Wise process routes for varying feedstock in base metal extraction

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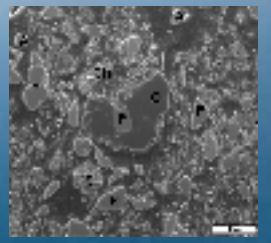
Aim

- Predict consequences of changing raw material base, primary/secondary, on the metal extraction chain
  - Complex and impurity rich mineralizations
  - Efficient use of secondary raw materials
  - Network
- Suggest tailor-made process routes
  - Hydrometallurgical
  - Pyrometallurgical
  - Combination hydro/pyro

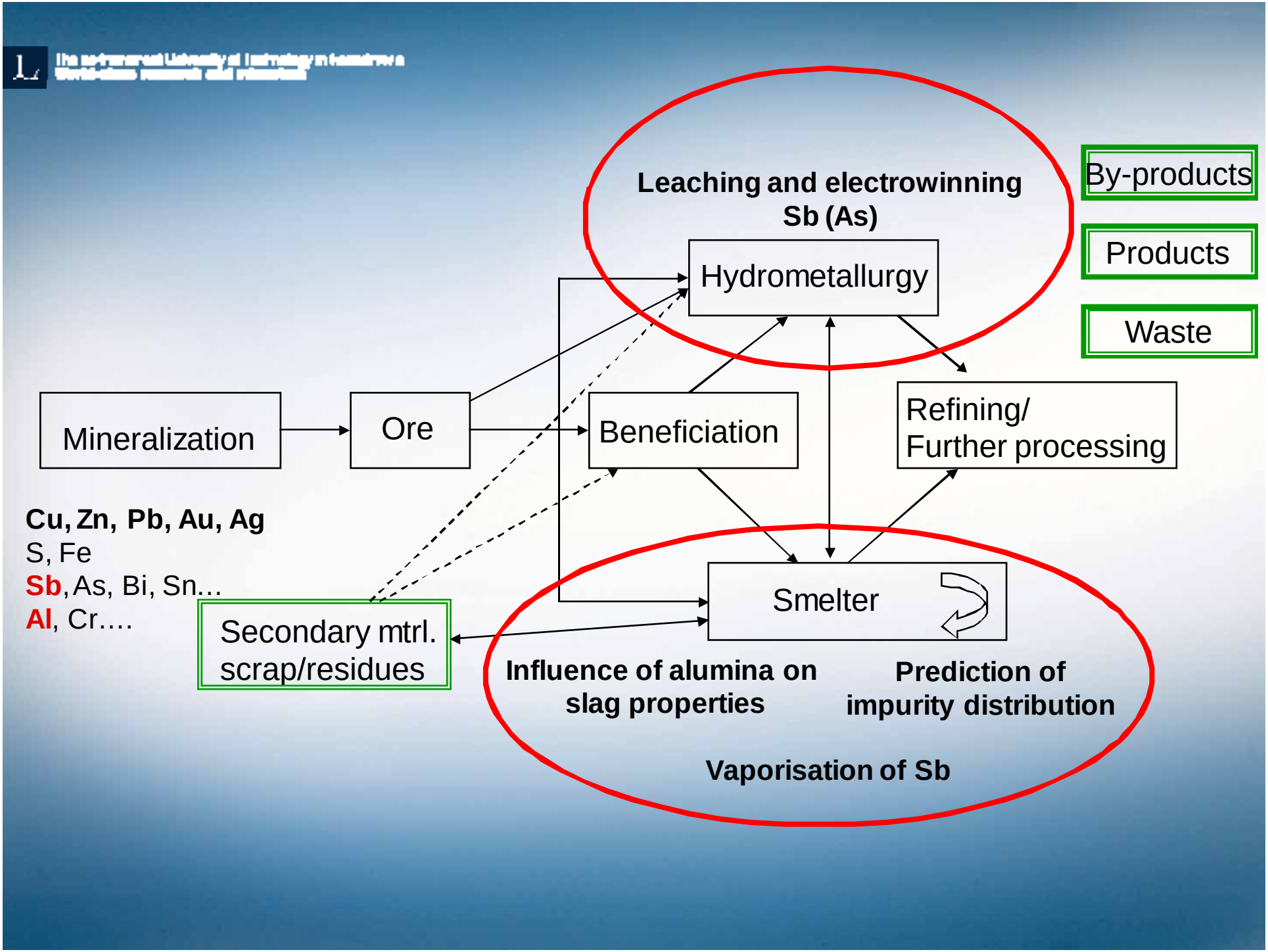
Background

- Lower grade raw materials (primary and secondary)
  - Large reserves of complex Cu-sulphide mineralizations in Northern Sweden, high impurity content, e.g Sb.
  - Increased treatment of scrap with varying and complex concentration, Sb, Al…
  - Extensive internal recycling may lead to enrichment of elements, Sb is today a limiting element in smelting processes
  - Control of material composition and flows for efficient process operation
  - Predicting element distribution for extraction of value added materials and/or elimination of deleterious elements

