Atmospheric deposition of microplastics recorded in Icelandic lake sediments

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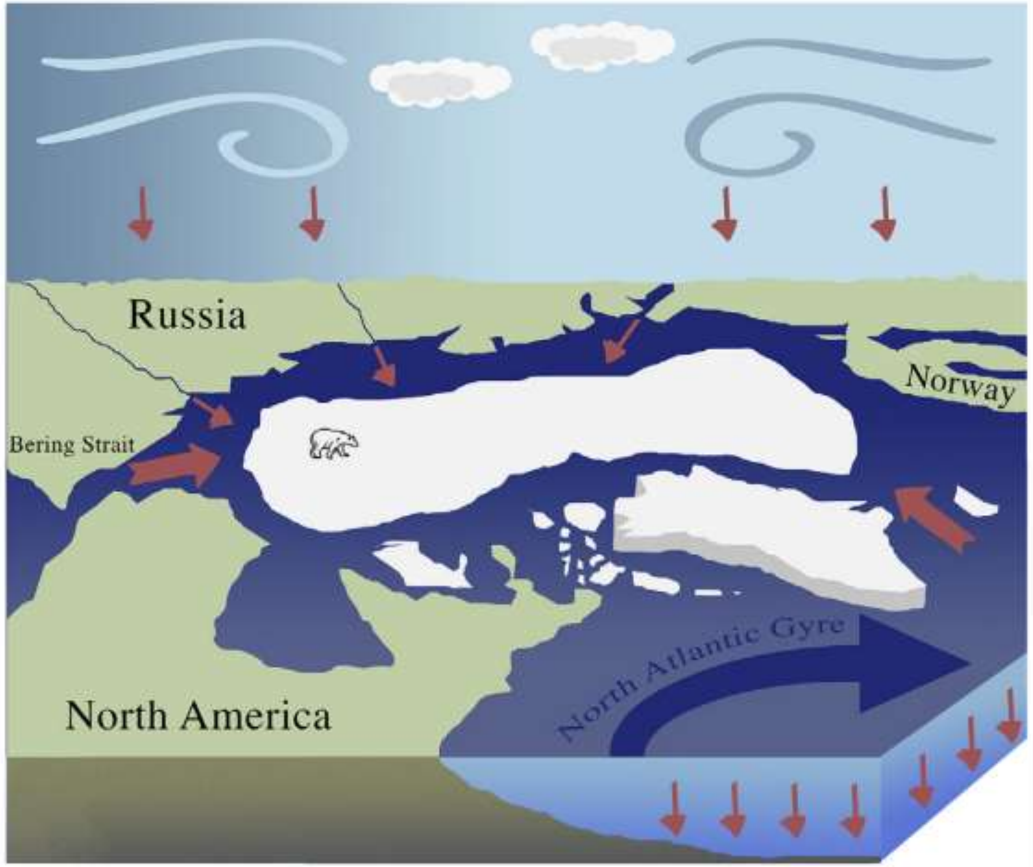
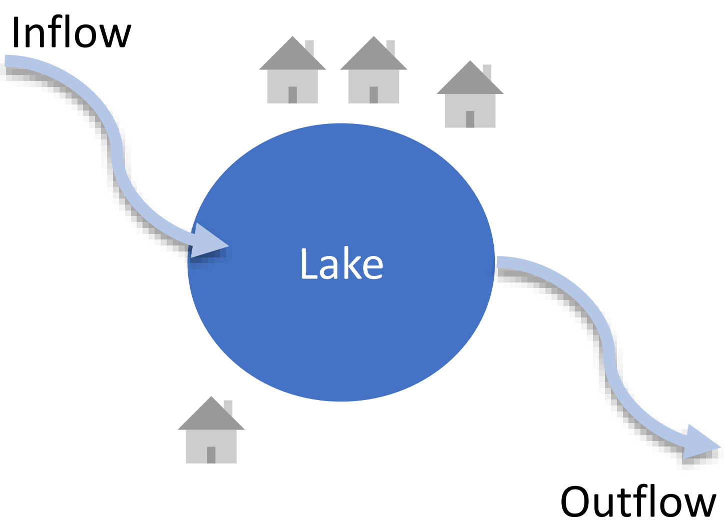
Atmospheric transport

- Major pathway for microplastics to reach remote regions (Evangeliou et al., 2020)
- Interaction between atmospheric and oceanic transport (Allen et al., 2022)
- Significance of the marine boundary layer (Wang et al., 2022)
- MPs in remote regions (Allen et al., 2019; Bergmann et al., 2019; Cunningham et al., 2022)



Source : Theodore Obbard Current Opinion in Environmental Science & Health

Study design



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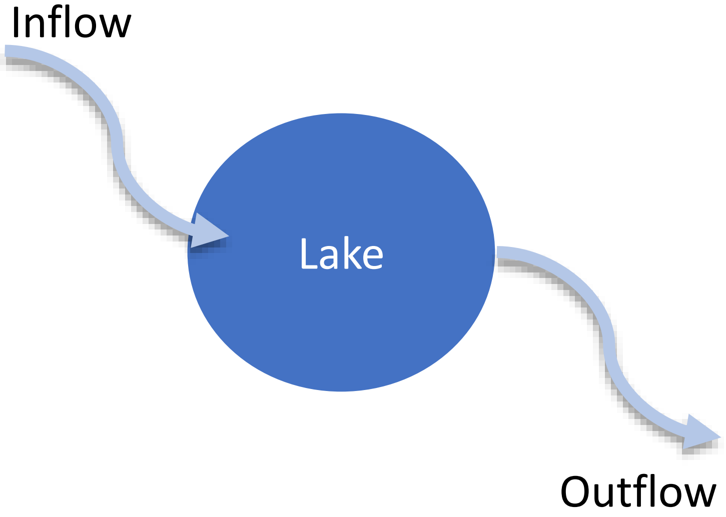

