



# Pathfinder Pinnacle configuration

## Benefits

- X-ray imaging filters
- Analysis automation source

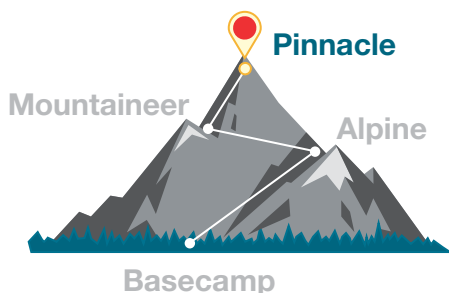
## Keywords

Automated analysis, edge finding filters, montage analysis, smoothing filters, sharpening filters, stage control, and 3D topographic image

At its Pinnacle, the Thermo Scientific™ Pathfinder™ X-ray microanalysis system provides all of the tools that enable remarkably clear results with X-ray image filters, phase-based mapping, and principal component analysis that make short work of complex samples and stage automation for maximum productivity in your SEM/EDS work.

## About the Pathfinder system

Built on the concepts of powerful, intuitive and fast, the Pathfinder system consists of the most modern software platform and analyzer electronics. Driving the Pathfinder system's performance are the latest developments in microanalysis algorithms and software development including automatic peak identification, background subtraction, and matrix corrections for quantitative analysis.

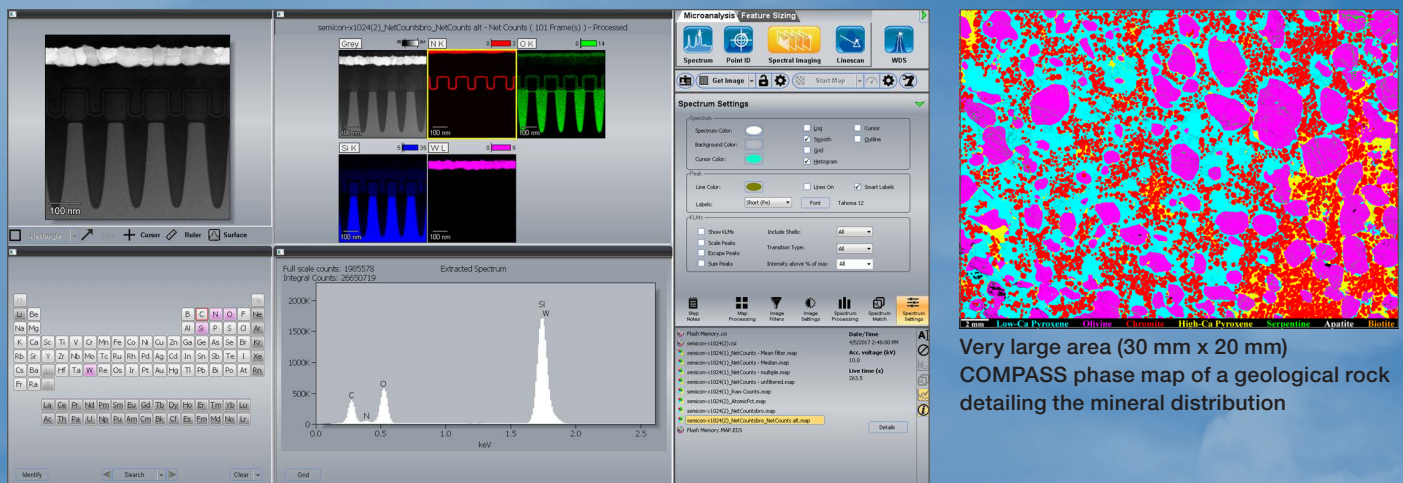


While the Pathfinder system contains all features and functionality of the levels below it, Pinnacle is best known for its mapping capabilities including: Extreme Element mapping with automatic artifact removal and Thermo Scientific™ COMPASS™ phase mapping using patented principal component analysis algorithms. A unique “headless computer” and advanced acquisition and data analysis technology bring lightning fast processing for live time display of these maps during the data acquisition.

