

Challenges and Opportunities in Modern Smelting

Bergforsk

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Challenges and Opportunities in modern Smelting

- Challenges
 - Political
 - Legal
 - Market
 - Structural
 - Economical
 - Environmental
 - Knowledge gaps
- Opportunities
 - Political
 - Legal
 - Market
 - Structural
 - Economical
 - Environmental
 - Knowledge gaps

Strategic Research Areas

Knowledge cannot replace resources.
Knowledge is the resources.

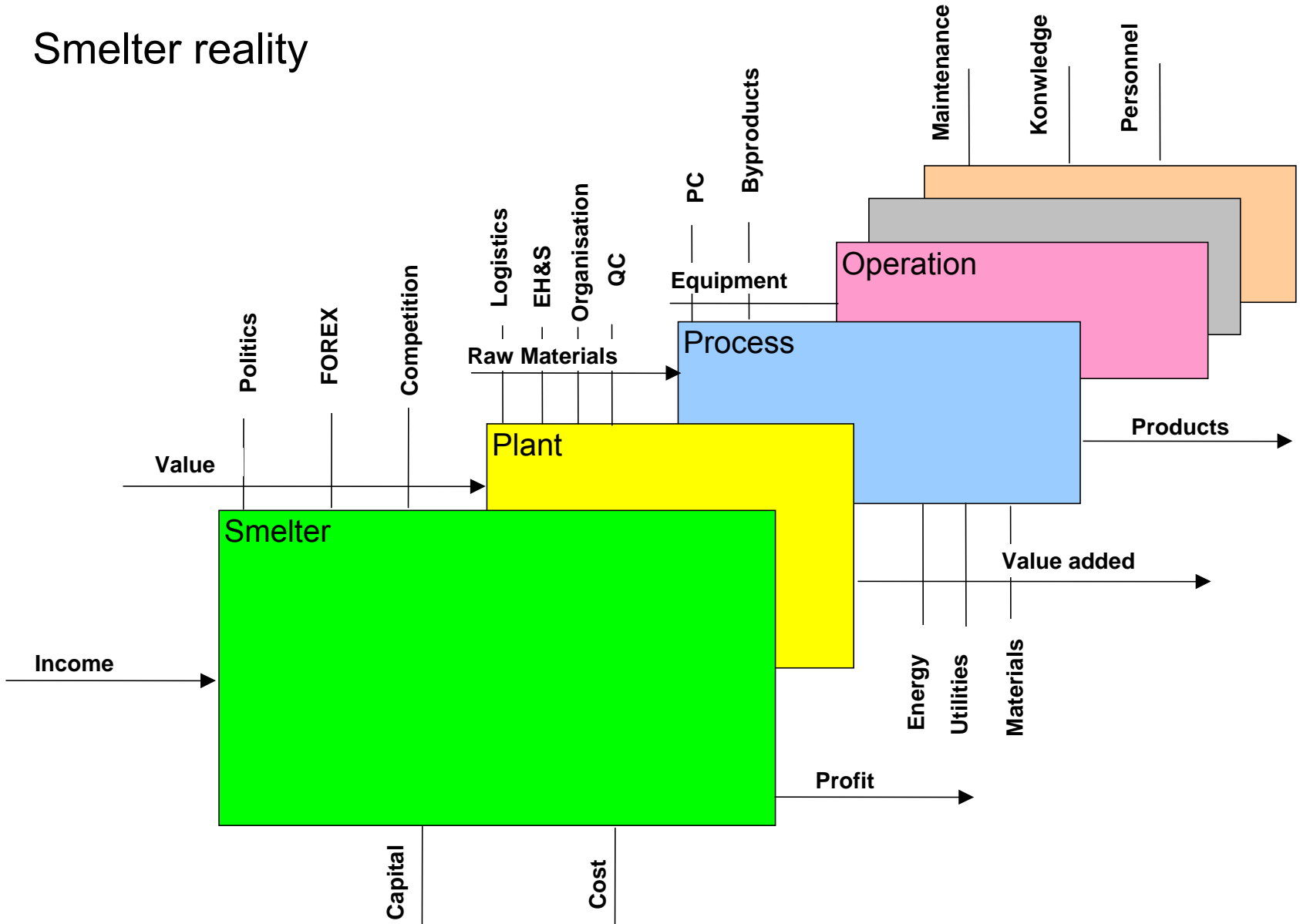
T.R.Gerholm



