



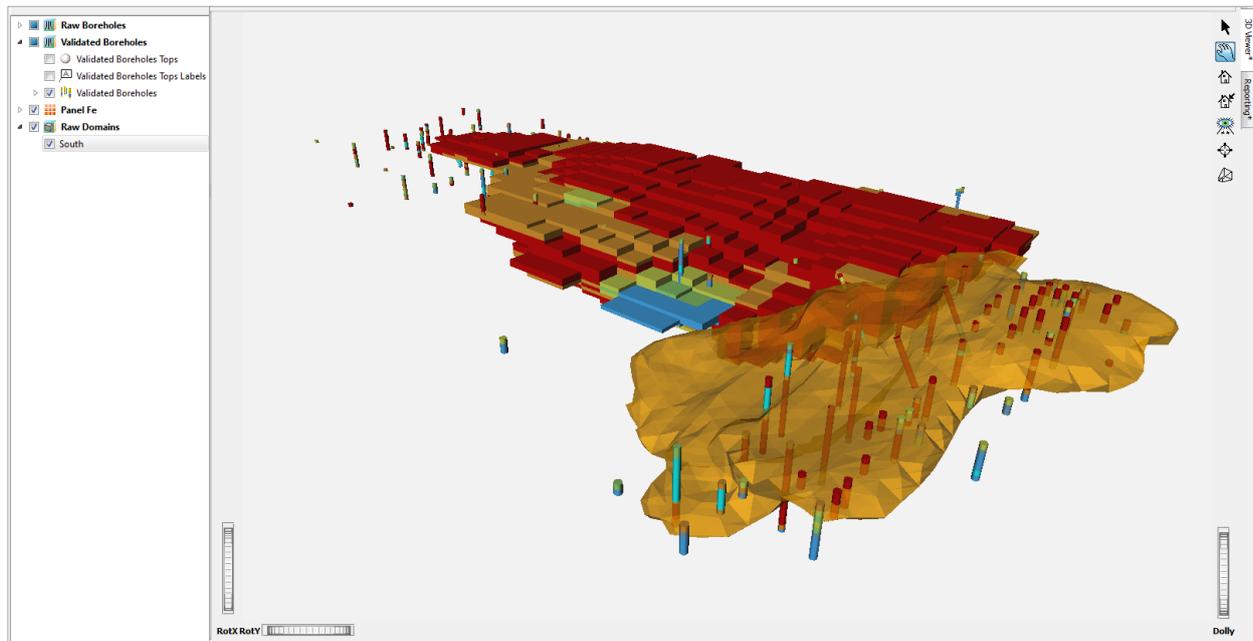
## THE ROUTE TO RESOURCE ESTIMATES

### Minestis 2016 Functionalities

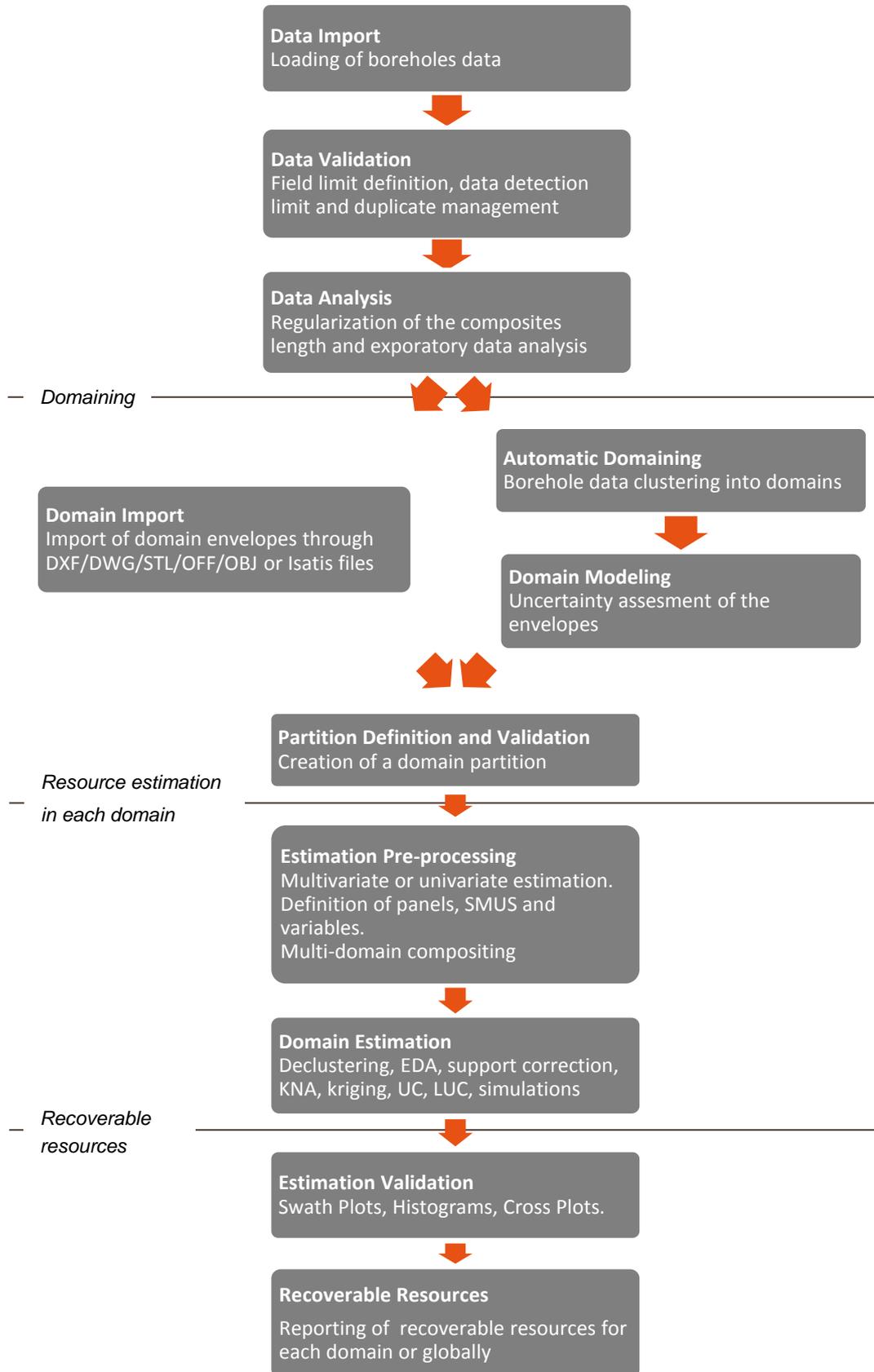
**Minestis** is an integrated mineral resource estimation workflow providing a simplified and secure approach to domain and resource modeling.

**Minestis** is designed for mining or resource geologists, planning or grade control engineers involved in geological modeling and/or resource estimation.

**Minestis** offers superior geostatistics to non-experts and ensures a coherent management of the estimation domains for reliable resource estimates.



# MINESTIS WORKFLOW



# 1. DATA HANDLING

## 1.1. Data integration

- Fully integrate and handle **3D borehole data**.
- Easily load **CSV/Excel** files or import data directly from **Isatis**. Variables are loaded with their units.

## 1.2. Database

- **Differentiate data** according to their types for a proper use: coordinates, Hole ID, analysed length, auxiliary numerical variables, auxiliary categorical variables, auxiliary text variables, azimuth, dip, depth from, depth to, density, grades.
- **Export data** to Isatis files (grid data & wireframes) or to CSV files.
