

Increased fuel flexibility and performance for boilers with challenging fuels

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Increased fuel flexibility and performance for boilers with challenging fuels

- Calderys
- E.ON
- Energiforsk
- Falu Energi & Vatten
- Kanthal
- MH Engineering
- Mälarenergi
- Stockholm Exergi
- Swerea IVF
- Valmet
- Vattenfall
- *Energimyndigheten*

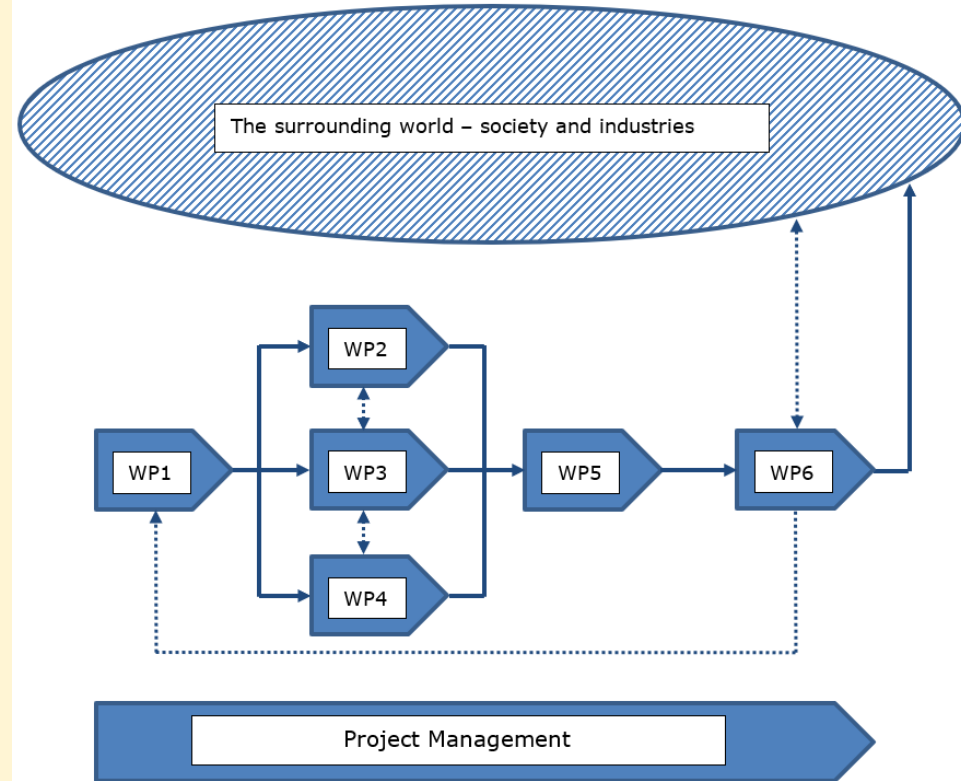
Background

- Biomass-based fuels often imply an elevated risk of corrosion caused by chlorides and alkali metals
- An additional challenge with recycled wood and waste is their content of paint, plastics and metals
 - This results in high content of heavy metals (e.g. Pb and Zn) and chloride causing increased corrosion



Contents

- WP1 – Challenges and possibilities
- WP2 – Performance of cooled metallic parts
- WP3 – Performance of uncooled metallic parts
- WP4 – Refractories
- WP5 – Excellence in performance
- WP6 – Co-operation and communication

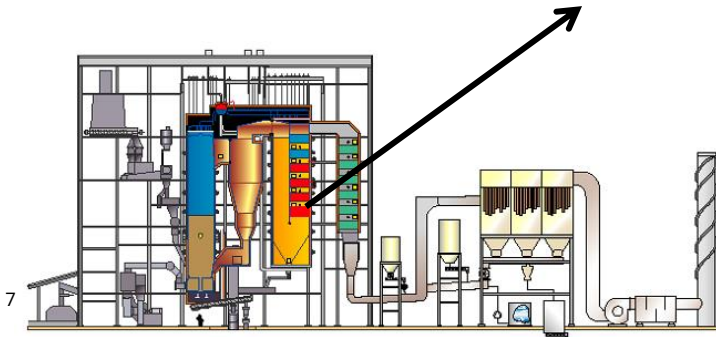


Selection of project goals

- To obtain new knowledge on how heavy metals in deposits influence corrosion of cooled parts
- To identify 1-2 coating candidates with the potential to improve the life performance by 20 %
- To obtain new knowledge on how corrosive fuel components degrade refractories
- To identify 1-2 refractory material candidates with the potential to improve the life performance by 20 %
- To achieve an understanding for when refractories are particularly beneficial to be used for protection of underlying metal and when other corrosion prevention methods may be attractive

