SMI JKMRC

Julius Kruttschnitt Mineral Research Centre

Integrated Process Prediction

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Integrated process prediction

Predicting the performance of the whole mining process is surely the holy grail of predictive simulation

Objective

Predict the response of the processing chain

mining → concentration

to changes in the ore type

Application

Greenfields design

- processing options to optimise the overall mine performance
- constraints and aspirations of the greater community
- environment

expansion and optimisation

- Changes in economic drivers
- Changes in ore types
- on-line control – predictive reaction to ongoing changes in ore processing types

Know the rock

- ore characteristics based on in-situ rock properties
- prediction of fragmentation
- predict and track progressive mineral liberation
- response to separation processes as a function of mineralogical properties.

Challenges

Transform processing capability

lower ore grades

environmental impact

detrimental elements

water

energy

the social license to operate

Profitability

Improved efficiency of process equipment

Halve energy use?

Grades at least halving

Energy intensity of production does not decrease

Future approach

Circuits designed to respond to variable:

- grade
- Competence
- feed size distribution
- liberation size

by processing to varying:

- target required grind size
- recovery options
- cut-off grades

Considerable, worthwhile challenge to ensure sustainability of our industry

Integrated Process knowledge

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THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

SMI

INTEGRATED PROCESS KNOWLEDGE

GCC
Global Comminution Collaborative

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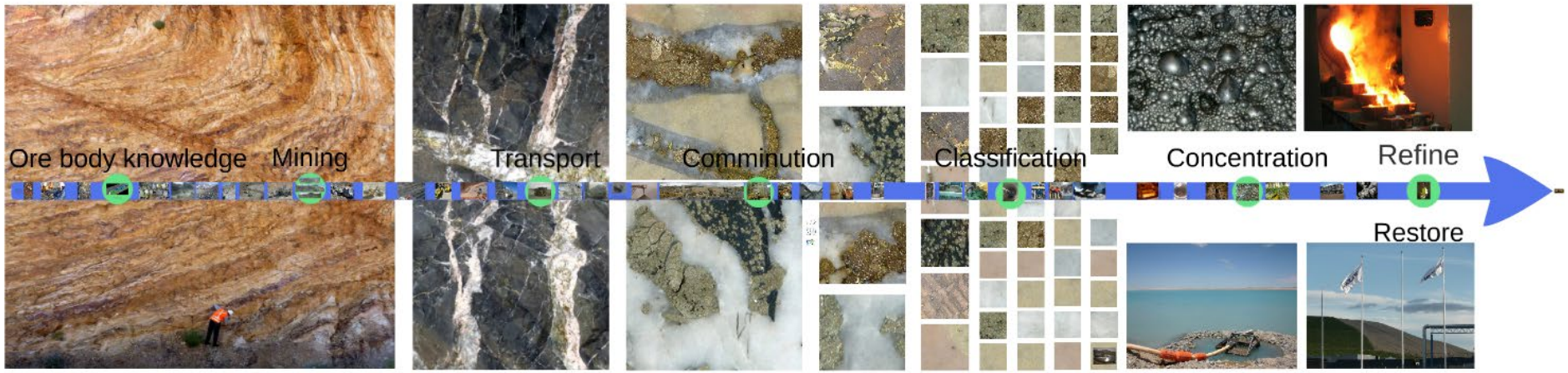


All about the rock

It’s all about the rock

Degree of reduction for high probability of recovery

- Mineral grain size
- Mineral associations
- Texture – intergrowth, veining, etc.
- Mechanical texture
  the energy required and optimal input mechanism
- Recovery process or processes
  - Surface
  - Volume
  - porosity dependent
  - Selectivity

