholeiite basalt, light grey, extremely strong, hard and brittle. For most part moderately to highly jointed, with some minor zones of crushed rock. Joints rough, undulating, coated with black clay. Relatively poor tunnelling rock.	18/60; 6, 22,8 kN, 136 MPa	R
	87–88	Slightly scoriaceous zone less than 1 m.		
	88–92	Tholeiite basalt, grey, very hard and strong but highly jointed.	K-8 / K-9	
269,0	92–96	Scoriaceous basalt, grey brown, well compressed and consolidated moderately strong to strong rock.		R
	96–100	Scoriaceous porous basalt, less compressed than above, low specific weight. Relatively fair tunnelling rock. Small pores partly open but also half filled with light grey clay or zeolites.	7, 7,8 kN; 15/24, 45,4 MPa; K-9	

Core %	RQD % 10 / 30 / 50 /100	Qc
99	**32/15/0/0**	
100	17/0/0/0	
72	0/0/0/0	
100	0/0/0/0	
100	62/41/0/0	
100	0/0/0/0	
100	0/0/0/0	
100	40/24/0/0	
100	**61/50/43/0**	***Qc = 4 - 21***
100		$Q=\frac{61}{6\text{-}10}\times\frac{2\text{-}4}{2\text{-}3}\times\frac{1}{1}$
	93/73/73/0	
100	81/81/65/0	
100	29/0/0/0	
100	43/13/0/0	
100	38/0/0/0	
100	27/0/0/0	
36	4/0/0/0	
99	62/55/43/0	
	96/79/30/0	
100	**48/25/12/0**	
93		***Qc = 3 - 8***
		$Q=\frac{48}{9\text{-}10}\times\frac{2\text{-}3}{2\text{-}3}\times\frac{1}{1}$
98	88/78/51/0	
100	60/0/0/0	
100	44/34/0/0	
82	19/0/0/0	
84	0/0/0/0	
100	64/0/0/0	
100	36/12/0/0	
100	10/0/0/0	
100	54/0/0/0	
87	48/29/0/0	
100	8/0/0/0	
100	60/0/0/0	
100	100/85/66/66	
88	**58/41/26/12**	***Qc = 4 - 20***
78		$Q=\frac{58}{6\text{-}10}\times\frac{2\text{-}4}{2\text{-}3}\times\frac{1}{1}$
	75/58/42/0	

GWT

Perm. (LU) 2,5 5,0 7,5

8-10 LU at 66,5-90,5m

4-5 LU at 73,2-132,5m

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	Fannardalur	Date Aug 2007	Page **3** of **7**
Empl. **VEGAGERÐIN**	**Corehole NF - 02 100 - 150 m**	Design AgG	Drawn AgG / EO
	Coord. X: 735.781,0 Y: 523.298,7 Elev.: 361,4	Driller RFS	Drilled Aug 2007

Description of corehole NF - 02

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
	100	K-10	100		71	0/0/0/0			
		Scoriaceous basalt.		R	100	69/37/0/0			
259,9	102	Tholeiite basalt, light grey, very hard and extremely strong. Moderately jointed, joints rough and undulating.	102		99	41/0/0/0			
		8 / 24,8 kN / 148 MPa; 13 / 53			100	73/47/47/0			
	104		104			**62/39/25/0**	***Qc = 4 - 11***		
					100	$Q=\frac{62}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$			
	106		106	R	100	55/50/0/0			
254,3	108	Scoriaceous basalt, dark grey and dark red grey, strong, well compressed and consolidated porous rock. Irregular pores and vugs half filled with zeolites and white clay. Fair tunnelling rock. K-10 K-11	108	R	100	80/56/0/0			
					100	84/50/34/34			
	110		110			**90/68/53/33**	***Qc = 6 - 15***		
	112		112		**100**	$Q=\frac{90}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$			**4-5 LU at 73,2-132,5m**
					100	100/83/83/57			
	114		114	R	100	95/95/95/0			
245,9	116	Tholeiite basalt, light grey, very hard and extremely strong, 2 to 3% small vesicles and slightly flow banded. Moderately jointed. Joints rough, undulating, coated with black clay.	116		100	79/20/0/0			
		21 / 49							
	118	5 / 25,1 kN / 150 MPa K-11	118	R	100	45/15/0/0			
	120	K-12	120						
240,9	122	Probably a mix of dyke and breccia, core loss. Possibly a fault breccia.	122	R	43	16/16/0/0			
		Tholeiite basalt			100	73/46/0/0			
	124	Scoria-scoriaceous basalt, dark, grey, mainly well compressed, moderately strong porous rock. Pores about 10% mainly empty or coated with light grey or light green clay.	124		73	29/0/0/0			
	126		126						
					100	89/72/61/0			
	128	6 / 2,6 kN / 14,8 MPa; 11 / 19	128			**63/41/27/9**	***Qc = 4 - 16***		
					92	$Q=\frac{63}{6\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$			
	130	K-12 K-13	130	R	100	73/25/0/0			
	132	Tholeiite basalt, light grey, hard and strong zone inside the scoriaceous basalt.	132	R	100	74/37/37/0			
					100	0/0/0/0			
	134	Scoriaceous basalt, dark grey, moderately strong, well compressed and consolidated porous rock of rather low specific weight. Relatively fair tunnelling rock.	134		100	86/65/46/0			
	136		136						
					100	67/67/54/34			**7-8 LU at 132,8-156,5m**
	138		138	R					
		21 / 30; 8 / 2,8 kN / 16 MPa K-13 K-14			100	88/77/62/45			
	140		140						
219,8	142	Tholeiite basalt, light grey, very hard and strong zone inside the scoriaceous basalt.	142		98	46/15/0/0			
	144	Scoriaceous basalt, dark grey and dark red grey, moderately strong, moderately well compressed and consolidated porous rock of rather low specific weight.	144		100	100/100/0/0			
	146		146		100	60/34/24/0			
	148	K-14	148	R	100	73/55/55/0			
	150	K-15	150						

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	Fannardalur	Date Sept 2007	Page 4 of 7
Empl. VEGAGERÐIN	**Corehole NF - 02 150 - 200 m**	Design AgG	Drawn AgG / EO
	Coord. X: 735.781,0 Y: 523.298,7 Elev.: 361,4	Driller RFS	Drilled Aug 2007