Performance of cooled metallic parts

Exposure – Tube shield evaluation



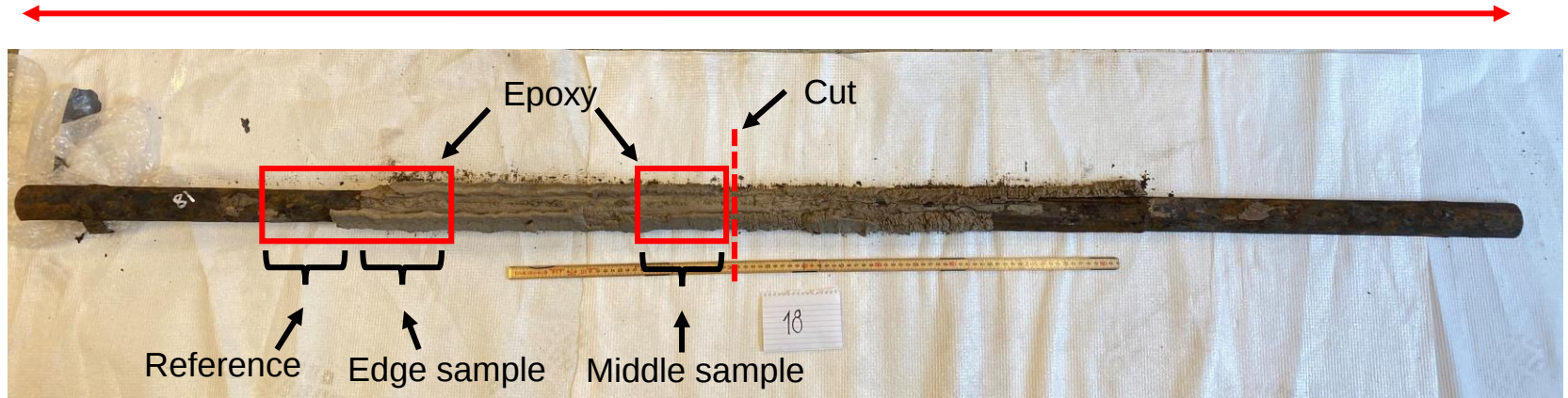
Convection bank 0 floor

Tube	6.	San 60
Tube	7.	Test alloy 2
Tube	8.	Test alloy 1
Tube	9.	APMT

Convection bank 1 roof

Tube	12.	San 60
Tube	13.	Test alloy 1
Tube	18.	APMT
Tube	21.	Test alloy 2

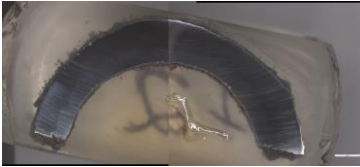
180 cm



SEM

- Middle cross section samples analyzed so far

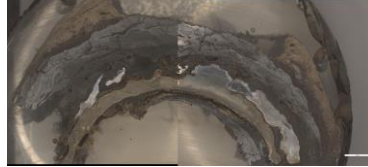
Tube 12 – San 60



Tube 21 – Test alloy 2



Tube 13 – Test alloy 1

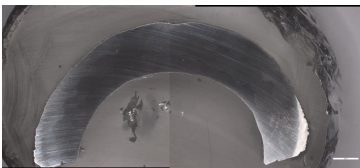


Tube 18 - APMT



“Roof”