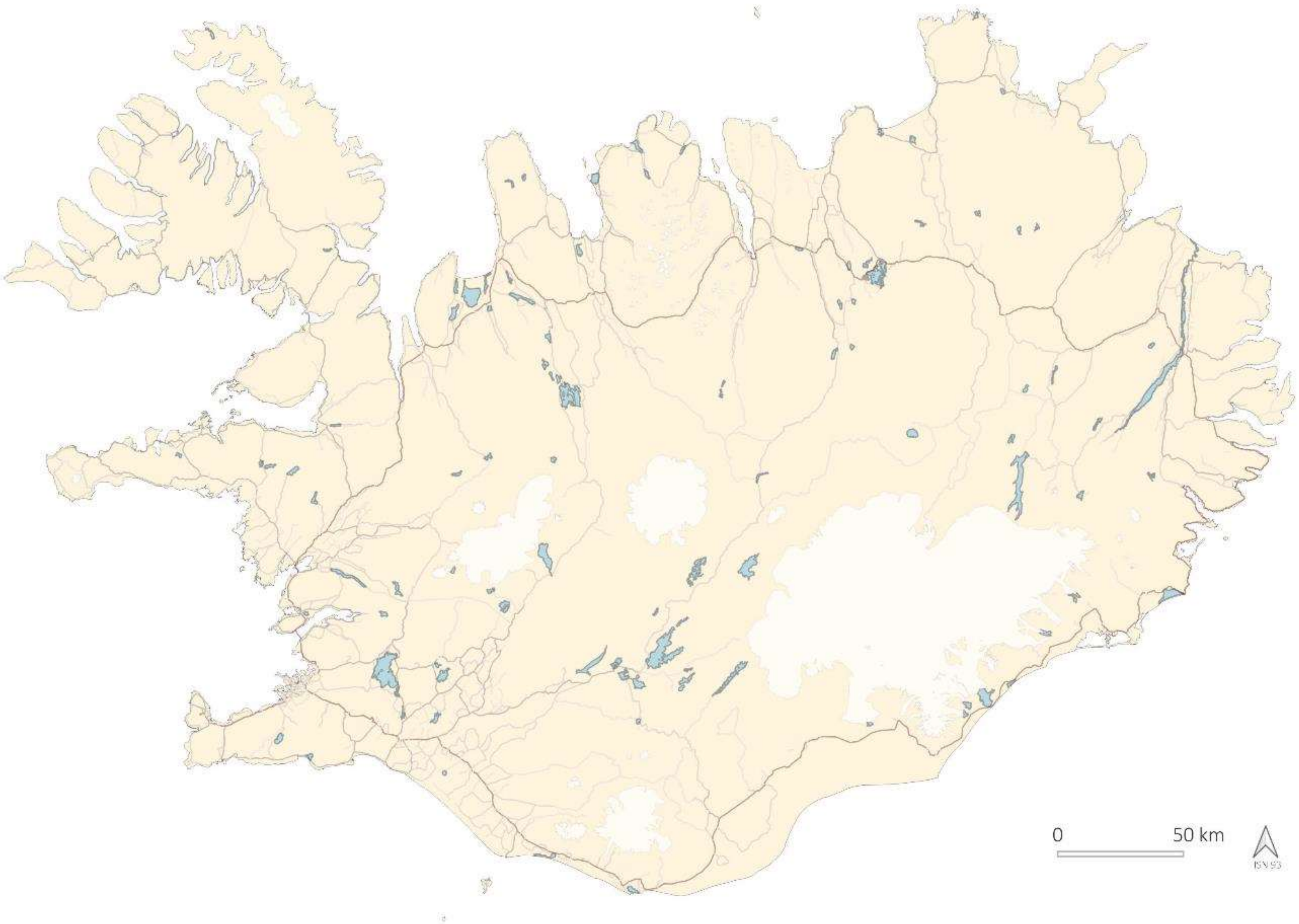

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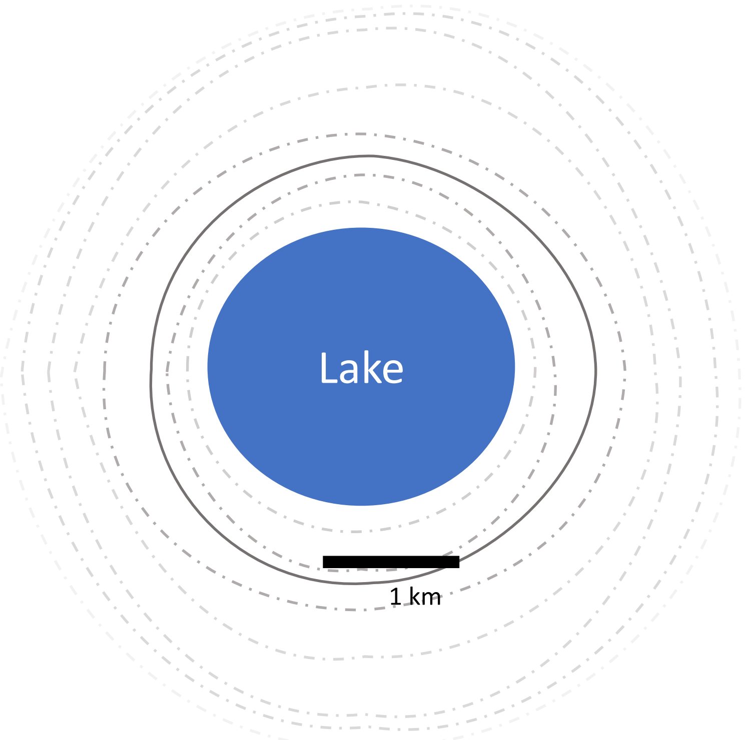