comminution objective revisited

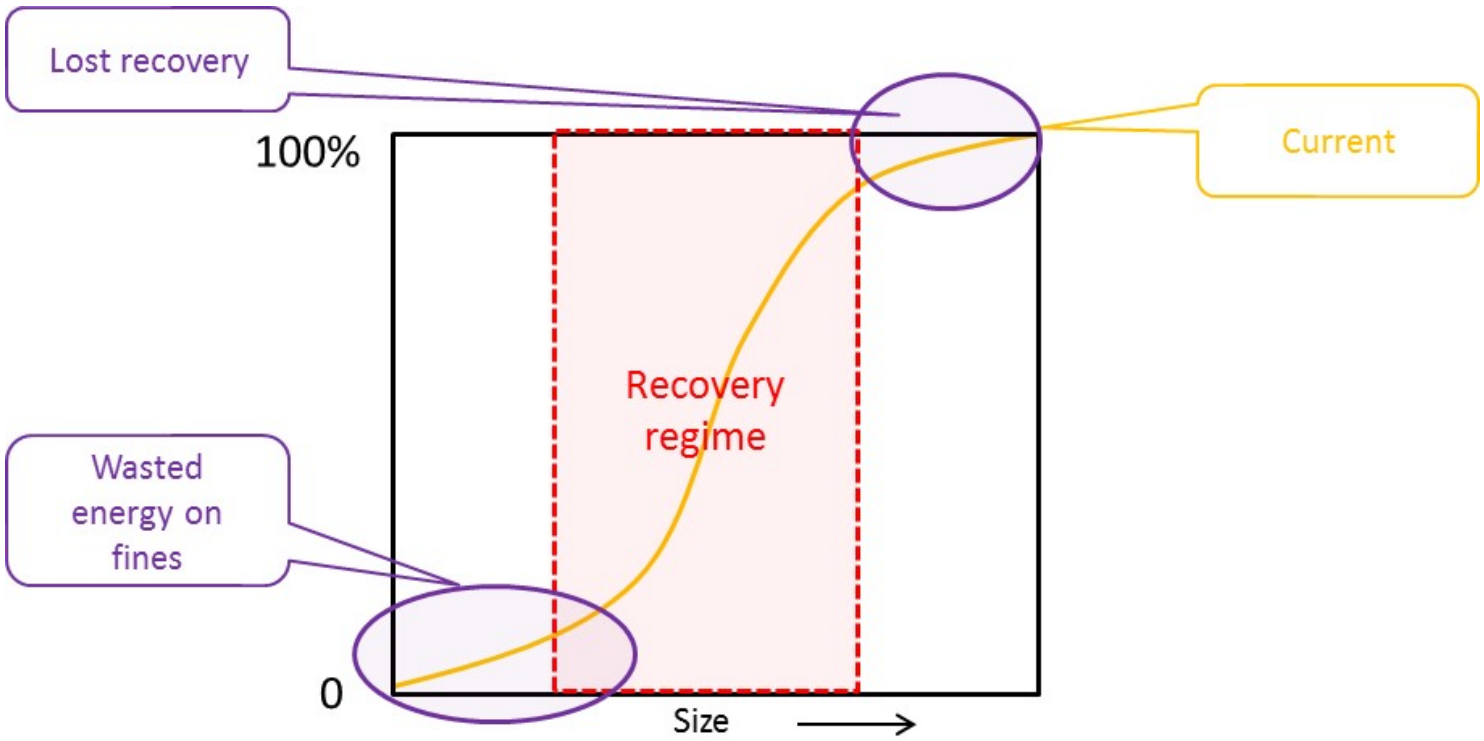
Minimum degree of breakage required to permit recovery of the valuable minerals
Staged recovery and progressive upgrade

The upside of Progressive upgrade

- Large removal in one step 40%
  - Lower recovery
  - Higher risk of erroneous removal

- Staged removal
  - Improved discrimination
  - High recovery per stage
  - Larger energy saving at fine end
  - Greater gangue rejection
  - High overall recovery