Description of corehole NF - 02

Elev. m a.s.l.	Depth m	Description
	150–155,0	Tholeiite basalt, light grey, very hard and extremely strong, moderately jointed, joints rough, undulating coated with black clay. Slightly flow banded in the lower part.
	155,0–157,8	Scoriaceous basalt, dark grey and red brown, strong, very well compressed and consolidated. Slightly porous, about 5 to 10% vesicles, mainly empty.
	157,8–161,0	Tholeiite basalt, medium grey, very hard and extremely strong but highly jointed rock. Additional thin black veins of joints, healed with black clay.
200,4	161,0–165,0	Scoriaceous basalt, dark grey, moderately strong, moderately well compressed and consolidated porous rock. About 10 to 20% pores and vesicles, half filled with zeolites or coated with black clay. Unclear boundary
	165,0–171,0	Tholeiite basalt, dark grey, moderately strong, very vesicular in the upper part. Decreasing porosity and vesicles downwards
190,5	171,0–174,2	Scoriaceous basalt, and very vesicular basalt, dark grey and dark brown grey moderately strong rock.
	174,2–180,5	Scoriaceous basalt, dark grey, very well compressed and consolidated moderately strong rock. Pores about 10%, half filled with light grey and greenish clay. No weakness at boundary.
180,9	180,5–184,0	Tholeiite basalt, medium grey. Very hard and strong but intensely jointed. No weakness at boundary.
177,5	184,0–189,0	Scoriaceous basalt, dark grey with red spots, moderately strong, very vesicular basalt, (dark grey in the upper most part then medium grey). Very vesicular, large vesicles about 15 to 10%, most of them are empty but some are half filled and filled with white zeolites (mordenite).
	189,0–200	Tholeiite basalt, light-medium grey, extremely hard and strong but intensely jointed and partly tectonized. Closely spaced joints and additionally black and white veins of healed joints. Joints are mainly curved and undulating, often with smooth surfaces, coated with black clay. Overall poor to fair tunnelling rock.

Depth m	Core %	RQD % 10 / 30 / 50 /100	Qc
150	100	28/0/0/0	
151	97	0/0/0/0	
152	100	100/54/0/0	
154	100	74/52/0/0	
150–155	**100**	**68/43/24/0**	**Qc = 5 - 11**; $Q = \frac{68}{9-10} \times \frac{2-3}{2-3} \times \frac{1}{1}$
156	100	86/86/86/0	
157	100	100/73/46/0	
159	100	59/0/0/0	
160	100	87/72/50/0	
161	100	56/43/43/0	
163	100	74/51/0/0	
161–165	**100**	**63/36/14/0**	**Qc = 4 - 11**; $Q = \frac{63}{9-10} \times \frac{2-3}{2-3} \times \frac{1}{1}$
166	100	36/0/0/0	
167	100	100/88/88/0	
168	100	22/0/0/0	
169	100	70/32/0/0	
171	100	90/72/0/0	
171	100	100/100/0/0	
173	100	84/67/52/0	
171–180	**100**	**92/83/66/22**	**Qc = 6 - 24**; $Q = \frac{92}{6-10} \times \frac{2-3}{2-3} \times \frac{1}{1}$
176	100	97/89/89/36	
178	100	95/90/75/35	
181	100	28/15/0/0	
180,5–184	**100**	**46/22/0/0**	
183	100	85/45/0/0	
184	100	40/0/0/0	
185	100	62/38/38/38	
188	100	53/33/0/0	
189	97	78/78/78/0	
189–200	**99**	**38/20/10/5**	**Qc = 3 - 7**; $Q = \frac{38}{9-10} \times \frac{2-3}{2-3} \times \frac{1}{1}$
191	95	38/0/0/0	
192	85	0/0/0/0	
193	94	15/0/0/0	
194	100	23/0/0/0	
196	100	8/0/0/0	
197	100	41/21/0/0	
199	100	53/44/18/0	

Samples: K-15 / K-16 (158–159 m); K-16 / K-17 (167 m); K-17 / K-18 (176 m); K-18 / K-19 (185 m); K-19 / K-20 (195 m)

Point load / strength tests: 16/52 (153,5 m); 10, 21,0 kN, 125 MPa (154,5 m); 18/26 (172,5 m); 7, 7,0 kN, 40,7 MPa (174 m); 21/28 (178 m); 8, 4,1 kN, 23,6 MPa (179 m)

Perm. (LU) 2,5 5,0 7,5: 1,5-2,5 LU at 157-198,5m. Packed

GWT

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	Fannardalur	Date Sept 2007	Page **5** of **7**
Empl. **VEGAGERÐIN**	**Corehole NF- 02 200 - 250 m**	Design AgG	Drawn AgG / EO
	Coord. X: 735.781,0 Y: 523.298,7 Elev.: 361,4	Driller RFS	Drilled Aug 2007

Description of corehole NF - 02

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
	200	Tholeiite basalt, light-medium grey, extremely hard and brittle, strong basalt, intensely jointed with close and very close joint spacing.	200				***Qc = 3 - 7*** $Q=\frac{38}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		
	202		202	R	100	16/0/0/0			
					100	12/0/0/0			
157,4	204	Scoriaceous basalt, dark grey, moderately strong, very vesicular basalt, dark grey. K-20 / K-21	204		96	60/60/46/0			
	206		206	R			***Qc = 4 - 14*** $Q=\frac{54}{6\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		
	208	Tholeiite basalt, crystalline basalt, medium-dark grey scattered vesicles, coated with black clay, highly jointed.	208		95	0/0/0/0			
		Scoriaceous basalt, dark grey, well compressed and consolidated porous moderately strong rock. Pores are partly filled with various clays. 8 / 3,6 kN / 20,6 MPa			**97**	**54/50/39/0**			
	210	No weakness at the boundary.	210	R	100	81/65/44/0			
149,9					100	77/77/77/0			
	212	Tholeiite basalt, light-medium grey very hard and strong. Moderately to highly jointed in addition to irregular network of thin black veins of joints, healed with black clay.	212		98	61/16/0/0			
		K-21 / K-22					***Qc = 4 - 10*** $Q=\frac{56}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		
	214		214		100	69/0/0/0			
	216		216		**94**	**56/12/0/0**			
	218		218	R	85	40/22/0/0			
		Probably weak boundary							
141,9	220	Scoria - Scoriaceous basalt, dark grey and dark brown, moderately strong. Porous rock. Most pores and vesicles are empty. Core loss.	220	R	32	12/0/0/0			Loss of drilling water
139,6	222	Tholeiite basalt, medium grey in the upper part, then light grey, very hard and strong basalt.	222	R	100	59/0/0/0			
	224	Intensely jointed and slightly tectonized with close spaced irregular net of black veins of healed joints from 223 m to 225 m depth.	224		100	68/63/22/0			**3-4 LU at 198,8-246,5m**
						68/46/6/0			
	226	Tholeiite basalt, light-medium grey, extremely hard and strong but moderately to highly joint. Frequent micro pore flow banded. K-22 / K-23	226		**100**		***Qc = 4 - 11*** $Q=\frac{68}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		
	228		228		100	72/31/0/0			
	230	Irregular pattern of very thin black veins of joints, healed with black clay.	230		100	66/49/0/0			
129,4	232	Scoriaceous basalt, 0.5 m at the base. Layer boundary tuffaceous sediment 0.3 m. Dark brown, waxy surface on core.	232	R	100	83/83/0/0			
		Scoriaceous basalt, dark brownish grey, moderately strong porous rock.			98	84/62/30/0			
	234	K-23 / K-24	234						
	236	Tholeiite basalt, light grey, extremely hard and strong, moderately jointed and frequently micropore flow banded.	236		100	49/21/0/0			
						72/53/28/0			
	238	Several joints probably indicating stress effects.	238		**99**		***Qc = 5 - 12*** $Q=\frac{72}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$		
	240	Light grey extremely hard and strong basalt, with micropore flow banding.	240		100	74/69/37/0			
	242		242		99	83/55/55/0			
		10 / 24,2 kN / 146 MPa K-24 / K-25							
	244		244		100	74/74/0/0			
116,7		Scoriaceous basalt, dark red grey, moderately strong rock. Porous and vesicular, about 15 to 20% vesicles, coated with clay. 8 / 3,3 kN / 18,9 MPa							
	246		246		100	82/60/40/0			Packing
		Tholeiite basalt, light grey, extremely hard and strong, moderately jointed, additionally some irregularly distributed black thin veins of joints healed with chlorophaeite clay.							
	248		248		100	73/43/20/0			
	250		250						

