Vorráðstefna
Jarðfræðafélags Íslands
60 ára afmæli félagsins

Ágrip erinda

Askja, Náttúrufræðahús Háskóla Íslands
13. mars 2026

Vorráðstefna Jarðfræðafélags Íslands 60 ára afmæli félagsins

Ágrip erinda

Umsjón

Þorsteinn Sæmundsson, Bjarni Gautason, Hafdís Eygló Jónsdóttir,
Halldór Geirsson, Lúðvík E. Gústafsson & Vala Hjörleifsdóttir

Dagskrá Vorráðstefnu JFÍ, 13. mars 2026

08:30 Skráning opnar. Veggspjöld hengd upp.

Fundarstjóri Bjarni Gautason

08:55 – 09:00 Setning
Dr. Þorsteinn Sæmundsson forseti Jarðfræðafélagsins

09:00 – 09:10 Ávarp frá Háskóla Íslands
Dr. Silja Bára R. Ómarsdóttir rektor

09:10 – 09:35 Jarðfræðafélag Íslands sextíu ára
Lúðvík E. Gústafsson

09:35 – 09:50 Kvikukerfið undir Grímsvötnum á sögulegum tíma samkvæmt gjóskulögum í Vatnajökli
Olgeir Sigmarsson

09:50 – 10:05 The Traditional Out of Africa I Model Revisited: A View from China
Christopher Bae

10:05 – 10:20 Integrating enhanced weathering with biochar and iron oxide for CO_2 drawdown and soil remediation
Prince Addai

10:20 – 10:40 Kaffi – Veggspjaldasýning

Fundarstjóri Vala Hjörleifsdóttir

10:40 – 10:55 Refining rates and the magnitude of Iceland´s Early Holocene sea level low-stand
Wesley Randall Farnsworth

10:55– 11:10 Quantitative petrography of lower crustal xenoliths from the 2021 Fagradalsfjall eruption
Bryndís Ýr Gísladóttir

11:10 – 11:25 Fyrstu íslensku steinhúsin og hleðslusteinninn í þeim
Árni Hjartarson

11:25 – 11:40 SWOT Satellite Altimetry Observations and Source Model for the Tsunami from the 2025 M 8.8 Kamchatka Earthquake
Angel Ruiz-Angulo

11:40 – 11:55 Næturvaktin: náttúrvárvöktun á Veðurstofu Íslands
Sigríður Kristjánsdóttir

11:55 – 12:10 Structural Controls of Holocene Age Volcanism along the Ljósufjöll Lineament, West Iceland
Elijah Owens

12:10 – 12:55 Matur – Veggspjaldasýning

Fundarstjóri Halldór Geirsson

12:55 – 13:10 Walker's legacy revisited on the occasion of his 100th birthday anniversary
Bjarni Gautason

13:10 – 13:25 A new geological map and dating of the Goðaland-Fimmvörðuháls area, south Iceland
Rosie P. Cole

13:25 – 13:40 The Geothermal Flow Loop: An Experimental Platform for Multiphase Flow at Geothermal Conditions
Adolph Bravo Jr.

13:40 – 13:55 High $^3He/^4He$ plumes are hotter and melt more: evidence from the petrology and geochemistry of ocean island basalts
Sunna Harðardóttir

13:55 – 14:10 Linking silicic magma reservoir growth to upper crustal deformation: Slaufrudalur pluton, Southeast Iceland
Orlando Quintela

14:10 – 14:25 Seismic monitoring of geothermal fields in El Salvador and the importance of location accuracy. Case study: Ahuachapán geothermal field, El Salvador
Alvaro Josué Campos Ramos

14:25 – 14:40 Skeiðarárhlaupið í nóvember 1996 og hafið
Jón Ólafsson

14:40– 14:55 The magmatism of 2021-23 Fagradalsfjall Fires, Reykjanes Volcanic Belt, Iceland
Þorvaldur Þórðarson

14:55 – 15:20 Afmæliskaffi & Veggspjaldasýning

Fundarstjóri Lúðvík E. Gústafsson

15:20 –15:35 Inflation in 2023 at the Þeistareykir high-temperature geothermal field, NE-Iceland, revealed by seismic, InSAR and GNSS time-series analysis
Egill Árni Guðnason

15:35– 15:50 Thermal effect of repeated diking during eruptions: The Krafla fires in 1975-1984
Patricia Fehrentz

15:50– 16:05 Samspil eldstöðvakerfa á umbrotatímum: líkön af Reykjanesskaga
Sonja H. M. Greiner

16:05 – 16:20 Has a mantle phase transition been misidentified as the Moho beneath Iceland?
Guðmundur H. Guðfinnsson

16:20– 16:35 Deformation and gravity change at Askja volcano, Iceland, during the current inflation episode, 2021 – 2025
Fjóla María Sigurðardóttir

16:35–16:50 Clinopyroxenes as archives of magma evolution from source to surface: The example of the Seljalandsheiði basalt from the Eyjafjallajökull Volcano, S-Iceland
Enikő Bali

16:50 –17:05 'Lodge' moraines: a common yet under-reported type of end moraine
Ívar Örn Benediktsson

Veggspjöld

Quantification and Analysis of Deformation in the Hengill Geothermal Area, SW Iceland, Using InSAR.
Binaya Dhakal, Halldór Geirsson & Yilin Yang

Tephra deposits and carbon dynamics in Icelandic peatlands.
Theresa Bonatotzky, Susanne C. Möckel, Róbert Í. Arnarsson, Egill Erlendsson & Guðrún Gísladóttir

Monte Carlo hermun með hitaglæðingu fyrir samtíma staðsetningu jarðskjálfta og ákvörðun á einvíðu hraðalíkani: „Lágmarks“ líkön með jarðlögum þar sem hraðastigull er fasti.
Einar Kjartansson & Ingi Þorleifur Bjarnason

The Dalvík Lineament, North Iceland: Structural and Seismo-Tectonic Implications for Geothermal Resources and Quaternary Landslides.
Danielle Forester & Gregory P. De Pascale

Brautryðjendur í rannsóknum á Íslandi á fornsegulsviði jarðar – Iceland's paleomagnetic pioneers.
Haraldur Auðunsson, Þorgerður Þorleifsdóttir & Elisa Johanna Piispa

Characterisation of two geothermal systems in SW Iceland: Hengill & Sveifluháls.
Franck Latallerie, Vala Hjörleifsdóttir, Marius Isken, Ettore Biondi, Anne Obermann & Shi Peidong

Observations of P-wave phase arrivals from major earthquakes with the IRIS fiber-optic subsea cable connecting Iceland and Ireland.
Aude Lepere, Vala Hjörleifsdóttir, Arnar Ingi Gunnarsson, Mikael Mazur, Valey Kamalov, Martin Karrenbach, Ethan F. Williams, Örn Jónsson, Nicolas. K.Fontaine, Roland Ryf, Lauren Dallachiesa & David T. Neilson

Safnkostur borkjarnasafns Náttúrufræðistofnunar myndaður og birtur í Kortaglugga Íslands.
María Helga Guðmundsdóttir, Ásta Kristín Óladóttir, Bjarni Gautason, Björn Darri Sigurðsson, Hrafnkell Hannesson, Kjartan Birgisson, Kaya de Bruijn, Kristin Fischer & Tabea Gans

Palaeodirectional Analysis of Westfjords Lava Flows to Investigate the Mid-Miocene Kleifakot Event
Shefali Poojary, Elisa Johanna Piispa, Jowita Kumek, Yuhji Yamamoto & Hiroyuki Hoshi

The ENKI project: Advances in thermodynamic modelling of volcanic systems.
Simon Matthews & the ENKI development team

Bergsegulmælingar á Vestfjella basaltstaflanum á Gondwana varpa nýju ljósi á flóðabasaltvirkni fyrir um 183 milljónum ára.
Elisa J. Piispa, Arto V. Luttinen, Johanna M. Salminen & Lauri J. Pesonen

Efnisyfirlit

Ágrip

Integrating enhanced weathering with biochar and iron oxide for CO_2 drawdown and soil remediation

Prince Addai[1]; Susanne Claudia Möckel[1]; Tobias Linke[2] & Albert Kobina Mensah[3]

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[3]CSIR-Soil Research Institute, Private Mail Bag, Kwadaso-Kumasi, Ghana

The rising trend in global soil degradation and climate change constitutes an urgent environmental crisis that requires sustainable, nature-based carbon dioxide removal (CDR) technology to halt, prevent, and reverse the associated negative impacts. Among the CDR approaches, enhanced weathering (EW) has shown promising results for atmospheric CO_2 removal. However, significant concerns have been raised about the ecotoxicological threats posed by EW, particularly the potential release of toxic metals (TMs) into soil. To date, no thorough studies have examined how EW interacts with biochar and iron oxide to influence both CO_2 reduction and potential TMs in degraded ferric acrisol in Ghana. This contribution introduces a developing research project investigating whether combining EW with biochar and iron oxide can enhance CO_2 drawdown and TMs remediation while restoring vegetation in a degraded ferric acrisol landscape where small-scale mining and agriculture coexist. The main land use is agriculture, but widespread small-scale mining has contributed to land degradation and TM contamination, which requires urgent intervention. The study will employ a pot-field experiment using a randomised complete block design (RCBD), with 7 treatments and 5 replications. Thus, the study will quantify CO_2 drawdown using cation charge balance and a first-order kinetic model to project the long-term potential for CO_2 removal following the application of the combined amendments. We will evaluate the effect of EW combined with iron-modified biochar on the geochemical behaviour, bioavailability, and plant uptake of potentially TMs (Cr, Ni, Pb) in degraded, amended soils, and compare the findings with those from lone-amendment applications. Finally, the study will propose sustainable land management and carbon-smart practices to enable large-scale use of the selected soil amendments in degraded tropical acrisol environments.

SWOT Satellite Altimetry Observations for the Tsunami from the 2025 M 8.8 Kamchatka Earthquake

Angel Ruiz-Angulo[1 *], Diego Melgar [2], Charly de Marez [3], Aurélien Deniau [4], Francesco Nencioli [5] & Vala Hjörleifsdóttir [6]

Institute of Earth Sciences, University of Iceland, Reykjavik, Iceland[1]; Department of Earth Sciences, University of Oregon, Eugene, Oregon, U.S.A. [2]; University of Brest, CNRS, Laboratoire d'Océanographie Physique et Spatiale (LOPS), IUEM, Plouzané, France [3]; Collecte Localisation Satellites (CLS), Ramonville St Agne, France[4]; Collecte Localisation Satellites (CLS), Ramonville St Agne, France[5]; Reykjavík University, Reykjavik, Iceland[6]

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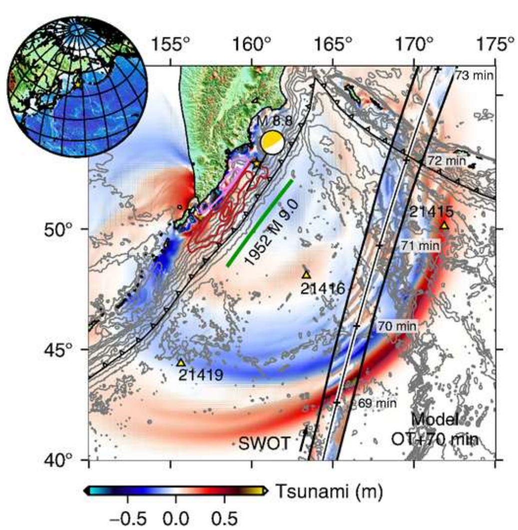
On 29 July 2025, an Mw 8.8 earthquake struck off Kamchatka, Russia, generating a Pacificwide tsunami and marking the largest earthquake since the launch of the surface water and ocean topography (SWOT) satellite in 2022. We analyze tsunami observations from SWOT together with three nearby deep-ocean assessment and reporting of tsunamis (DART) buoys to resolve the source of the event. SWOT provided the first high-resolution spaceborne track of a great subduction-zone tsunami, capturing waveforms that reveal complex propagation, dispersion, and scattering. Inversion of the DART time series using Gaussian unit sources shows that the rupture extended ~400 km along strike, with peak uplift of ~4 m, significantly different from the published finite-fault model. A blended source that combines the DART-inverted uplift with subsidence from the seismic–geodetic model best matches both datasets and reproduces the SWOT observations. Comparison with reconstructions of the 1952 Mw 9.0 Kamchatka earthquake indicates that the 2025 rupture likely reactivated significant portions of the megathrust that broke in 1952 but occurred farther down-dip and with little to no near-trench slip, consistent with its smaller tsunami impact. These findings highlight the hazard implications of short recurrence intervals of great earthquakes and show how rupture style governs tsunami severity. They also demonstrate the value of satellite altimetry for improving tsunami source characterization, post-event forecasting, and understanding of hydrodynamic processes.



Fyrstu íslensku steinhúsin og hleðslusteinninn í þeim

Árni Hjartarson

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Íslendingar komust furðulega seint upp á lag með að byggja steinhús. Fyrsta steinhúsið, Viðeyjarstofa, var reist á árunum 1753-1757. Síðan komu Hóladómkirkja sem byrjað var á 1757, Bessastaðir og Nesstofa 1761. Gamli torfhlaðni bærinn hélt þó velli sem aðalhúsagerðin í 140 ár eftir það. Talsvert hefur verið skrifað um steinhúsin gömlu á Íslandi og þá er átt við þessi fáu steinhlöðnu og múruðu hús sem reist voru á 18. og 19. öld. Minna hefur verið talað um bergið sem notað var, það er hleðslugrjótið sjálft, eiginleika þess og grjótnámurnar þar sem það var tekið. Hér verður fjallað um tvö fyrstu steinhúsin, Viðeyjarstofu og Hólakirkju. Helstu forvígismenn um þetta mál voru þeir Skúli Magnússon og Magnús Gíslason amtmaður á Bessastöðum. Fljótlega eftir að Skúli varð landfógeti 1750 fékk hann Viðey til ábúðar og samþykki konungs um að þar yrði byggður yfir hann nýr embættisbústaður. Skúli hafði mikinn áhuga á því að reist yrði hlaðið steinhús eins og gert var erlendis. Hann var einnig með hugmyndir um að vegghleðslur yrðu úr íslensku grjóti og hafði þá sandstein í huga eins og tíðkaðist í Kaupmannahöfn og öðrum stórum stöðum út um heim. Efnið virðist hann hafa ætlað að sækja í Háubakka við Elliðavog. Hann sendi meira að segja sýni af sandsteininum til Kaupmannahafnar til rannsókna. Hugmyndir Skúla voru samþykktar og steinsmiðir og byggingakalk voru send til landsins. Það kom þó fljótt í ljós að sandsteinninn frá Elliðavogi var óhentugur sem hleðslusteinn. Endirinn varð sá að húsið var að mestu hlaðið úr grágrýti og dóleríti úr Viðey. Þarna komust menn að því að Reykjavíkurgrágrýtið hentaði vel sem hleðslusteinn í húsveggi og garða enda ber Reykjavík nútímans þess merki. Þegar Skúli fógeti lét reisa Viðeyjarkirkju nokkrum árum síðar, hafði hann veggina alfarið úr grágrýti.