Designer products for recovery



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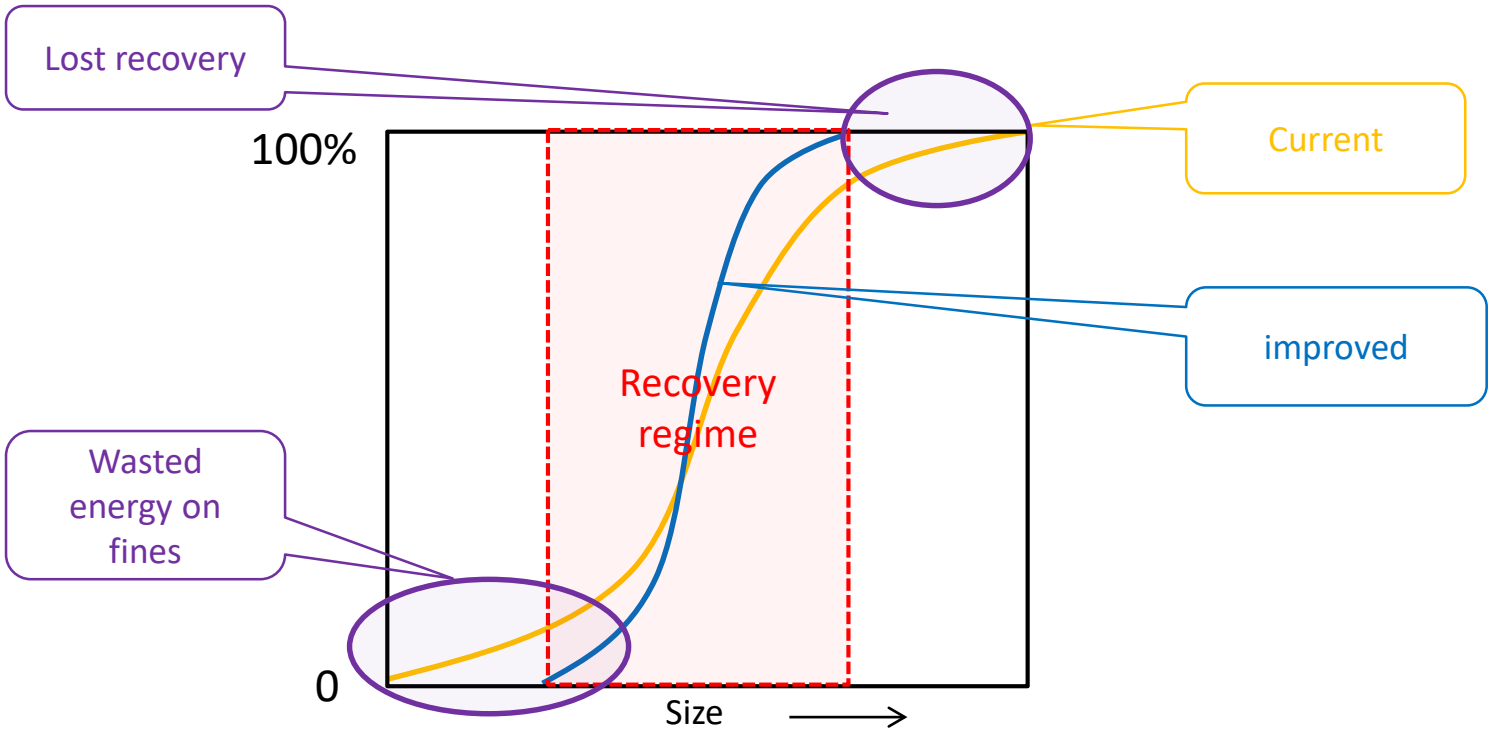
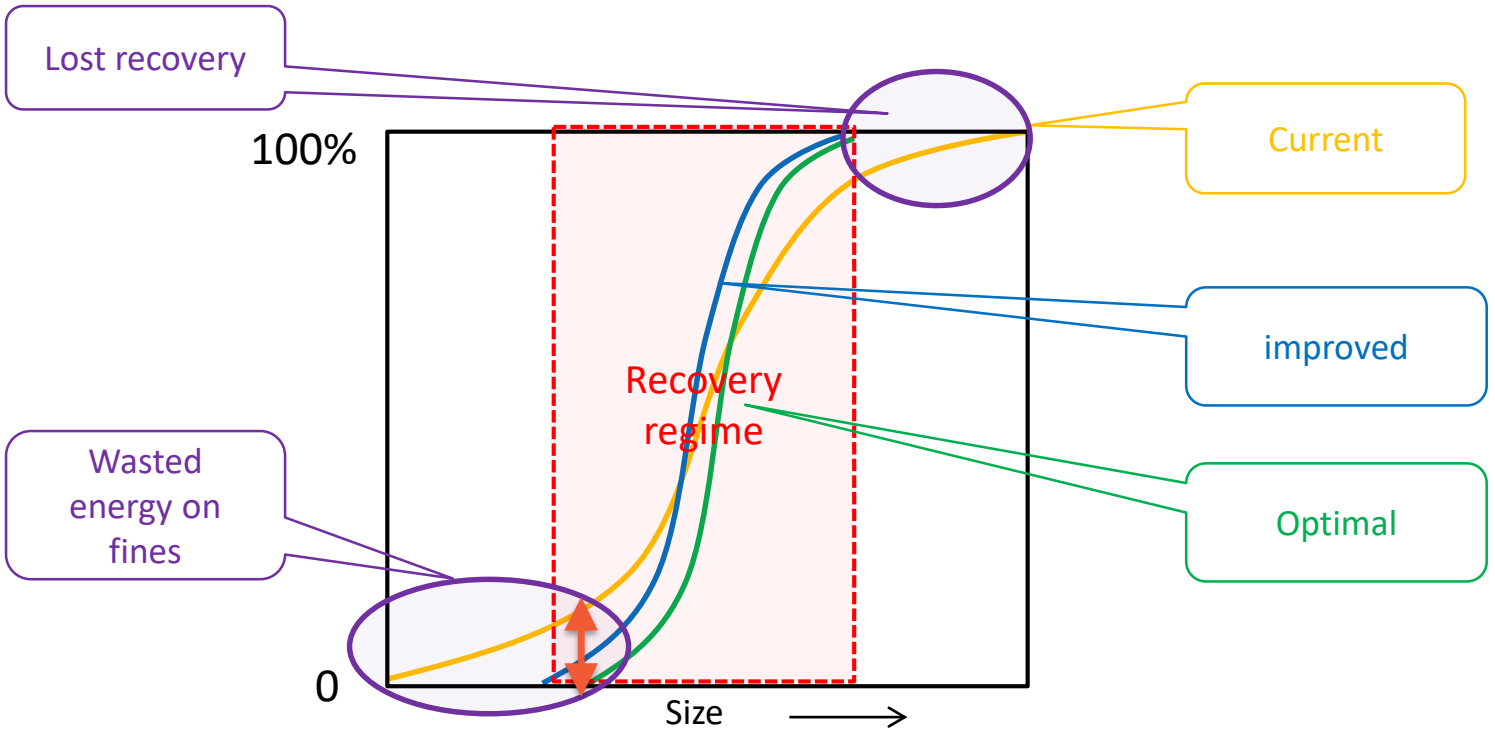