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Empl. VEGAGERÐIN	**Corehole NF - 02 250 - 300 m**	Design ÁgG	Drawn AgG / EO
	Coord. X: 735.781,0 Y: 523.298,7 Elev.: 361,4	Driller RFS	Drilled Aug 2007

Description of corehole NF - 02

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
	250	**Tholeiite basalt,** light grey extremely hard and strong basalt, moderately jointed and several thin black veins of joints healed with chlorophaeite clay. Joints rough, undulating and coated with thin black clay. 6 21,3 kN 127 MPa K-25 K-26	250		100	79/69/18/0			
	252		252		**100**	**74/52/28/0**			
						Qc = 5 - 13			
					100	$Q=\frac{74}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$			
	254		254			75/61/48/0			
	256	Vesicular in the lowest 0.5 m. Sharp boundary with weakness.	256		99	50/0/0/0			
104,6		Sediment 0.2 m, dark brown sandstone and siltstone.			100	71/55/29/0			
	258	**Scoriaceous and vesicular basalt,** dark grey and grey, moderately strong, vesicles about 15%, mostly coated with black clay.	258		**100**	**65/42/26/0**			
						Qc = 5 - 16			
	260	Moderately jointed, joints rough undulating coated with black clay. 10 3,0 kN 17,1 MPa	260		100	$Q=\frac{65}{6\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$			
						59/37/26/0			
99,6		Unclear boundary. K-26 K-27			100	100/0/0/0			
	262	**Tholeiite basalt,** light-medium grey, extremely hard and strong, frequently jointed, joints randomly spaced, rough, undulating, coated with black clay.	262		100	54/28/0/0			
	264		264		**99**	**43/10/0/0**			
						Qc = 3 - 7			
	266	Dyke veins 0.2 m thick (sub horizontal).	266		98	$Q=\frac{43}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$			
						41/0/0/0			
	268	Fair tunnelling rock.	268		100	31/0/0/0			
92,1		Unclear boundary.							
	270	**Scoria - Scoriaceous basalt,** red and dark grey, porous but well compressed and consolidated but breaks up during drilling. K-27 K-28	270		89	14/0/0/0			Serious leakage >>100 LU
					100	44/44/0/0			
	272	**Tholeiite basalt,** medium grey, very hard and strong vesicular basalt. Vesicles 5-10% mainly empty or coated with thin black clay, moderately jointed, joints rough, undulating, coated with black clay.	272		100	29/0/0/0			
					100	35/0/0/0			
	274		274		**98**	**45/6/0/0**			
						Qc = 3 - 8			
					100	$Q=\frac{45}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$			
	276	**Tholeiite basalt,** light grey, very strong.	276			72/0/0/0			
-84,5		Scoriaceous basalt, 0.2 m			100	0/0/0/0			
		Sediment, dark red and green sandstone, weak rock.							
		Basaltic dyke sheet 0.8 m, dark grey strong rock.							
	278	Green tuffaceous sandstone, welded ignimbrite.	278		99	75/51/38/38			
		Sediment - Ignimbrite - Pyroclastic, light green, fragments of a pebble size, angular and subrounded, well cemented of various origin, welded ignimbrite, moderately strong rock. 8 4,7 kN 27,1 MPa K-28 K-29							
	280		280		100	99/99/99/99			
	282	The rock mass is moderately strong to strong sedimentary rock with very few original joints.	282						
		Probably favourable tunnelling rock if not prone to very high stress. 11 5,1 kN 29,4 MPa			100	97/97/97/97			
	284	Very few steeply inclined joints, rough, undulating.	284		**100**	**92/87/85/85**			
	286		286			***Qc = 5 - 15***			
					100	$Q=\frac{92}{6\text{-}9}x\frac{2\text{-}3}{3\text{-}4}x\frac{1}{1}$			
		9 5,5 kN 31,8 MPa							
	288		288			87/87/87/87			
		K-29							
	290	Welded ignimbrite. K-30	290		100	98/98/98/98			
	292	**Sandstone,** light green, stratified, moderately strong to strong rock. Probably partly welded 9 7,6 kN 44,2 MPa	292		100	94/85/85/85			
67,3	294	**Sediment, tuffaceous claystone,** very dark brown, waxy surface on core, very weak rock. Weak sandstone in the lower part. Core loss	294		100	100/0/0/0			
66,2					77	43/0/0/0			
	296	**Scoriaceous basalt,** vesicular basalt, dark grey and very vesicular in the topmost 2 m but then grey, hard and strong **Tholeiite basalt,** zeolites up to 0,7 m from the dyke.	296		100	51/30/0/0			
64,0									
	298	**Basaltic dyke - Sill,** dark grey very strong rock. Two short (0.2 and 0.3 m) parts of tholeiite basalt inside the dyke near its boundary. The dyke is a subhorizontal sheet. K-30 K-31	298		100	80/70/56/0			
	300		300						

Permeability at 246,8-298,5m depth. The pump could not build up a pressure at 550 L/min

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Empl. VEGAGERÐIN	**Corehole NF - 02 300 - 306,5 m**	Design ÁgG	Drawn AgG / EO
	Coord. X: 735.781,0 Y: 523.298,7 Elev.: 361,4	Driller RFS	Drilled Aug 2007

Description of corehole NF - 02

Sill - Sub horizontal basaltic dyke-sheet, dark grey very strong, relatively coarse grained with small pores and micro pores. Few scattered joints, rough undulating, coated with thin black clay (chlorophaeite).

6 12,7 kN 74,7 MPa

5 14,2 kN 83,8 MPa

Bottom of hole 29. August 2007.

The drilling rods were stuck in the hole, as a result of drilling difficulties. Later the rods were blasted apart.

Sediment, dark brown red and green.

Bottom of hole 10. Sept. 2007.

Core %: 100 / 100 / 100

RQD % 10 / 30 / 50 /100: 86/77/42/42 | **68/61/34/11** | 92/85/32/0

Qc: ***Qc = 4 - 11***

$$Q = \frac{68}{9\text{-}10} \times \frac{2\text{-}3}{2\text{-}3} \times \frac{1}{1}$$

Elev. 54,9 m a.s.l.