Um þetta leyti var kirkjan á Hólum í Hjaltadal orðin gömul og hrörleg og að falli komin. Ljóst var að ráðast þyrfti í nýja kirkjubyggingu. Magnús amtmaður á Bessastöðum, ásamt með Hólabiskupi Gísla Magnússyni, gerðist þá baráttumaður fyrir því að kirkjan yrði hlaðin úr steini eins og dómkirkjur í sannkristnum löndum. Í bréfi til danska kirkjustjórnarráðsins (General Kirke Inspections Collegium) og segir hann m.a.: „Náttúran hefur gætt Hólastað fegurra og endingarbetra byggingarefni en unnt er að panta úr öðrum löndum. Nefnilega hinum yfirmáta fagra rauða sandsteini sem þar finnst gnótt af í næsta nágrenni ...“. Þessum hugmyndum var vel tekið í Kaupmannahöfn enda voru Danir orðnir áhugasamir um að Íslendingar lærðu að reisa sér hús sem entust lengur en hálfur mannsaldur. Ráðinn var þýskur steinsmiður í verkið, Sabinsky að nafni, sem kom til Hóla í ágúst 1757. Meðal hans fyrstu verka var að skoða bergið sem Magnús amtmaður hafði mælt svo mjög með sem byggingarefni í kirkjuna. Honum leist þokkalega á það og taldi að besti staður fyrir grjótnám væri í gili einu allmiklu í Raftahlíð innan og ofan við Hóla. Þarna er allþykkt rautt og sandsteinslegt lag í 400-500 m hæð, inn á milli basaltlaganna, sem rekja má gil úr gili eftir endilangri hlíðinni. Lagið er víðast 10-15 m þykkt. Þetta er ekki raunverulegur sandsteinn, þótt hann hafi jafnan verið kallaður svo, heldur sérstæð, fínkorna basísk gjóska. Sabinsky réð til sín mannskap og lét gera veg eða slóð upp í fjallshlíðina að hinni væntanlegu námu. Við námavinnsluna beittu menn púðri og sprengdu bergið og fluttu heim á staðinn í vagni, og á sleða þegar snjór var á jörðu, þar sem það var höggvið til. Þannig fékkst góður hleðslusteinn. Stærð steinanna voru takmörk sett af bergfræðilegum ástæðum, enginn var t.d. nógu langur til að ná yfir glugga og hurðir.

Stærstu steinar í hleðslunum eru 80 cm á lengd. Almennt séð reyndist bergið vel sem hleðslusteinn. Það hefur þó ekki verið notað í neinar aðrar byggingar. Náman var opnuð á ný þegar gert var við kirkjuna seint á síðustu öld en ekkert umfram það. Ekki er vitað um sambærilegt lag annars staðar á landinu.

Bygging bæði Viðeyjarstofu og Hóladómkirkju var sannkölluð þrautaganga og tók miklu lengri tíma og kostaði meira fjármagn en áætlað var í byrjun og það hefur loðað við íslenskan byggingariðnað æ síðan. En þarna voru þær línur lagðar sem að lokum urðu til þess að Íslendingar skriðu út úr moldarkofunum.

The Traditional Out of Africa I Model Revisited: A View from China

Bae, Christopher J.[1], Tu, Hua[2], Granger, Darryl[3], Lai, Zhongping[2] & Shen, Guangjun[4]

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The traditional Out of Africa I model posits that *Homo erectus* moved out of Africa and into Asia beginning around 1.8 Ma. This model is based on two assumptions: 1) *H. erectus* was the first hominin to be physically capable of making the move out of Africa and across Asia; and 2) the earliest sites in Asia date to 1.8 Ma or younger. This talk examines the second part of this model, particularly by taking a closer look at the early-middle Early Pleistocene archaeological record of China and how the application of the cosmogenic burial dating method has really forced paleoanthropologists to rethink how we consider this model. Recent dating analyses of the Yunxian *H. erectus* site indicates that this hominin was present in eastern Asia by 1.8 Ma, soon after it appears in Africa (1.9 Ma). Further, dating analysis of the enigmatic Xihoudu site indicates that the earliest archaeological record in eastern Asia dates back to 2.43 Ma. Because no hominin fossils were found at Xihoudu we can only hypothesize who this may have been. If anything, it would suggest that the origin of *H. erectus* could or should be pushed back to the Plio-Pleistocene transition (~2.6 Ma). However, because of questions related to the paleobiology of *H. erectus*, it may also be time for paleoanthropologists to reconsider who the earliest hominin that dispersed out of Africa may actually have been. The earliest disperser could have been a form of Early *Homo* (e.g., *H. habilis*, *H. rudolfensis*) or perhaps even an australopith.

Clinopyroxenes as archives of magma evolution from source to surface: The example of the Seljalandsheiði basalt from the Eyjafjallajökull Volcano, S-Iceland

Enikő Bali[1], Quinten van den Meer[1], Bryndís Ýr Gísladóttir[1], Guðmundur H. Guðfinnsson & Manuel J. Román Alpiste[2]

[1]Institute of Earth Sciences, University of Iceland, Reykjavík, Iceland, [2]Andalusian Earth Science Institute, Granada, Spain

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Clinopyroxenes are excellent archives of magma evolution. The partitioning of jadeite and enstatite-ferrosillite components between clinopyroxene and silicate melt is sensitive to pressure (P) and temperature (T); thus, clinopyroxenes are commonly used as geothermobarometers to assess crystallization conditions (e.g.: Putirka, 2008). Clinopyroxenes are also trace element sinks, and using appropriate partition coefficients, we can recalculate trace element contents in their parental melts. Clinopyroxenes might also preserve intricate zonation patterns as many of the major and trace elements of interest have low diffusivity in them (Van Orman et al., 2002, Muller et al., 2013). This allows us to reconstruct the P-T conditions and melt compositions at the time of the crystallization of a given clinopyroxene zone. In this way, we can unravel major or even minor changes, both in the magma reservoir and potentially in the mantle source that gives rise to the basalt magmas which periodically replenish magma reservoir(s).

To test how well clinopyroxenes might preserve all this information, we selected a clinopyroxene-rich basalt from the Eyjafjöll Volcanic System. The Seljalandsheiði basalt has 20-30 vol% macrocrysts, dominated by clinopyroxenes. We collected element maps of 20 clinopyroxene crystals by wavelength-dispersive spectroscopy (Fig. 1). Based on these maps, eight well-defined textural positions were distinguished, and all were analyzed for major and trace element compositions, by electron microprobe and laser ablation ICP-MS, respectively.

Based on these analyses, we distinguished three main magmatic environments during pyroxene growth: primitive (Mg#>80) clinopyroxene cores crystallized in the deepest and hottest part of the lower crust (environment1 - ~5 kbar, 1180 °C), somewhat above the current Moho depth (Jenkins et al. 2018). The main magma reservoir (environment2) was situated shallower in the lower crust (~2.5-3.5 kbar, 1150°C), where most of the clinopyroxene cores formed. At similar depth, a cooler magma reservoir (environment3, 1100°C) produced evolved clinopyroxene cores (Mg#<75). Based on the textural relationships (Fig. 1), we can establish that environment1 and 2 and environment1 and 3 were well connected. Environment1 should have supplied the melt that formed reverse zones on crystals growing in the shallower reservoirs. We do not observe zones in crystals from environment3 that grew over cores which formed in environment1 or 2, only resorbed cores formed in environment3 are surrounded by mantles and rims formed in environment2. This suggests that an originally cool mid-crustal reservoir (environment3) was gradually taken over by a warmer reservoir (environment2) by repeated magma replenishment from the deep reservoir (environment1) before the eruption of the Seljalandsheiði basalt.

2) The trace element concentrations of the parental melt for each clinopyroxene segment were calculated. Much of the trace element variation is the result of fractional crystallization. The relationship between trace element ratios that are not sensitive to fractional crystallization suggests diverse mantle source compositions. Melt compositions can be reproduced by mixing of melts produced by melting of a garnet pyroxenite with MORB-like composition, and a depleted spinel peridotite mantle composition.

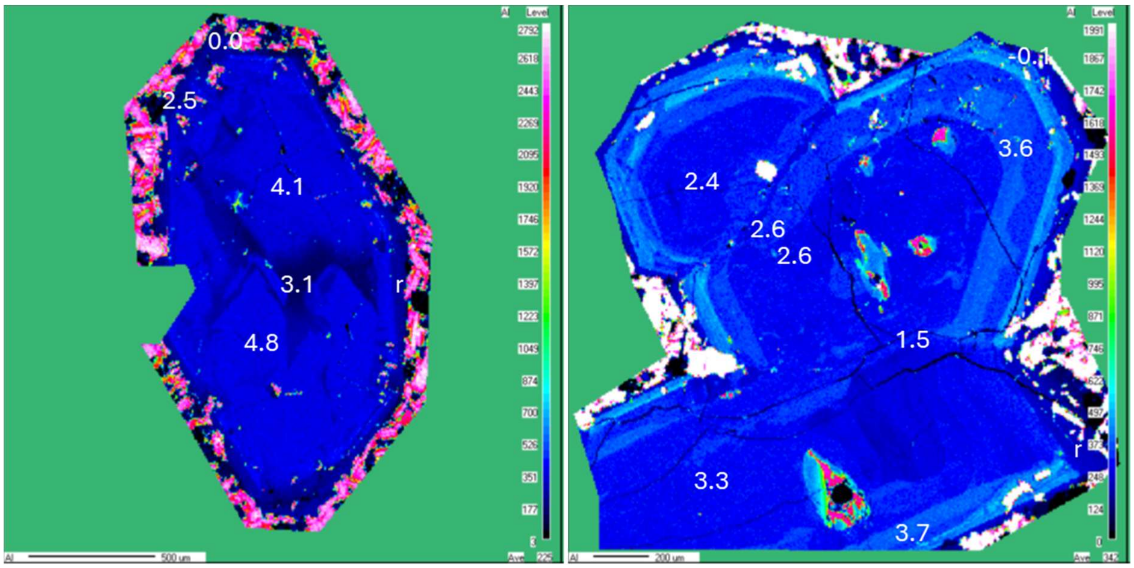

Fig. 1: *Elemental maps for Al in clinopyroxene crystals with different growth histories. Lighter blue colors indicate higher Al-contents. Numbers indicate calculated equilibrium pressures in kilobars, with the uncertainty of 1.4 kbar. Pink and white Al-rich phases are plagioclase intergrown with rims or as inclusions.*

References

Putirka (2008): Rev Min Geochem, 69, 61-120;
Van Orman et al. (202): Earth Planet Sci Lett,198/1–2, 93-112;
Muller et al. (2013): Contrib Min Pet, 166, 1563-1576;
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George Walker's legacy revisited on the 100th anniversary of his birth

Bjarni Gautason

Rannsóknasetur Háskóla Íslands á Breiðdalsvík, 760 Breiðdalsvík.

The year 2026 marks 100 years since the birth of George P.L. Walker. Walker was one of the 20th century's most pre-eminent volcanologists. His career spans five decades and his influence on the earth sciences will last for a long time, both due to his own work and to that of his many successful students. Walker's life and his career is the subject of several publications, both locally in Icelandic media and internationally [1-7]. This short account is based on said publications.

George Patrick Leonard Walker was born on March 2nd, 1926, in London England. He was the only child of Leonard Walker and Evelyn Frances Walker (née McConkey). Evelyn came from a farming family in Antrim County, Northern Ireland, where the family often spent their summer holidays. Leonard, George's father, passed away in 1932 when George was six years old. After the war broke out in 1939 the family opted to stay in Northern Ireland.

It is well documented that George took an interest in geology at an early age. It was on November 16th, 1942 that he bought himself a copy of *Geology for Beginners* by W. W. Watts. In an interview decades later Walker recalled [7]:

> *At high-school [...] I realized I knew nothing whatever about geology or botany. I had saved some money and bought a book about each. That one on geology was very interesting. I was then living in Northern Ireland on the margin between Cenomanian chalk and overlying Paleocene flood basalts of Antrim, and followed up with field work, roaming widely to chalk and basalt quarries on my bike. I can still remember how excited I was to make my first mineral identifications: calcite and apophyllite. Within weeks I knew I wanted to become a geologist.*

George recorded his exploration at this time, and his field notes reveal that by the age of 17 he could identify the common zeolite minerals. George completed high school in Lisburn and then went on to study geology at the Queen's University in Belfast, where he completed his B.Sc. and M.Sc. in 1948 and 1949 respectively.

Walker's career can be divided loosely into four main themes. The first of these is the study of zeolites and the zeolite mineralization in the Antrim plateau lavas of Northern Ireland. This was the subject of his Ph.D. thesis at the University of Leeds, which he formally completed in 1956. At the time of completing his PhD, Walker had already turned his focus to Iceland.

From 1954 to 1965 Walker carried out field work in Iceland, first more or less on his own but later with his students. After a reconnaissance trip in 1954, Walker turned his attention to the volcanic successions of Eastern Iceland, the second theme of his career. His work in Eastern Iceland resulted in several groundbreaking publications and a new understanding of the geology of Iceland. The methods Walker developed in the field are still used today with only minor modification. Put together, the key papers led Walker to coin the phrase *crustal drift* to explain his observations. His work contributed directly to the *plate tectonic revolution,* the approximately ten-year period from the early 1960's to the early 1970's when the current view of plates and plate motion, hot spots, and mantle plumes emerged.

