

Effekter av sprengstein på fisk

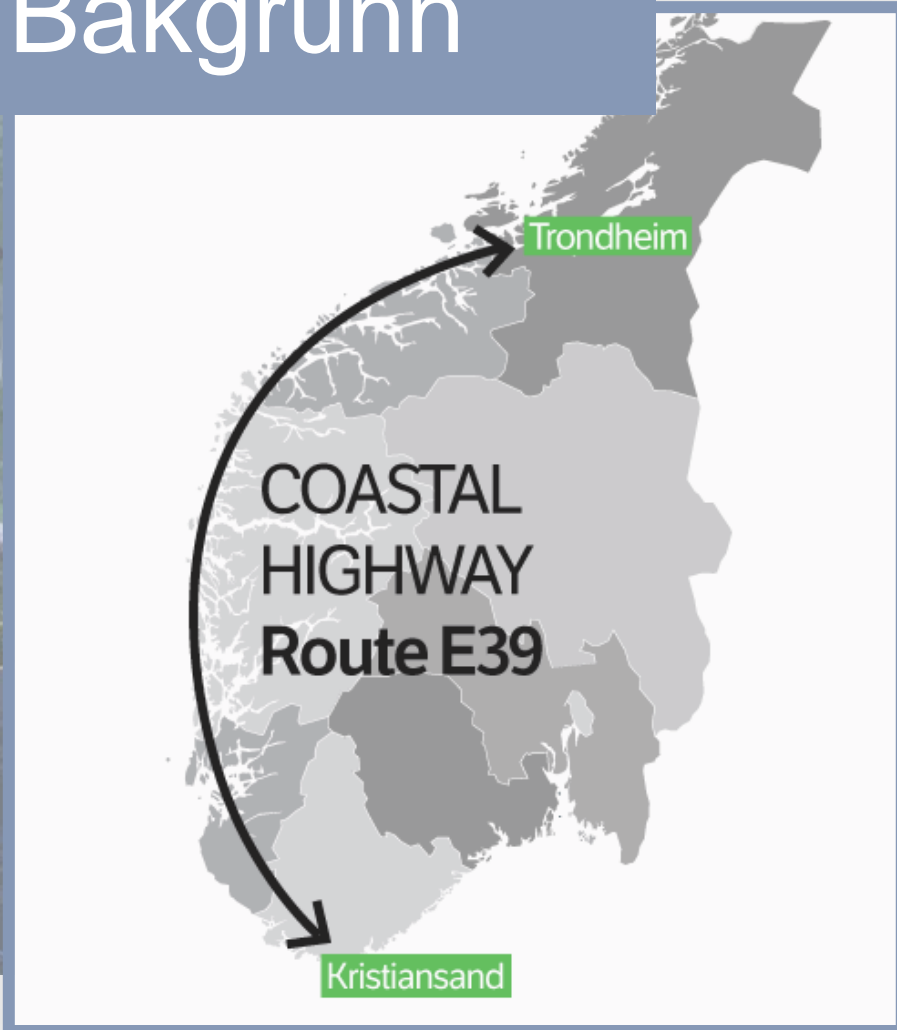
16.03.2022 Emelie Skogsberg

Presentasjons oversikt

- Bakgrunn
- Overordnede mål
 - Delmål
- Sprengstein fra tunnel driving
- Fiskeforsøk



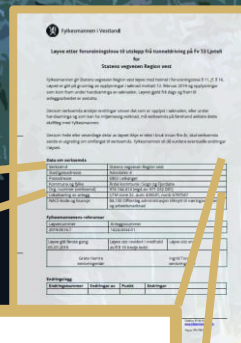
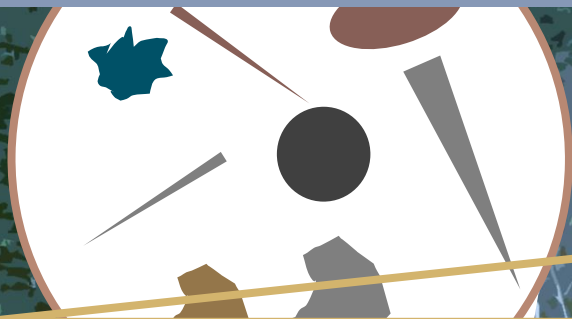
Bakgrunn



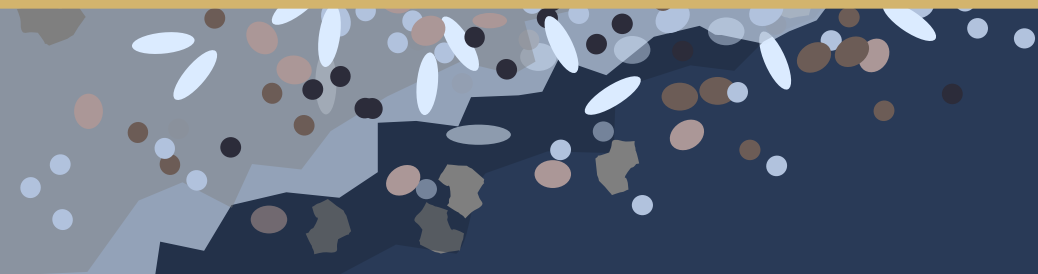
Bakgrunn



Bakgrunn



Parameter	Grenseverdi for STS i utløp	Grenseverdi for STS i resipient
Suspendert tørrstoff (STS)	400mg/l	100mg/l