Perm. (LU) 2,5 5,0 7,5

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Empl. **VEGAGERÐIN**	**Corehole NF - 03 0 - 15,8 m**	Design AgG/TW	Drawn AgG / EO
	Coord. X: 735.603,3 Y: 523.222,9 Elev.: 371,5	Driller RFS	Drilled Sept 2007

Description of corehole NF - 03

371,5 m a.s.l. / 0 m

The hole is drilled vertically with odex bit and cased with 3,5" casing down to 9 m depth.

Holes NF-03 and NF-04 are drilled at the same location.

Core drilling with NQ triple tube core barrels, 44,5 mm core.

362,5 m a.s.l. / 8 m

Unconsolidated talus material stones of various size and various types of basaltic rock, core stumps of various porosity. K-1

Some 0,2 m core stump of cemented brownish debris, all other fine material is washed away.

Small eroded fragments of basalt.

Top of bedrock.

356,5 m a.s.l. / 14 m

Sediment, very dark green claeyous sandstone/siltstone of very low strength. Waxy core, week rock K-1

355,7 m a.s.l. / 15,8 m

Drilling cancelled owing to drilling difficulties.
Bottom of hole 4. Sept 2007.

Depth m	Core %	RQD % 10 / 30 / 50 /100	Qc
10	70	18/0/0/0	
	32	13/0/0/0	
	0	0/0/0/0	
12	67	46/0/0/0	
	30	0/0/0/0	
	21	0/0/0/0	
14	0	0/0/0/0	
	57	0/0/0/0	
	36	18/0/0/0	
	88	0/0/0/0	

GWT

Perm. (LU) 2,5 5,0 7,5

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Empl. **VEGAGERÐIN**	**Corehole NF - 04 0 - 49 m**	Design AgG/TW	Drawn AgG / EO
	Coord. X: 735.603,3 Y: 523.222,9 Elev.: 371,5	Driller RFS	Drilled Sept. 2007

Description of corehole NF - 04

371,5 m a.s.l. — 0 m

The hole is drilled vertically with odex bit and 3,5" steel casing to 18 m depth

The hole is located at the same site as NF-03

Not obvious where the hole enters the bedrock. Possibly around 15 m depth

Core drilling with NQ triple tube core barrel, diameter of core 44,5 mm.

353,5 — 18 m

Scoria, mixed with red sandstone, red and dark red moderately strong rock — K-1 — 12 — 2,2 kN — 12,5 MPa

20 m

Scoriaceous basalt, and porous basalt varying in colour, grey and dark purple, moderately strong and strong zones

Scoriaceous top zone of a complex andesitic rocks, rich of scoria zones. The crystalline part is highly jointed, jointsare rough, undulating coated with green clay

24 m

Sudden increase in zeolite fillings vesicles and pores half filled with zeolites

Very vesicular dark grey basalt, moderately strong

26 m

Tholeiite basalt - basalt andesite, medium grey, hard and strong basalt with varying ammount of vesicles (about 3 to 6%). Joints are closely spaced, rough, undulating, coated with green clay. Most vesicles half filled with zeolites — K-1 / K-2

341,5 — 30 m

~~Sediment-Sandstone, with few pebbles, well cemented~~

Scoriaceous basalt, medium to dark grey, moderately strong rock. Vesicular basalt, porosity about 10 to15%, almost all pores and voids filled with white zeolites. Relatively competent tunnelling rock — 9 — 2,7 kN — 15,4 MPa

34 m

More crystalline, hard andesite rock. Closely spaced network of thin white veins of joints healed with zeolites. Almost all joints and voids are filled with zeolites — K-2

38 m — K-3

Scoriaceous basalt, medium and dark grey, very strong, moderately and closely spaced joints, rough, undulating. Porous zones with intense zeolite filling. Porosity varying from 3 to over 10%

42 m

Andesite, medium grey, extremely hard and brittle basalt. Joints closely and very closely spaced, rough, undulating coated with hard black and grey clay.

44 m

Great part of the rock is intensely jointed, possibly by former stress.

46 m — K-3 / K-4

The rock contains scattered xenolites

323 — 48 m

Bottom at 48,5 m depth. 5th Sept 2007

50 m

Depth m	Core %	RQD % 10 / 30 / 50 /100
18	86	58/0/0/0
	100	90/31/0/0
20	97	90/74/25/0
22	62	39/21/21/0
		58/28/9/0
		Qc = 4 - 9
24	**90**	$Q=\frac{58}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$
	98	69/35/0/0
26	100	70/34/0/0
28	100	10/0/0/0
	100	42/0/0/0
30	100	56/0/0/0
32	100	86/70/51/0
34	100	78/58/47/0
		70/49/30/0
36	**96**	***Qc = 5 - 12***
		$Q=\frac{70}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$
38	88	55/23/0/0
40	97	62/53/25/0
42	100	0/0/0/0
	93	16/0/0/0
	81	0/0/0/0
44	**85**	**2/0/0/0**
	98	0/0/0/0
	95	0/0/0/0
	94	0/0/0/0
46	27	0/0/0/0
	85	0/0/0/0
48	67	0/0/0/0
50		

Qc = 0,1 - 0,4

$Q=\frac{10}{18\text{-}20}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{2,5}$

GWT

Perm. (LU) 2,5 5,0 7,5

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Empl. **VEGAGERÐIN**	**Corehole NF - 05 0 - 27 m**	Design AgG / TW	Drawn AgG / EO
	Coord. X: 735.411,9 Y: 523.316,5 Elev.: 379,6	Driller RFS	Drilled Sept 2007

Description of corehole NF - 05

Elev. m a.s.l.	Depth m	Description		Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
380	0	The hole is drilled inclined 30° from vertical towards the slope							
	2	Percussion drilling with odex bit and 3,5" casing to 9 m depth.							
	4								
	6								
		Most probably top of bedrock at sedimentary rock							
	8								
372,2		Sediment, stratified sandstone-siltstone, weak rock	K-1		98	36/0/0/0			
					87	33/0/0/0			
371,4	10	Porphyritic basalt, very vesicular at the top. Vesicles half filled or coated with black clay and zeolites			67	0/0/0/0			
					97	80/40/0/0			
	12	Porphyritic basalt, medium grey, very hard and strong, plagioclase phenocrystals about 10% less than 4 mm in size. Moderately jointed, joints rough, undulating, coated with black and green grey clay.				**69/42/15/0**			
					97		***Qc = 5 - 12***		
						$Q=\frac{69}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$			
	14	Brown alteration zones into the rock at some joints.			100	84/84/50/0			
					96	61/38/0/0			
	16	Possibly a thin dyke at the layer contact.	K-1		100	71/0/0/0			
					100	0/0/0/0			
365,3					100	0/0/0/0			
		Sediment, claystone, red and green, stratified, very weak, waxy surface on core. Numerous joints with slicken sides. Glossy waxy surface on the core. The sediment breaks up during drilling and handling.	K-2		100	0/0/0/0			
	18				100	47/0/0/0			
						28/0/0/0			
					91	**26/0/0/0**			
	20	The sediment is mainly consisting of basaltic tuffs but compressed and altered to claystone.			**91**				
					86	22/0/0/0			
		Core loss at the base of sediment			67	0/0/0/0			
361,1	22	Scoria-Scoriaceous basalt, dark grey and brown grey containing claystone in filling			97	73/48/31/0			
						77/45/15/0			
	24						***Qc = 5 - 14***		
		Tholeiite basalt, grey, very hard and strong. Few vesicles filled with black clay. Joints rough, undulating and coated with black clay			95	$Q=\frac{77}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$			
	26	Core loss 30 cm				81/42/0/0			
		Scoriaceous basalt at the base	K-2						
356,2	28	Bottom of hole at 27,53 m depth. September 2007							
	30								
	32								
	34								
	36								
	38								
	40								
	42								
	44								
	46								
	48								
	50								

