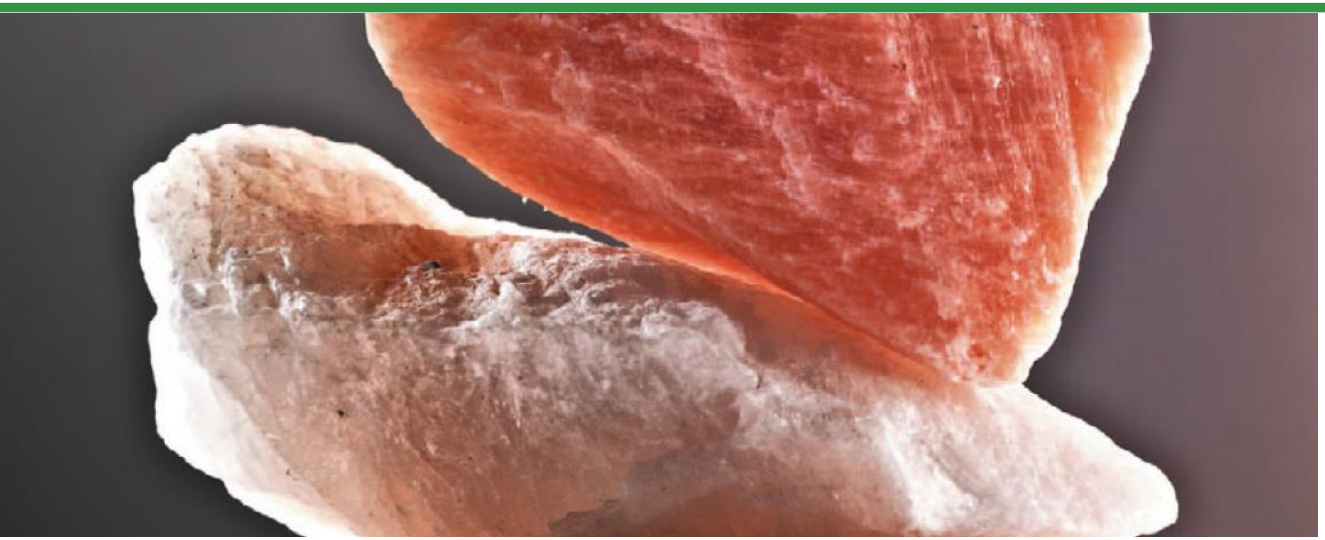
Sensor Based Sorting



A. J. DeCenso
Preferred Process Solutions

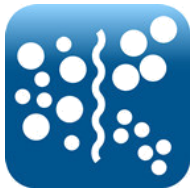
Tord Svensson
TOMRA Sorting Solutions

Industrial Minerals Association – North America

IMA-NA Industrial Minerals Association North America