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

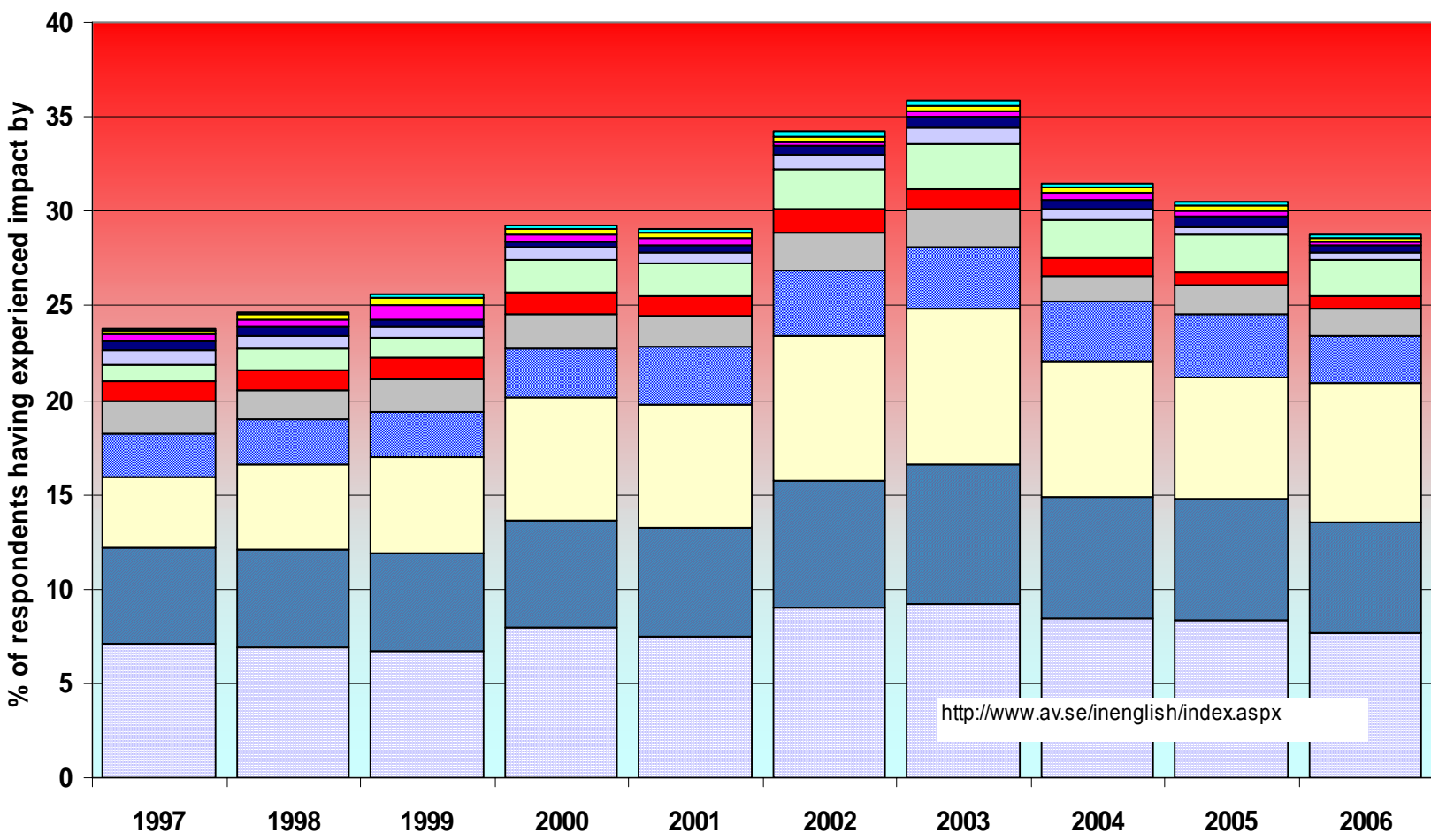
American Indian Chieftain

Smelter reality



Swedish Work Environment Authority Annual Enquiry Statistics

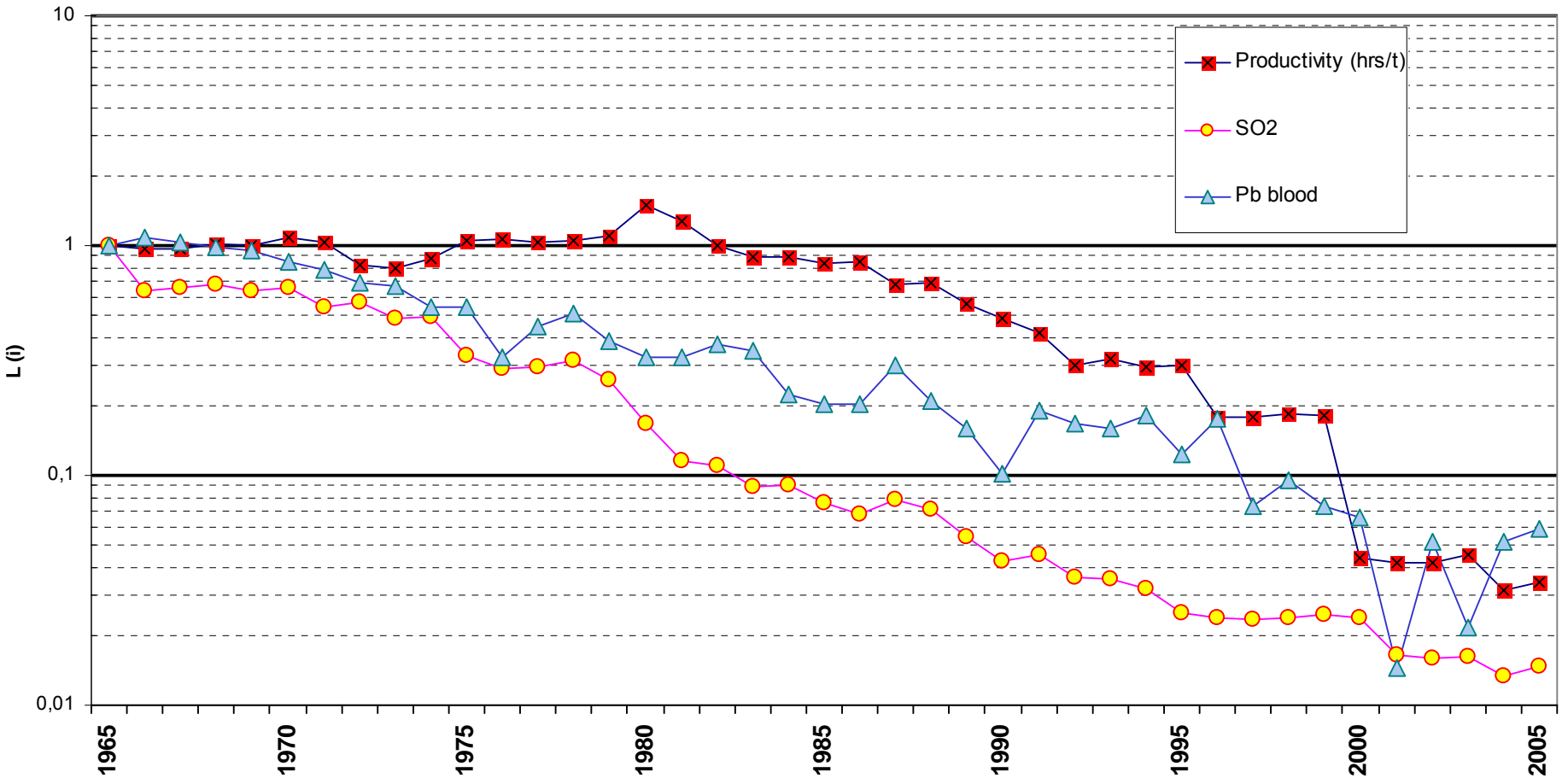
- mobbing
- violence
- animal /plant substances
- vibrations
- heat & cold
- IT related
- chemicals
- noise
- repetitive work
- stress
- heavy manual load
- ergonomic



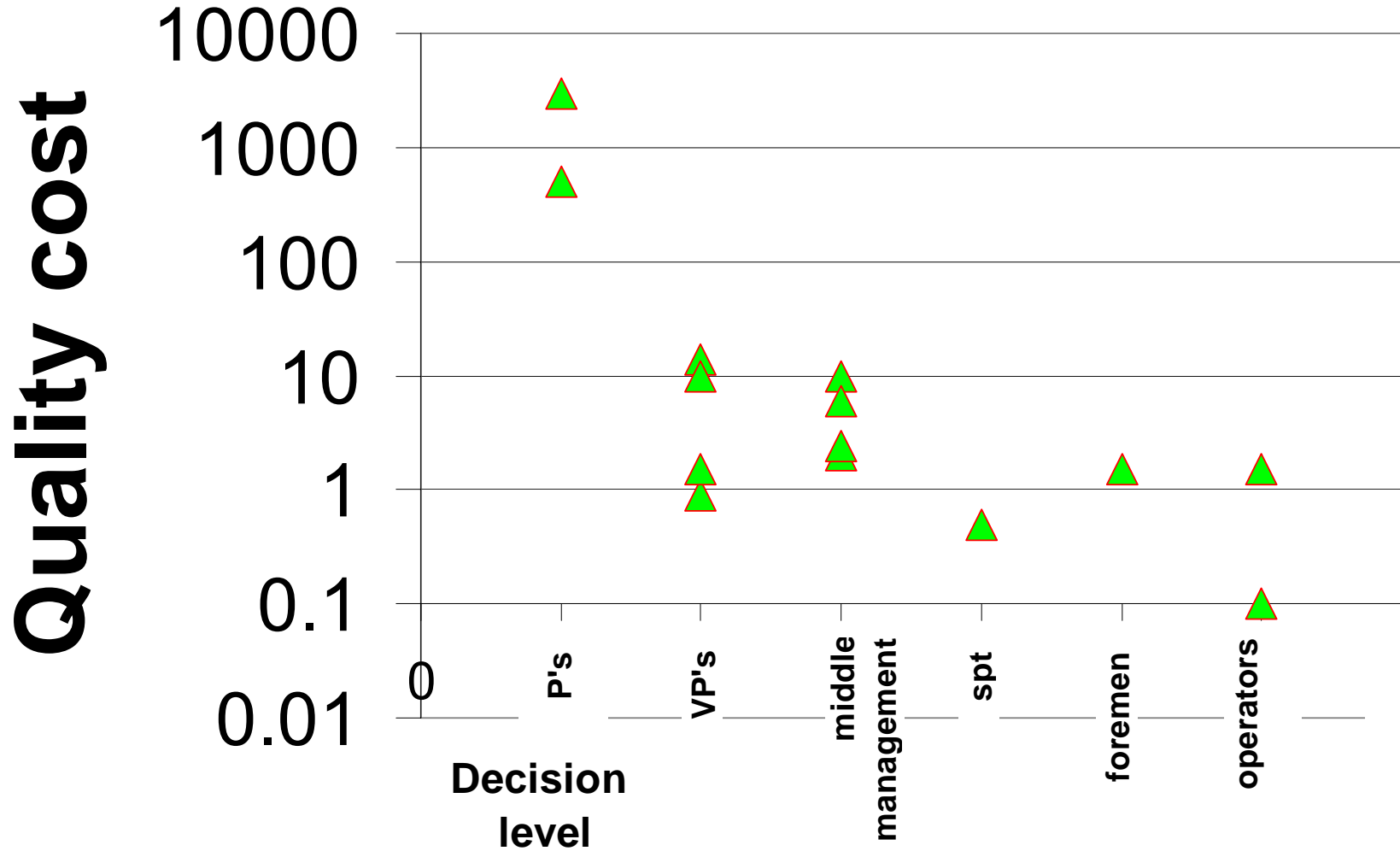
<http://www.av.se/inenglish/index.aspx>

Industrial Learning Curves go hand – in - hand

LCV



High level quality costs ?