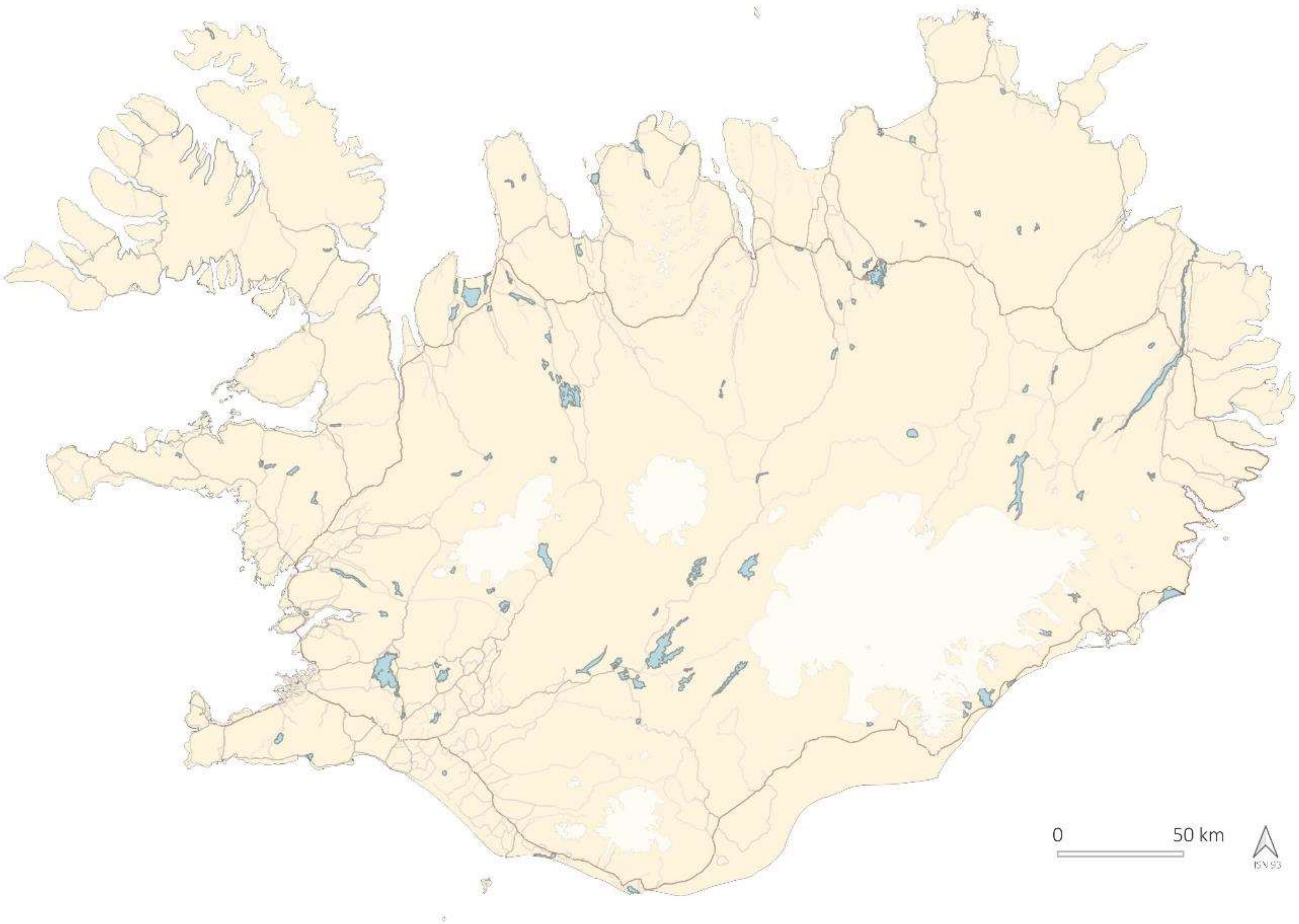

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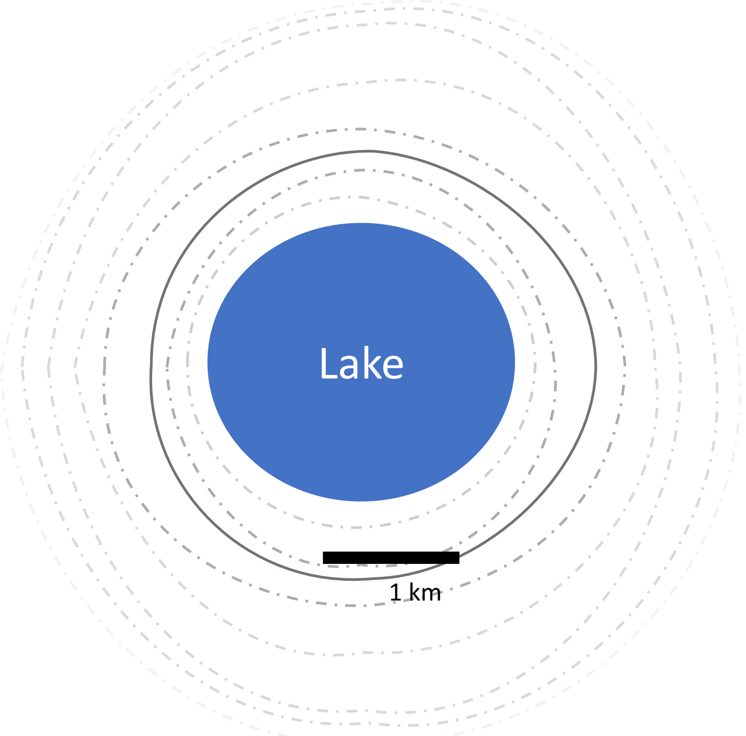

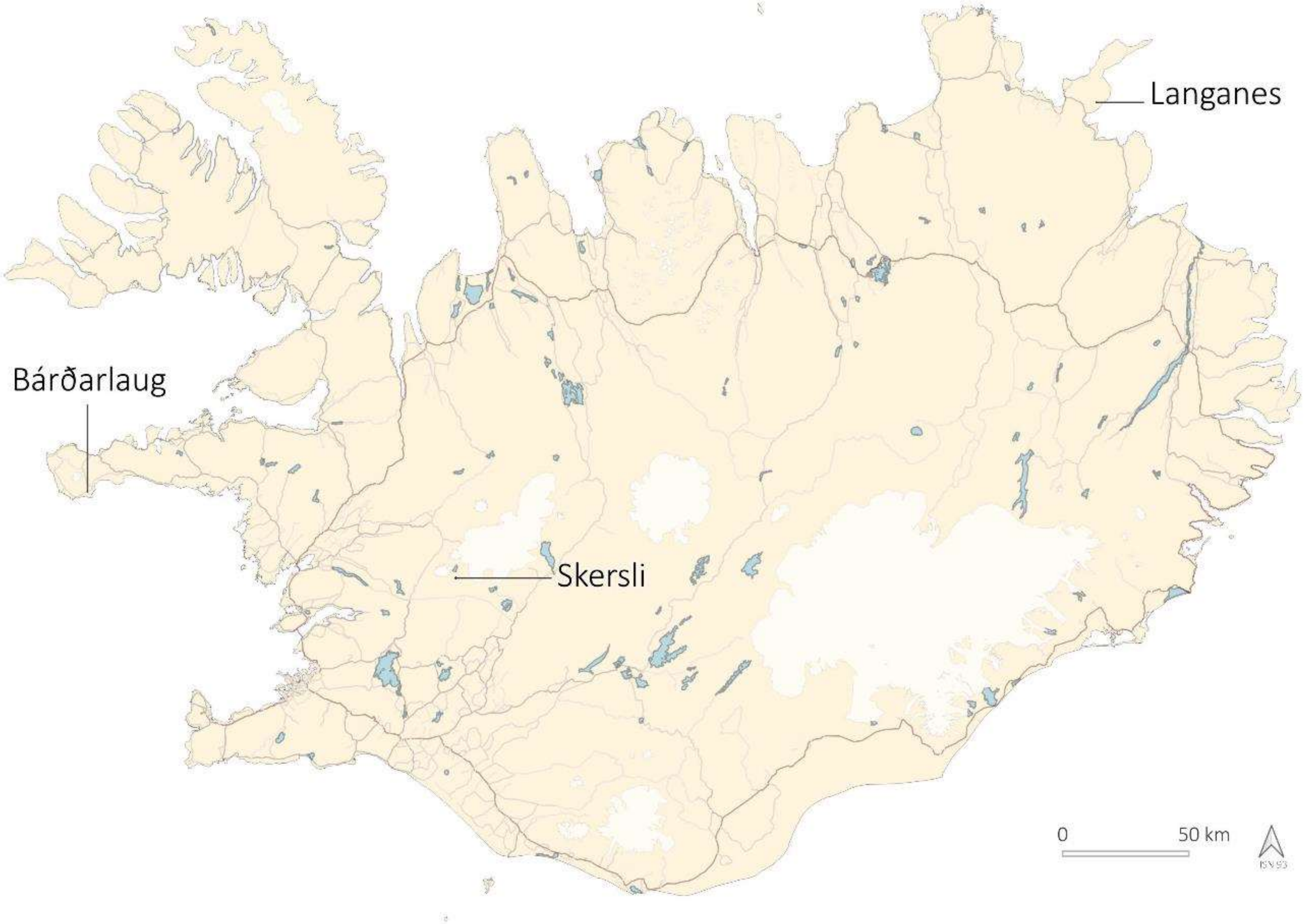

Study design

Watershed:	0.07km²
Lake area:	18,546 m²
Lake/catchment:	25.0%
Depth:	5 m

Watershed:	1.02 km²
Lake area:	196,670 m²
Lake/catchment:	19.2%
Depth:	22 m

Watershed:	0.25 km²
Lake area:	53,154 m²
Lake/catchment:	20.7%
Depth:	6 m

Bárðarlaug
Skersli
Langanes
0
50 km

Study design

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Skersli
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- Uppermost centimetre of sediments
- 3 replicas per lake + blanks
- Short core to estimate Sediment Accumulation Rate (SAR)

