



## MLA 650F

### Automated, Quantitative Petrographic Analyzer

MLA 650F is a laboratory-based, automated petrography analyzer, initially developed for the Mining Industry by the University of Queensland, Australia (JKTech). It serves Mineralogy, Petrology and Metallurgy use cases in a range of Natural Resources industries, such as Mining, and Geoscience Institutes.

A key attribute of the MLA 650F system is synchronous acquisition of mineral and textural (microstructure) data pertaining to one coherent dataset. Advanced software automation enables unattended data acquisition. Basic system data such as modal mineralogy, grain sizes, mineral associations and mineral liberation, or calculated data such as elemental chemistry, rock matrix density or grade-recovery curves, are typically based on hundreds of thousands of underlying individual measurements and mineral classifications.

MLA 650F excels at integrating high resolution images from backscattered electrons, and elemental chemistry from X-rays, inspired on image analysis technology developed in the 80's and 90's. The results are high spatial resolution petrographic images that are intuitive and readily accessible to a wide range of professions outside the laboratory. The images form the basis of subsequent image or particle-by-particle textural, mineralogical, chemical or associated data analysis. The interaction between backscattered electron imaging and X-ray analysis can be optimized for a range of use cases using different predefined measurement modes.

Common applications in the Mining Industry are ore characterization for populating block models, plant optimization and yield excursion troubleshooting, and mineral processing monitoring. In Geosciences, MLA is used for a range of use cases, including but not limited to, soil analysis and carbon sequestration.

Field electron emission (FEG) provides a premium user experience, enhancing e.g. ease of use, beam current stability, image and X-ray acquisition throughput and backscattered electron image quality.

#### Key benefits

- Petrographic analyzer, i.e. combined Mineralogy and Texture
- High resolution, versatile SEM platform
- Petrographic data; modal mineralogy, grain size, mineral association, mineral liberation
- Calculated data; particle or rock matrix density, assay, grade – recovery, elemental distribution
- Statistically meaningful data
- 24/7 system productivity
- Retrospective data interrogation (off-line)
- Dedicated support resources (geologists, mineralogists)

## Essential specifications

### Key features

- Petrographic analyzer, i.e. combined Mineralogy and Texture
- FEG-SEM platform
- Seamless integration of backscattered electron and X-ray data acquisition
- Mineralogy classification by spectrum matching (fingerprinting) algorithms
- Ultra-fast – at up to 200 measurements per second
- Automated for unattended analysis
- Particle-by-particle (mineral-by-mineral) analysis
- Quantitative, consistent data acquisition and analysis
- Comprehensive support through annual subscriptions including software upgrade licenses
- Smallest practical particle size: 0.2 µm

### System

- Environmental, Field Emission Scanning Electron Microscope (FEG-ESEM™)
- Dual silicon-drift Energy Dispersive X-ray spectrometers (EDS)
- MLA software suite

### ESEM™

- Intrinsic SEM imaging resolution: 1.2 nm
- Up to 30 kV electron beam excitation energy
- Sample stage stroke: 150 mm (X) x 150 mm (Y)
- Model: FEI Quanta™ 650 FEG
- Electron emission: field (FEG source)
- Solid-state backscattered electron detector, two segments
- Keithley picoammeter
- 14 resin block (30 mm diameter) holder standard, thin section and rough rock holder optional
- Refer to Quanta 650 FEG product data sheet for additional product data

### FEG benefits (compared to thermal emission)

- 1 year guaranteed emitter life
- No filament changes required
- Fewer column adjustments required
- Improved system setup time
- Significantly faster image acquisition
- Improved small, submicron bright phase detection (e.g. Pt, Au, U)

### EDS

- Liquid-nitrogen free, silicon drift-type detectors
- 2 x 30 mm<sup>2</sup> active X-ray detection area
- Energy resolution: ≤ 133 eV
- Typical input countrate: 800 kcps

### MLA software suite

- MLA system manager – SEM & EDS interface and licensing
- MLA measure – data acquisition module, includes email notification when run completed and aborted
- MLA Mineral Reference Editor – creates and adjusts Mineral Standards
- MLA Image Processing – data analysis module
- MLA Data Transfer Tool – data and project management module
- MLA DataView – data interrogation and reporting module

### Measurement modes

- XBSE – single X-ray analysis per grain identified in the backscattered electron image
- SXBSE – refinement of XBSE with selective long count X-ray spectrum collection
- XMOD – point count technique for fast modal analysis
- GXMAP – mineral specific X-ray mapping
- SPL – Sparse phase search technique for minerals present in low concentration such as in tailings samples
- SPL\_Lt – Refinement of SPL for minerals of interest contained in bulk rock or core samples
- SPL\_DZ & DD – SPL Dual Zoom & Dual Dwell. Refinements of SPL for trace minerals
- Automated STD – Refinement of XBSE for automated standards collection
- BSE – Automated BSE image mosaic acquisition