1960



1970



1980



1990

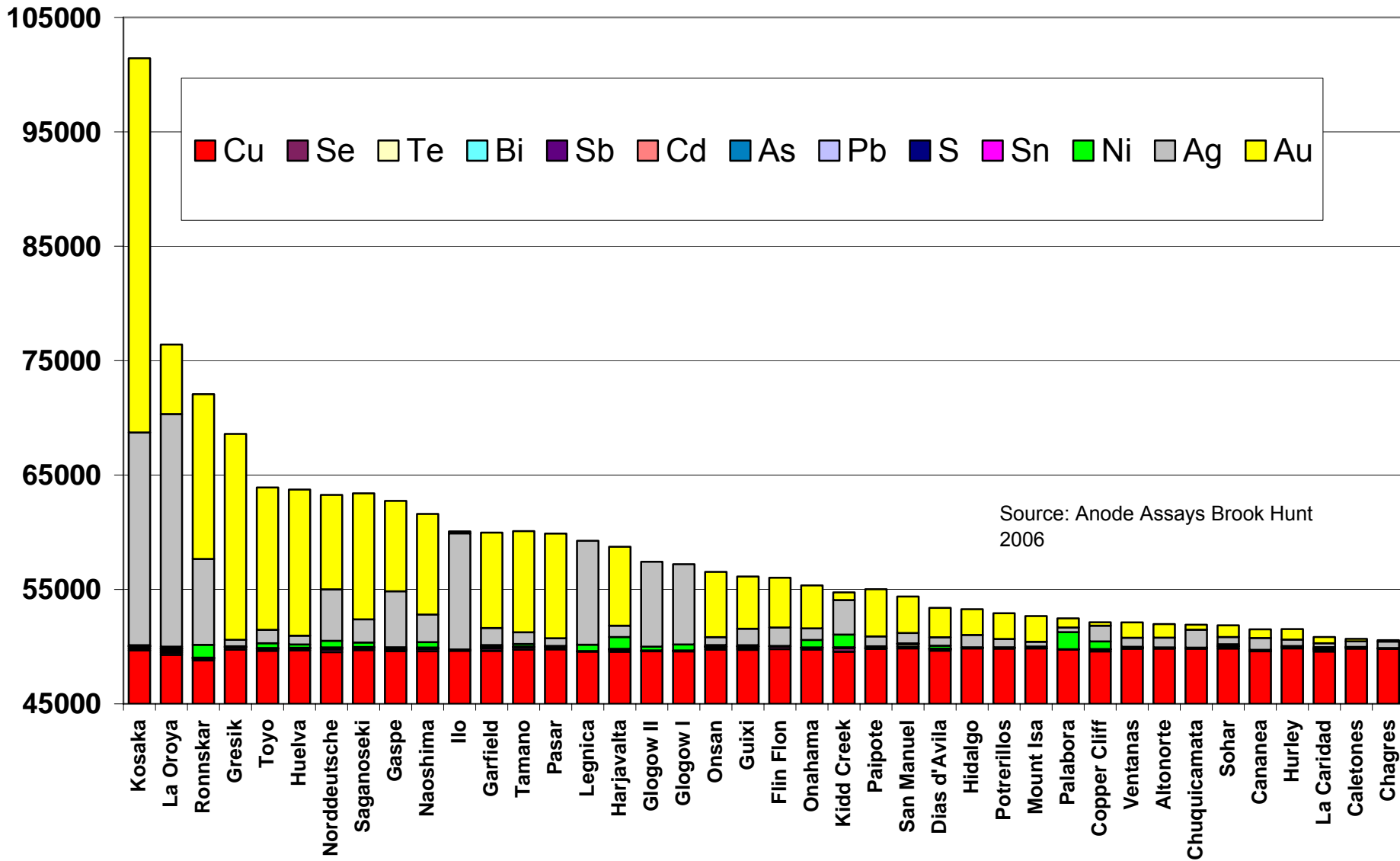


2006



Less metals

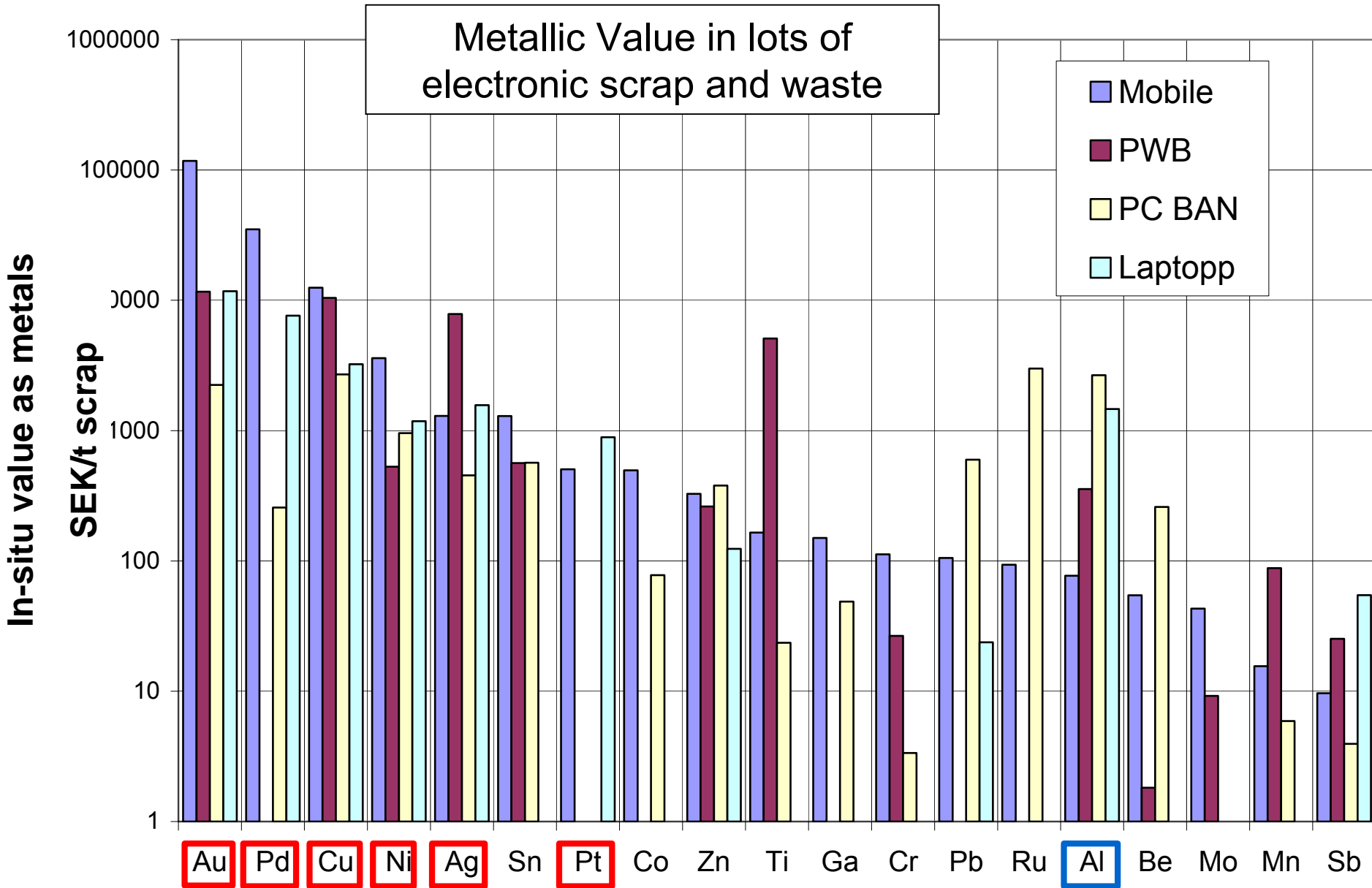
Values i Anodes

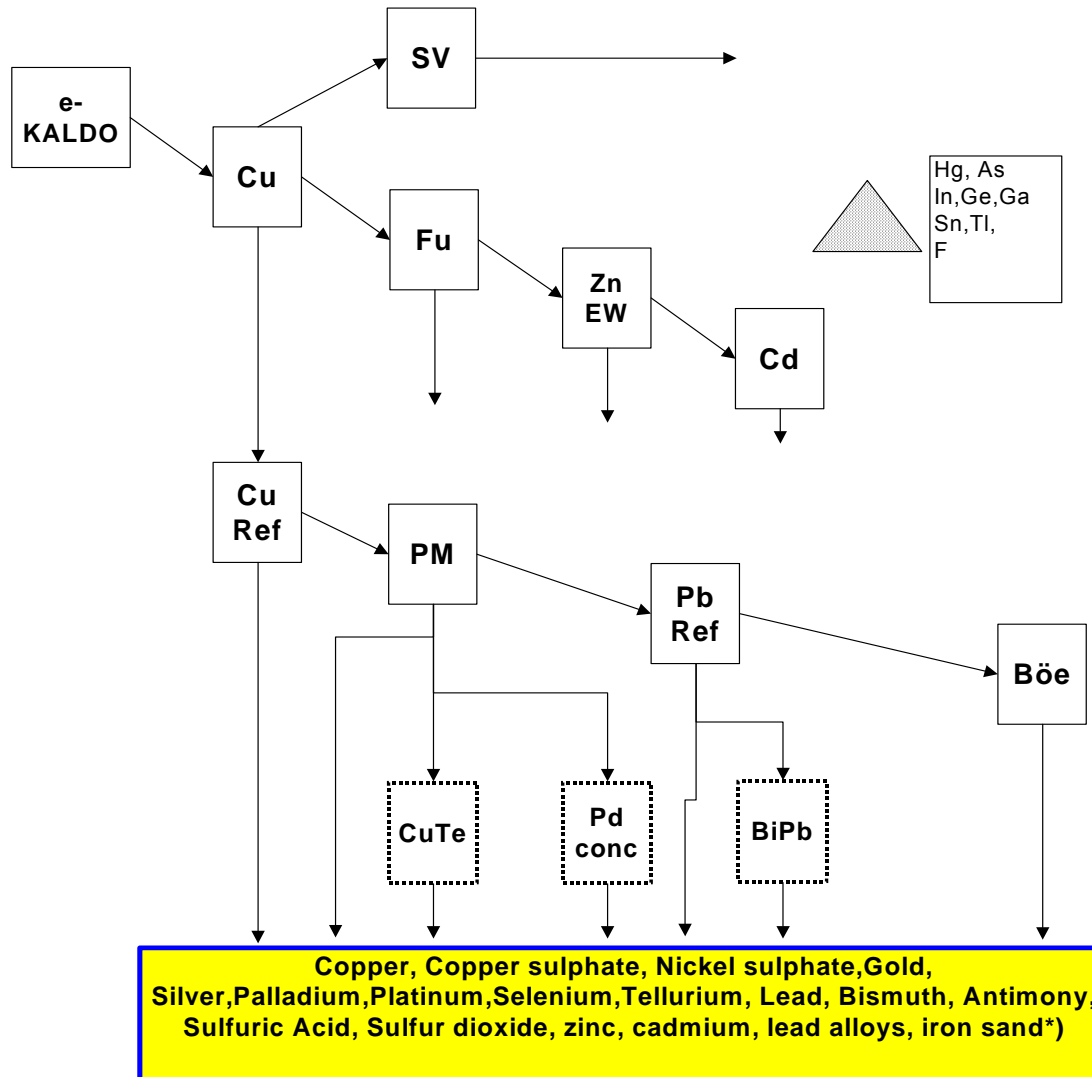


What if all the content would be turned into by-products ?

	med % WP	max % WP
Se	125%	650%
Te	245%	5205%
Bi	9%	200%
