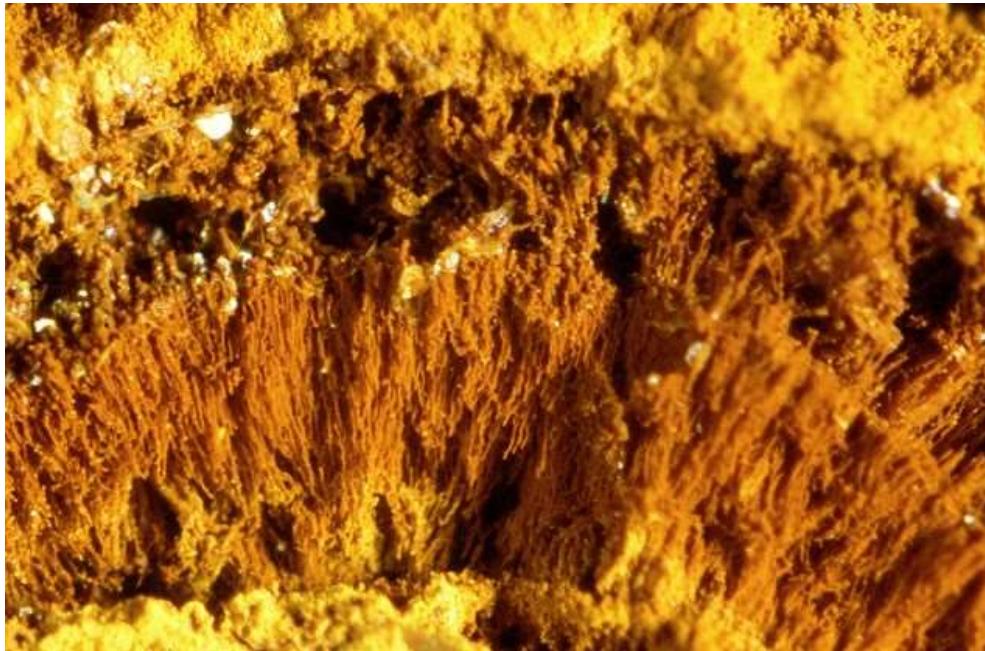


Málþing um steingervinga, 26.8.2017

Lífverur í ummyndunarsteindum í Breiðdal, Austfjörðum

Christa Feucht (Breiðdalssetur ses)

Beda A. Hofmann (University of Berne Switzerland)



Dr. Beda A. Hofmann, Háskóli í Bern



Efnisyfirlit

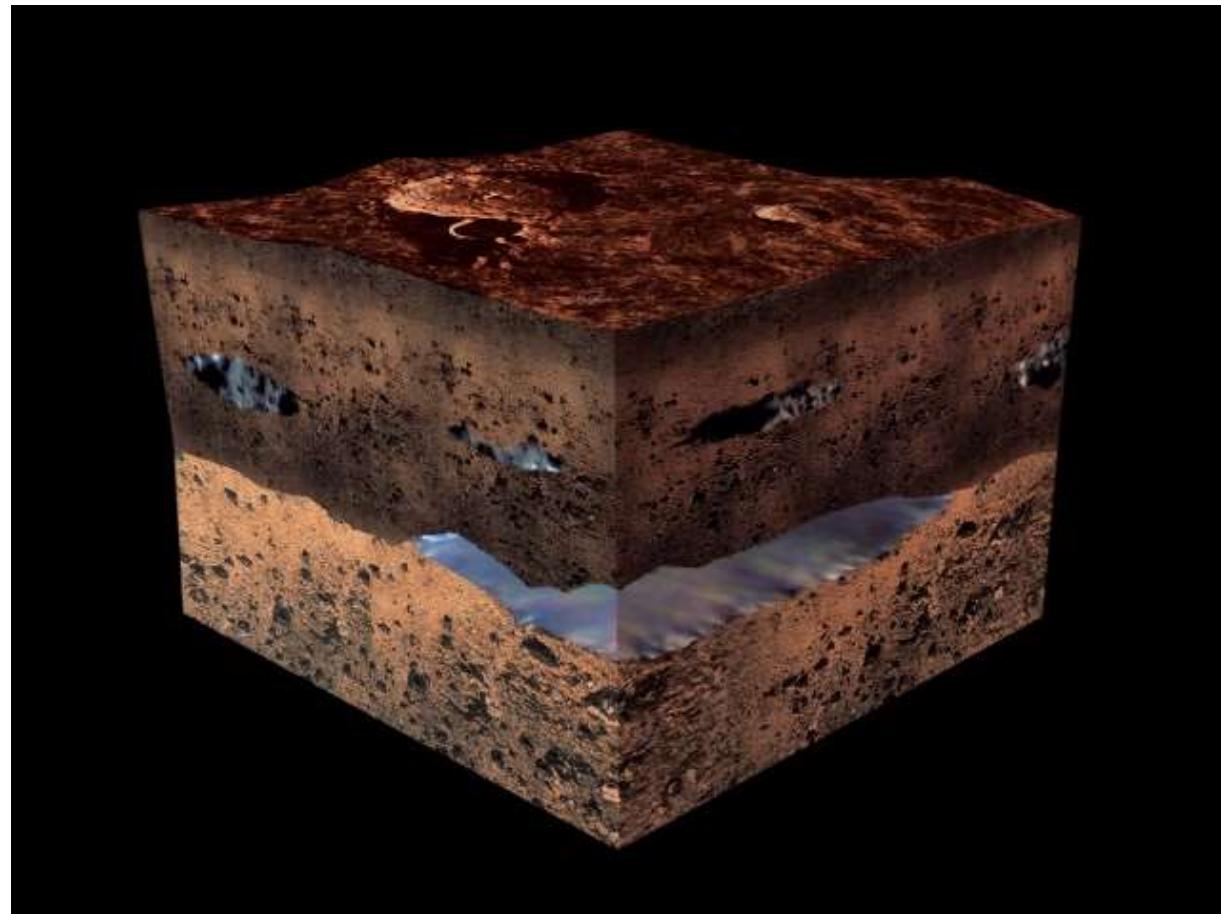
- 1. Inngangur
- 2. Jarðfræði Breiðdals á Austfjörðum
- 3. Ummynndunarsteindir
- 4. Vísbendingar um lífverur undir yfirborði jarðar
- 5. Umræða og ályktanir
- 6. Heimildir



1. Inngangur

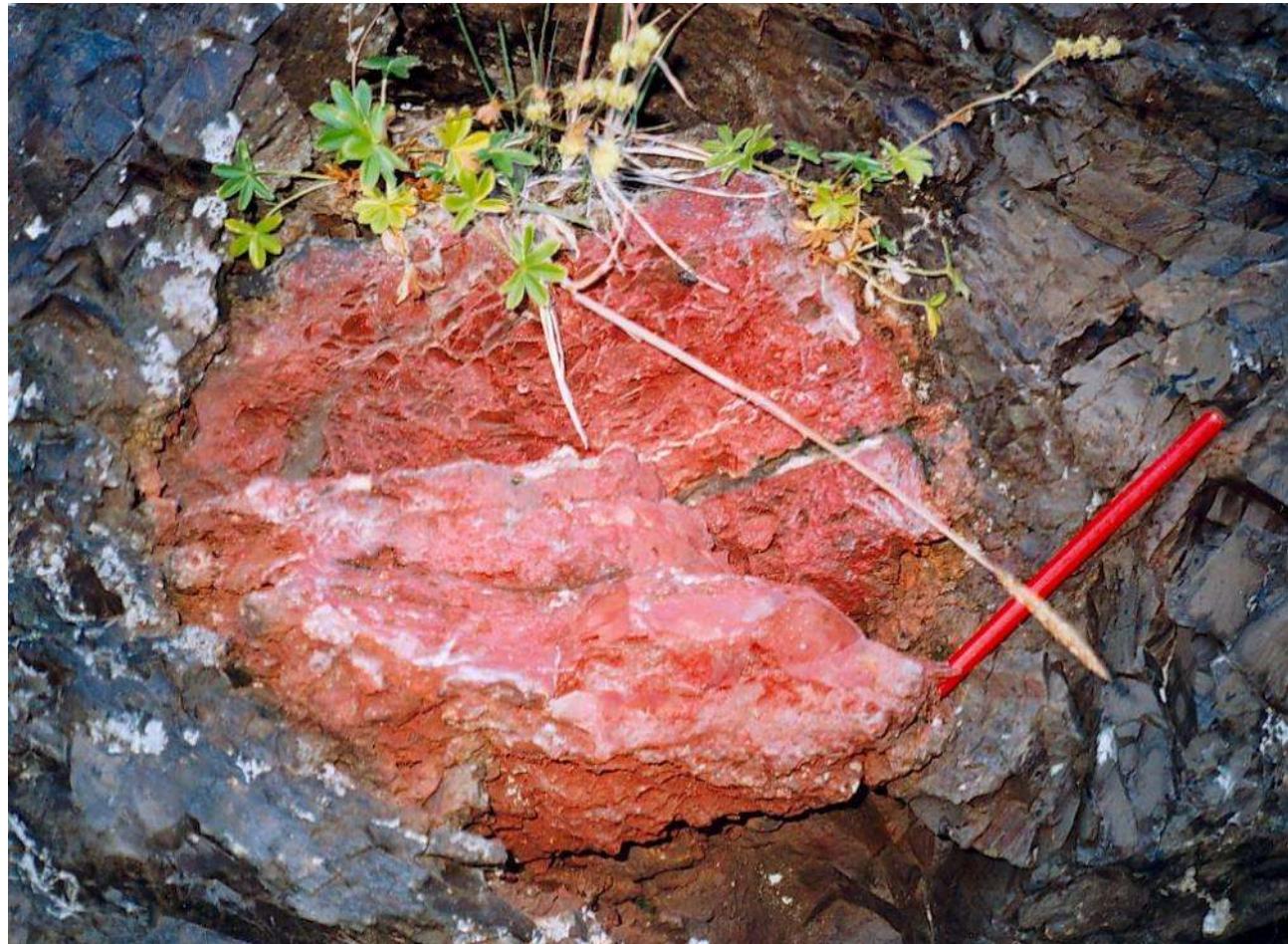


Lengi var ekki vitað hve margar tegundir af örverum eru til í neðan jarðar.
Stór hluti af lífmassanum er gerður úr örverunum.



