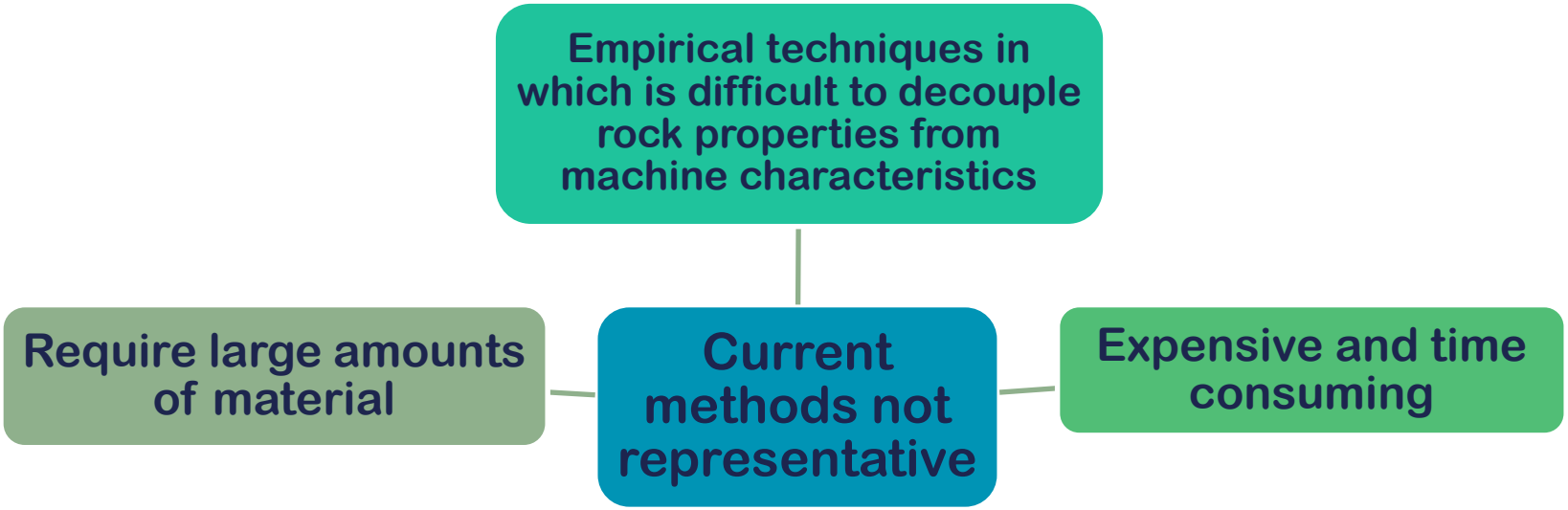
SMI JKMRC
Julius Kruttschnitt Mineral Research Centre

Linking quantitative mineralogy and texture to breakage properties of rocks at microscale

Pia Lois-Morales
BGeolSc (Hons), MSc. *Universidad de Chile*
PhD Scholar in Mineral Processing. *University of Queensland*

PROBLEM

- **Problem context:** Increasingly complex ore bodies causes variability on the plant performance which is difficult to predict.



Result: Lack of information for design in feasibility stages, for planning the plant feed and prediction of throughput, in production stages.

SOLUTION

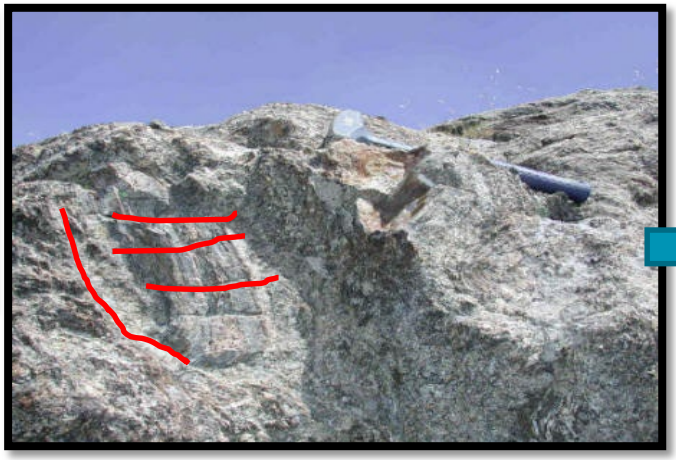
- **GeoMet: Integrated approach of geoscientific discipline with metallurgy/minerals engineering for better understanding of the ore deposit character, identifying optimum economic pathways towards optimization of complex ore bodies treatments** (Amira P843, Powell 2013, Dominy & O'Connor 2016).