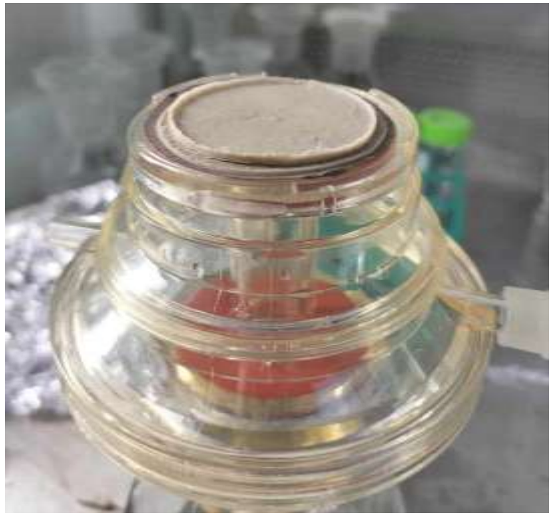

GORE-TEX

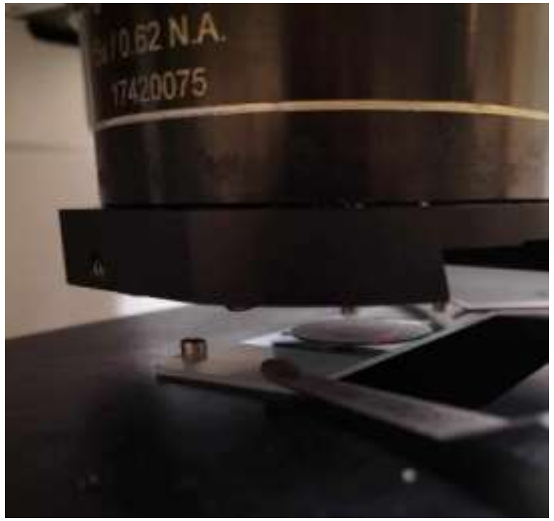
Sample preparation and analysis

Sample preparation for analysis[1]

Purification protocol (adapted from Löder et al., 2017):

- H_2O_2 pretreatment
- Heavy-liquid density separation
- Enzymatic purification method (Protease, Lipase, Cellulase and Amylase)





Analysis of MPs[2]

- Identification with FTIR spectroscopy
- FTIR data analysed using siMPle software (Primpke et al., 2020)

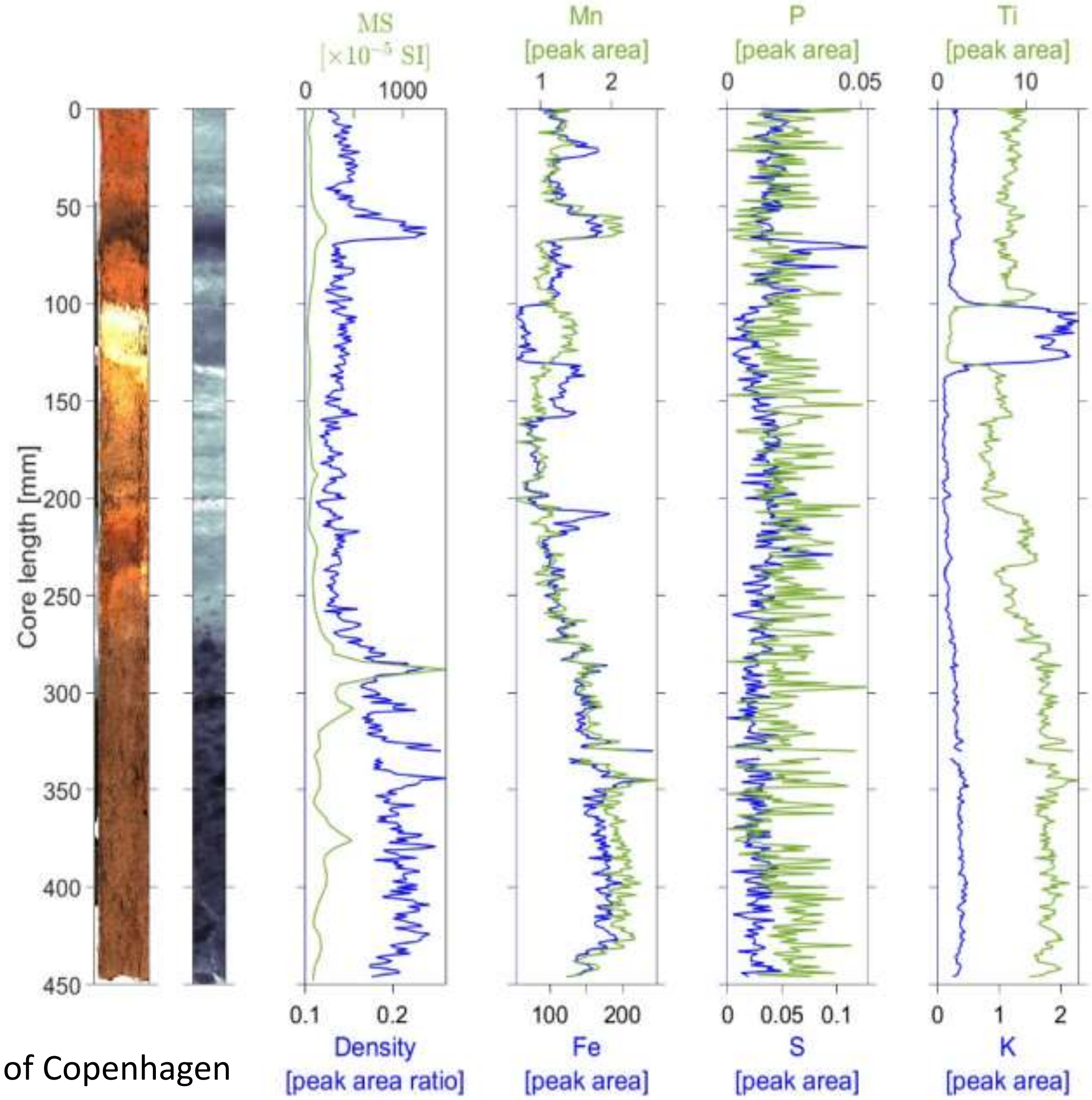
[1] conducted in Finland, University of Turku [2] conducted in Kuopio, University of Eastern Finland

Sediment Accumulation Rate (SAR)