Sb	1%	27%
As	18%	94%
Pb	0%	1%
Sn	0%	1%
Ni	0%	5%
Ag	18%	517%
Au	3%	124%

Metallic Value in lots of electronic scrap and waste

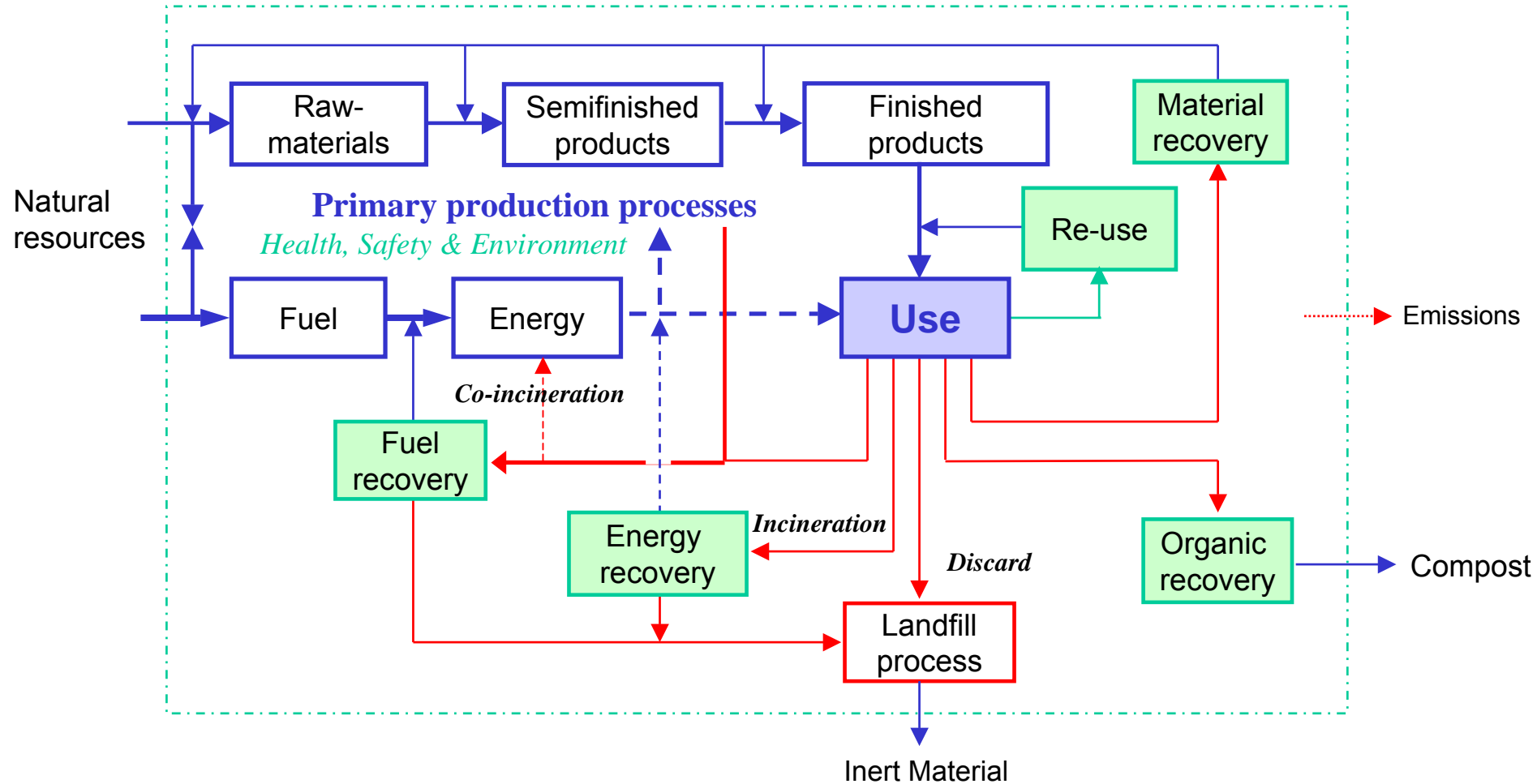




Value Cascade

*) Fe, Si, Al, Mg, Ca, Na, K, Be, O, P, Cr, U, Ta

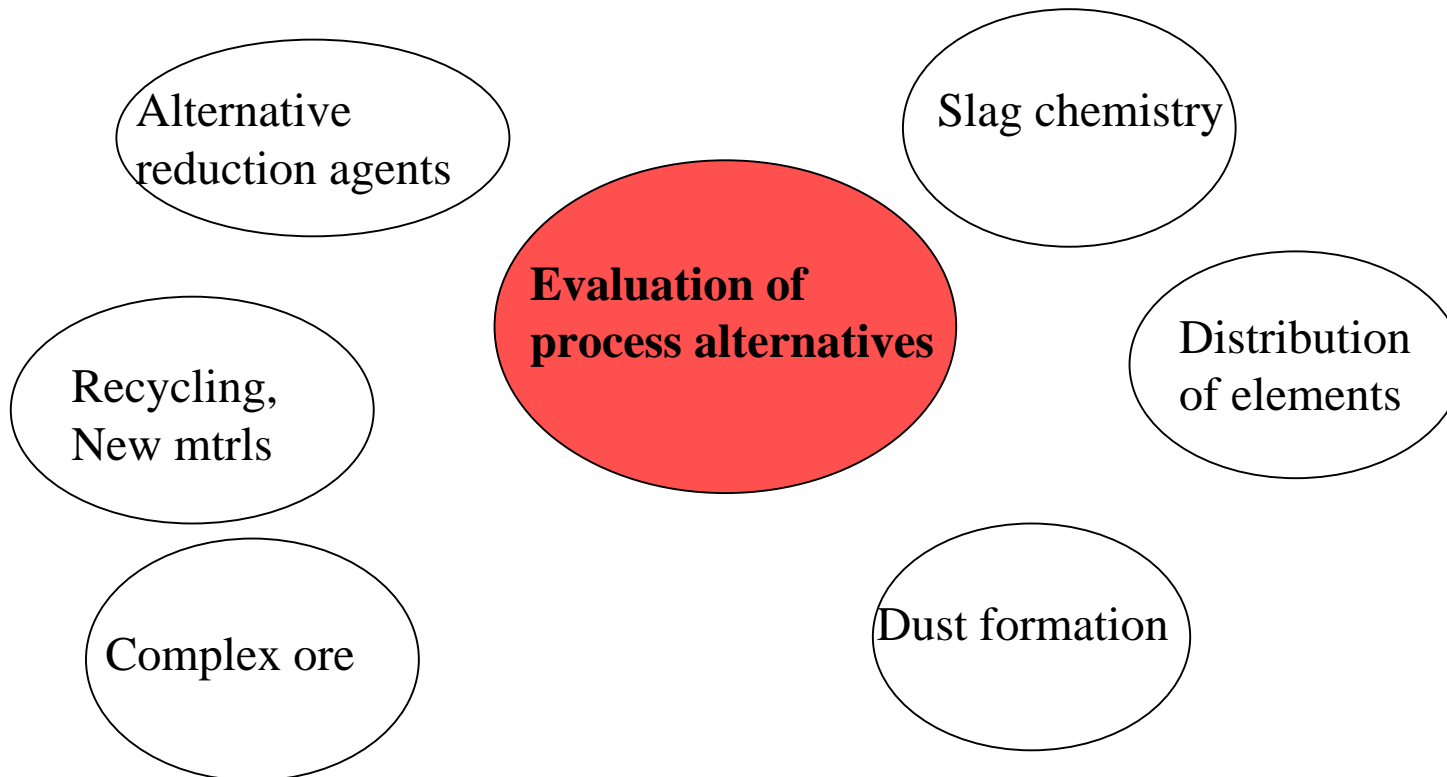
Integrated Resource and Waste Management