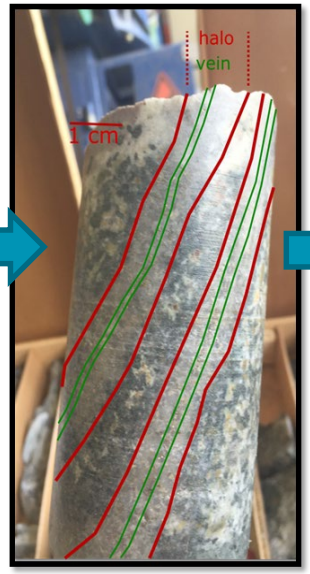
Current focus is on the plant..

Change the focus to the rock…

Solution: Improve understanding of rock Properties

- **Rocks are naturally complex:** Many studies to understand mesoscale textures against comminution indexes (Diaz, et al., 2016; A. Nguyen, et al., 2016; K. Nguyen, 2013; Perez-Barnuevo, et. al, 2016).





Variability?
Decoupling rock properties?

Wightman et al. (2008)

Lets understand how the most fundamental pieces behave which will help us to build the whole puzzle!

Real Rock Properties

- **Properties:** Elastic parameters, strength, force/energy to break the rock.
- **Characteristics:** Mean value and variability.
- Many authors have demonstrated that they are controlled by geological characteristics but nobody has clearly quantified this relationship yet.

Authors	Breakage Method	Rock Characteristic	Proportional Relationship
Bojcevski 2004; Genc et al. 2009; Yildirim et al. 2016	Bwi, A*b(i)	Mineralogy	Direct
Ozturk and Nasuf, 2006; Esamaaldeen et al, 2013; Bourgeois and Lippiat, 2015	SILC	Porosity	Inverse
Howarth & Rowland 1987; Prikryl 2014; Ozturk and Nasuf 2006-2014; Esamaaldeen et al. 2014	UCS	Texture	Direct
Oyarzun & Arevalo 2011	BWi	Texture – interfacial energy interpretation	Direct
Undul, 2015-2016	UCS – elasticity parameters	Texture	Inverse

Obj: Quantify the relationship in homogeneous rocks.

METHODOLOGY: END MEMBERS SELECTION

Basalt Bromilton

Basalt Saucito

Increasing porosity

Bronces T1

Bronces T2

Bronces T4

Increasing potassic alteration (hard minerals)
Increasing grain size

Bronces T1

Bronces T3

Bronces T8

Bronces T7

Increasing Al-phyllosilicates
Decreasing grain size

KUCC T2

KUCC T4

Increasing Mg/Fe phyllosilicates
Increase grain size

KUCC T5.1

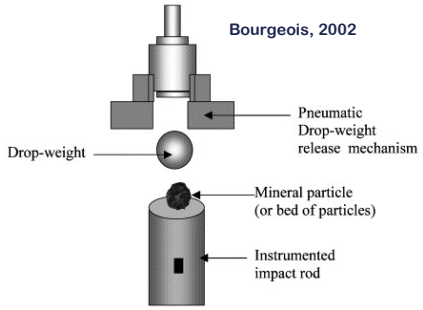
KUCC T5.2

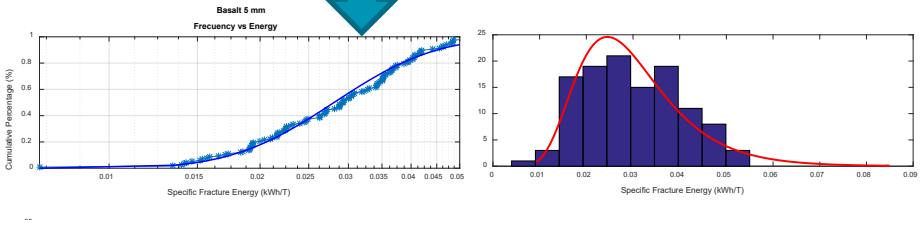
Increasing percentage of phenocrysts/ matrix

