



Wise process routes for varying feedstock in base metal extraction

VINNOVA

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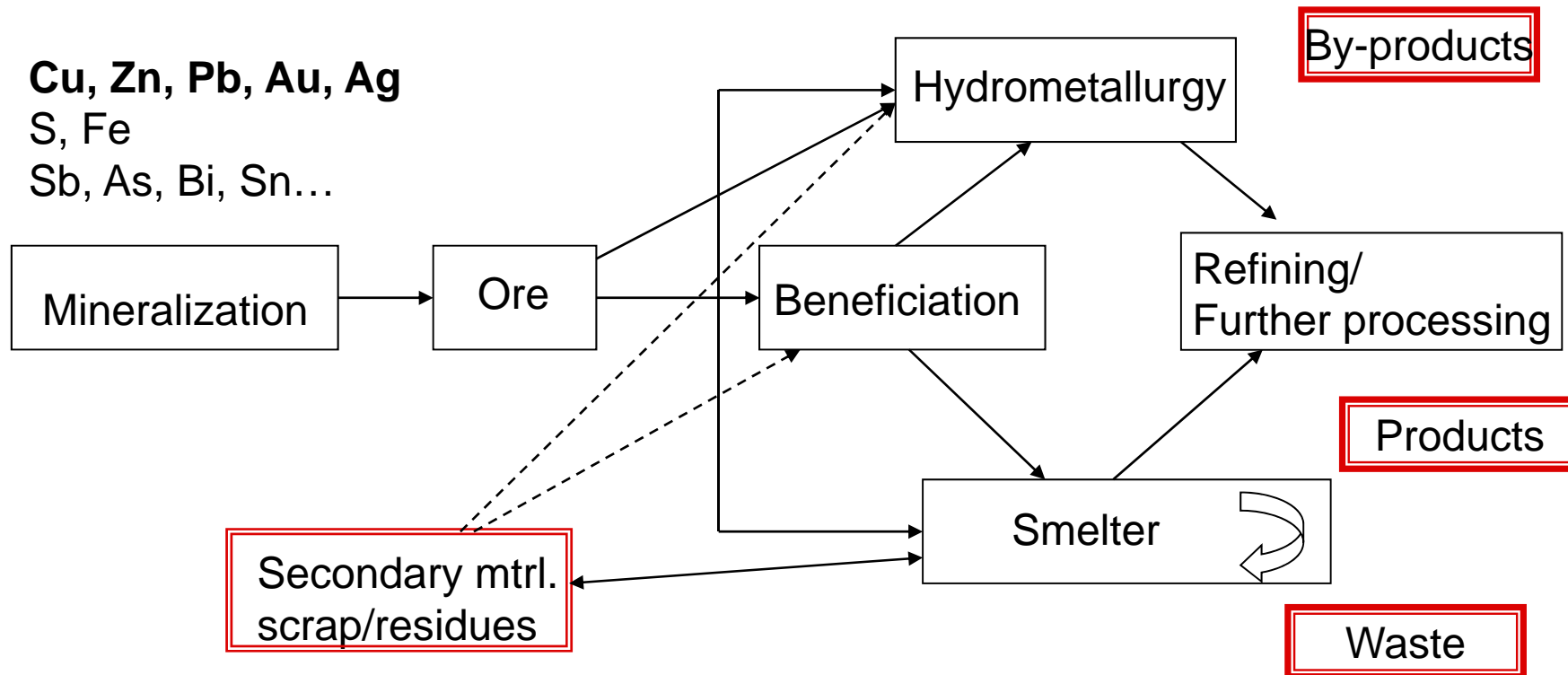
Aim

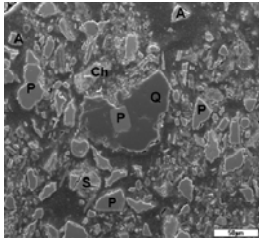
- Predict consequences of changing raw material base, primary/secondary, on the metal extraction chain
 - Complex and impurity rich mineralizations
 - Efficient use of secondary raw materials
 - Network
- Suggest tailor-made process routes
 - Hydrometallurgical
 - Pyrometallurgical
 - Combination hydro/pyro



Aim

Wise process routes





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
 - 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 student)
 - 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