- **Export domain or surfaces** to Isatis Wireframes or DXF/DWG/STL/OFF/OBJ files.

## 1.3. Boreholes validation and compositing

- Process sequentially your data from loading to validation thanks to a double-level database:
  - **Raw Data**. These are the raw 3D boreholes data directly imported from CSV files or from Isatis before a validation step.
  - **Validated Data**. These are data cleared from possible duplicates. All duplicates can either be removed or one of the duplicates can be kept. Data below detection limit are also automatically processed (assigning to them either 0, the detection limit or half this limit). The existence of boreholes samples overlaps or duplicates is automatically detected.
- Perform global sample compositing according to a length set by you.

# 2. DOMAINING AND PARTITIONING

## 2.1. Domain import

- Easily import domains and/or surfaces from **csv, DXF/DWG/STL/OFF/OBJ files** or from **Isatis**.

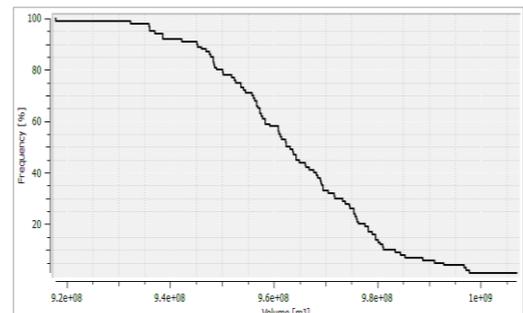
## 2.2. Domain definition

- **Automatically define estimation domains** based on sample clustering according to their grade (or any continuous variables) and/or

lithology (or any categorical variables) values.