METHODOLOGY DEVELOPMENT

- **Breakage method**

  Sample preparation in 5 sizes from 2 mm up to 28 mm

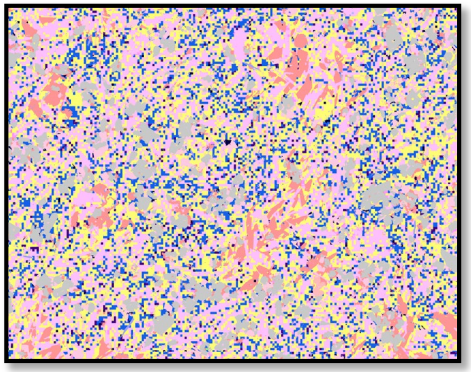




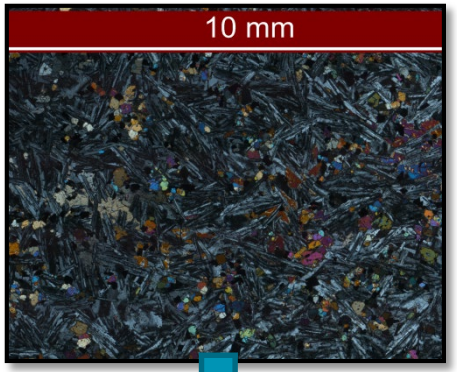
- **Quantitative mineralogy**

  Complementary techniques

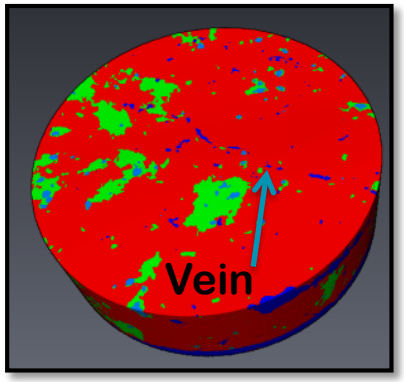
MLA



DOM



3D techniques



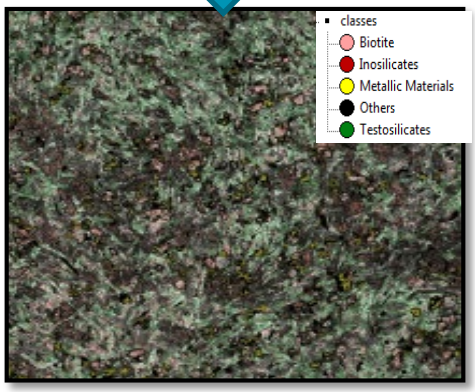
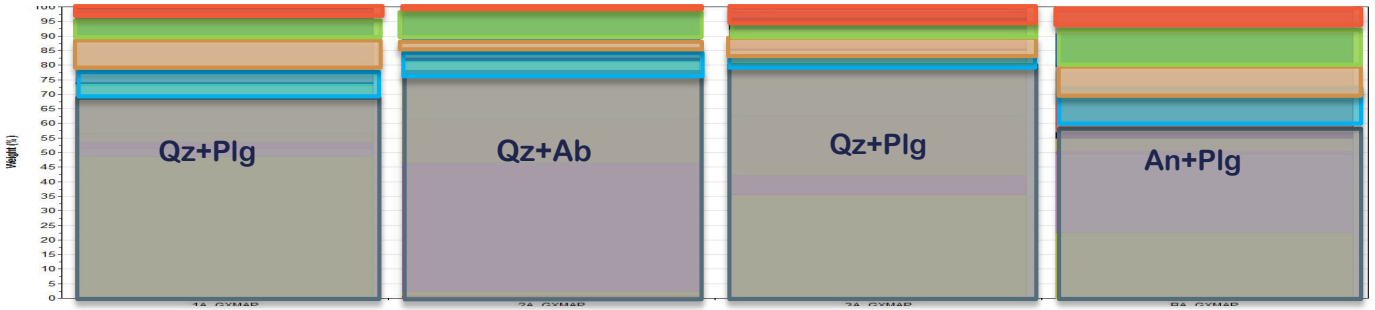
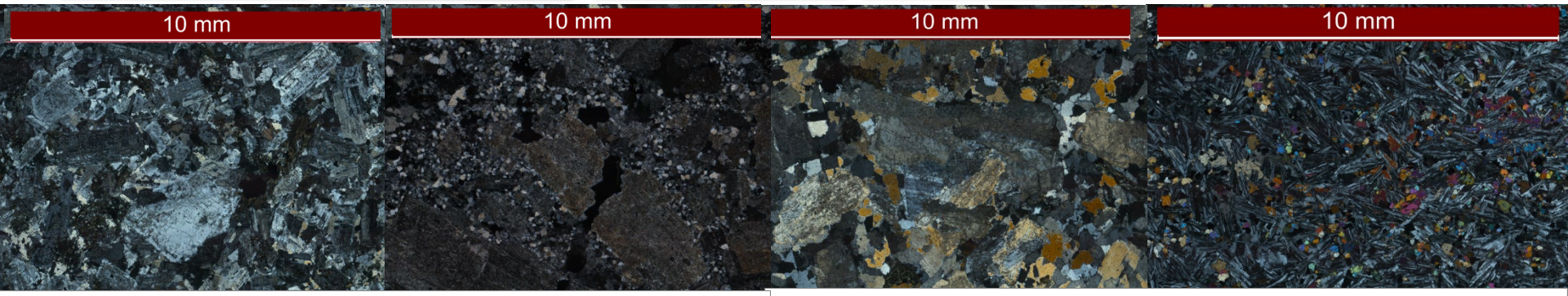
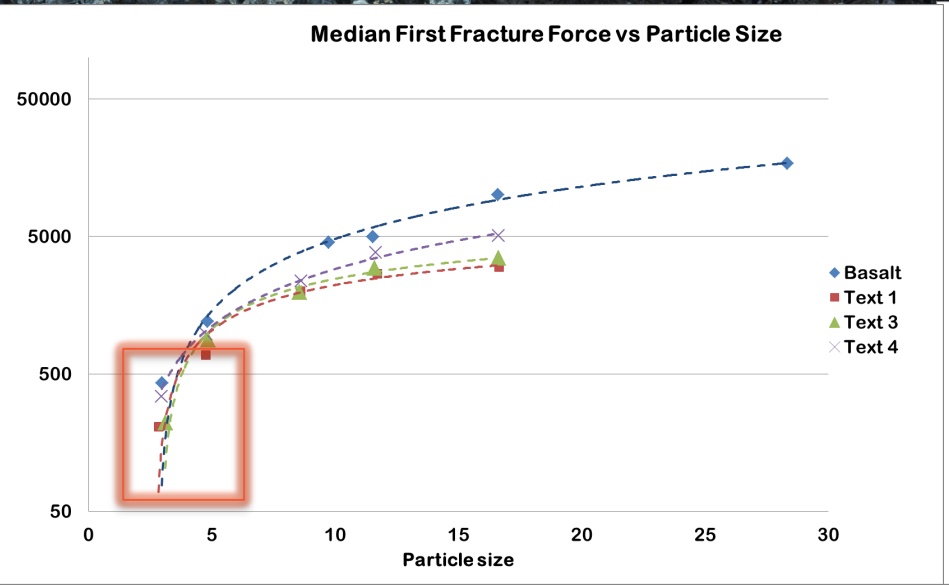