- Use of tephra chronology

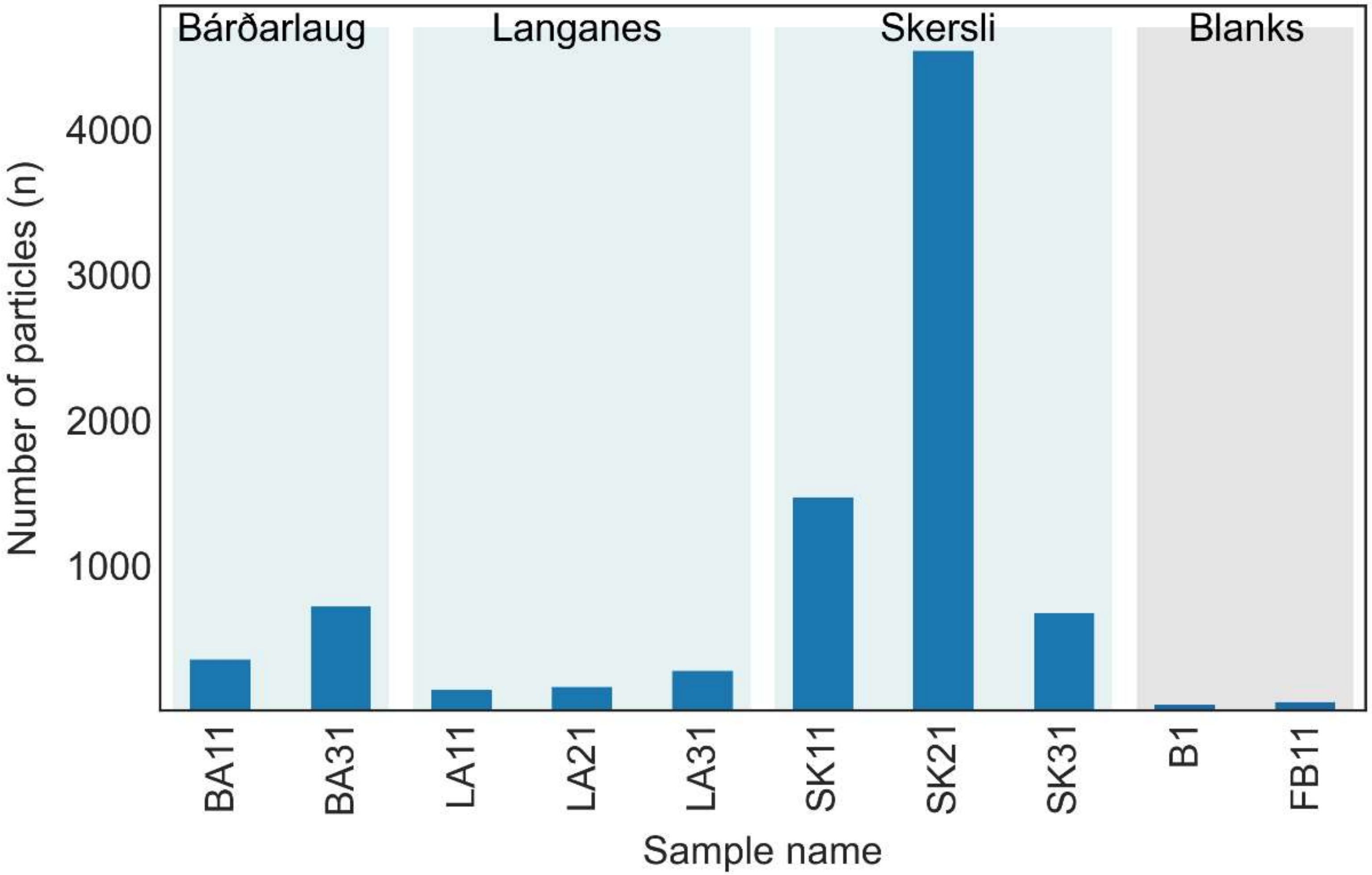
Lake	Identified layer	Identified layer 2	SAR estimate
Skersli	Hekla 3 (3000 years ago) at 1400 mm depth	Veiðivötn (1477 AD) at 310 mm depth	0.47 to 0.56 mm/yr
Bárðarlaug	SN01 from Snæfellsjökull (200 AD) at 409 mm depth	Veiðivötn eruption (Landnám layer; 871 AD) at 350 mm depth	0.23 to 0.30 mm/yr
Langanes	Hekla 3 (3000 years ago) at 120 mm depth		0.04 mm/yr

Langanes



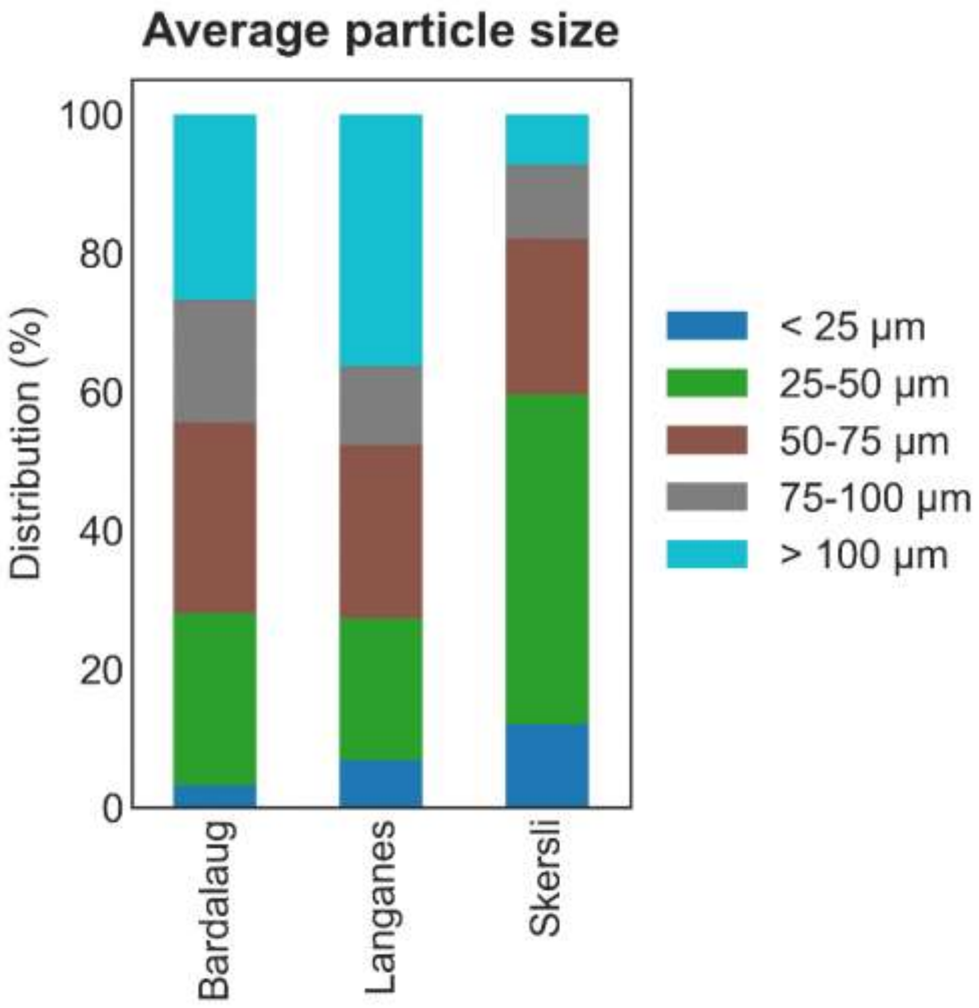
Scanned at Globe Institute, University of Copenhagen