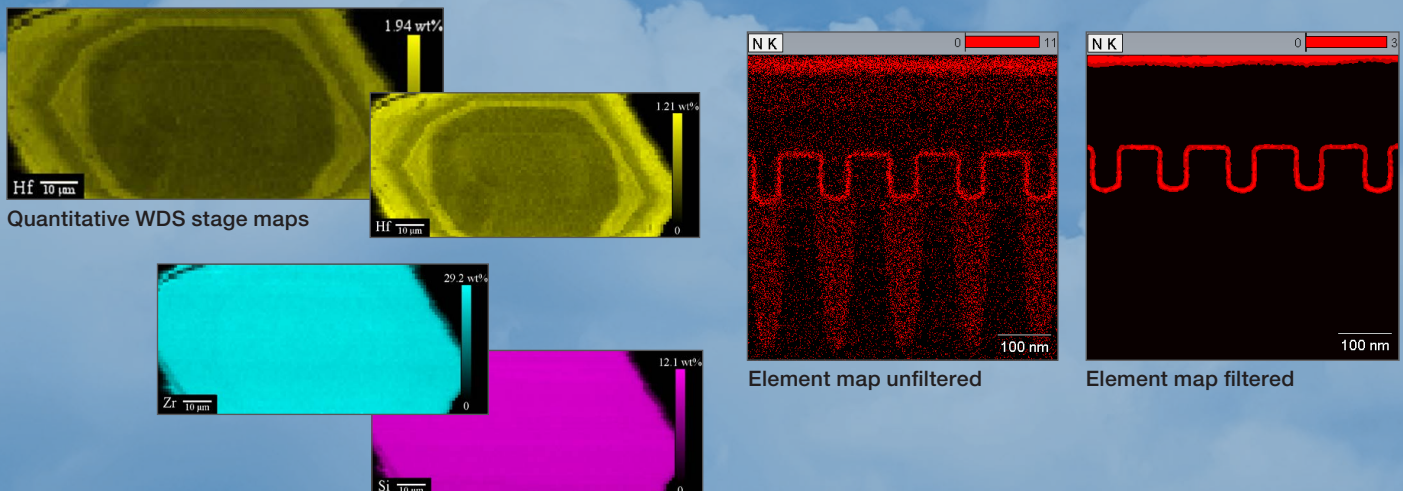
# Pathfinder Pinnacle

The Pathfinder Pinnacle configuration brings together all of the tools for effective SEM/EDS microanalysis, combining start-of-the-art spectral processing, phase-based mapping, post-processing image filters, and analysis automation.

- Analysis automation
  - Controls the stage of the microscope and collects full frame, point, rectangular, circular, beam rastered line scan or user defined areas for analysis
  - Controls the stage for stage movement line scans
  - Templated and nested automated analyses are performed in sequence
  - Montage analysis of areas collected using Analysis Automation with results presented as X-ray maps (counts, net counts, atomic %, weight % or k-ratio)
- Montage analysis of areas collected using Analysis Automation with results presented as COMPASS phase maps
- X-ray image filters
  - Includes 30 types in smoothing, sharpening and edge finding that can be applied to any X-ray element map or COMPASS component map
  - X-ray image filters that include: Symmetric Nearest Neighbor Filter, Kuwahara-Nagao Filter, Edge Preserving Smoothing Filter, Extended Maximum Homogeneity Neighbor Filter and Weiner Filter
  - Ability to combine multiple filters together as well as change order of execution
  - Ability to apply filters during the data acquisition
  - Display an X-ray map as a 3D topographic image