Bakgrunn

1. Naturlig, eroderte partikler
kontra sprengstein

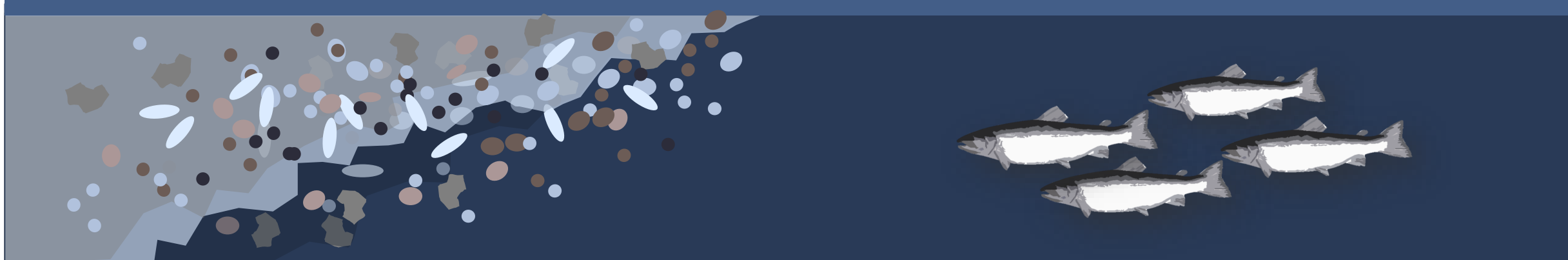


Bakgrunn



1. Naturlig, eroderte partikler
kontra sprengstein

2. Mineralogi påvirker
morfologi



Bakgrunn



1. Naturlig, eroderte partikler
kontra sprengstein

2. Mineralogi påvirker
morfologi

3. Ikke morfologi eller
mineralogi



Bakgrunn



1. Naturlig, eroderte partikler
kontra sprengstein

2. Mineralogi påvirker
morfologi

3. Ikke morfologi eller
mineralogi

En partikkel er en liten del
av hva som helst



Bakgrunn

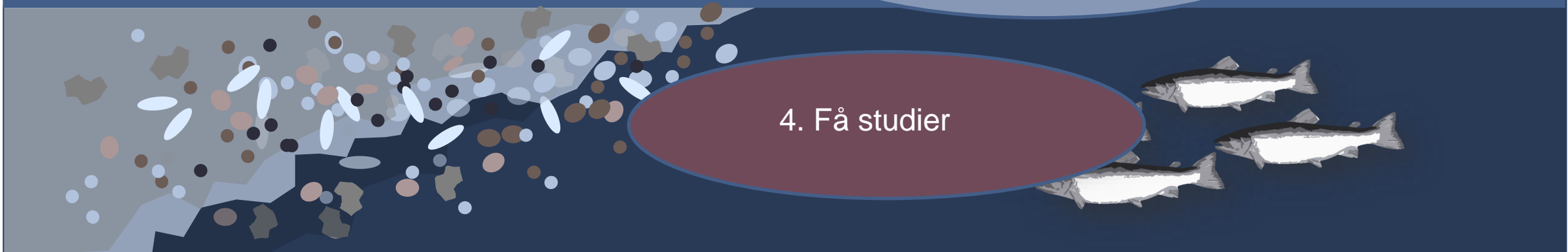


1. Naturlig, eroderte partikler
kontra sprengstein

2. Mineralogi påvirker
morfologi

3. Ikke morfologi eller
mineralogi

4. Få studier



Overordnet mål

Effekter av sprengsteins
partikler fra vei- og
tunnelkonstruksjon i
akvatisk biota



Delmål

1 Morfologisk og geokjemisk karakterisering av sprengstein

2 Effekter av sprengstein i laks

3 Økologisk risikovurdering



Delmål

1

Morfologisk og geokjemisk karakterisering av sprengstein

2

Effekter av sprengstein i laks

3

Økologisk risikovurdering



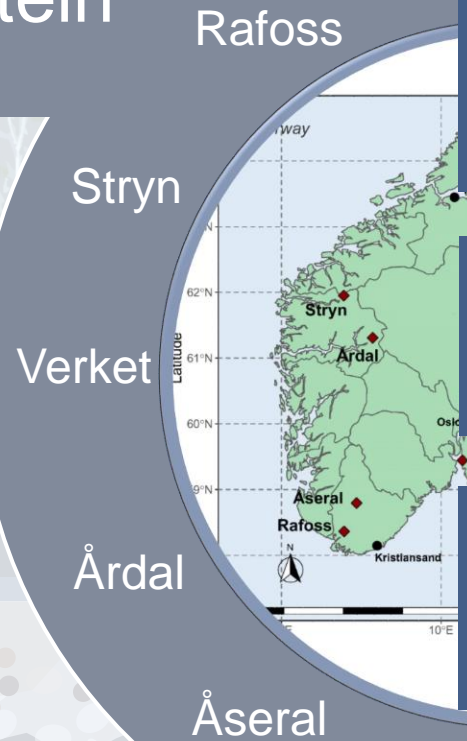
Delmål I

Sprengstein

Mineralogi

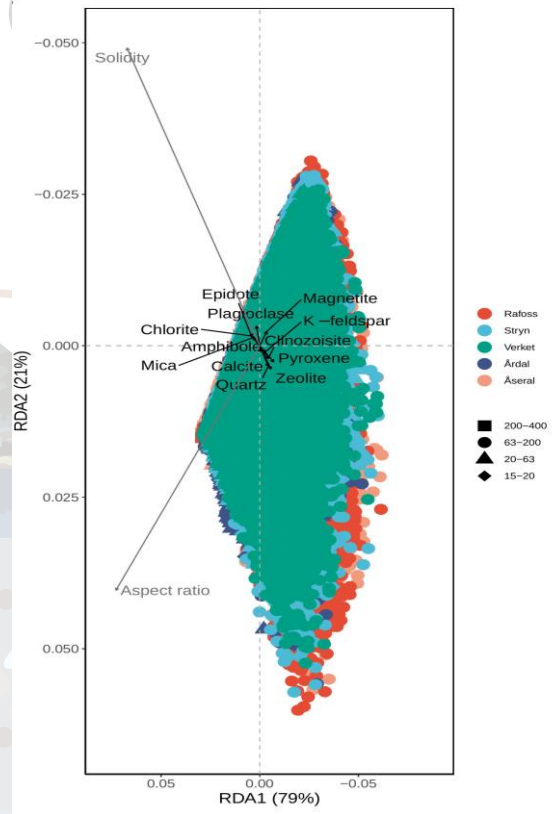
Grunnstoffer

Morfologi og
størrelse



Delmål I

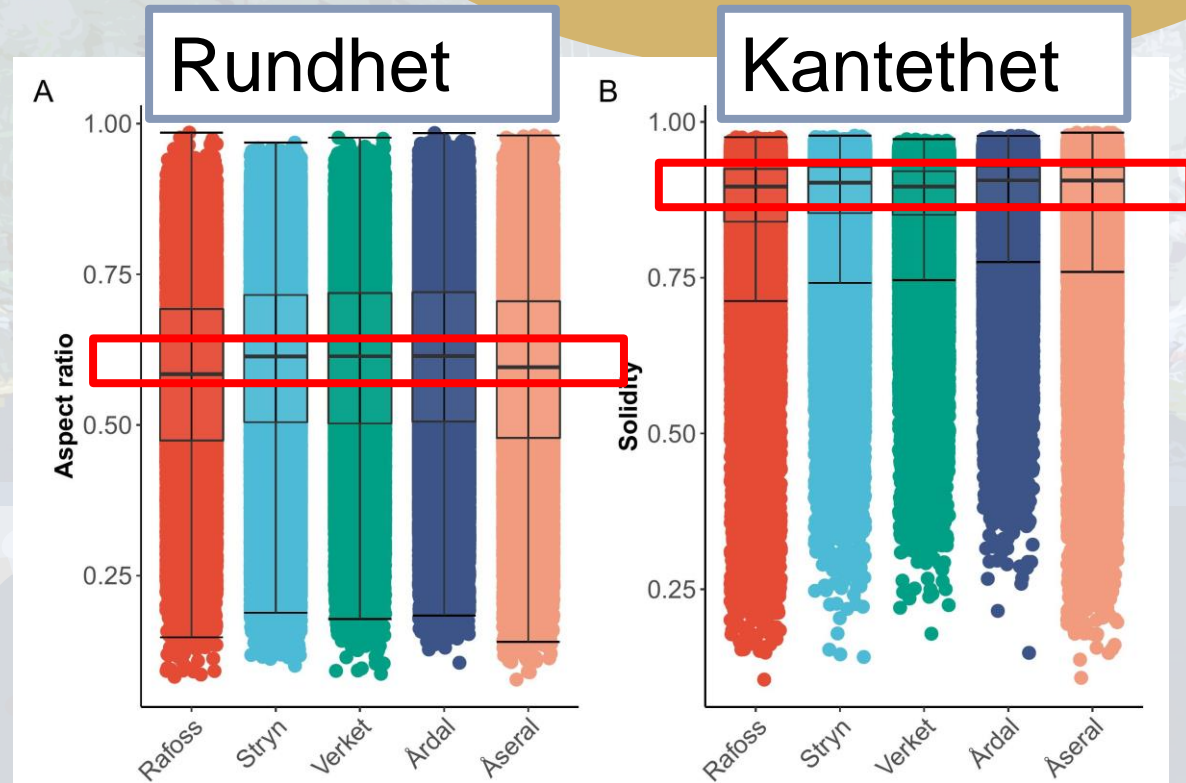
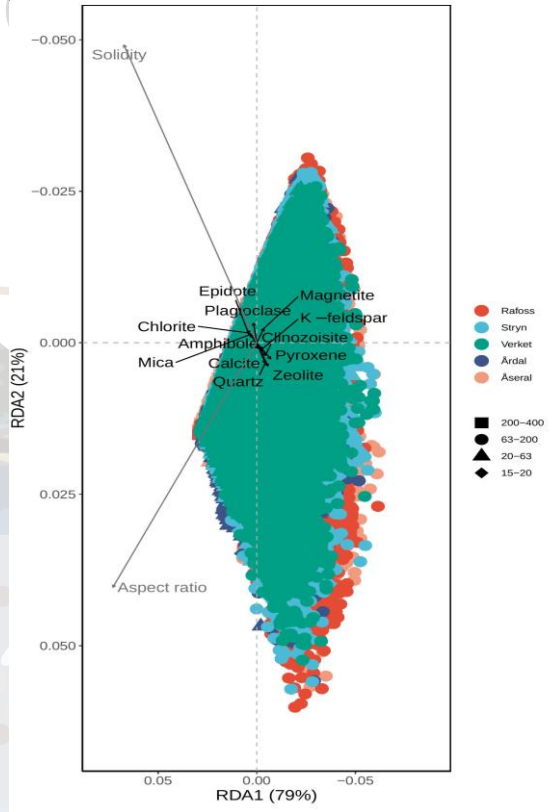
Påvirker mineralogi
morfologi til
sprengstein?