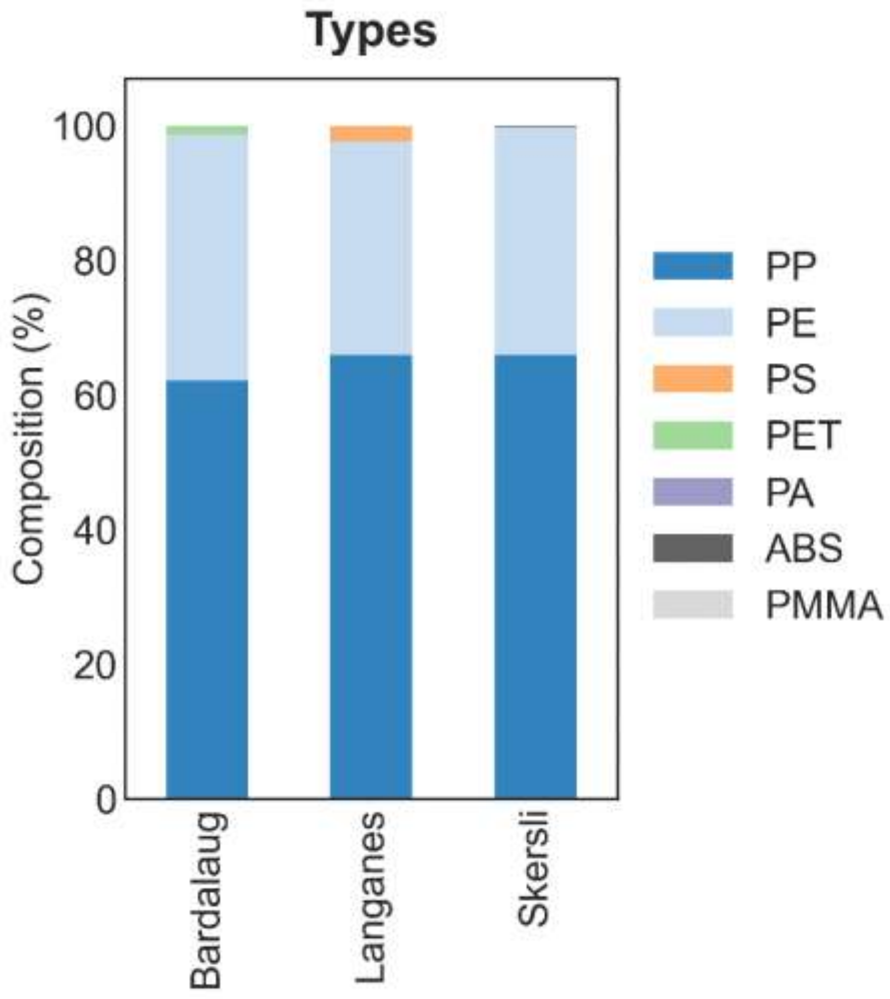
Results



Bárðarlaug
Langanes
Skersli
Blanks
4000
3000
2000
1000
Number of particles (n)
BA11
BA31
LA11
LA21
LA31
SK11
SK21
SK31
B1
FB11
Sample name

Preliminary results





Preliminary results

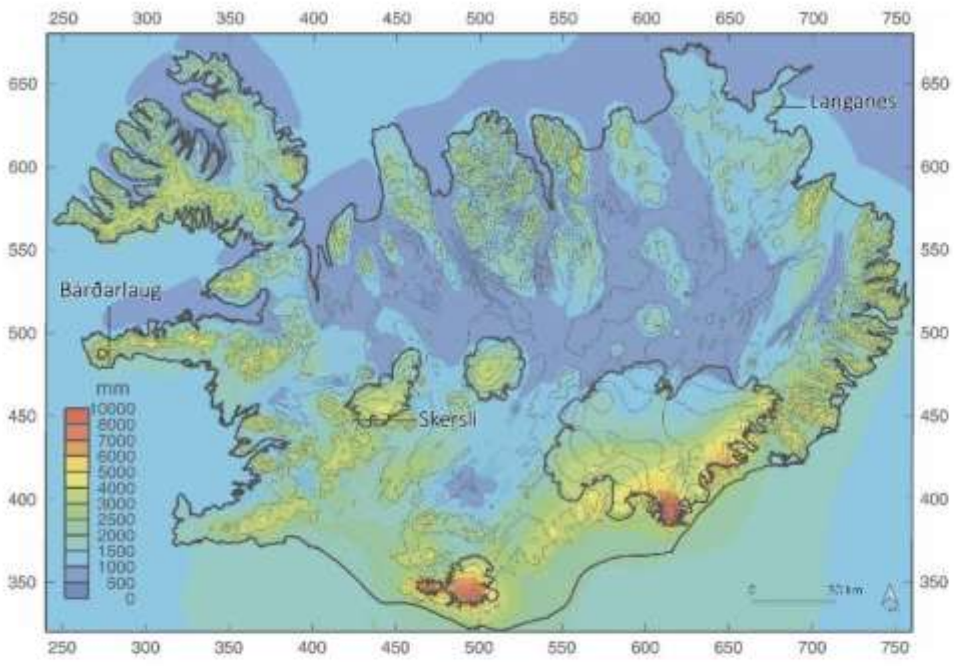
- Based on **estimated** SAR
  - Highest flux of MPs: Skersli
  - Smallest flux: Langanes

Lake	Estimated flux (particles/m²/d)
Skersli	113.4
Bárðarlaug	14.2
Langanes	2.5

Preliminary results

- Based on **estimated** SAR
  - Highest flux of MPs: Skersli
  - Smallest flux: Langanes

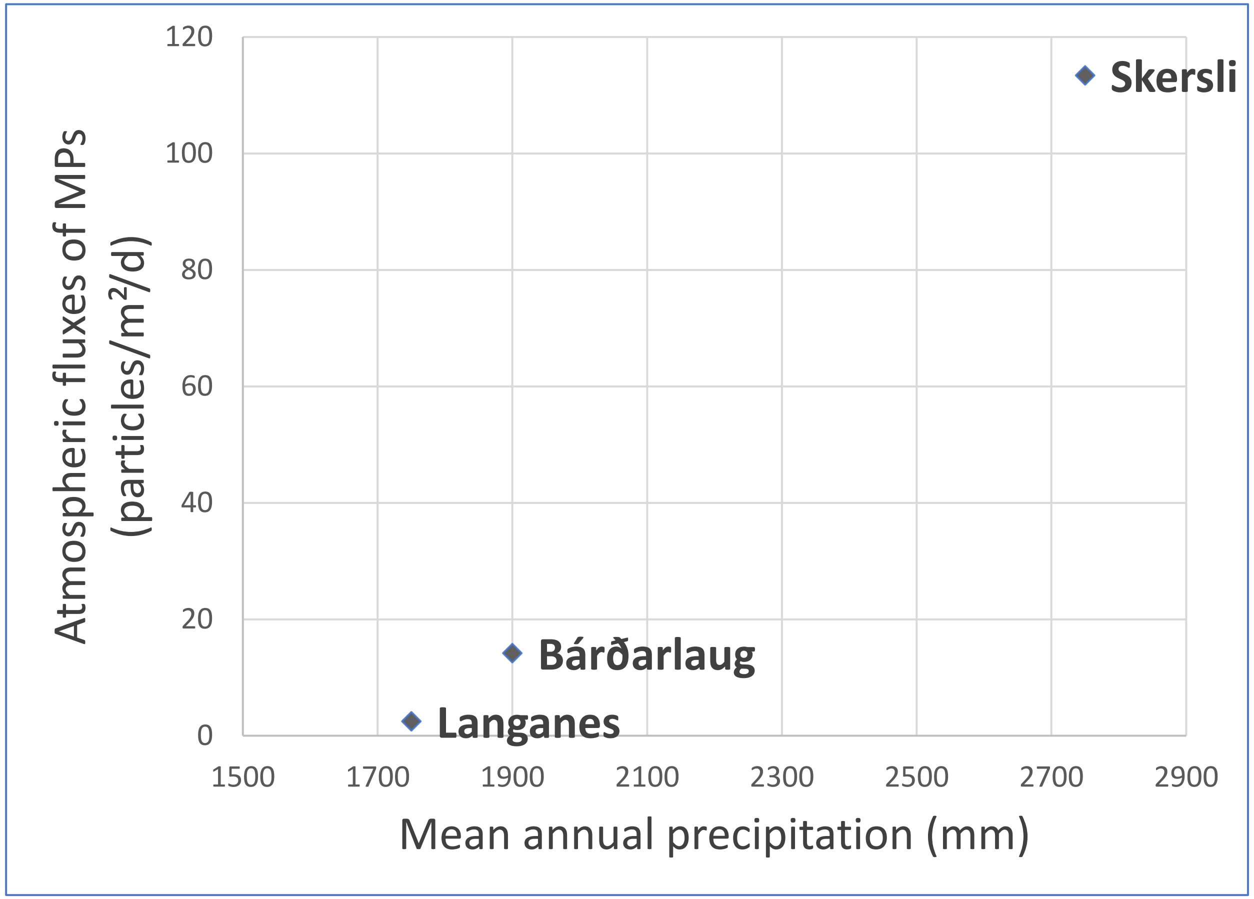
- Precipitation patterns?