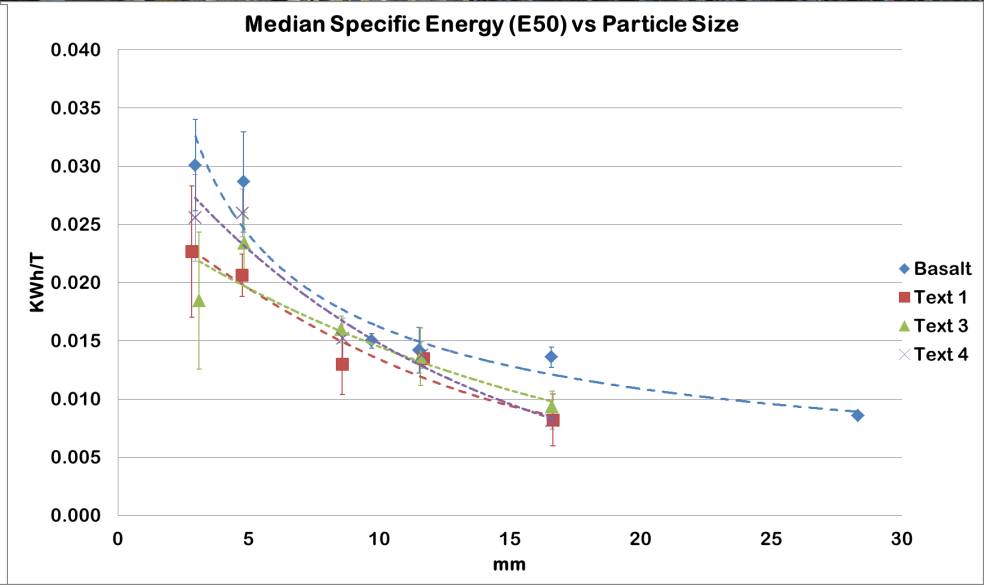
Image from vac students presentation 2018.