n=711 263

Delmål I

Påvirker mineralogi
morfologi til
sprengstein?



n=711 263

Delmål I

Morfologi og størrelse

Sprengstein



Rafoss

Stryn

Verket

Årdal

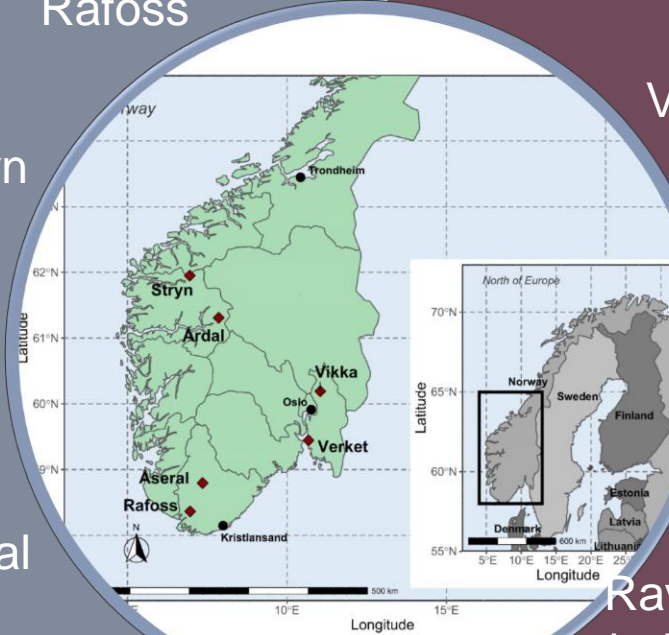
Åseral

Vikka

Ravine-
bekken
oktober*

Ravine-
bekken
november*

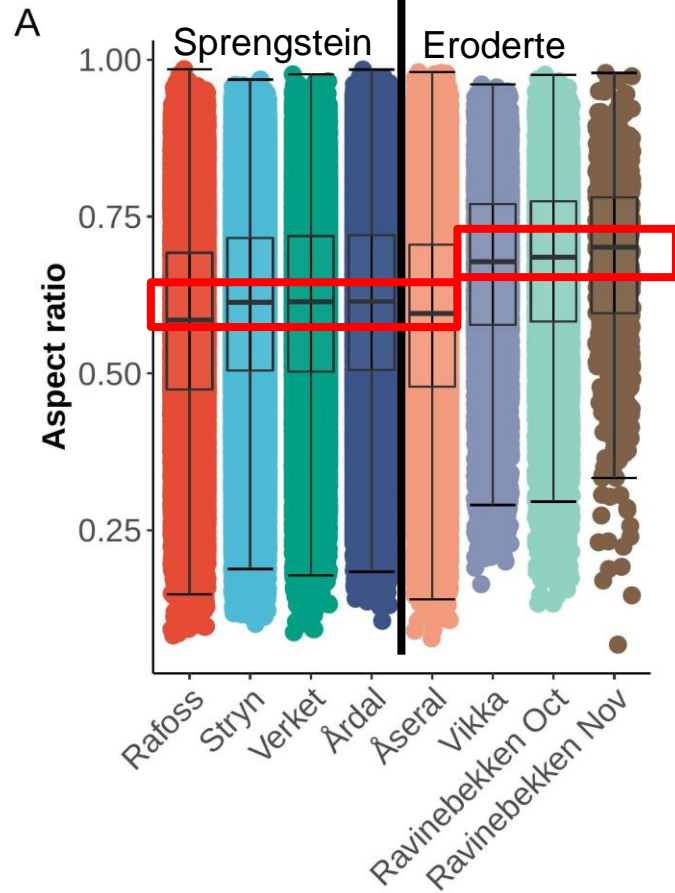
Naturlig eroderte partikler



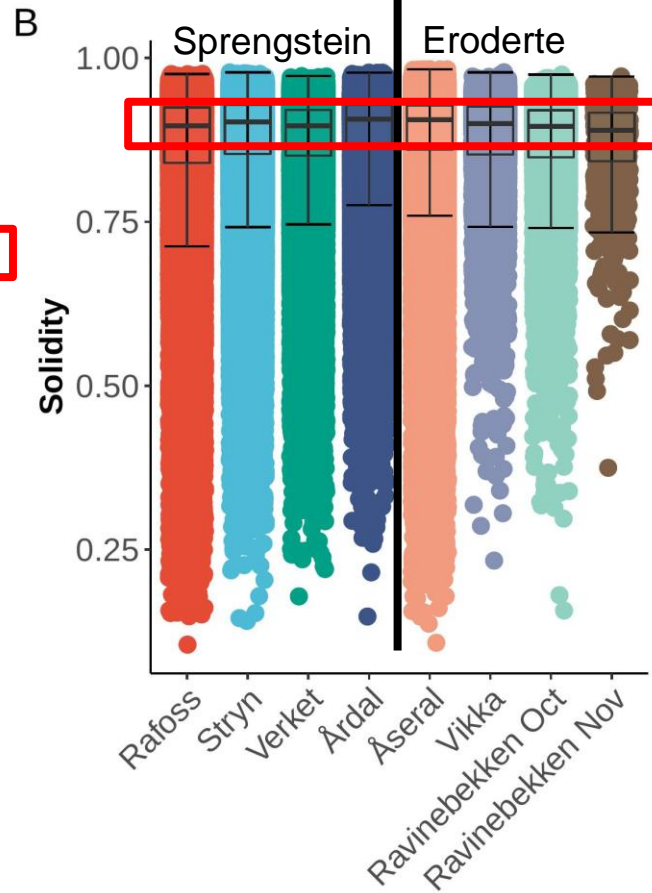
*Samlet inn av NVE

Delmål I

Rundhet



Kantethet



Er eroderte partikler mer runde og mindre kantete enn sprengstein?