Screen shot of Pathfinder Pinnacle user interface



Quantitative WDS stage maps

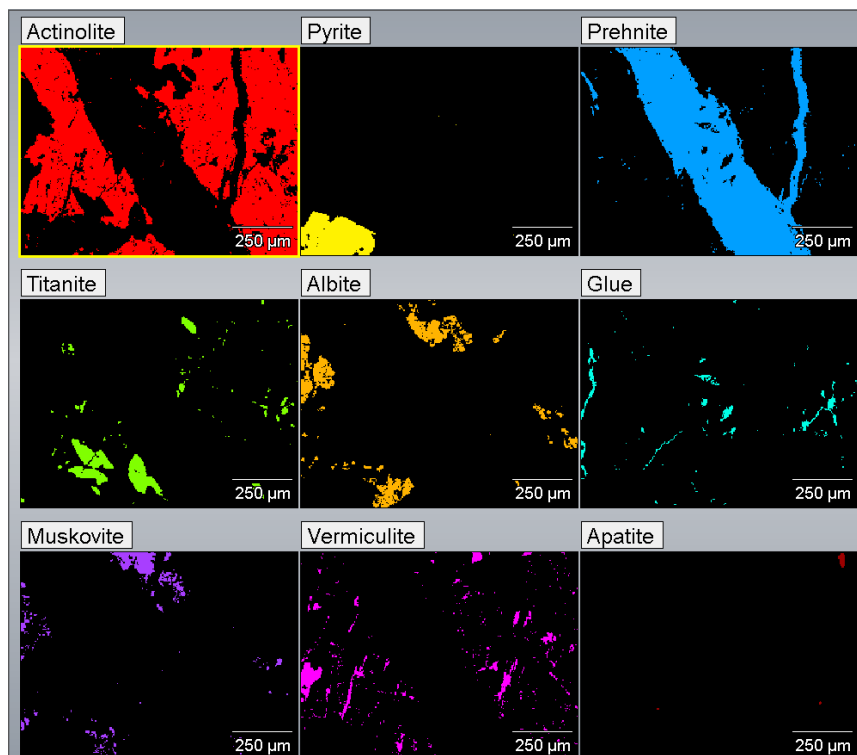
Element map unfiltered

Element map filtered

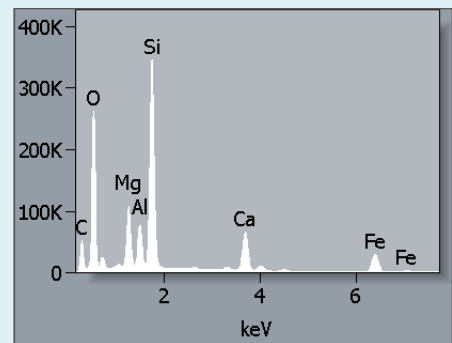
# Mountaineer configuration

*Everything in Pathfinder Basecamp and Alpine with the addition of:*

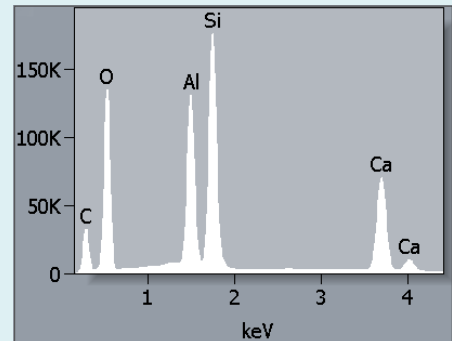
- COMPASS phase mapping
  - Utilizes Principle Component Analysis and the methods described in U.S. Patents 6584413 and 6675106 and in Microscopy and Microanalysis 12 (2006) pp 36–38, 538–544
  - No elemental identification or selection is required and no user input is required
  - Direct to Phase mapping where a COMPASS component result is converted to a binary, the binary is used as a template to extract a spectrum from a spectral image database, the extracted spectra is processed using spectral match and the identified compound is used as a label for the COMPASS component and extracted spectra
  - Perform COMPASS or direct to phase mapping lifetime during data acquisition using methods described in US Patent 7567871
  - Ability to pause the display and to inspect the individual phases and associated spectra collected while the data acquisition proceeds
  - Ability to match the phase spectra against a Spectral Match database to automatically identify the phases identified
  - Phase mapping based on one or a combination of concurrent gray image, EDS element maps or WDS element maps



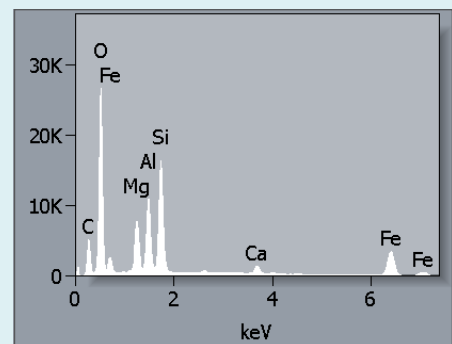
25 million pixel phase map using Stage Automation