Map adapted from Crochet et al. 2007

Lake	Estimated flux (particles/m²/d)	Mean annual precipitation (mm)
Skersli	113.4	2750
Bárðarlaug	14.2	1900
Langanes	2.5	1750

Preliminary results



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Skersli	113.4	2750
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Langanes	2.5	1750

Food for thoughts & next steps

- High number of MPs found in the highlands
- PP and PE dominate
- Up to 100’s of particles/m^2/d, even in remote area (tbc with tephra chronology)
- Smaller particles seems to be travelling further away from the coastline

Next steps :

- Confirm SAR with tephra chronology
- Additional lakes
- Traps data to be analysed
- Use sediment traps across high precipitation gradient
- Backtracking of particles


Takk fyrir tímann
Thank you for your time
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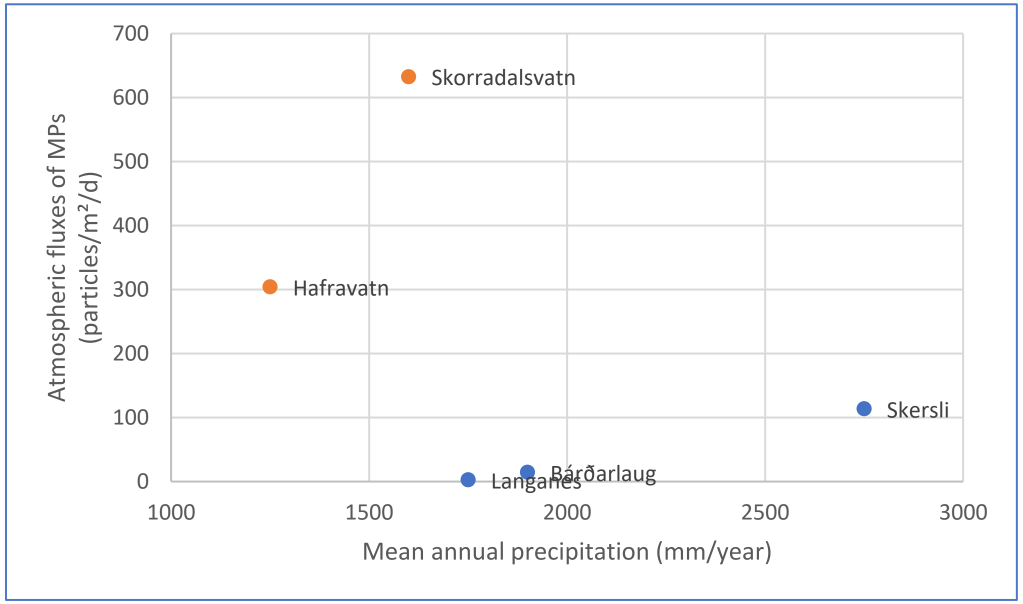
Bonus daily fallout

Name	Skersli	Bárðarlaug	Langanes	Skorradalsvatn	Hafravatn
Estimated annual prcipitation (mm)	2750	1900	1750	1600	1250
Estimated MPs flux n/m²/d	113.4	14.2	2.4	632.4	304



- Some daily MPs fallout values from other places:
  - Remote location in the Pyrenees:
    - 365 MPs/m²/d (±69, particles ≥5µm) (Allen et al., 2019)
  - Urban area:
    - 110±96 and 53±38 MPs/m²/d (Paris) respectively ≥100µm and ≥50µm (Dris, R. et al., 2017)
    - 228±43 MPs/m²/d (Dongguan) ≥ 200µm (Cai, L. et al., 2017)