Publications on the volcanology, petrology, and mineralogy of Iceland continued all through the 1960's. But Walker's attention was turning towards active volcanoes, inspired in part by witnessing the Surtsey eruption in 1963 and a visit to Etna in 1965. Walker studied volcanoes and their products in this next phase of his career. With his with colleagues and students at Imperial College, Walker developed a "flourishing school" of pyroclastic deposits in the early seventies. Walker was instrumental in transforming volcanology from a largely descriptive endeavor to quantitative science.

In 1978 Walker moved to New Zealand on a Captain James Cook Fellowship, which allowed him to concentrate on research for almost three years while stationed at the University of Auckland. There Walker and his student Colin Wilson began working on the Taupo ignimbrite. Their research led to many new concepts such as *low-aspect ratio ignimbrites*, *ground layers*, *fines depletion* and *ignimbrite facies*.

In the final stage of Walker's career he again turned to basaltic volcanism when he accepted the Gordon MacDonald Professorship in Volcanology at the University of Hawai'i at Manoa, where he worked until his retirement in 1996. There Walker and his students made important contributions to the understanding of lava dynamics, recognizing the *lava-rise mechanism* and accompanying surface deformation structures such as *tumuli.* Silicic magmatism and explosive eruptions one the one hand and basaltic volcanism and effusive eruptions on the other are the third and fourth themes in Walker's career. They both have their roots in his work in Iceland.

Walker's influence on geoscience in Iceland in particular, and on volcanology in general, can hardly be overstated. His achievements have been recognized by the community with several distinguished awards. A list of awards too long to be enumerated here.

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Tephra deposits and carbon dynamics in Icelandic peatlands

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The co-occurrence of active volcanism and severe soil erosion sets Icelandic peatlands apart from peatlands of volcanic regions elsewhere. Located in an active volcanic environment and often in close vicinity to glacial outwash plains and eroded drylands, they display a wide range in mineral and organic content. Mineral material of volcanic nature as distinct tephra layers deposited during volcanic eruptions, but also in the form of recurring fluxes of windborne dust from aeolian source areas are often well preserved in Icelandic peatland soils. Carbon (C) rich subsoil layers are frequently found below more mineral surface soil layers, reflecting destabilization of the environment owing to the onset of anthropogenic influence after the human settlement of Iceland c. 870 AD, which led to widespread vegetation destruction, soil degradation and erosion.

Despite extensive areas of peatlands worldwide being located within active volcanic regions, the interactions between tephra deposits from volcanic eruptions and peatland C dynamics are still poorly understood. V*arious previous studies have shown that tephra deposits may induce shifts in vegetation and the hydrology of peatlands. By that, they may also affect C accumulation. However,* questions remain as to how mineral deposits within these soils, in the form of distinct tephra or aeolian material from eroded dryland soils, impact the C accumulation. Thus, Icelandic peatlands offer a unique opportunity to investigate the effect of tephra deposits and anthropogenic impact on C dynamics in peatlands.

To determine how distinct tephra deposits impact C dynamics of peatland soils, we focus on soil layers right above and below tephra layers and present a study on C accumulation and C decomposition of disturbed peatlands in Iceland over time.

The Geothermal Flow Loop: An Experimental Platform for Multiphase Flow at Geothermal Conditions

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Multiphase flow governs critical flow assurance challenges in geothermal fields, shaping how vapor, water, and dissolved minerals move through wells and pipelines and how phase distribution and flow regimes evolve. These processes are particularly important in high temperature geothermal systems where steam and water flow simultaneously. Current multiphase correlations rely primarily on air-water and oil-gas experiments conducted near ambient conditions, which limits reliability for geothermal applications and reduces accuracy in predicting flow behavior and mineral deposition. The present work introduces the Geothermal Flow Loop (GFL), a purpose-built experimental facility designed to investigate multiphase flow at conditions representative of geothermal environments. Results demonstrate agreement with established correlations at low-temperature conditions, while deviations progressively increase with temperature rises. The experimental platform enables development of geothermal specific gas slippage correlations, analysis of flow regime transitions, and investigation of mineral deposition under realistic conditions.

Quantitative petrography of lower crustal xenoliths from the 2021 Fagradalsfjall eruption

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Recent volcanic activity of the Reykjanes peninsula has provided rare access to fragments of the otherwise inaccessible lower crust (>5 km)[1]. During the 2021 eruption in Fagradalsfjall, numerous crustal xenoliths were entrained in the lavas, offering direct samples of deep crustal lithologies beneath Fagradalsfjall volcano. These xenoliths provide an opportunity to investigate the structure and crystallization history of the lower crust using quantitative petrographic approaches.

We investigate 23 thin sections of xenoliths collected from the 2021 lava flow using Qemscan-based mineral mapping[2] combined with textural analysis. The xenoliths are dominated by gabbroic and anorthositic lithologies including gabbro, olivine-gabbro, leuco-gabbro and anorthosite. Plagioclase is the most abundant mineral phase in all samples, with clinopyroxene and minor olivine occurring interstitially. Quantitative mineral maps (Fig. 1) were used to determine modal mineralogy and extract crystal size and shape parameters for plagioclase.

Plagioclase commonly displays bimodal grain size distribution, consisting of smaller euhedral grains and larger subhedral to anhedral crystals. Crystal aspect ratios (AR) derived from Qemscan images provide a quantitative measure of plagioclase morphology and crystal growth behavior[2-3].

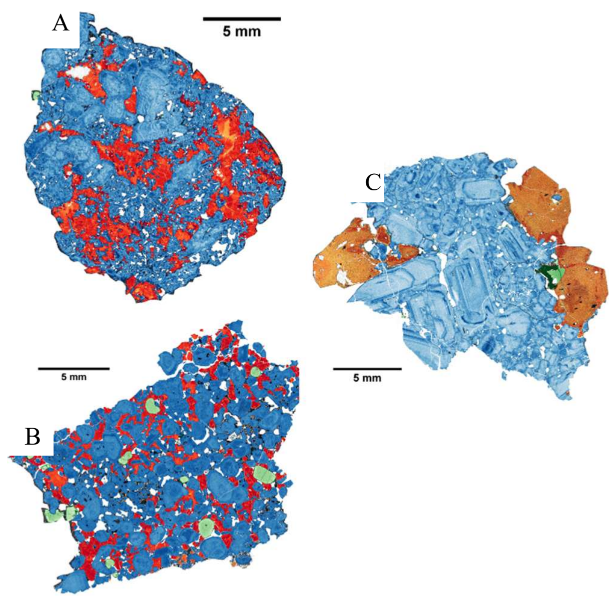

Figure 1 *Qemscan images of xenoliths. A) Gabbro, B) Olivine-gabbro, C) Anorthosite. Blue color represents plagioclase, orange/red color represents clinopyroxene and green color represents olivine. Black is groundmass/basalt and white are visecles.*

Variation in AR reflects differences in crystal growth kinetics and can therefore be used to constrain crystallization conditions and perhaps crystallization timescales within magmatic systems [2-3].

In gabbroic xenoliths, three plagioclase populations are identified (Fig. 2) based on aspect ratio distribution: a population dominated by moderately high-AR crystals, a population dominated by low-AR crystals and a population characterized as one in between the two first. These variations likely reflect differences in crystallization environment and growth conditions within the lower crustal magma reservoir.

The results highlight the potential of quantitative petrography and automated mineral mapping to characterize the textural architecture of lower crustal rocks and to provide new constraints on crystal growth processes within basaltic mush systems beneath the Reykjanes Peninsula.

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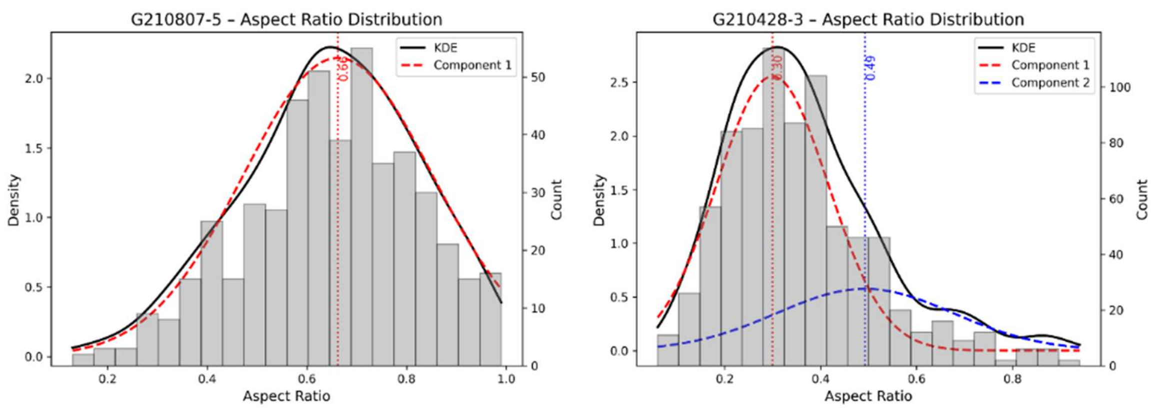

Figure 2 *Distribution of plagioclase aspect ratios for samples G210807-5 and G210428-3. Gray bars show the measured data as histograms. The black line represents the kernel density estimate (KDE) of the distribution. The KDE was deconvoluted into Gaussian components (dashed red and blue curves) representing distinct sub-populations. Vertical dotted lines mark the peak positions of the Gaussian fits, with labels indicating the corresponding aspect ratio values.*

A new geological map and dating of the Goðaland-Fimmvörðuháls area, south Iceland

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We present a new geological map of the Goðaland-Fimmvörðuháls area at 1:10,000 scale. The mapping area encompasses several deep canyons that dissect the conjoining flanks of Katla and Eyjafjallajökull volcanoes, revealing a sequence of glaciovolcanic evolution. The map better differentiates the volcanic and glacial deposits in this area elucidating the mountain building processes of these two iconic volcanoes over the last glacial-interglacial cycle. The map has been made by a combination of traditional field mapping and photogrammetry using drone images of the remote areas and cliffs. The Þórsmörk ignimbrite and deposits bearing Vedde-composition pumice and obsidian clasts are present in the sequence, acting as key stratigraphic markers. In addition, we use $^{40}Ar/^{39}Ar$ and paleomagnetic dating of lavas across the area to build a chronology of volcanic eruptions and landscape evolution. The mapped sequence represents ~ 57 kyr of volcanic and glacial history.

At the base of the sequence are extensive, subglacially emplaced hyaloclastite-lava sheets and pillow breccias. Lava lobes within the basal hyaloclastite sheets have an $^{40}Ar/^{39}Ar$ age of 57.3 ± 5.0 ka. These subglacial units are intercalated with the Þórsmörk ignimbrite, which has been previously dated to 55.6 ± 2.4 ka (Guillou et al. 2019) and was deposited in an ice-free environment. This relationship indicates a locally fluctuating ice margin during this period. Stratigraphically above these units is Útigönguhöfði, a tuff-dominated peak intruded by an irregular and fluidal network of columnar-jointed intrusions. An $^{40}Ar/^{39}Ar$ age of 19.4 ± 4.8 ka was determined for the intrusions. We interpret this formation was emplaced within an ice sheet with a surface elevation exceeding 800 m a.s.l. Similar tuffs and intrusions on Merkurtungahaus suggest a possible connection existed between the two landforms, now eroded. Adjacent to Útigönguhöfði is Morinsheiði, a flat-topped lava delta comprised of lobate lava and pillow lavas that transition laterally to steeply dipping pillow breccia. Pillow lavas low in the sequence are overlying clastic deposits from Útigönguhöfði and debris deposits bearing Vedde Ash-composition pumice and obsidian clasts. Dated lavas from Morinsheiði range from 13.6 ± 3.6 ka to 11.1 ± 3.2 ka, indicating formation during the last glacial-interglacial transition. The pillow lava, fed from several dykes that trend NE-SW through the formation, was emplaced into an englacial lake. Overlying lobate to subaerial lavas from the west flank of Katla flowed into the lake where they transitioned into pillow lava and pillow breccia. The lake was partially confined by Útigönguhöfði and had a minimum surface level ~ 800 m a.s.l. A 250 m-deep, narrow canyon now separates Morinsheiði from the west flank of Katla, formed by very rapid incision since the youngest subaerial lavas were emplaced.

Our new map reveals a wide variety of volcanic products comprise the flanks of Katla and Eyjafjallajökull, reflecting eruptions that occurred beneath a fluctuating ice sheet with changing hydrological conditions. We show how detailed mapping of polygenetic volcanoes can contribute to paleoenvironmental reconstructions over millennial timescales.

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Quantification and Analysis of Deformation in the Hengill Geothermal Area, SW Iceland, Using InSAR

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The Hengill geothermal area in southwest Iceland is a high-temperature geothermal system that hosts two major geothermal power plants, Hellisheiði and Nesjavellir. The region is located near a tectonic triple junction between the North American, Eurasia, and Hreppar plates. Significant geothermal fluid extraction and reinjection takes place in the area. Tectonic, volcanic and anthropogenic activities have produced significant surface deformation in the Hengill area. This study investigates ground deformation in the Hengill geothermal field using TerraSAR-X interferometric synthetic aperture radar (InSAR) time-series analysis covering the period from 2009 to 2024. Velocity maps derived from the InSAR time series reveal persistent subsidence centered on the geothermal production fields, forming nested bowl-shaped deformation patterns centered on the major geothermal production areas at Hellisheiði, Nesjavellir, and Hverahlíð, as well as the east part of the Hengill area. The long-term maximum deformation rate reaches approximately -16 mm/yr in the satellite line-of-sight (LOS) within the main fluid extraction zones. To examine spatiotemporal changes, the deformation was analyzed over three five-year intervals. The maximum LOS deformation rates are -21.2 mm/yr for 2009–2014, -15.8 mm/yr for 2014–2019, and -25.9 mm/yr for 2019–2024, indicating spatially and temporally variable subsidence related to geothermal operations. To investigate the subsurface deformation sources, inverse modeling was performed using the Geodetic Bayesian Inversion Software (GBIS). Prior to the inversion, regional plate motion was removed from the InSAR velocity field in order to isolate the local anthropogenic deformation. Estimated shallow source depths are approximately 2.1 km (1.3–3.2 km) beneath Hellisheiði, 1.3 km (0.9–1.8 km) beneath Nesjavellir, and 2.6 km (1.5–3.0 km) beneath Hverahlíð over the full observation period. In addition to these shallow sources, the modeling indicates a deeper pressure source located in the eastern Hengill region, represented by a Mogi point source at a depth of approximately 9.5 km (7.3–10.9 km) with an estimated pressure change of 0.3 MPa/yr. The combined results demonstrate that the observed surface deformation is primarily controlled by fluid extraction-induced reservoir compaction superimposed on the tectonic setting of the Hengill volcanic system. In addition to that, deformation profiles across the Nesjavellir geothermal field show a sharp break in LOS displacement in the eastern sector of the power plant area, indicating fault-related deformation.