Research vision

Wise processing for varying feedstock

- ❖ Fundamental competence in Pyro- and hydro metallurgy
- ❖ Process knowledge



Rönnskärs metallurgy

"influence of impurities on slag properties/quality"
"Distribution of impurities"

Sulphur products

Waste, stabilisation

Cu, Fe, S,

Au, Ag, Al,
Ca, Mg, Cr,
Hg....

O₂,
SiO₂

Glass as additive and replacement of SiO₂?

Plastic-mtrl
Reduction agent, energy?

slag

Addition of glass

Cu,
Au, Ag

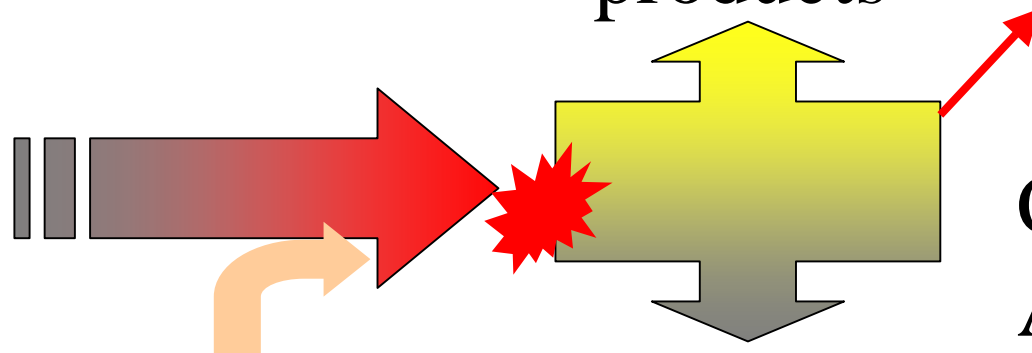


Illustration of research activities

On-going projects

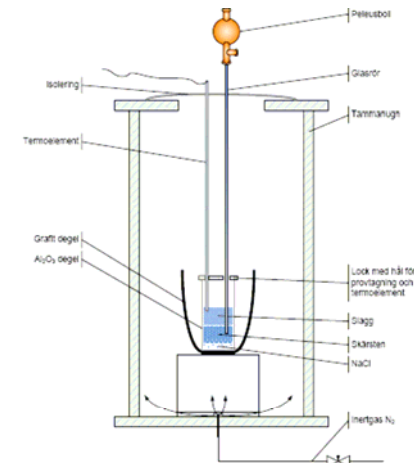
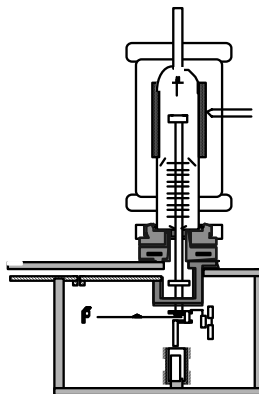
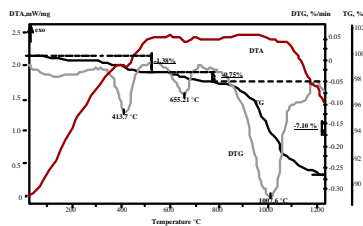
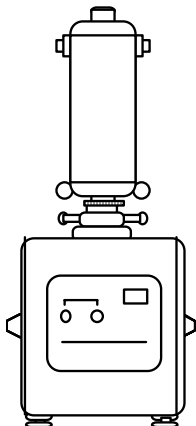
*Anita Wedholm, Ltu- responsible for experimental trials
Studentprojects*

- Use of CRT och LCD glass in smelt processes
Use as slag former or as addition to melted slag
- Filler and flame retardants in rubber and plastic
Replacement of brominated flame retardants
 - Aluminium oxide and its influence on slag properties
- Distribution of chlorine between matte and slag

Illustration of research activities

On-going projects

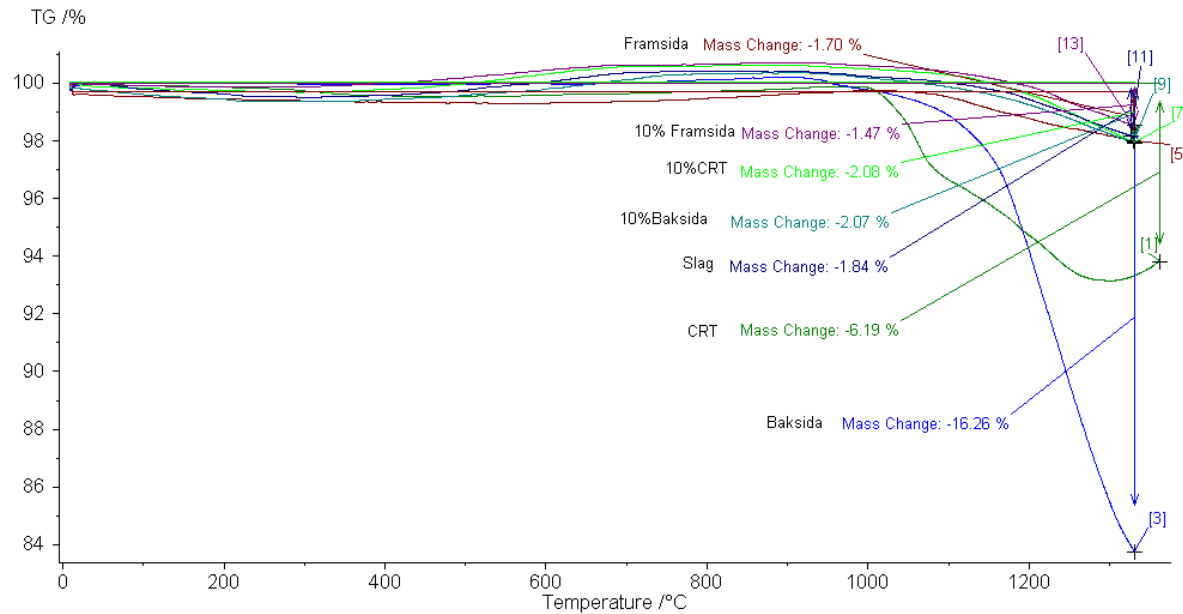
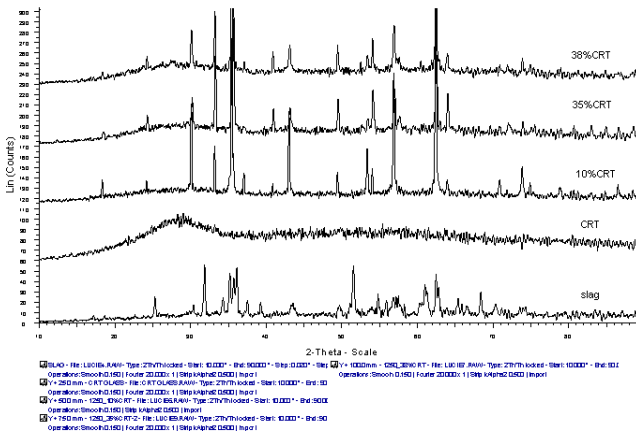
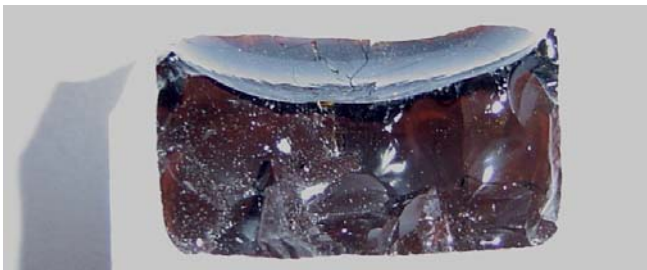
- Literature survey
- Thermodynamic calculation
- Preliminary bench scale test



Figur 3.1. Schematisk bild över försöksupställningen och provtagningsförfarande för skärsten.