Results

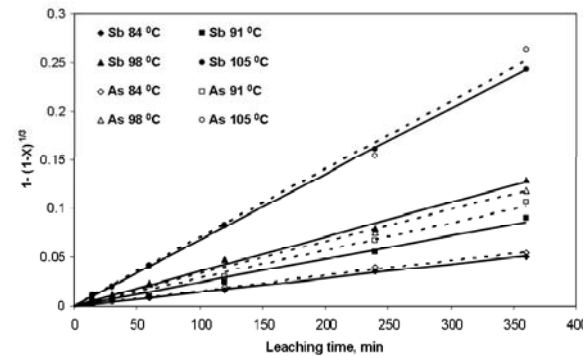
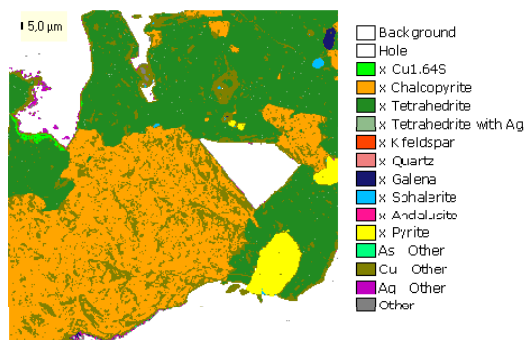
Impurity management

- Pretreatment of Cu-sulphide concentrate with high Sb, alkaline sulphide leaching-electrowinning
 - Leaching tests on concentrates – positive results (Boliden mine division/LTU)
 - Electrowinning test (LTU)
 - Fundamental studies on pure Sb-mineral, tetrahedrite – dissolution kinetics (LTU)
 - Characterisation using QemScan equipment (LKAB)



Fundamental studies of pure Sb-mineral, tetrahedrite

- Kinetics of dissolution of tetrahedrite
 - Particle size, leachate, temperature..
- Selective leaching of Sb from tetrahedrite
 - Alkaline sulphide leaching is a suitable pre-treatment process