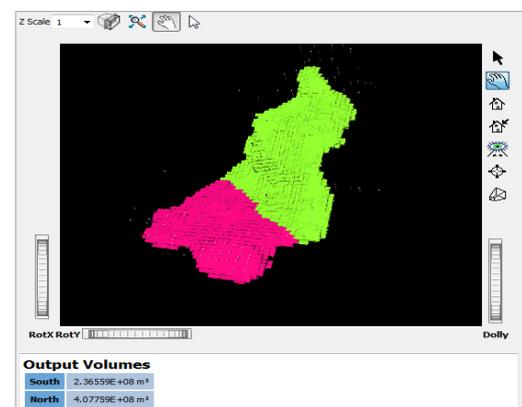
## 2.3. Domain modeling

- Quickly **model the envelope of each domain** derived from previous sample clustering.
- External constraints can be set to refine the envelopes: contact points between domains, points inside/outside domain, surfaces, gradients, and external drifts.
- Achieve uncertainty analysis on domain envelopes and get domain volume curves.



## 2.4. Domain validation and partitioning

- Detect if the wireframe mesh is open or closed.
- Make sure that domains do not overlap each other. Manage areas outside domains.
- Build **coherent partitions** of your estimation area. A partition may intercept several domains. Each sample will be assigned to a given partition.
- Quickly get the volumes of each of the domains.



# 3. LOCAL/GLOBAL RESOURCE ESTIMATION

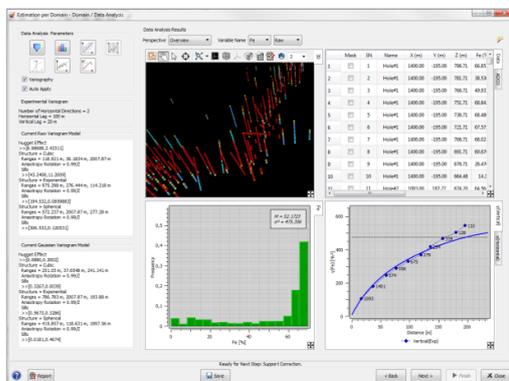
- Benefit from robust and trusted geostatistics based on Geovariances unique experience in geostatistical software development.



- All the needed tools to perform data analysis and resource estimation are merged into a single geostatistical workflow.
- Easily perform **multivariate or univariate** estimation and choose as many secondary variables as you wish.

### 3.1. Data analysis

- Analyse **borehole sample lengths** and achieve **length regularization** inside each domain for coherent domain estimation.
- Achieve relevant **data declustering** based on tangible statistical outputs.
- Instantaneously perform **structural analysis** on both the **raw grades** and the **Gaussian transformed grades**. Results are displayed in several views:
  - **3D Viewer**. Visualize and locate the boreholes inside the study area.
  - **Histogram** with basic statistics: minimum, maximum, mean and standard deviation values. Assess the data global distribution and check the data transformation quality if performed (see below).
  - **Experimental variogram, variogram cloud and variogram model**. Characterize the spatial variability of the contamination and highlight outlier samples.
  - Swath Plots / Cross-plot with an auxiliary variable. Identify the different data populations.
- **Refine all calculated statistics/functions** by tuning the involved parameters interactively.

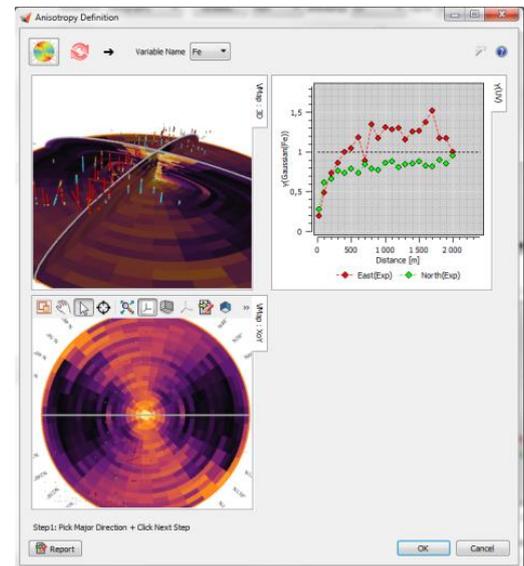


- Benefit from the **dynamic link** between these different graphics and thoroughly explore your data. When you highlight points in the 3D viewer or histogram bars, they are immediately highlighted in the other graphics so that you can check where they are. You may also apply a

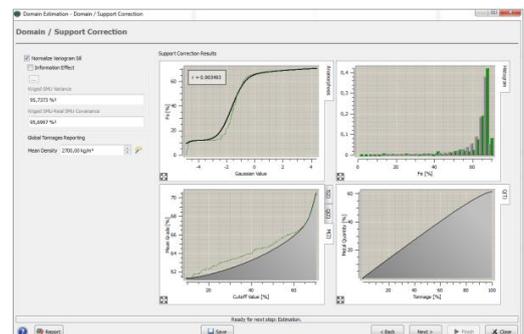
filter or mask samples on the fly and instantaneously check the impact on the variogram and further maps.