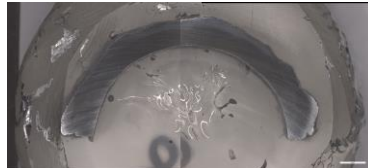
Tube 6 – San 60



Tube 7 – Test alloy 2



Tube 8 – Test alloy 1

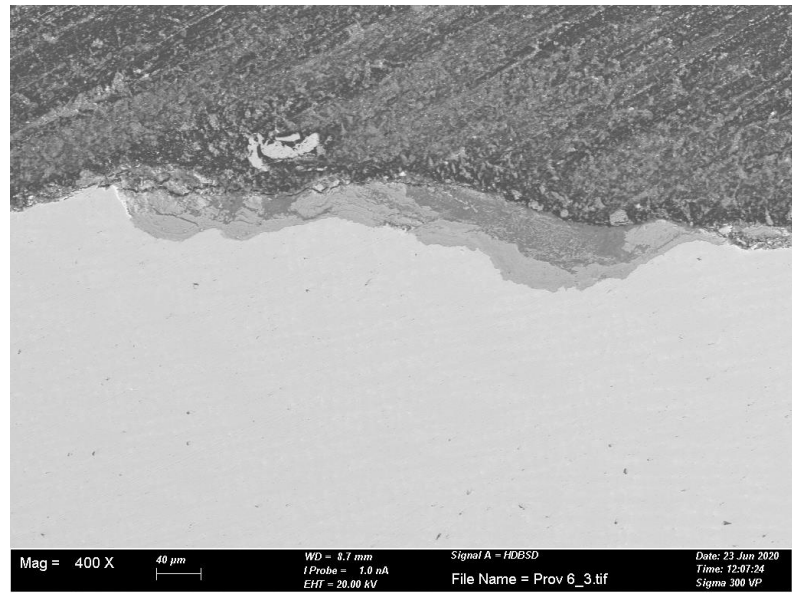
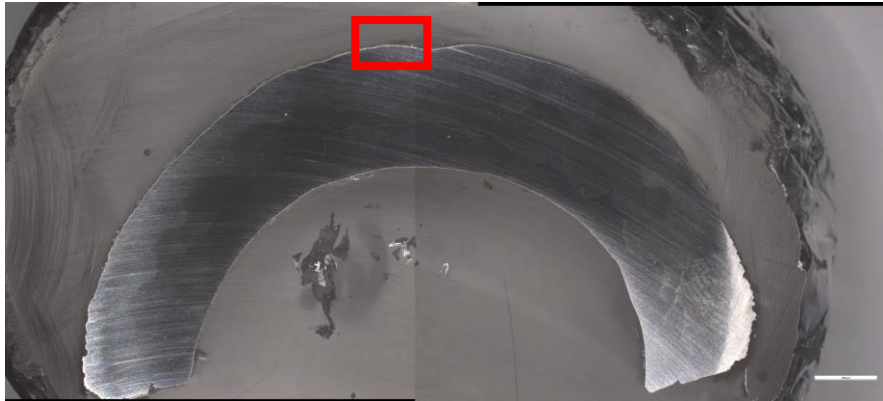


Tube 9 - APMT



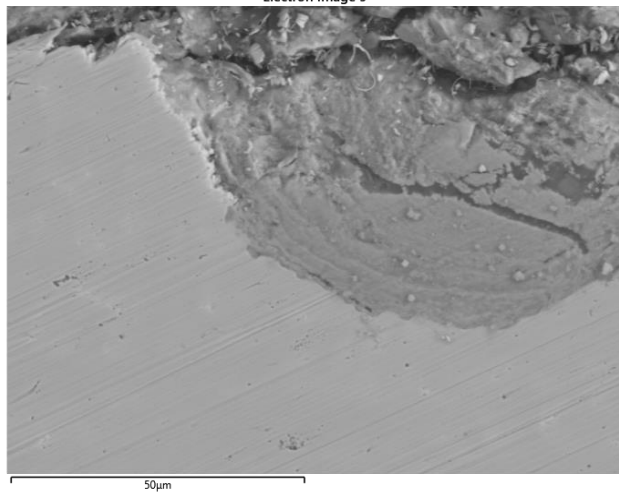
“Floor”

