

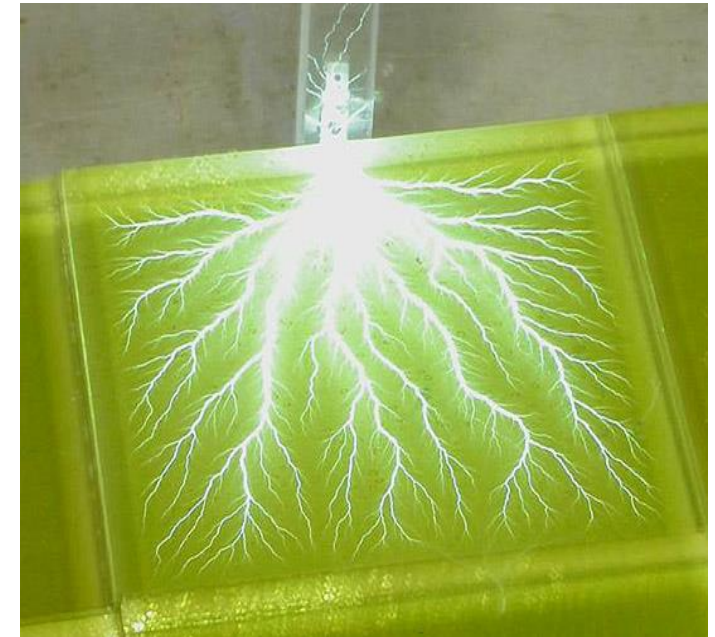
# Unlocking the potential of advanced high voltage pulse commutation

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# HVP research at the SMI-JKMRC

- HVP (High Voltage Pulse) as an alternative comminution technology
  - Short pulsed energy – lightning
  - HVP applied to the mineral industry since 1970s
  - Better mineral liberation, but excessive energy consumption
- SMI-JKMRC started HVP research in 2007
  - Initial funding provided by ARC (AMSRI, LIEF)
  - Research sponsored by various mining companies
  - 7 HDR students (4 graduated)
  - Two HVP facilities installed
  - >20 papers published

Lightning energy



*‘Thunder is good, thunder is impressive;  
but it is lightning that does the work.’*

*— Mark Twain (1835-1910)*

# Improving ore processability by HVP

- HVP selective breakage
  - Ore pre-concentration
  - Waste rejection
- HVP selective weakening
  - Cracks/micro-cracks generation in mineralised particles
  - Reduced comminution energy consumption
- HVP preferential liberation
  - Hybrid processing method
  - Improved valuable mineral liberation and recovery



**Potential to TREAT & UNLOCK Complex Orebodies!**

# Example: SAG mill pebble treatment

Product	Ecs (kWh/t)	Yield (wt%)	Grade (Cu%)	Distr. (Cu%)
Broken	2.5	73.1	0.276	91.5
Unbroken		26.9	0.07	8.5
Total		100.0	0.221	100.0