Inflation in 2023 at the Þeistareykir high-temperature geothermal field, NE-Iceland, revealed by seismic, InSAR and GNSS time-series analysis

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Þeistareykir is one of five active volcanic systems of the Northern Volcanic Zone, NE Iceland, along with Krafla, Fremrinámar, Askja and Kverkfjöll, from north to south, respectively. The Þeistareykir volcanic system includes a N-S trending rifting fissure swarm, approximately 70-80 km long and 7-8 km wide, extending through it. There are neither postglacial eruptive fissures nor a clear caldera formation at Þeistareykir, with the latest eruption occurring ~2,400 years ago.

Þeistareykir comprises a high-temperature geothermal system which has been systematically explored over the past 50 years, with around 20 exploration and production wells drilled to date. Since 2017, geothermal energy has been utilised at Þeistareykir with a 90 MWe power station currently operated by Landsvirkjun, the National Power Company of Iceland. Extensive monitoring of the geothermal field is carried out through e.g., various geophysical measurements.

An inflation was observed to start at Þeistareykir at the beginning of 2023, with the centre of uplift approximately 2.5 km west of the Þeistareykir power plant. The vertical component of the continuous Global Navigation Satellite System (GNSS) station in Þeistareykir (THRC), located ~0.5 km northeast of the uplift centre, indicates a best-fit onset time of the inflation around 9 February 2023, and an initial uplift rate of 21.5 mm/yr.

Earthquake activity in Þeistareykir occurs in about three separated clusters, and prior to the start of inflation, an increase in seismicity rate was observed within the two northernmost clusters, with the largest earthquake reaching M_L 2.2 at 5.2 km depth. Earthquake depths within these two clusters range between ~3–7 km, deepening towards north. No significant change is observed in faulting mechanisms within the clusters, despite the inflation, with oblique strike-slip events most common.

Synthetic Aperture Radar Interferometry (InSAR) of Sentinel-1 images was used to measure the inflation. The anomaly is ~10 km wide and the uplift in its centre is ~12–15 mm between the summers of 2022 and 2023. Knowing that the uplift started around the beginning of 2023, the actual uplift rate is therefore ~20–25 mm/yr at the uplift centre. Geodetic modelling, using the InSAR data, indicates that a model with a point source pressure within a uniform elastic half-space can explain the observations. The inferred source has a centre depth in the range of 4.4–6.2 km (95% confidence interval), and a volume change of (1.1–2.5) $\times 10^6$ m^3 (95% confidence interval) until the end of summer 2023.

This inflation episode, which lasted until the end of 2023, is similar to the two previous inflation episodes observed in the area in 1995-1996 and 2006-2009, suggesting that small episodic magmatic recharge may be characteristic of the system.

Monte Carlo hermun með hitaglæðingu fyrir samtíma staðsetningu jarðskjálfta og ákvörðun á einvíðu hraðalíkani: „Lágmarks“ líkön með jarðlögum, þar sem hraðastigull er fasti

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Geislarakningu í gegnum einvítt jarðlíkan, sem samanstendur af lögum með föstum hraðastiglum og samfelldum gildum á milli laga, er beitt til að meta og bæta hraðalíkan fyrir úrvinnslu á smáskjálftagögnum á Íslandi. Ítrekuð Monte Carlo (MC) aðferð með hitaglæðingu (simulated annealing) er notuð til að áætla hraðagildi á mörkum laga. Þar er leitað að þeim hraðaföllum, sem lágmarka frávik á mældum komutímum fyrir bæði P- og S-bylgjur smáskjálfta.

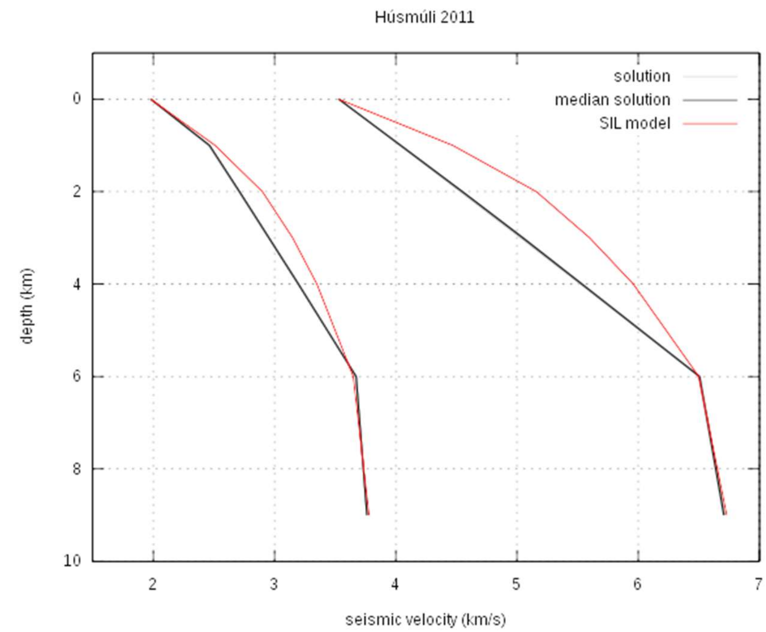
Aðferðafræði

- MC-aðferð nýtir tilviljanakennda leit í líkanrúmi til að finna bestu lausnina.
- Notast er við kvaðratrót af meðaltali tímafrávika í öðru veldi (RMS) fyrir hvern mældan fasa sem mælikvarða á gæði prófunarlausna.
- Hitaglæðing er útfærsla á MC-aðferðinni, þar sem prófunarlausnir eru stundum samþykktar, jafnvel þótt gæði mælikvarðans minnki.
- Úrvinnsla á stafrænum jarðskjálftagögnum frá landskerfinu á Íslandi styðst í flestum tilfellum við staðlaða SIL-hraðalíkanið, sem notar lög með föstum hraðastiglum.
- Byrjað er á SIL-líkaninu og P- og S-hraðar (Vp og Vs) ákvarðaðir samtímis í andhverfuútreikningi.
- Vægi P-bylgjumælinga er 1,73 sinnum meira en vægi S-bylgna.

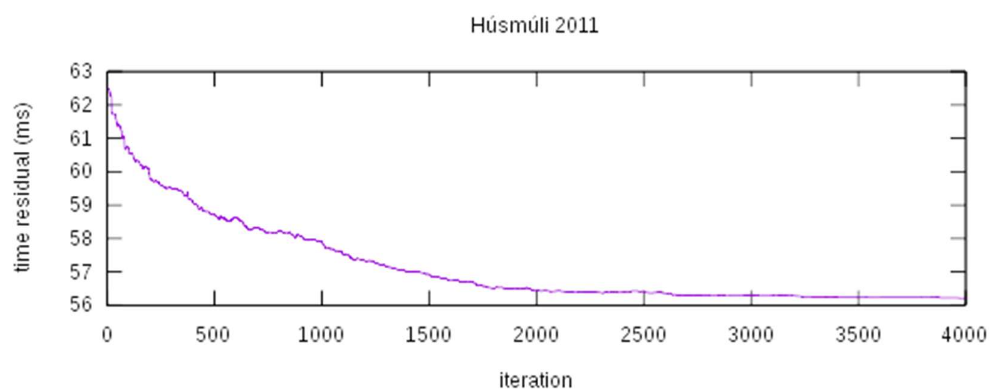
Niðurstöður og greining

- Sýndar eru niðurstöður, þar sem hraðagildi á 1, 2, 3, 4, 6 og 9 km dýpi voru ákvörðuð með MC-aðferðinni. Á öðru dýpi eru gildi úr SIL-líkaninu notuð óbreytt.
- Hraðaföllin eru háð þeirri takmörkun, að fastur hraðastigull hvers lags fer minnkandi með auknu dýpi.
- Þetta tryggir, að ferðatímakúrfur eru eintækar og án samleitni geisla, þ. e., að geislar með mismunandi brautir og ferðatíma enda ekki á sama stað.
- Jarðskjálftarnir eru endurstaðsettir í hverri ítrekun.
- Niðurstöðurnar sýna, að staðlaða SIL-líkanið hentar vel fyrir staðsetningu skjálfta í miðhluta Suðurlandsundirlendis, en mismikið misræmi kemur fram annars staðar.
- Athygli vekur, að Vp/Vs hlutfallið er lægra í efri lögum (1–4 km dýpi) við Húsmúla, eða um **1,70–1,74**, samanborið við **1,78** í SIL-líkaninu. Þetta stafar af meiri lækkun á Vp en Vs og er í samræmi við ummyndun bergs af völdum jarðgufu á svæðinu.

Húsmúli 2011



Af 3.186 skráðum skjálftum á Húsmúlasvæðinu voru 730 notaðir í MC-andhverfu. Myndin sýnir MC-hraðalíkön (svört), þar sem SIL-líkanið (rautt) er notað sem upphafslíkan.Vp/Vs hlutfall MC-líkansins er breytilegt eftir dýpi og víkur frá fastri tölu SIL-líkansins (1,78). Það gefur vísbendingar um breytingar á eðlisfræðilegum eiginleikum bergsins af völdum jarðhitavirkni.



Myndin sýnir þróun á kvaðratrót meðaltals tímafrávika í öðru veldi (RMS-leifar) fyrir komutíma P- og S-bylgna með vaxandi fjölda ítrekana með Monte Carlo-andhverfunni. Takið eftir, hvernig hitaglæðingin velur í flestum tilvikum lausnir, sem lækka frávikin, en leyfir stundum lausnir með hærri frávik til að forðast staðbundin lágmörk í líkanrúminu. Aðferðin skilar um það bil 10% betri samsvörun við mæld gögn eftir 4.000 ítrekanir.

Refining rates and the magnitude of Iceland´s Early Holocene sea level low-stand

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The thin, dynamic crust of Iceland is particularly sensitive to the loading and unloading of the land by glaciers and ice sheets. Determining the pattern and rate of postglacial sea level change in Iceland is critical for constraining models of deglaciation, ice sheet behavior, and palaeoclimate. Despite decades of work, relative sea level (RSL) histories remain poorly resolved due to patchy coverage, poorly constrained sea level indicators, chronological uncertainties and minimal data from the shallow marine environment. While many of these records can be improved with enhanced geochronological precision today, the largest unknown relates to the sea level low-stands during the deglaciation. This project will compile and quality assess existing data as well as further investigate submerged peat to improve our understanding of relative sea level low-stands. The database will be supplemented with new geochronological (tephra and radiocarbon) data from submerged coastal peatlands located in west Iceland, specifically the classic site of Seltjörn, Grótta (-4.2 m beneath hightide). These findings contribute to our understanding of the deglaciation of the Icelandic Ice Sheet and the Early Holocene sea level low-stand.

Thermal effect of repeated diking during eruptions: The Krafla fires in 1975-1984

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Young igneous systems are maintained by magmatic recharge. During the Krafla fires, 21 eruptive and intrusive events took place, while seven dyke intrusions intersected the geothermal system. This study uses simple 2D models to capture the dominant thermal heat transfer processes occurring in geothermal systems following dyke injections and determines an order-of-magnitude heat budget.

With numerical heat transfer and fluid flow models (HYDROTHERM), we investigate the thermal effects of this repeated diking on the Krafla geothermal system. Two different set-ups are tested: a) repeatedly injecting dykes, as observed during the Krafla fires, and b) injecting a single dyke at the start of the eruptive episode, whose volume and energy are the same as their sum for the multiple dykes. The simulations show that at the end of the eruptive episode, the heat budget is similar for multiple-injected dykes and a single-injected dyke. This indicates that the set-ups a) and b) have a similar long-term thermal effect on the reservoir.

The initial temperature is based on borehole data from the Krafla exploration area. Two different models are run: a) initial temperatures close to the boiling point, b) an isothermal layer underlain by an aquiclude with a linear conductive temperature gradient and near-boiling temperatures below the aquiclude. The initial temperature determines the amount of steam generated: model a) developed a higher amount of steam, as temperatures are closer to the boiling point in the upper high-permeability layer.

While the dyke cools and solidifies, steam rises in this higher-permeable hyaloclastite and lava flow layer. In the deeper layer of basement intrusions, which has lower permeability, the steam is less mobile and stays in the vicinity of the dyke. The main changes in pressure, temperature, and enthalpy in the system are in areas where two-phase liquid and superheated steam are generated.

The heat input from the dyke into the geothermal system is ~4.5e17 J, assuming a reservoir depth of 2.7 km. In addition to the average natural heat loss of the system, the heat brought into it by the dykes can be lost by a) steaming to the atmosphere and b) heating of cold groundwater.

The energy lost by steaming was derived from analyses of aerial photographs taken during the Krafla fires. According to the empirical relationship by Hochstein and Bromley (2002), the steam cloud area is proportional to its heat loss. Convective heat loss by steaming (a) accounts for 9% of the dyke's energy, ~ 4e16 J.

The Krafla geothermal system is located on a topographic high, where groundwater is recharged by precipitation. Heating a 100 m groundwater layer by 20 °C up to a distance of 1 km from the dyke requires ~8e15 J. Maintaining this temperature by heating of the precipitation requires ~5e15 J. In total, cold groundwater currents (b) mine 3% of the dyke's energy.

The heat loss to the surface in the numerical models ranges from ~ 5e16 J, with a low-permeable clay cap as surface layer, to ~ 9e16 J, inserting a 50 m-wide high-permeable pathway into the clay cap. The heat loss in these simulations includes the additional heat loss of the geothermal system due to diking, as well as the average natural heat loss of the system.

These results indicate that similar to 13% of dyke's heat is lost to the atmosphere and cold groundwater currents (a & b) during the eruptive episode, so that 88% of the heat is transported in the geothermal system. The heat exploited for the power plant can be estimated by the mass flow of steam and its enthalpy from borehole data. They indicate that in the first 10 years ~ 5e16 J, similar to 11% of the dyke's energy, was exploited. This suggests that the natural heat loss and energy exploitation, similar to 77% of dyke's energy, remained in the geothermal system by the end of the Krafla fires.

