JARÐHITALEIT Á AUSTURLANDI Í 25 ÁR

Ómar Bjarki Smárason

STAPI ehf - Jarðfræðistofa

INNGANGUR UM WALKER

- George Patrick Leonard Walker fæddist 2. mars 1926.
- Hann ólst upp í Middlesex til 12 ára
- 1939 flutti fjölskyldan til Norður Írlands
- BSc frá Queens University í Belfast 1949
- PhD frá University og Leeds 1956
- Kom fyrst til Íslands 1954 og hér samfellt til 1965
- Imperial College (1953?), Nýja Sjáland (1978), Hawaii frá 1980-1996.
- Lést 17. janúar 2005

Walker tjaldar, líklega við Sandá 1954

PZ-19 í vandræðum

George og Leonard Walker 1977

George og Leonard Walker 1977

Með Walker á Ströndum 1977

George Walker við Ófærufoss 1977

George og Leonard við jökulsporð 1977

Walker tekur öskulagasýni við Hvolsvöll 1980

Steve Self og Steve Sparks að störfum

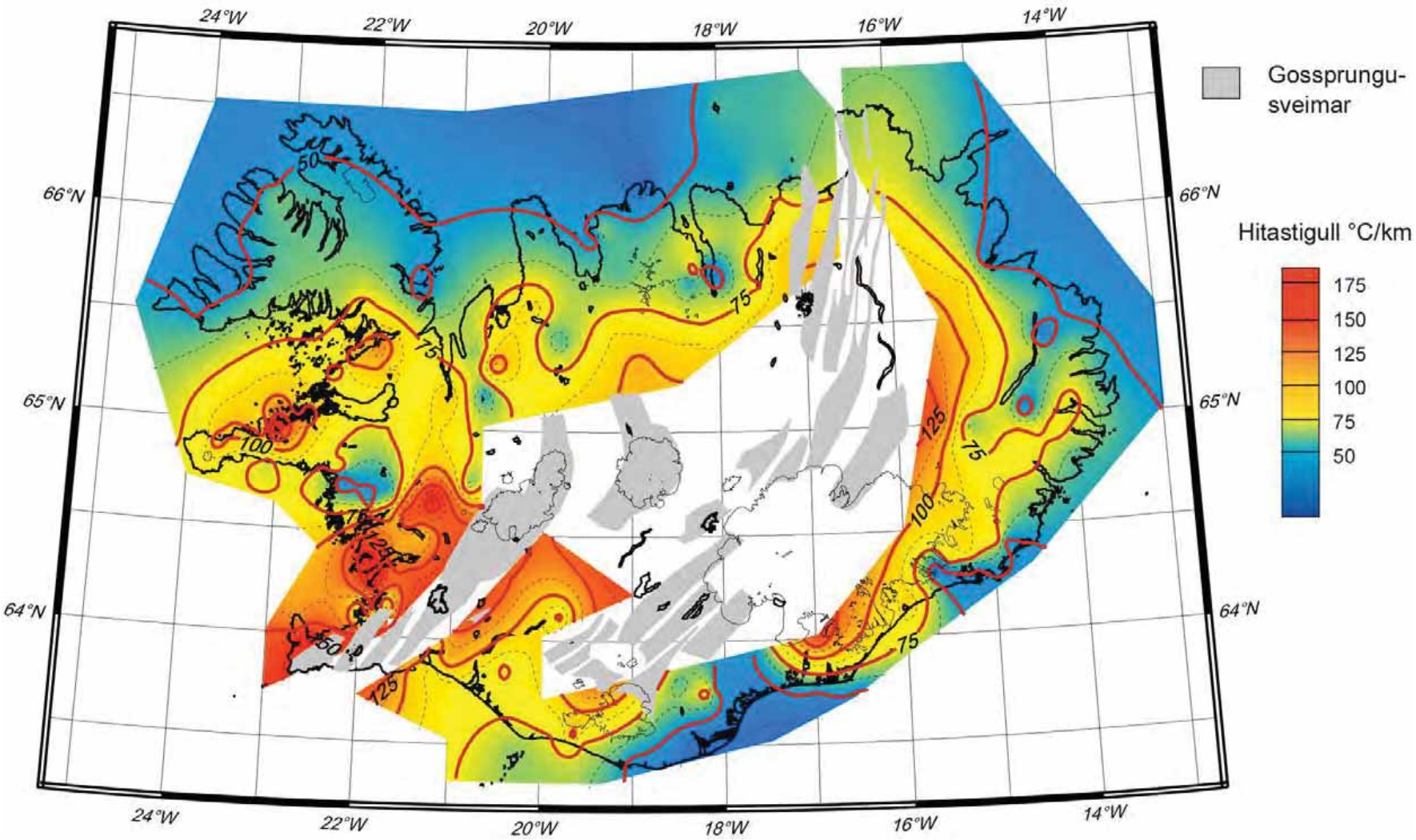
TESCO

THE GEORGE WALKER RESEARCH CENTRE

Jarðhitaleitin á Austurlandi

- Hitaveita Egilsstaða og Fella: Stofnuð 1979 (Viðnám 1982)
- Stapi kom að jarðhitaleit fyrst 1994 og átak hófst 1999
- Holur um 50 m djúpar, eða a.m.k. 40 m í klöpp
- Hitamælingar gefa hitastigulsferil
- Hitastigull framreiknaður í 1 km dýpi
- Hitastigull gefinn í °C/km
- Svæðishitastigull á Austurlandi er 50-60°C/km
- Eða 5-6°C hækkun fyrir hverja 100 m
- Tvöföldun á svæðisstigli (>120°C/km) bendir til nýtanlegs jarðhitakerfis fyrir hitaveitur

Austurland var talið kalt svæði



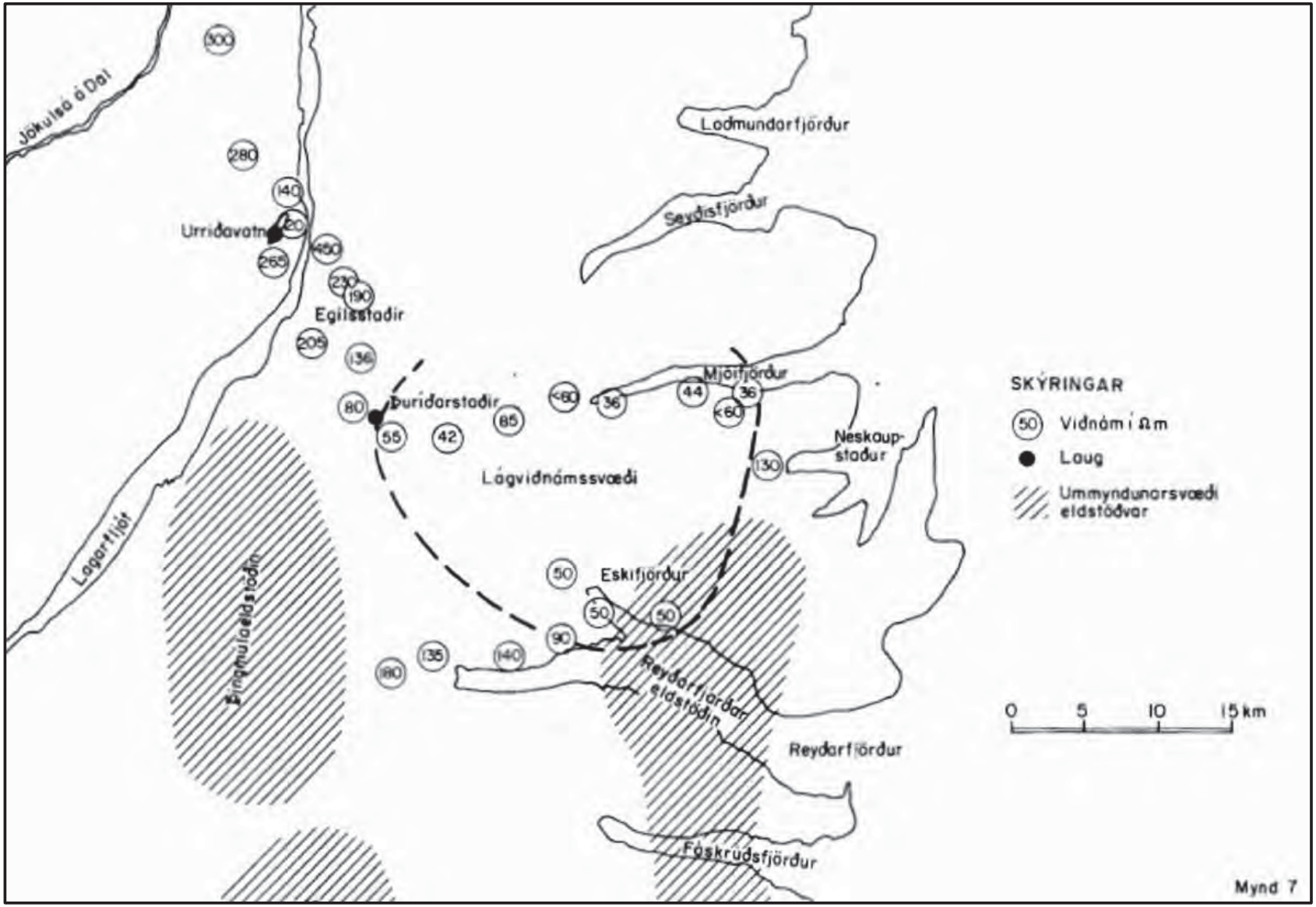
Þekktir jarðhitastaðir á Austurlandi

- Urriðavatn: 76°C í borholum
- Eskifjörður: 81°C í borholum
- Reyðarfjörður: >48°C og efnahiti >60°C í borholum
- Selárdalur í Vopnafirði: 51,8°C í borholu FN-1
- Djúpivogur: >45°C og efnahiti 75°C í holu VF-28
- Hvammsheiði í Svalbarðshreppi: 29°C volgra og hiti 30°C í 300 m djúpri holu
- Fljótsdalsheiði - Laugará
- Þuríðarstaðir í Eyvindarárdal?
- Á Geithúsárdal í Reyðarfirði er sögð vera volgra

Þekktir jarðhitastaðir á Suðausturlandi

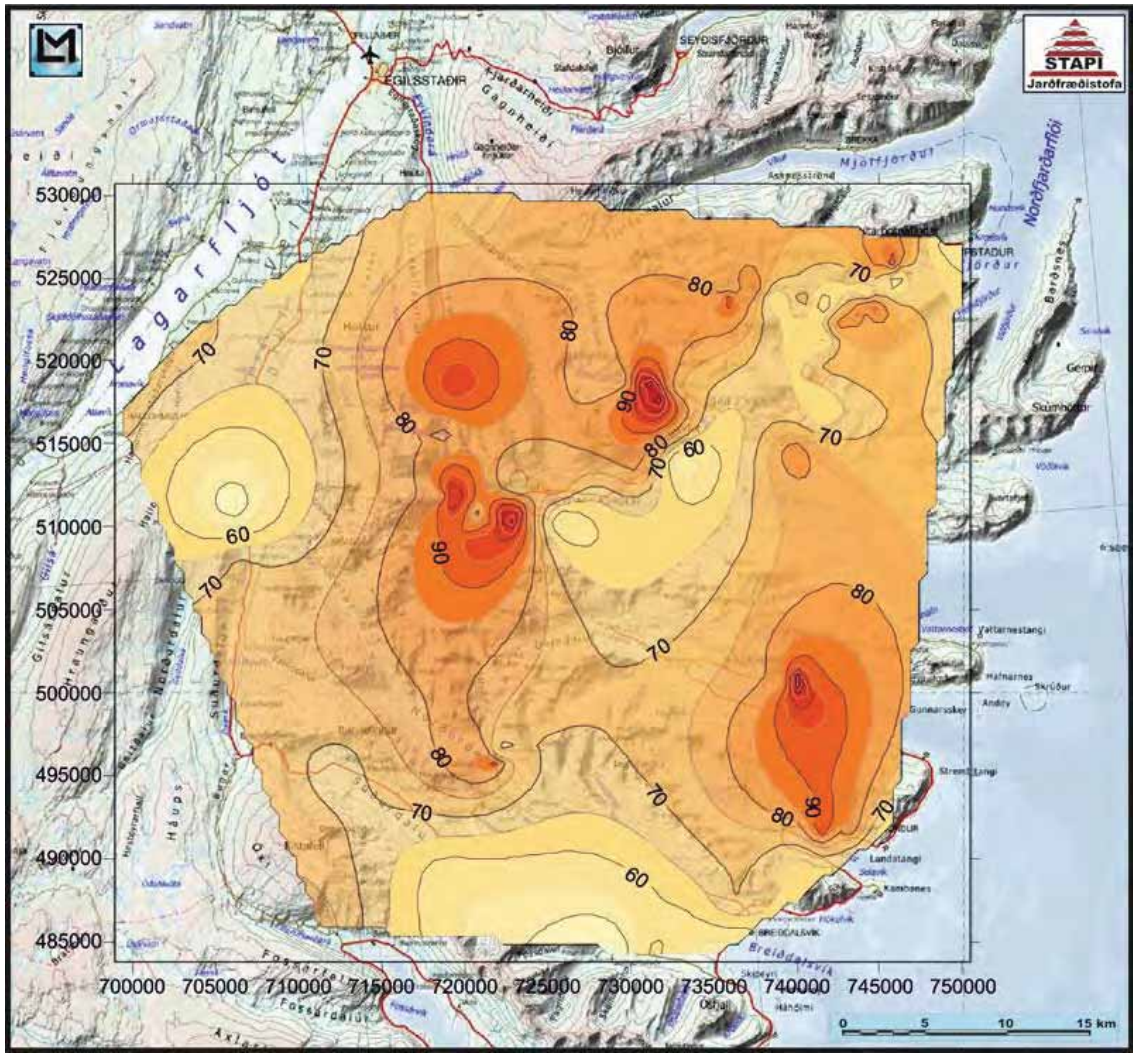
- **Hali í Suðursveit: >108°C og efnahiti bendir til yfir 100°C vatnskerfis**
- **Hoffell í Nesjum: 80°C og efnahiti 80°C**
- Vatnsdalur á Mýrum: 50°C og efnahiti 75°C
- Vandræðatungur í Nesjum: 60°C
- Kálfafellsdalur: >60°C
- **Skaftafell: >65°C og efnahiti >70°C**
- Jökulfell í Öræfum: 60-75°C