### Mineral standards files

- Embedded mineral database with X-ray spectra and properties data for over 500 minerals
- Mineral properties: index, name, assigned color (in petrographic image), density, average atomic number, chemical formula, elemental composition, reference EDS spectrum
- User can add mineral standards
- Drag and drop functionality to move mineral standards from one standards file to another
- Spectrum mixing: spectra from different minerals can be mixed using various proportions to create pseudo spectra which can be added to the mineral standards file, to address boundary phases (where the EDX interaction volume spreads across mineral boundaries)
- Composition calculator: elemental composition can be calculated from chemical formulas and automatically update the mineral properties

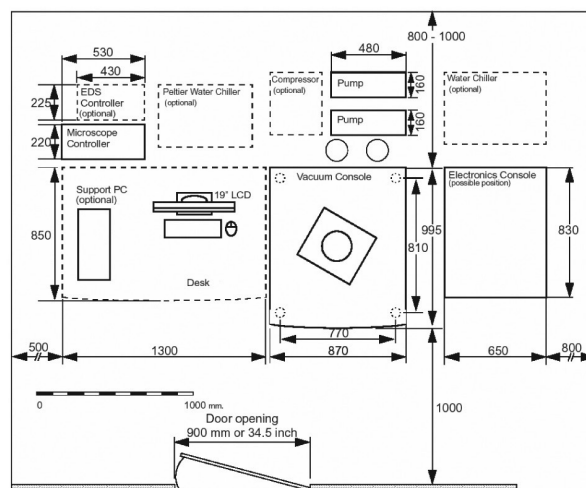
**Processing**

- Frame-by-frame view
  - Sorting of particles by properties
  - Filtering of particles by properties
  - Particle selection for subsequent processing
  - Details view – individual particles can be selected, copied and pasted into other documents
  - BSE overlay – correlation with individual particle BSE images
  - Numerical and graphical data overlay – e.g. scale bar, EDS spectrum, bookmark, stage coordinates
- Mineral Classification
  - Match probability values
  - X-ray window limits – additional control over mineral identification using spectrum window (energy range) limits
  - BSE limits – additional control over mineral identification using BSE value limits
  - Classification log – distribution of match scores for each mineral
- Image processing
  - De-agglomeration – separate touching particles
  - Touch-ups – typically used to remove small amounts of unknowns and other noise from the image
  - Clean-up – digitally removes particles according to size, touching frame or sample edges
  - Join particles – merges particles that span across frame edges
  - Selection of particle selective processing filters
  - Data extracted from processing is stored in an MS-Access database (referred to as datasource)

**Dataview**

- Datasources can analyzed separately, combined, or compared
- Calculations:
  - Particle properties
  - Grain properties
  - Modal mineralogy
  - Assay – calculated from mineral compositions
  - Elemental distribution across minerals
  - Mineral grade recovery
  - Element grade recovery
  - Particle size distribution
  - Mineral grain size distribution
  - Particle density distribution
  - Mineral association
  - Mineral locking
  - PSSA – phase specific surface area
  - Mineral liberation by particle composition
  - Mineral liberation by free surface
- Reporting
  - Templates – used to set up and run a series of calculations that can be exported to a number of formats including excel, word, text and database
  - Clipboard export
  - Datasource filters
  - Predefined and custom liberation classes
  - Mineral groupings
  - View, sort and filter images of particles within a particular datasource

**Floorplan**



**Installation requirements and floor plan**

- Refer to the Quanta FEG pre-installation guide available upon request

**Cost of ownership**

- Warranty: 1 year standard
- Choice of hardware service contracts after warranty
- Comprehensive software support subscription after warranty
  - Software update / upgrade licenses
  - 1 annual site visit
  - Software issue reporting and ticketing
  - UGM's – user group meetings, annual
  - FEI Australia-based training events
  - Telephone application support

Notes

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[fei-natural-resources.com](http://fei-natural-resources.com)

**World Headquarters**  
Phone: +1.503.726.7500

**FEI Europe**  
Phone: +31.40.23.56000

**FEI Japan**  
Phone: +81.3.3740.0970

**FEI Asia**  
Phone: +65.6272.0050

**FEI Australia**  
Phone: +61.7.3512.9100



TÜV Certification for design, manufacture, installation and support of focused ion- and electron-beam microscopes for the Electronics, Life Sciences, Research and Natural Resources markets.

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