Additional heat input from basal heat flow and cooling sill at a depth of 2.1 km has only minor effects during the eruptive episode, as the energy input is similar to 3% of dyke's energy. Still, it is expected to have a stronger influence in the long term (decades to centuries).

The Dalvík Lineament, North Iceland: Structural and Seismo-Tectonic Implications for Geothermal Resources and Quaternary Landslides

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Seismicity along the Tjornes Fracture Zone (TFZ), North Iceland, resulted in infrastructure damage and important landscape changes in the past. However, many faults responsible for these events (up to Mw 7) including those that form the Dalvík Lineament (DL), are poorly understood. Remote sensing mapping coupled with fit for purpose drone-derived structure from motion data and field mapping were used to identify faults, dikes, and Quaternary elements such as large landslides along the TFZ and DL. As opposed to other faults or seismic lineaments in the TFZ, there is no through-going mappable DL fault scarp which may be do to a number of reasons. Instead, there is a coincidence between the mapping of dikes and seismicity as generally north-south trends.

Landslide distribution and frequency are correlated with seismicity along portions of the DL and dikes mapped in the field. These landslides are most spatially concentrated in zones with higher microseismicity. Many of the landslides have headscarps coincident with dikes that cut the regional lava pile which shows an important structural control on landslide distribution. Previous studies suggest that landslide events were triggered by glacial debuttressing and permafrost melt, however our data suggest seismic and structural controls on major landslides in the Trollaskagi region. Through the development of a 3D model of one local along the northwestern area of the DL, it is clear that low-temperature geothermal fields in the Trollaskagi Peninsula align with these dikes. This shows the importance of geological structures in controlling subsurface fluid flow, in particular when regional bedding of the stratified sequences intersects dikes down dip which can aid geothermal exploration.

Deformation and gravity change at Askja volcano, Iceland, during the current inflation episode, 2021 – 2025

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Askja is one of the most monitored volcanoes in Iceland. Since 1966, annual ground deformation measurements have been carried out in Askja along a leveling line. In 1993 the first Global Navigation Satellite System (GNSS) measurements were made in Askja and in 1992 the first Interferometric Synthetic Aperture Radar (InSAR) images of Askja were gathered. Since 2021 there has been inflation at Askja volcano, after decades of subsidence. The uplift is observed with GNSS and InSAR measurements. The net uplift from June 2021 to December 2025 is approximately 90 cm with a decreasing rate. Previous geodetic models of the observed ground deformation inferred an inflation source at a depth of 2.7 – 2.8 km. Gravity surveys have been carried out regularly since 1988, and annually since 2021. Gravity measurements show mass or density changes in the sub-surface. From 1988 to 2016 there was a net gravity decrease. Between 2016 and 2022 there was a gravity increase of 80 – 120 µGal at the center of the caldera.

We carried out GNSS campaigns and gravity surveys in August of 2024 and 2025. We measured 18 gravity stations and 20 GNSS stations scattered around Askja. The gravity was measured with two relative spring gravimeters (Scrintex CG5 and CG6). Gravimeters are very sensitive and prone to sudden data tares, to mitigate this we used two gravimeters. We evaluate the uplift between years with GNSS and InSAR data and apply the theoretical Free Air gradient to correct for the effects on gravity due to elevation change. The maximum uplift between 2021 – 2023 is approximately 60 cm, the uplift between 2023 and 2024 is approximately 25 cm, and the uplift from 2024 to 2025 is approximately 10 cm. The gravity change, after height correction varies. There is an increase in gravity from 2022 – 2023. Numerical models from Sepúlveda-Araya et al., (2025) indicate that the uplift and gravity increase can be explained with a model of magma flowing into a mush zone. However, there was a gravity decrease during 2023 – 2024, suggesting that the pressure increased, causing uplift, but the mass was decreasing. During the period from 2024 – 2025 the gravity changes were small, despite the continued uplift. This could indicate a change in the processes causing the uplift in the 2022 – 2025 period. Overall, the gravity measurements add important constraints to the deformation processes ongoing at Askja.

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Samspil eldstöðvakerfa á umbrotatímum: líkön af Reykjanesskaga

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Það er mikilvægt að skilja hvernig kvika hreyfist í gegnum jarðskorpuna. Oft eru takmarkaðar upplýsingar um ferli sem eiga sér stað á miklu dýpi, því þau eru falin af ýmsum ferlum í efri hluta jarðskorpunnar. Skáreksbelti þverar endilangan Reykjanesskaga og þar finnast nokkur (5-6) skástíg eldstöðvakerfi. Á Reykjanesskaga hafa orðið gosskeið sem vara í 200-400-ár, en goslaus tímabil sem spanna um 800-1000 ár. Yfir 10 eldgos síðan 2021 má túlka sem nýtt gosskeið sé byrjað. Þessi eldgos og tengdar kvikuhreyfingar hafa veitt innsýn inn í kvikukerfi í efri og neðri hlutum jarðskorpunnar. Skjálftavirkni og jarðskorpuhreyfingar sýna að bara eitt kerfi er virkt á hverjum tímapunkti, en hvaða kerfi er virkt getur þó breyst hratt. Þar að auki á meðan eldsumbrotin hafa staðið yfir í Svartsengi, síðan 2023, hefur mælst landsig í Krýsuvíkurkerfinu. Allt þetta bendir til samspils eða sambands á milli kerfanna.

Við prófum tilgátu um djúpt samspil á milli eldstöðvakerfa í gegnum nokkur reiknilíkön t.d. einfölduð stikalíkön (*e. Lumped-parameter models*) og bútalíkön (*e. Finite-Element models*), þar sem kvikuhólf í efri hluta jarðskorpunnar eru tengd við stærri kvikusvæði nálægt mótum skorpu og möttuls. Við hugsum okkur þetta dýpra svæði sem blöndu af aðgreindum kvikulinsum, hlutbráð og seigfjaðrandi efni, sem er aflfræðilega veikara en grannbergið. Dýpra svæðið getur því borið þrýstibreytingar án stórra kvikuhreyfinga milli kerfanna.

Tímaþróun rennslis kviku undir Svartsengi, metið með jarðskorpuhreyfingum, var borið saman við líkönin. Samanburðurinn bendir til þess að djúpa svæðið sem kvikan kom frá var smátt í byrjun umbrota, en eftir því sem leið á umbrotin benda líkönin til að svæði þar sem þrýstingur breyttist sé stærra, á stærðargráðu skagans.

Einfölduðu stikalíkönin gera ráð fyrir djúpu kvikusvæði á stærð við Reykjanesskaga sem efri kerfin tengjast í gegnum pípur þar sem rennsli er skilyrt við ákveðin gildi með líkindadreifingu, til að gera ráð fyrir óvissu og breytilegum aðstæðum. Þessi líkön geta hermt mismundandi einkenni eldvirkni á Reykjanesskaga, t.d. að aðeins eitt kerfi sé virkt á einu, hraðar breytingar í virkni milli kerfa, og passíf svörun af kerfunum sem eru ekki virk. Líkönin sýna í heild að kvikukerfin undir Reykjanesi eru tengd á flókinn hátt.

Has a mantle phase transition been misidentified as the Moho beneath Iceland?

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Over the past few decades, two main models for the crust under Iceland have emerged. According to the thin-crust model, the crust is thought to be 10-20 km thick by most proponents, whereas the thick-crust model generally assumes crustal thickness up to about 40 km under central Iceland. Although having gained ever more favor in recent years, the thick-crust model is not without its problems. This includes crustal thickness under central Iceland being considerably greater than under West and East Iceland, as well as beneath the Greenland-Iceland and Iceland-Faeroe Ridges. This is difficult to reconcile with geodynamic models for divergent plate boundaries.

Jenkins et al. (2018) conducted one of most detailed seismic modeling of the Icelandic crust to date. They found evidence for two main seismic discontinuities, a shallower one at about 20 km depth and a deeper one down to about 44 km depth. They then offer two possible explanations for the deep discontinuity; first, that it represents the Moho beneath Iceland, and second, that it represents a discontinuity within the mantle, in which case the shallow discontinuity would stem from the Moho. Ultimately, Jenkins et al. favor the first explanation. However, considering problems related to the thick-crust model, it is worth exploring the possibility of the deep seismic discontinuity being within the mantle. To this end, I have modeled melting of plagioclase and spinel lherzolite in the system CaO-MgO-Al_2O_3-SiO_2-FeO (CMASF) (Gudfinnsson and Presnall, 2000), which includes about 99% of the chemical composition of mantle peridotite. As it happens, the pressure at the deep seismic discontinuity (1.2-1.3 GPa) is close to that of the experimentally determined plagioclase-spinel lherzolite phase transition of mantle peridotite, both in the CMASF system and some other petrologic models.

In the CMASF system, the lherzolite phase assemblage (olivine + orthopyroxene + clinopyroxene + plagioclase / spinel / garnet) coexists with melt along a divariant surface in pressure-temperature space. The advantage of using experimental data from the CMASF system is that, with algebraic methods (Presnall, 1986), melting can be modeled and information about the composition of all phases and their proportions can be retrieved, using a bulk mantle composition of choice. Using a Python computer code, I have calculated isobaric melting points from 0.7-1.7 GPa, which is equivalent to roughly 25-55 km depth. The resulting information about pressure, temperature and crystalline phase proportions and phase compositions was then used as input for the Burnman Python toolkit (https://burnman.readthedocs.io/en/latest/) (Myhill et al., 2021), using mineral physical properties from Stixrude and Lithgow-Bertelloni (2011). The Burnman code then yielded information about density and seismic velocity in the pressure range of interest.

In the 0.7-1.7 GPa pressure range, the densities retrieved with the Burnman code are within the range for layers 4 and 5 beneath Iceland, according to the model of Kaban et al. (2002) (*Fig. 1*). The calculated density change across the transition is about 100 kg m^{-3}. The CMASF system gives unrealistically narrow transition interval, well below 0.1 GPa. However, the model of Till et al. (2012), which includes experimental data from natural and multicomponent compositions, gives a transition interval of about 0.1 GPa (~3 km) at 1.3 GPa pressure for a realistic peridotite composition. As the presence of even small amounts of melt tends to lower seismic velocities, and since melt is not included in the Burnman calculations, the calculated seismic velocities are likely to be on the higher side. This is especially true for shear-wave velocity. Nevertheless, the calculated Vp is within the range of published values for the presumed lower crust and mantle beneath Iceland, or about 7.3 and 7.6 km s^{-1} in the plagioclase and spinel lherzolite stability field, respectively. The calculated Vs is about 4.1 and 4.35 km s^{-1} in the plagioclase and spinel lherzolite stability field, respectively.

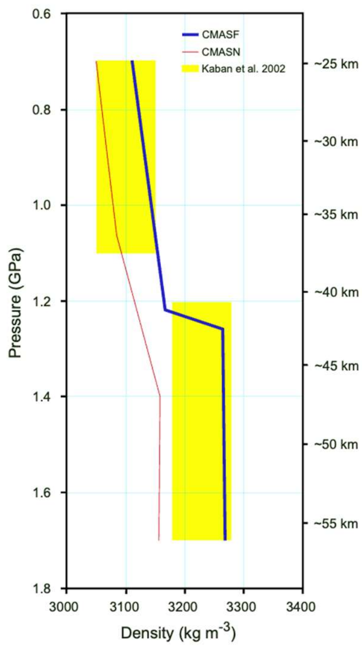

***Figure 1**. Calculated density profile from 0.7-1.7 GPa using CMASF data as input for the Burnman toolkit. The blue profile represents the CMASF modeling. CMASN modeling (red lines) has also been included but densities are unrealistically low because of the absence of iron. The yellow fields represent the range of densities for layers 4 and 5 in the density model of Kaban et al. (2002).*

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Brautryðjendur í rannsóknum á Íslandi á fornsegulsviði jarðar - Iceland's paleomagnetic pioneers

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Iceland holds a unique place in the history of paleomagnetism. Its position at the intersection of a mid-ocean ridge and a mantle plume has resulted in an exceptional geological archive of Earth´s magnetic field preserved in nearly continuous sequences of volcanic lava flows spanning roughly the last 16 million years. This provides an unusually complete and reliable record of geomagnetic field behaviour through time and has made Iceland a natural laboratory for paleomagnetic research. Since the mid-20th century this archive has attracted many pioneering scientists, who participated in establishing the foundations of modern paleomagnetism. In this contribution we present a concise, synthesized timeline highlighting key developments and the scientists behind them, tracking the evolution of paleomagnetic research in Iceland from its earliest observations through the mid-1980s. We have identified several key scientists, both Icelandic and international, whose work played a central role in shaping the field. These include, but are not limited to, Eggert Ólafsson, Trausti Einarsson, Þorbjörn Sigurgeirsson, Jan Hospers, George P. L. Walker, Ari Brynjólfsson, Norman D. Watkins, and Leó Kristjánsson. Their and other scientists collective work spans early observation of magnetic properties in lava flows, methodological advances in isolating stable remanent magnetization, and extensive field studies documenting magnetic polarity patterns and changes across large volcanic sequences. These contributions helped establish Iceland as a key locality for global paleomagnetic research and played an important role in confirming geomagnetic reversals, refining the geomagnetic polarity timescale, and in general improving our understanding of the long-term behaviour of Earth’s magnetic field.

Photo from Leó Kristjánsson showing scientists who participated in one of the major field campaigns in 1964 in eastern Iceland. The photo was taken in Geithellnadalur in Álftafjörður 1 September 1964. The three children are probably from a nearby farm. From left: Georg P. L. Walker, Rod L. Wilson, Norman D. Watkins, Stephen E. Haggerty, Gísli Þorsteinsson (the cook for the group), Jakob Yngvason, Peter I. Smith, Peter Dagley and Leó Kristjánsson (his first, and lasting, encounter with paleomagnetism).

’Lodge’ moraines: a common yet under-reported type of end moraine

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‘Lodge’ moraines, originally defined by Chamberlin (1894) along with ‘push’ and ‘dump’ moraines, are a type of submarginal end moraine created by incremental deposition of subglacial till beneath the ice margin. Chamberlin considered lodge moraines to be the most common type of end moraine in the United States Midwest, and subsequent researchers described similar end moraines in Illinois, Indiana, Ontario and Sweden as having been formed by this process. Similar but smaller submarginal end-moraines have also been described from modern glacier environments in Iceland and Norway. Typically, these moraines are asymmetrical, wedge-shaped, with steeper distal slopes and the crest representing the location of the ice margin. They are composed primarily of subglacial till.