n=740 103

Delmål

1

Morfologisk og geokjemisk
karakterisering av
sprengstein

2

Effekter av sprengstein i
laks

3

Økologisk risikovurdering



Delmål II

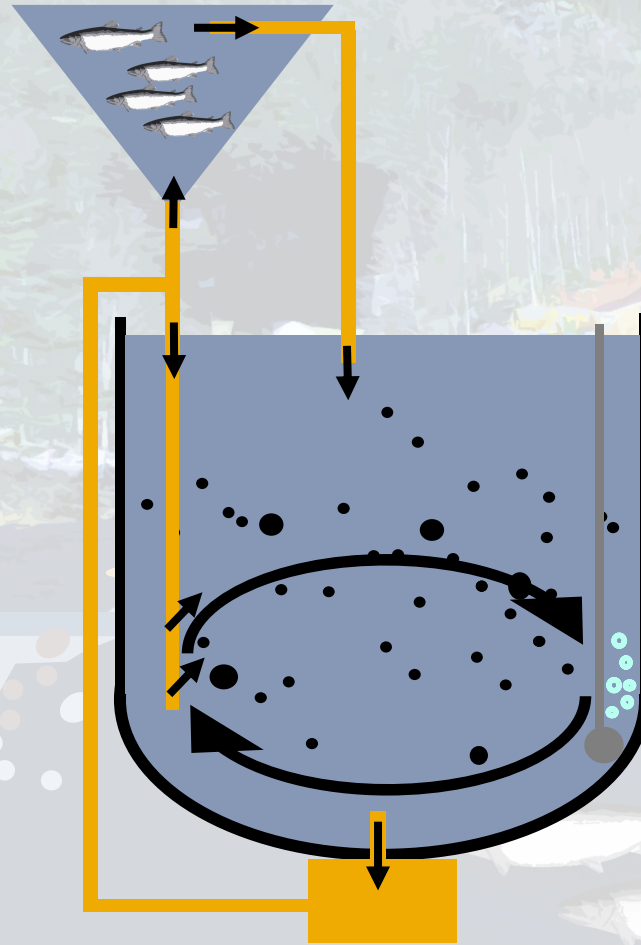
Verket & Rafoss

192h

Sublethal effekter

Juvenil Atlantisk laks (*Salmo salar*)

Partikkel størrelse 0.4-400 μ m (80% <63 μ m)



Delmål II

Verket

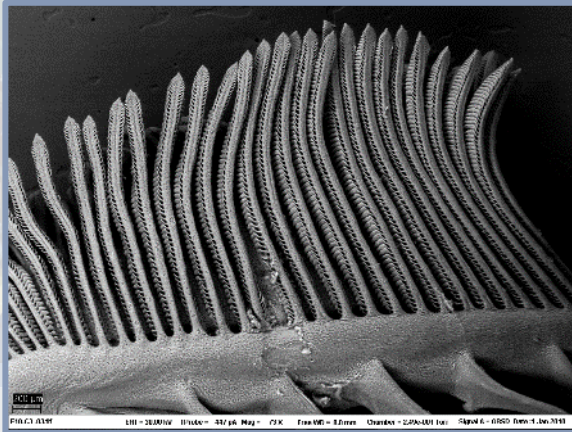
0 mg/L	100 mg/L	400 mg/L	800 mg/L	2000 mg/L	3500 mg/L	5000 mg/L
100% overlevelse 192h	100% overlevelse 192h	100% overlevelse 192h	100% overlevelse 192h	100% overlevelse 192h	100% dødlighet <48h	100% dødlighet <24h



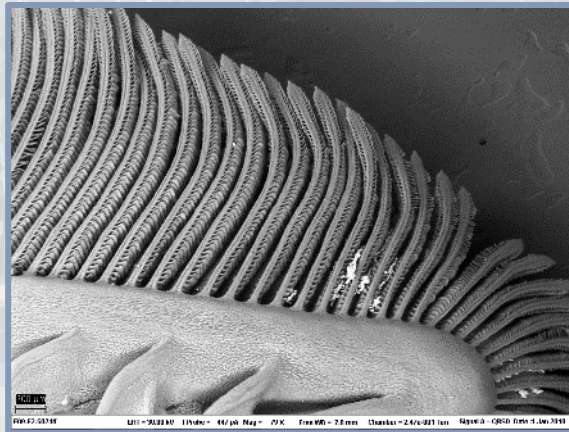
Delmål II

SEM

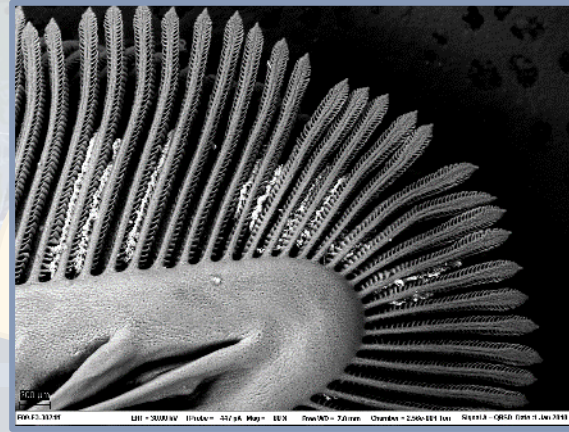
(Scanning electron microscope)