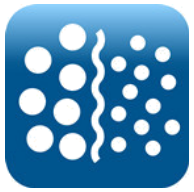
2014 Technology Workshop

About Preferred Process Solutions, LLC


Screening


Sorting


Air Classifying


Milling


Centrifuging


Drying


Coating


Plant Design

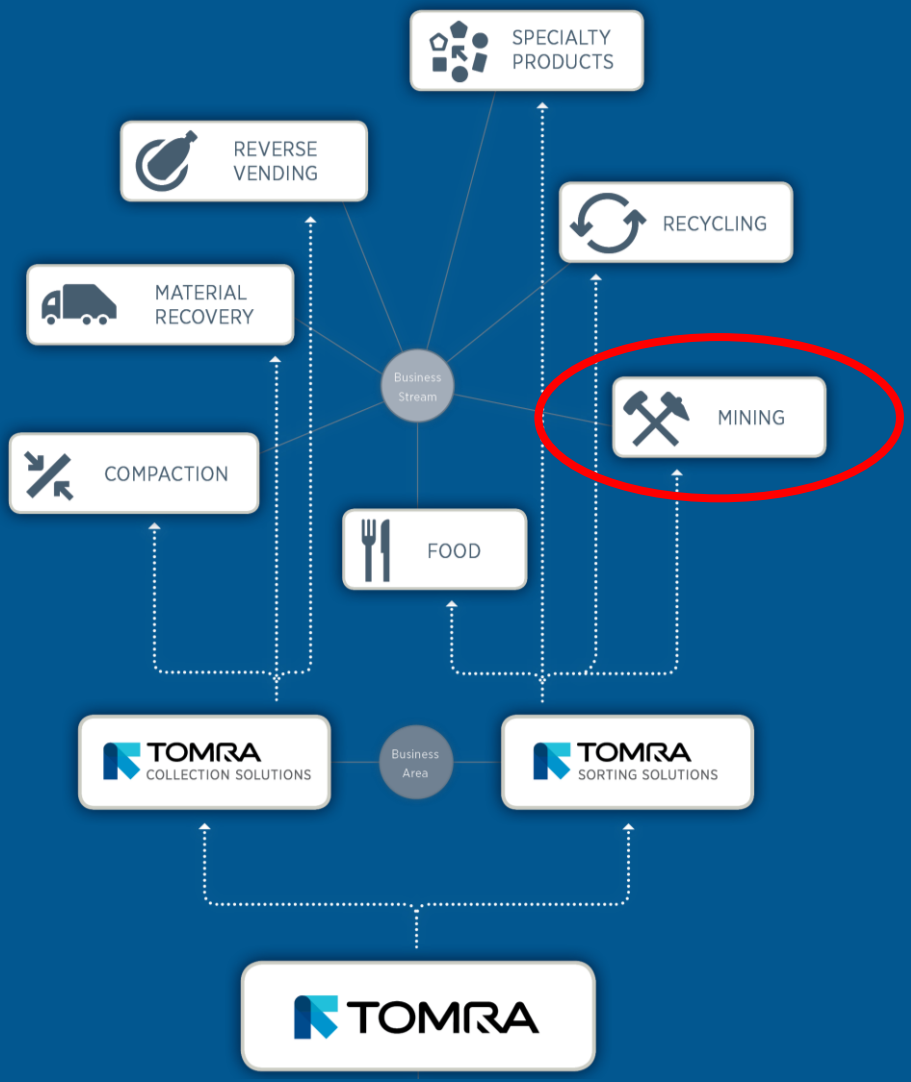
TOMRA SORTING SOLUTIONS

