



Wise process routes for varying feedstock in base metal extraction

VINNOVA

Boliden Mineral AB

LKAB

Adolf H. Lundin Charitable Foundation

Process Metallurgy, LTU

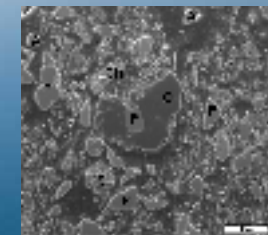
Aim

- 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



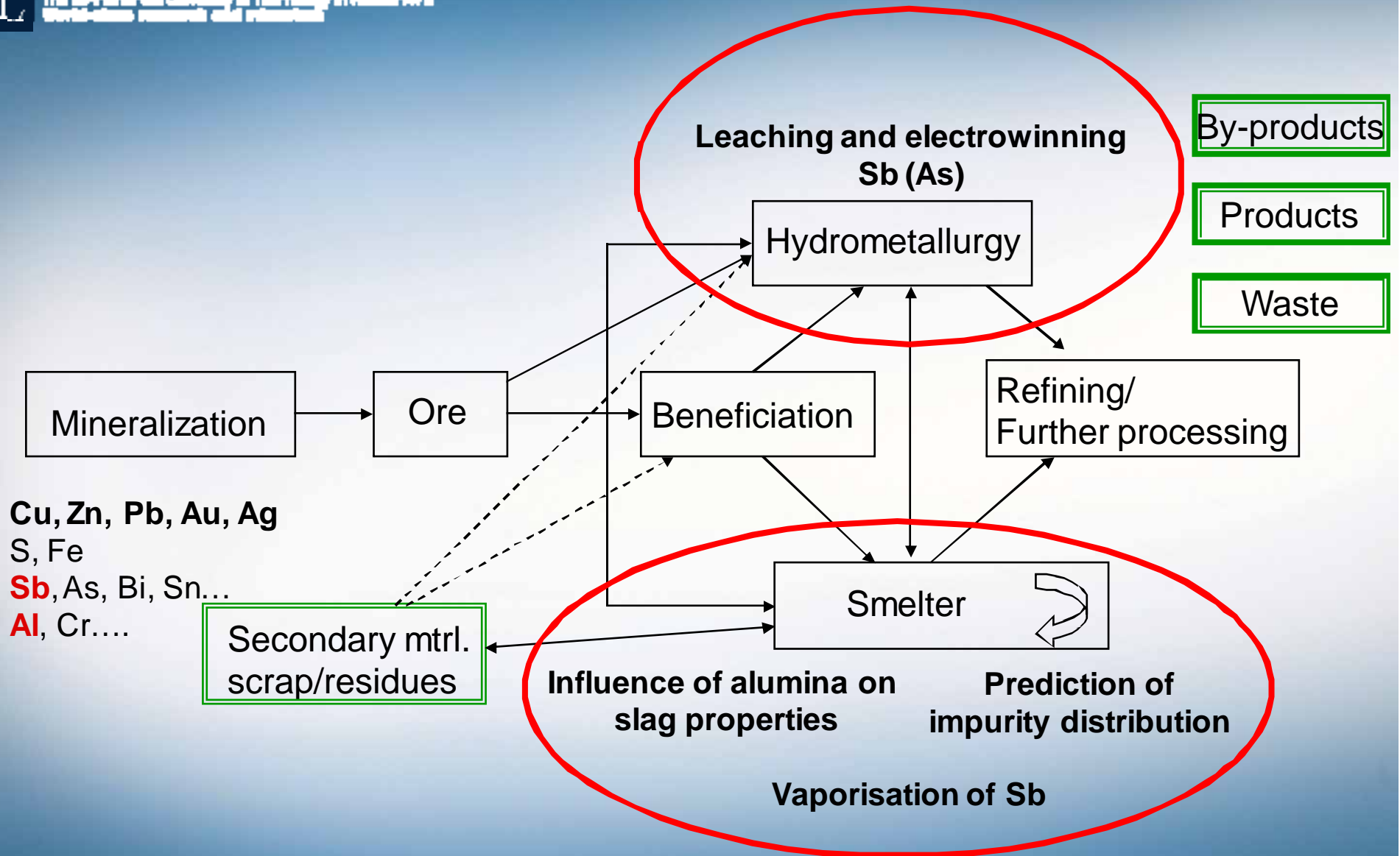