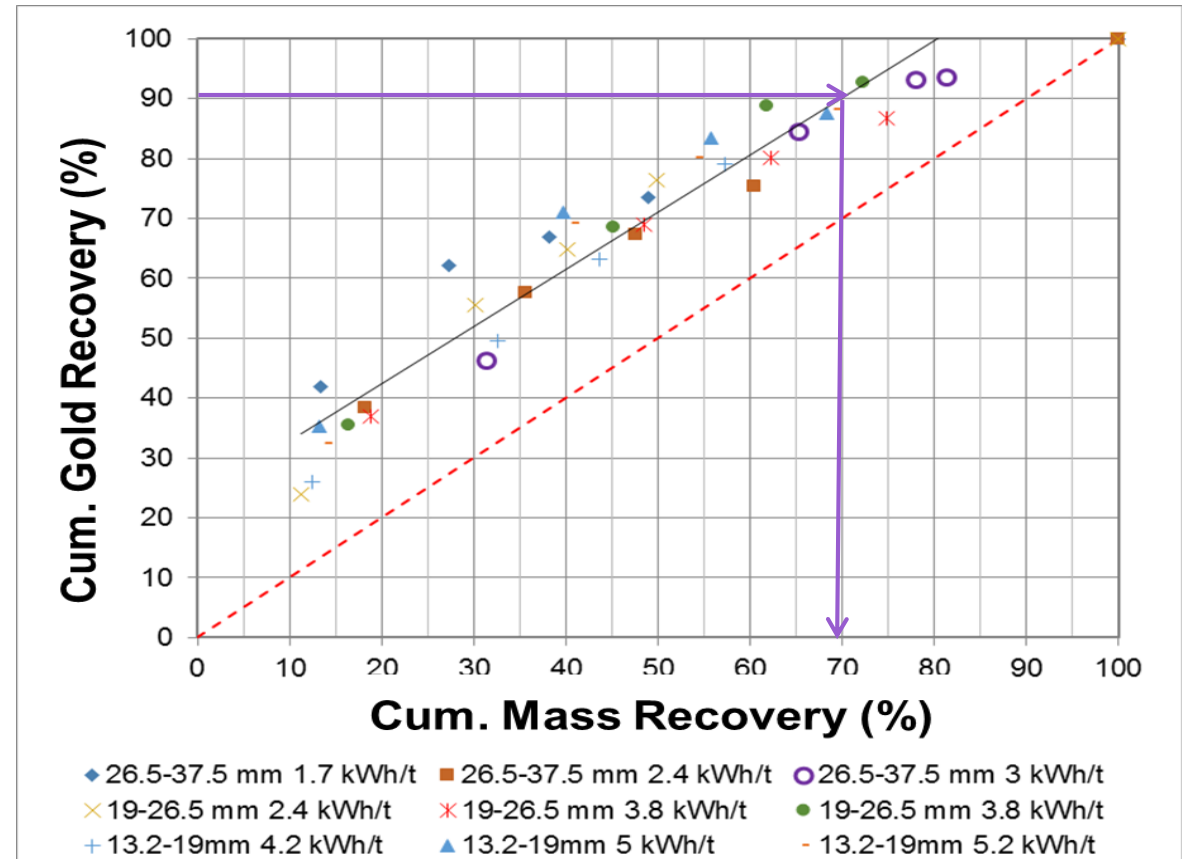
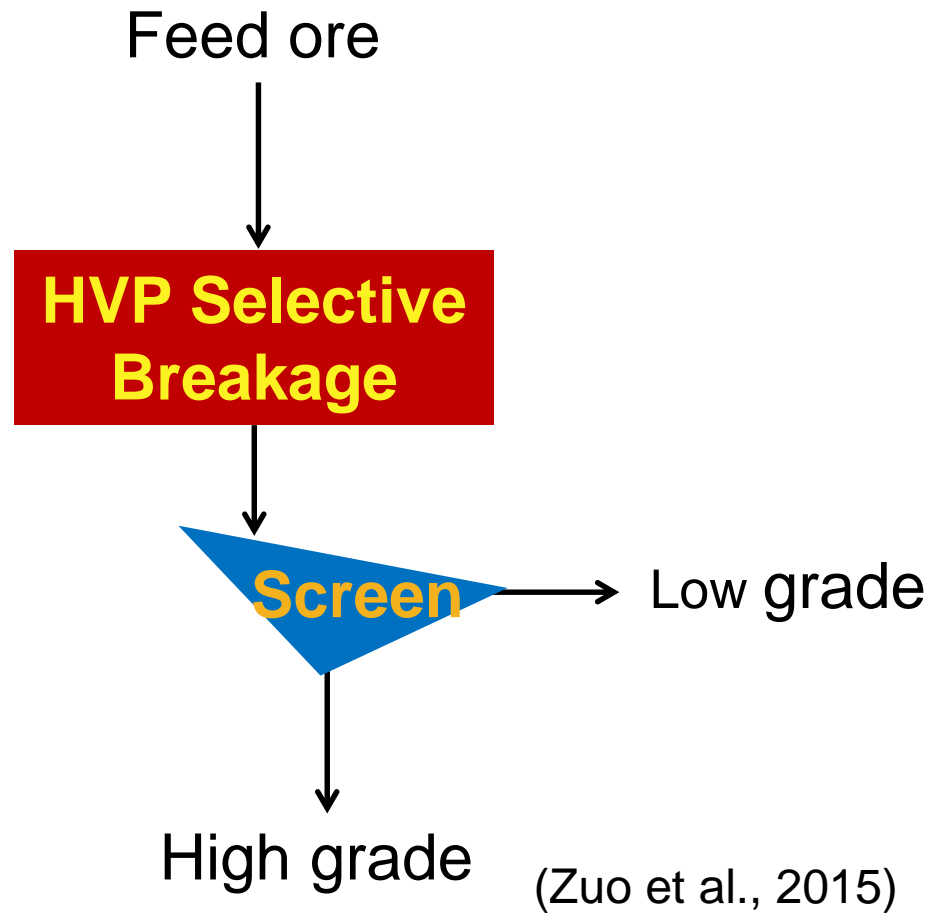
Before treatment, 0.22 Cu%