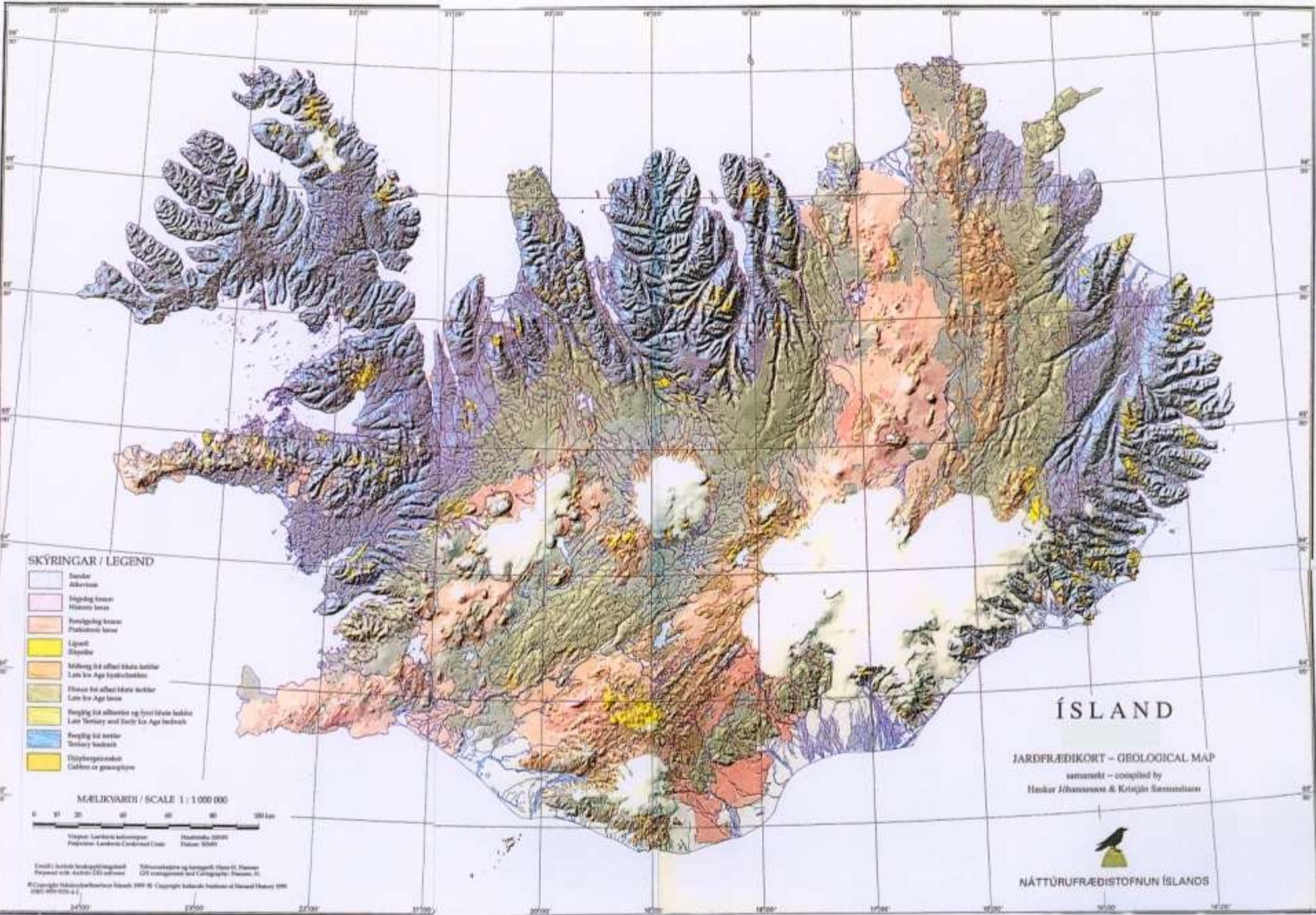
Basalt frá tertieri inniheldur holufyllingar

Jaspís: Kísilsteindir með
auka járn-oxídum eins og
hematít og jarnríkar
leirum.



2. Jarðfræði í Breiðdal





Megineldstöðvar frá tertíeri og flæðibasaltlög

STRUCTURAL MAP OF EASTERN ICELAND

- Selected stratigraphic horizons
- Dip of lavas
- Areas with dip of 10° or more
- Acid volcanic rocks and palagonite tuffs
- Calderas
- Intrusions: granophyre, granite & gabbro
- Lignites
- Quaternary or late Tertiary palagonite breccias

INTRUSIONS

- 1 Austurhorn & Krossanesfjall
- 2 Rauðfjall
- 3 Vesturhorn
- 4 Slaufrídal
- 5 Ketillaugafjall
- 6 Geitafell & Viðborðsfjall
- 7 Thormóðarhínúta

STRATIGRAPHIC HORIZONS

- k Base of Heiðarvatn QB. group
 - j Base of Fossárvík PB. group
 - h Base of Fagradalur QB. group
 - g Base of Gránavatn PB. group
 - f Berufjörður acid tuff
 - e Hölmastindur acid tuff & lignite
 - d Reyðarfjörður acid tuff & PB.
 - c Top of Hólmars O.B. group
 - b Base of Vindháls R.B. group
 - a Base of Gerpir RB. group
- (O.B.: olivine-basalt
P.B.: feldspar-porphyritic basalt)

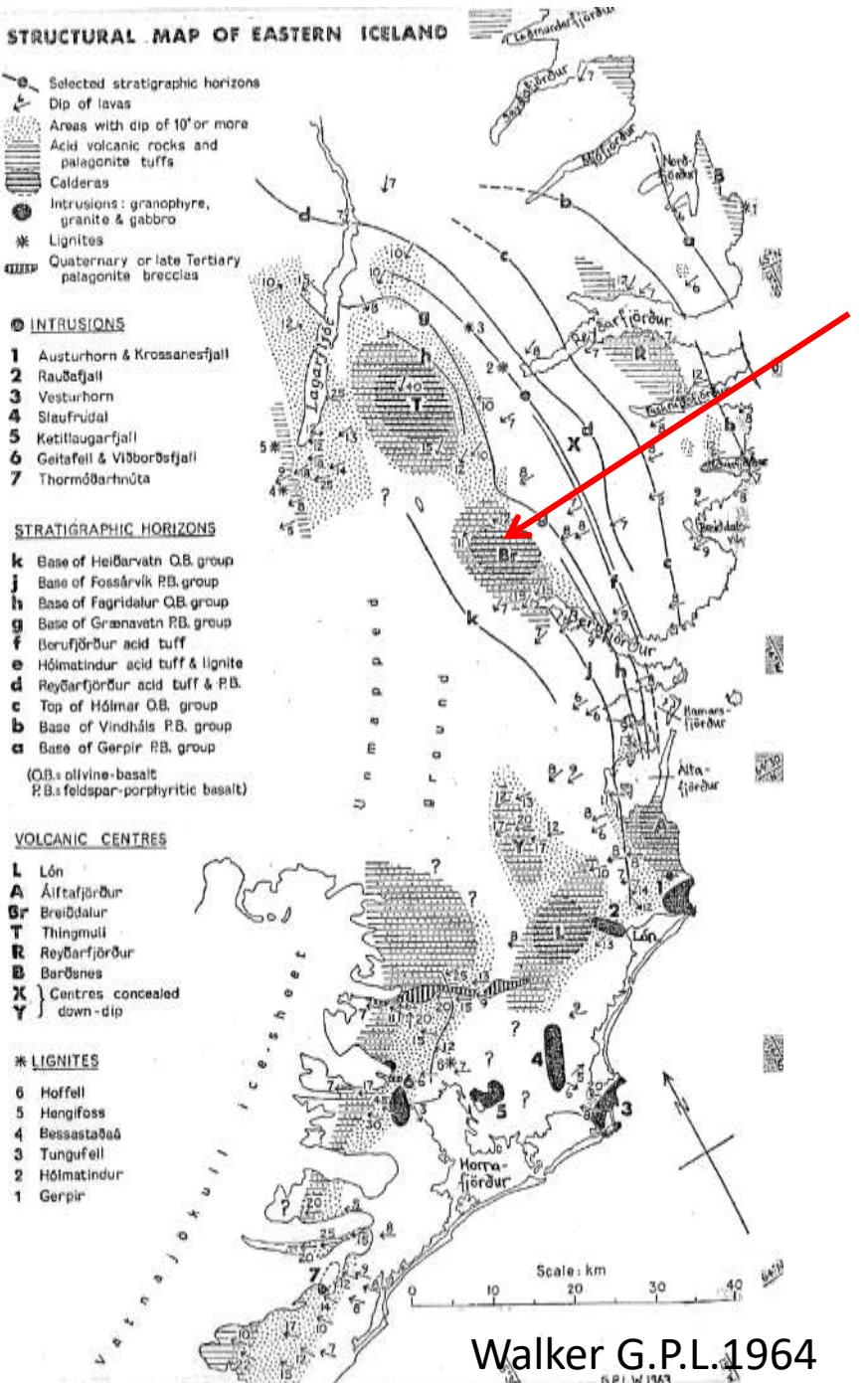
VOLCANIC CENTRES

- L Lón
- A Álftafjörður
- Br Breiðdalur
- T Thingmull
- R Reyðarfjörður
- B Þordánes
- X } Centres concealed down-dip

* LIGNITES

- 6 Hoffell
- 5 Hengifoss
- 4 Bessastaða
- 3 Tungufell
- 2 Hölmastindur
- 1 Gerpir

Walker G.P.L. 1964
R.P.I.W.M.A.T.