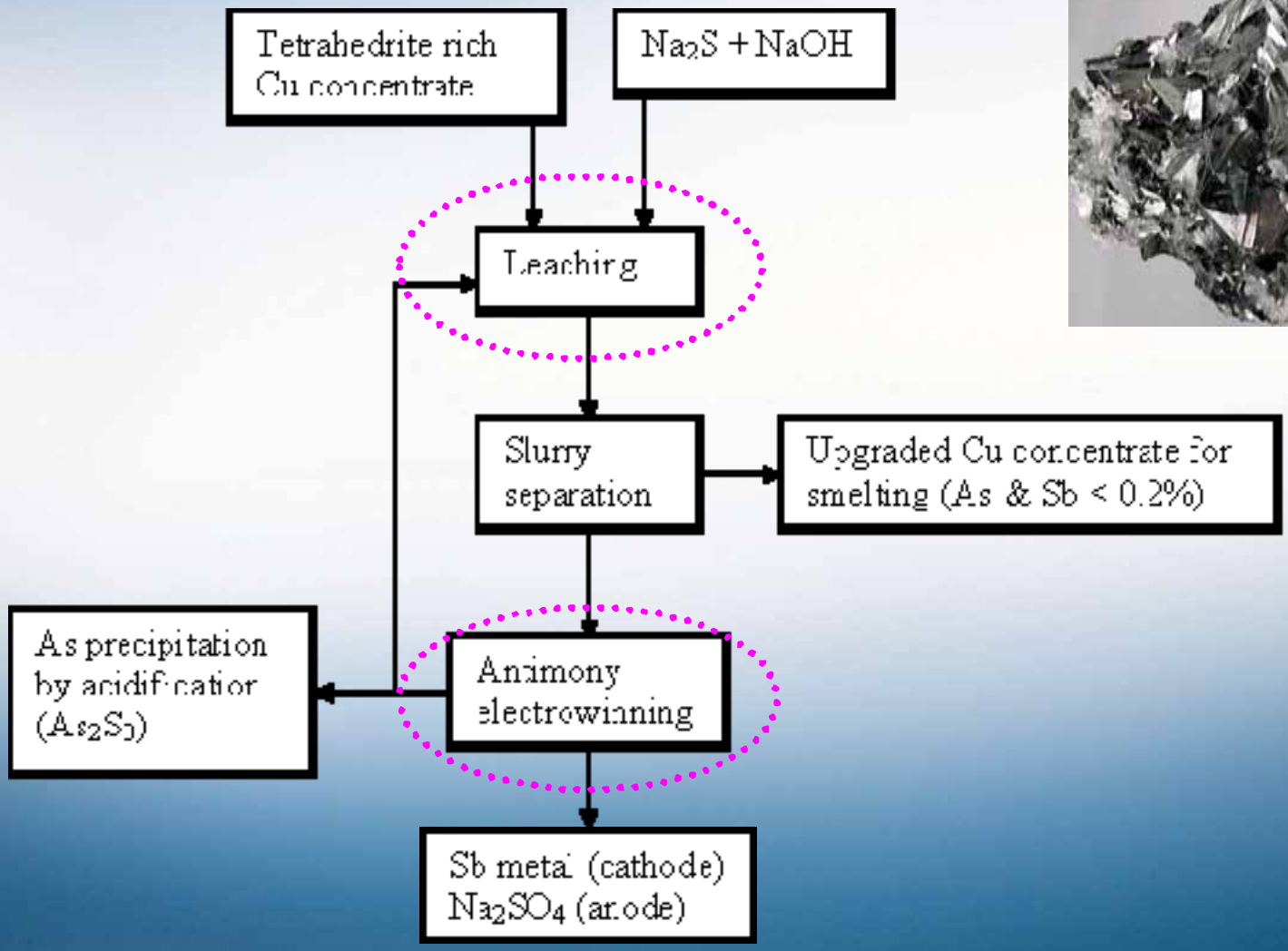


Research organisation

- WP 1: Impurity management and valorisation
  - Hydrometallurgical treatment (PhD student)
- WP 2: Impact of impurities on extraction, smelting and refining processes (PhD students)
  - Thermodynamic modelling
  - Impurity distribution in smelting systems
  - Impurity capacity
- WP 3: Evaluation of process options
  - Selection of raw materials
  - Tools for modelling
  - Collection of data