Designer products for recovery

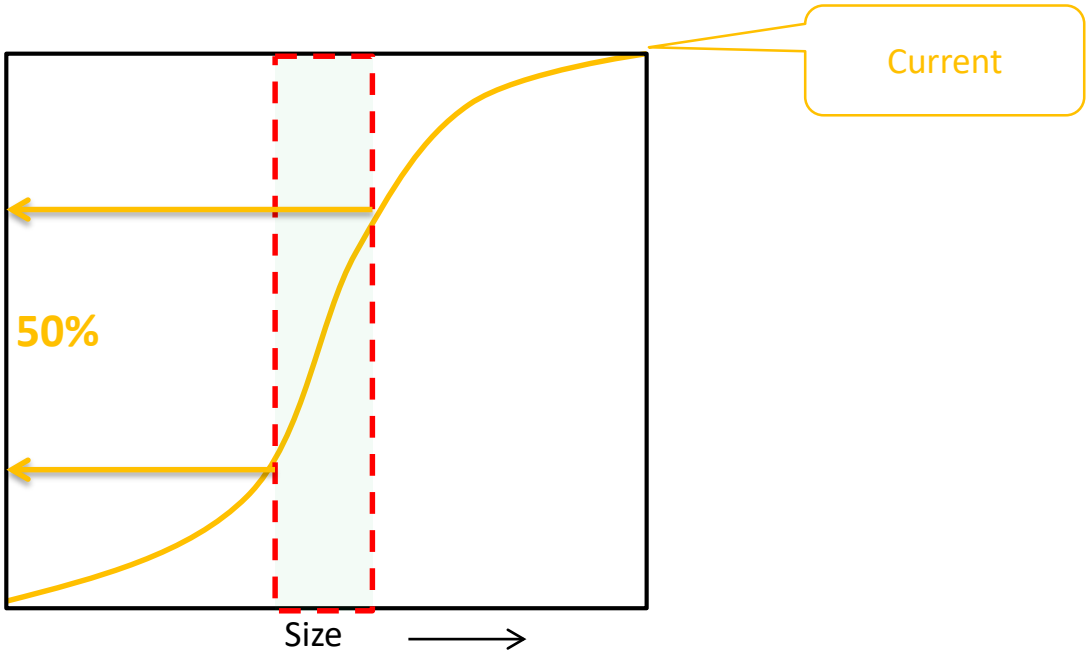
Higher recovery
50% energy (based on SSE)