Background

- 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

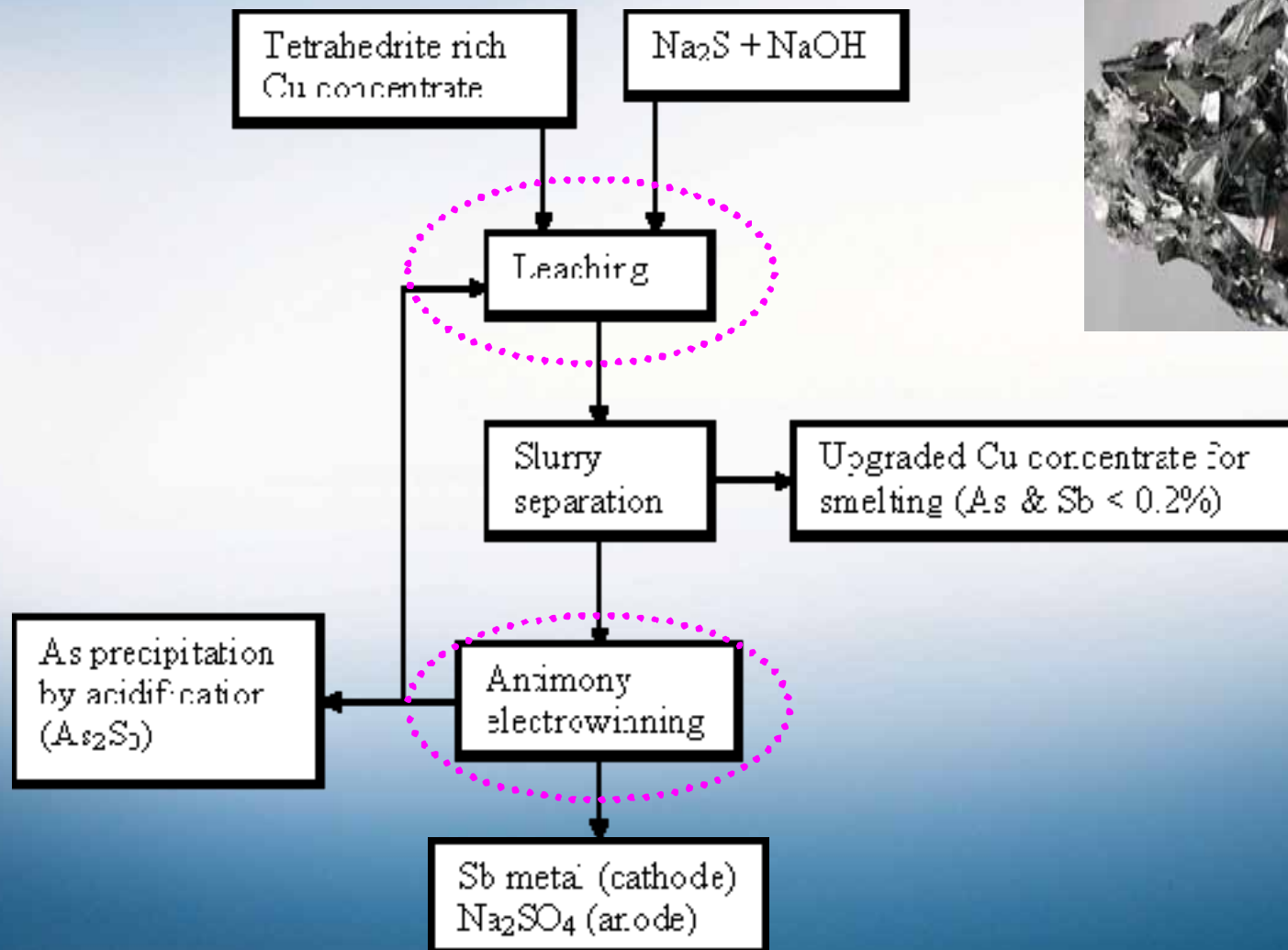


Research organisation

- 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



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)

Secondary
Raw Material

Zinc Clinker
Iron Sand

Copper
Conc.