Broken, 0.28 Cu%

Unbroken, 0.07 Cu%



# HVP pre-concentration technology



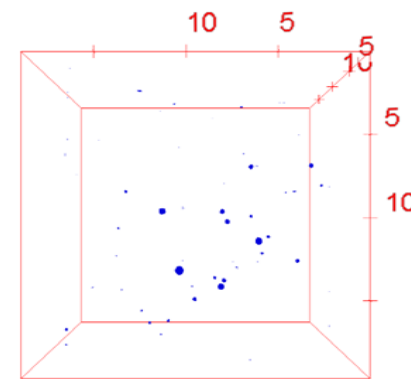
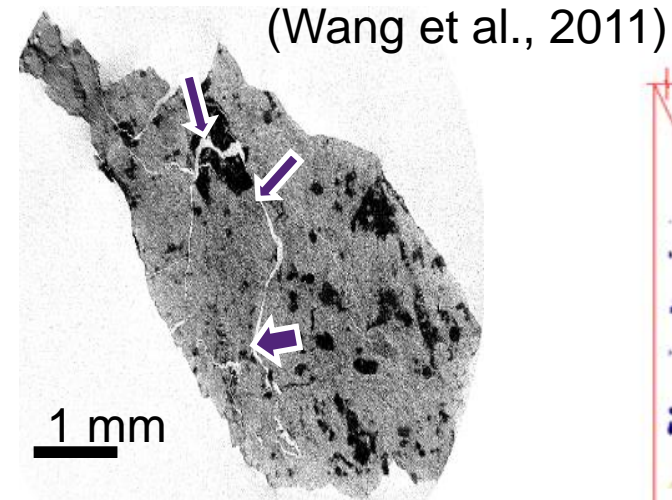
(Huang et al., 2018)

- Potential to discard 31% of the mass whilst losing only 10% of gold recovery.

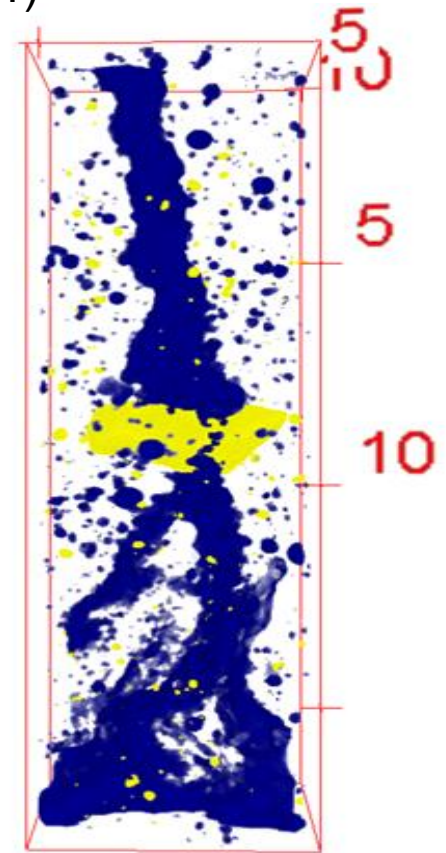


# HVP pre-weakening effect

- HVP damages the structure of mineralised particle
  - With 1-3 kWh/t
  - Detected by X-ray tomography & mercury porosimetry
  - Cracks/microcracks on the mineralised particle
- Pre-weakened fragments
  - Axb increases from 31 to 84 (easier to break)
  - Simulations indicate \$19M/a saving in a 2000 t/h operation.