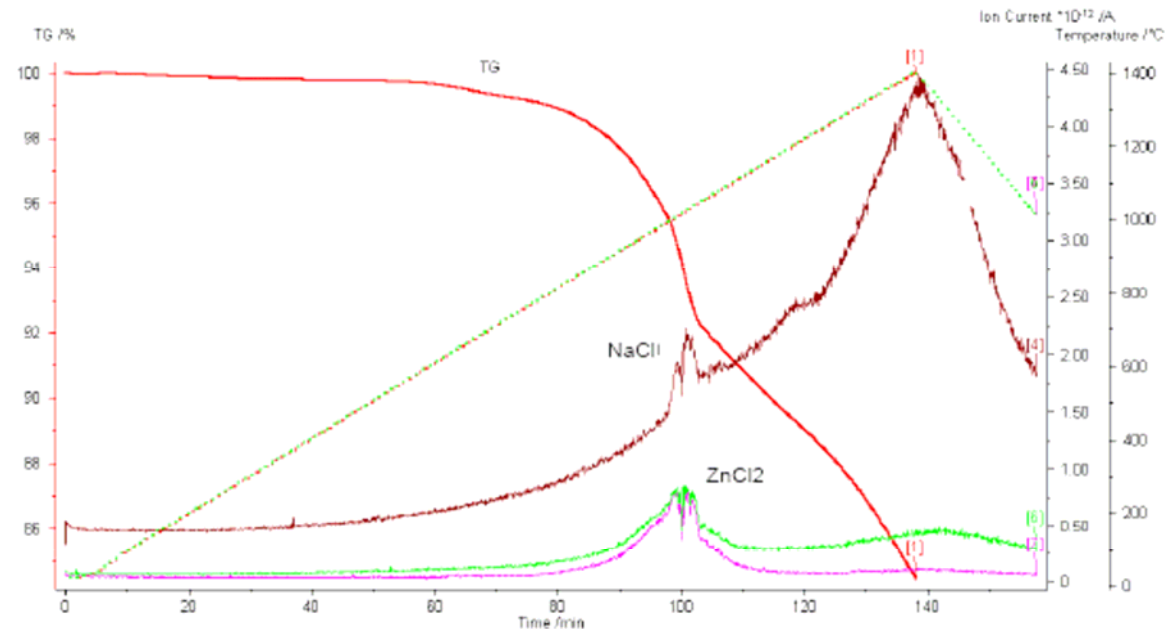
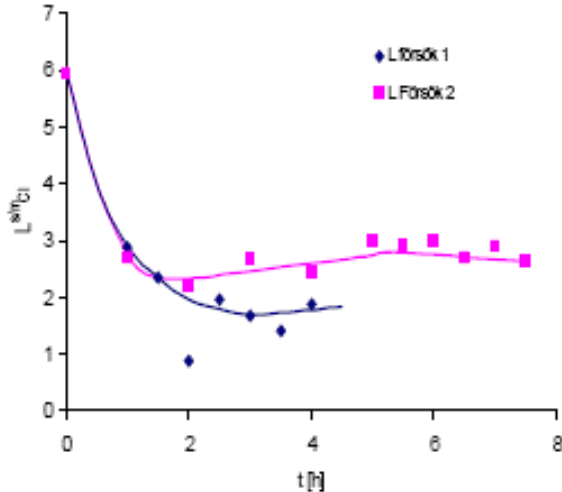
Use of CRT and LCD glass

- Decreases solubility of copper in slag
- Decreased leaching of metals from slag
- Below 35% glass addition – no visual phase separation



Distribution of chlorine between matte and slag

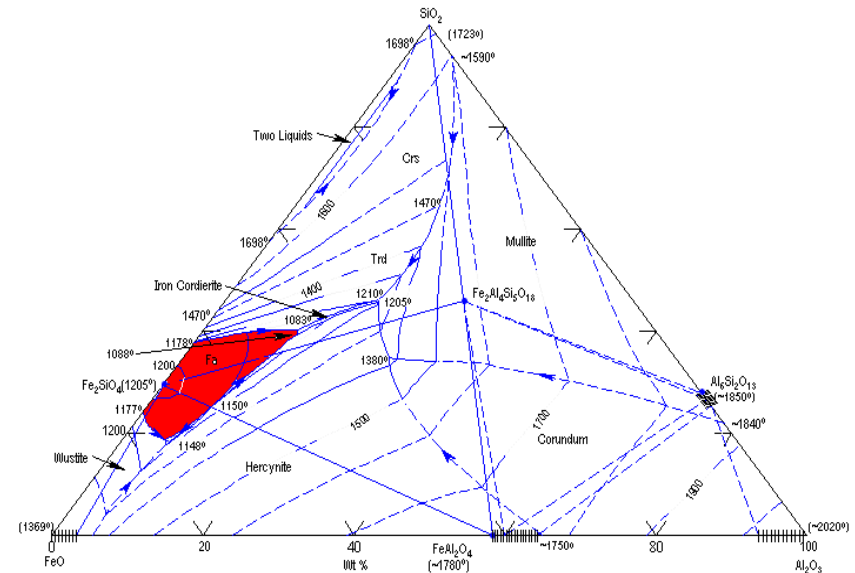
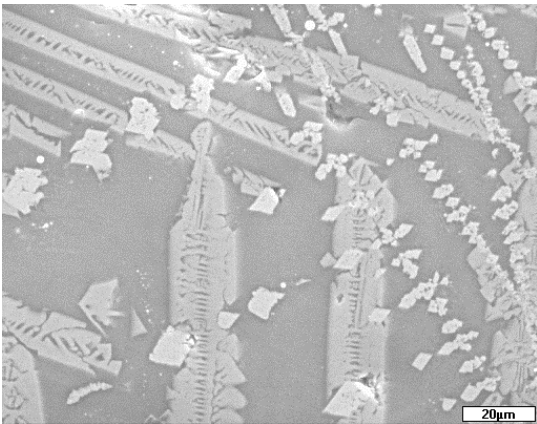
- $L_{sl/sk} \approx 2-3$
- Vaporisation of NaCl and ZnCl₂



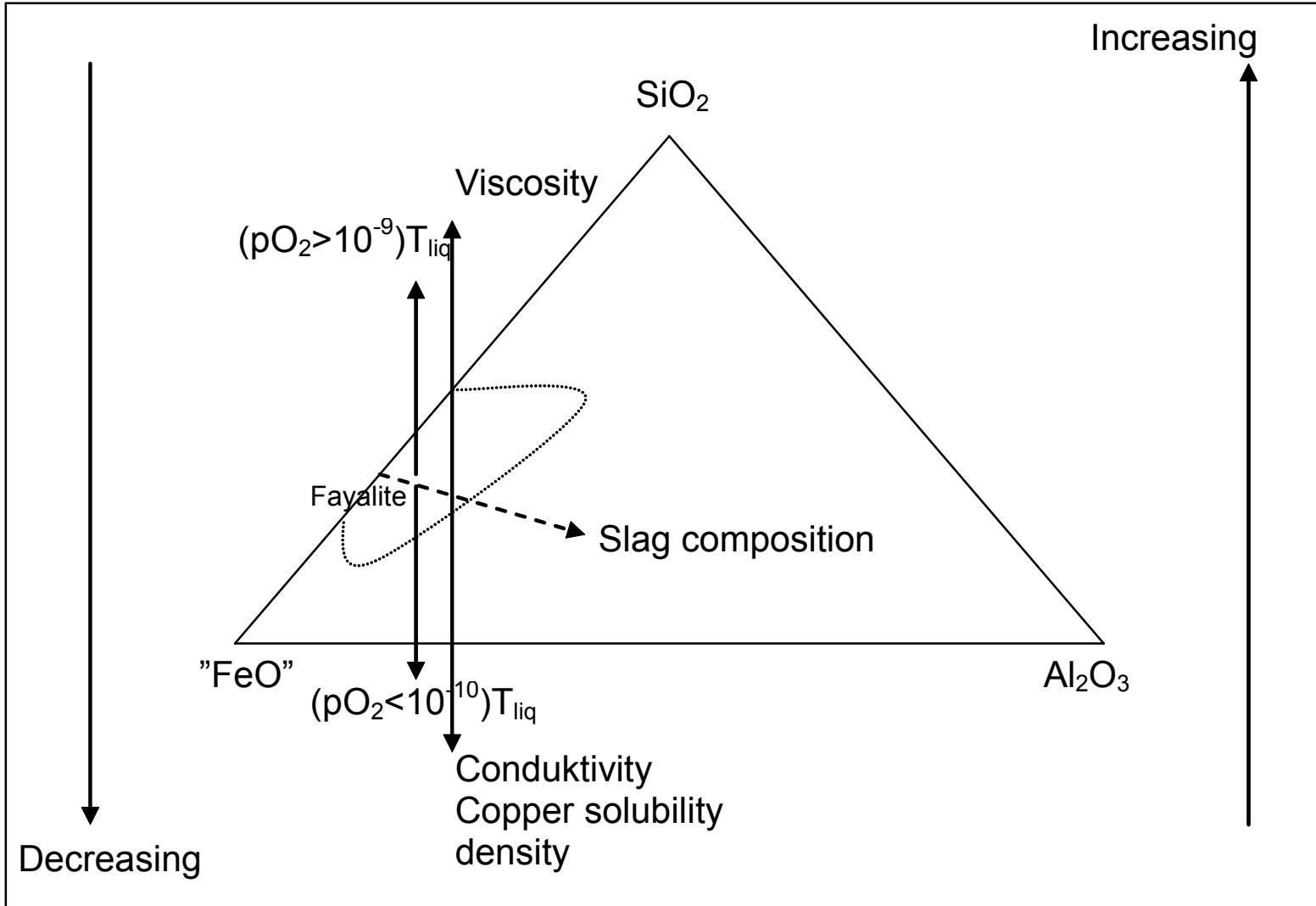
Figur 4.8. NaCl och ZnCl₂ avgång samt temperatur.