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Empl. VEGAGERÐIN	**Corehole NF - 06 0 - 50 m**	Design AgG/TW	Drawn AgG / EO
	Coord. X: 736.533,5 Y: 523.527,5 Elev.: 237,81	Driller RFS	Drilled Oct 2007

Description of corehole NF - 06

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
237,81	0	Drilled vertically in a steep slope with moraine and moss on the surface.	0						
	2	Percussion drilling with odex bit and cased with 3,5"steel casing to 12 m depth	2						
	4		4						
	6		6						
	8		8						
	10		10						
		Core drilling with NQ triple tube core barrels, core diameter 44,5 mm							
225,7	12	**Scoriaceous basalt,** red brown, medium strong rock but highly jointed K-1	12		24	0/0/0/0			
					85	17/0/0/0			
	14	**Tholeiite basalt,** medium grey, strong rock but highly jointed. Vesicular and porous rock, almost scoriaceous zones with up to 15% vesicles. Vesicles almost empty or coated with black clay.	14		92	32/0/0/0			
	16	Obviously highly permeable rock.	16						
					93	71/12/0/0			
	18		18						
					74	31/0/0/0			
	20		20						
					26	10/0/0/0			
	22		22						
		K-1 / K-2			100	69/65/0/0			
	24		24						
					50	0/0/0/0			
	26	**Scoriaceous basalt,** grey and brown, strong porous rock. 12 / 5,0 kN / 28,8 MPa Vesicles are almost empty or coated with black clay.	26		100	82/69/69/0			
	28	Unclear boundary.	28		100	28/0/0/0			
		Scoriaceous basalt, grey, and dark red brown, well compressed and consolidated, strong rock.			100	84/39/39/0			
	30	Diffuse boundary.	30		**100**	**59/24/11/0**	***Qc = 4 - 10*** $\frac{59}{9\text{-}10} \times \frac{2\text{-}3}{2\text{-}3} \times \frac{1}{1}$		
		Tholeiite basalt, grey, very hard and brittle, strong basalt but highly jointed and with zones of crusted basalt, also thin black veins of joints, recemented with black clay.			100	54/24/0/0			
	32	K-2 / K-3	32		100	31/0/0/0			
		The basalt is highly jointed (tectonized) and joints partly recemented.			100	0/0/0/0			
	34	**Scoriaceous basalt,** dark grey and red brown, well compressed and consolidated strong rock.	34		100	89/69/48/0			
	36	10 / 10,1 kN / 59 MPa	36		100	100/100/0/0		GWT at 69 m hole depth	
		Tholeiite basalt, grey, very hard and brittle strong rock, micropore flow banded.			100	21/0/0/0			
	38		38		100	67/19/0/0			
	40	The basalt is highly jointed in addition to a thin black veins pattern of joints, healed with black clay. Joints, rough, undulating, coated and filled with black clay. Widespread pattern of thin black veins of healed joints, caused by tectonic stress.	40		100	27/0/0/0			
					100	83/43/24/0			
	42	K-3 / K-4	42						
		Thin frequent micropore flow banding			100	57/0/0/0			
	44		44						
	46	5 / 17,0 kN / 101 MPa	46		100	68/0/0/0			
190,51		Sandstone, dark brown, weak			75	0/0/0/0			
	48	**Scoriaceous basalt,** grey and brown, varying between tholeiite and scoriaceous basalt, moderately strong but intensely jointed intact rock	48		93	17/0/0/0			
					71	0/0/0/0			
	50	Core loss,	50		64	0/0/0/0			

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Empl. **VEGAGERÐIN**	**Corehole NF - 06 50 - 100 m**	Design AgG/TW	Drawn AgG / EO
	Coord. X: 736.533,5 Y: 523.527,5 Elev.: 237,81	Driller RFS	Drilled Oct 2007

Elev. m a.s.l.	Depth m	Description of corehole NF - 06	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
	50		50		81	24/0/0/0			
	52	Scoriaceous - Tholeiite basalt, grey and brown, moderately strong but highly jointed and erodes during drilling	52		33	0/0/0/0			
		Core loss K-4 K-5			100	92/66/66/0			
	54		54		100	43/0/0/0			
	56	Tholeiite basalt, light grey, extremely hard and strong, moderately jointed basalt.	56		100	65/18/18/0			
						49/26/15/0			
		Micropore flow banded. Joints are rough, undulating, coated with black clay.			**83**		***Qc = 3 - 8***		Problem with packing
	58		58				$Q=\frac{49}{9-10}x\frac{2-3}{2-3}x\frac{1}{1}$		
					100	88/48/20/0			
	60		60						
		7 23,8 kN 142 MPa			100	87/69/69/0			**> 50 LU at pumping test**
	62	Diffuse boundary, no weakness.	62						
		Scoriaceous basalt, grey-brown. K-5 K-6			100	73/58/0/0			
	64	Core loss, fragments of scoria with open pores, probably high permeability. Possibly tectonized zone. Loss of drilling water	64		46	17/0/0/0			
	66	Tholeiite basalt, grey, very strong, with about 3% vesicles, filled with black clay and zeolites. Irregularly spaced black veins of joints which are healed with black clay.	66		84	55/41/0/0			
	68		68		100	24/0/0/0			
168,61		Sediment, brown tuffaceous sandstone, weak rock Shrinks during drying			78	0/0/0/0			
	70	Bottom of the hole 69,21m on 5th October 2007	70						
	72		72						
	74		74						
	76		76						
	78		78						
	80		80						
	82		82						
	84		84						
	86		86						
	88		88						
	90		90						
	92		92						
	94		94						
	96		96						
	98		98						
	100		100						