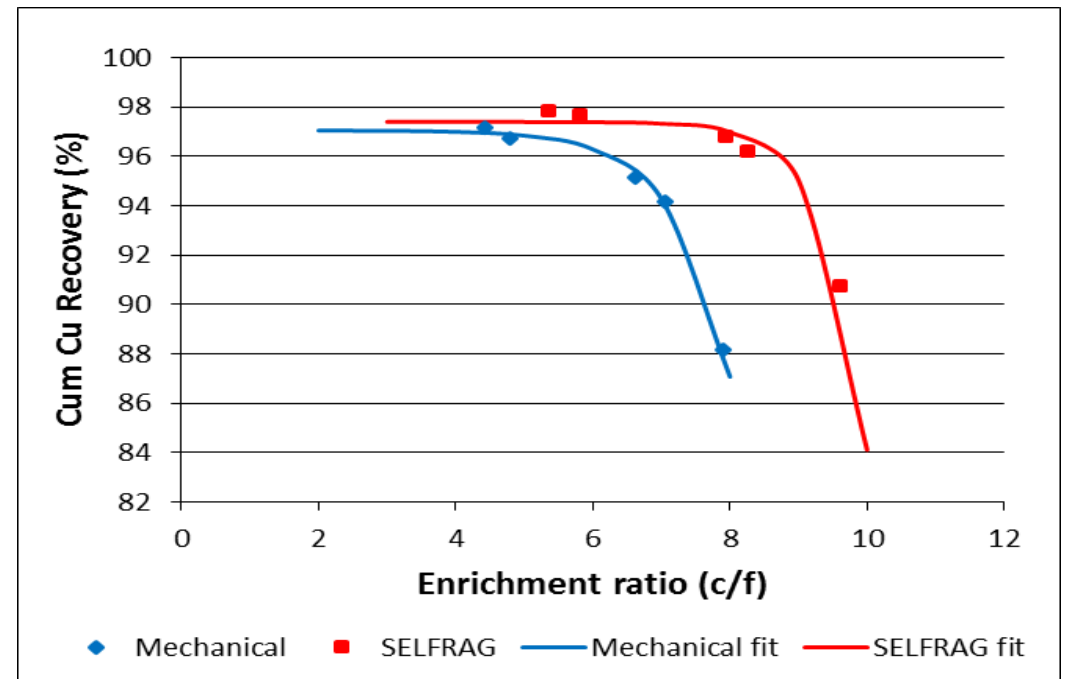
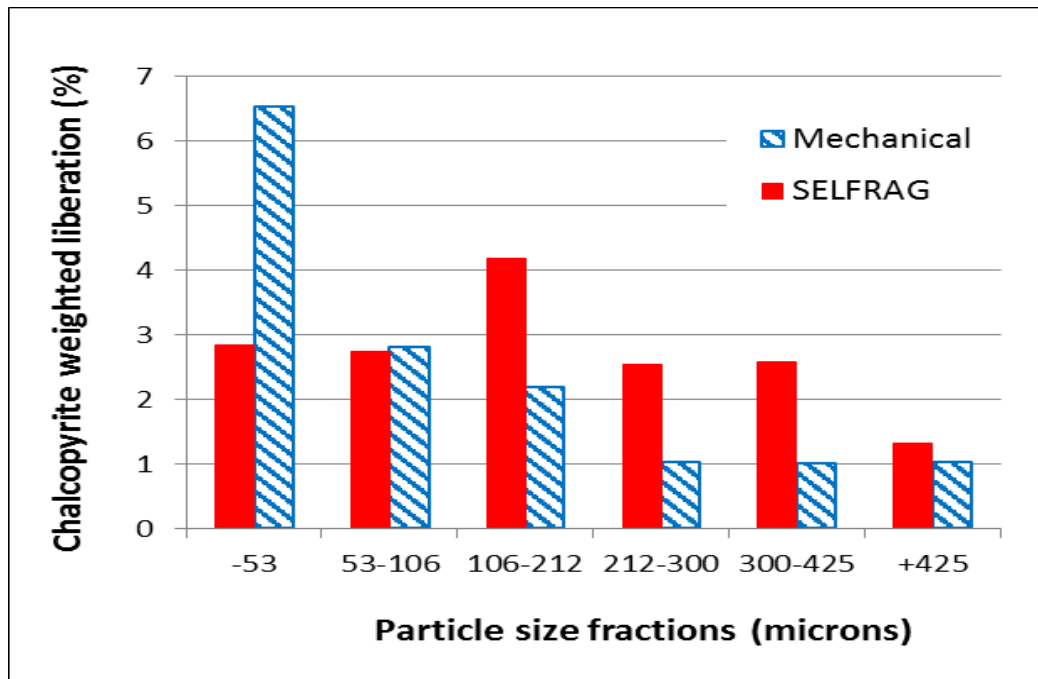