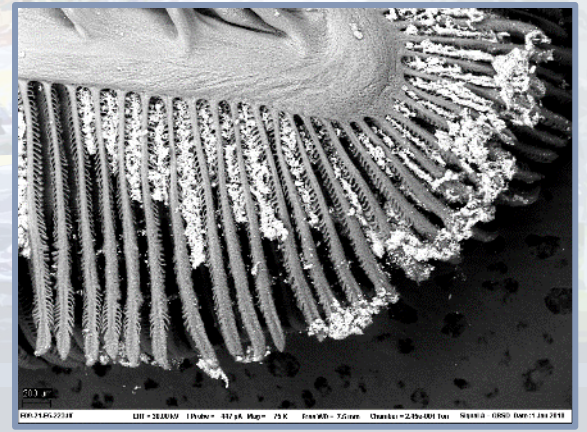
Kontroll



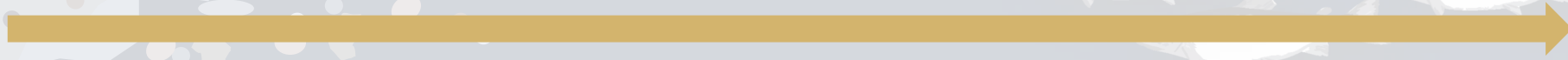
400mg/l



800mg/l



3500mg/l
etter 48h



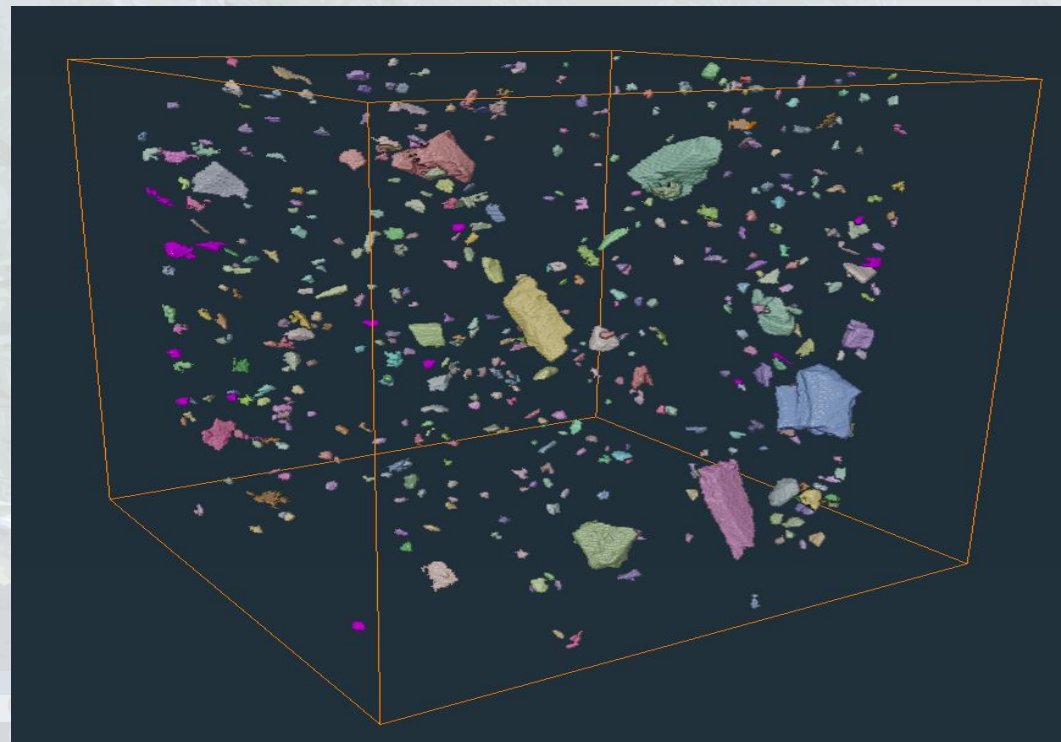
Delmål II

μ CT

(X-ray micro-computed tomography)