Jarðfræðistofan Ehf
JFS Geological services Ltd

Empl. VEGAGERÐIN

Norðfjarðagöng

Fannardalur
Corehole NF - 07 0 - 50 m

Coord. X: 737 583,8 Y: 523 285,9 Elev.: 259,1

JFS-74 | Drwg. A-9a
Date Sept. 2012 | Page 1 of 3
Design ÁgG | Drawn ÁgG / SK
Driller RFS | Drilled July 2008

Elev. m a.s.l.	Depth m	Description of corehole NF - 07	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
259,1	0	The hole is drilled in a steep slope just below cliffs	0						
	2	Percussion drilling with 3 1/2" casing down to 7.35 m depth. No core from this part of the hole	2						
	4		4						
	6	Core drilling with NQ core from 7,35 m depth	6						
251,7	8	**Tholeiite basalt**, medium grey, very hard and strong but highly jointed, fine crystal grains, vesicles about 3%, <5 mm some micropore flow bonding. Joints medium to closely spaced, rough, undulating, coated with thin brown clay. Brown alteration colour at joints indicates permeable rock	8	R	75 100 **91** 100 100	10/0/0/0 66/66/0/0 **29/13/0/0** 24/0/0/0 47/0/0/0			
	10		10					30 m	
	12	**Scoriaceous basalt**, red and grey, moderately strong, porous rock. Vesicles and voids about 10%, open pores, coated with thin green and black clay. Joints closely to medium spaced	12	R R	100 **100** 100	54/0/0/0 **45/0/0/0** 24/0/0/0			
	14	**Tholeiite basalt**, grey, hard but very porous, moderately strong. At 14 m core loss. Brown alteration colour indicates permeable rock K-1 K-2	14		41	8/0/0/0			
	16	**Tholeiite basalt/basalt-andesite**, grey, extremely hard, strong intact rock but intensely jointed, joints closely and very closely spaced, undulating, coated with brown and black clay. Very fine grained crystals	16	R R	93 96 **79** 100	0/0/0/0 6/0/0/0 **8/0/0/0** 17/0/0/0			
	18	**Scoriaceous basalt**, dark brown and grey, moderately strong, very well compressed and consolidated, porous rock but half of the pores filled with various clays	18	R	100 **100** 100	0/0/0/0 **67/67/67/0** 104/104/104/0			
	20	**Tholeiite basalt**, grey, very fine-grained crystals, very hard and strong intact rock but highly jointed. Joints closely to very closely spaced, rough, undulating, coated and filled with black clay K-2 K-3	20	R	62 94	0/0/0/0 15/0/0/0	***Qc = 1 - 4*** $Q=\frac{22}{9-10}x\frac{2-3}{2-4}x\frac{1}{1}$		
	22		22		**92** 100	**22/0/0/0** 34/0/0/0			
236		Core loss at layer contact							
	24	**Sedimentary rock**, tuffaceous sandstone at top, coarse grained sandstone and fragments of gravel-size. UCS=28 MPa. Green fine-grained colourful conglomerate with tuffaceous sandy matrix, well cemented, moderately weak and weak rock which breaks up during drilling and handling. TS=2,6 MPa. TS=3,1 MPa.	24		16 100 **82**	0/0/0/0 57/0/0/0 **50/5/0/0**	***Qc = 0,3 - 1*** $Q=\frac{50}{6-9}x\frac{1-2}{3-4}x\frac{1}{5}$		
	26		26						
	28	Dark grey and green sediment, with fragments of small pebble size cemented in dark sandy matrix. Moderately weak and weak rock. UCS=31 MPa. TS=3,4 MPa. K-3 K-4	28		100 74	16/0/0/0 135/32/0/0		54 m	
	30	**Ignimbrite**. Light green welded sediment, probably pyyroclastic flow. Angular fragments of various rock types and different shape. Cemented in tuffaceous sandy matrix. Moderately strong to strong rock.	30	R	51 98	51/0/0/0 47/13/0/0			
	32		32	R	**94**	**51/14/0/0**	***Qc = 1,5 - 5*** $Q=\frac{51}{6-9}x\frac{1-2}{3-4}x\frac{1}{1}$		
	34	Loss of part of the drilling water	34		97	72/0/0/0			Loss of drilling water
	36	**Ignimbrite**, light green welded sedimentary rock, consisting of fragments of various origin and shape, well cemented in sandy matrix, moderately strong intact rock but frequently jointed and even crust zones. K-4 K-5	36		100 99	57/0/0/0 22/0/0/0			
	38	UCS=59 MPa. 12 3,7 kN 21,2 MPa	38		96	64/42/0/0			
	40	More loss of part of the drilling water at 43 m depth. Lower limit of welded ignimbrite K-5 K-6	40		98 98 100	51/27/0/0 0/0/0/0 0/0/0/0			Loss of drilling water
	42	**Sediment**, green stratified sandstone, moderately weak and weak rock. Sediment varies in grain size between silt and coarse grained sand with very small pebbles in tuffaceous matrix. Moderately strong rock. UCS=25 MPa. TS=6,8 MPa. More loss of drilling water. Sharp boundary	42		100 **100** 100	39/0/0/0 **51/14/0/0** 61/25/0/0	***Qc = 0,3 - 1***		
215,3	44	**Scoriaceous basalt**, dark grey and brownish grey, very porous, moderately weak rock. 15-20% vesicles, <10 mm about half filled with black and green clay. The rock breaks up during drilling and handling	44	R	100 **100**	60/20/0/0 **43/16/5/0**			>15 LU at 3-4 bar
	46		46	R	100	0/0/0/0			
	48	**Basalt-andesite**, dark grey (on a broken surface) very fine-grained, extremely hard, brittle and strong intact rock but highly jointed. Joints medium and closely spaced, rough, undulating, coated and filled with black clay. K-6 K-7. 8 27,1 kN 162 MPa	48	R	100 100 **100**	46/29/29/0 48/19/0/0 **43/16/5/0**	***Qc = 3 - 8*** $Q=\frac{43}{9-10}x\frac{2-3}{2-3}x\frac{1}{1}$	60,5 m	
209,1	50								

Jarðfræðistofan Ehf / JFS Geological services Ltd	Norðfjarðargöng	JFS-74	Drwg. A-9b
	Fannardalur	Date Sept. 2012	Page **2** of **3**
Empl. **VEGAGERÐIN**	**Corehole NF - 07 50 - 100 m**	Design AgG	Drawn AgG / SK
	Coord. X: 737 583,8 Y: 523285,9 Elev.: 259,1	Driller RFS	Drilled July 2008