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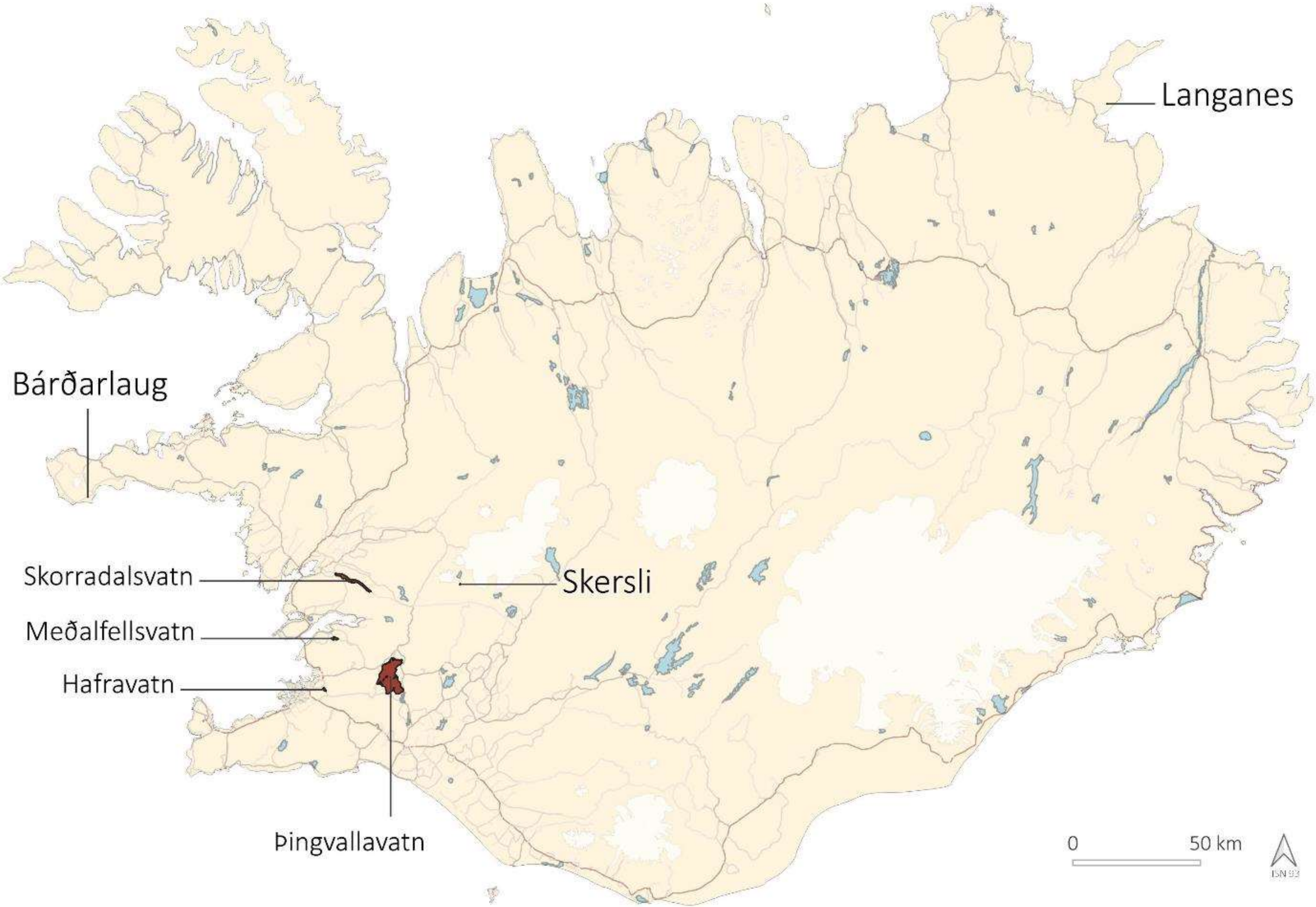
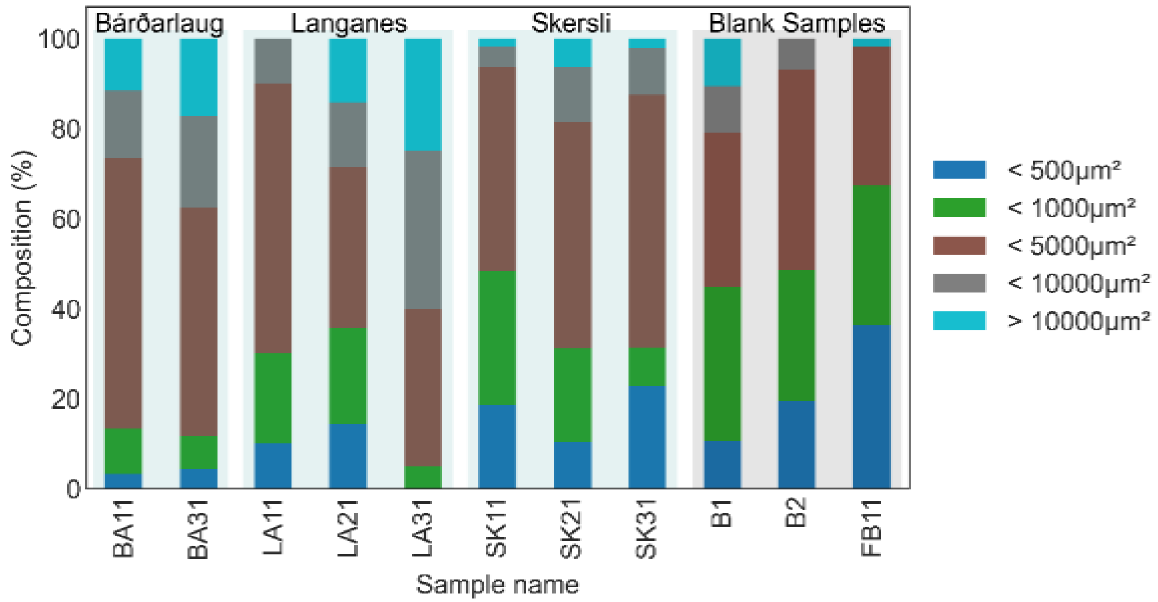
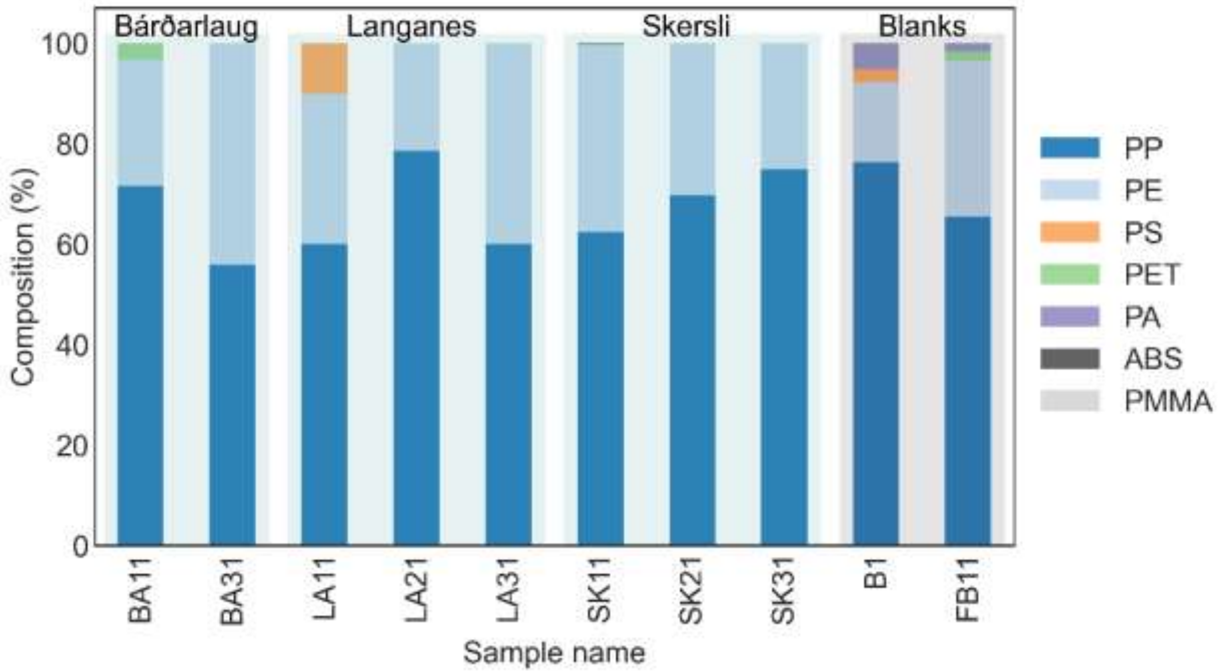

Langanes
Bárðarlaug
Skorradalsvatn
Meðalfellsvatn
Hafravatn
Skersli
Þingvallavatn
0
50 km


Bárðarlaug
Langanes
Skersli
Blank Samples
Composition (%)
Sample name
BA11
BA31
LA11
LA21
LA31
SK11
SK21
SK31
B1
B2
FB11
< 500µm²
< 1000µm²
< 5000µm²
< 10000µm²
> 10000µm²


Bárðarlaug
Langanes
Skersli
Blanks
Composition (%)
Sample name
BA11
BA31
LA11
LA21
LA31
SK11
SK21
SK31
B1
FB11
PP
PE
PS
PET
PA
ABS
PMMA