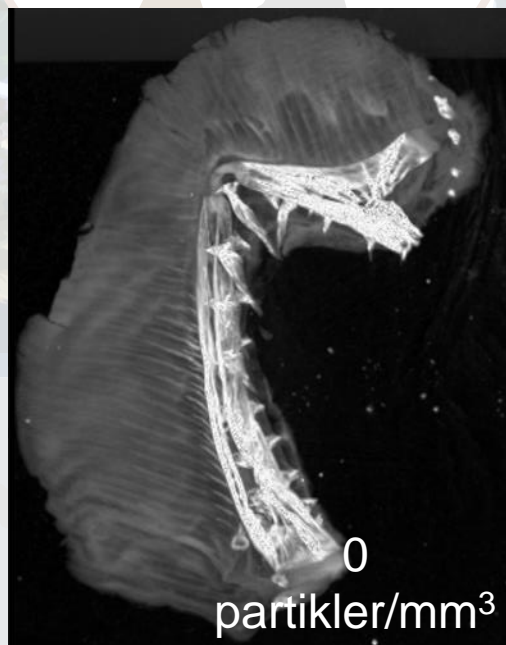


Studerer den tredimensjonale naturen til geologiske og biologiske material

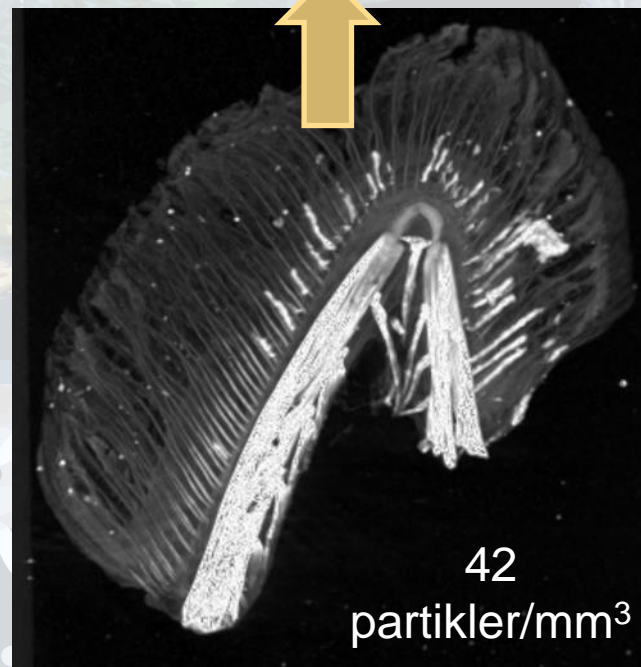


Delmål II

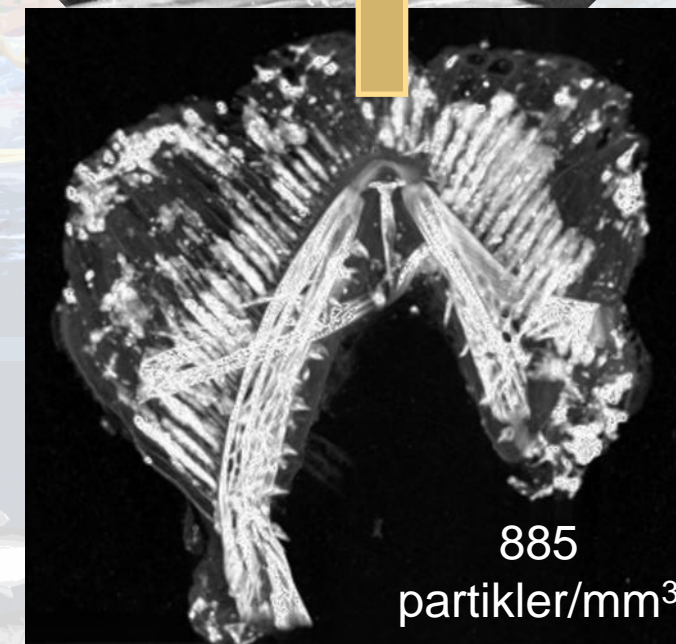
μ CT



0 mg/L



1000 mg/L

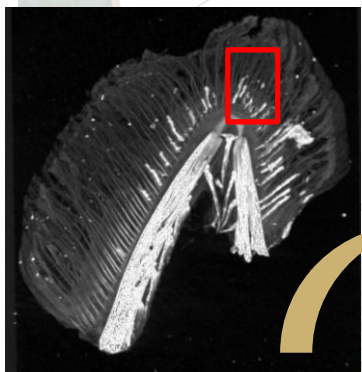


5000 mg/L

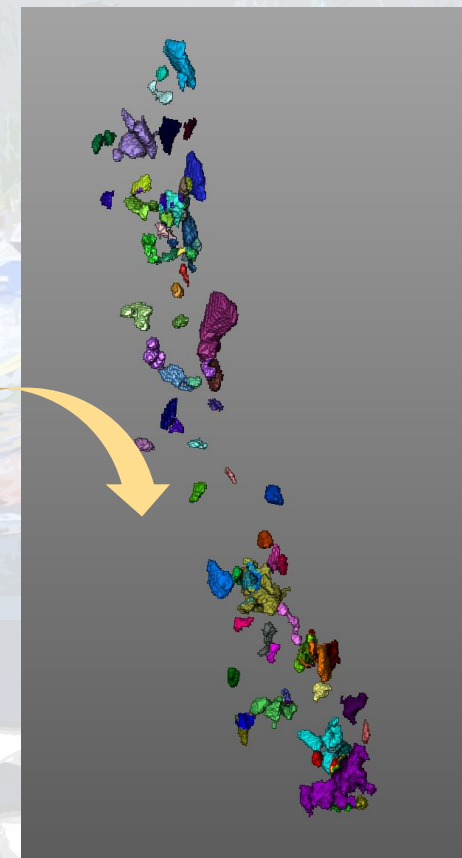
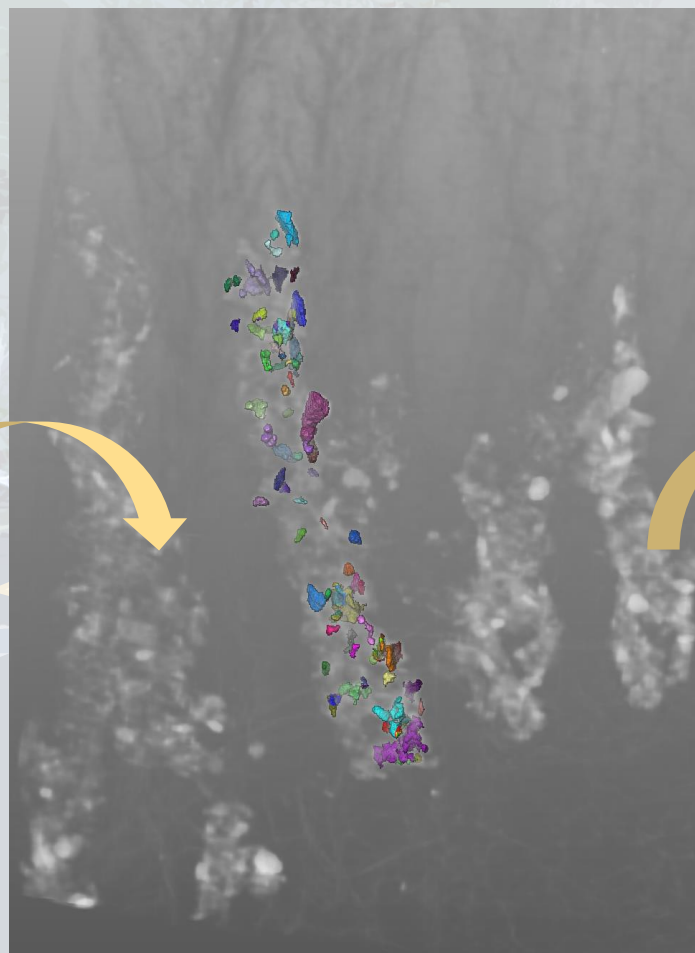
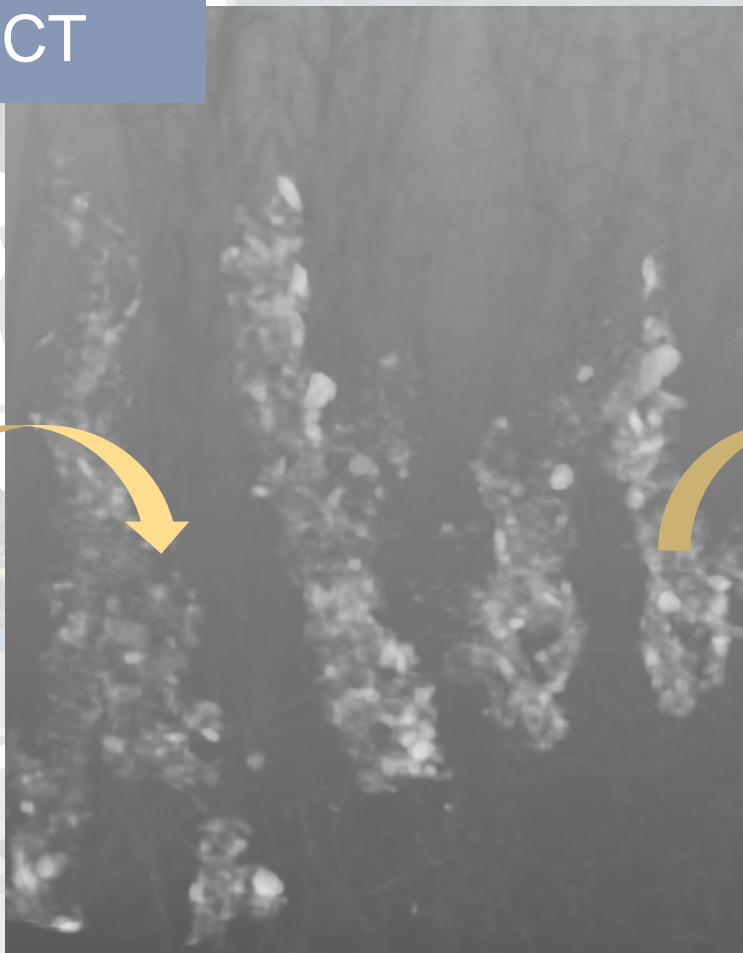
μ CT bilder fra Jakub Jaroszewicz (Warszawa Teknologiske Universitet) og Ole Christian Lind (NMBU)