Barren particle



Mineralised particle  
(Huang et al., 2019)

# Coarse particle liberation and recovery



(Parker et al., 2015)

- HVP + mechanical grinding hybrid treatment
- Coarse liberation >106 mm
- Improved grade and recovery in flotation

# Potential applications

- Waste rejection

- Productivity
- Haulage costs
- Cracks/microcracks on the mineralised particle

**“A potential Game-Changer!”**

**- CEEC 2017 Medal Selection Committee**

- Selective processing routes based on grade

- Energy saving
- Improved grade and recovery

- Ore upgrade

- Viable orebody cut-off grade

- SAG mill pebble treatment

- SAG feed treatment



# Gaps for industrial uptake

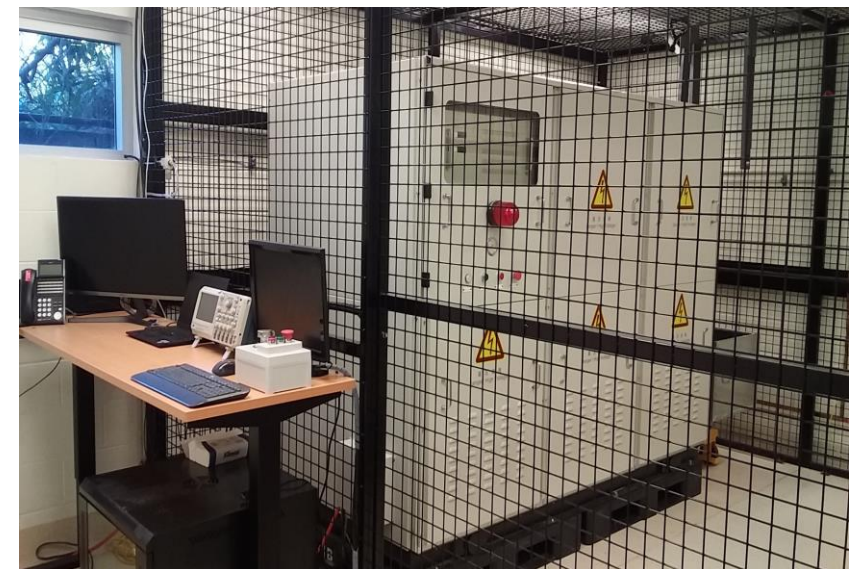
- HVP parameters
  - The effects of HVP parameters on various HVP applications
- HVP generator system
  - HVP generation, power, efficiency, service life, insulation
- Scale-up
  - From batch lab testing to a small scale continuous system
- Circuit options
  - New opportunities for mining and processing circuit design
- Ore amenability
  - Variation in ore response to HVP treatment; Ore amenability characterisation.