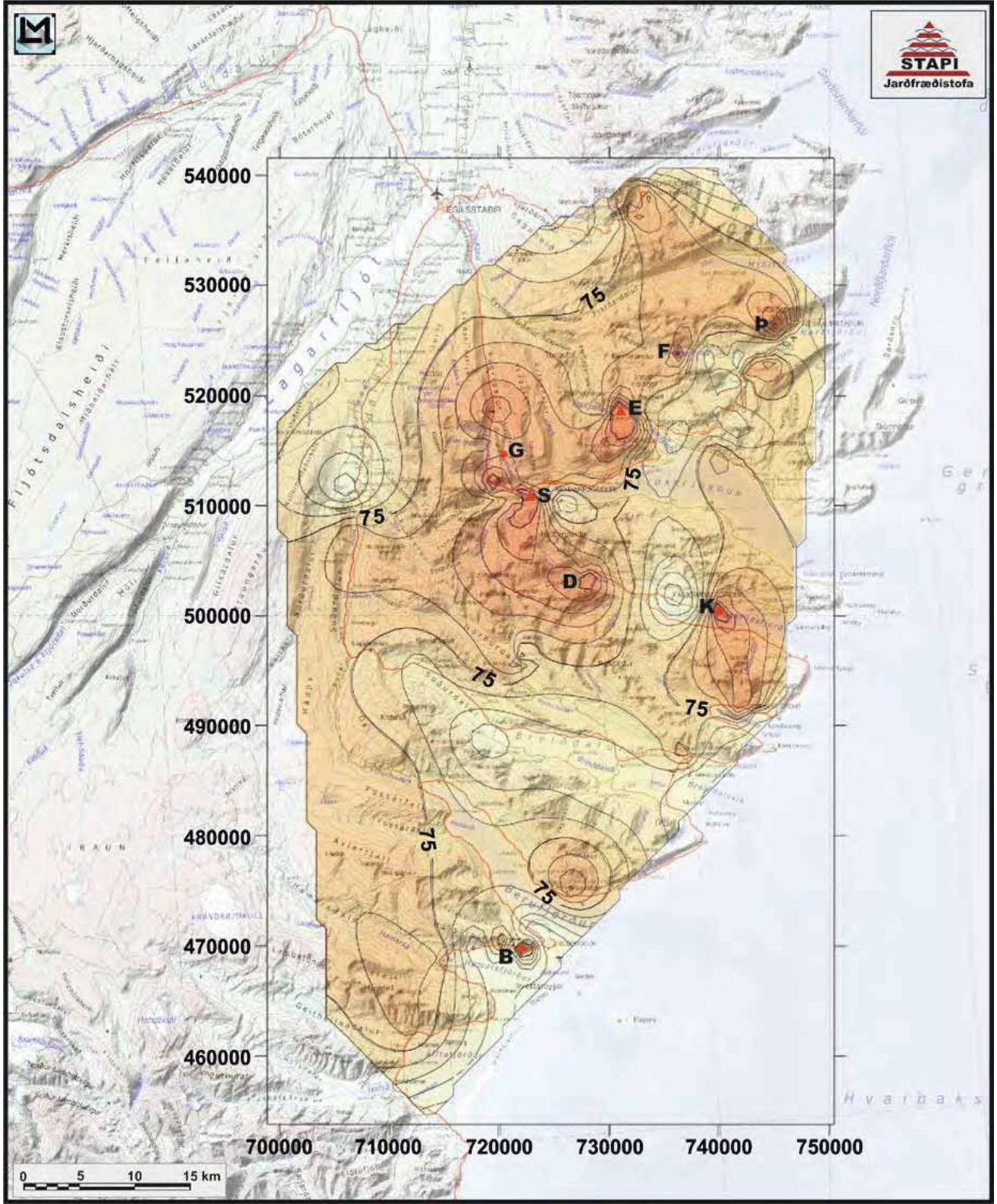
Viðnámsmælingar 1975



STAPI
Jarðfræðistofa

Hitastigull á Austfjörðum

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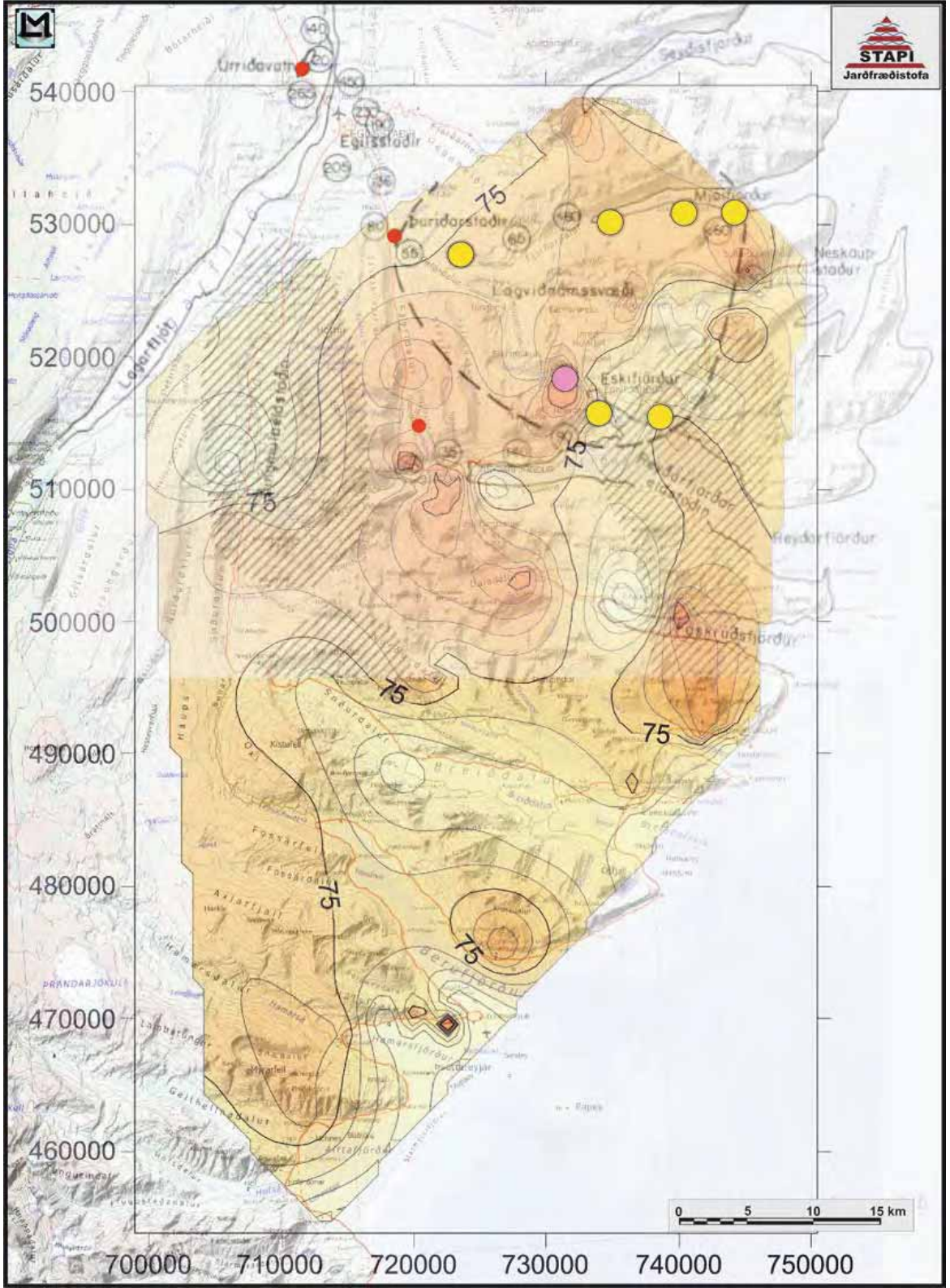
0 5 10 15 km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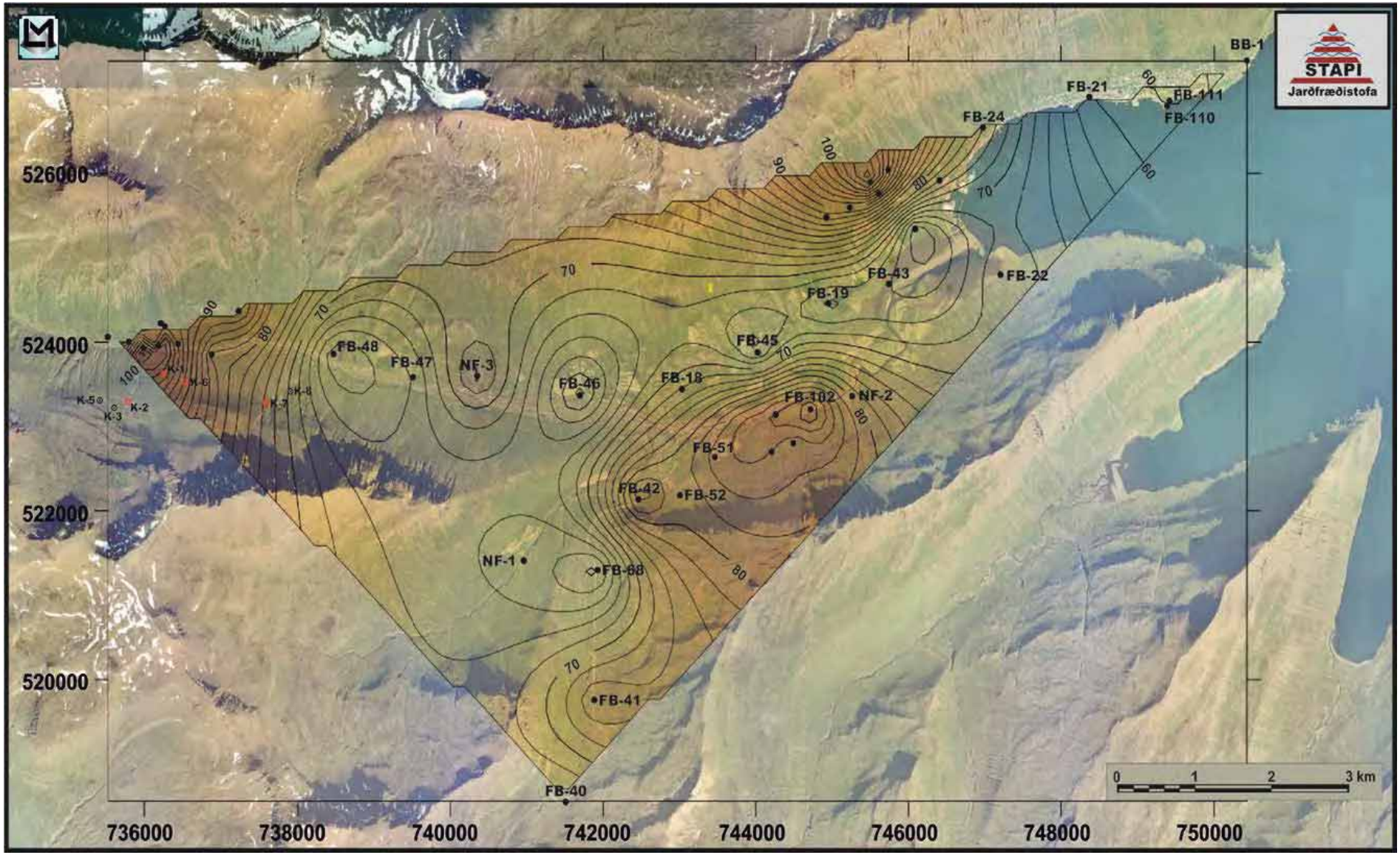
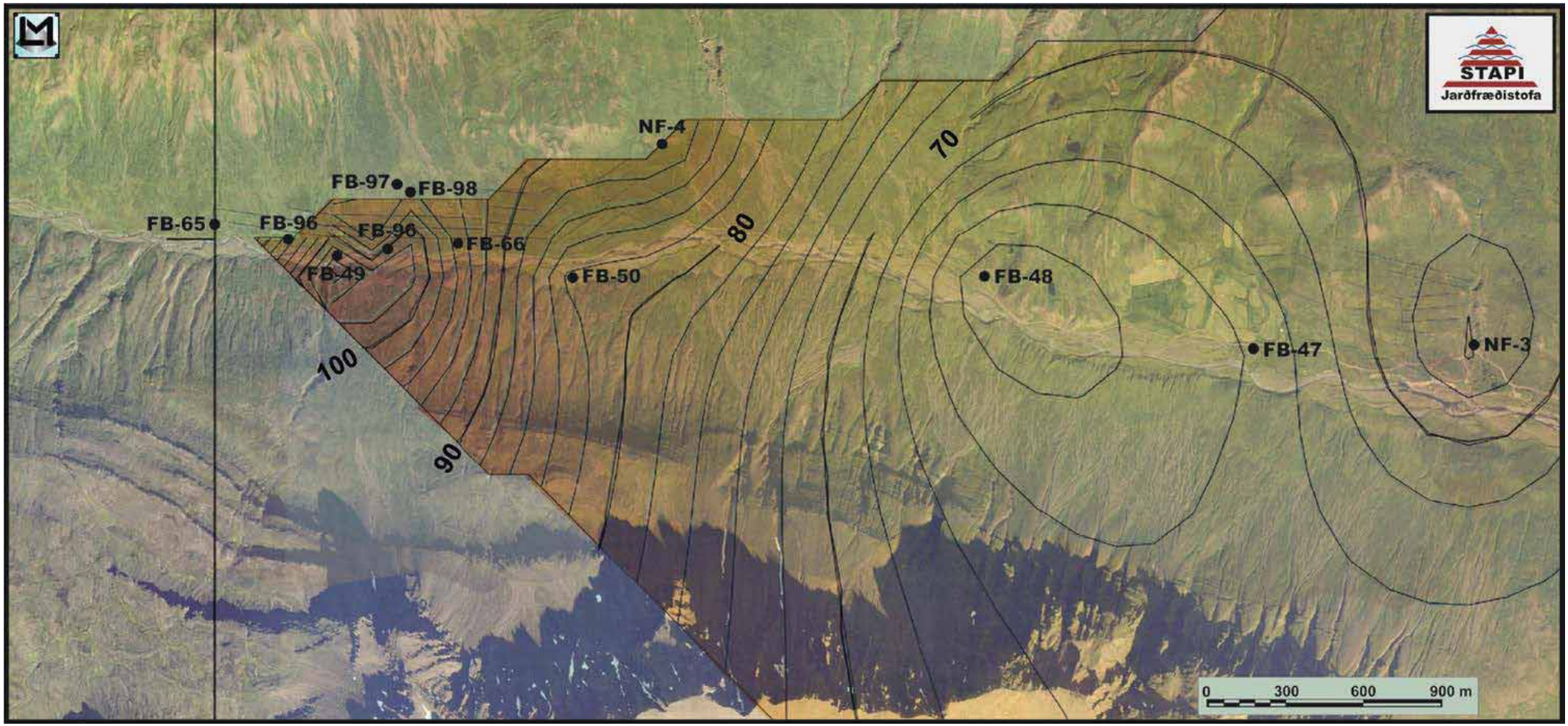
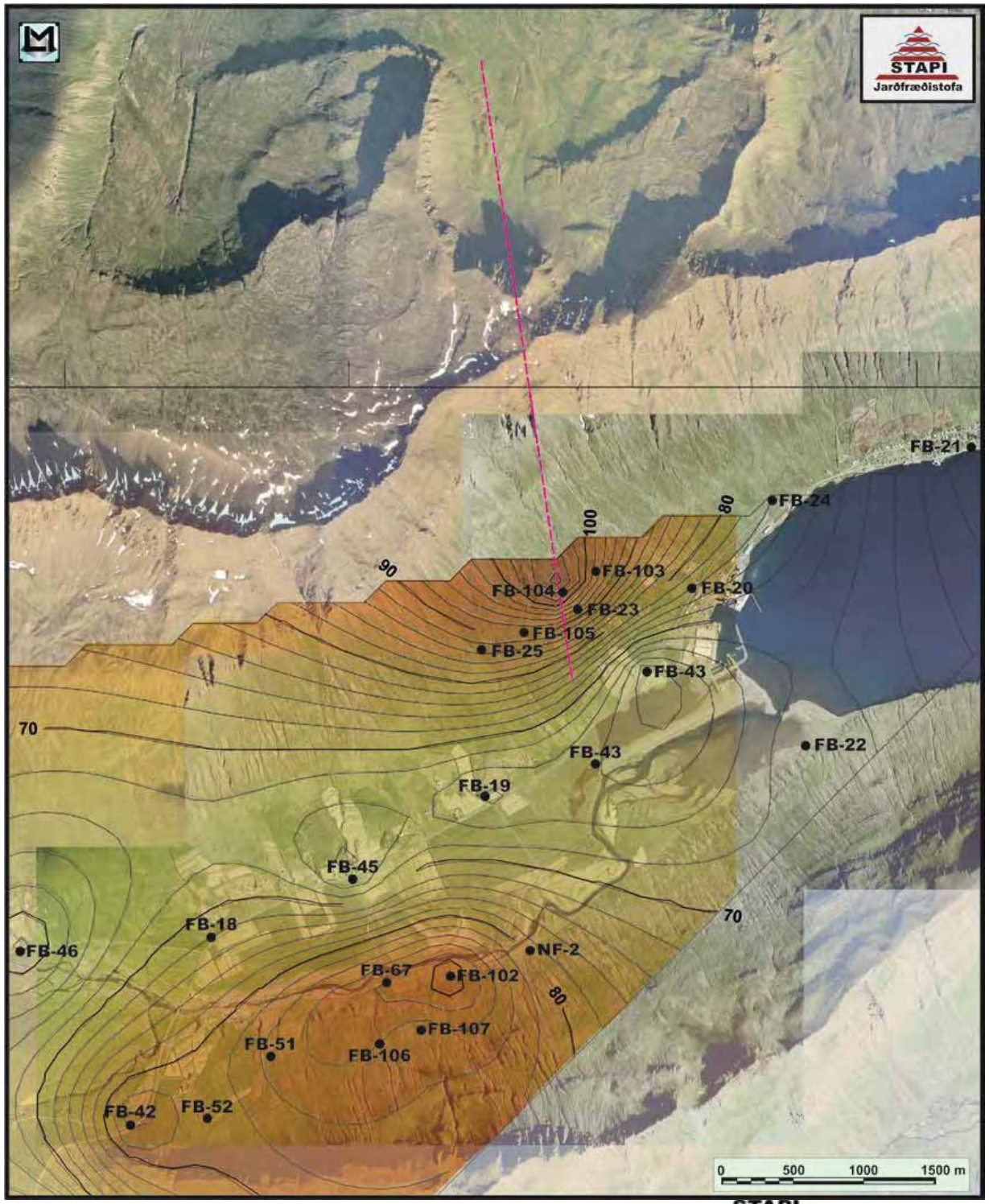
750000
75
Egilsstaðir
Eskifjörður
Reyðarfjörður
Fáskrúðsfjörður
0 5 10 15 km