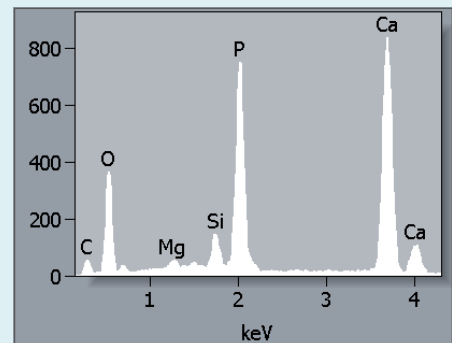
Actinolite



Prehnite



Vermiculite



Apatite



# Alpine configuration

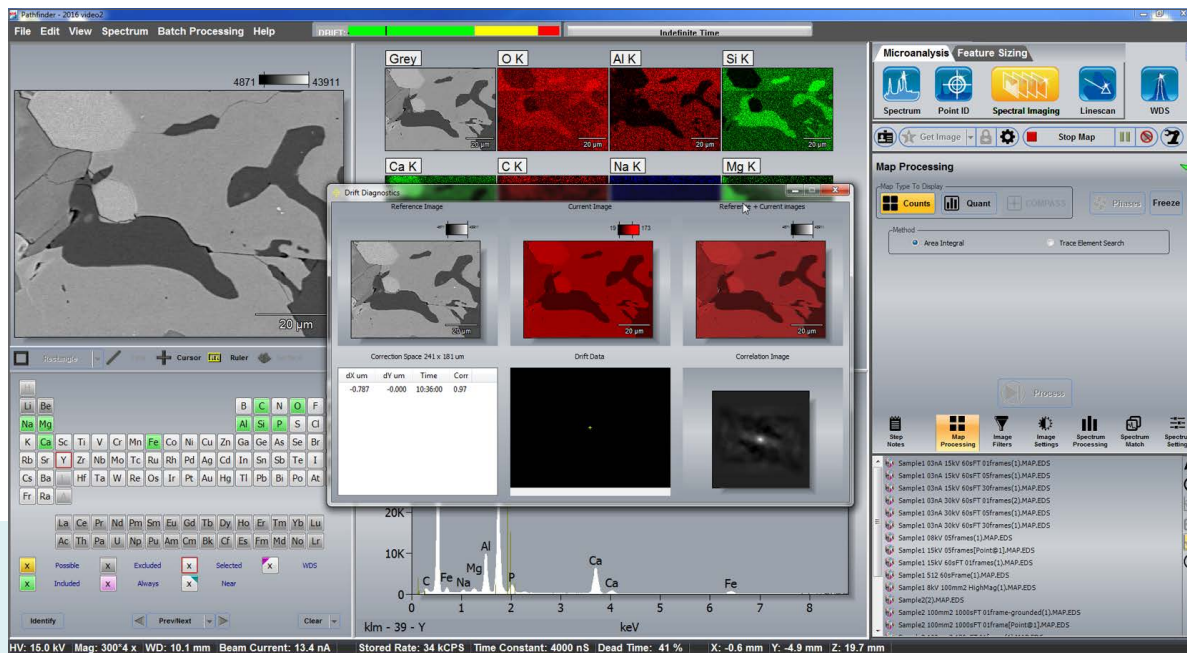
## Everything in Pathfinder Basecamp with the addition of:

- Extreme element X-ray mapping
  - Automatic background subtraction, peak deconvolution and quantification in every pixel
  - Programmable image kernel size, detail level and result method: Net Counts, Atomic %, Weight % or K-ratios
  - Quantitative mapping performed during the data acquisition
  - Licensed access to Intel® Math Kernel Libraries and hyper-threading to all processor cores for maximum speed
  - Live time analysis and display during acquisition
- Spectral Match using filtered least squares fitting and match references created by example spectrum, composition or a table of composition
- Automated drift compensation
  - Automated drift compensation performed with the real-time electron image acquired concurrently with the EDS spectral acquisition so that no pause in acquisition is required to collect the image use for compensation
  - Sample drift compensation performed on Point ID, Spectral Imaging and linescan acquisitions



Use artifact free and fully quantified X-ray element maps with Alpine background subtraction & peak deconvolution

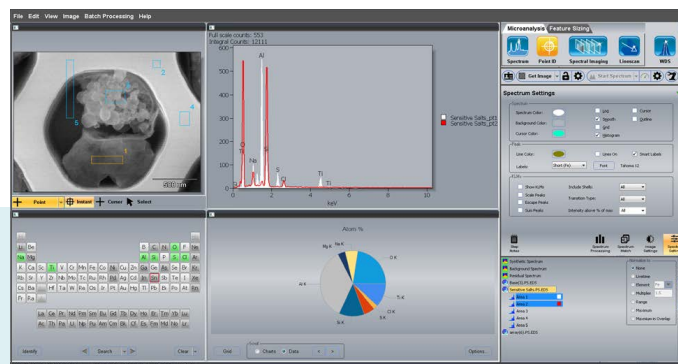
- Drift compensation diagnostic tool that includes delta table, reference image, current image, reference + current image, correlation image and path of drift image
- Drift compensation available on a separate tracking area
- Standards collection for use in standards-based quantitative analysis, standards-based line scan acquisition and standards-based quantitative mapping



