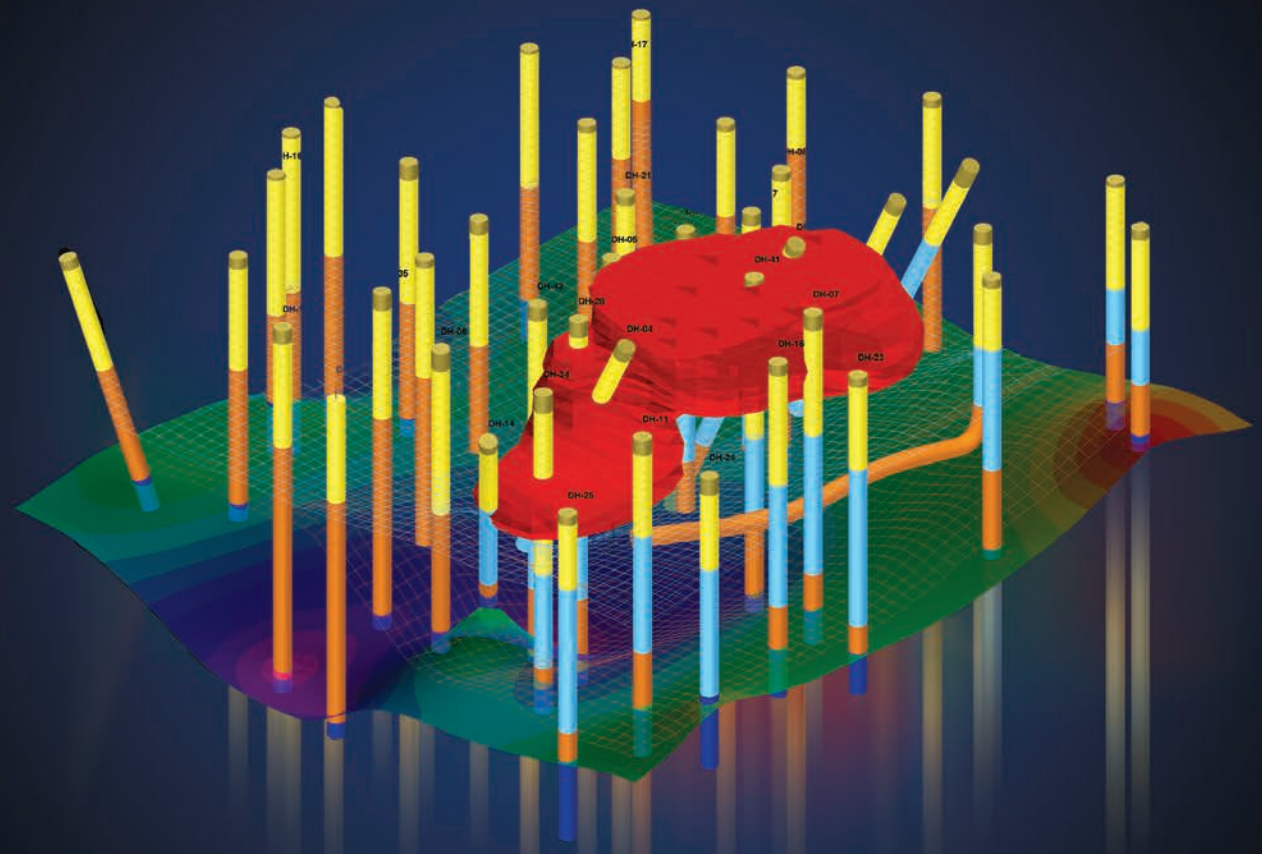
GEOSCIENCE SOFTWARE, CONSULTING & TRAINING

FOR OVER 39 YEARS



Environmental

Geotechnical

Hydrology

Mining

Petroleum

RockWare®

Since 1983

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RockWare Consulting

RockWare was founded in 1983 to provide geoscientific software and consulting to a variety of markets, including environmental, civil engineering, mining, and petroleum. RockWare consists of geoscientists with a wide variety of technical knowledge and real world experience upon which customers rely for assistance with their projects, fast reliable analysis of their data, and litigation support using videos and graphics. RockWare's ability to quickly create scientifically accurate, understandable, and appealing analyses, diagrams and videos has provided enormous benefit for our satisfied customers.