However, the term ‘lodge’ moraine is rarely used; more often the moraines studied are simply referred to as ‘end moraines.’ Because of this, lodge moraines – and the process by which they form – have been neglected in the six most widely used glacial geology textbooks of the last half century.

We present lodge moraines as one of the four primary genetic types of end-moraines (along with push, dump and hummocky end moraines). We give examples of Pleistocene lodge moraines from United States, Canada, and Sweden, as well as of modern lodge moraines from Iceland and Norway. We also speculate why this important moraine type has been neglected, and why it should not.

Skeiðarárhlaupið í nóvember 1996 og hafið

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Þegar Skeiðarárhlaup braust fram að morgni 5. nóvember 1996 var rannsóknaskipið Bjarni Sæmundsson í leiðangri útaf miðju Norðurlandi. Samkvæmt áætlun var verkefni leiðangursins frestað og skipinu samstundis siglt austur fyrir land. Eftir stutta viðkomu og áhafnarskipti í Austfjarðahöfn var áfram siglt og komið á rannsóknasvæðið útaf Ingólfshöfða um hádegi 6. nóvember. Um það leyti var hlaupinu að ljúka en það skilaði 3.6 km^3 til sjávar. Á 40 klukkustundum var gögnum safnað á rösklega 40 stöðvum auk þess sem farið var upp að ósum á gúmmíbáti. Niðurstöður veita innsýn á útbreiðslu og flæði hlaupvatnsins og gruggsins sem því fylgdi. Sýnum var safnað til mælinga á hita, seltu, og einnig næringarefnunum fosfati, nítrati og uppleystum kísli.

Búist hafði verið við stóru jökulhlaupi því mikil ísbráð hafði safnast í Grímsvötn eftir eldgos í Gjálp og spurningar á Hafrannsóknastofnun um áhrif á sjó voru:

> Er líklegt að jökulhlaupið leiði til eðjustraums suður eftir og útfyrir landgrunnið?
>
> Hver gætu orðið áhrif jökulhlaupsins á vistkerfi?
>
> Hve langt ná áhrif hlaupsins?

Characterisation of two geothermal systems in SW Iceland: Hengill & Sveifluháls

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There are several active volcanic systems in SW of Iceland, of which four are used for power production, together producing about 20% of Iceland's electricity and providing 80% of the population with district heating. In this poster, we present seismic studies to characterise two volcanoes and associated geothermal systems, Hengill and Sveifluháls, with the goal of supporting decision making for geothermal utilisation.

The volcano Hengill, to the east of Reykjavík, has two major geothermal stations (Nesjavellir & Hellisheiði). Intermittent seismic activity has been observed to the west at Mosfellsheiði, but the origin for this seismicity is unclear. In this project, we aim to clarify the possible role of geothermal fluids, and thus to inform on the potential of the area for geothermal production. We use data from the recent two large seismic deployments; DEEPEN and COSEISMIQ. We implement the double-difference method on P- & S-wave travel times from local earthquakes to estimate Vp/Vs ratios local to clusters of earthquakes. These ratios are heavily perturbed by the presence of fluids and can thus shed new light on the origin of the clusters of seismicity at Hengill, and more particularly, on the new seismicity at Mosfellsheiði.

Sveifluháls, a volcanic ridge to the southwest of the capital area, shows natural geothermal springs at the surface (e.g. at Seltún). Recently, intense seismicity together with inflation and subsidence has been detected. The potential for geothermal production has motivated research for decades, but further information is needed to evaluate the potential production capacity of the new prospect. In this project, we implement reflection methods applied to local earthquakes to detect and map reflective layers, such as the top of a magma chamber. We have deployed a dense line of seismic nodes (SmartSolo) across the Sveifluháls ridge, and we are planning on using DAS on an optic fibre lying along Krýsuvíkurvegur, the 'road to Krýsuvík' parallel to the ridge. The reflection images produced in this study will further provide information on the geothermal context of the area and its potential for future geothermal production.

Observations of P-wave phase arrivals from major earthquakes with the IRIS fiber-optic subsea cable connecting Iceland and Ireland

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Approximately 70% of the Earth's surface is covered by the oceans. Installing permanent seismic sensors on the seafloor is both difficult and costly, resulting in a gap in the global seismic monitoring. Recently, the potential of using the existing network of submarine fiber-optic cables for the observation of seismic waves has been investigated, several works demonstrating the feasibility of using trans-oceanic subsea cables as seismic sensors (f.ex. Marra 2018,2022; Zhan, 2021; Mazur 2024).

In this work, we use a distributed fiber optic sensing (DFOS) prototype capable of measuring the integrated strain between each repeater along the entire length of a fiber optic cable (the repeaters are typically placed 100 km from each other). This instrument is used on the IRIS telecommunication cable, an operational subsea cable connecting Iceland to Ireland, transforming 17 spans of the cable into an array of 17 individual seismic sensors. Signals from several large earthquakes can be observed on the recorded data from the cable and surface waves as well as multiple seismic body wave phases can be tracked across the spans.

To assess the capability of the monitoring system to detect the P-wave phase, we use an STA-LTA algorithm to automatically detect the arrival of P-waves in the data and we compare the phase detections to those predicted by travel-time curves from a catalogue of major earthquakes from the USGS database (with a magnitude above 6 and a distance of 30 to 100° from the fiber-optic subsea cable). We manage to retrieve 40% of our earthquake catalogue with our detection algorithm. However, a large part of our detections are not pickings of the P-wave phase.

Jarðfræðafélag Íslands sextíu ára

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Jarðfræðafélag Íslands var stofnað af 14 stofnfélögum þann 16. mars 1966 á veitingahúsinu NAUST. Fjórir af stofnfélögum eru enn lifandi. Félagið var stofnað í þeim tilgangi að auka samstarf og samhæfa jarðfræðirannsóknir á landinu, að fyljast betur með og samhæfa rannsóknir erlendra jarðfræðinga á Íslandi og að vera fulltrúi íslenskra jarðvísinda á alþjóðavettvangi. Meðal stofnfélaga voru þekktustu íslensku jarðvísindamennirnir, bæði hérlendis og erlendis, á borð við Sigurð Þórarinsson, Guðmund E. Sigvaldason og Trausta Einarsson, til að nefna fáein nöfn. Sigurður Þórarinsson var fyrsti formaður félagsins.

Meginverkefni félagsins í gegnum tímann hafa verið ráðstefnu- og fundarhald um jarðvísindi. Félagið var stofnað á þeim tíma þegar botnskriðs- eða landrekskenningin var að ná fótfestu meðal jarðvísindafólks. Félagið stóð fyrir tveimur stórum ráðstefnum árin 1967 og 1974 um þessi málefni sem vöktu mikla athygli. Flest íslenskt jarðvísindafólk var ekki lengi að sannfærast um ágæti þessarar nýju kenningar sem margar niðurstöður mælinga og rannsókna studdu. Frá árinu 1995 hafa verið haldnar svo til öll ár bæði vor- og haustráðstefnur á vegum félagsins. Haustráðstefnurnar hafa þá oftast verið með sérstakt þema, til dæmis jarðhita og mannvirkjajarðfræði.

Á Norðurlöndum hefur jarðvísindafólk hist á tveggja ára fresti á norrænum vetrarmótum, fyrst árið 1952. Fyrsta Norræna vetrarmótið á Ísland var haldið 1982 og síðan á tíu ára fresti, síðast árið 2022. Jarðfræðafélagið hefur borið hitann og þungann við skipulagningu á þessum vetrarmótum.

Á níunda og tíunda áratug síðustu aldar vöktu nefndir á vegum jarfæðfélagsins athygli stjórnvalda á skipulagi jarðvísindarannsókna, m.a. með stofnun sérstakra jarðfræðistofnana eins og þær þekkjast í mörgum löndum, m.a. öllum Norðurlöndum. Því miður virðist ekki hafa verið hljómgrunnur hjá stjórnvöldum að stefna skipulagi jarðfræðarannsókna í þessa átt og því var ekkert framhald af samskiptum jarðfræðafélagsmanna og stjórnvalda.

Árið 1986 ákváðu alþjóðlegu samtök eldfjallafræðinga IAVCEI að veita framúrskarandi rannsóknarfólki sérstaka viðurkenningu í formi verðlaunapenings sem var kenndur við Sigurð Þórarinsson (Sigurðarmedalía). Jarðfræðafélagið hefur séð um fjármögnun á þessu verkefni og verið með fulltrúa í nefnd sem veitir verðlaunin. Fyrsta Sigurðarmedalían var veitt árið 1987 til Robert L. Smith og síðan hafa tíu eldfjallafræðingar fengið þessa verðlaun.

Auk fjölmargra fræðslufunda og ráðstefna hefur félagið staðið fyrir skoðunar- og fræðsluferðum sem á síðustu árum hafa einnig verið farnar til útlanda, til Svíþjóðar og Danmerkur, svo og Skotlands. Á þessu ári er stefnt til Baskastrandar á Norður-Spáni.

Fjöldi félagsmanna hefur rúmlega tuttugufaldast á þessum sextíu árum, úr 14 árið 1966 í rúmlega 330 í dag. Helstu vinnustaðir jarðvísindafólks í dag eins og árið 1966 eru hjá hinu opinbera, Háskóla Íslands, Íslenskum orkurannsóknum (áður Orkustofnun), Veðurstofu Íslands, Náttúrufræðistofnun og Náttúrustofum. Enginn félagi starfaði árið 1966 hjá einkafyrirtæki, en félagar úr einkafyrirtækjum voru 38 árið 2025. Enginn var eftirlaunaþegi árið 1966 en þeir skipta tugum í dag.

Félagið hefur í dag sjö manna stjórn, forseta (svo nefndur til að fylgja hefð annarra Norðurlanda), ritara, gjaldkera og meðstjórnendur. Þeim var fjölgað úr fimm í sjö árið 1994 eða 1995, líklega til að dreifa álagi við að sinna síauknum verkefnum með stöðugri fjölgun félagsmanna.

Heimildir

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The ENKI project: Advances in thermodynamic modelling of volcanic systems

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The ability to make quantitative predictions about the chemical reactions that magmas undergo is essential tool in modern petrology and geochemistry. For example, being able to quantify the control of pressure and temperature on the chemical composition of coexisting minerals and melts enables us to estimate the depths at which magmas are stored before eruption. However, magmas, and their associated minerals and fluids, are chemically complex, requiring sophisticated thermodynamic treatments in order to accurately represent their chemical properties.

The ENKI (ENabling Knowledge Integration) project provides a platform for rapidly producing, calibrating, and testing new thermodynamics, as well as intercomparing different databases, and building applications. I will present an overview of the project and its development so far, as well as new developments in its application to Icelandic magmatic systems. For more information, check our website at enki-portal.org or gitlab.com/swmatthews-research/ThermoEngineLite.

Safnkostur borkjarnasafns Náttúrufræðistofnunar myndaður og birtur í Kortaglugga Íslands

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Borkjarnasafn Náttúrufræðistofnunar samanstendur af borkjörnum og svarfi úr yfir 4000 borholum, um 100 km af kjarnaholum og 500 km af svarfholum. Hlutverk safnsins er að varðveita þennan safnkost og gera hann aðgengilegan rannsakendum til mælinga og sýnatöku. Undanfarin ár hefur verið lögð áhersla á uppbyggingu stafrænna innviða til að auðvelda notendum aðgengi að safnkostinum. Upplýsingum um safnkostinn er miðlað í gegnum WFS-þjónustu, í Kortaglugga Íslands á www.kortagluggi.is, og í samevrópska gagnagátt European Plate Observing System (EPOS).

Til að bæta enn frekar aðgengi mögulegra notenda að safnkostinum er nú unnið að því að ljósmynda alla borkjarna í safninu. Ljósmyndirnar eru vistaðar í gagnagrunni borkjarnasafnsins og gerðar aðgengilegar í WFS-þjónustu safnsins og Kortaglugga Íslands. Ljósmyndirnar nýtast rannsakendum til að bera kennsl á hentuga kjarna til frekari rannsókna og flýta fyrir afgreiðslu sýnatökubeiðna. Nú hafa 2.913 af 10.785 borkjarnakössum verið ljósmyndaðir, eða 27%. Stefnt er á að ljúka ljósmyndun safnkostsins veturinn 2026-27.

Vísindafólk er hvatt til að kynna sér safnkostinn með hjálp þessara innviða og nýta hann við rannsóknir. Sýnatökureglur og aðrar upplýsingar um safnkostinn má nálgast á vef á slóðinni https://www.natt.is/is/rannsoknir/visindasofn/borkjarnasafn. Umsjónarmaður safnsins aðstoðar umsækjendur við leit að viðeigandi efniviði fyrir rannsóknir og útfyllingu sýnatökubeiðni. Hægt er að óska eftir því við umsjónarmann að tilteknum borkjörnum sé forgangsraðað við ljósmyndun.

Kvikukerfið undir Grímsvötnum á sögulegum tíma samkvæmt gjóskulögum í Vatnajökli

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Breytingar á og þróun kvikukerfa með tíma undir virkum eldstöðvum eru líkleg til að hafa áhrif á kvikusamsetningu og þar með goshegðun. Einsleit basaltkvika kemur líklegast úr einföldu kvikuhólfi þar sem hræring og blöndun eru ríkjandi ferli. Flækja af misstórum sillum tengdum með göngum getur leitt aftur á móti til kvikuþróunar á misjöfnu dýpi og því breytilegrar kvikusamsetningu frá einni sillu til annarar. Í þunnum og flatarmálsmiklum sillum er líklegt að kvika í þeim miðjum sé betur blönduð en út við enda sillanna. Langlífi hinna mismunandi kvikukerfa, sem og hversu hratt þau breytast, er lítið þekkt. Ein aðferð til að bæta þekkingu á hegðun kvikukerfa og breytingum á þeim er að mæla samsetningu gosefna yfir ákveðið tímabil.