Influence of Al_2O_3 on slag properties

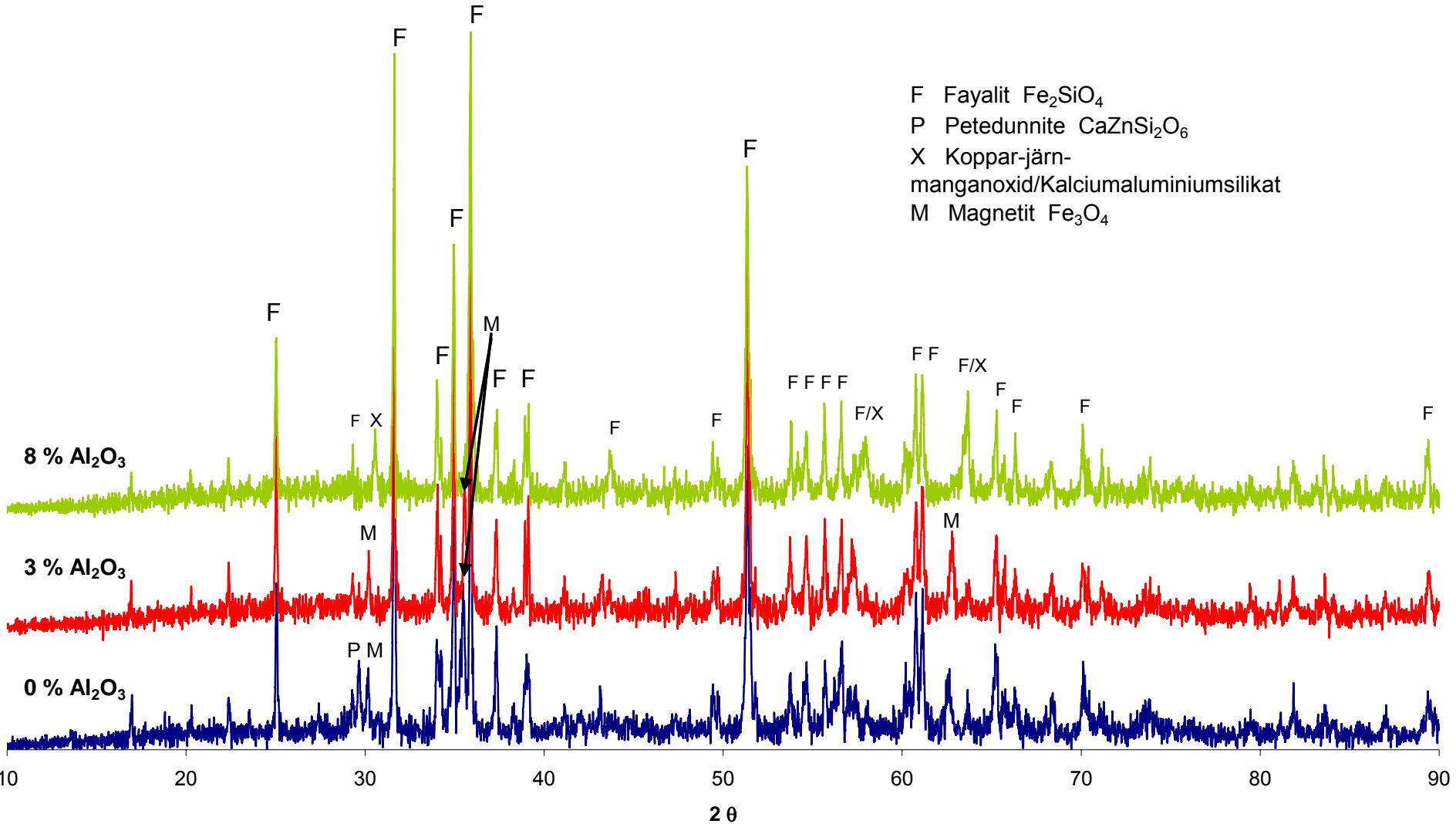
- Melting point
 - Dependent on gas composition- $p\text{O}_2$
 - Slag composition etc
- Leaching properties
 - Decreased leaching of several metals