Norðfjörður - Hitastigull

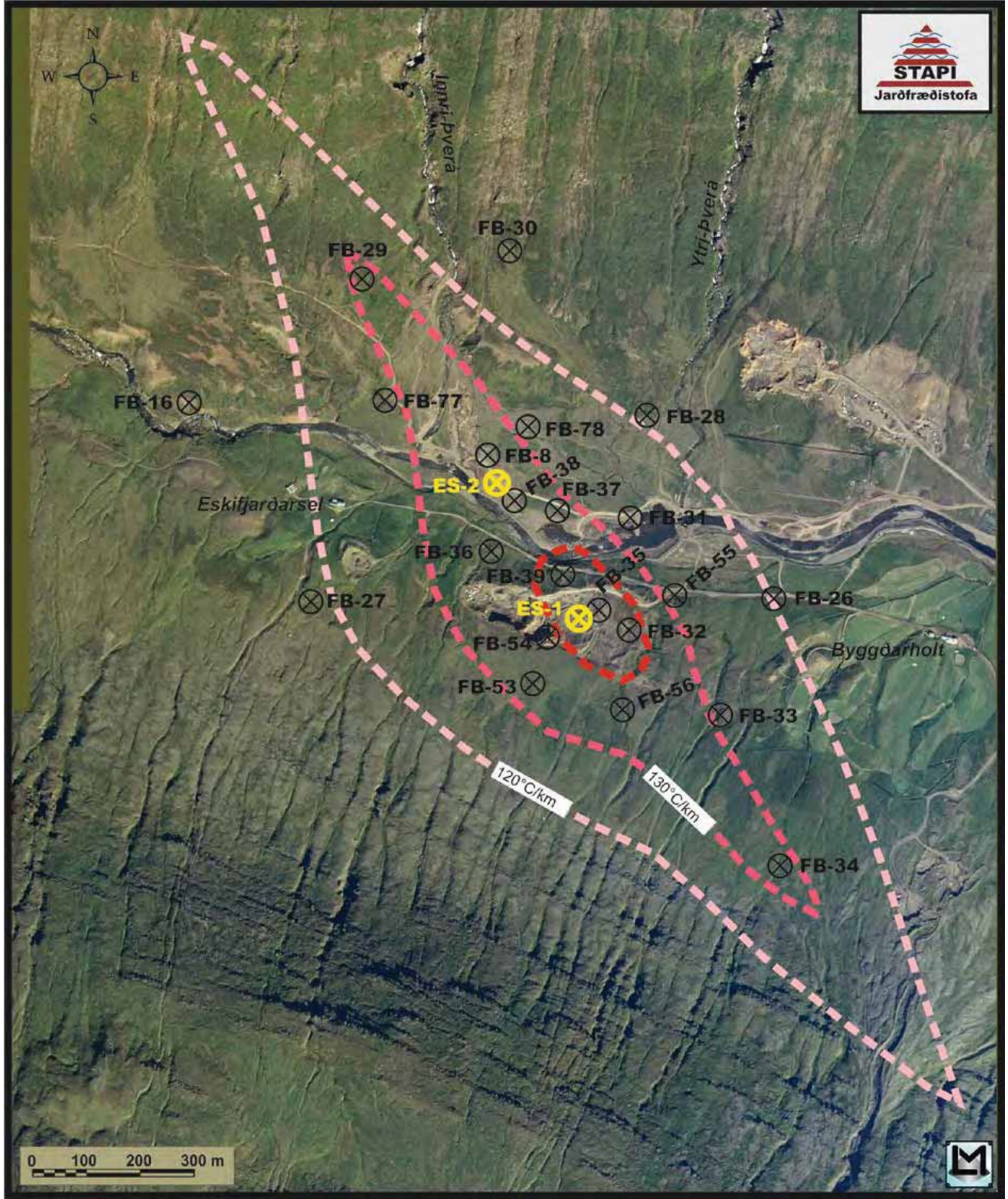


Fannardalur - Hitastigull

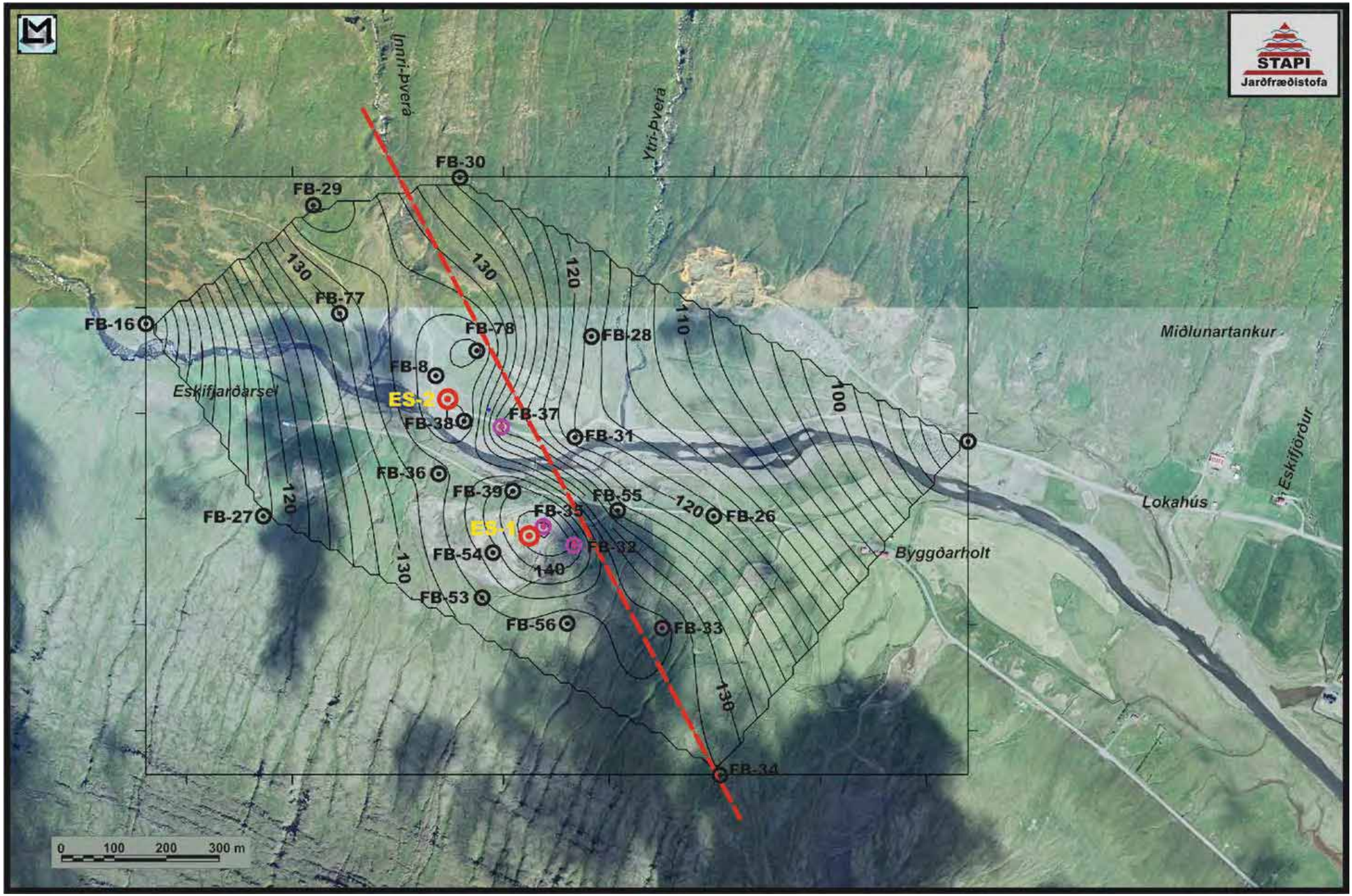




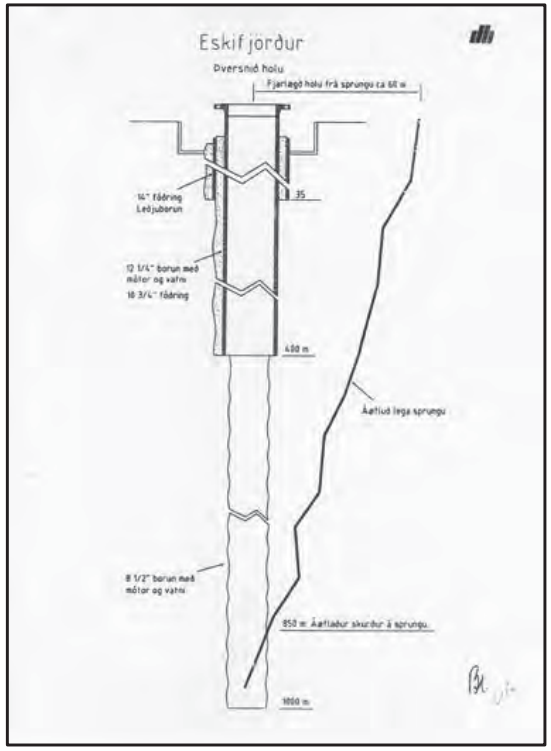
Norðfjörður - hitastigull



Eskifjörður – borholur og hitastigull


STAPI
Jarðfræðistofa
Innri-Þverá
Ytri-Þverá
FB-30
FB-29
FB-77
FB-16
FB-78
FB-28
FB-8
ES-2
FB-38
FB-37
FB-31
Eskifjarðarsel
FB-36
FB-39
FB-55
FB-35
FB-26
FB-27
ES-1
FB-32
FB-54
FB-53
FB-56
FB-33
FB-34
130
120
110
100
140
Miðlunartankur
Eskifjörður
Lokahús
Byggðarholt
0 100 200 300 m

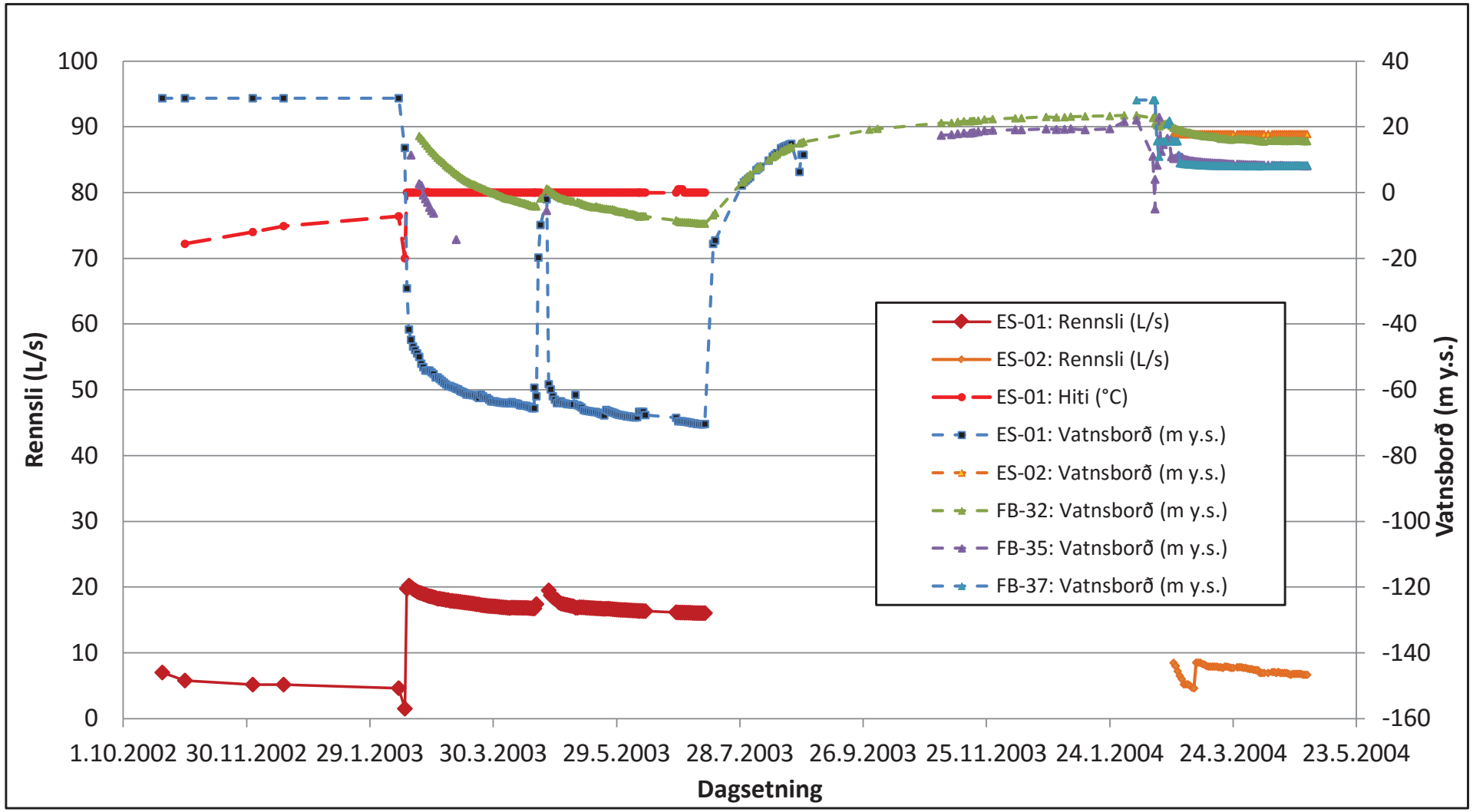
Sleipnir á holu ES-1 á Eskifirði, 2002



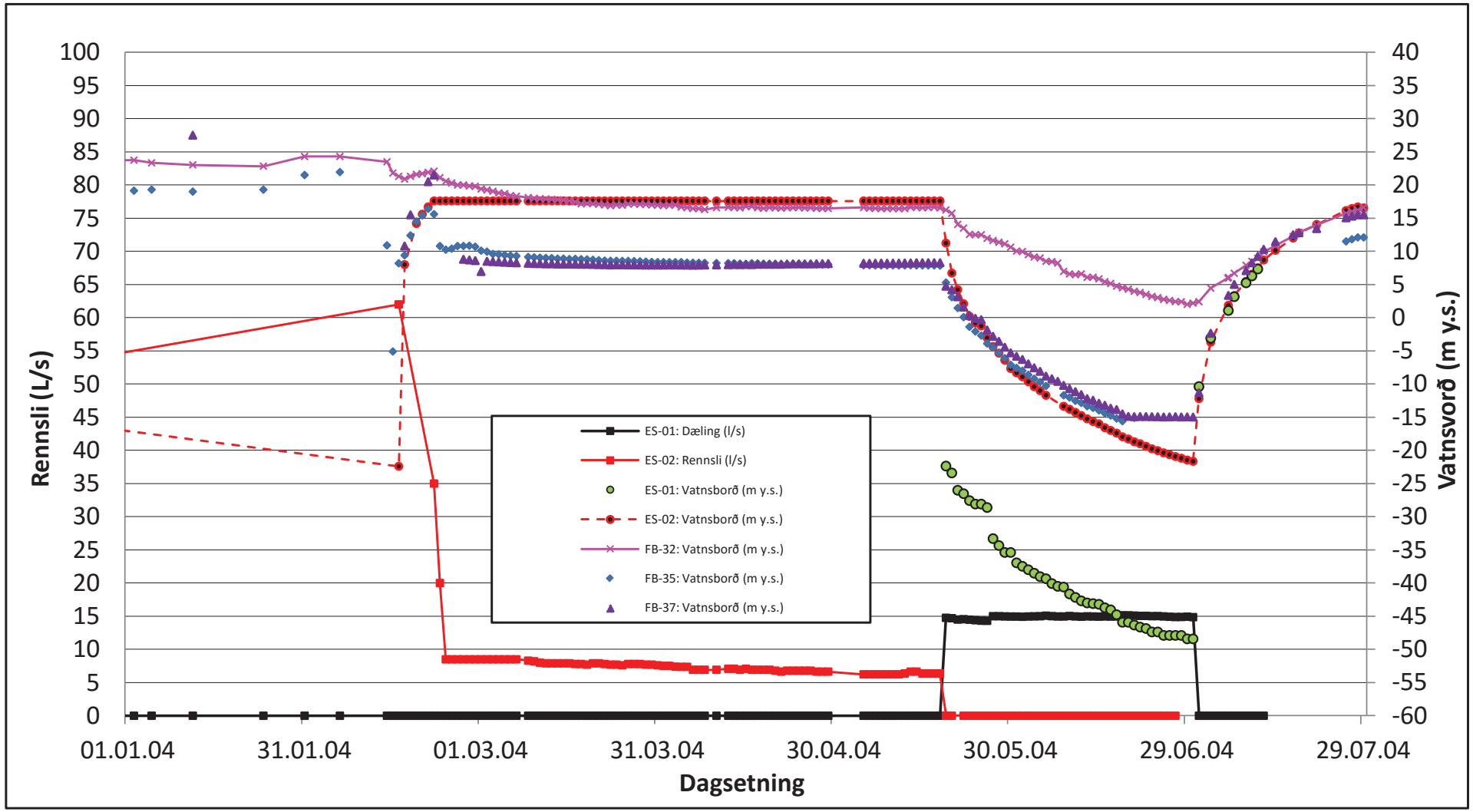
Dælan í holu ES-2

Niðursetning dælu í holu ES-1, febrúar 2003

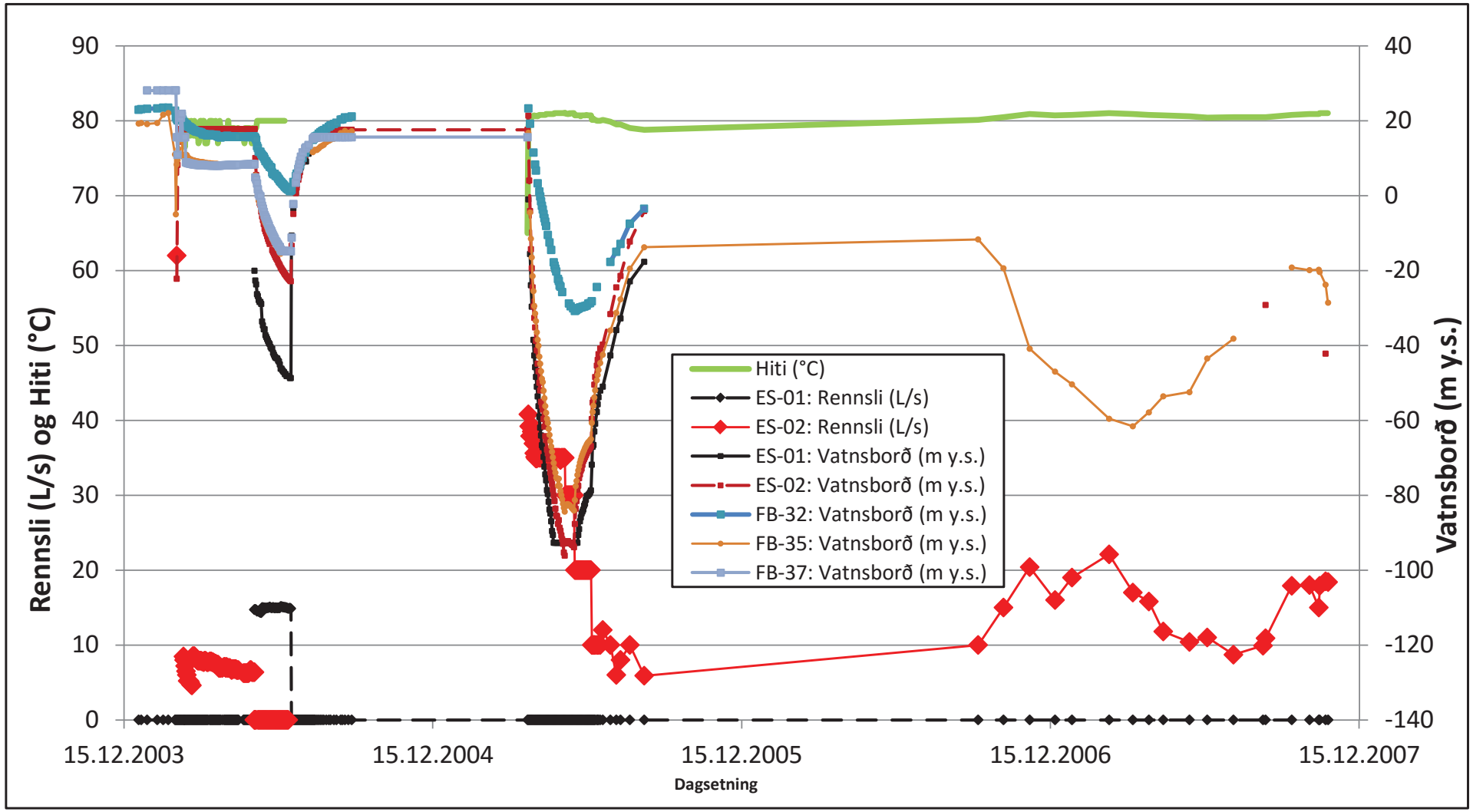
Dæluprófun: Rennsli og Vatnsborð 2002-2004