Flæðibasalt



Lakagígar 1783



BREIDDALSETUR
MÁLVISINDI - JARÐFRÆÐI - SAGAN
RESEARCH AND HERITAGE CENTRE

Megineldstöðvar



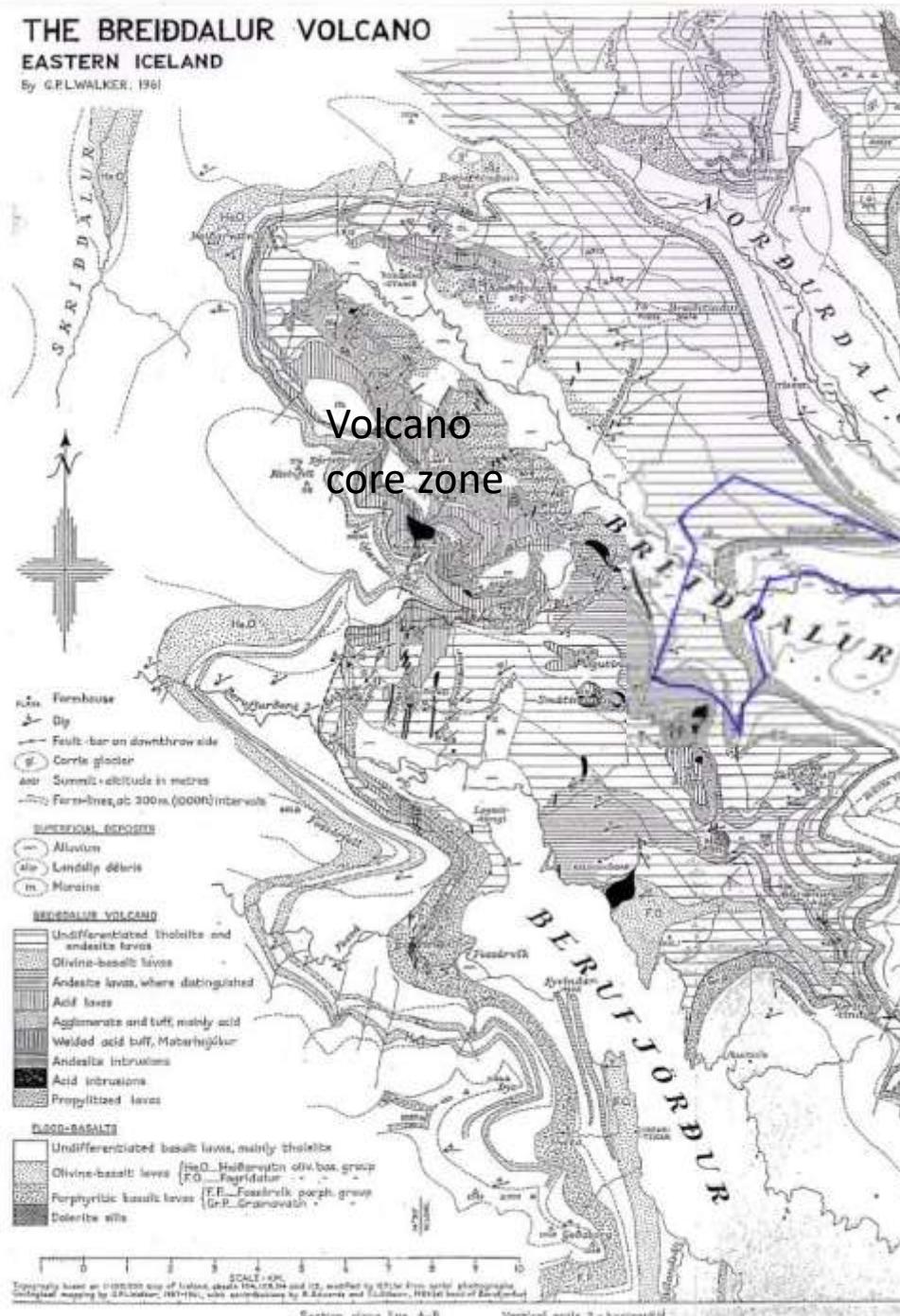
Eyjafjallajökull april2010

Walker G.P.L. 1963

THE BREIDDALUR VOLCANO

EASTERN ICELAND

By G.P.L. WALKER, 1961





3. Ummynndunarsteindir

- Geislasteinar
- Karbonöt
- Kísilsteindir: Kvarts, kalsedón, ópall
- Annað (Seladonít, Goethít)



Geislasteinar

Geislasteinar



Plötuform



Skólesít

Stilbít



Karbonöt

Kalsít



Aragontít



Kísilsteindir

Kvars



Ópall



Kíslsteindir

Glerhallur, kalsedón



Annað

Seladonite



Goetít



4. Vísbendingar um lífverur undir yfirborði jarðar





Pússaðar þunnsneiðar af jaspísi úr Breiðdal

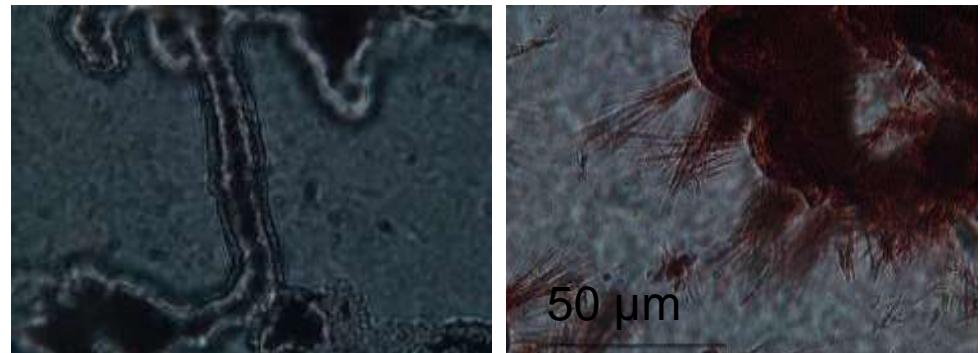


Núverandi lífverur sem taka orku úr efnahvarfi
Fe²⁺ í Fe³⁺ ($\text{Fe}^{2+} + \frac{1}{4} \text{O}_2 + \text{H}^+ \rightarrow \text{Fe}^{3+} + \frac{1}{2} \text{H}_2\text{O}$)
Gallionella ferruginea, finnst í mýrum

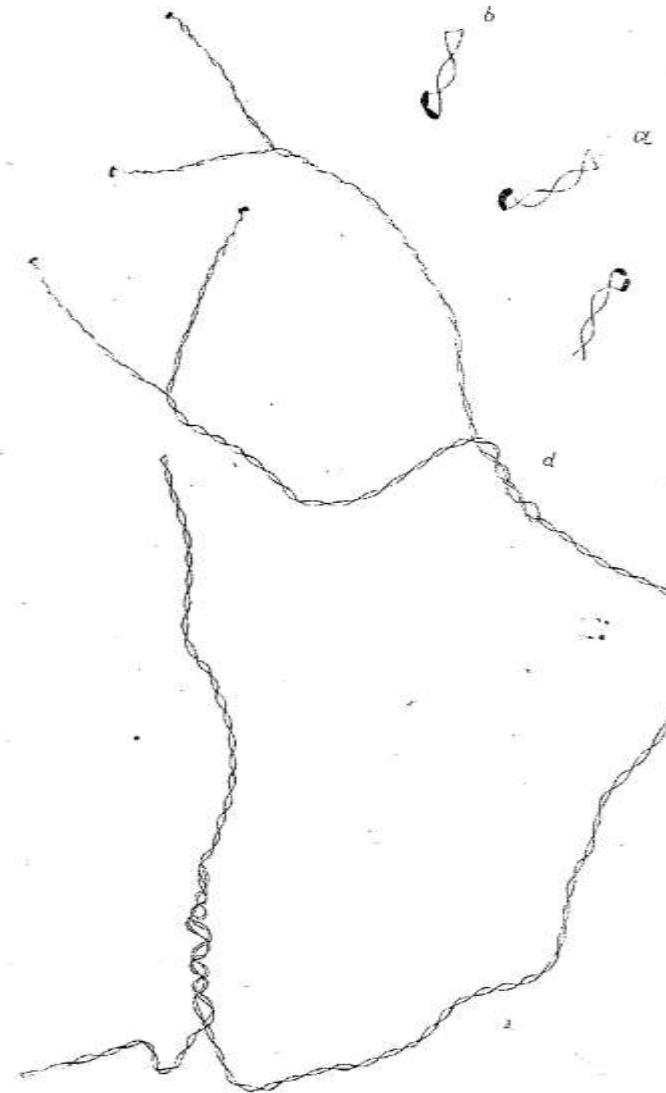
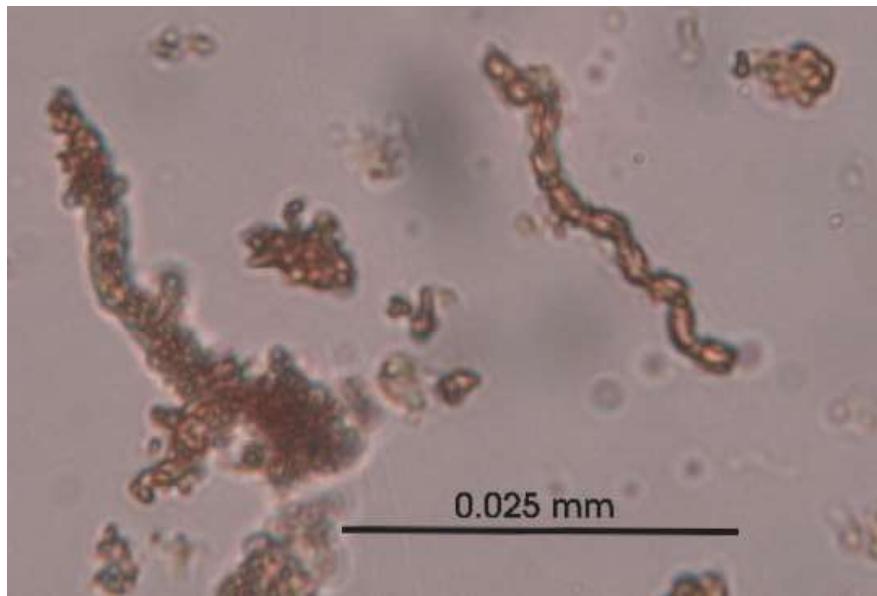