Preferred Process Solutions

SWECO

ecutec®

About TOMRA Group

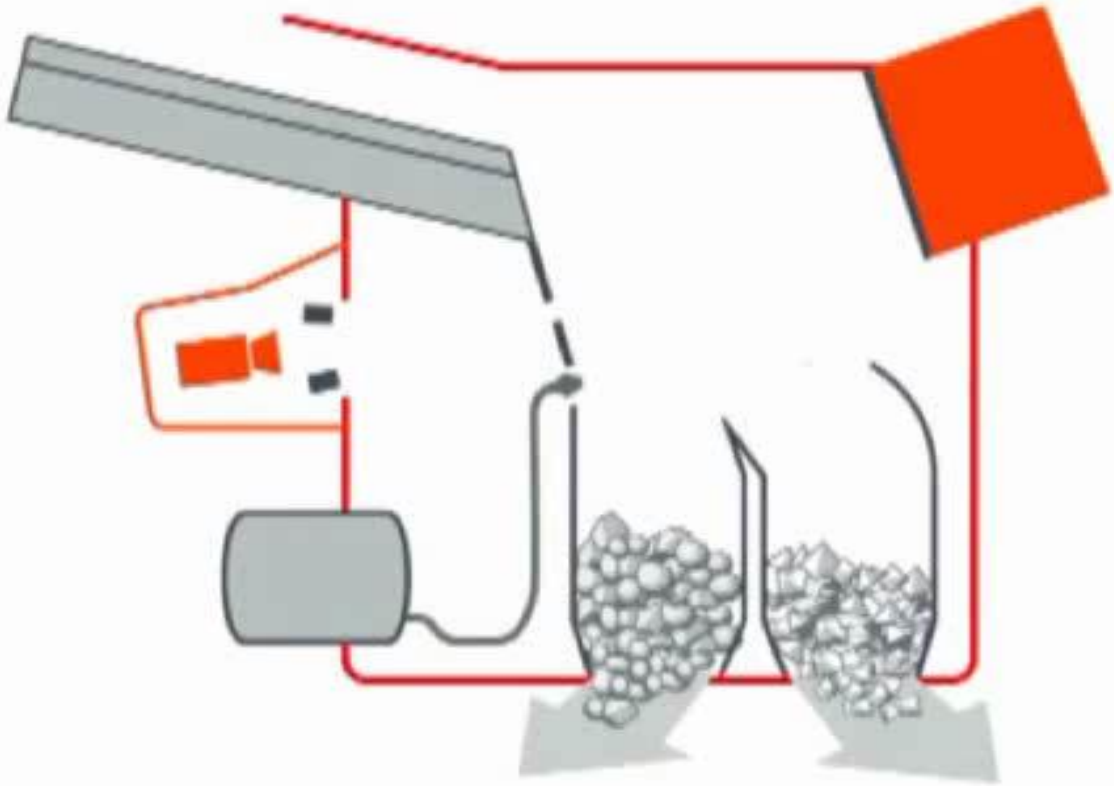


The Tomra Group

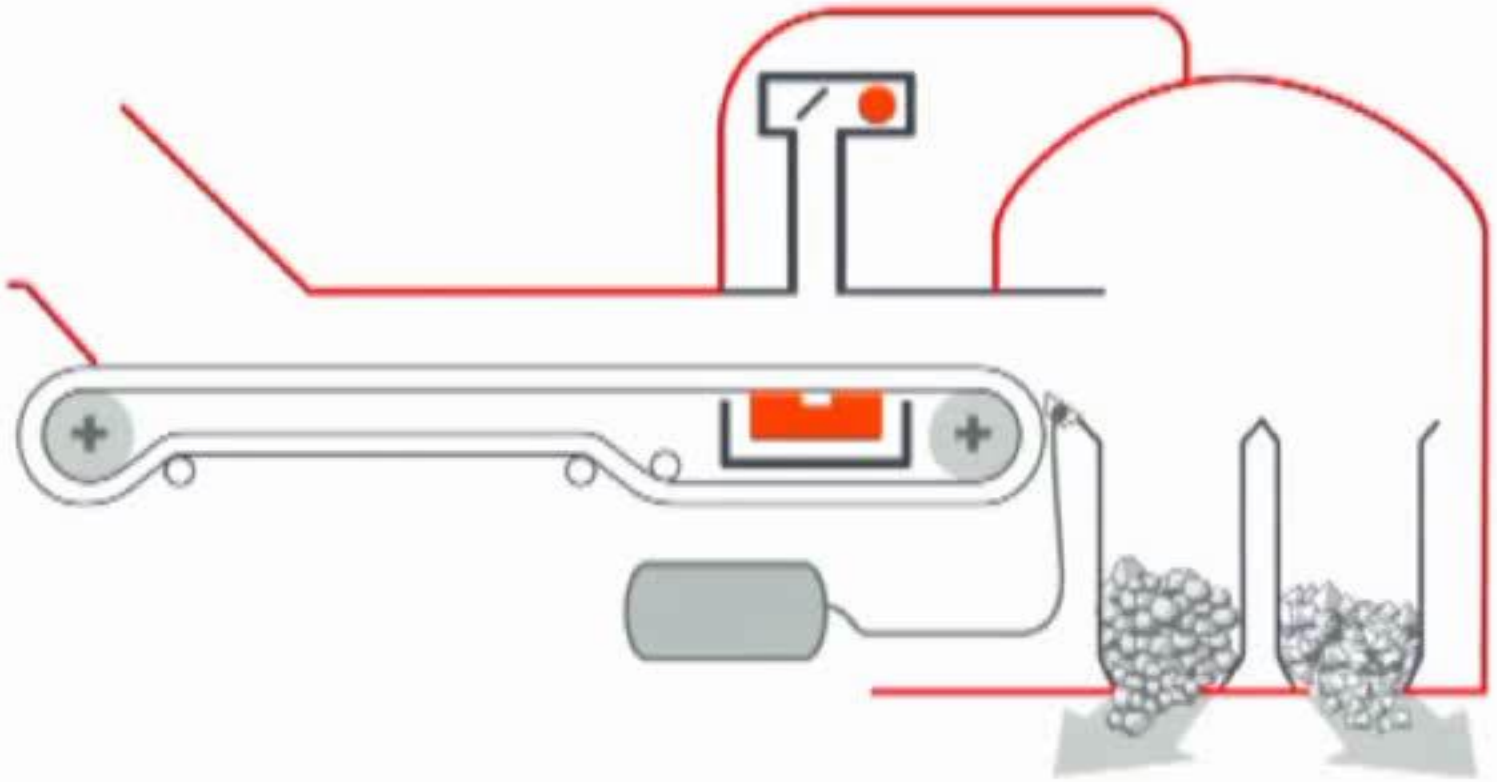
- Listed on Oslo Stock Exchange (OSEBX:TOM)
- 2,200 employees
- Revenues of 550 million EUR (2012)