Gold
Silver
Selenium

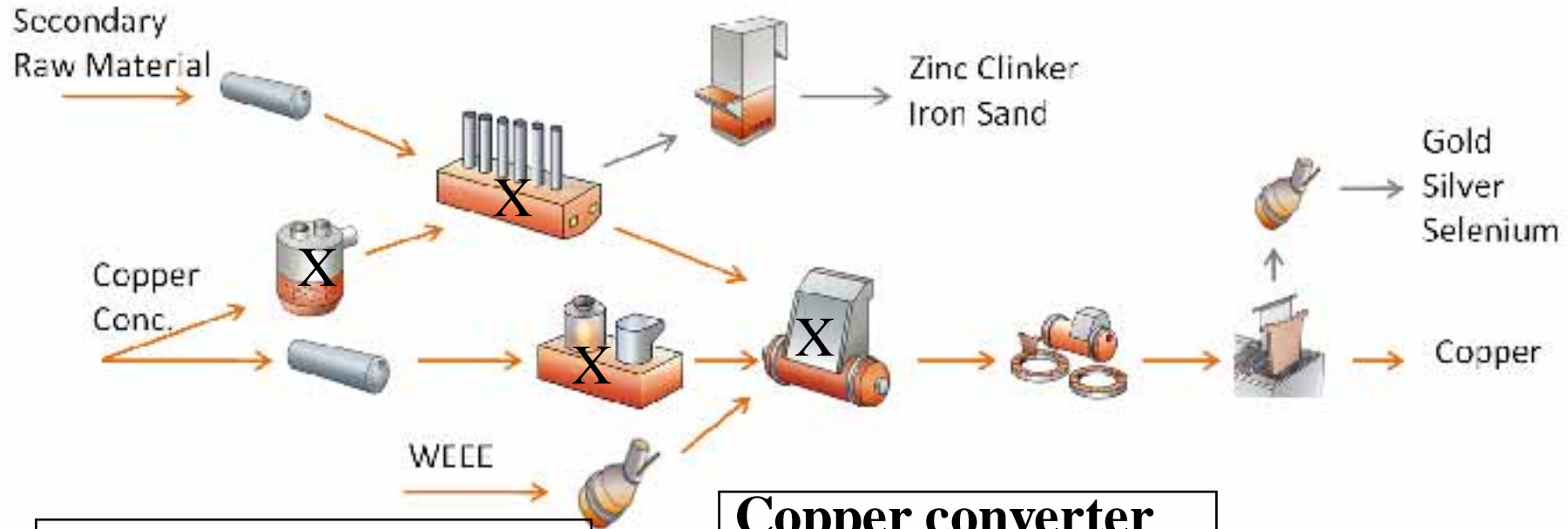
Copper

WEEE

Enhanced vaporisation
of Sb

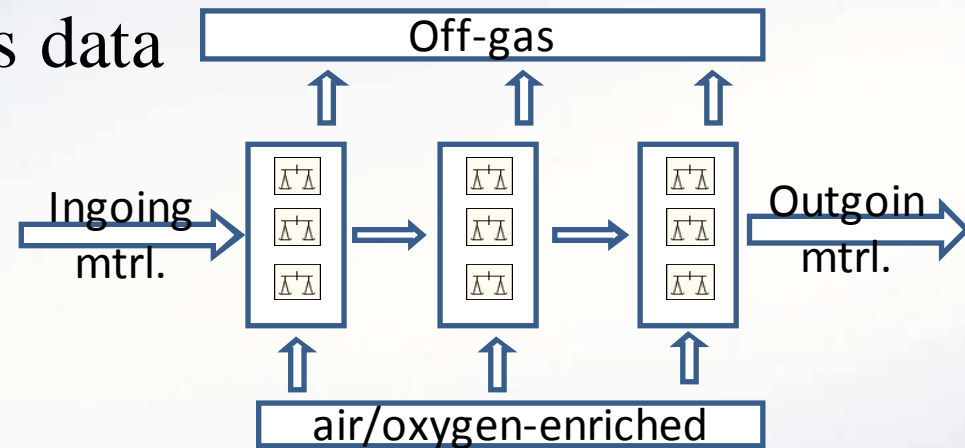
Copper converter

Modelling -
slag formation,
element distribution



Thermodynamic model

- Converter model (SimuSage)
 - Verification with process data

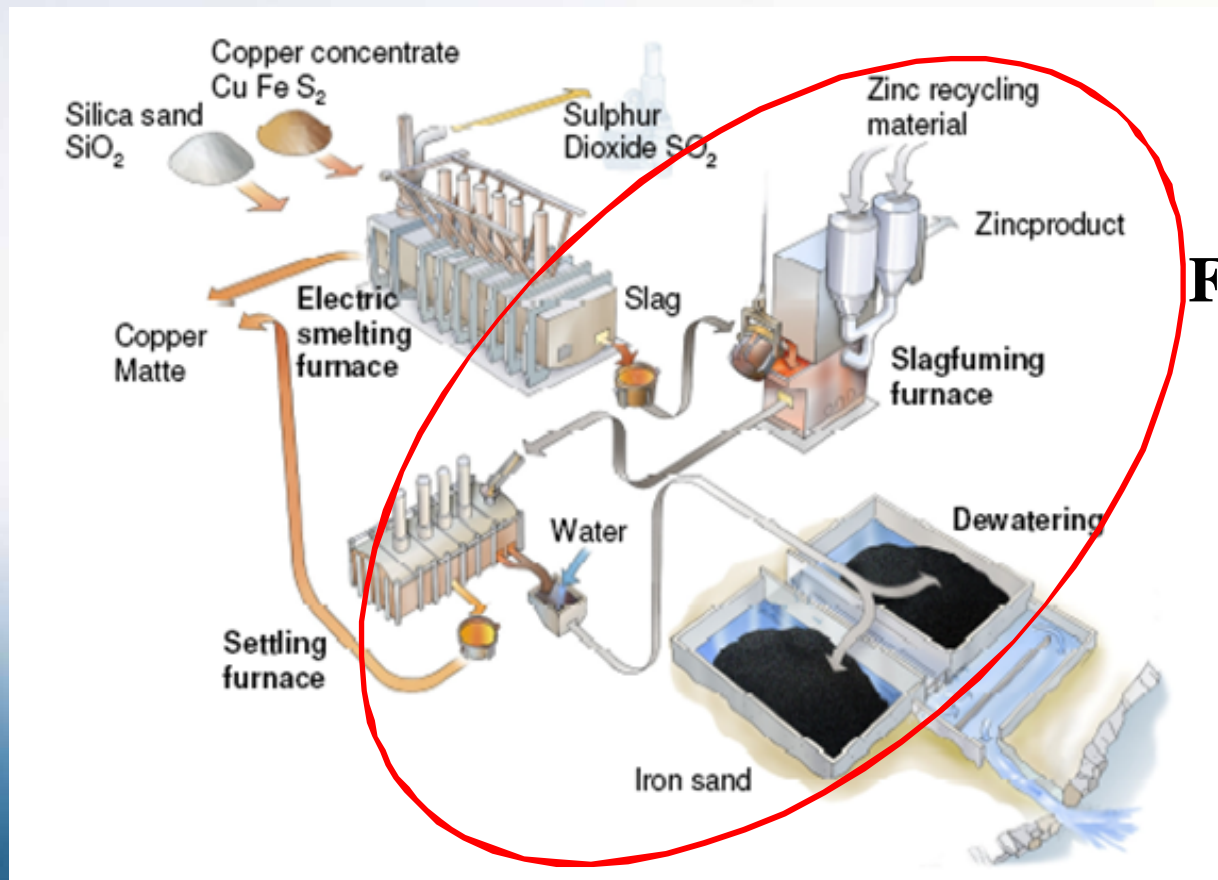