Leaching and electrowinning
Sb (As)
Hydrometallurgy
By-products
Products
Waste
Mineralization
Ore
Beneficiation
Refining/
Further processing
Cu, Zn, Pb, Au, Ag
S, Fe
Sb, As, Bi, Sn…
Al, Cr….
Secondary mtrl.
scrap/residues
Smelter
Influence of alumina on
slag properties
Prediction of
impurity distribution
Vaporisation of Sb

Hydrometallurgical pretreatment of complex concentrate



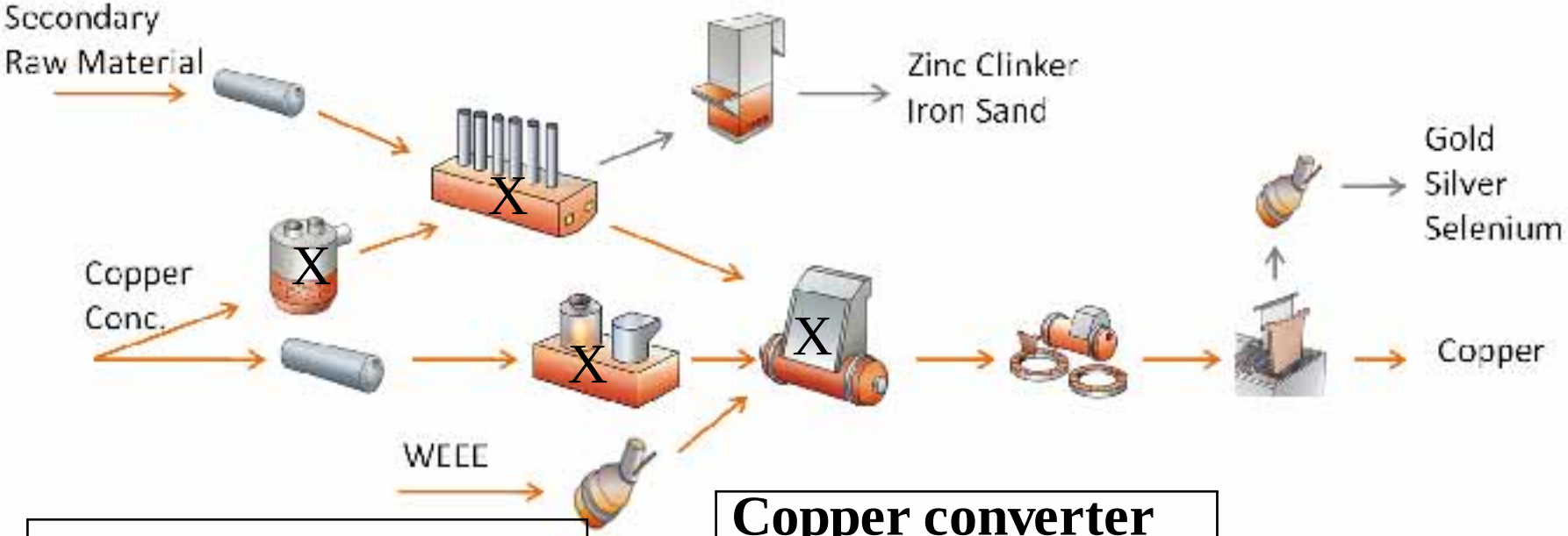
Hydrometallurgical pretreatment of complex concentrate

- Laboratory leaching tests on tetrahedrite-bearing concentrate has been conducted and completed
- Alkaline sulphide leaching shows a good selectivity for Sb and As
- Sulphide leaching of tetrahedrite depends strongly on sulphide and hydroxide ions concentrations, reaction temperature, particle size and leaching time
- Electrowinning of Sb from alkaline sulphide electrolyte in laboratory scale is on-going
- A complete process for hydrometallurgical pretreatment will be evaluated

Copper flow
Rönnskär smelter

Sampling campaigns

Fuming plant
Impurity capacity slag (Al)