Tube no. 6 – San 60

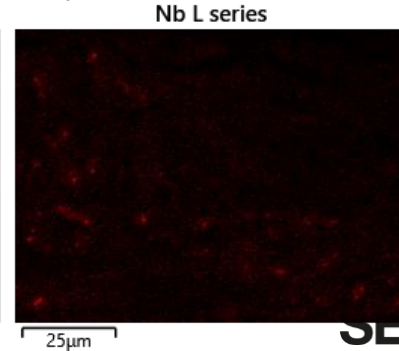
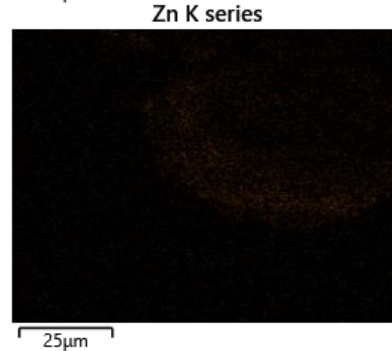
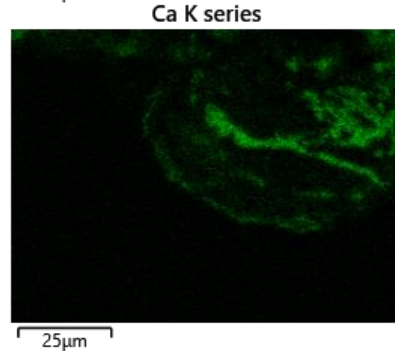
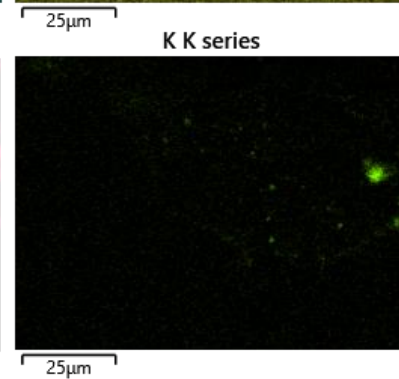
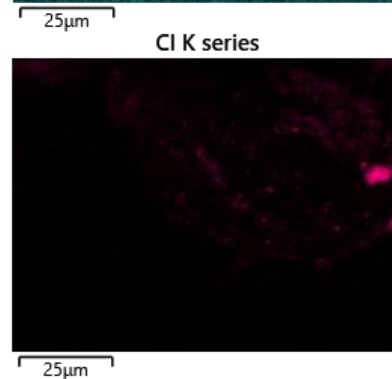
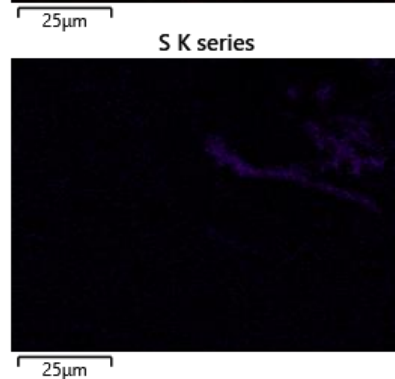
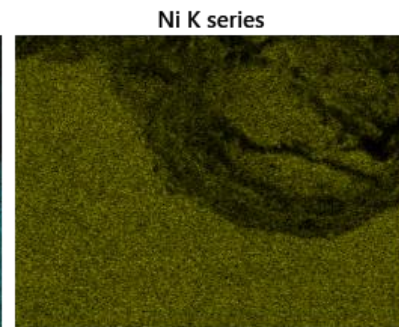
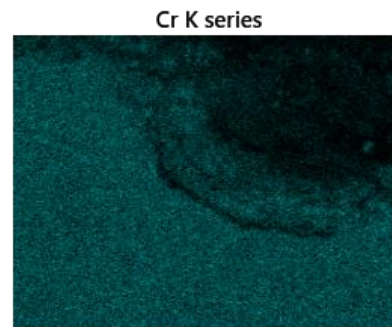
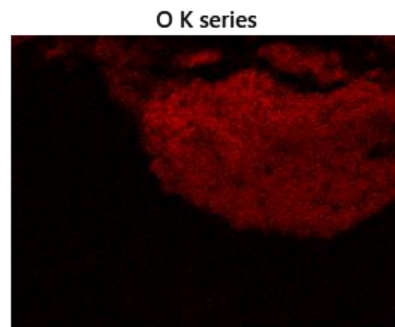
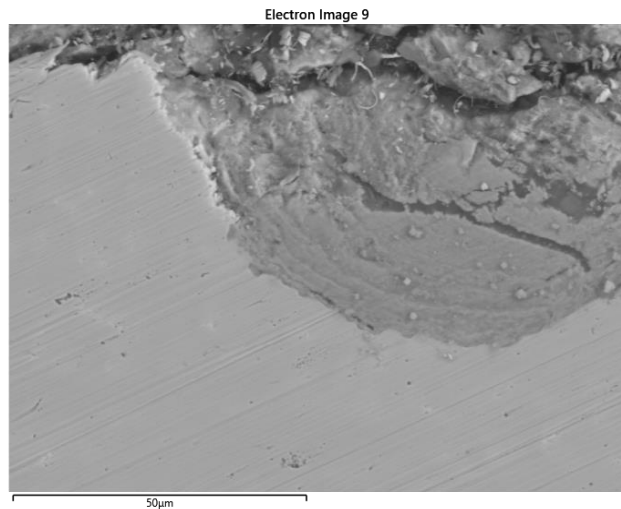