Description of corehole NF-07

Elev. m a.s.l.	Depth m	Description	Depth	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
	50	The rock is very hard and brittle and intensely jointed near the base	50	R	100	68/22/0/0			Loss of drilling water
	52	Sharp boundary, weakness at the contact UCS=307 MPa	52	R	100	35/0/0/0		##,## m	
205,8				R	100	0/0/0/0			
	54	**Sediment-ignimbrite**, green, moderately strong to strong, welded. pyroclastic rock Fragments of various origin from angular and subangular, welded from sandy tuffaceous matrix K-7 K-8 10 4,3 kN 25 MPa UCS=11 MPa UCS=20 MPa	54		100	57/0/0/0			>15 LU at 3-4 bar
					100	52/31/17/0			
					96	**64/41/36/30**			
	56		56			***Qc = 0,7 - 3*** $Q=\frac{64}{6-9}x\frac{1-2}{3-4}x\frac{1}{2,5}$			
	58		58		100	72/61/61/61			
	60	14 4,7 kN 27 MPa K-8 K-9 Lower limit of welded ignimbrite Weakness at layer contact	60		100	93/93/93/93			
					68	52/0/0/0			
	62	**Sandstone** - dark grey and green, moderately weak and weak, poorly cemented coarse grained sandstone, weak to moderately weak rock TS=2,4 MPa	62		29	22/0/0/0			
					100	65/55/0/0			
	64	**Conglomerate**, fragments of various shape and different rock types. Green sandy matrix, moderately strong rock UCS=14 MPa 11 2,1 kN 11,9 MPa UCS=31 MPa TS=3,0 MPa	64		96	92/68/52/0			
					89	**68/41/27/0**			
						Qc = 0,7 - 3 $Q=\frac{68}{6-9}x\frac{1-2}{3-4}x\frac{1}{2,5}$			
	66	**Sandstone** with scattered pebbles in a sandy matrix, stratified sandy and silty, clayous zones Weak rock TS=0,8 MPa	66		96	47/29/29/0			
	68	K-9 K-10 Sharp boundary	68		100	80/0/0/0			
189,8									
	70	**Tholeiite basalt, scoriaceous basalt,** medium grey, moderately strong, very porous and vesicular, vesicles about 20% , half filled with black clay Strong contact	70		100	57/0/0/0			>>30 LU at 4 bar
					100	86/72/63/38			
					100	**57/43/33/20**			
	72	**Basaltic dyke**, medium grey, very hard and strong, moderately jointed, possibly a dyke sheet	72	N		***Q = 4 - 10*** $Q=\frac{57}{9-10}x\frac{2-3}{2-3}x\frac{1}{1}$			
					99	31/16/0/0			
	74	The basalt is highly jointed in the lower part Sharp boundary K-10 K-11	74		100	0/0/0/0			
					100	43/0/0/0			
	76	**Sediment,** tuffaceous sandstone-siltstone, clayous weak rock. TS=2,5 MPa Stratified brown/grey claeyous tuffaceous, weak to very weak not sharp boundary	76		**100**	**77/19/0/0**			
					100	88/25/0/0			
182,1									
	78	**Scoriaceous basalt,** dark grey, very well compressed and consolidated, medium strong-strong rock 8 4,1 kN 23,6 MPa	78	N	100	67/67/67/67			
					98	58/30/0/0			
	80	**Tholeiite basalt,** medium-dark grey, very hard and brittle, very strong intact rock. Joints moderately to closely spaced, rough, undulating, coated with black clay K-11 K-12	80	N	**98**	**65/42/16/11**			
						Q = 4 - 10 $Q=\frac{65}{9-10}x\frac{2-3}{2-3}x\frac{1}{1}$			
	82		82		100	68/63/0/0			
	84	Joints moderately and closely spaced, coated and cemented with black clay, additionally a pattern of thin black veins og joints healed with black clay UCS=345 MPa 10 21,9 kN 131 MPa	84		100	111/60/60/0			>>40 LU at 4 bar
					93	53/15/0/0			
	86	Diffuse boundary	86		100	0/0/0/0			
					100	18/0/0/0			
	88	**Scoriaceous basalt**, dark grey and redbrown, very well compressed and consolidated, moderately strong rock. Very few original joints but breaks during drilling and handling K-12 K-13 9 5,1 kN 29,4 MPa	88	N		***Qc = 5 - 20*** $Q=\frac{79}{6-10}x\frac{2-3}{2-3}x\frac{1}{1}$			
					100	**79/72/63/63**			
	90	90,3 m Open joints and coreloss, the rock seems to be crushed by tectonic and recemented. Heavy leakage from the hole	90		100	91/86/86/86			
168,4					100	108/108/0/0			
	92	**Tholeiite basalt**, medium grey, very hard and brittle, very strong intact rock, but highly jointed. About 3-5% vesicles filles with black clay. Zones with close micropore flowbanding	92		86	58/23/23/0			
	94	K-13 K-14	94		95	43/0/0/0			>30 LU at 4 bar
		Intensely jointed and crushed rock							
	96	Compedent massive basalt, widely spaced joints, rough undulating coated with black clay	96		100	48/39/39/0			
					100	94/44/64/39			
	98	Compedent massive basalt, widely spaced joints, rough undulating coated with black clay. Vesicles 2-4%, filled with black clay, faint micripore flow banding 7 25,1 kN 150 MPa	98	N	**97**	**61/35/29/8**			
						Qc = 4 - 11 $Q=\frac{61}{9-10}x\frac{2-3}{2-3}x\frac{1}{1}$			
159,1	100	K-14	100						

Jarðfræðistofan Ehf / JFS Geological services Ltd	Norðfjarðagöng	JFS-74	Drwg. A-9c
	Fannardalur	Date July 2008	Page **3** of **3**
Empl. **VEGAGERÐIN**	**Corehole NF - 07 100 - 129,4 m**	Design AgG	Drawn AgG / SK
	Coord. X: 737 583,8 Y: 523285,9 Elev.: 259,1	Driller RFS	Drilled July 2008