Sorter Video

How a Chute Sorter Works…



How a Belt Sorter Works…



Color Sorting Examples

	Accepts	*Rejects*
Quartz		
Limestone		

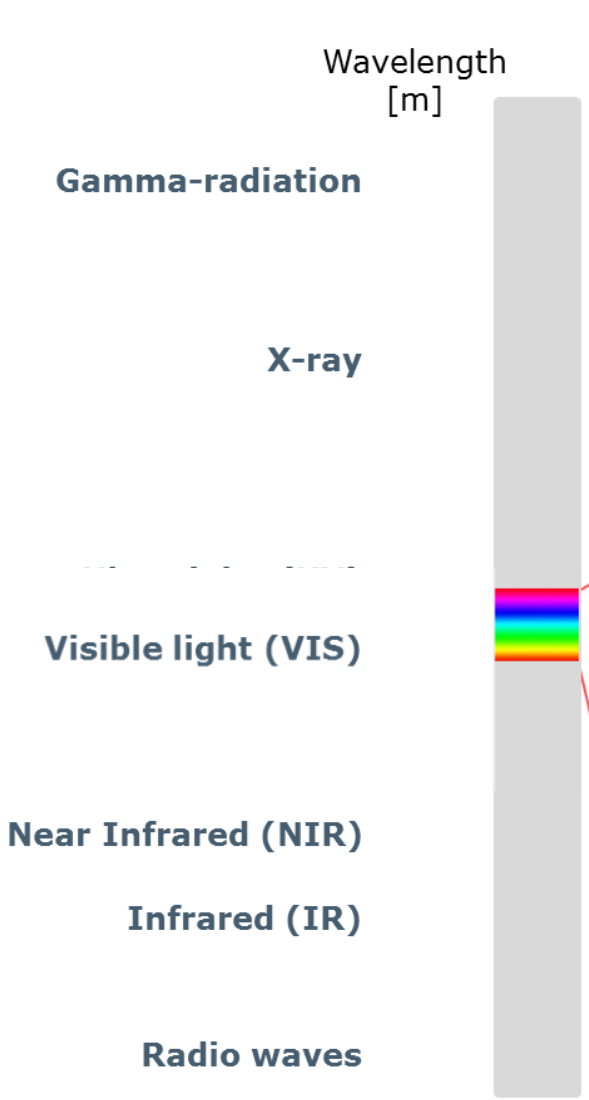
Color Sorting Examples

	Accepts	*Rejects*
Talc		
Magnesite		

Sensor Technologies

Sensor/ Technology	Material Property	Applications
COLOR (CCD Color Camera)	Reflection, Absorption, Transmission	Base-, Precious Metals Industrial Minerals Diamonds
PM (Photometric)	Monochromatic Reflection/Absorption	Industrial Minerals Diamonds