Delmål II

μ CT

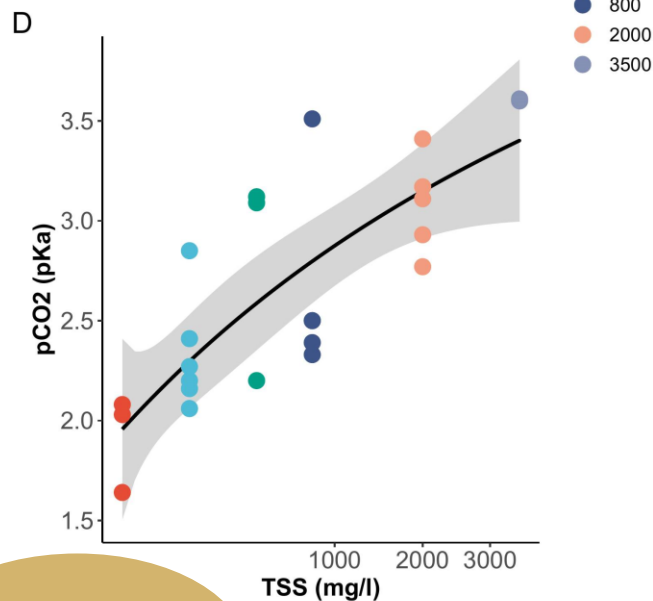
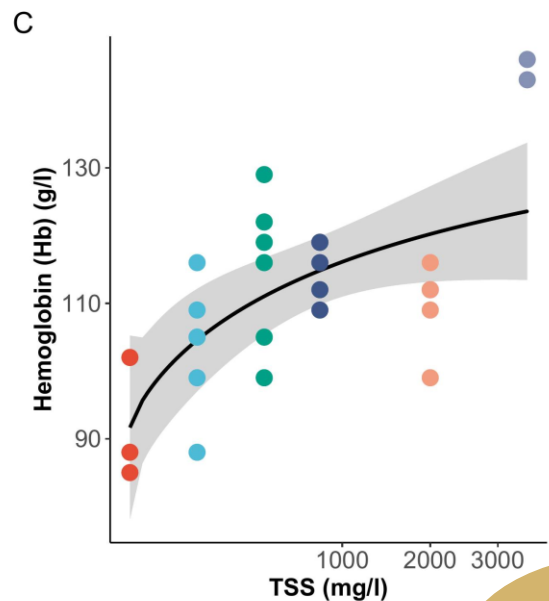
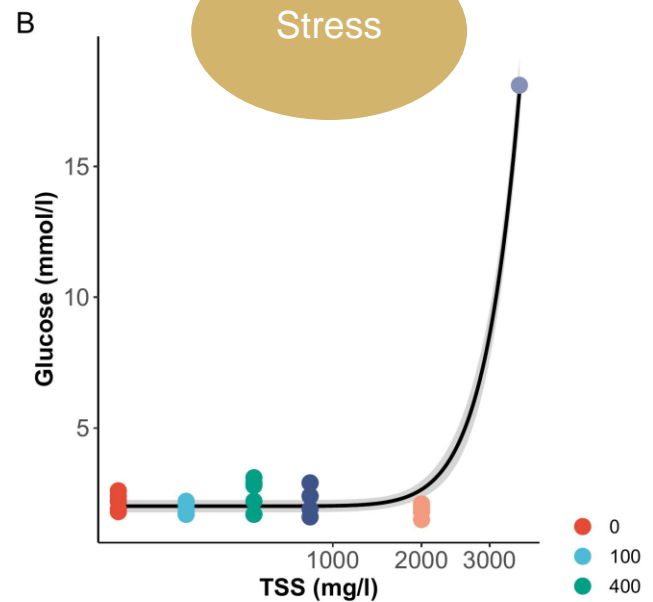
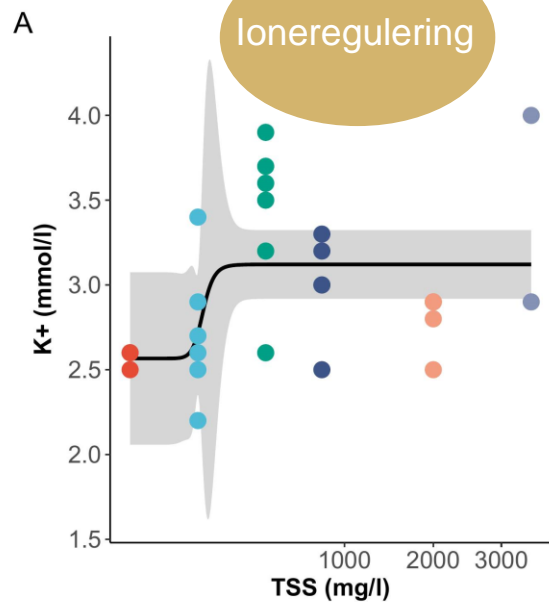


1000 mg/L



Delmål II

Verket



- 0
- 100
- 400
- 800
- 2000
- 3500

Respirasjon

Takk for oppmerksomheten

Takk til

- Veilederteam Sondre, Lene og Hans-Christian
- Medforfattere og kolleger ved NIVA og isotoplaboratoriet og fiskelaboratoriet ved NMBU
- Hans-Christian Teien for støtte og hjelp under fiskeforsøkene
- Disseksjonsteam: Aurora Hansen, Erica Maremonti, Estela Reinoso Maset, Hans-Christian Teien, Thea Oma og Yetneberk Ayalew Kassaye
- μ CT-analyse av Jakub Jaroszewicz (Fakultet for materialvitenskap og ingeniørvitenskap, Warszawa teknologiske universitet) og Ole Christian Lind (NMBU)
- Innsamling og DIA-analyse av partikler fra Ravinebekken av Norges vassdrags- og energidirektorat.



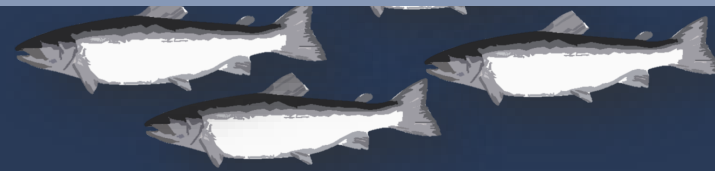
Norwegian University
of Life Sciences



Norwegian Institute for Water Research



Statens vegvesen
Norwegian Public Roads
Administration



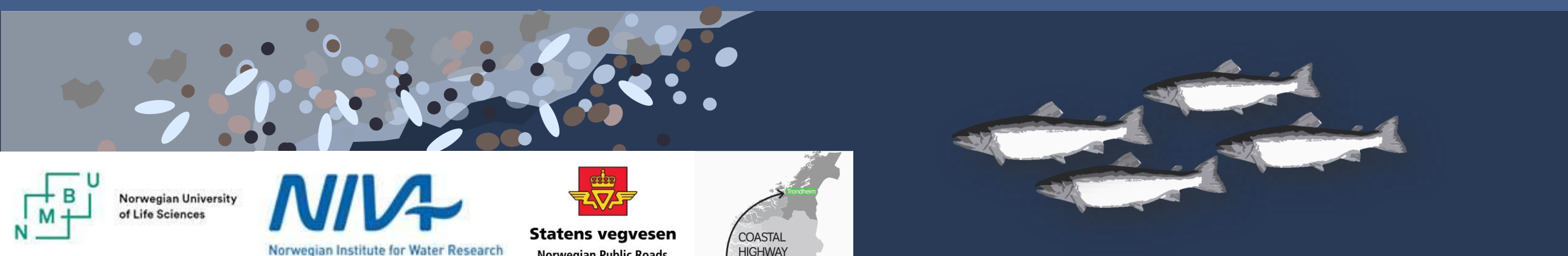
Refranser

Liu, E. J., Cashman, K. V., & Rust, A. C. (2015). Optimising shape analysis to quantify volcanic ash morphology. *GeoResJ (Amsterdam)*, 8, 14-30. doi:10.1016/j.grj.2015.09.001

Cioni, R., Pistolesi, M., Bertagnini, A., Bonadonna, C., Hoskuldsson, A., & Scateni, B. (2014). Insights into the dynamics and evolution of the 2010 Eyjafjallajökull summit eruption (Iceland) provided by volcanic ash textures. *Earth and planetary science letters*, 394, 111-123. doi:10.1016/j.epsl.2014.02.051

Leibrandt, S., & Le Pennec, J.-L. (2015). Towards fast and routine analyses of volcanic ash morphometry for eruption surveillance applications. *Journal of volcanology and geothermal research*, 297, 11-27. doi:10.1016/j.jvolgeores.2015.03.014

WHO(1985). The WHO/EURO man-made mineral fiber reference scheme. *Scandinavian Journal of Work, Environment & Health*, 11(2), 123-129. Retrieved from <https://www.jstor.org/stable/40965197>



Experiments

Effects



Contaminants

- **Particles** from blasting/drilling
- **Metals** leaching from the particles
- **Oil spills** from machinery



Physical interaction with gills

Interaction with gills

Interact with biomolecules and enzymes

Gene expression
(EROD, CYP1A, MT)

Effect respiration

Effect osmoregulation

Blood chemistry
(in situ measurements of ions, hematocrit, hemoglobin, glucose, respiration gases)

Oxidative stress

DNA damage

Micronucleus (MN)