Sundurgreining þráðanna: lífrænt vs ólífrænt

- Þræðir
- Óreglulegir
- Lína í þræði $<5 \mu\text{m}$
- Línan í þræðinum beygist óreglulega ($<0,5^\circ/\mu\text{m}$), breytir oft um átt $>10/\text{mm}$)
- Umhverfi er hentugt fyrir frumlífverur,
 - Vökvi
 - Orkugjafi (steindir eða uppleyst efni)
 - Hitinn hentugur $0 < 120^\circ\text{C}$



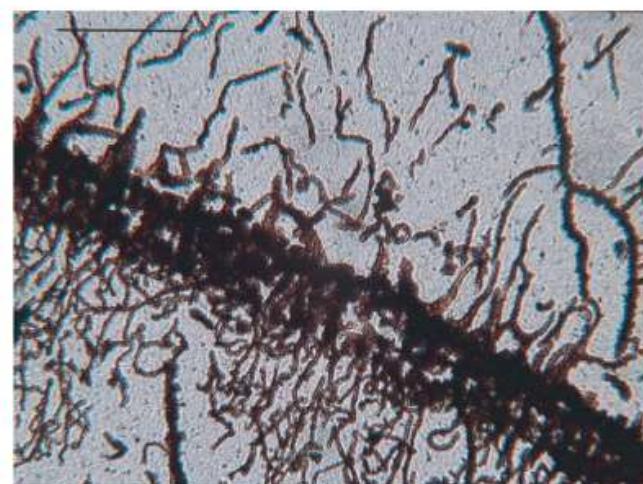
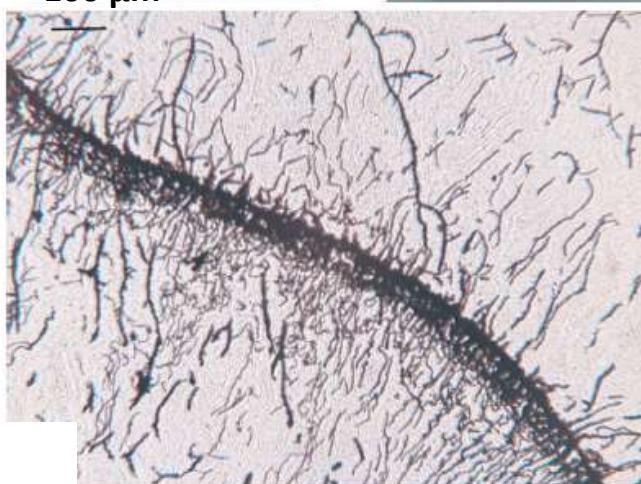
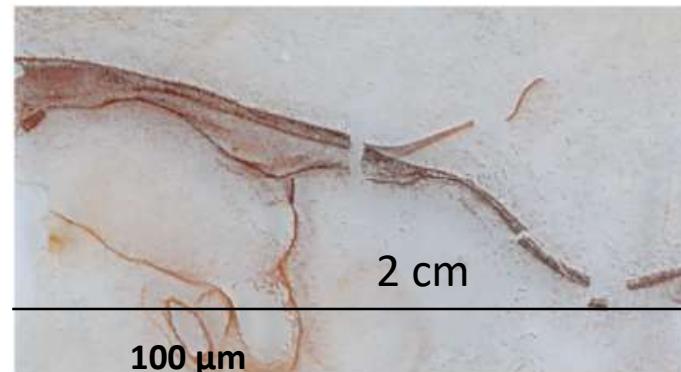
Dæmi um mögulega
lífveru undir yfirborði:
Gallionella ferruginea
Tekur orku úr efnahvarfi frá
Fe²⁺ í Fe³⁺



Spor af *Gallionellu* f.
lífverunni, stækkað 1000x
Ref. Cholodny 1924



Steingerðir þræðir með lífrænan uppruna



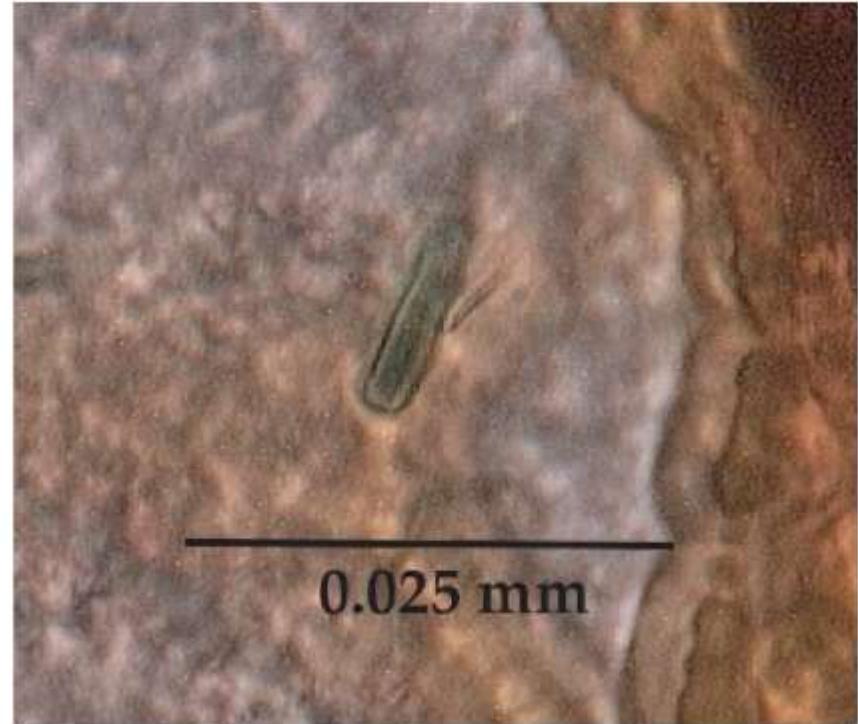


Picture <----> ca 300 µm, skautað ljós

Leptothrix (baktería)