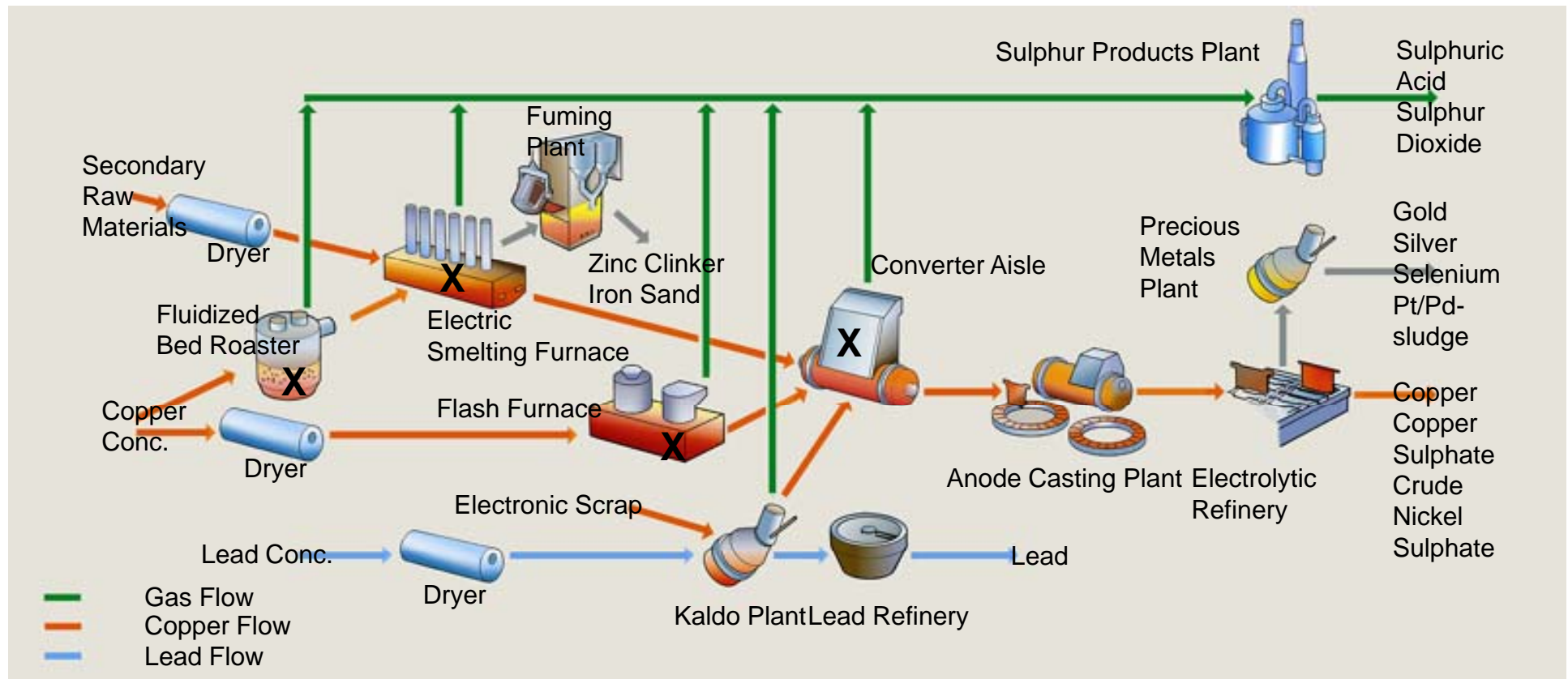
Results

Impact of impurities

- Collection of data – sampling of main part of process units at Rönnskär Smelter
 - First sampling for roasting, smelting (electric furnace and flash), converting
 - Modeling of mass- and energy flows (Boliden smelting unit)
- Thermodynamic modeling – description of solutions appropriate for systems at a Smelter (LTU)
- Determination of distribution of elements vs pO_2 - pS_2 – experimental studies in lab scale (LTU)



Sampling campaign; mass – energy flow, thermodynamic modelling

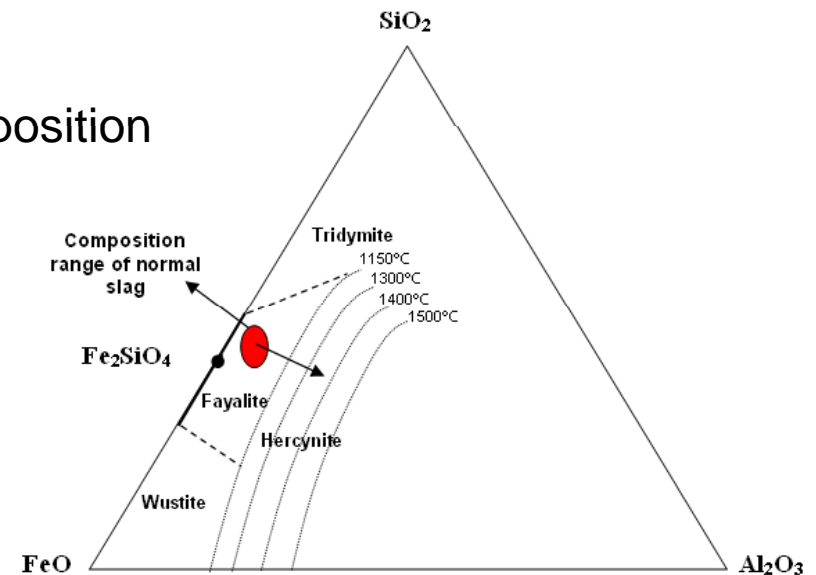




Results

Slag capacity

- Influence of alumina on slag quality
 - Mineralogy
 - new phase formed,
 - Spinel phase; increases, changes composition
 - Melting/solidification
 - Increased liq. temp
 - Stepwise melting/solidification
 - Leaching
 - Slow-cooled
 - related to mineralogical changes
 - Water granulated
 - Amorphous structure





Slag capacity

- Up to 15% Al_2O_3 addition
 - new phase formed,
 - Spinell phase increases, and changes composition
 - Increased liq. temp
 - Stepwise melting/solidification
 - Leaching of slow cooled slag - related to mineralogical changes



Conclusions

- Selective leaching of Sb
 - Potential to treat complex sulphide mineralisations
- Extensive sampling
 - Enhanced knowledge of element flows
 - Possible to predict impurity distribution
- Close collaboration between industrial partners and University
 - Exchange of knowledge, use of equipment etc.

Yet : ... Knowledge is about the past,
Wisdom is about the Future.

American Indian Chieftain