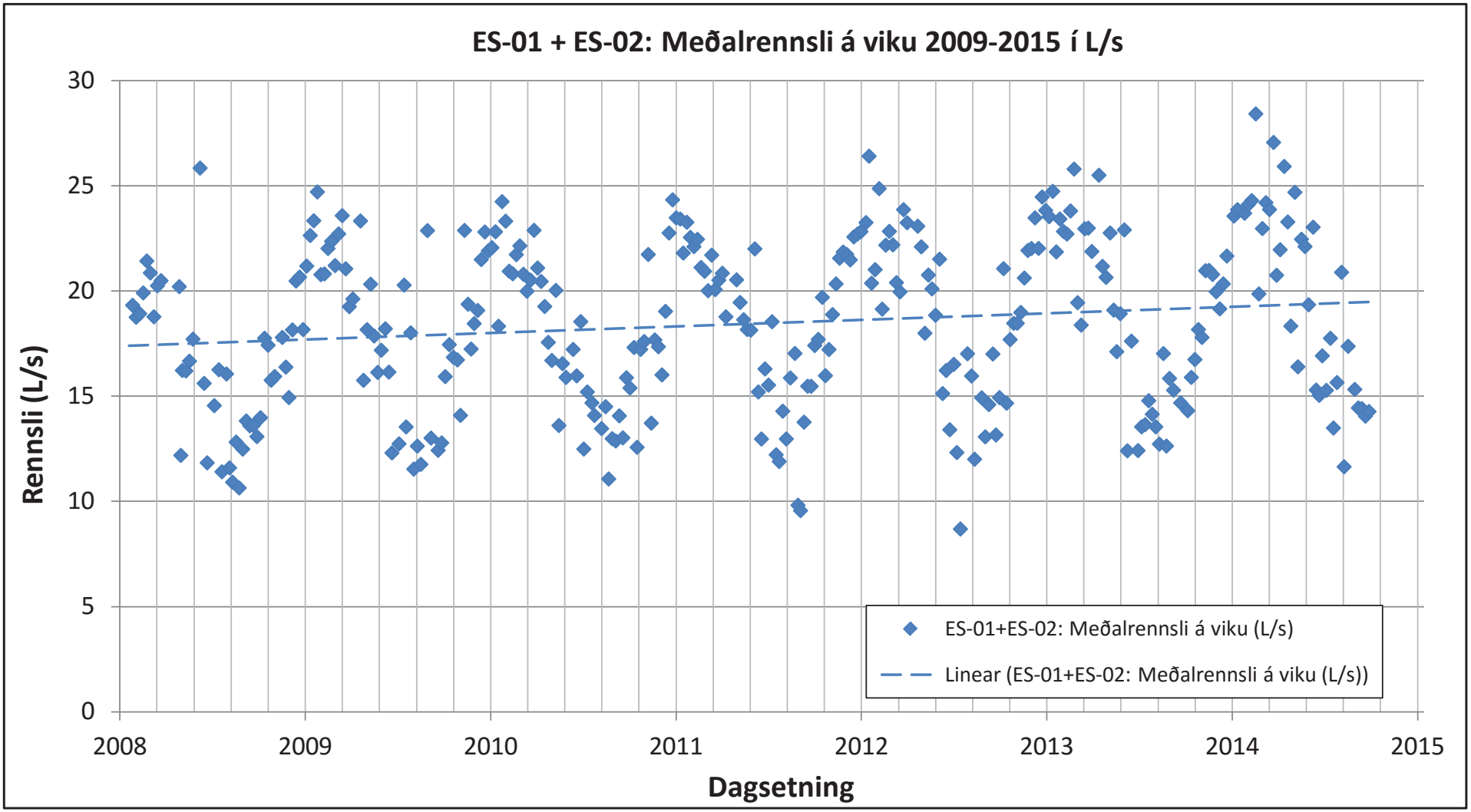
Dæluprófun: Rennsli og Vatnsborð 2004



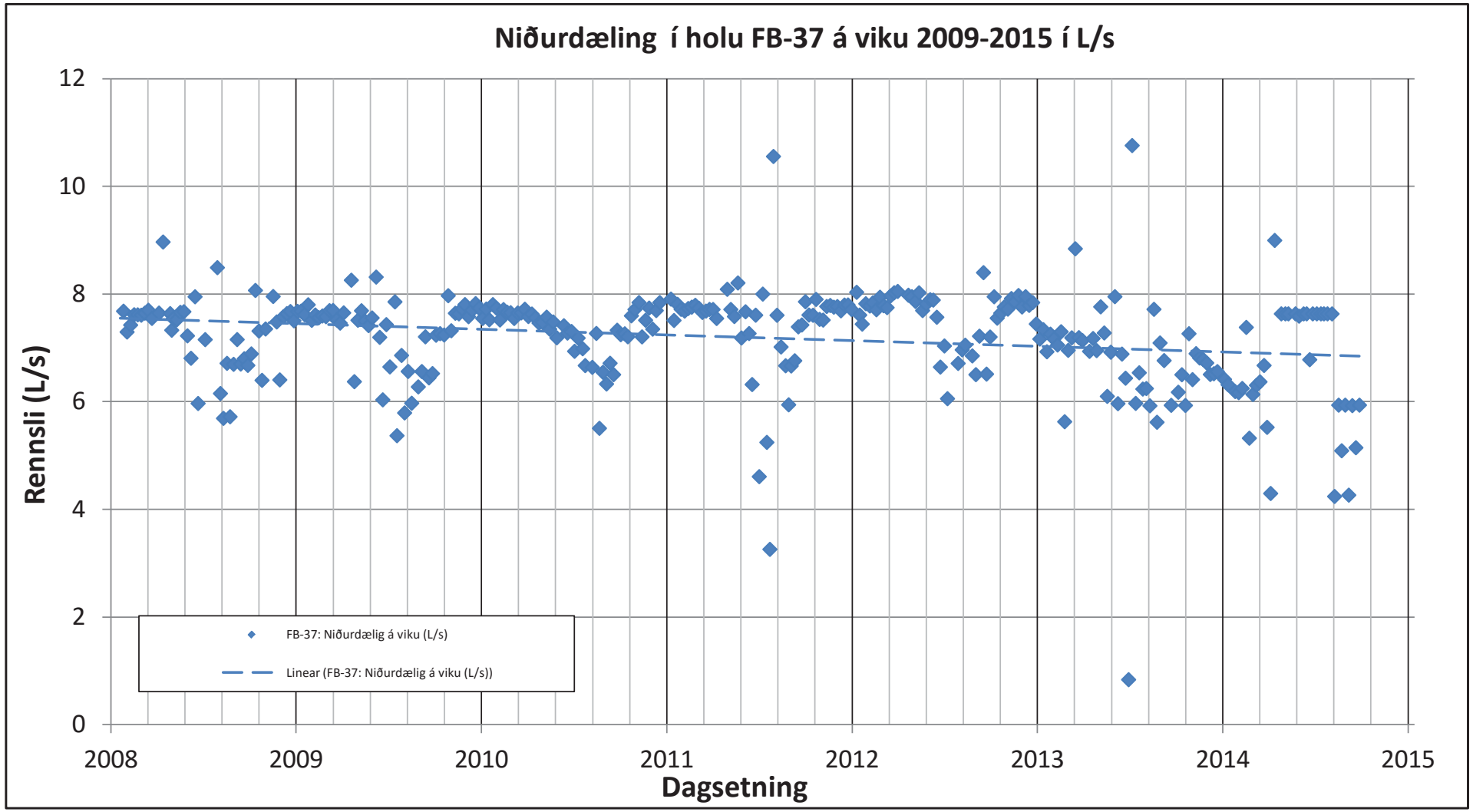
Dæluprófun og Vatnsborð 2003-2007



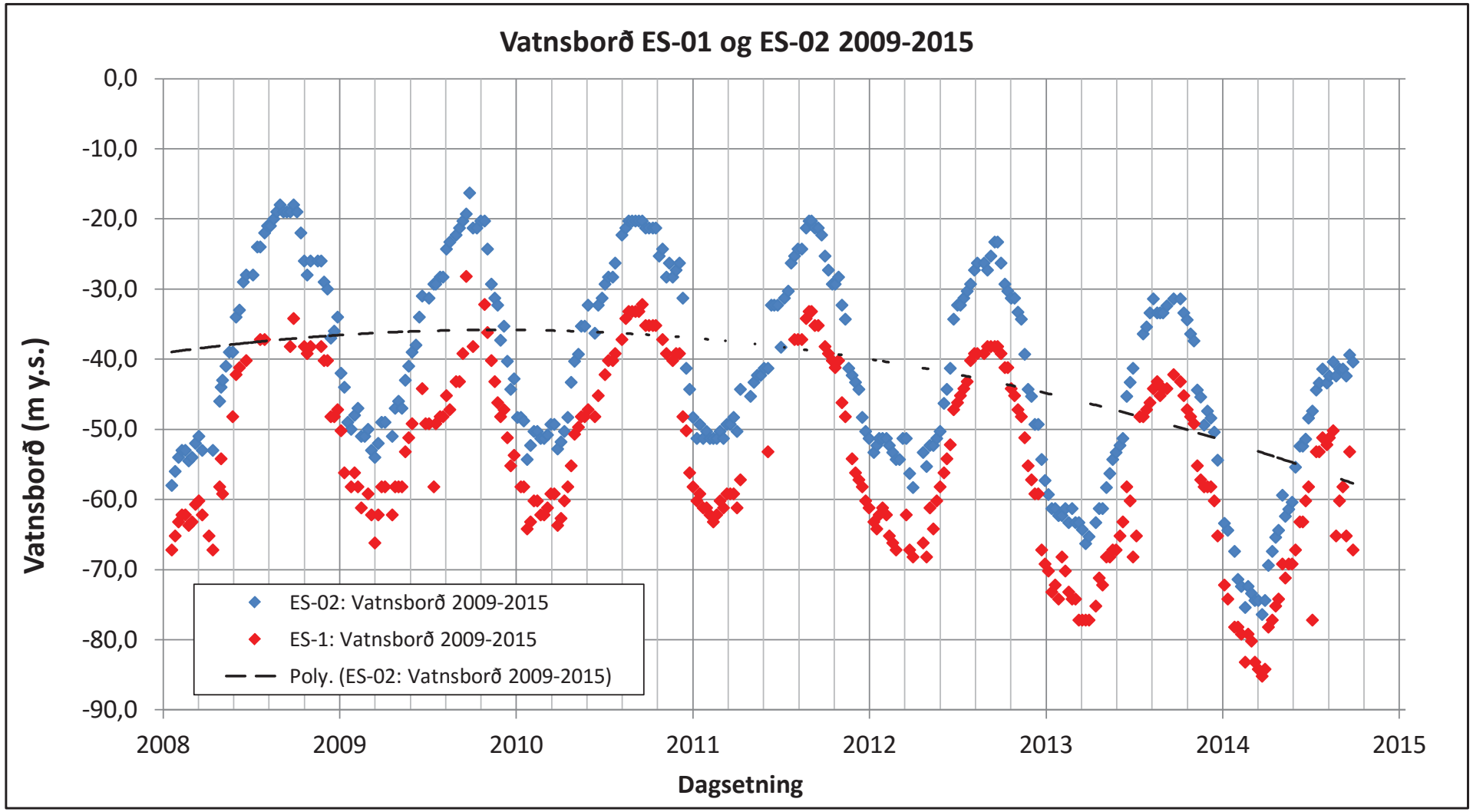
Dæling á Eskifirði 2008-2015



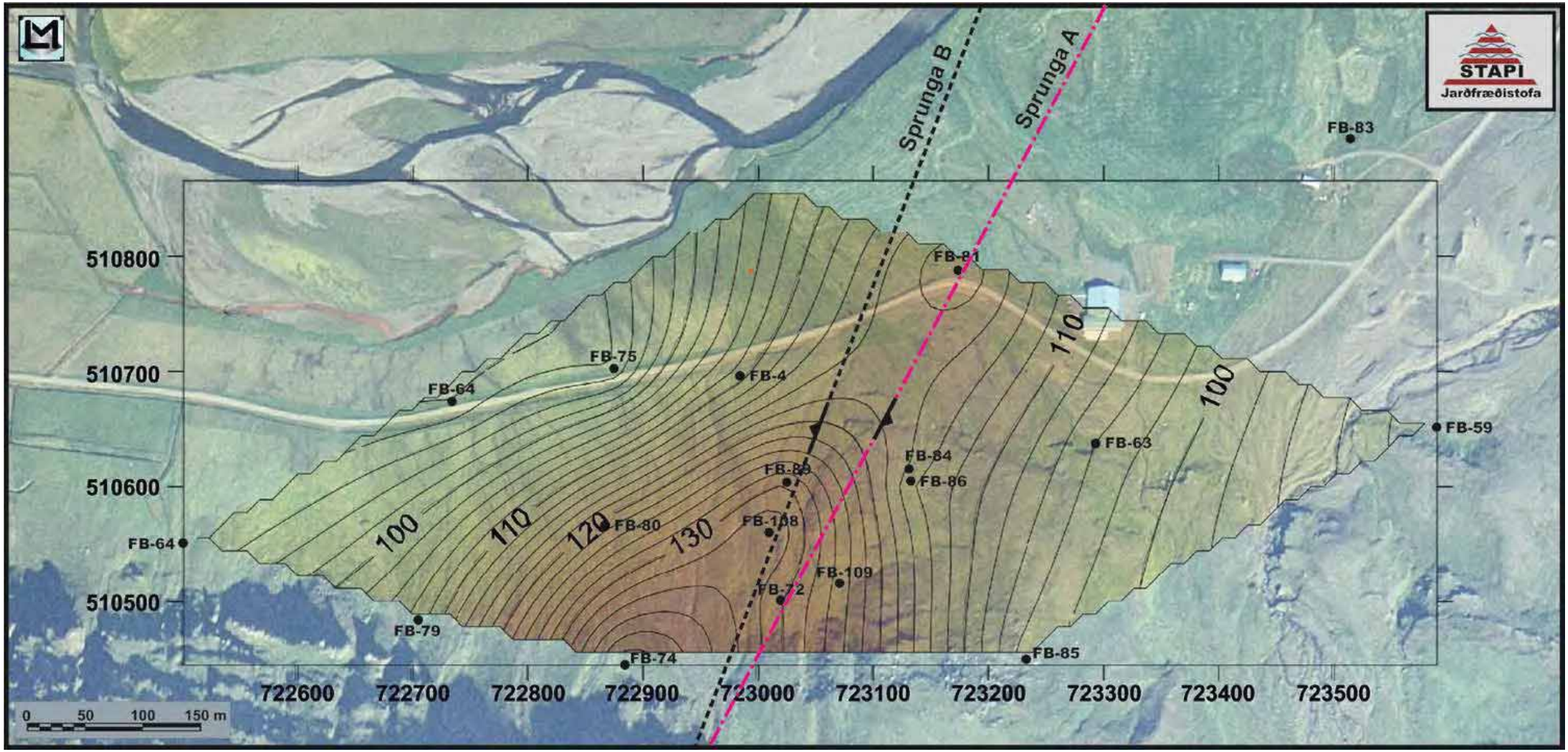
Niðurdæling á Eskifirði 2008-2015



Vatnsborð í ES-1 og ES-2: 2008-2015



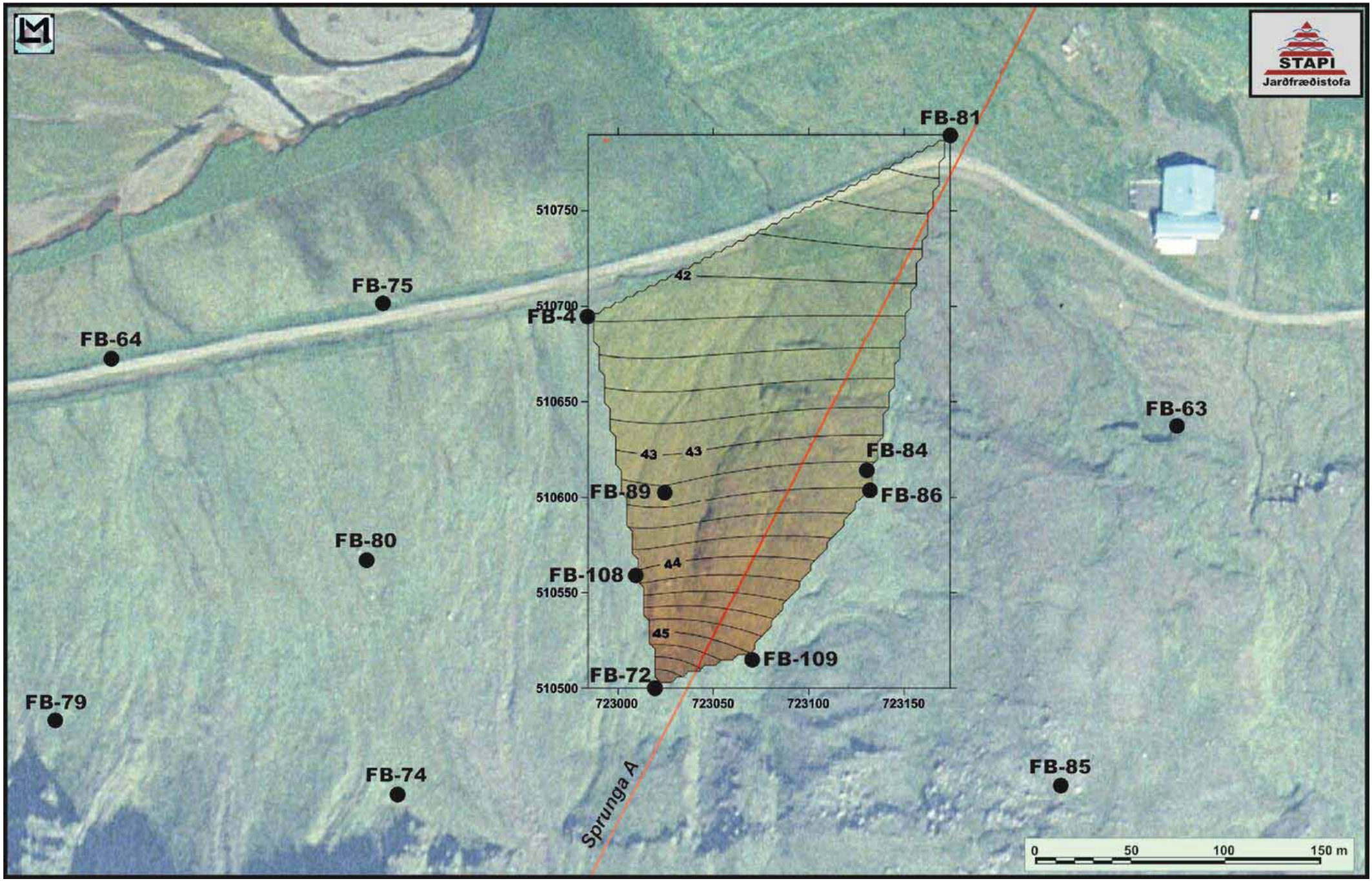
Reyðarfjörður – Slétta: Stigull



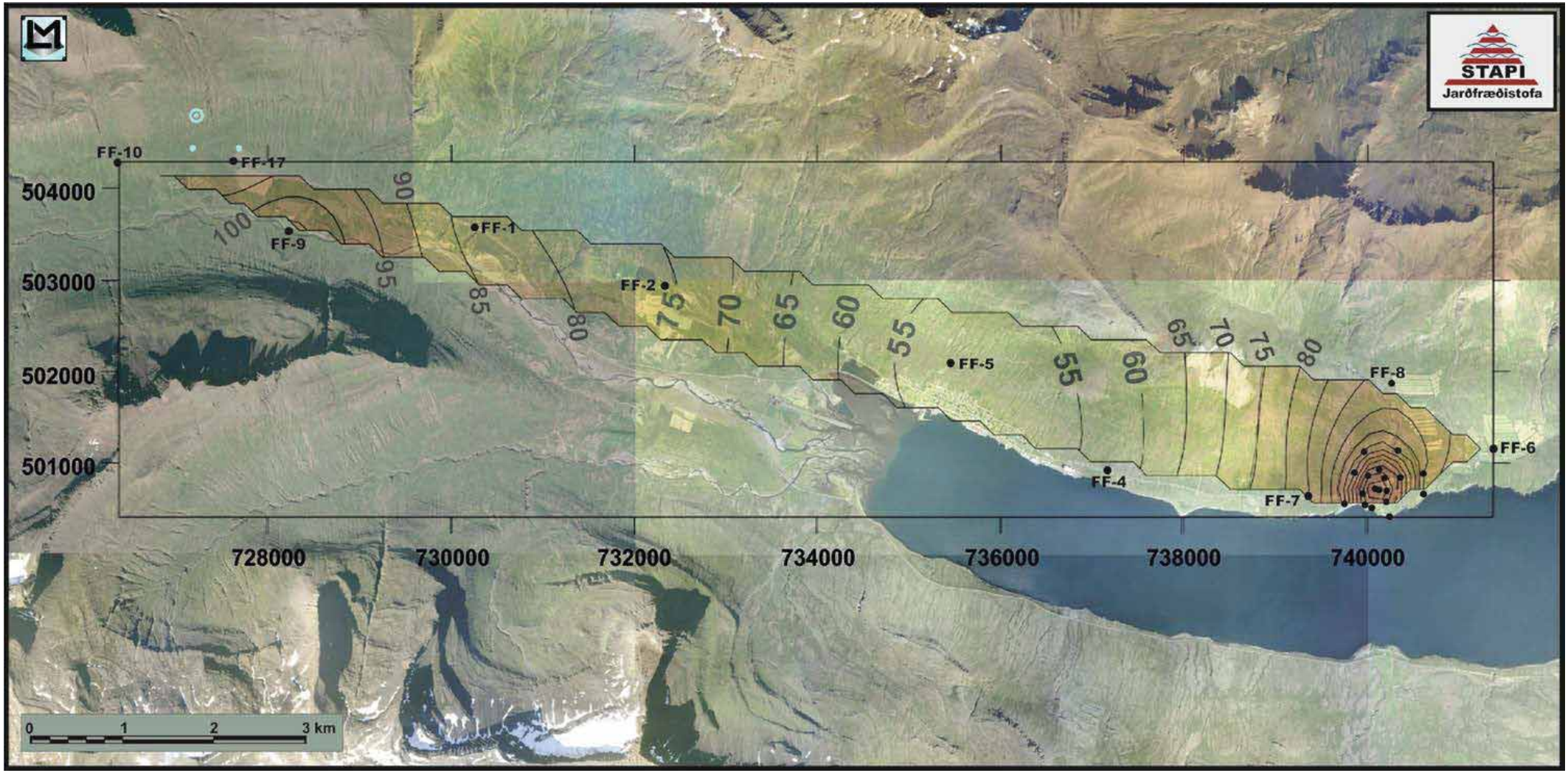
Skessa

Reyðarfjörður – Slétta: FB-109

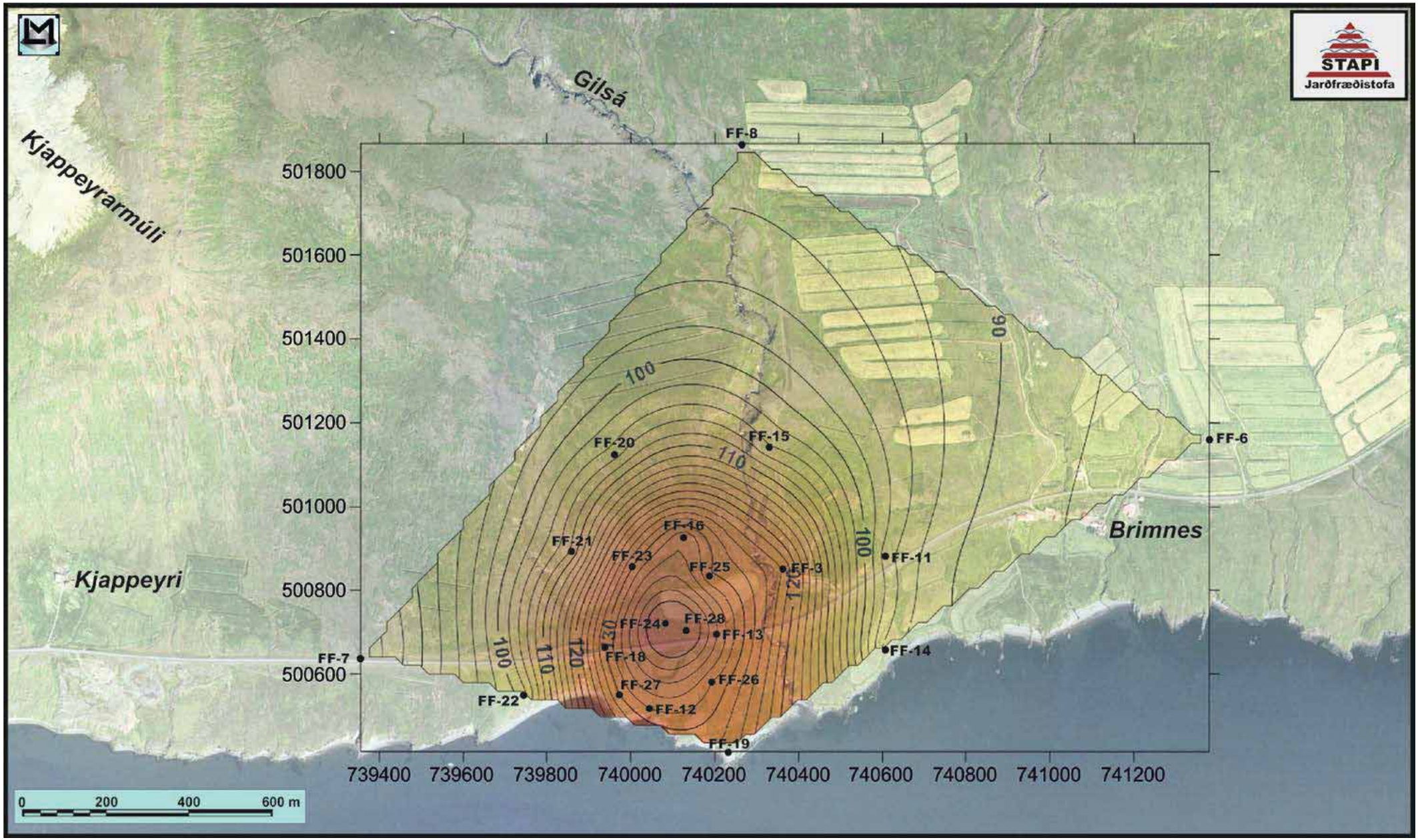
Slétta – hiti í 400 m undir Skessu



Fáskrúðsfjörður – Stigull