Tube no. 6 – San 60

Electron Image 9



Tube no. 6 – San 60



Refractories

- Example of challenges encountered

Calderys is acknowledged for providing the image



Test material

- Reference materials produced by Calderys (3 batches) installed in Händelö P14 & P15:
 - CALDE STIX PB 85 CG
 - CALDE CAST LM 74 A
 - CALDE SPRAYCAST SIC 70
- Bulk specimens prepared



Specimen preparation

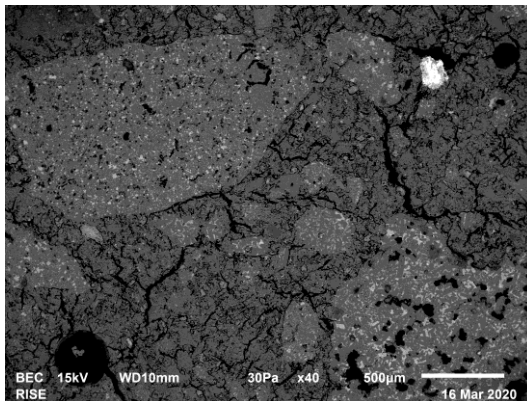
- Cutting method evaluated
- Mechanical grinding and polishing
- Final oxide polishing step (OPS) for EBSD
- Water cooling



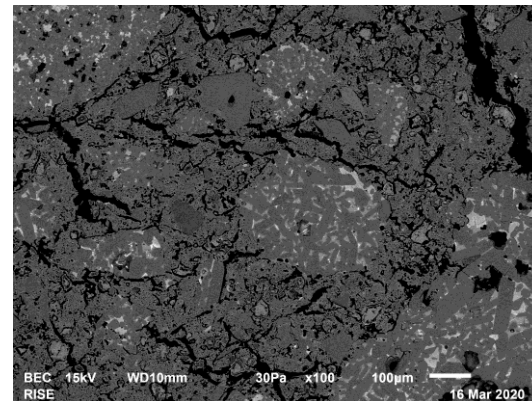
CALDE STIX PB 85 CG – microstructure

Reference
Unexposed (REF)