Mechanical damage

Histopathological examinations
(morphological changes, mucus cells, immunohistochemistry)

Gene expression
(LPO, SOD, GST)

Experiments



Contaminants

- **Particles** from blasting/drilling
- **Metals** leaching from the particles
- **Oil spills** from machinery

Interact with/and uptake by gills

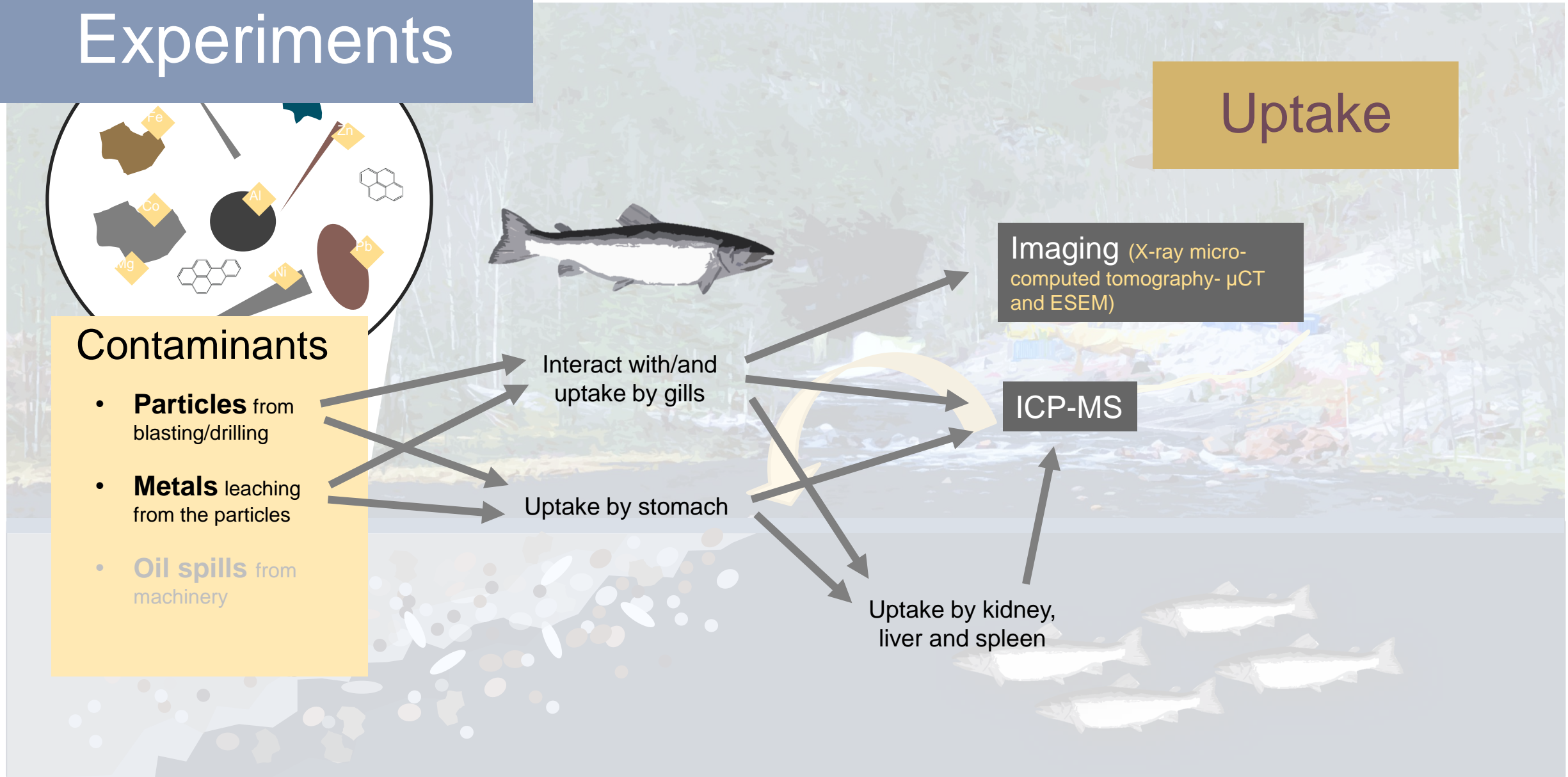
Uptake by stomach

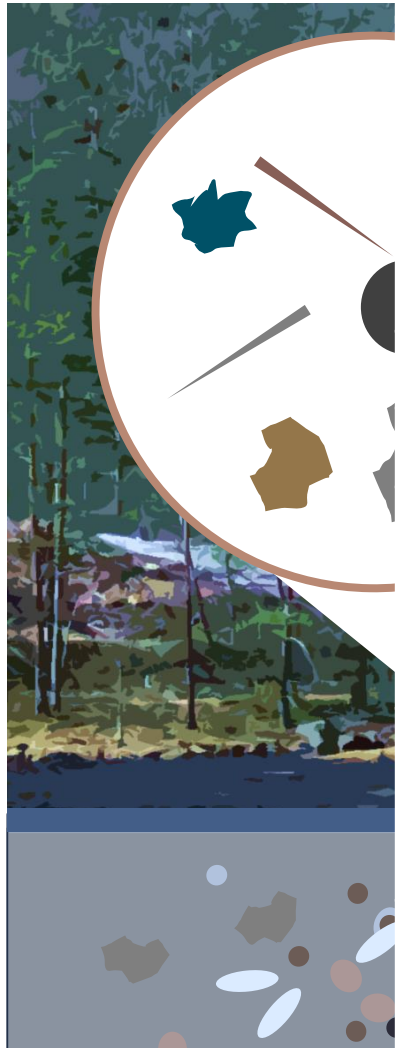
Uptake by kidney, liver and spleen

Imaging (X-ray micro-computed tomography- μ CT and ESEM)

ICP-MS

Uptake





Size measurement	Abbreviation	Definition			DIA vs SIA
Minimum Feret diameter	F_{min}	Shortest distance between two lines tangential to the particle outline			Same measurement
Maximum Feret diameter	F_{max}	Maximum distance between two parallel lines tangential to the particle outline			Same measurement
Area of the particle	A_p	Area of the pixels in the particle			Same measurement
Area of the convex hull	A_{ch}	Area of the pixels in the convex hull			Same measurement
Perimeter of the particle	P_p	Length of the outside boundary of the particle			Not measured in DIA
Perimeter of the convex hull	P_{ch}	Length of the outside boundary of the convex hull			Not measured in DIA
Diameter of the circle of equal projection area	D_{EQPC}	Diameter of the circle having the same area as the particle's projection			Same measurement
Shape parameters	Abbreviation	Formula	Sensitivity to	Refence	DIA vs SIA
Aspect ratio	AR	F_{min} / F_{max}	Form	(Liu et al., 2015) and references herein	Same calculation
Solidity	SLD	A_p / A_{ch}	Roughness (morphological roughness)	(Cioni et al., 2014 ; Leibrandt & Le Pennec, 2015 ; Liu et al., 2015)	Same calculation*
Convexity	CVX	P_{ch} / P_p	Surface texture (textual roughness)	(Leibrandt & Le Pennec, 2015 ; Liu et al., 2015)	Not calculated in DIA
Fibers		$\geq 3 F_{max} / F_{min} \ni$		(MMMMF, 1985)	Same calculation

ICP-MS particle uptake