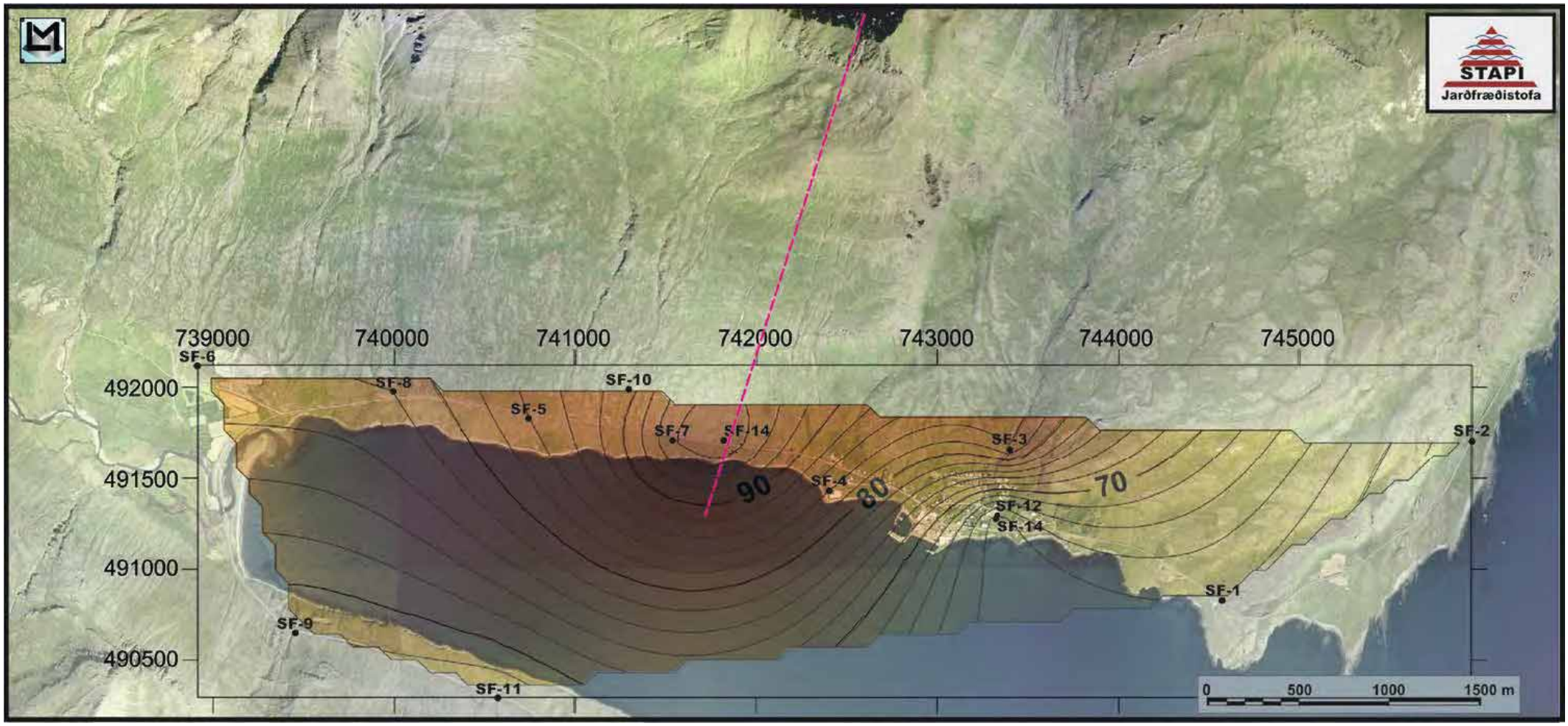


Fáskrúðsfjörður – Gilsá: Stigull

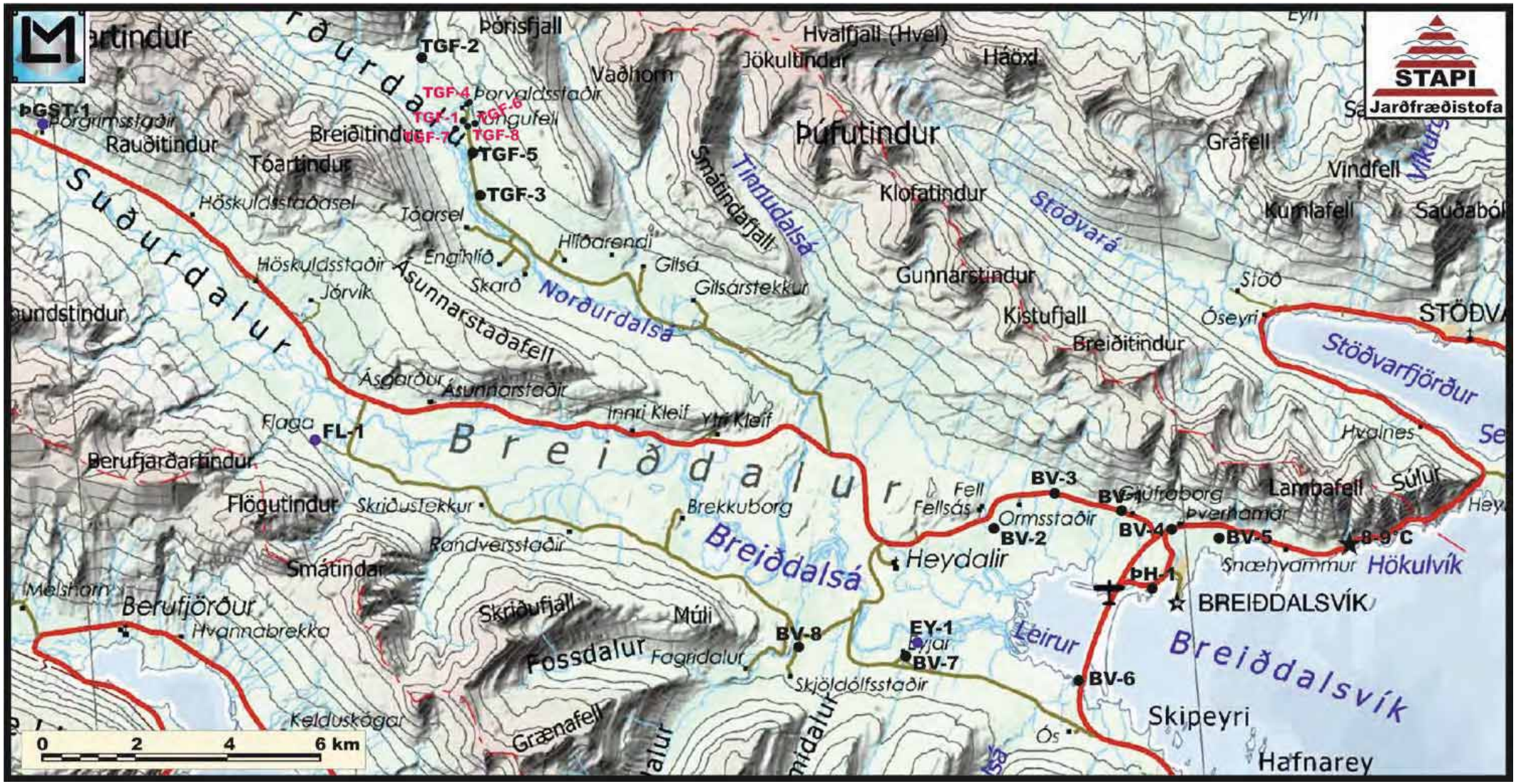


Fáskrúðsfjörður – Gilsá
FF-28 var boruð í 642 m

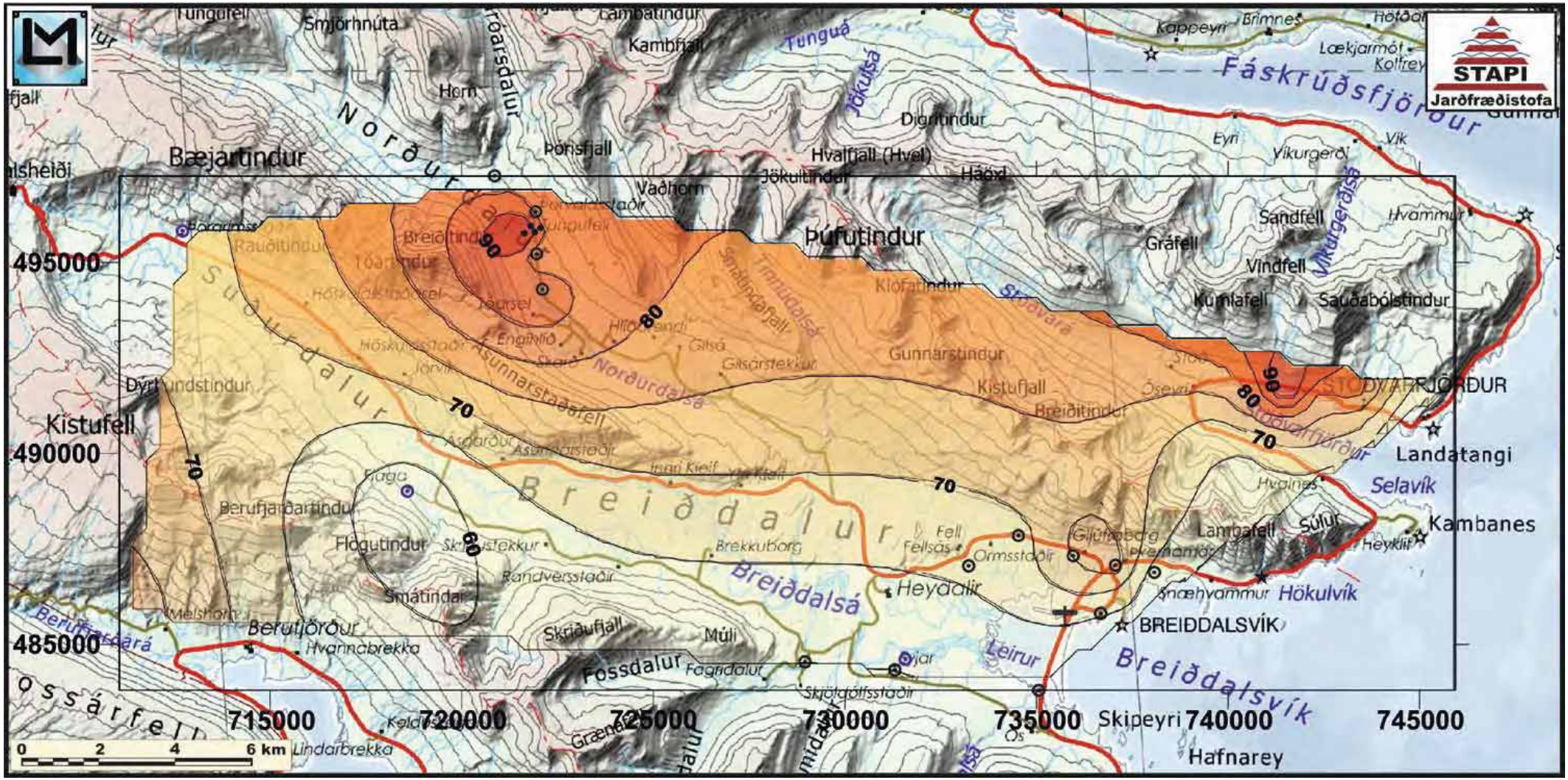
Stöðvarfjörður – Stigull



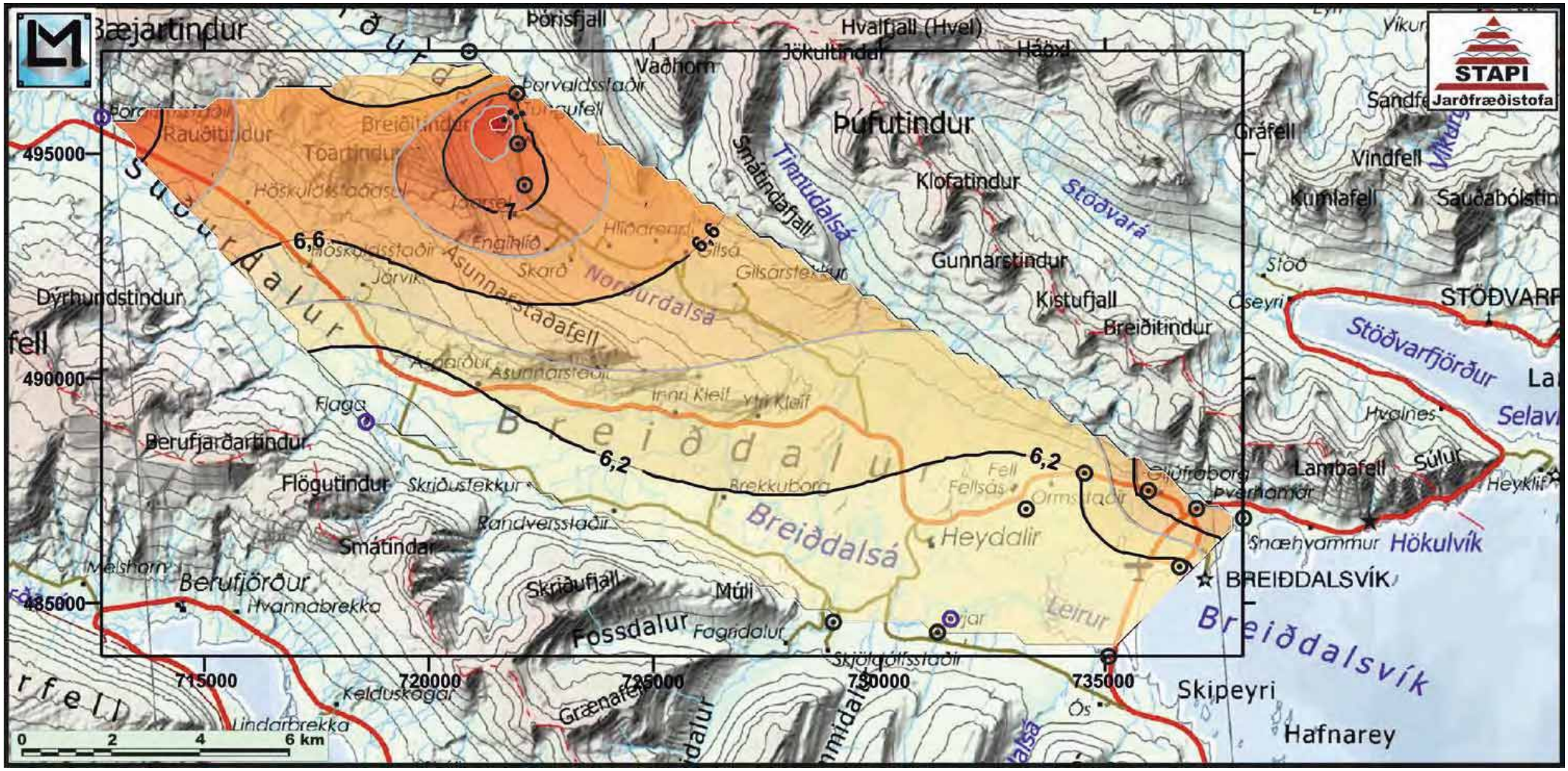
Breiðdalur - borholur



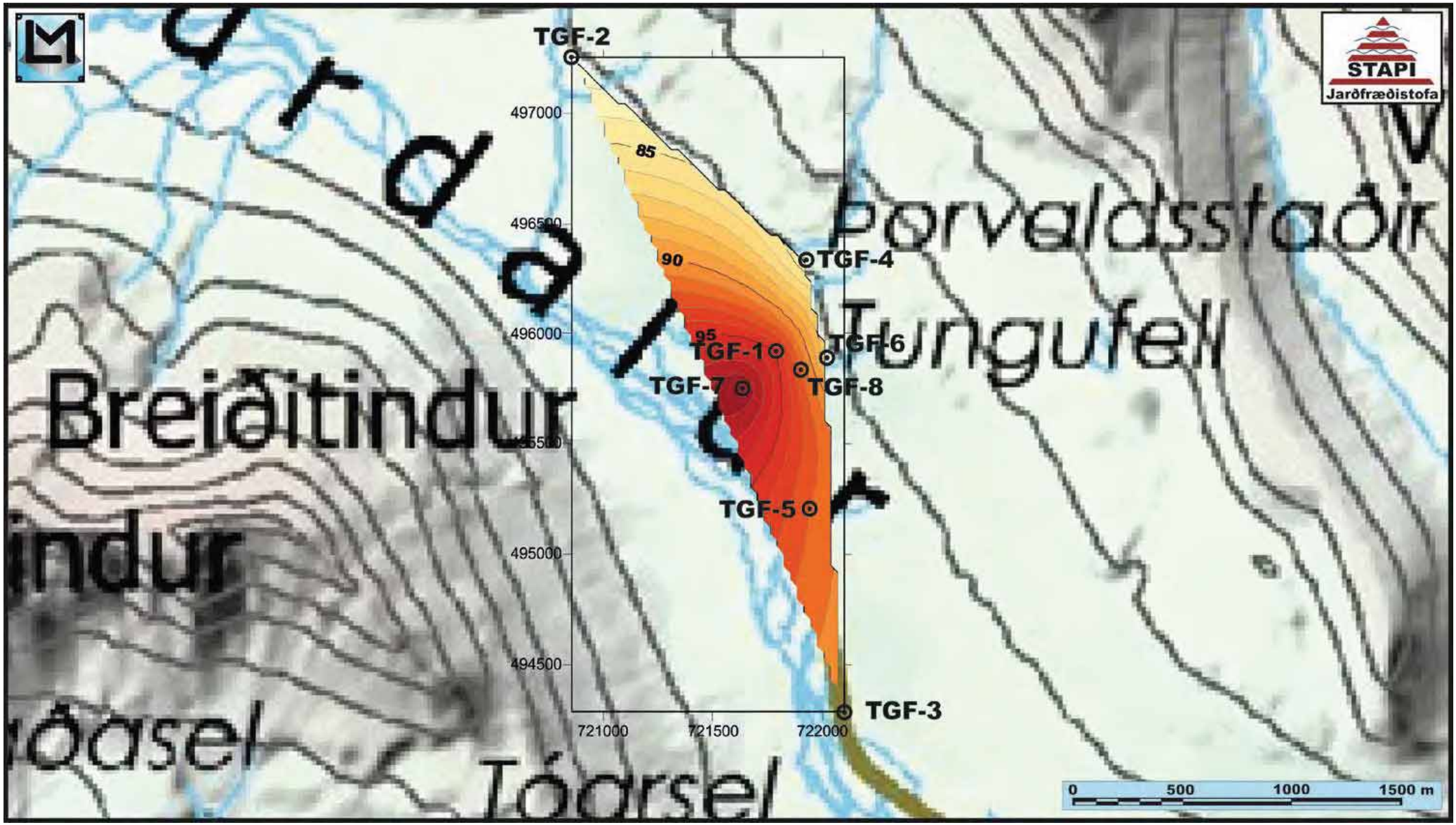
Breiðdalur og Stöðvarfjörður



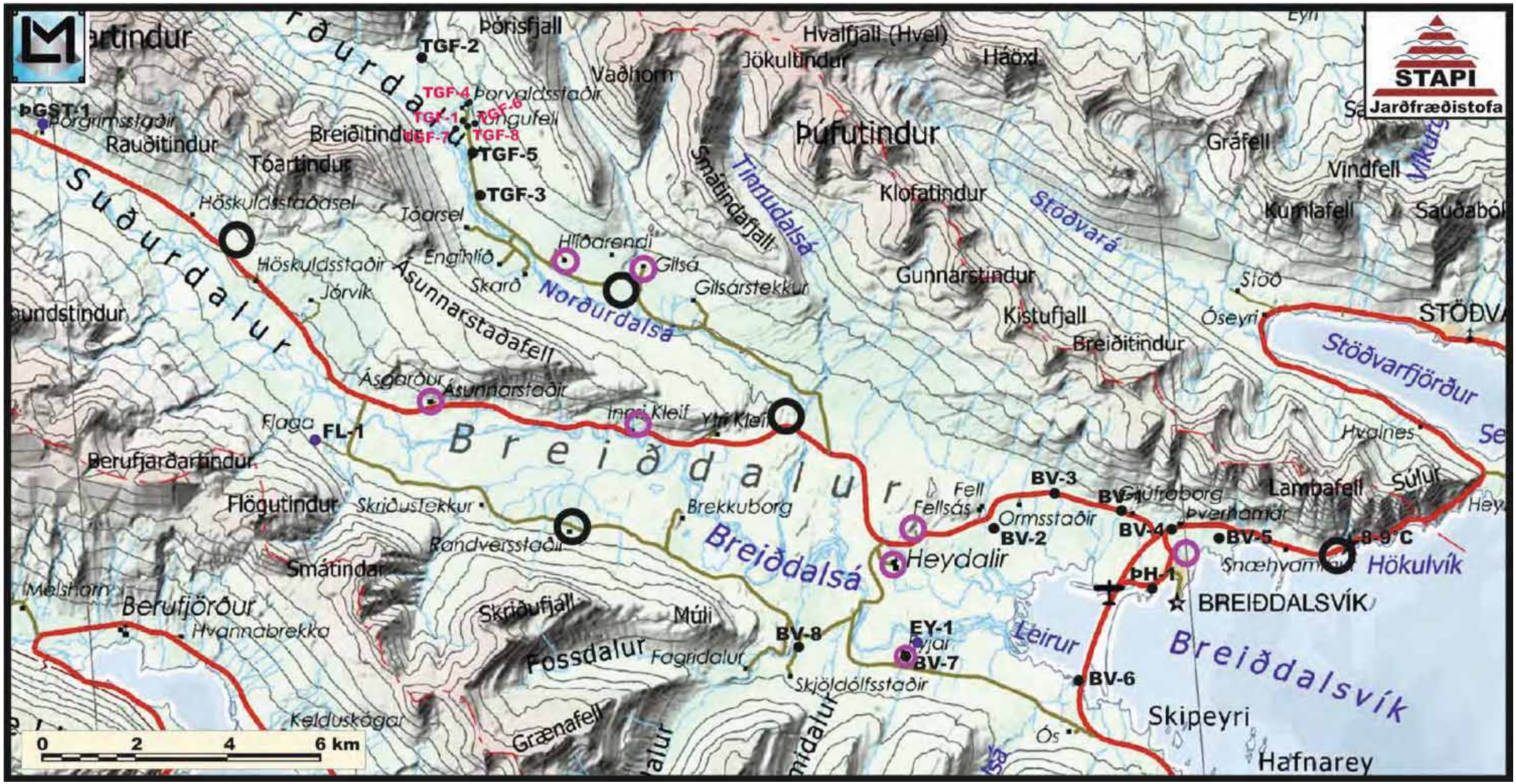
Breiðdalur – Hiti í 50 m dýpi



Tungufell – Hitastigull



Framhald jarðhitaleitar í Breiðdal

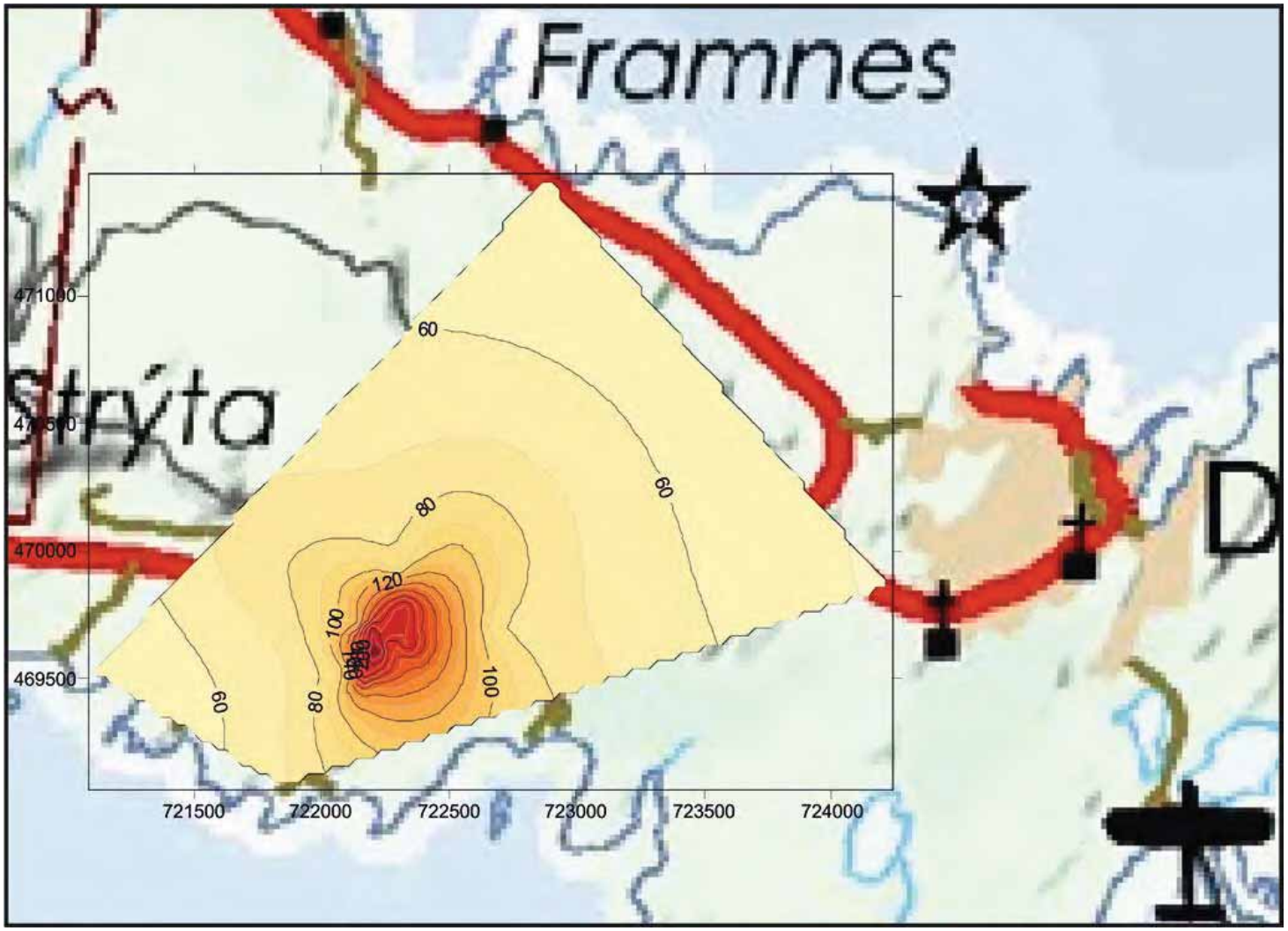


Berggangar á Breiðdalsvík

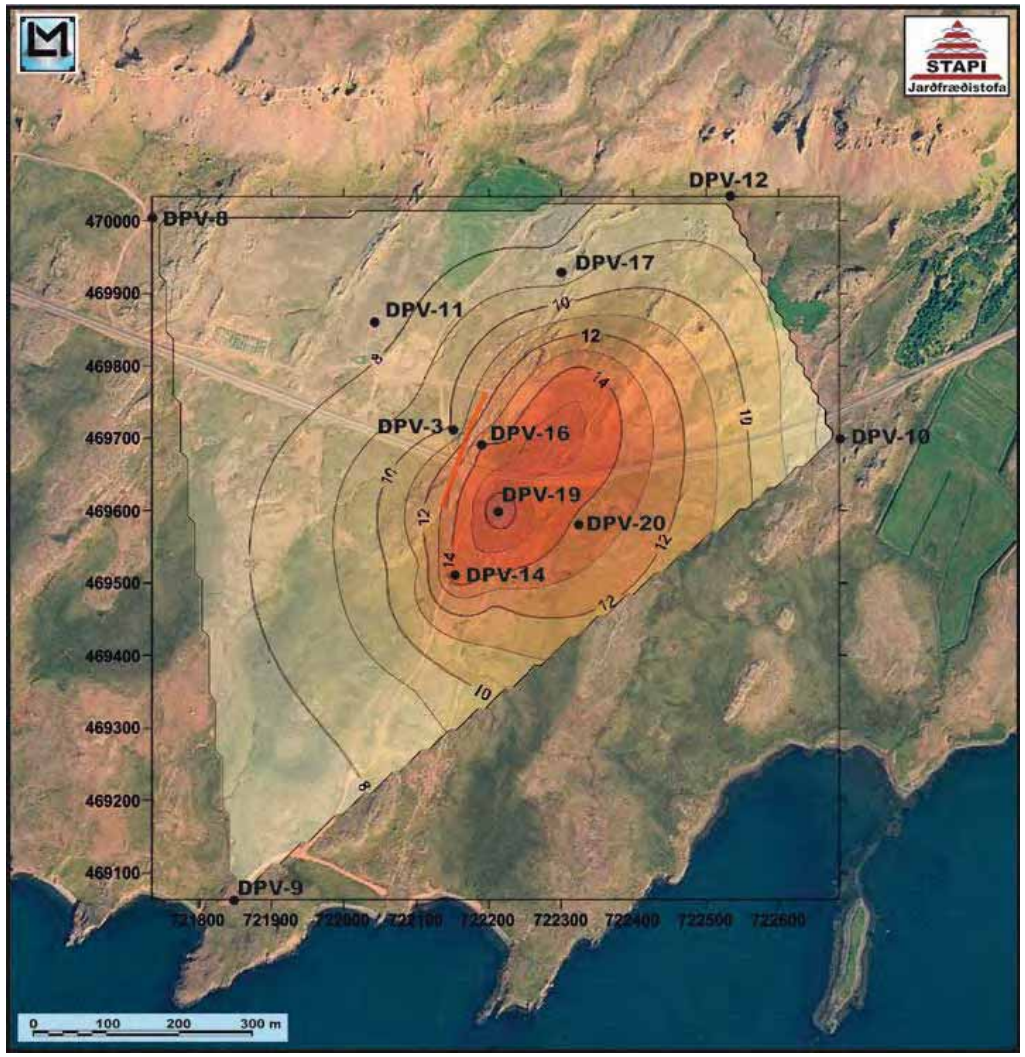