Designer products for staged upgrade

Upgrade 0.4 removal of gangue

0.4 x 50% = 20% removal = 80% energy and processing downstream



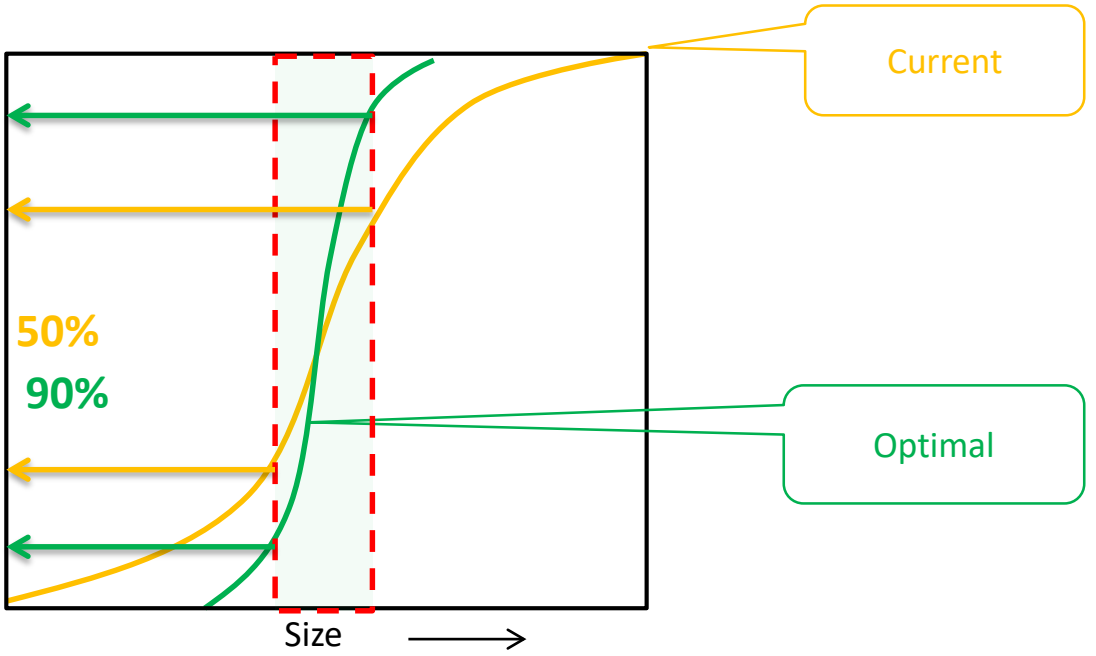
Designer products for staged upgrade

Upgrade 0.4 removal of gangue

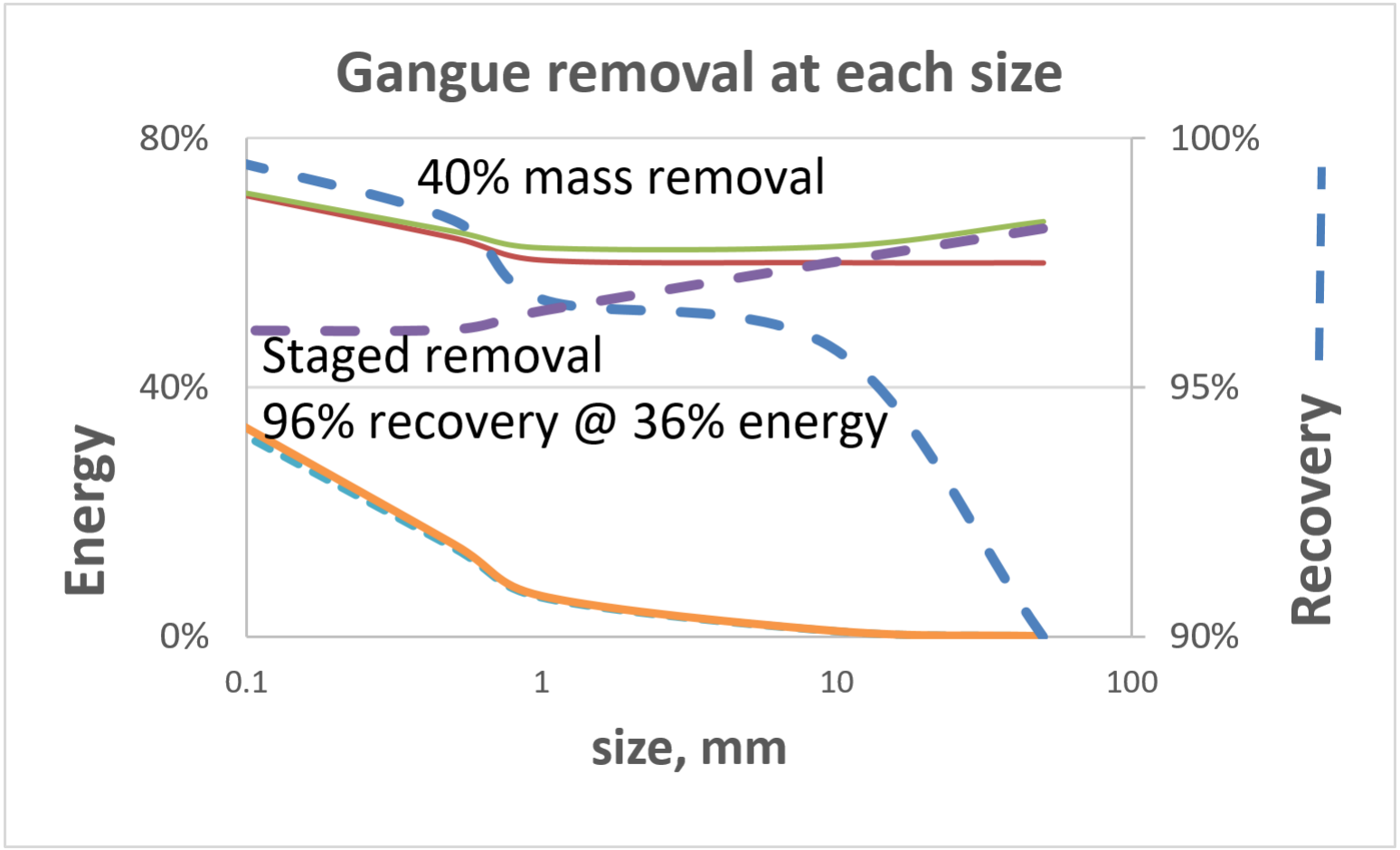
0.4 x 50% = 20% removal = 80% energy and processing downstream

0.4 x 90%= 36% 64%

16% energy and processing saving



Potential of staged vs mass upgrade



Process performance

Measurement directly influences process choice or changes

- Define target
- Then efficiency as function (target)
- ∑ circuit → entire circuit