Real-time drift compensation using a concurrent-gray FFT guarantees rock-solid X-ray mapping capabilities regardless of sample drift

# Basecamp configuration

- Four distinct modes of EDS X-ray data collection
  - Spectrum-only mode for dedicated spectral analysis
  - Point ID mode for elemental analysis at user-selected locations within the electron image
  - LineScan mode
  - Spectral Imaging with a full X-ray spectrum collected at every pixel for X-ray element mapping and data post-processing
- Menu control system includes both basic and advanced modes
- Step Notes mode provides mode-specific tips and tricks to the analyst
- Single click report to Microsoft® Word or Microsoft® Power Point® (if installed) or \*.pdf (if installed)
- Automated quantitative analysis of acquired spectra with the analyst in mind
  - Automatic X-ray peak identification and standardless elemental quantification
  - Automatic background removal using unique digital top-hat-filter algorithm that eliminates the need for background modeling or for user-selectable parameters to define the background
  - Automatic Peak deconvolution to separate overlapping peaks and intensity calculation by linear least squares fitting with derivative references
  - Factory supplied reference peak shapes and intensities with the option for user-collected reference shapes
  - PROZA Phi-Rho-Z and ZAF matrix corrections for bulk samples
  - Selective element elimination from quantitative analysis for no-quant of thin layers or contaminants
- Full flexibility of data acquisition
  - EDS Spectral acquisition with termination based on time or statistics
  - User-definable templates that store acquisition and analysis settings for automatic application to future projects
  - Acquisition area in Point ID or in Spectral imaging modes may be selected as a point, rectangular area, circle, polygon or an area matched to the grey level of the electron image
  - Instant or planned acquisition for Point ID analysis
  - Line scan data acquisition with linescan re-processing of elements
- Data analysis display with communication in mind
  - Spectral overlay of multiple spectrum with easy comparison of data in Quant table or bar charts
  - Region tool to define spectral ranges for analysis
  - Spectral quantitative results in a pie chart or bar chart display
  - X-ray element map overlay on electron image
  - Concurrent electron image collected with mapping and spectral imaging data
  - Electron image and X-ray element map intensity adjustment with brightness, contrast and gamma
  - Line scan overlay on electron image with line smoothing or spline
  - Batch quantitative analysis of multiple spectrum with export to \*.csv and \*.xls
  - Spectral Image extraction area from stored data selected as a point, rectangular area, circle, polygon, an area matched to the grey level of the electron image or linescan



Point and Shoot Mode

## General specifications

- Distributed processing with a dedicated single board computer running a real time operating system to control pulse processors and digital imaging
- Proprietary data streaming from the single board computer to the uniquely licensed Intel Math Kernel Libraries with automated hyper-threading to all cores in order to maximize the host PCs processing power
- Able to handle up to 1,000,000 input X-ray counts per second
- Able to collect Spectral Imaging data at dwell times as low as 10 microseconds per pixel
- Able to run up to 2 EDS detectors simultaneously
- 2 video inputs, 1 Multi-channel counter input, 1 trigger out available
- Digital pulse processor with moving window deconvolution technology to provide superior throughput and baseline correction
- Digital pulse processor shaping times continuously variable from 200 nS to 6.4  $\mu$ S
- Automatic selection of digital pulse processor settings based on microscope and detector performance including energy range, time constant and zero peak cut off
- Diagnostic oscilloscope and FFT display of X-ray pulses
- Digital imaging with scan dwell times as fast as 1  $\mu$ S per pixel
- Digital imaging acquisitions with programmable retrace and over scan times to prevent image distortion
- Compatible with Microsoft Windows 7, 8.1 and 10 operating systems
- Full and unlimited off-line site license for Pathfinder application software with FOREVER Pathfinder software upgrades
- Automatic communication with the electron microscope for Get/Set of key parameters such as accelerating voltage, working distance and magnification
- Project-based data storage for organization of analytical files
- Spectrum data stored in standard \*.emsa file format
- Images stored in \*.tiff or \*.bmp, exportable to Full resolution \*.tiff or \*.csv formats
- Mouse-controlled spectrum manipulation: expand/contract; log/linear; Auto or Manual vertical scale
- Automatic energy scaling based on microscope accelerating voltage
- KLM Markers for selected elements
- User selectable: Colors and peak label format
- Spectral math and peak reference subtract
- Batch quantitative analysis of multiple spectrum with export to \*.csv and \*.xls

Find out more at [www.thermofisher.com/pathfinder](http://www.thermofisher.com/pathfinder)

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