Virkasta eldstöð landsins, Grímsvötn, hentar vel til að athuga breytingar með tíma á kvikukerfi þar sem hún hefur gosið basaltkviku með sömu samsætuhlutföllum (Sr, Nd, Pb, Th, O) á sögulega tíma. Einsleit samsætuhlutföll benda til móðurkviku að neðan sem er vel blönduð. Blöndunin eyðir áhrifum ólíkra möttulbráða á samsetningu gosefnanna. Samsetningin endurspeglar því kvikuferli sem áttu sér stað í jarðskorpunni á leið kviku til yfirborðs. Tuttugu og tvö gjóskusýni úr Vatnajökli og tvö sýni úr Skaftáreldahrauni sem mynda tímarunu frá 1200 e.kr. til dagsins í dag hafa verið tekin til mælinga. Öll sýnin eru af kvars-normatífri þóleiít samsetningu nálægt hvarfpunktinum á basalt fasa-diagrömmum þar sem aðalefnasamsetning breytist lítið með kristöllun yfir ákveðið hitabil. Styrkur utangarðsefna (efni sem ganga illa inn í steindir og safnast því saman í afgangsvökva við hlutkristöllun; t.d. frumefnið Th) eykst með tíma í gjósku frá 13. öld til þeirrar 21. Að sama skapi lækkar styrkur efna sem ganga audveldlega inn í steindir, eins og Ni í ólivín og Cr í pýroxen, og hvoru tveggja er auðskýrt með hlutkrisöllun og aðskilnaði steinda og vökva (afleiddrar kviku). Regluleg samsetningarbreyting Grímsvatnagjóskunnar er af og til rofin með innspýtingu að neðan á frumstæðari móðurkviku inn í kvikukerfið.

Vinsælt líkan af basaltkvikuhólfi var sett fram af O'Hara (1977), kvikuhólf sem endurhlóðst annað slagið og gaus á ný eftir kvikublöndun móðurkviku og afgangskviku eftir hvert gos (Albarède 1985). Slíkt kvikuhólf leiðir til ákveðinnar dreifingar á t.d. styrk Th sem falli af Ni með tíma. Breytileiki þessara efna yfir sögulegan tíma í gosefnum Grímsvatna fellur ekki að þessu líkani. Frá u.þ.b. 1200 þar til snemma á 17. öld breyttist styrkur Th og Ni mjög óreglulega (Th= 0.88 – 1.11 ppm; Ni= 32 - 39 ppm). Breytileikinn hvarf smám saman og endaði í einsleitri samsetningu basalts sem gaus í Skaftáreldum 1783-1784. Síðari Grímsvatnagos, frá 19. öld og fyrri hluta 20. aldar, framleiddu basaltgjósku af mjög svipaðri snefilefnasamsetningu (Th~1.3 ppm og Ni~30 ppm), að öllum líkindum úr vel blönduðu kvikuhólfi hærra í jarðskorpunni þar sem aukið hitatap og aukin hlutkristöllun leiddi að lokum til gossins 1998 (Th= 2.04 ppm). Þetta grunnstæða kvikuhólf tæmdist í gosinu 2011, sem eftir kröftuga innspýtingu af frumstæðri móðurkviku gaus misleitri blöndu af kristöllum, afgangskviku og frumstæðu kvikunni.

Breytileikinn í snefilefnasamsetningu gjóskunnar með tíma er líklega vegna ólíkrar hegðunar kvikukerfisins undir Grímsvötnum á sögulegum tíma. Það veldur breytilegum hlutföllum steinda sem falla út úr basalbráðinni (vegna breytilegs hitastigs, þrýstings sem og afgösunar kvikunnar). Niðurstöðurnar sýna jafnframt að kvikukerfi basalts geta breyst hratt undir einni og sömu eldstöðinni.

Heimildir

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Structural Controls of Holocene Age Volcanism along the Ljósufjöll Lineament, West Iceland

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Ongoing unrest makes understanding geological rates critical for understanding future geological hazards. Volcano-tectonic interactions are critical for understanding crustal dynamics in regions of active tectonics, yet key questions remain about the interplay between surface deformational features and subsurface processes in Iceland's geologically complex Ljósufjöll Volcanic Zone (LVZ) that has not had an eruption in over 1000 years but has had increasing seismic unrest since 2021. Using a combination of geological and structural mapping and remote sensing, this research examines structural patterns on the surface and their connection to Holocene age volcanic products. ~20 postglacial eruptions were identified with lava volumes ranging from 0.0035 - 0.50 km3. Groups of five different geological structures were observed and validated in the field. There is important NE-SW extension observed in the region (perpendicular to the main NW-SE striking fabric of extension along the boundary of the NA Plate) which has clear Holocene grabens present. Post-glacial cones appear to be preferentially located in structurally complex areas that are also found in glacial valleys, i.e. low lying areas, which is likely due to local loading and less material for vertical migration to the surface. Viewed holistically, the LVZ Holocene eruptive history is around 2.3 km3 of dry rock equivelant (DRE) lava which likely represents several periods of Holocene unrest since the 20th Century Krafla fires were 0.25 km3, and the modern unrest from 2020 to early 2026 over 9 eruptions has a total DRE volume of 0.35 km3 along the Reykjanes Peninsula. This shows that the LVZ is a major source of eruptive materials in the Holocene, with extension contrary to the average in West-Southwest Iceland and with increasing seismicity there that gives important insight into the eruptive potential of the LVZ that is likely in a likely pre-eruptive state.

Bergsegulmælingar á Vestfjella basaltstaflanum á Gondwana varpa nýju ljósi á flóðbasaltvirkni fyrir um 183 milljónum ára

Paleomagnetic constraints from ~183 Ma Vestfjella flood basalts (Antarctica) on the Gondwana LIP

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The breakup of Gondwana around ~183 Ma was accompanied by voluminous mafic magmatism between the Grunehogna (East Antarctica) and Kalahari (southern Africa) cratons, forming the Karoo and Ferrar continental flood basalts. These together constitute the Gondwana Large Igneous Province (also known as the Karoo-Ferrar LIP). This LIP coincides with the Early Jurassic Toarcian oceanic anoxic event and the associated biotic changes, highlighting its potential environmental significance. Although geochemical and isotopic correlations between Karoo and Ferrar provinces are relatively well established, paleomagnetic data from East Antarctica are limited, leaving intercontinental connections insufficiently constrained.

The Vestfjella mountains of Dronning Maud Land preserve one of Antarctica's most extensive flood basalt records of this event. Over 400 oriented samples were collected from seven nunataks during two FINNARP Antarctic expeditions. These span compositionally diverse low- and transitional-Ti lava types with close geochemical analogues on the southern African side. Rock magnetic analyses, such as thermomagnetic curves, first order reversal curves and hysteresis analysis, indicate that pseudo-single domain low-Ti titanomagnetite is the dominant remanence carrier. Thermal and alternating-field demagnetization directions are generally stable and resolve the primary magnetization direction. Both normal and reverse polarities are recovered, and a positive reversal test confirms primary magnetization. The resulting polarity stratigraphy of the longest continuous sections from Basen and Plogen nunataks closely mirrors that of the African Karoo sequences, reinforcing the connection between the Karoo and Ferrar provinces. These results contribute towards refining the paleomagnetic framework of the Gondwana LIP, with implications for both plate reconstructions and the environmental consequences of this major magmatic event.

Early Holocene vegetation and environmental responses to abrupt climate variability in the Icelandic highlands

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North Atlantic climate is strongly regulated by the strength of the Atlantic Meridional Overturning Circulation (AMOC). At present, the stability of this circulation is increasingly questioned, as enhanced freshwater input from accelerated Arctic warming is freshening the North Atlantic and potentially weakening deep-water formation. High-resolution palaeoarchives from Iceland provide a valuable long-term perspective on past AMOC variability and associated climate tipping points, given Iceland's strategic location within the North Atlantic climate system.

The Early Holocene (11.7–8.2 ka BP) climate in the North Atlantic was characterized by a thermal maximum interrupted by rapid, short-lived cooling events linked to AMOC instability. The Icelandic highlands are likely among the most sensitive environments to external disturbances such as climate change and volcanic activity, yet their long-term ecological trajectories remain poorly constrained. This study investigates how vegetation and environmental conditions in the Icelandic highlands responded to Early Holocene warming and abrupt climatic fluctuations associated with AMOC variability.

A multi-proxies approach was applied to lake sediment sequences from the Arnarvatnsheiði region, Iceland. Vegetation dynamics were reconstructed using pollen analysis. Loss-on-ignition, organic carbon and nitrogen contents (C/N ratios), stable carbon and nitrogen isotopes, and elemental geochemistry derived from XRF scanning were used to assess soil erosion processes and landscape stability. Tephrochronology and radiocarbon dating provided robust chronological control, enabling analysis of climate–ecosystem interactions at centennial to millennial timescales.

By identifying past regime shifts and ecosystem persistence under rapid climate perturbations, this study advances theoretical understanding of ecosystem resilience.

Palaeodirectional Analysis of Westfjords Lava Flows to Investigate the Mid-Miocene Kleifakot Event

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Geomagnetic excursions are generally interpretated as failed attempts of the geomagnetic field to undergo a complete polarity reversal. Several excursions have been documented in marine floor, sedimentary, and volcanic sequences, yet the mechanisms responsible for these events are not well-understood. One hypothesis proposes that excursions occur when the geomagnetic field reverses in the liquid outer core but fails to persist long enough to diffuse into the solid inner core. This study investigates the mid-Miocene Kleifakot event (~13 Ma), first identified by Kristjánsson[1] in the lava flows of Westfjords, northwest Iceland. It aims to examine the complex and chaotic behavior of the geomagnetic field during excursions in high temporal resolution. Fieldwork was conducted at two basaltic lava profiles in Westfjords, JO and DT, located approximately 35 kms apart. A total of 30 and 22 lava flows were sampled from JO and DT profiles respectively. Natural remanent magnetization and bulk susceptibility were measured for all the specimens, and thermomagnetic curves were obtained for each lava flow. For palaeodirectional analysis, 256 specimens from JO profile and 103 specimens from DT profile were subjected to stepwise demagnetization using alternating field and thermal methods, to isolate the characteristic remanent magnetization. The site-mean directions were calculated using principal component analysis.

The JO profile lies above a hydrothermal alteration zone, whereas the DT profile is within the chabazite-thomsonite zone. Thermomagnetic analysis indicates that both profiles are dominated by magnetic mineralogy of two distinct types: high Ti-titanomagnetite and low Ti-titanomagnetite. Virtual geomagnetic pole (VGP) calculations reveal complex polarity sequences involving normal (N), reversed (R), and transitional (T) states. The JO profile records a N-T-N-T-R-T-R-T-N polarity sequence, while the DT profile shows a T-N-T-R-T-N sequence. Based on similarity of the polarity patterns, the DT sequence overlaps with the upper sections of JO sequence. These results are comparable to previous observations from Westfjords lava sequences reported by Kristjánsson[1]. Based on an estimated extrusion rate of 1816 m/Ma for western Westfjords[2], the transitional VGP interval corresponds to an estimated duration of ~28,000 years. This is unusually long for a single excursion or even for a polarity reversal. Future work will incorporate palaeodirectional data from two additional Westfjords lava profiles (DU and DX). These results will aid the construction of mid-Miocene secular variation curve and improve constraints on geodynamo models that simulate geomagnetic reversals and excursions.

Seismic monitoring of geothermal fields in El Salvador and the importance of location accuracy. Case study: Ahuachapán geothermal field, El Salvador

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El Salvador lies within the western margin of the Caribbean Plate, which is a part of the Chortis block (CH), located roughly 100 km north of the active convergent boundary where the Cocos Plate (CO) subducts beneath the Caribbean Plate (CA) (Figure 1). Subduction beneath this segment is approximately orthogonal to the trench, and the plate interface beneath El Salvador is commonly interpreted as only weakly coupled (plates are sliding past each other with little friction, so only a small amount of stress is transferred from the subducting plate to the overriding plate). Several studies have documented different motions between the Chortis block to the north of the Central American Volcanic Arc (CAVA) and the volcanic forearc sliver (CAFA) to the south; this relative displacement cannot be explained by the Cocos Plate subduction alone (Alvarado et al., 2011; Correa Mora et al., 2009; LaFemina et al., 2009). The most recent hypothesis from geodetic and geological data show that an additional tectonic driver is required, such as forearc sliver escape, variations in plate-interface coupling, or interaction with the North American Plate to account for the full magnitude and direction of the relative displacement (Portela et al, 2024) (Figure 1). These geological and active tectonic settings create the favorable conditions for the existence of high-temperature geothermal fields, with the permeability and fluid pathways needed for geothermal energy production.

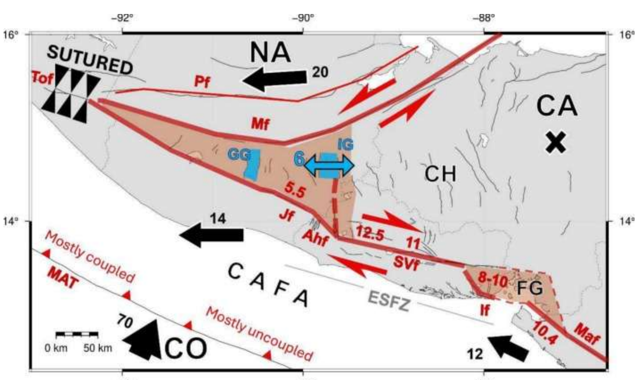

Figure 1: Tectonic sketch showing block motions (black arrows, mm/yr) referenced to the Caribbean Plate (CA, fixed). Block labels: CAFA — Central American volcanic forearc; CH — Chortis block; CO — Cocos Plate; FG — Fonseca Gulf block; NA — North America (Portela et al., 2024).

One of the harnessed high-temperature fields in El Salvador is in Ahuachapán. Electricity production in this area began in 1975 with the installation of a 30 MWe unit; after one year another unit of similar characteristics was added and by 1980 the third installed unit of 35 MWe was added, a total installed capacity of 95 MWe. This means that the geothermal field has been in operation for almost 51 years. An important part of the development of the geothermal field is to continue various ways of monitoring to understand the evolution of the system, and one of these is seismic monitoring. A precise location of the seismic activity is an important part in the identification of permeable zones in geothermal systems, as well as providing information on how it has evolved with the harnessing of the resource, and whether there is a direct correlation between seismicity and production and/or fluid injection. Obtaining a local velocity model is important for reliable location of earthquakes. In this study, the minimum 1D velocity model for the Ahuachapán geothermal area is presented using a selection of microearthquakes from 2023 to July 2025 using the softwate VELEST (Kissling, E. 1995) and their relocation with the NonLinLoc software (Lomax, A, 2020) which uses a non-linear probabilistic inversion method. The seismicity within the Ahuachapán geothermal field appears to be controlled primarily by regional tectonics, with no clear indications of induced seismicity related to geothermal exploitation or injection (Figure 2). Instead, the data highlight possible permeable zones that could be investigated further.