### 3.2. Variography

- Experience Minestis **automatic variogram fitting** and instantaneously get a model well-suited to your raw grades and/or Gaussian transformed grades.
  - Interactively **fit your variogram models** and adjust the involved parameters (structure type - spherical, exponential, cubic - range and sill for each structure). You may add several structures if the grade shows different behaviors at different scales. Choose to consider or not a nugget effect.
- Or fit the variogram visually using the mouse and the anchors displayed on the variograms.
- **Interactively identify and handle anisotropies** from horizontal and vertical variograms through **variogram maps**. The defined anisotropy is automatically sent to the experimental variogram parameters.

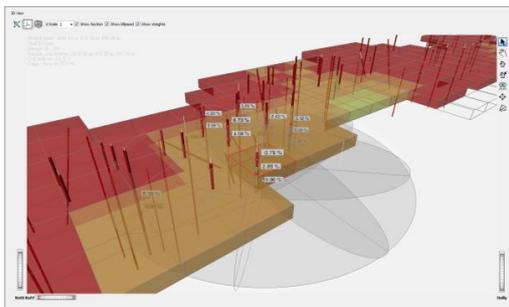


- Apply a **support correction** to your data and take the **Information Effect** into account.

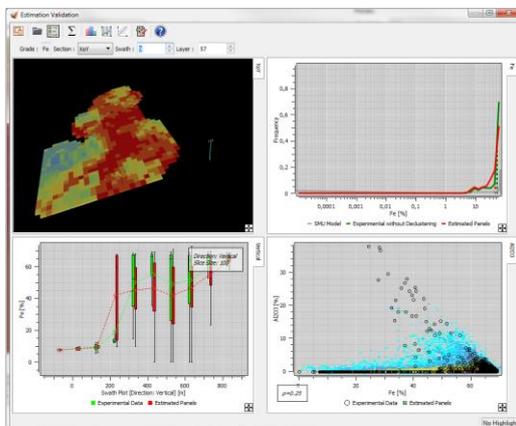


### 3.3. Resource Estimation

- **Ordinary kriging** algorithm is implemented for block estimation.
- A **moving neighborhood** is used. You may tune the number of neighbors as well as the size of the neighborhood to get more robust results.
- If needed, **nested neighbourhood** can also be used to improve the neighbourhood search.
- **Kriging Neighborhood Analysis** helps you derive relevant neighborhood parameters for your data.
- **Verify the relevance of the defined kriging parameters** by displaying, for any target cell, the kriging weights in a 3D view.



- Define panel and SMU sizes and run kriging for local estimation, Uniform Conditioning, Localized Uniform Conditioning and/or Turning Bands simulations for global resource estimation on both supports in one hit.
- **Quicky validate your estimation** by comparing estimates versus drillhole information through swath plots, statistics, histograms and 3D visualizations.

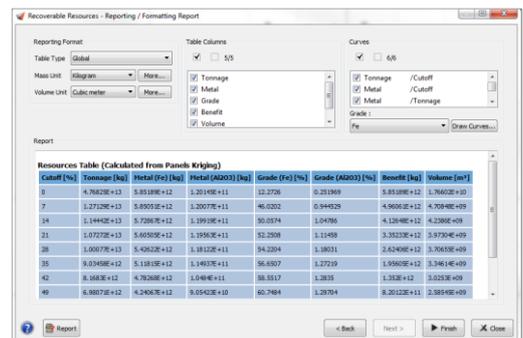


### 4. RECOVERABLE RESOURCES

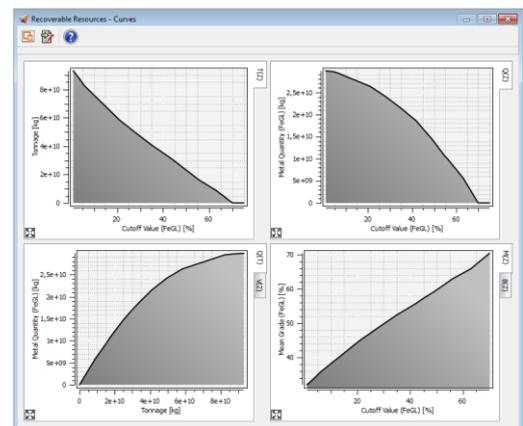
- **Get recoverable resources (both at global and local scales)** for the current partition and/or

for each domain in the partition from kriging, Uniform Conditioning, Localized Uniform Conditioning, and/or simulation outputs. Results are given for each defined cutoff and for either panel or SMU support.