Sensor Technologies

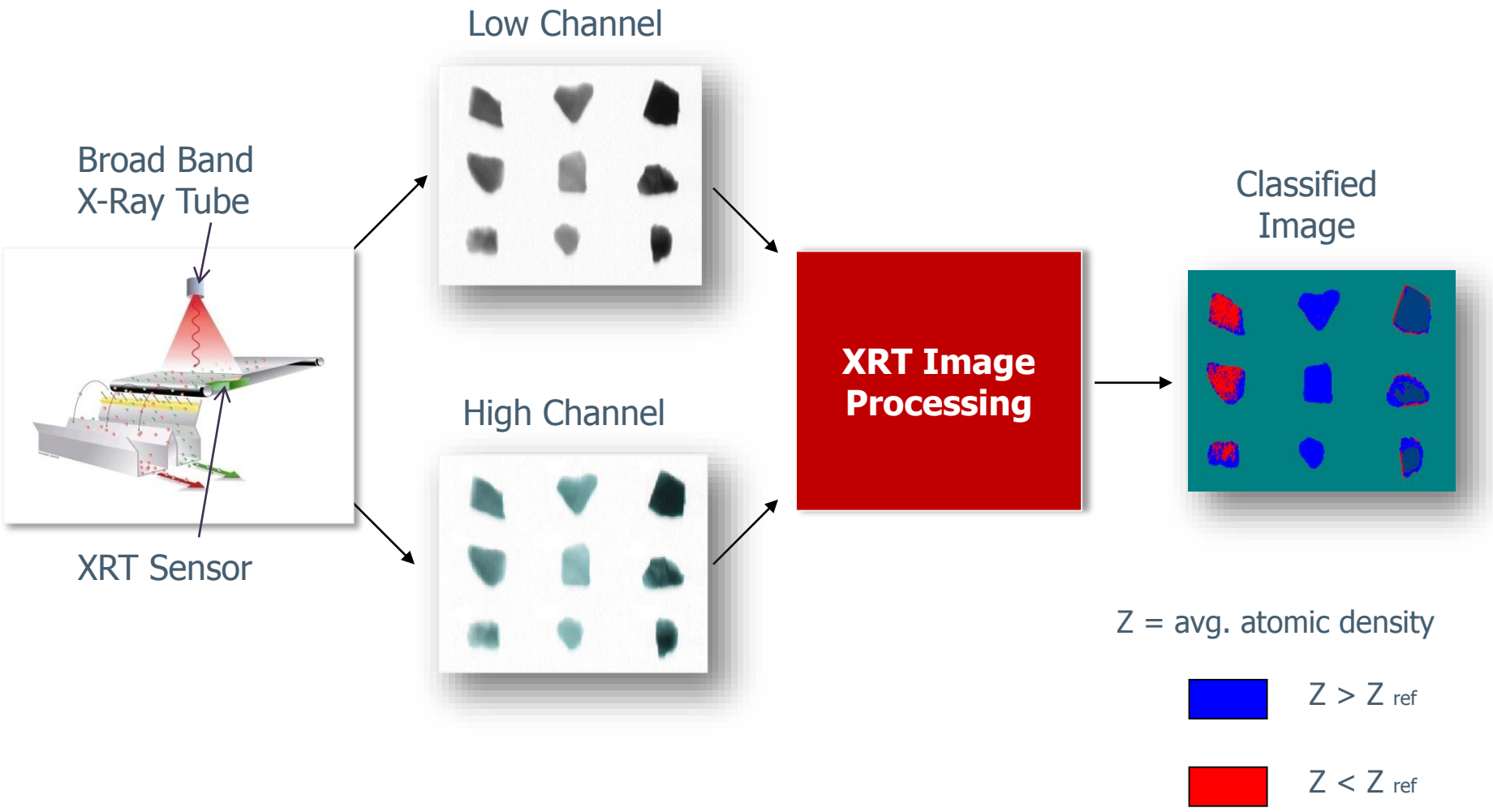


Sensor/ Technology	Material Property	Applications
RM (Radiometric)	Natural Gamma Radiation	Fuel, Precious Metals
XRT (X-ray transmission)	Atomic Density	Base Metals Precious Metals Industrial Minerals Fuel, Diamonds
ED-XRF (Energy Dispersive XRF)	X-ray Fluorescence	Base Metals Precious Metals Industrial Minerals
XRF (X-ray Fluorescence)	Visible Fluorescence under X-rays	Diamonds
COLOR (CCD Color Camera)	Reflection, Absorption, Transmission	Base-, Precious Metals Industrial Minerals Diamonds
PM (Photometric)	Monochromatic Reflection/Absorption	Industrial Minerals Diamonds
NIR (Near Infrared Spectrometry)	Reflection, Absorption	Base metals Industrial Minerals
IR (Infrared cam)	Heat conductivity, heat dissipation	Base Metals Industrial Minerals