PRELIMINARY RESULTS









STATE OF DEVELOPMENT

100% Choose samples with different characteristics

70% Preparing samples

50% Breakage test at microscale

25% Quantitative textural and Mineralogical Characterisation

40% Building a data base

20% Data base analysis

5% Model to test more complex scenarios

DONE

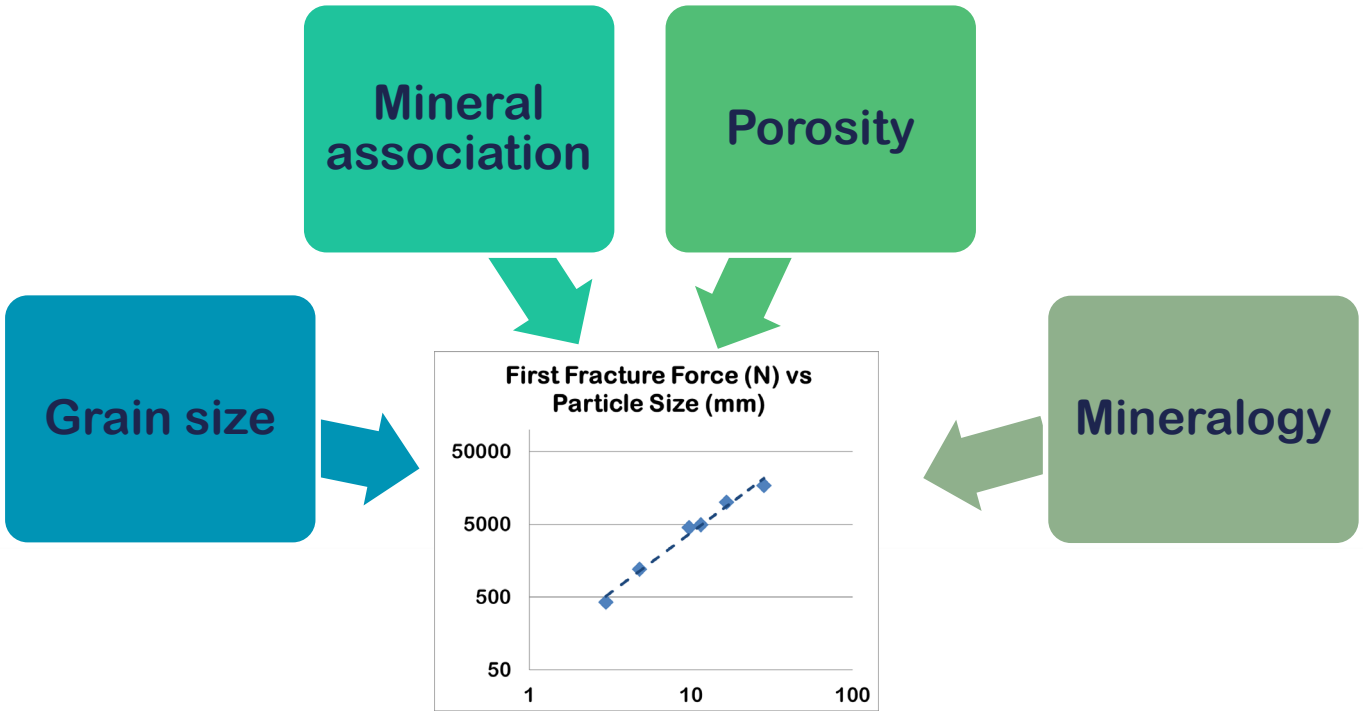
Finish by mid year

Finish by end of the year

Sept 2019

RESEARCH OUTCOMES

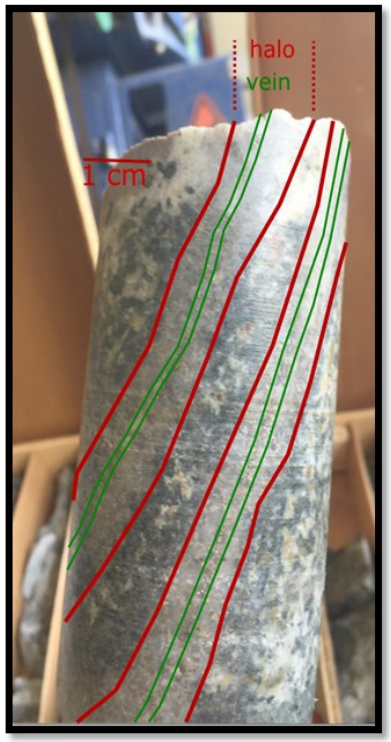
- A methodology to quantify the relationship between mechanical properties of a rock and quantitative textural/mineralogical characteristics at microscale.
  - Single breakage
  - Image Analysis
- A model of the variability and median values of the mechanical properties of rock as a function of its mineral texture for homogenous rocks in a particle size range.



Potential Applications

1) Modelling of different scenarios or incorporating effects of veins or brecciation.

2) Scale up into mesoscale. Potential link with research in core imaging/logging with comminution test work.



3) To finally: Determine values of E_{cs} direct from rock characterisation (geo), improving information available for processing (met) design/planning/control from early stages of mine development.

THANKS FOR LISTENING