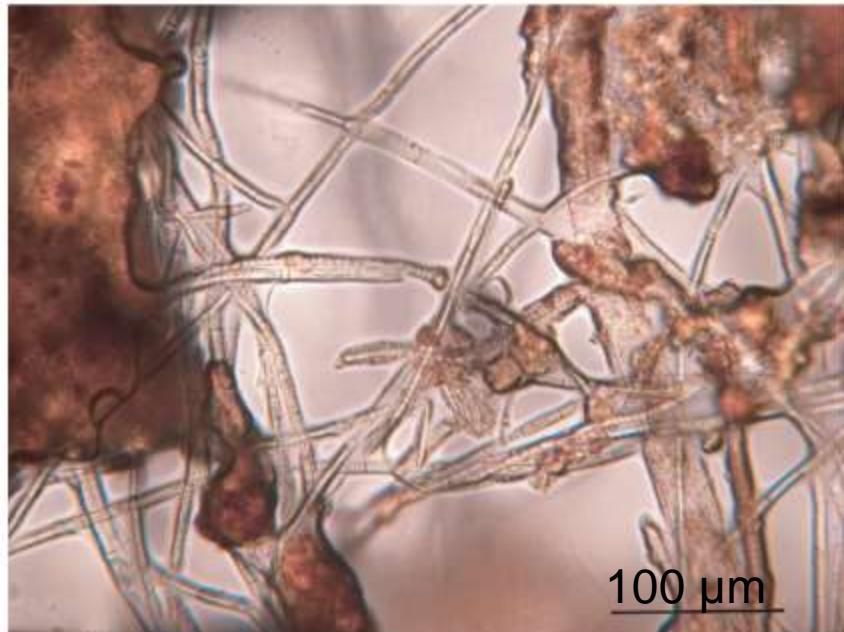
Tekin úr mýri í Breiðdal



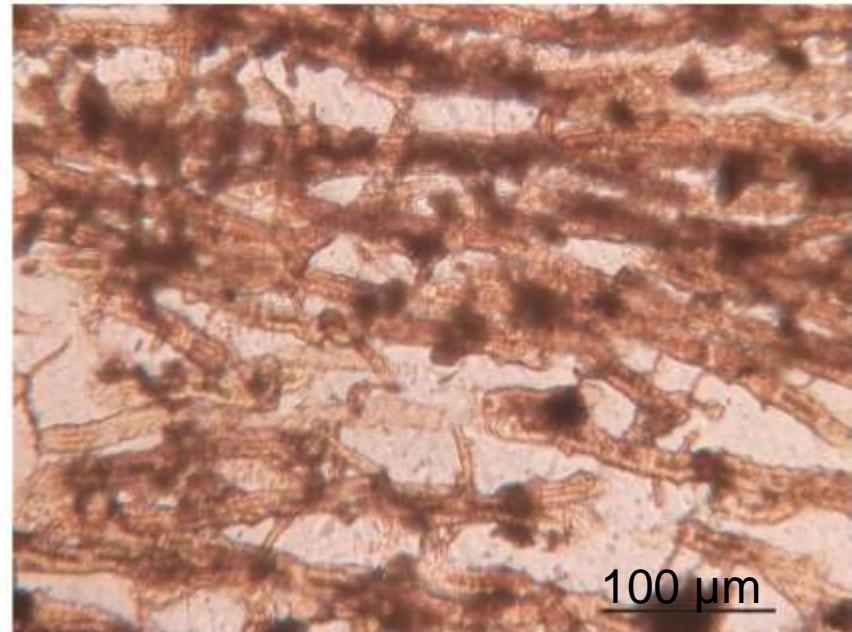
Steingert í jaspísi



Sveppir

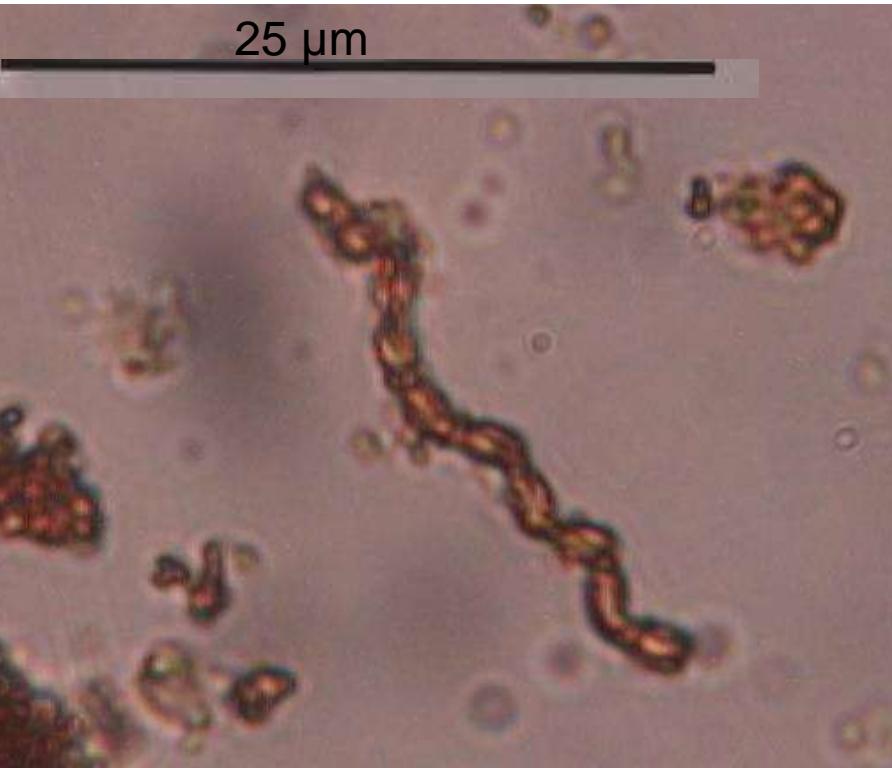


Lífandi í dag

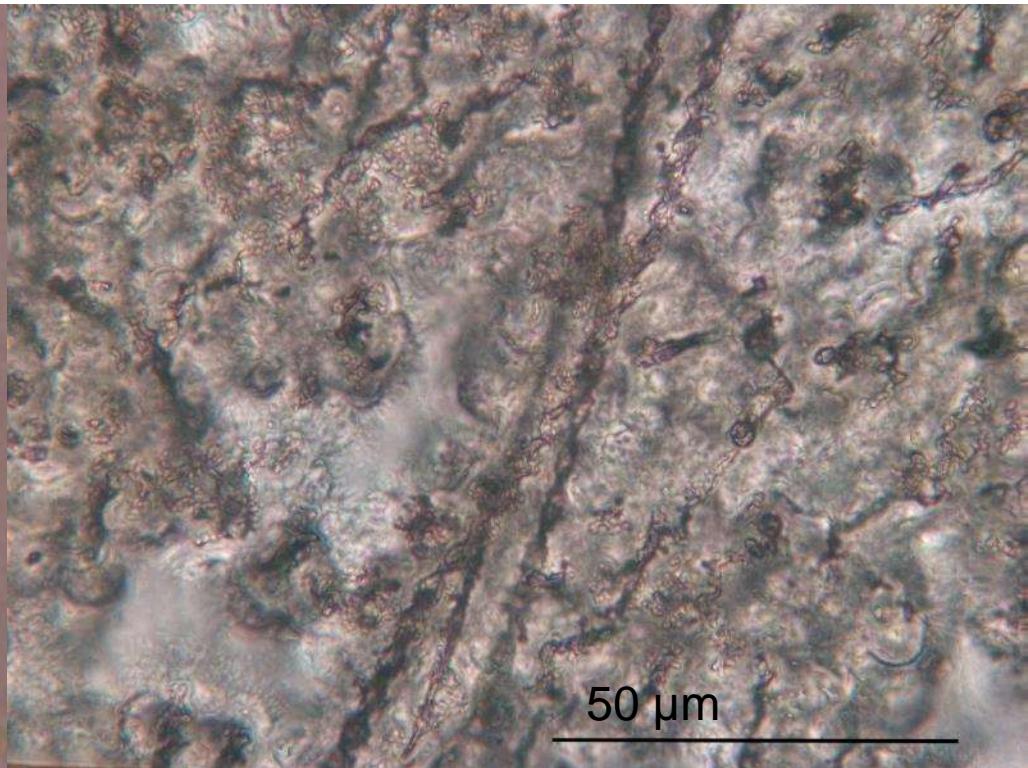


Fannst í jaspísi

Gallionella ferruginea, Fléttuð formgerð, *Gallionella ferruginea*

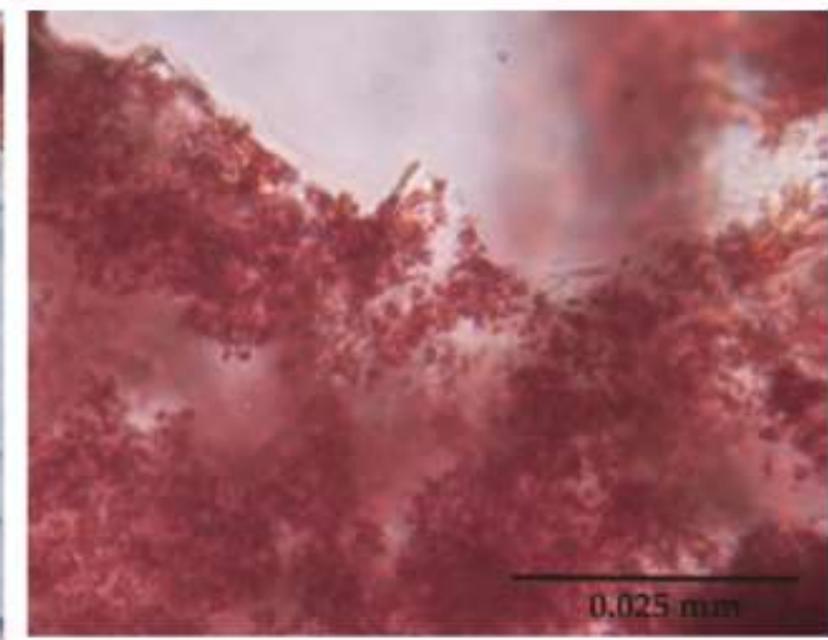


Nútíma úr mýri