EM (Electro-Magnetic sensor)	Conductivity, permeability	Base Metals

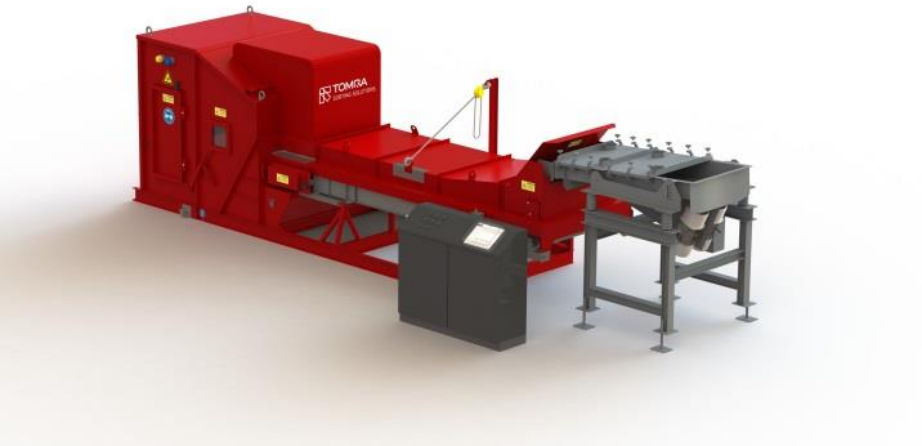
XRT Technology Application: Phosphates

Sensor/ Technology	Material Property	Applications
XRT (X-ray transmission)	Atomic Density	Base Metals Precious Metals Industrial Minerals Fuel, Diamonds

XRT – Dual Energy Image Processing



COM Series XRT Sorter



- Size range +8mm-60mm
- Capacity up to 70t/h
- Easy to replace wear liners
- Counterbalance feeder arrangement
- Dual Energy XRT sensor
- Liquid cooled X-ray system
- Highest level X-ray safety

Sorting of Phosphate Using XRT

Feed Material Phosphate Ore with chert/ Flintstone (SiO_2) contaminants

Objective Remove as much chert as possible before downstream process of crushing, milling, flash calcination or for flotation