Description of corehole NF-07

Elev. m a.s.l.	Depth m	Description	Depth	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
159,1	100	**Tholeiite basalt**, light grey core, very hard and strong intact rock but very brittle, vesicles 2-3% filled with black clay. K-15	100		100	68/51/17/0			
	102		102		**97**	**61/35/29/8**			
		Subvertical and steeply inclined joints, joints rough, undulating, coated with black clay The basalt is intensely jointed over the base		N	100	35/22/0/0			
	104		104		100	54/54/54/0			
153,8		**Scoriaceous basalt**							
	106	UCS=67 MPa UCS=36 MPa UCS=36 MPa TS=9,7 MPa **Sediment sandstone-conglomerate**, red brown, moderately strong, fragments of various rock types, mainly angular. 10 6,6 kN 38,3 MPa K-15	106		100	100/100/100/100			
					100	**74/54/49/49**			
						Qc = 4 - 8			
	108	Well cemented in sandy matrix. Very few original joints K-16 UCS=27 MPa TS=7,2 MPa	108			$Q=\frac{74}{6-9}x\frac{2-3}{3-4}x\frac{1}{1}$			**>>30 LU at 4 bar**
	110	**Sediment**, tuffaceous claystone,vaxy surface on core, stratified of various colour, brown and green. Light green zone of pumic 0,4 m, weak, vaxy rock TS=1,0 MPa UCS=14 MPa	110			***Qc = 0,4 - 1,6***			
					99	51/11/0/0			
	112	**Scoriaceous basalt**, dark purple-brown, well compressed and consolidated, moderately strong rock About 10% pores, half filled with zeolites 9 4,5 kN 25,9 MPa K-16	112	N	100	0/0/0/0			
					100	93/93/93/93			
					100	**76/69/61/61**			
	114	K-17	114			***Qc = 5 - 16***			
		Tholeiite basalt, medium grey, very hard, brittle and strong intact rock, moderately to highly jointed, joints rough			100	42/23/0/0			
	116	**Sediment**, dark brown tuffaceous claystone, very weak and erodes during drilling 10 1,8 kN 10,2 MPa UCS=27 MPa UCS=28 MPa	116		73	0/0/0/0			
						Qc = 0,6 - 1,4			
		Sandstone-agglomerate, dark brown tuff, sandy matrix with various fragments of pebbles, moderately weak rock TS=2,3 MPa TS=1,0 MPa				$Q=\frac{54}{6-9}x\frac{1-2}{3-4}x\frac{1}{2,5}$			
	118	Brown and green tuffaceous claystone, weak and very weak vaxy rock UCS=4 MPa UCS=9 MPa UCS=8 MPa	118		**90**	**54/39/39/39**			
140,1					100	85/61/61/61			
		Scoriaceous basalt, dark grey, well compressed and consolidated, mainly moderately strong with some weak zones			100	56/22/0/0			
	120		120	N	**100**	**73/47/24/0**			
		K-17			100	91/73/48/0			
		K-18							
	122	**Tholeiite basalt**, light grey core, very hard and strong but brittle	122		96	60/0/0/0			
					100	98/98/98/0			
	124	Intensely jointed zone, crushed rock	124		100	12/0/0/0			
		More competent rock			100	64/24/24/0			
	126	Joints medium to closely spaced, in addition to thin black veins of joints, healed with black clay K-18 K-19	126	N	**98**	**65/28/28/0**			
						Qc = 4 - 11			
	128	Joints rough, undulating, coated with black clay. Vesicles 1-3% filled with black clay Very few joints in the lowest part of the hole 8 19,8 kN 118 MPa	128			$Q=\frac{65}{9-10}x\frac{2-3}{2-3}x\frac{1}{1}$			
129,7					97	79/29/29/0			
	130	Bottom of hole 124,43 m 10th of July 2008	130						
	132		132						
	134		134						
	136		136						
	138		138						
	140		140						
	142		142						
	144		144						
	146		146						
	148		148						
	150		150						

Jarðfræðistofan ehf
JFS Geological services Ltd

Empl. VEGAGERÐIN

Norðfjarðargöng

Fannardalur

Corehole NF - 08 0 - 42,5 m

Coord. X: 737 910,2 Y: 523 419,6 Elev.: 175,8

JFS-74	Drwg. A-10a		
Date Agust 2008	Page 1 of 1		
Design AgG	Drawn AgG /SK		
Driller RFS	Drilled July 2008		

Description of corehole NF - 08

Elev. m a.s.l.	Depth m	Description	Depth m	Rock column	Core %	RQD % 10 / 30 / 50 /100	Qc	GWT	Perm. (LU) 2,5 5,0 7,5
175,8	0	The hole is drilled at the base of a steep slope Percussion drilling with 3 1/2 " steel casing down to 6,2 m depth No core from this part of the hole	0					##,#m	
	2		2						
	4		4						
		Rock surface near 5 m depth Core drilling with NQ core barrel from 6,2 m							
169,8	6	**Tholeiite basalt**, medium grey (light grey core), very hard and strong intact rock but highly jointed with medium to very close joint spacing. Joints rough undulating, coated with black clay. Small pores 2-3% filled with black clay. Micropore flow banding, closely spaced flow bands	6		100	19/0/0/0			
					100	0/0/0/0			
	8		8	N	100	33/0/0/0			
		9 22,2 kN 132 MPa			**43**	**14/3/0/0**			
	10		10		100	56/27/0/0			
					0	0/0/0/0			
					0	0/0/0/0			
	12	**Sediment**, clayeous siltstone-sandstone, weak and very weak, dark red and brown at top but mainly green voxy clayeous, tuffaceous rock	12		71	7/0/0/0			
		K-1			**77**	**16/0/0/0**			
		K-2			100	29/0/0/0			
162	14	**Scoriaceous basalt**, dark grey and dark red grey, very well compressed and consolidated moderately strong rock	14		100	92/62/62/62			
		8 2,5 kN 14,2 MPa							
	16		16	R	**100**	**79/44/44/18**			
					100	82/53/53/0			
		Porous scoriaceous basalt				***Qc = 5 - 26***			
	18		18			$Q=\frac{79}{6\text{-}10}x\frac{2\text{-}4}{2\text{-}3}x\frac{1}{1}$			
		Unclear boundary K-2			100	52/0/0/0			
	20	**Tholeiite basalt**, medium grey, very hard and strong but highly jointed and broken at subvertical joints K-3	20		100	0/0/0/0			
		9 23,9 kN 143 MPa			**100**	**48/41/25/0**			
					100	61/48/48/0			
	22		22		100	89/89/0/0			
					100	**80/33/0/0**			
		7 4,4 kN 25,3 MPa							
	24	**Tholeiite basalt** K-3	24		100	109/0/0/0			
		K-4							
	26	**Tholeiite basalt**, medium grey, porous and vesicular moderately strong rock. Pores and vesicles 10-15%, half filled with black clay The basalt is highly jointed, joints mainly closely spaced, rough undulating, coated with black clay	26	R	100	48/24/0/0			
					100	73/32/0/0			
	28	Scoriaceous zones like this, is common in tholeiite for central volcanoe type	28		100	58/53/26/0			
		Tholeiite basalt, medium grey, porous and vesicular moderately strong rock. Pores and vesicles 10-15%, half filled with black clay				***Qc = 3 - 8***			
	30		30			$Q=\frac{46}{9\text{-}10}x\frac{2\text{-}3}{2\text{-}3}x\frac{1}{1}$			**2,5 LU at 4 bar**
		8 20,1 kN 120 MPa							
	32	Scoriaceous zone	32	R	**100**	**46/32/10/0**			
		Vesicular basalt			100	55/29/18/0			
	34	Scoriaceous zone	34		100	41/17/0/0			
		Tholeiite basalt, medium grey, porous and vesicular moderately strong rock. Pores and vesicles 10-15%, half filled with black clay and white zeolites							
	36		36		100	9/0/0/0			
		Basaltic dyke, hard and strong intact rock, medium grey, 1-2% small vesicles filled with black clay			100	0/0/0/0			
	38	Joints medium to closely spaced, undulating, coated with black clay	38		100	79/25/0/0			
		Faint subvertical micropore flow banding			100	47/37/0/0			
	40	9 22,6 kN 135 MPa	40	A					
					100	90/70/24/0			
133,3	42	Bottom of hole at 42,53 m depth 13th of July 2008	42						
	44		44						
	46		46						
	48		48						
	50		50						