Breiðdalur

- Engar vísbendingar fundist um jarðhita enn í nágrenni þorpsins.
- Boraðar hafa verið hátt í 20 holur
- Boraðar hafa verið 8 holur við Tungufell í Norðurdal, en nánast ekkert vatn
- TGF-1 dýpkuð í 402 m
- TGF-8: 30,6°C í 305,5 m
- Stigull >95°C/km og hiti í 400 m er 40°C í TGF-1
- Hitahámarkið gæti legið milli Tungufells og Höskuldsstaða

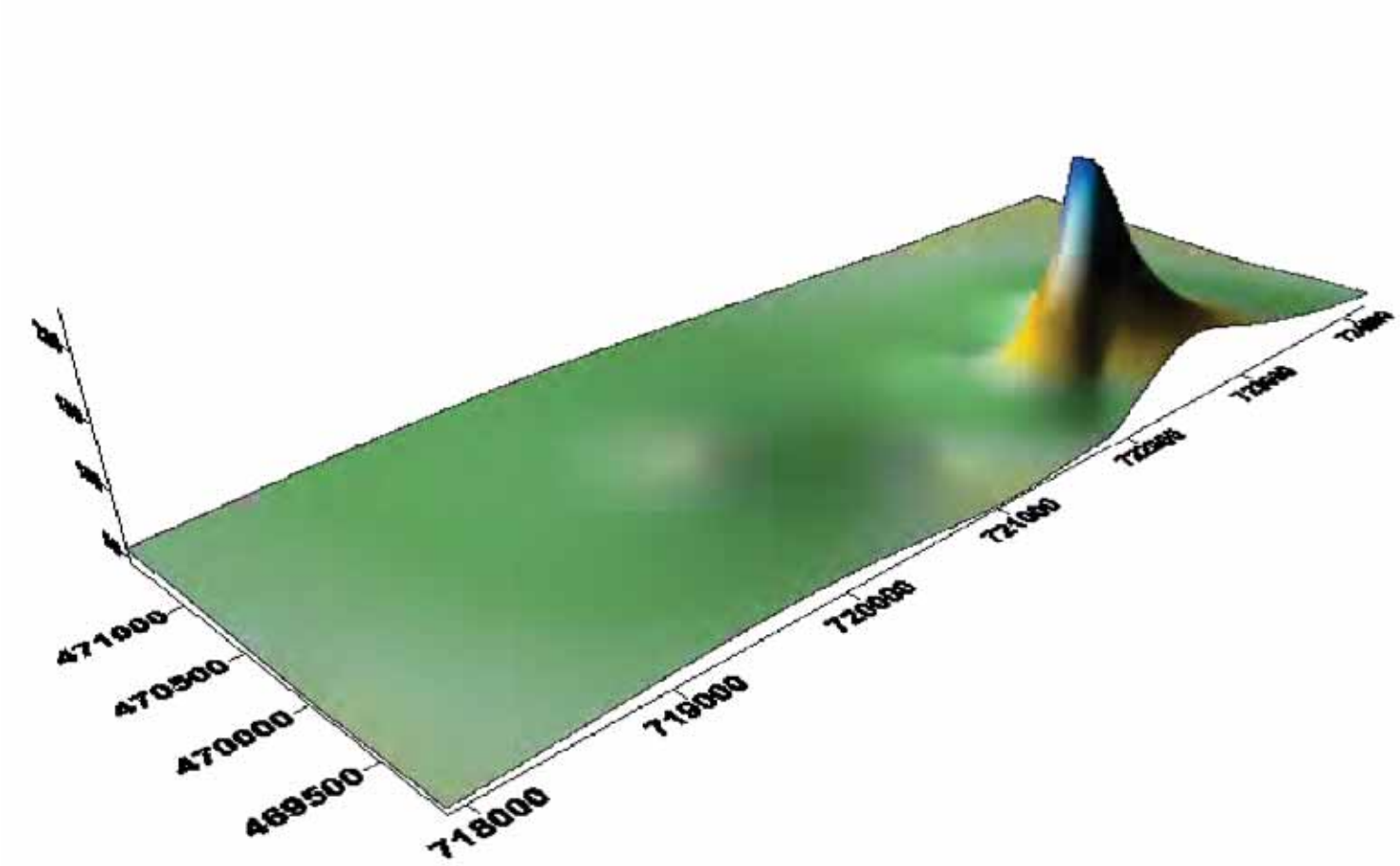
Djúpivogur - Búlandsnes



Djúpivogur - Búlandsnes



Djúpivogur - Búlandsnes



Djúpivogur – Hrímnir: VF-29

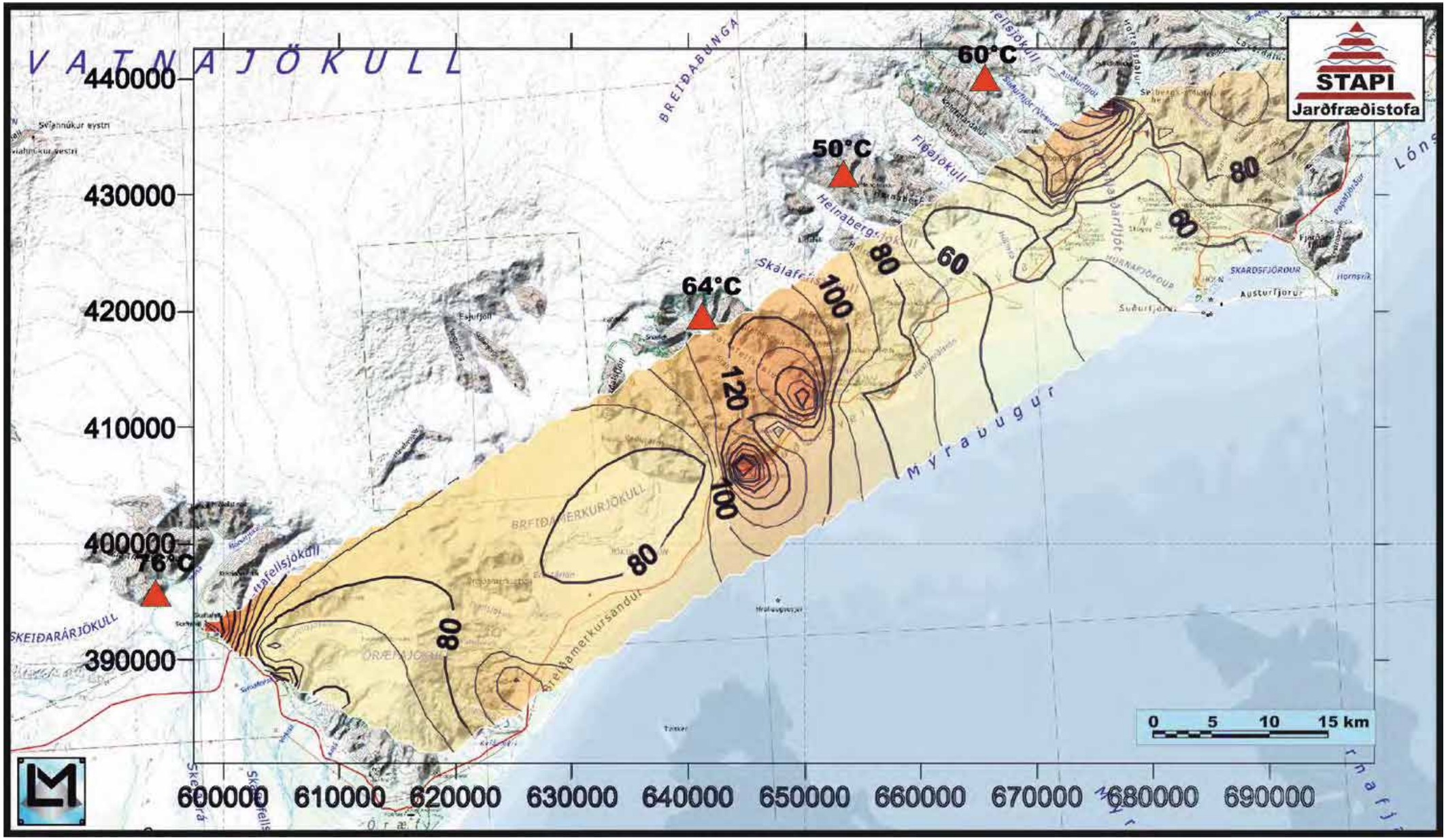
Djúpivogur – Hola VF-28: 5 l/s í sjálfrennsli