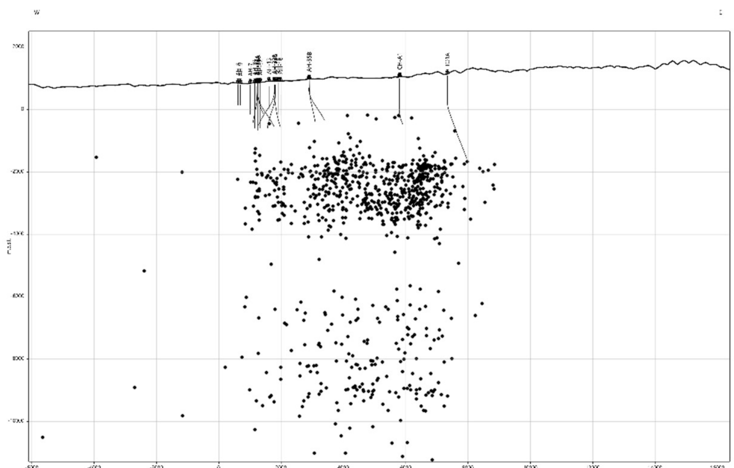

Figure 2: *Hypocenter distribution within the Ahuachapán geothermal field between 2023- July 2025, shown together with the locations and trajectories of geothermal wells down to 1.5-2.5 km depth.*

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Sequestration of arsenic from water by the precipitation of mimetite $Pb_5(AsO_4)_3Cl$

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Arsenic contamination of water is a major environmental challenge linked to geogenic sources, mining activities, fossil fuel combustion, and arsenic-based products. Mining and excavation processes frequently generate leachates enriched in toxic elements such as As, Pb, Cd, Cu, Fe, and Zn. Conventional arsenic removal technologies typically rely on centralized, multi-step treatment systems. This project investigates an alternative mineral-based approach suitable for compact, mobile treatment units. The concept is based on induced precipitation of the highly insoluble arsenate mineral mimetite ($Pb_5(AsO_4)_3Cl$) through controlled Pb^{2+} release and immediate reaction with arsenate in chloride-bearing waters.

Two complementary Pb sources were evaluated: synthetic lead carbonate (cerussite) and Pb-modified zeolite derived from natural clinoptilolite. In the cerussite pathway, partial $PbCO_3$ dissolution supplies Pb^{2+}, which reacts with arsenate via a coupled dissolution-precipitation mechanism to form mimetite.

In the zeolite pathway, Pb^{2+} was pre-sorbed onto Na-clinoptilolite (~70 g Pb/kg), creating a reactive material that functions as a Pb reservoir. Upon contact with arsenate-bearing aqueous solution, controlled Pb release induces mimetite crystallization directly on mineral surfaces. Pb binding remains sufficiently strong to prevent significant leaching while allowing sustained arsenate removal.

Any residual dissolved Pb can be immobilized by addition of phosphate source, e.g. synthetic hydroxylapatite ($Ca_5(PO_4)_3OH$) or the glassy phosphate fertilizer VitroFosMak, which is characterized by controlled, slow release of phosphate ions.

Static batch experiments demonstrated efficient arsenic reduction (up to 99%) across a broad initial concentration and pH range, even in the presence of competing ions. XRPD and SEM-EDS confirmed crystalline mimetite formation in both systems. Importantly, the approach was validated not only in synthetic solutions but also using arsenic-contaminated natural waters, achieving >90% removal. Additional dynamic fixed-bed tests with granulated Pb-zeolite confirmed its suitability for continuous-flow operation. In both cases, any excess of Pb was reduced up to 99% by formation of stable pyromorphite ($Pb_5(PO_4)_3Cl$). Notably, the use of VitroFosMak resulted in substantial Pb reduction while maintaining phosphate concentrations below detection limits, minimizing the risk of secondary nutrient release. Overall, both cerussite and Pb-modified zeolite provide effective and scalable pathways for arsenic sequestration, supporting the development of mobile treatment systems.

High $^3He/^4He$ plumes are hotter and melt more: evidence from the petrology and geochemistry of ocean island basalts

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High $^3He/^4He$ (i.e., $^3He/^4He$ above the convecting upper mantle mid-ocean ridge basalt range (8±2 R_A)) is a rare component identified in hotspots that sample an early-formed, less-degassed domain in the planet. Relationships between the maximum $^3He/^4He$ and high hotspot buoyancy flux, and between maximum $^3He/^4He$ and low seismic shear-wave velocity anomalies, suggest that high $^3He/^4He$ is entrained only by the hottest and most buoyant mantle plumes. A prediction of this model is that the high $^3He/^4He$ component is sampled by high-degree melting. We use a new geochemical database of ocean island lavas to demonstrate that high $^3He/^4He$ is found only in tholeiitic (low alkali index) and mildly alkalic (intermediate alkali index) lavas, which result from high and moderate degrees of melting, respectively. Highly alkalic (high alkali index) lavas that are generated by low degrees of melting are not observed to have very high $^3He/^4He$. These observations support a model where the highest $^3He/^4He$ plumes are the hottest and therefore melt to high degrees, which results in generation of tholeiites and mildly alkalic lavas. However, our observations suggest that high degrees of melting of hot plumes is a necessary but insufficient condition for generation of high $^3He/^4He$ lavas. High degrees of melting of mantle domains with a high fraction of recycled material and/or depleted mantle material—both of which have low $^3He/^4He$—will generate low $^3He/^4He$ lavas. Thus, only hot melting of mantle domains that have relatively pure high $^3He/^4He$ source material (i.e., little or no recycled material or depleted low $^3He/^4He$ mantle material) will result in generation of high $^3He/^4He$ lavas. The conclusion that high $^3He/^4He$ plumes melt more is supported by geophysical observations that suggest high $^3He/^4He$ plumes are hotter—they have higher buoyancy flux and lower shear-wave velocity anomalies in the upper mantle—and hotter plumes should melt more than cooler plumes.

Næturvaktin: náttúrvárvöktun á Veðurstofu Íslands

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Á Veðurstofu Íslands er sólarhringsvöktun á allri náttúruvá alla daga, allan ársins hring. Hlutverk náttúruvársérfræðinga er að vakta jarðskjálfta, eldfjöll, eldvirkni og jökulár auk þess að gera veðurathuganir fyrir Reykjavík og Reykjavíkurflugvöll. Starfið er 10 ára gamalt og hefur þróast töluvert frá því að það byrjaði og mun halda áfram að gera það í takt við auknar kröfur samtímans og tækniþróun. Kjarninn er þó alltaf að vera með áreiðanlega vöktun og tímanlega upplýsingagjöf, en mikilvægur þáttur í starfi náttúruvársérfræðinga er miðlun til hagaðila, fjölmiðla og almennings. Á daginn eru tveir náttúruvársérfræðingar á vakt þar sem annar sér um að vakta vatnafar og gera veðurathuganir á meðan hinn fer yfir skjálfta sem koma inn í kerfið og vaktar okkar jarðskjálftasvæði og virkni í eldfjöllum. Á nóttunni er aðeins einn á vakt, en við erum alltaf með bakvakt sem hleypur þá til þegar þurfa þykir.

Álag hefur aukist mjög mikið síðustu ár með eldvirkninni á Reykjanesskaga. Bæði er eldvirknin og hættan meiri, en ekki síður er krafist meiri upplýsingagjafar, t.d. til sérfræðinga innanhúss, Almannavarna, viðbragðsaðila, fjölmiðla og almennings. Í öllu okkar starfi treystum við á aðra sérfræðinga á Veðurstofunni, en starf okkar gerir okkur að sérfræðingum í rauntímatúlkun á gögnum. Oftar en ekki þurfum við upp á eigin spýtur að skera úr um hvort ástæða sé til þess að virkja viðbragð eða ekki. Bakgrunnur flestra náttúruvársérfræðinga er í jarðvísindum og af þrettán náttúruvársérfræðingum er einn karl (auk fagstjórans). Flestir eru á aldrinum 25-39 ára, en umfram allt erum við samstilltur hópur sem leggur sig fram um að vakta landið okkar til að leggja okkar af mörkum til að tryggja öryggi og hagsmuni þjóðarinnar.

Linking silicic magma reservoir growth to upper crustal deformation: Slaufrudalur pluton, Southeast Iceland

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Silicic magma reservoirs are constructed by the successive emplacement of smaller magma pulses. The pulsed emplacement has implications for the structure of reservoirs, for example, internal layering, mingling zones, and magmatic faulting. The transport of magma pulses to the emplacement site depends on creation of space. In the shallow upper crust, the creation of space typically occurs by roof uplift or floor subsidence with implications for host rock deformation. A structural aureole develops around growing reservoirs, with the deformation being accommodated by fracturing and faulting of the host rocks. Within this framework, how is the internal deformation of upper crustal reservoirs linked to host rock deformation? Here, we focus on the Slaufrudalur pluton (Southeast Iceland), an exposed solidified reservoir, to investigate the interplay between incremental reservoir buildup, internal deformation, and structural aureole development. The study employs a variety of field- and lab-based methods, including structural analysis, magnetic fabric analysis, and complementary fluid inclusion analysis. Our results highlight the layered internal structure of the pluton, structural features indicative of concurrent magmatic and brittle deformation, transport of magmatic fluids, and incursion of hydrothermal fluids. We propose a model of strike-slip deformation active during and even after pluton emplacement that questions previous models of floor sinking by cauldron subsidence. Furthermore, our model has implications for the regional geology of Southeast Iceland, as it proposes silicic magma reservoir growth in between volcanic systems. Ultimately, the study reveals a protracted history of pulsed magma emplacement in the Slaufrudalur pluton that is directly related to host rock deformation.

High-Resolution Microseismicity Provides Insights into Ring-Fault Geometry at the Re-inflating Bárðarbunga Caldera, Iceland

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In 2014-15, the subglacial Bárðarbunga caldera collapsed, subsiding 65 metres as magma flowed out from beneath it to feed a fissure eruption at Holuhraun. Subsequently, the caldera has been re-inflating, indicating recharge of the shallow crustal magma reservoir. Sustained seismicity along the caldera ring faults – but with reversed focal mechanism polarity compared to the eruption period – provides further evidence for its ongoing resurgence. In summers 2021, 2024 and 2025 we installed temporary broadband seismic arrays on the ice cap above Bárðarbunga, to provide improved constraints on earthquake hypocentres and focal mechanisms.

We use QuakeMigrate to produce catalogues of microseismicity, with > 60,000 events located across the three campaigns. The magnitude of completeness, M_C is ~ -1. Relative relocation reveals a sharply defined ring fault, consistent in geometry with geodetic constraints obtained during the 2014-15 collapse, thus providing strong evidence that the same structure is being reactivated as the caldera re-inflates. Tightly constrained focal mechanisms show excellent agreement with the local ring-fault geometry defined by the relocated microseismicity, and steep dip-slip faulting corresponding to uplift of the caldera floor. The geometries and direction of motion are confirmed by cGNSS data, which shows coseismic uplift of the caldera floor during M_w ~ 5 earthquakes captured during the 2024 and 2025 campaigns, and InSAR images which further confirm reversal of slip on the same ring fault that hosted caldera collapse. Together, these observations provide a high-resolution picture of the geometry of the Bárðarbunga ring-fault, which is currently experiencing incremental caldera resurgence – a phenomenon which has not previously been observed.

The magmatism of 2021-23 Fagradalsfjall Fires, Reykjanes Volcanic Belt, Iceland

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Keywords: Iceland, Fagradalsfjall, magmatism

On the evening of 19 March 2021, after 781 years of quiescence, the Reykjanes Volcanic Belt (RVB), Iceland, entered into its 4th Eruption Period in the last 4000 yrs when an eruption began on a 180-m-long linear vent system at the Fagradalsfjall volcanic complex. This event also marked the onset of the 2021-23 Fagradalsfjall Fires, which featured three effusive eruptions: 19.03-18.09.2021 at Geldingadalir, 03-21.08.2022 at Meradalir, and 10.07-05.08.2023 at Litli-Hrútur. Collectively they erupted 135x10^{6}m^3 (DRE) of mostly enriched, olivine tholeiite (8-8.5wt.% MgO) magma. However, the 2021 Geldingadalir eruption initially expelled depleted olivine tholeiite magma. These magmas were extracted from a ~100 km^3 crystal-mush-rich magma storage zone situated at 9-12 km depth beneath Fagradalsfjall (e.g., Troll et al 2024). Major element analyses of groundmass glass in tephra from the 2021 Geldingadalir eruption reveal that during the first 12 days, the melts were depleted olivine tholeiites (8.02±0.12 wt.% MgO, n=85) with a K_2O/TiO_2 value of ~0.15, which is consistent with the highest K_2O/TiO_2 melts (0.015-0.16) erupted during the Holocene on the RVB. From day 13, the K_2O/TiO_2 value of the erupted melt at Geldingadalir (8.19±0.18 wt.% MgO; n=50) steadily increased until day 39, when it plateaued at a value of ~0.25. For the remaining 4 months (i.e., days 39-180) of the 2021 eruption (8.43±0.25 wt.% MgO, n=117) and throughout the 2022 Meradalir (7.59±0.26 wt.% MgO, n=172) and 2023 Litli-Hrútur events (7.35±0.21 wt.% MgO, n=72), the erupted melt K_2O/TiO_2 value was remarkably steady at ~0.25. This is a uniquely high K_2O/TiO_2 value for basaltic melts with these MgO contents, as melts with 6.5-8.5 wt.% MgO within the axial rift in Iceland typically have K_2O/TiO_2 values of ~0.15 or lower and all values are <0.20. The same applies to the 6.5-8.5 wt% MgO alkalic basalt melts from Hekla, Katla, and Vestmannaeyjar volcanic systems (i.e., K_2O/TiO_2 <0.20). The only 6.5-8.5 wt.% MgO melts with higher K_2O/TiO_2 values (average, 0.49±0.29) are melt inclusions from an effusive basalt eruption in the Snæfellsnes Volcanic Belt (Kahl et al 2021). It is, therefore, unlikely that the enriched melts erupted during the 2021-23 Fagradalsfjall Fires have been previously delivered to the surface by the Holocene volcanism in Iceland. It is more likely a new addition to Iceland´s magmatism.

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