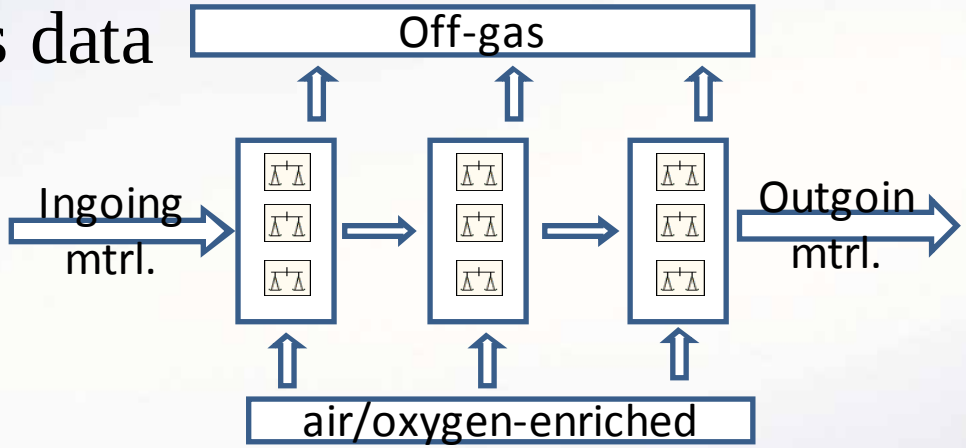


Enhanced vaporisation of Sb

Copper converter
Modelling -
slag formation,
element distribution

Thermodynamic model

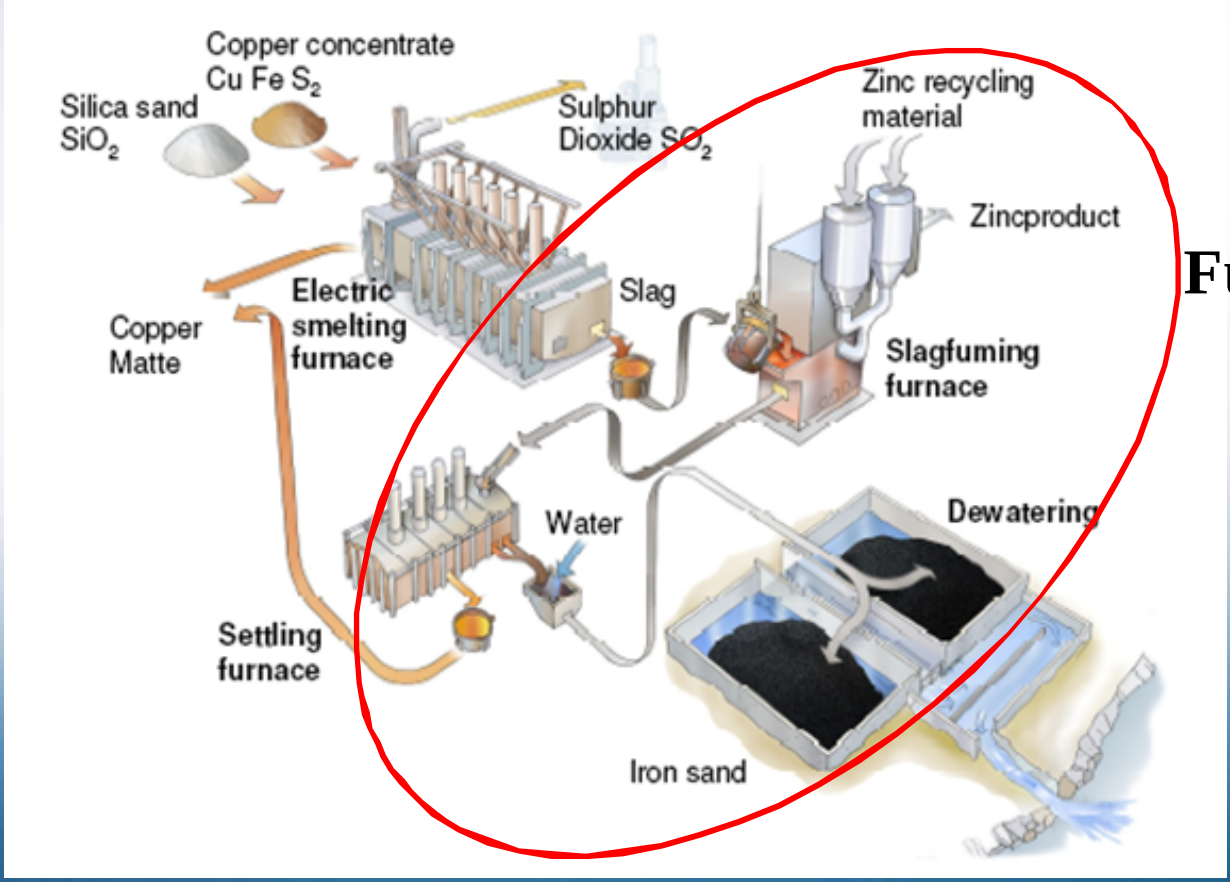
- Converter model (SimuSage)
  - Verification with process data