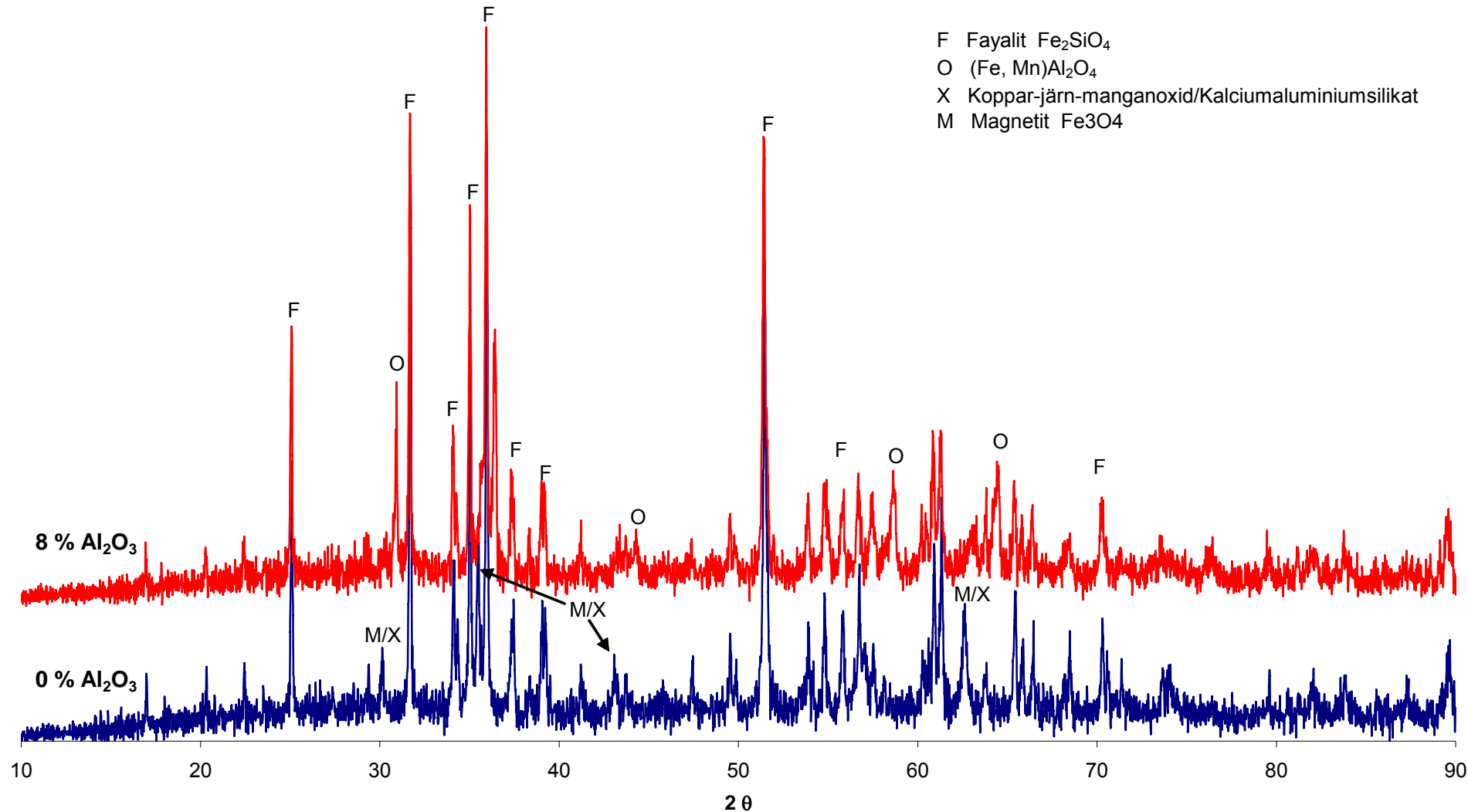
Literature survey



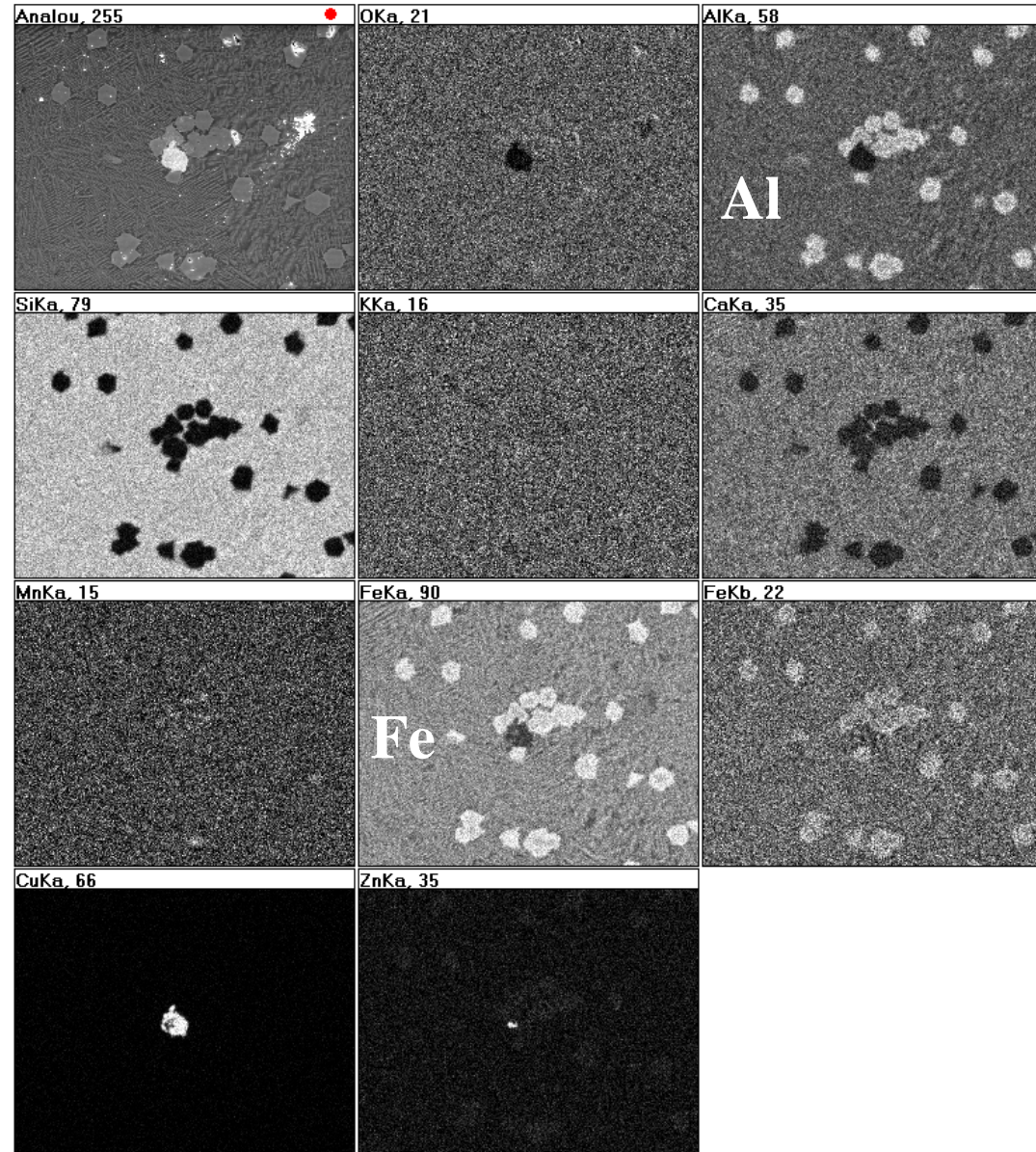
XRD-analysis after remelting and adding Al_2O_3 to the fumingslag



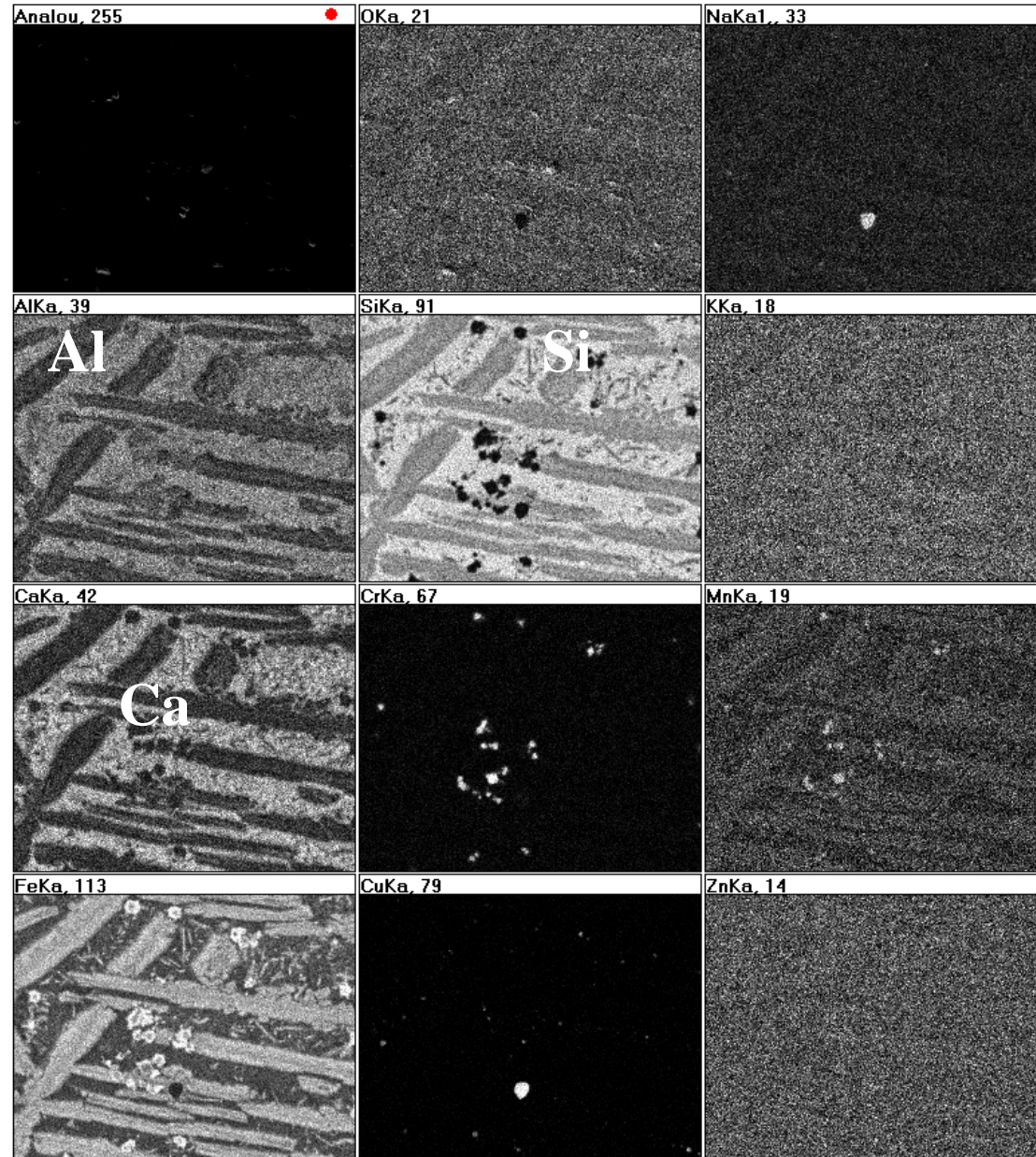
XRD-analysis after remelting and adding Al_2O_3 to the electric furnace slag



No additional Al_2O_3
added to the fuming-
slag



8 weight% Al_2O_3 added
To the fuming slag



**Resources should be used with wisdom and knowledge
to give the future generations worldwide
wealth in a healthy environment**