10 l/s af 45°C vatni úr holu VF-28

GAMLA KAUPFELAGID

Nokkur áhugaverð verkefni í vinnslu

- Hali í Suðursveit: >100°C heitt vatnskerfi
- Hoffell í Nesjum: um 80°C heitt vatnskerfi
- Vopnafjörður: 51,8°C, efnahiti um 60°C.
- Hitaveita komin í Skaftafelli. Nýtir 58°C vatn.
- Svínafell í Öræfum gefur góðar vonir
- Kálfafellsdalur í Suðursveit er heitur


VATNAJÖKULL
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60°C
50°C
64°C
76°C
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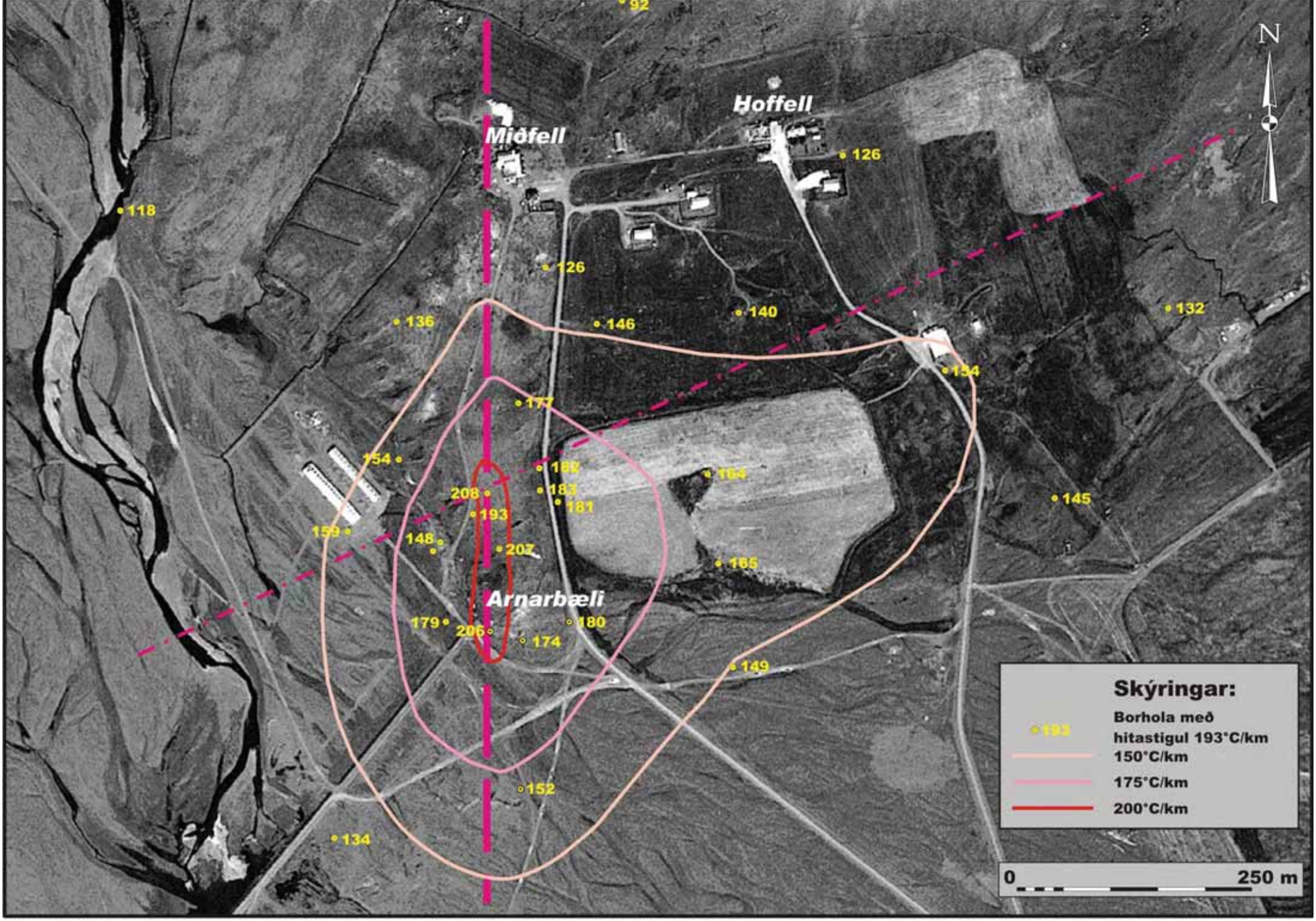
680000
690000
0 5 10 15 km



MYND 2. Hitastigull í borholum og jafnhitastigulslínur við Hoffell og Miðfell í Nesjum.

Proceedings World Geothermal Congress 2015
Melbourne, Australia, 19-25 April 2015

Well Site Selection Based on Acoustic Borehole Image Logs: A Case History from Hoffell Low-Temperature Geothermal Field in Southeast Iceland

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[1)] Iceland GeoSurvey (ISOR), Rangárvellir, P.O. Box 30, IS-602, Akureyri, Iceland

[2)] Iceland GeoSurvey (ISOR), Grensásvegur 9, IS-108, Reykjavík, Iceland

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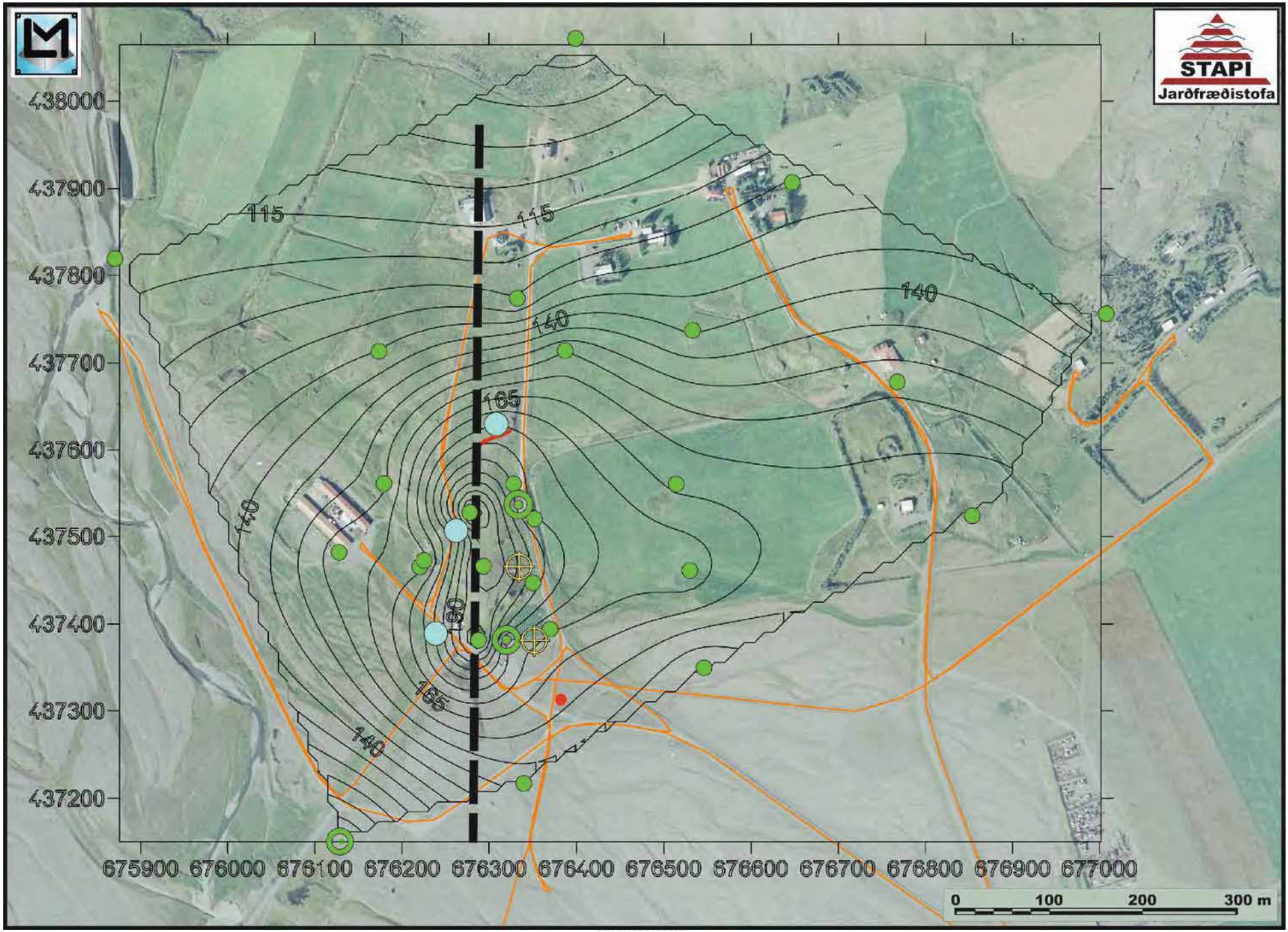
Keywords: Televiewer, acoustic borehole image logs, low-temperature, Iceland, Hoffell, fractures, feed zone, heating utility, well siting

ABSTRACT

Geothermal prospecting in the Hoffell area in Southeast Iceland commenced in 1992, as potentials for a heating utility in the main town of the region were estimated. The research included drilling of 33 shallow exploration wells and resulted in a model of a workable low-temperature geothermal system with two predominant fracture trends, ENE-WSW and approximately N-S. Prior to siting a deep exploration well in 2012, acoustic borehole image logs (Televiewer) were performed in seven of the existing wells in the purpose of identifying orientations of permeable fractures. Results of these measurements demonstrate a quite complex sub-surface fracture system with fractures which arguably have formed during different geological periods. Focus was set on large, permeable fractures, which were clearly observed in Televiewer images from two of the deepest wells. The trends of these fractures, calculated from Televiewer data, support the two previously mapped predominant fracture trends. Final determination of a site for the deep exploration well was based on the orientation of one of these feed zones, namely ENE-WSW strike and ~73° dip towards SSE. The well was drilled more than 200 m away from the peak of the geothermal gradient anomaly and was anticipated to intersect fracture planes which are connected to this feed zone, only at greater depths, where estimated temperature was 80°C. The well intersects several feed zones and one of these, trending ENE-WSW and dipping 83° towards SE at 1340 m depth, is believed to be related to the intended fracture planes. The well yields ~25 l/s of 73°C hot water, which is found to be successful. The acoustic borehole image logging is in its early phase in Iceland and well siting on grounds of such measurements has proven to be a helpful addition to the conventional method of siting wells on the base of geothermal gradient data, usually drilling at or near the temperature geothermal-gradient maximum.


STAPI
Jarðfræðistofa
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437900
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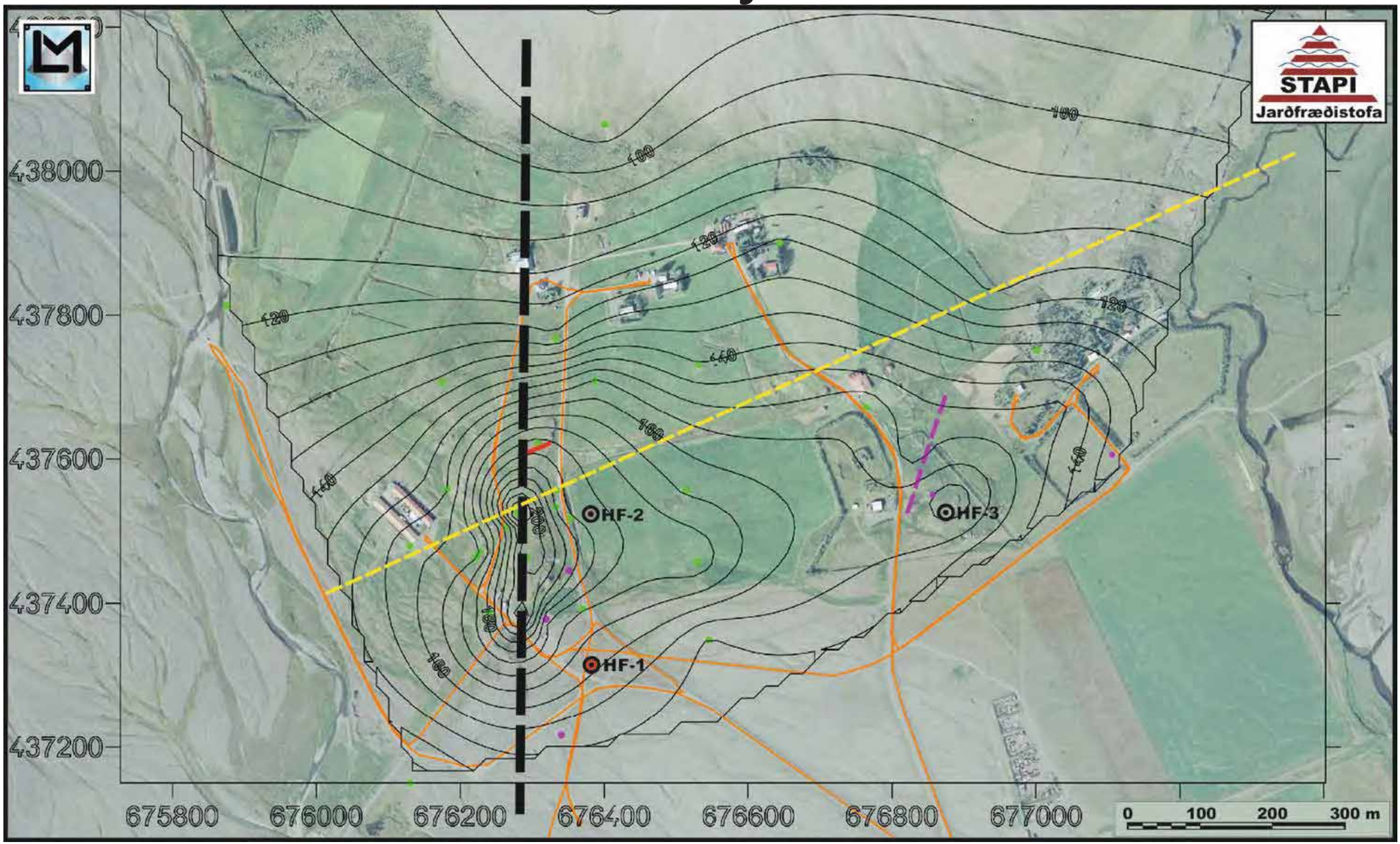
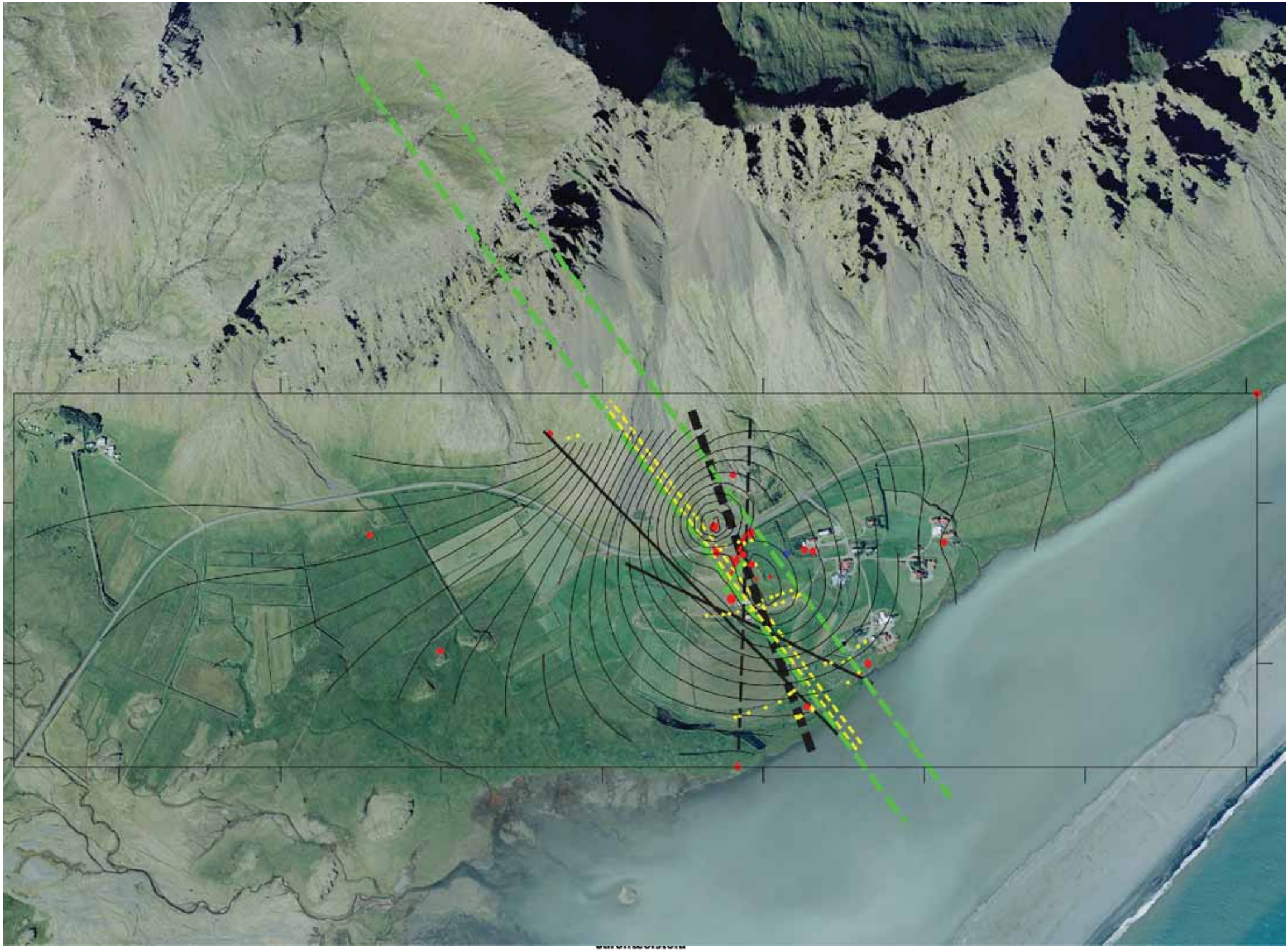
437700
437600
437500
437400
437300
437200
675900 676000 676100 676200 676300 676400 676500 676600 676700 676800 676900 677000
0 100 200 300 m