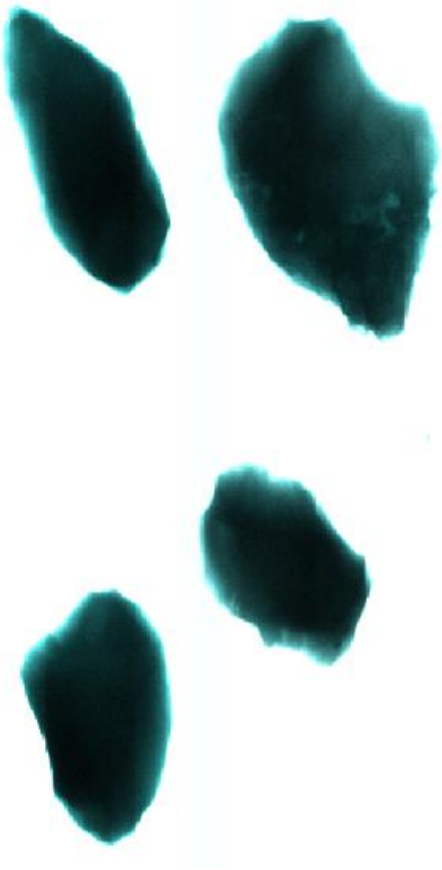
Not as Easy as it Looks…

Although it looks like a color separation, much of the chert is covered by white phosphate

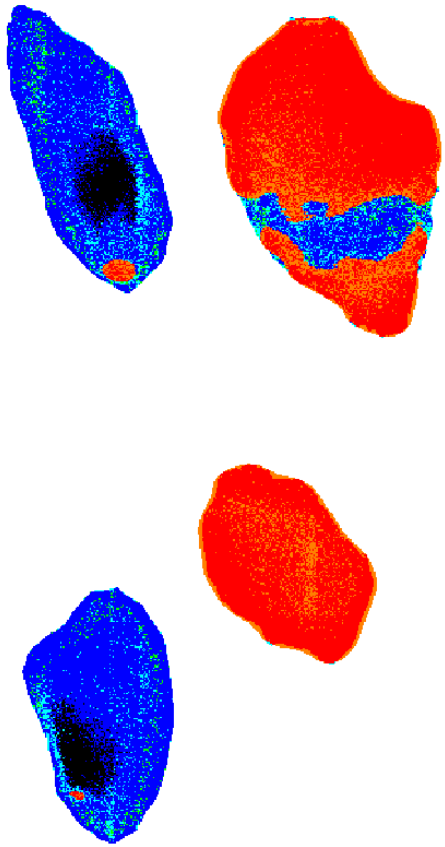
XRT Image Acquisition and Processing

Visible Image

Raw XRT Image



Processed XRT Image



Results

- ✓ Decreased Chert-content from 11 % to ~0.2 % (98% removal efficiency)
- ✓ Recovery of > 98 % of the phosphate

OPEX Estimates for Selected Applications

	Limestone	Talc	Coal	Nickel
Sensing technology	color	NIR	XRT	EM
Feed rate	180 t/h	35 t/h	100 t/h	60 t/h
Production hours / year	3,750 hrs	3,750 hrs	3,750 hrs	3,750 hrs
Feed tonnage per year	675,000 tpa	131,250 tpa	375,000 tpa	225,000 tpa
Pct. product in feed	70 %	90 %	75 %	60 %
Product recovered per year	435,500 tpa	107,000 tpa	258,000 tpa	126,000 tpa
Annual Operating Costs				
Energy usage, sorter	$4,556	$4,556	$6,075	$6,075
Energy usage, peripherals	$71,685	$71,685	$15,188	$47,385
Maintenance	$22,275	$22,275	$22,275	$22,275
Replacement parts	$36,450	$29,228	$46,980	$47,952
Service / support	$18,900	$18,900	$18,900	$18,900
Total OPEX	$153,866	$146,644	$109,418	$142,587
OPEX per ton of feed	$0.23/ton	$1.12/ton	$0.29/ton	$0.63/ton
OPEX per ton of product	$0.35/ton	$1.37/ton	$0.42/ton	$1.13/ton

Contacts

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