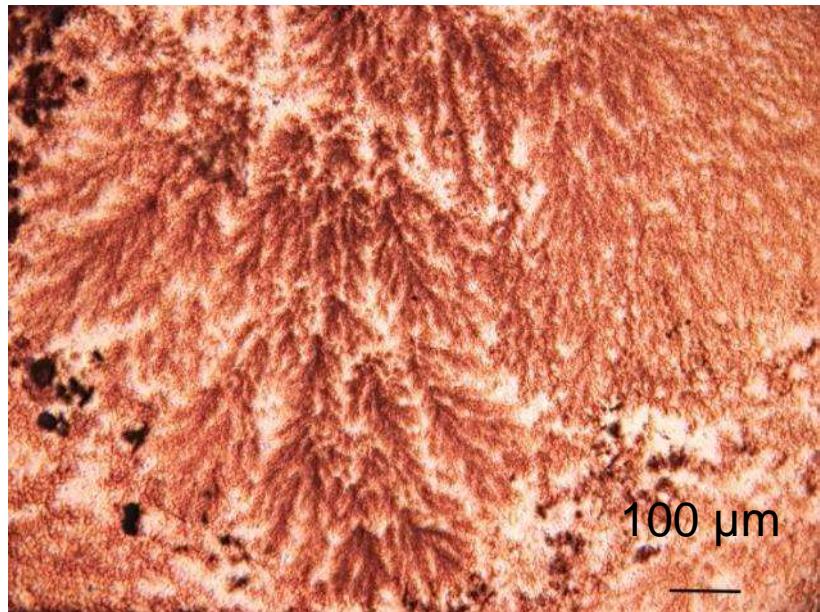
Steingert í jaspísi

Óljóst hvort lífrænt eða ólífrænt

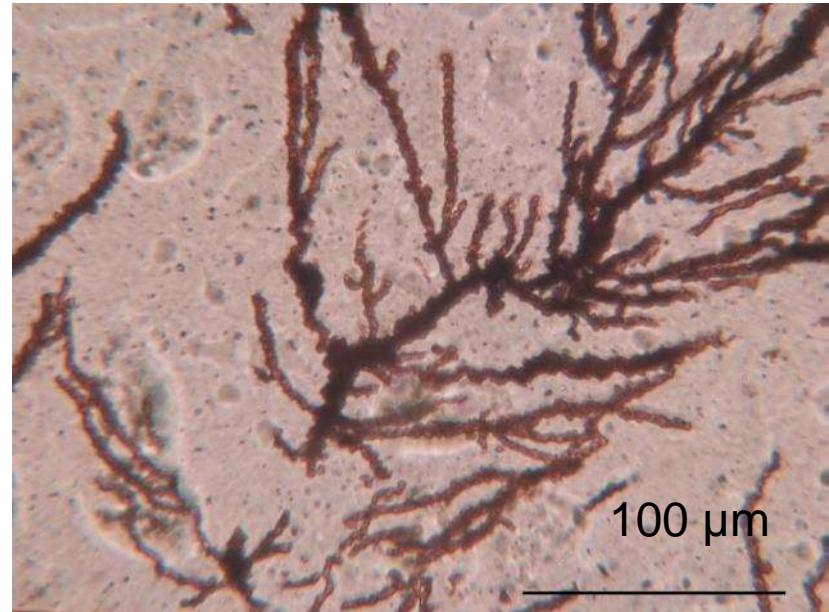


Óljóst hvort lífrænt eða ólífrænt: Dendrites

Líklega ekki lífrænt uppruna



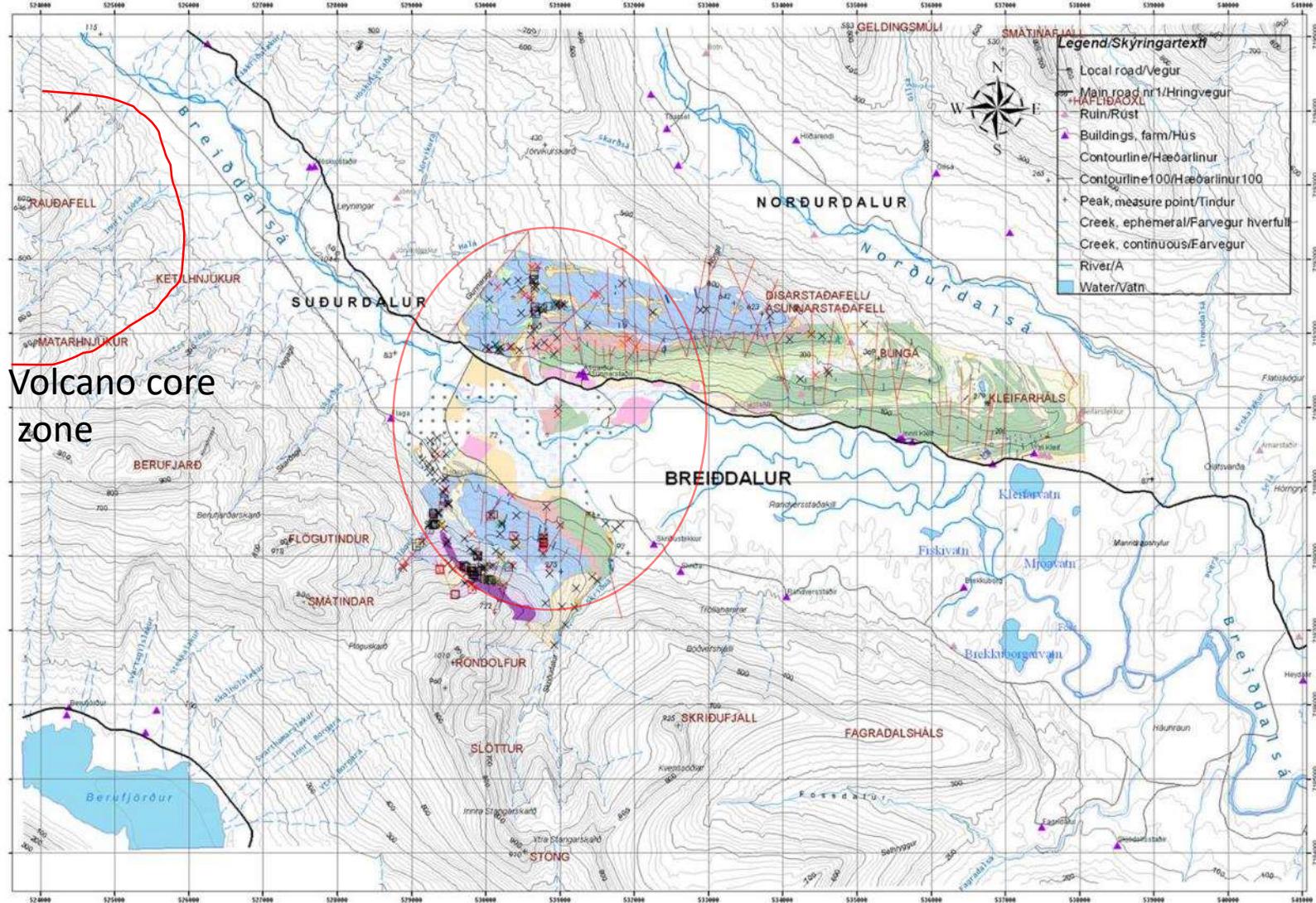
Líklega lífrænt uppruna



5. Niðurstöður



Jaspís tengt Breiðdalseldstöð, baugur ~5 km frá eldstöðvarkjarna sem jaspís virtist vera algengastur