- Thermodynamic description; (GTT Aachen)
 - Cu-Fe-S system
 - Slag system
- Distribution data
 - Minor elements



Influence of alumina on slag properties

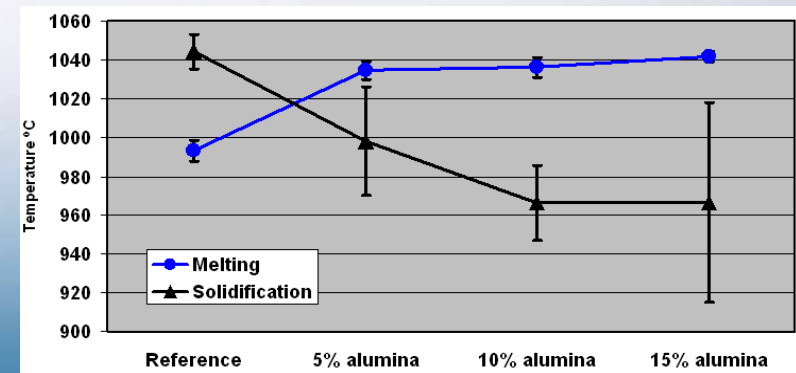
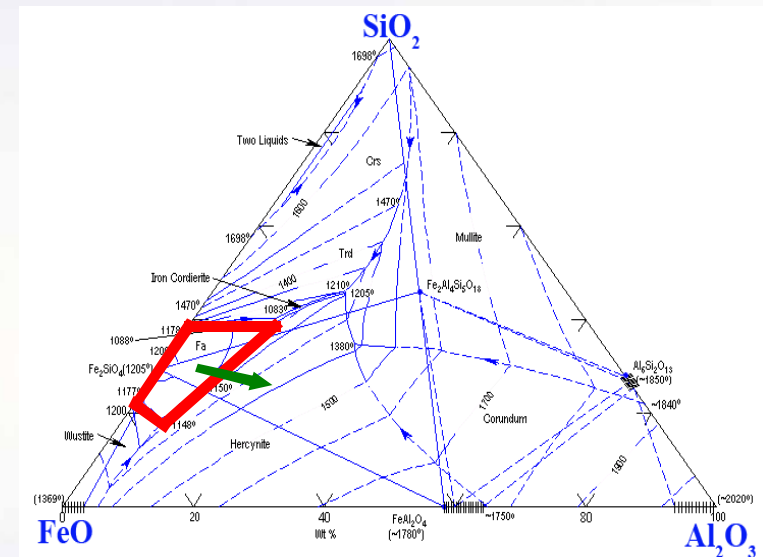
Mineralogy, leaching, thermo-chemical and – physical properties



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