x40

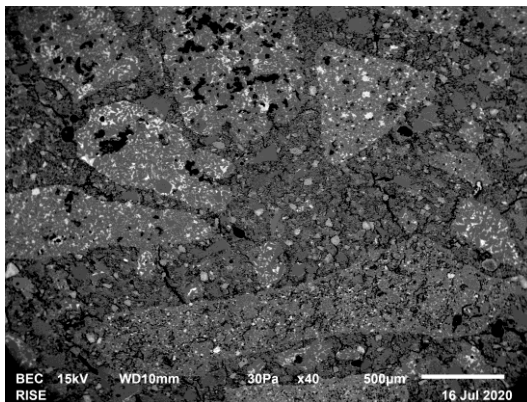


x100

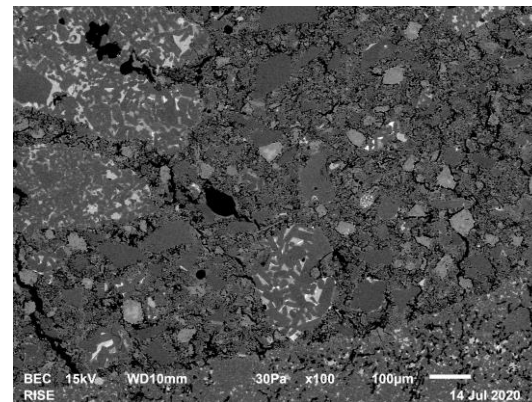


Cyclon
exposed
6 months
(Exp 6m)

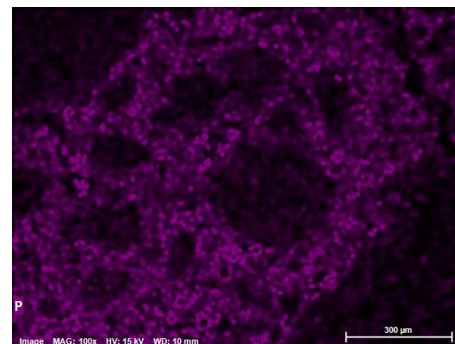
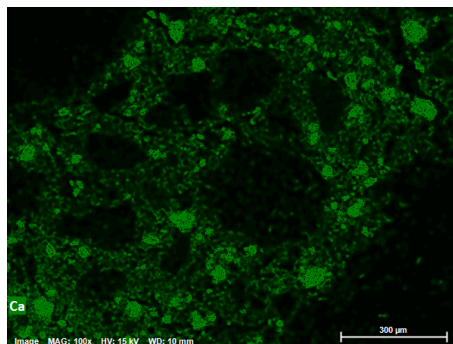
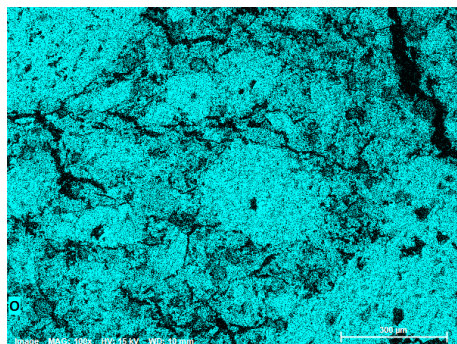
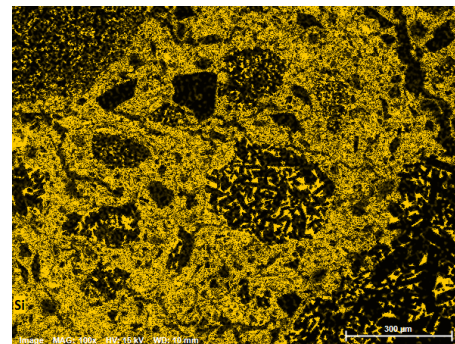
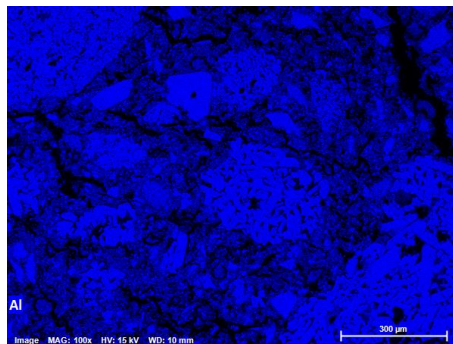
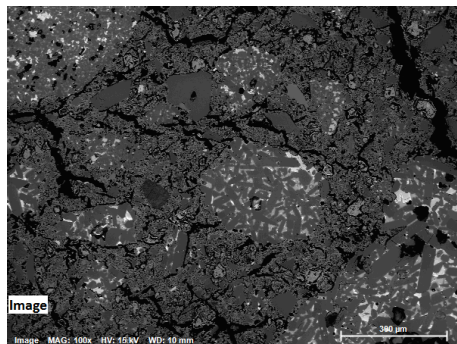
x40