Í basalti og andesíti

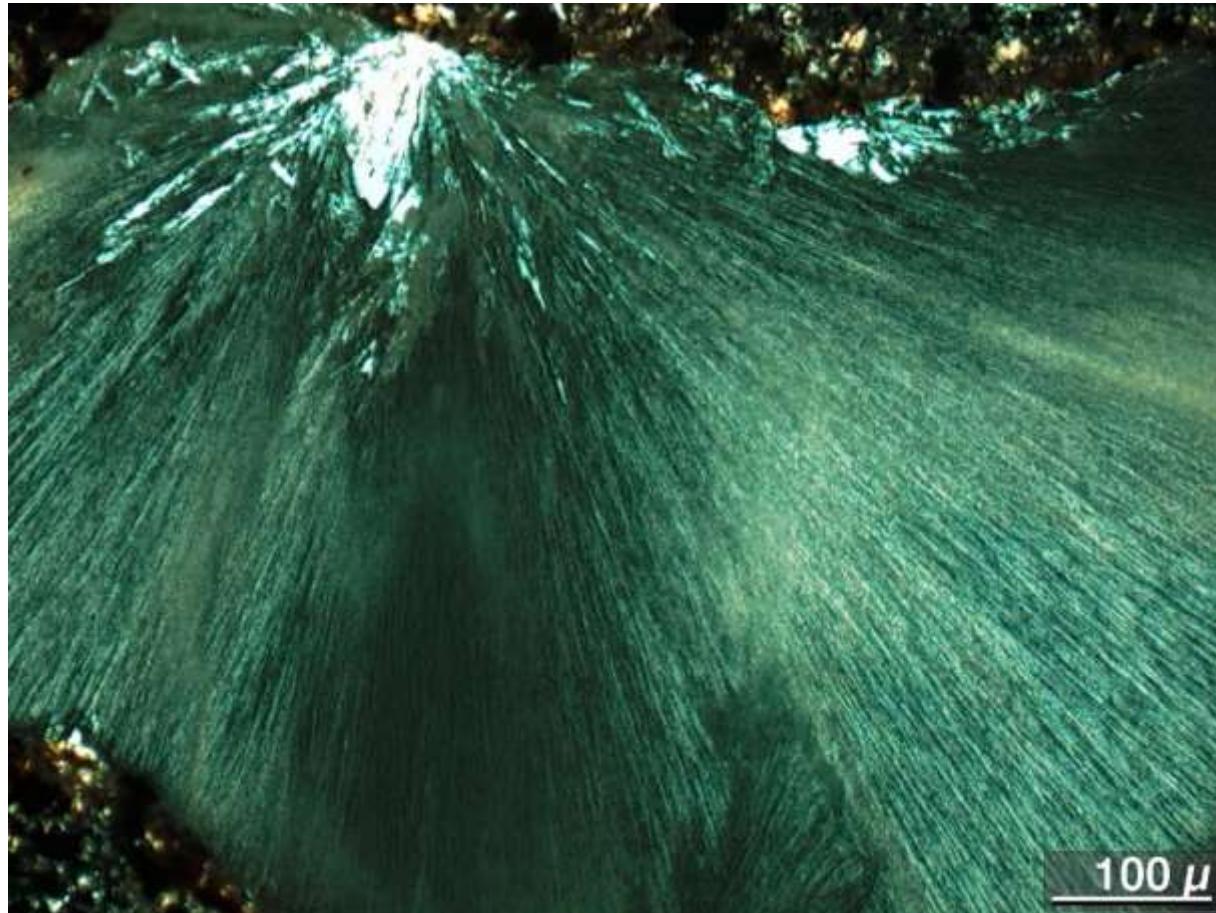
Basalt



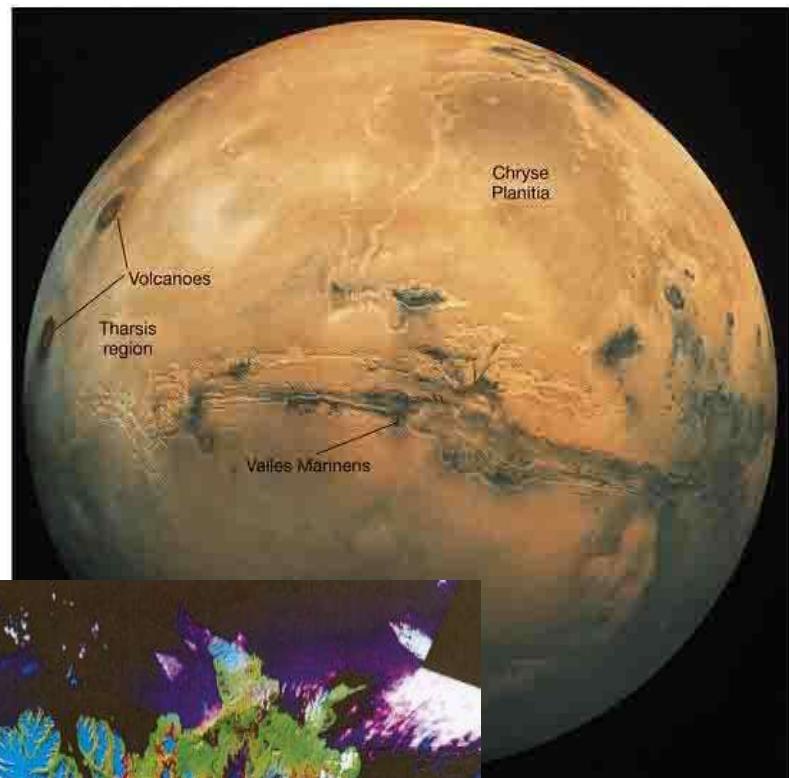
Andesít



Engar frumverur fundust í geislasteinum héðan



Tillgangur rannsóknanna???? Líf utan jarðar



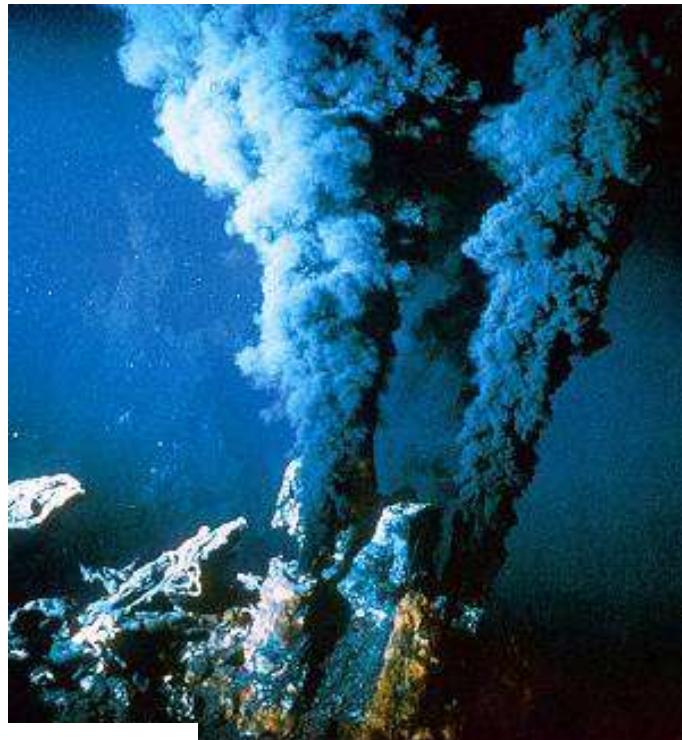
Umhverfi nauðsynlegt fyrir frumlíf

- Vatn eða annar vökvi?
- Steindir leystar í vökvanum
- Hiti



Frumlífverur heima (á jöðinni): Í sjónum

Black smoker



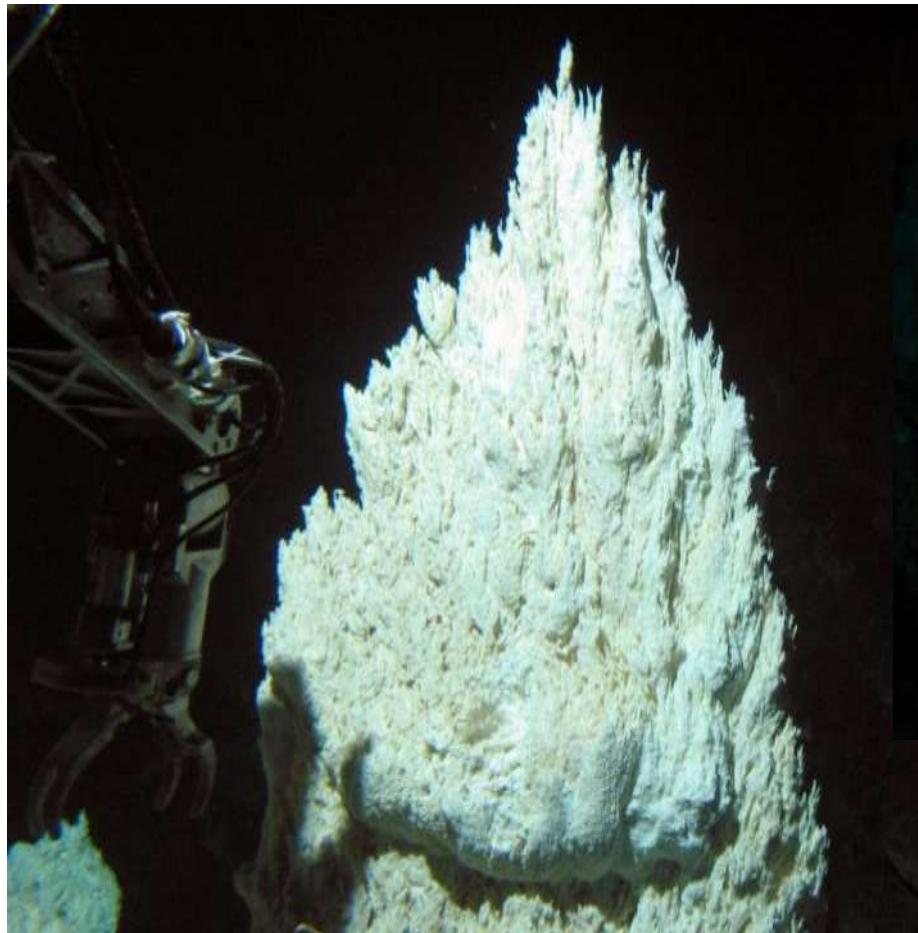
White smoker



Frumlífverur heima (á jöðinni): Non-smokers, lost City, 2000



Frumlífverur heima (á jöðinni): Úr karbonötum



Vatn 40-75°C



Frumlífverur á Mars: tenging til Íslands



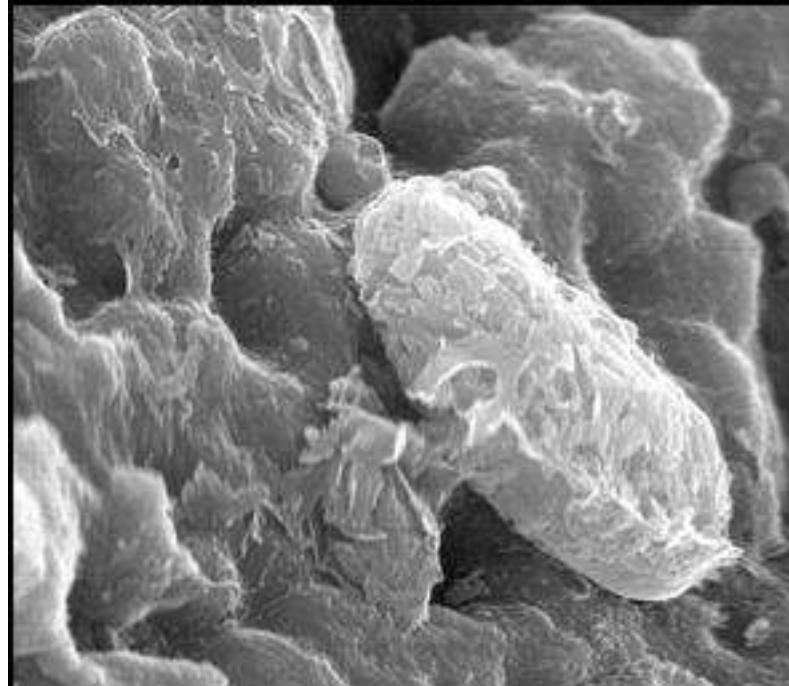
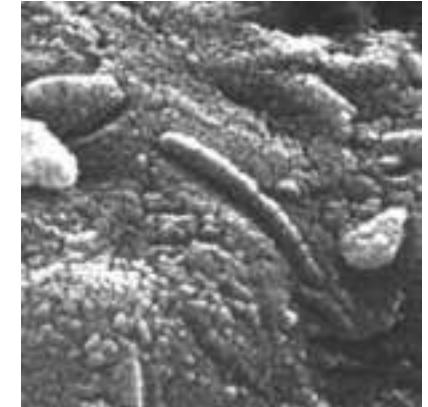
Olympus Mons

Tharsis eldfjallasvæðið,
virkt??, vatn í vökvaformi?

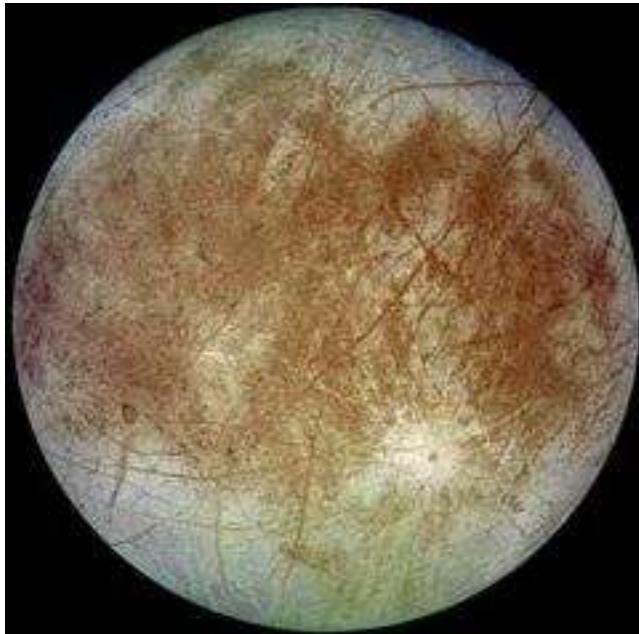
Frumhlífverur á Mars: tenging til Íslands

Mars Meteorite ALH84001, Antarctica lífrænt strúktúr?