- **Get quantile maps.**
- Benefit from **flexible reporting format**. Display the outputs of your choice in a single table: **recoverable tonnage, metal, grade** and/or **benefit** figures, computed for a unique metal or for several or all metals, on panels or on SMUs, by domain or over the whole study area.

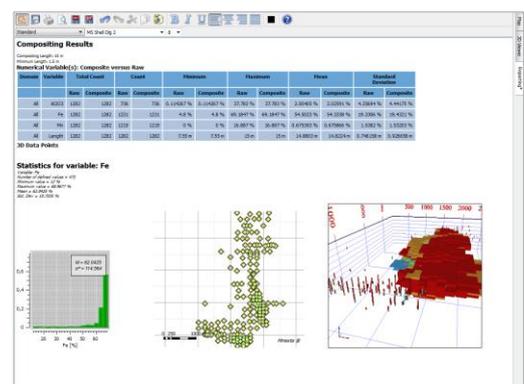


- Easily display **Grade Tonnage Curves**.



### 5. REPORTING & EXPORT

- Enjoy the efficiency of an **integrated word processor**.



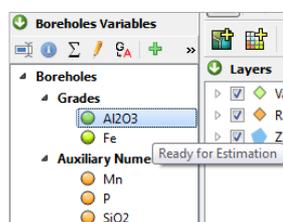
Minestis offers all the essential tools to create your own report as the project is built: copy/paste from the data tables, message windows, GIS to the word processor, text edition and formatting, storage to pdf, odf or html documents, etc.

## 6. INTEGRATED 3D VIEWER AND GIS COMPONENTS

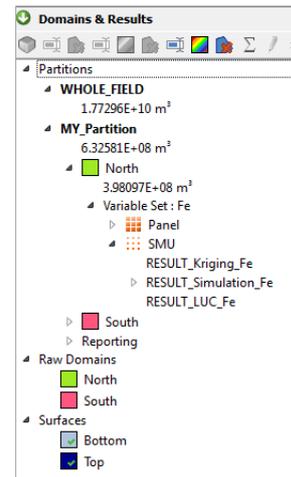
- Experience **Minestis ease-of-use** through a global interface from where all the applications are launched.
- Strengthen your understanding of the orebody thanks to an **integrated 3D Viewer**.
  - Gather boreholes, headers, topography and/or lithologic surfaces in a single view.
  - Visualize the whole project and concerned volumes in 3D.
  - Easily export your data, graphics and results.
- Enrich your 2D views with imported standard image, geoTIFF or geographic vector files (i.e. Shapefiles).
- Benefit from usual **geographical tools**. Display is organized in superimposed layers with all the attached functionalities: display/mask, add/delete, edit, move forward/backward, zoom in/out, scale, compass grid, or graduation display, etc.), so that you customize the view to your own needs.
- **Create Polygons** to delineate specific areas or for delimiting the estimation area.
- Customize the display according to your **visual style guidelines**. Symbol shape, color, size, color scales can be set.

## 7. PROJECT MANAGEMENT

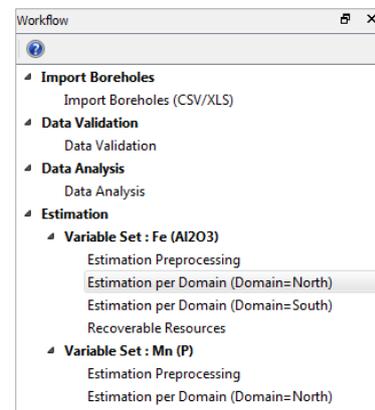
- **Encompass all your data** from a single view: grade and auxiliary variables, partitions, domains, surfaces, estimation results and reporting.
- **Easily check and manage your data**. Rename or delete variables, compute statistics, edit properties or change the variable function.
- Always be informed of the next step to come thanks to the tooltip displayed on each variable.



Easily check your partitions, domains, surfaces and results and display them in the 3D viewer in a click.



- Benefit from **Minestis Workflow** to prepare tasks and run them interactively at the time you need it.



## 8. STUDY MANAGEMENT

- Switch your project list from **icon to list view** and display general information regarding a study (e.g. location on disk, size, version).
- **Attach/detach** a project from your list of projects. **Backup/restore** a project for future use.
- Access the most recent projects in a mouse click.