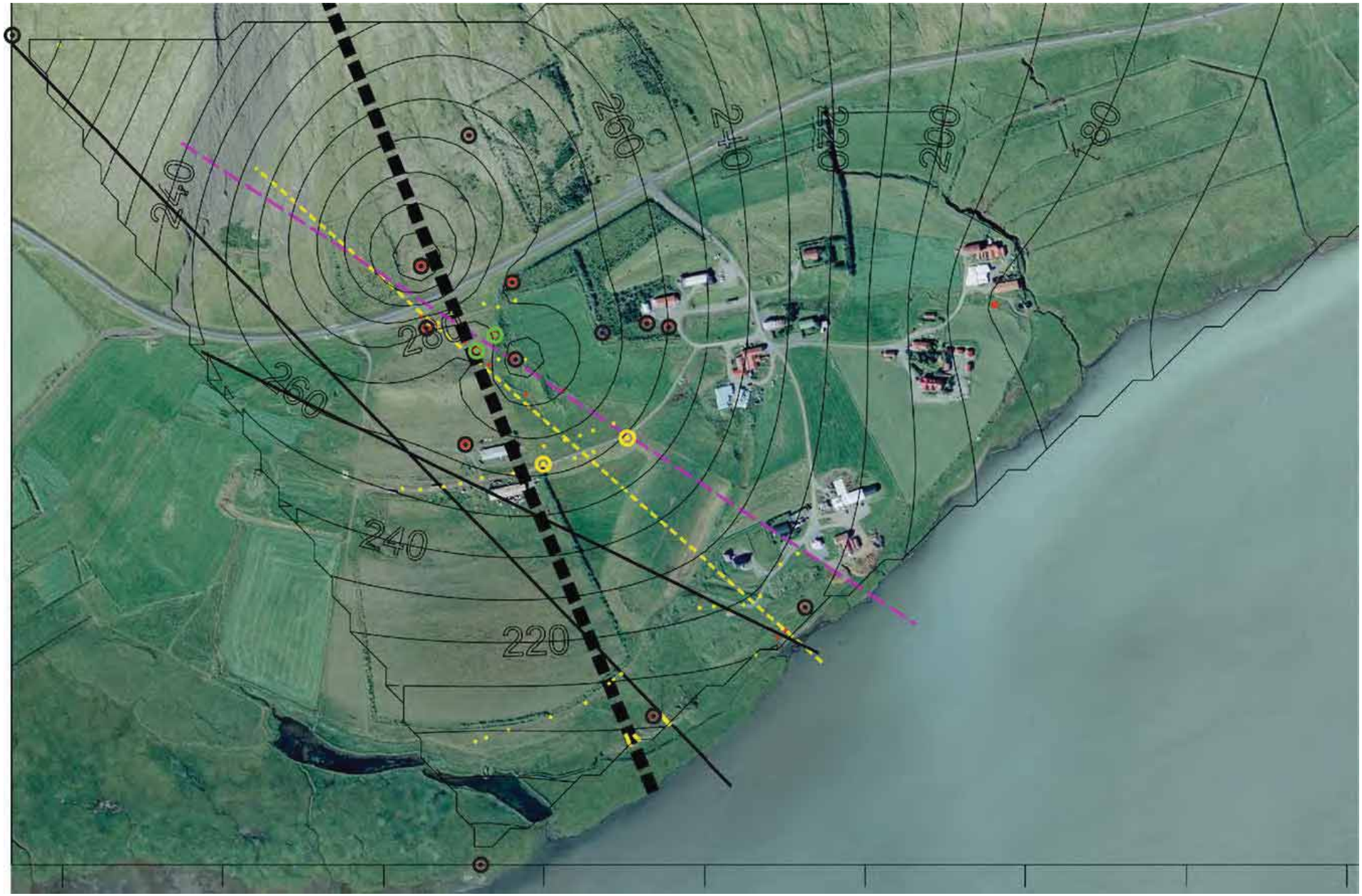
Hoffell í Nesjum 2016



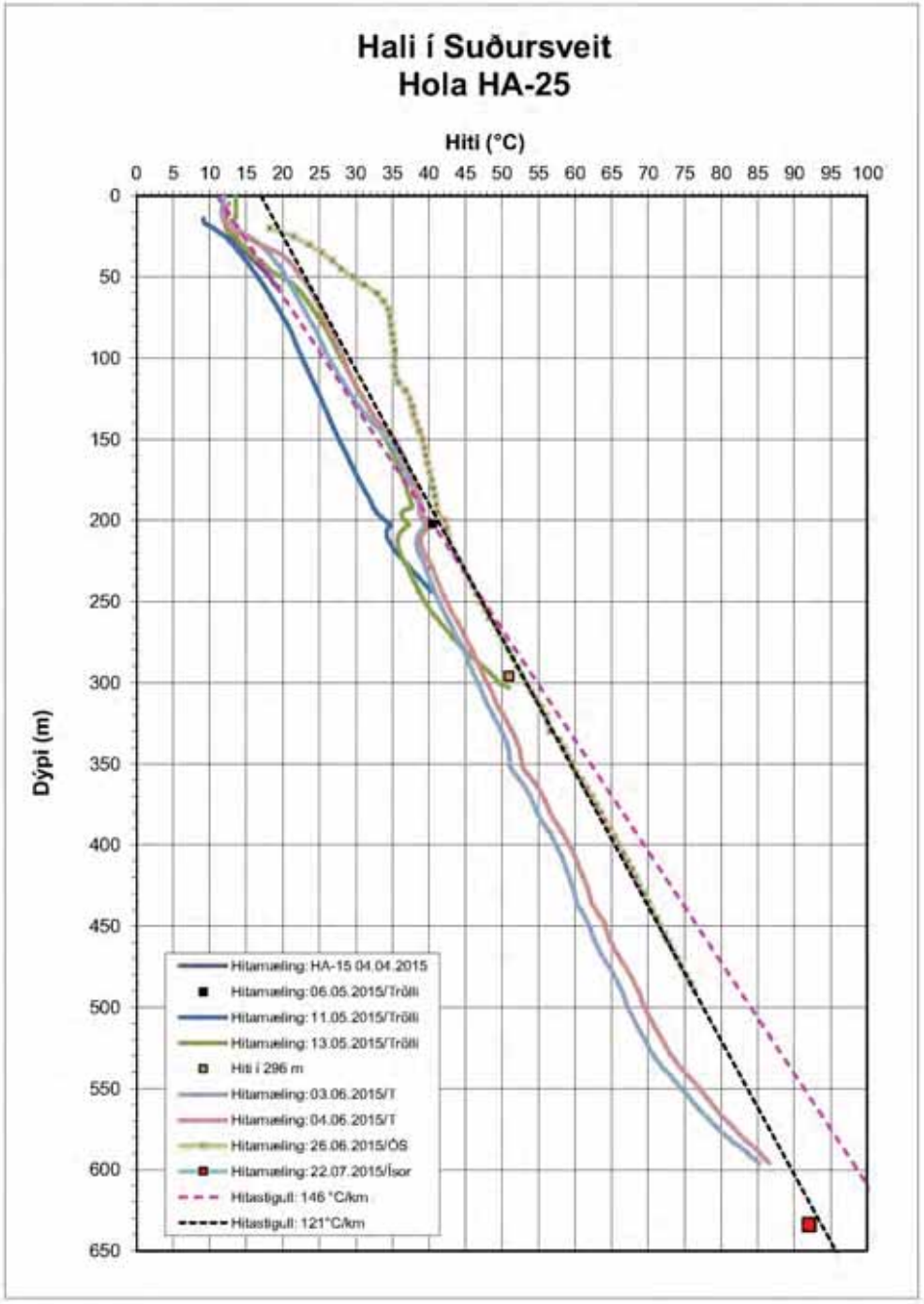
Nasi borar við Hoffell í Nesjum 2016



Hali í Suðursveit 2015

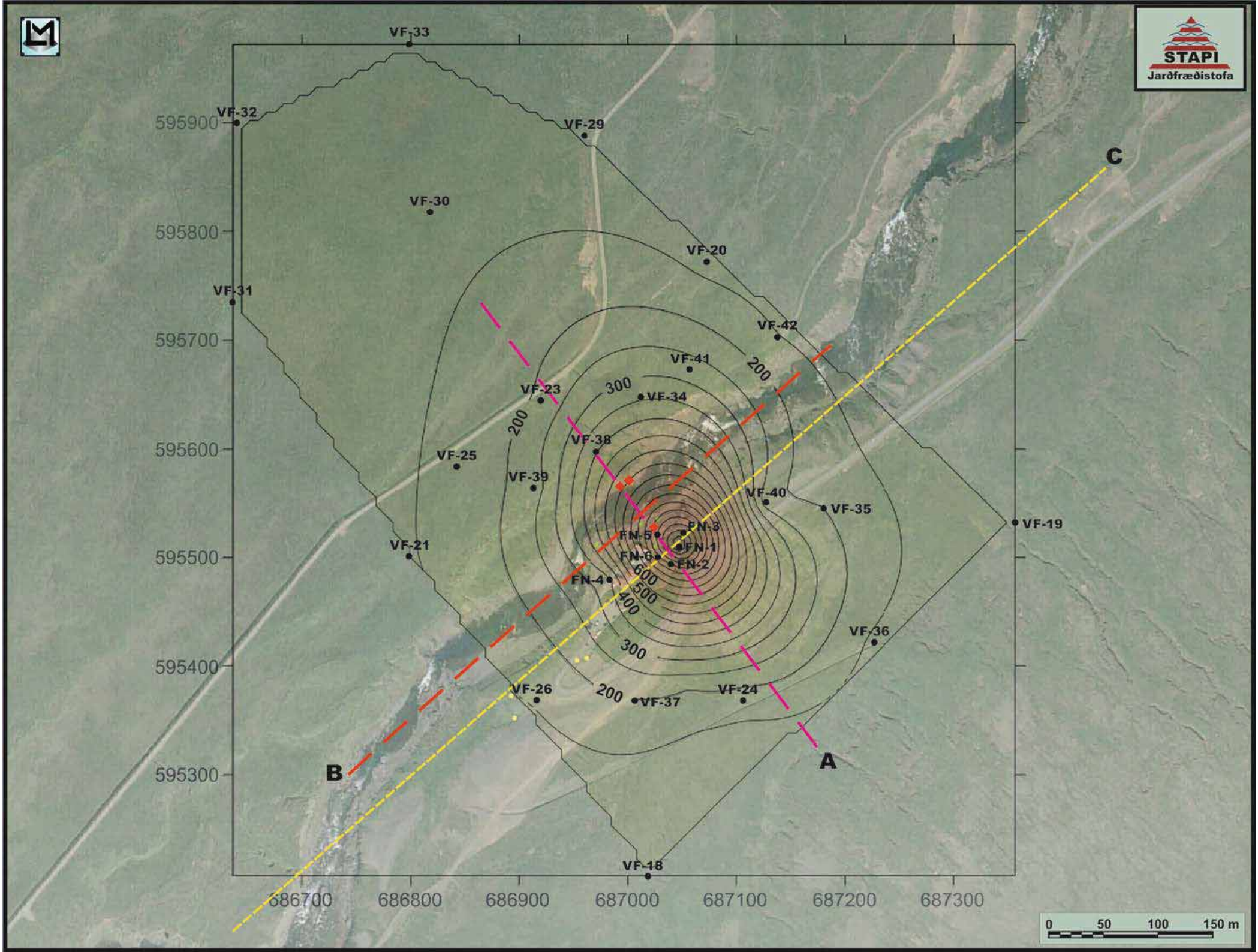


Hali í Suðursveit 2015: HA-25 opin sprunga í 190-194 m dýpi



MYND A-25. Hitamæling í holu HA-25 við Hala í Suðursveit. Hitastigullinn er 146°C/km frá 60 m niður í 202 m dýpi. Fiskun lauk 12. júní 2015.

Vopnafjörður – VF-35 árið 2002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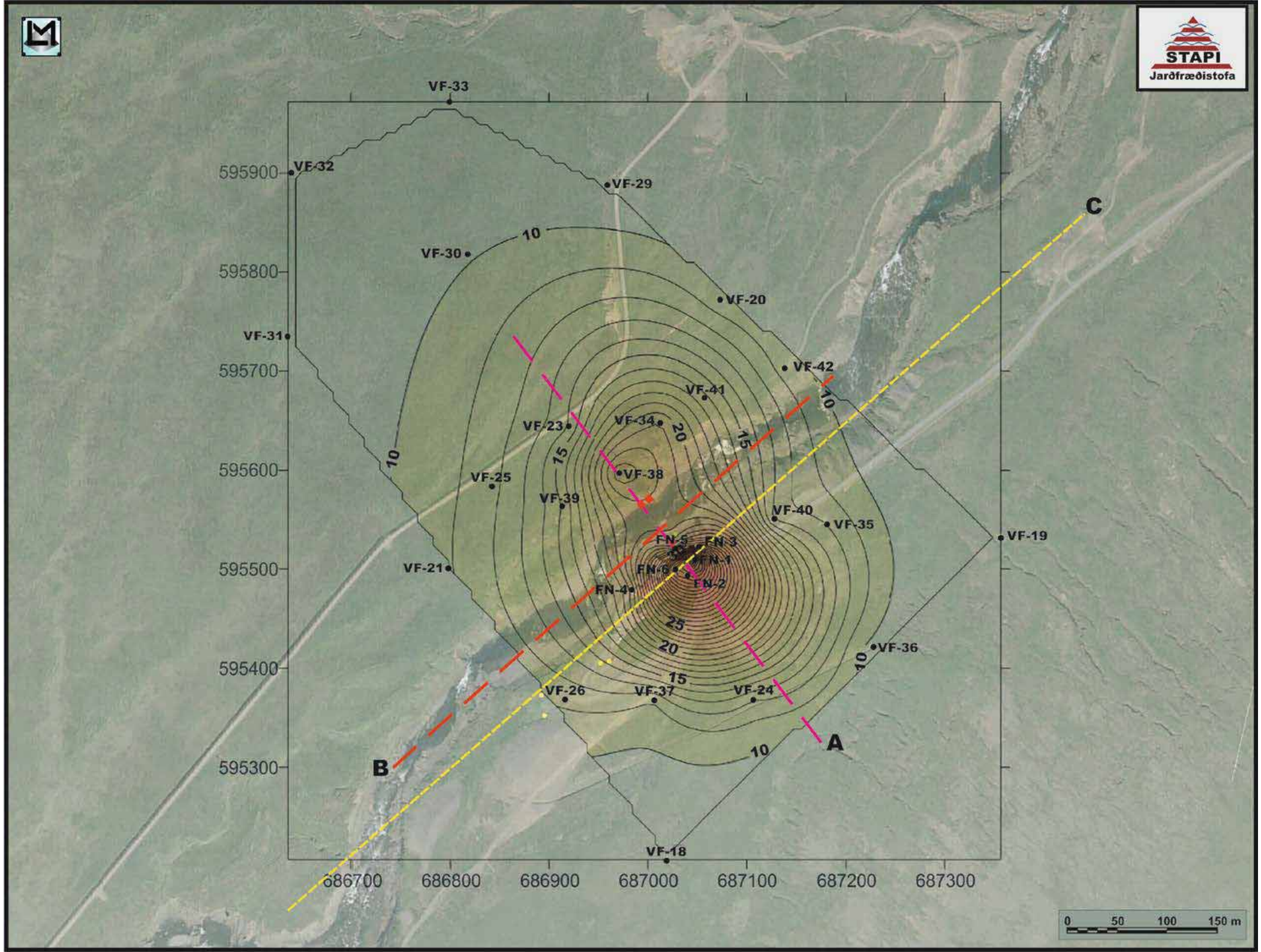
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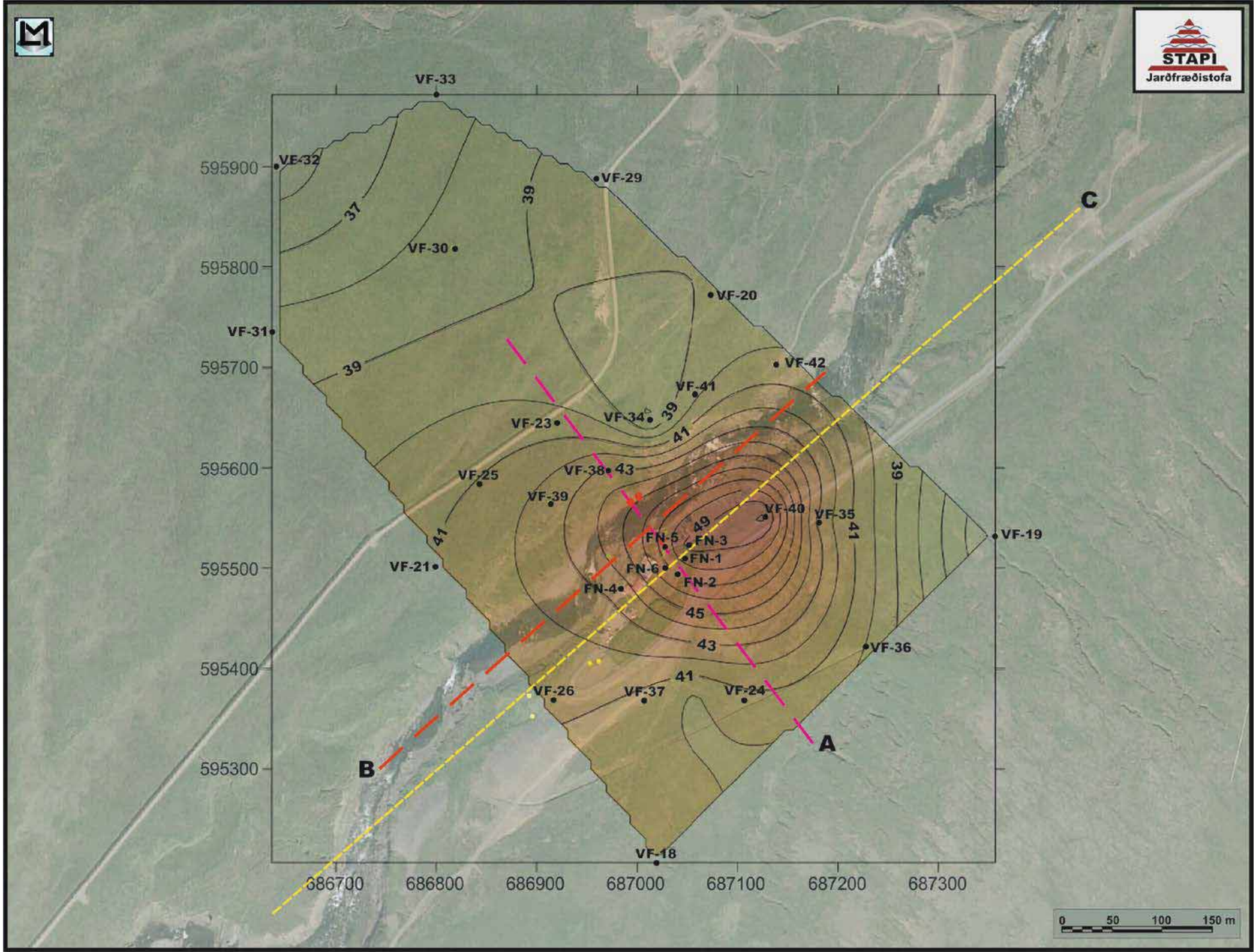
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150 m

Bestu vonir um jarðhita í þéttbýli

1. **Eskifjörður: Hitastigull >145°C/km; 81°C kerfi**
2. **Höfn: >80°C vatnskerfi við Hoffell er staðfest**
3. **Djúpivogur: Hitastigull >260°C/km, efnahiti 75°C**
4. **Fáskrúðsfjörður: Hitastigull >140°C/km**
5. **Reyðarfjörður: Hitastigull >130°C/km**
6. Vopnafjörður: >51,8°C vatnskerfi í Selárdal?
7. Neskaupstaður: >100°C/km í Fannardal
8. Seyðisfjörður: ca. 100°C/km
9. Stöðvarfjörður: >94°C/km. Lítið kannað

Lokaorð

- Höfundur setti sér það markmið árið 2002 að hitaveituvæða Austurlandið á 10 árum, þ.e. fyrir árið 2012. En svo kom **hrunið**!
- Jarðhitaleit á lághitasvæðum hentar einkar vel fyrir sjálfstæðar Jarðfræðistofur.
- Lághitann er auðveldlega hægt að meðhöndla á einkarekinni stofu úti í bæ.... og kannski betur?