x100

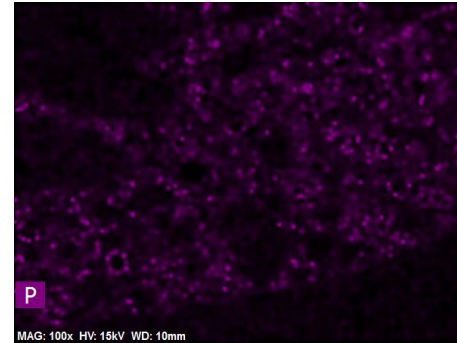
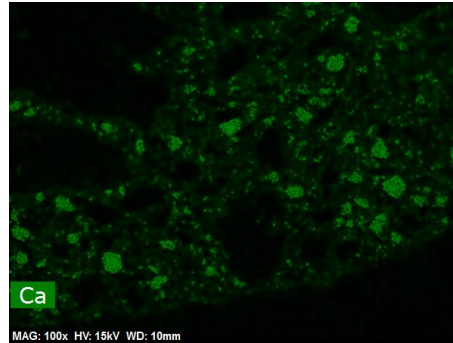
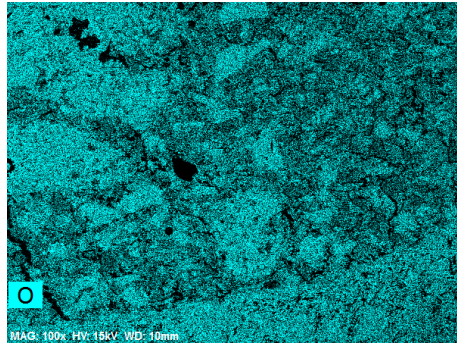
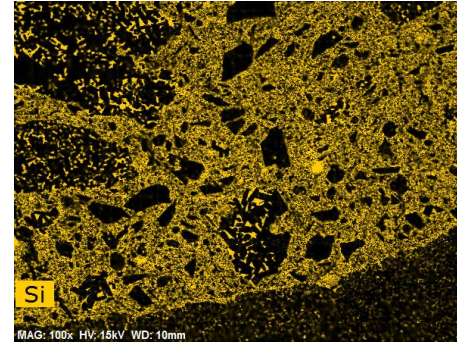
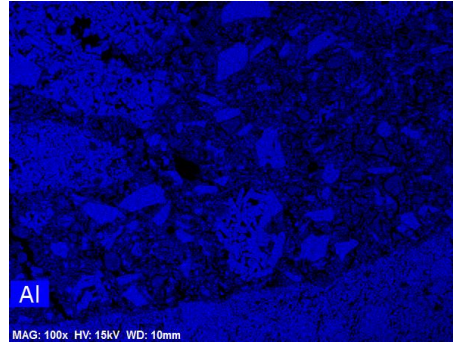
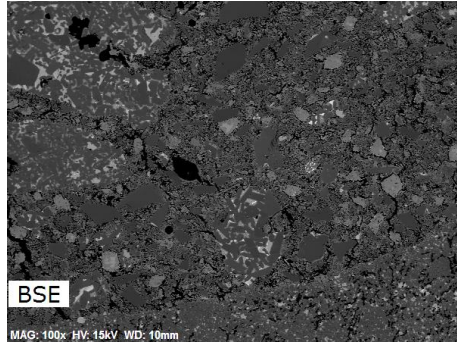


REF: CALDE STIX PB 85 CG – EDS mapping



Bulk specimen

Exp 6m: CALDE STIX PB 85 CG – EDS mapping



Area: center (bulk)

Observations and comments, SEM/EDS

- Microstructure of reference materials and exposed (+slag) material extracted after 6 months from Händelö P15 is characterized by SEM/EDS
- Composition results from EDS analysis are semi quantitative, and should primarily be evaluated relative to each other to determine trends (increasing/decreasing composition after exposure compared to reference)
- **No obvious difference is observed** in the microstructure images after exposure 6 months compared to reference materials
- Evaluation of exposed material in P15 shows that there is a **small increase in the concentration of:**
 - **Na₂O and K₂O** in CALDE STIX PB 85 CG (after 6 months)

Thank you for listening!