# Flexible HVP testing facility

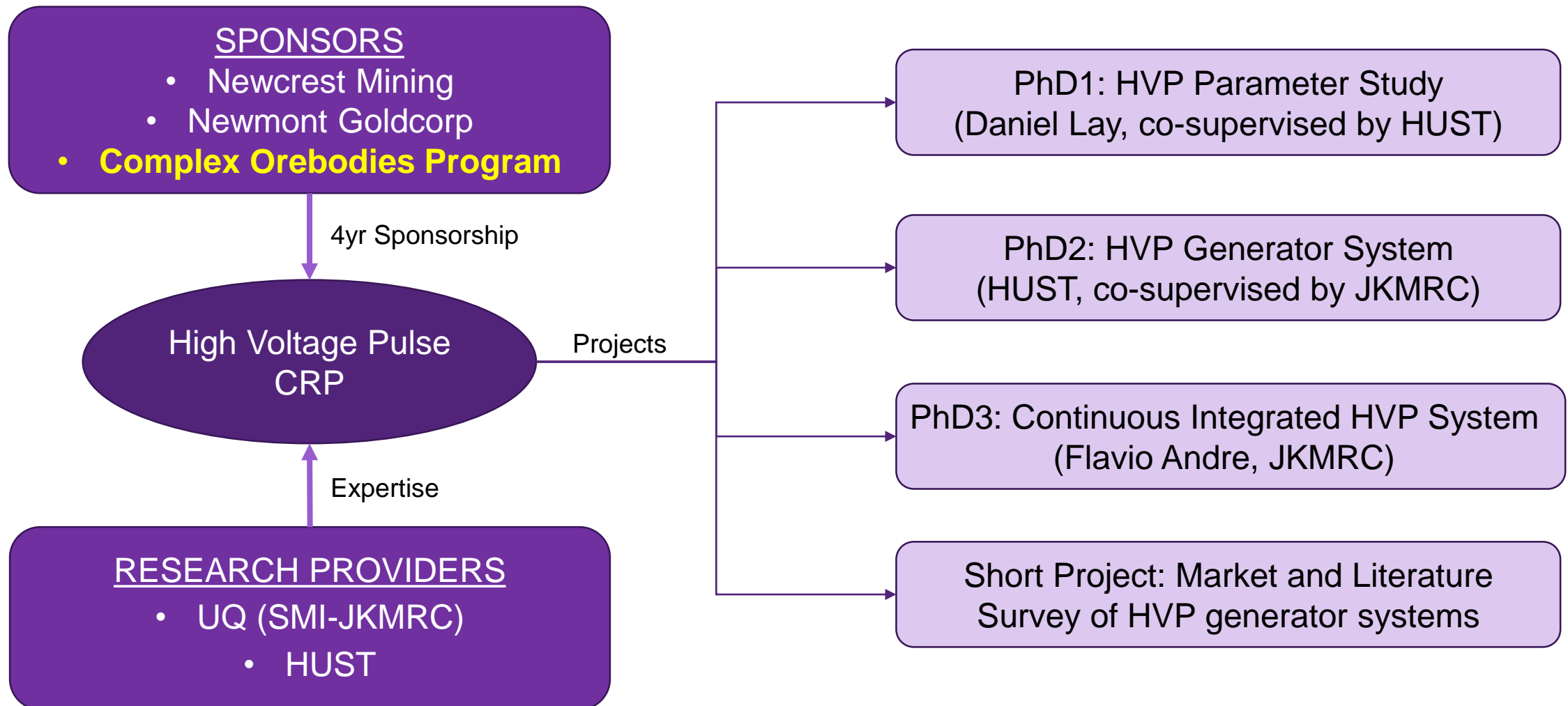
- Newcrest Mining / UQ (SMI-JKMRC) sponsored facility
- Bespoke HVP unit from HUST
- Highly configurable & upgradeable
- HV: pulse transformer generator



	Specification
<b>Throughput</b>	Ability for batch and continuous processing
<b>Energy Efficiency</b>	Ability to change different parameters that can influence energy efficiency i.e. pulse rising time
<b>Processing Medium</b>	Possibility to process in air or minimal water by changing process parameters



# HVP Collaborative Research Program



# Conclusion

- **Emerging opportunities**

- HVP selective breakage combined with size-based separation for ore pre-concentration and waste rejection
- HVP selective weakening for reduced comminution energy consumption
- Hybrid HVP liberation for improved metal recovery

- **Unlocking the HVP potential**

- Collaborative HVP research program
- Pathways for industrial uptake
- New technology to **TREAT & UNLOCK** complex orebodies for the mining industry