- Thermodynamic description; (GTT Aachen)
  - Cu-Fe-S system
  - Slag system
- Distribution data
  - Minor elements

Influence of alumina on slag properties

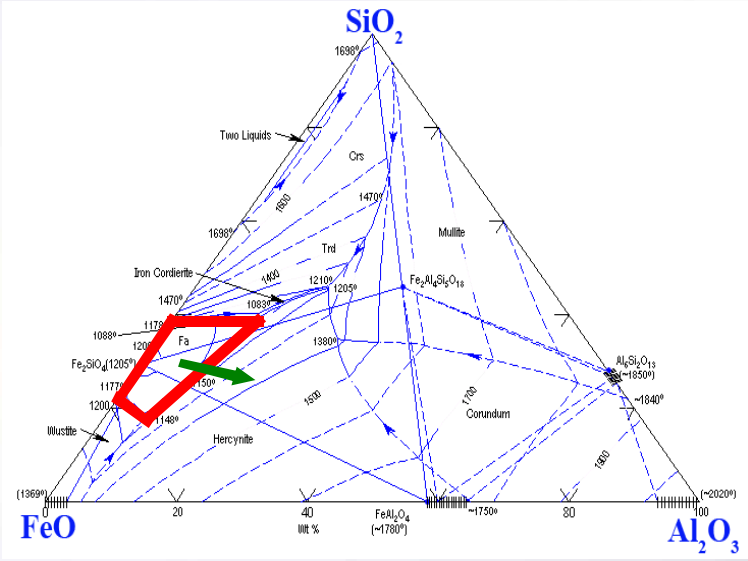
Mineralogy, leaching, thermo-chemical and – physical properties

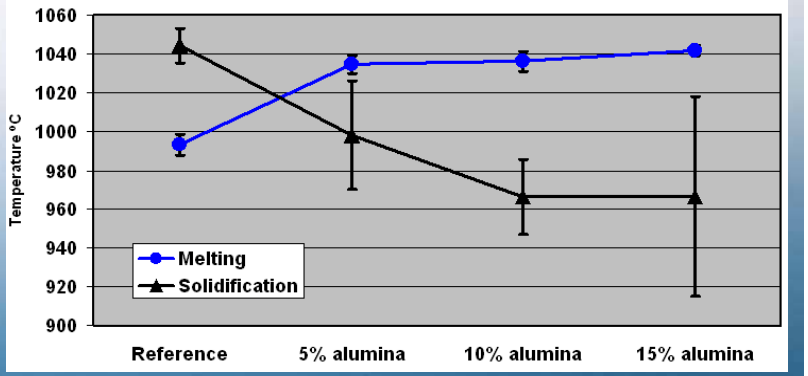


Fuming plant

Influence of alumina on slag properties

- Mineralogy
  - Formation of alumina-rich spinel phase
  - New phase (anorthite) is formed ~10 alumina (alumina saturation)
- Leaching
  - Initially slight increase in leaching
  - Lowest leaching values at alumina saturation (spinel formation)
- Melting
  - Increased melting temperature (spinel formation)
  - Decreased solidification temperature (undercooling)
- Thermophysical properties
  - On-going tests





Student projects

- Project based learning
- Integrating undergraduate studies with research
- Preparation for master thesis work
- Project´s related to Gruvforskningsprogrammet”
  - Leaching of secondary materials
  - Leaching of different types of Sb minerals
  - Distribution of Sb between different melt phases

Concluding remarks

- Close cooperation between Industry and University – strong R&D
- Integrating undergraduate studies – recruitment of engineers
- Focus on Sb (complex concentrates and secondary materials)
  - Different alternatives for treating complex materials with high Sb content (hydro –and pyro –metallurgical
- A ”good” slag is a key to efficient smelting