Ore body information

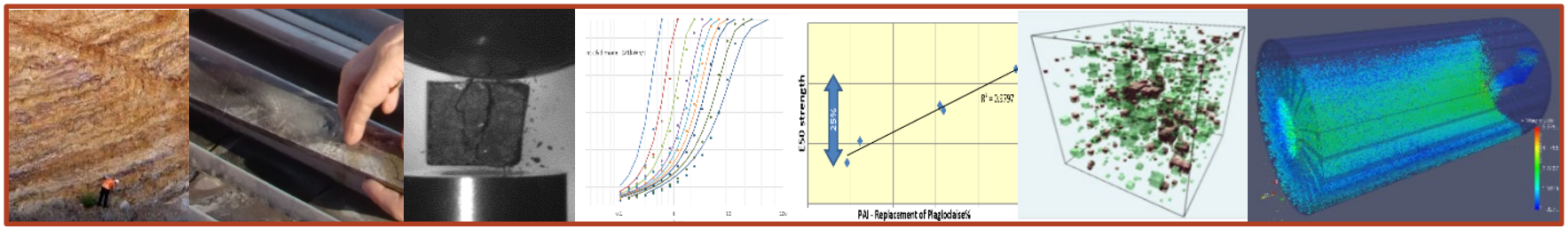
- Size specific Energy (SSE) - linear & additive
- Impact strength
- Abradability & product size
- Texture parameters related to liberation size
- Grade deportment factor - grade by size in blasted rock
- Clay
- Process-specific recovery indicators

  floatability, magnetic susceptibility, leach response, etc.
- Orebody-specific relationship to parameters
  - Core logging data - alteration, silica content, ……
- Some, but not all, current stored data
  - grades of key minerals and deleterious elements, …….

primary rock properties

- mineral association
- mineral strengths
- rock strengths in these mineral associations
- Mineralogical liberation

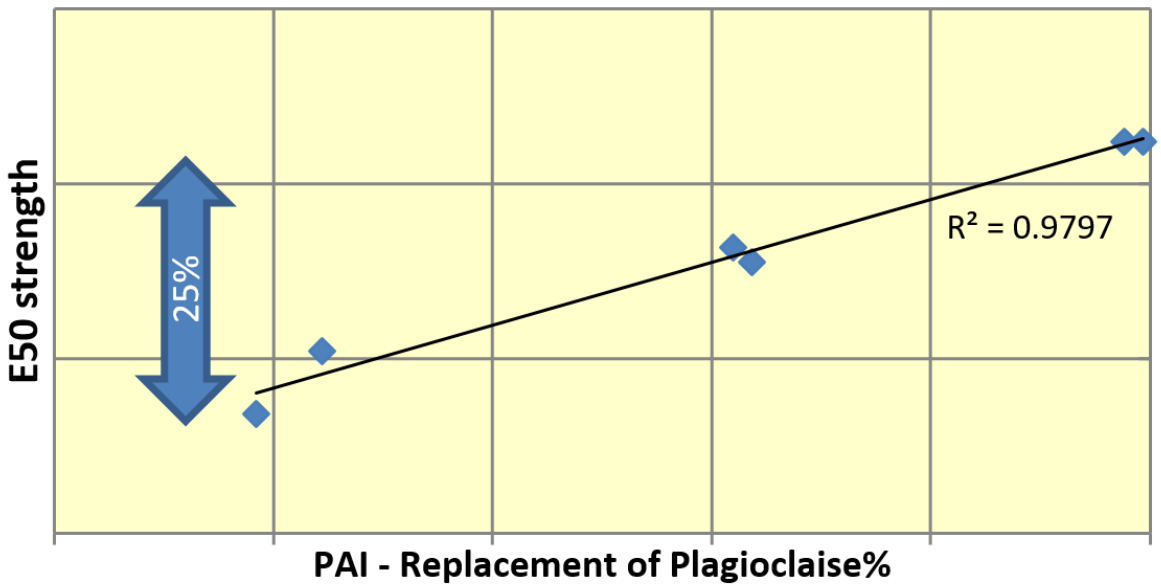
- in-situ rock
  - mapped back into the ore body
  - carried along the process chain
  - calculating processing properties at every stage



In situ rock	core knowledge	fracture strength	breakage response	relationship to geology	Mineral association	Mill model

Rock strength based on mineral structure and alteration

A primary rock property



The vision

- Shift our paradigm of processing costs and effectiveness
- Integrated processing prediction approach
- Multi-stages of progressive upgrade in a usable circuit
- Flexible processing utilises natural variability of ore

JKMRC has built many base tools

A comprehensive research thrust offering significant uplift to the mining industry