Mckay et al. 1996.



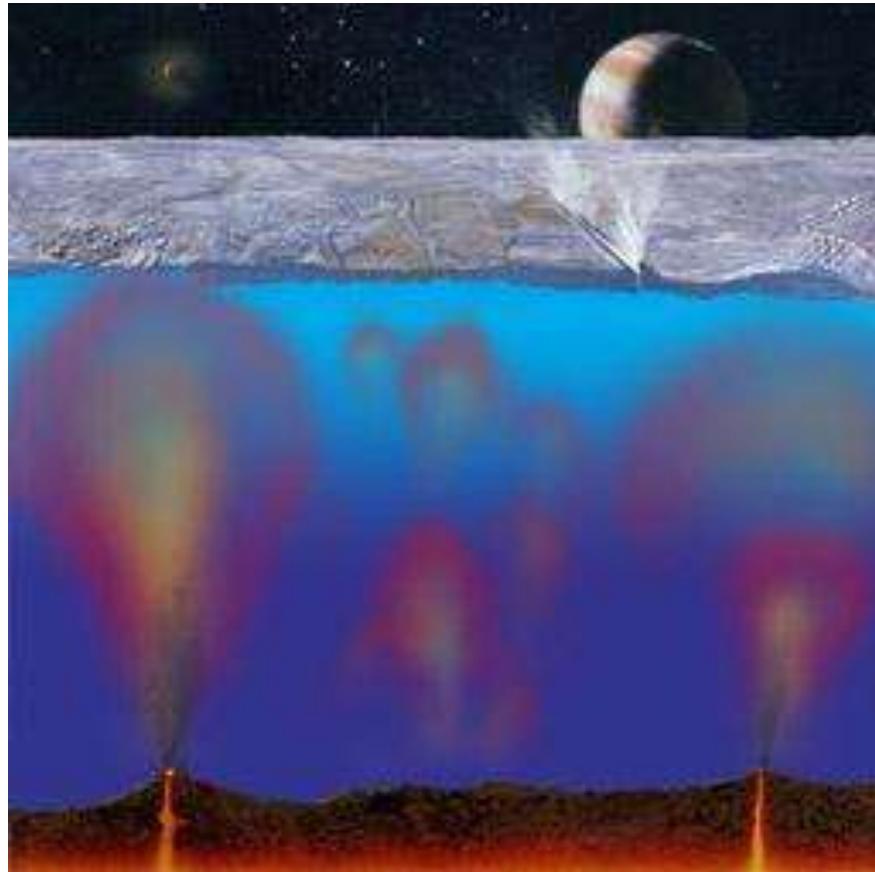
Frumlífverur á Júpíter tungli Evropu



PIA3878

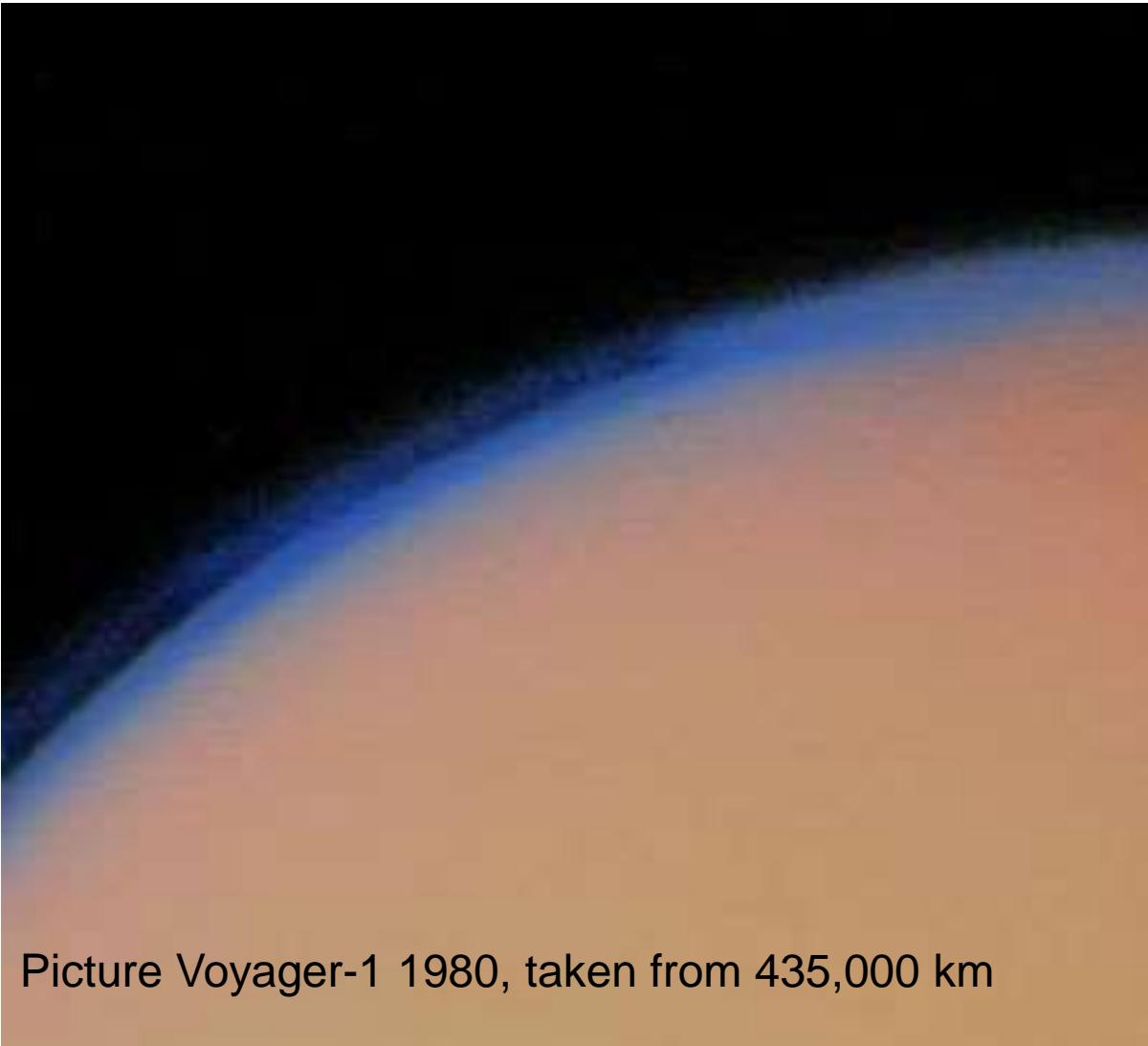


Frumlífverur á Júpíter tungli Europa



Europa: Flekaskil á ís?

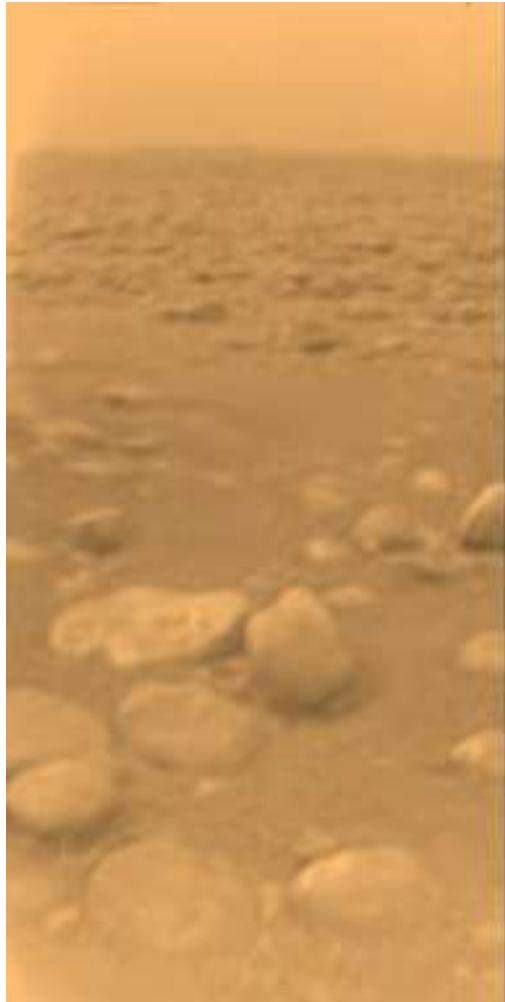
Frumlífverur á Saturnus tungli Títan



Picture Voyager-1 1980, taken from 435,000 km



Frumlífverur á Saturnus tungli Títan



ESA, Space probe
Huygens, jan 2005,
landing site



Methan í vökvaformi,
mynd frá 16 km

6. Heimildir



References

My researches based on:

- Hofmann und Farmer 2000:

Filamentous fabrics in low-temperature mineral Assemblages: Are they fossil biomarkers? Implications for a subsurface fossil record on Earth and Mars.



References: Subsurface Filamentous Fabrics

Hofmann B.A. et al.

- Hofmann B. A., 2007. Morphological biosignatures from subsurface environments: recognition on planetary missions. *Space Science Reviews*. DOI 10.1007/S11214-007-9147-9.
- Hofmann et al. 2008: Subsurface Filamentous Fabrics: An Evaluation of Origins Based on Morphological and Geochemical Criteria, with Implications for Exopalaeontology. *Astrobiology*, Volume 8, Number 1, 2008
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Reference for extreme life

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- MARTEINSSON, V.B., KRISTJANSSON, J.K., KRISTMANNSDÓTTIR, H., DAHLKVIST, M., SÆMUNDSSON, K., HANNINGTON, M., PÉTURSDÓTTIR, S.K., GEPTNER, A. & STOFFERS, P. 2001: Discovery and description of giant submarine smectite cones on the seafloor in Eyafjörður, Northern Iceland, and a novel thermal microbial habitat. *Applied and Environmental Microbiology* 67, 827-833

Takk fyrir

2004