Support & Graphics for:

- Environmental
- Hydrogeological Sciences
- Mining
- Oil and Gas

Extensive expertise in:

- Hydrogeology
- Geology
- Geochemistry
- Geomodeling
- Physics
- Geomorphology
- Groundwater Modeling
- And much more

Modeling, volumetrics, graphics, and videos of virtually any type of subsurface data including:

- Site Characterization
- Contaminant Plume Modeling
- 3D Visualization
- Virtual Tour/Flyover Videos
- Field Mapping
- Ore Bodies
- Reserve Estimates
- Reservoirs
- Digital Well/Borehole Log and Cross-Section Creation
- Well/Borehole Geophysics

RockWare Consulting – A Case Study

In 2019, RockWare was contracted by a client directed by a state agency to help with the modeling and visualization of a groundwater contamination plume based on well data dating back to the mid-1980s. This project involved the creation of numerous contour maps, cross-sections, fence diagrams, volumetric computations, and animations depicting lithology, stratigraphy, hydraulic conductivities, groundwater pathways, and contaminant concentrations.

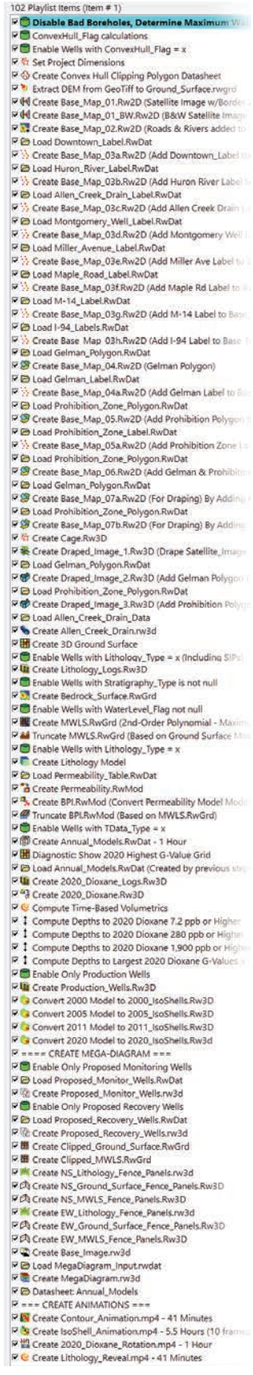
Initially, the project was based on incomplete historic data from multiple sources. In addition, data from groundwater monitoring wells was, and still is, being added to the project database on an ongoing basis. The challenge was to frequently create three-dimensional "snapshots" of the data in order to identify bad or missing historical data and to monitor the plume migration to facilitate the identification of optimal locations for additional monitor and recovery wells. In other words, the task was to repeatedly perform a complex series of steps involving modeling and visualizations as the data and the project dimensions continued to be changed.

To streamline the processing, the steps involved in automating the modeling and visualizations were added to a RockWorks Playlist (Figure 1). By doing so, all of the data could be re-processed with a single click every time the data was changed. These steps included the creation of;

- a series of base maps depicting major features, prohibited drilling boundaries, well locations, etc.,
- an upper constraining grid surface based on high-resolution LIDAR data,
- a 3D display of underground stormwater drainage pipes,
- a 3D terrain model (Figure 2A),
- 3D lithology and stratigraphy striplogs,
- a 3D bedrock surface model,
- a maximum water level surface model,
- a lithology block model (Figure 2B),
- a hydraulic conductivity model based on the lithology model,
- a BPI (Boolean Permeable/Impermeable) model based on the hydraulic conductivities,
- a truncated BPI model based on the maximum water level surface model,
- 25 annual contaminant (dioxane) models based on the time-based water samples and constrained by the BPI model,
- 25 annual 3D dioxane concentration striplogs,
- annual highest dioxane level grid models,
- depth to dioxane >7.2ppb, >280ppb, >1,900ppb grid models,
- production/remediation well location maps,
- annual 3D diagrams depicting 7.2, 280, and 1,900ppb isoshells,
- proposed monitor and recovery well maps,
- 3D lithologic fence diagrams (Figure 2C),
- 3D maximum ground water level fence diagrams,
- a 2D groundwater contamination animation from 1986 to 2019 (Figures 2D & 3),
- a 3D isoshell animation 1986-2020 (Figure 2E), and
- a 3D lithology cutaway animation.

As with any project, the lateral and vertical extents of the area changed as more data became available. In addition, the resolution (i.e., voxel dimensions) of the models also changed. These models were used to create cross-sections with superimposed borehole striplogs so that the client could QA/AC the data in an iterative fashion. This process was repeated until the client was satisfied with the quality of the data and the models. The addition of new data involved a similar iterative process.

A high-resolution LIDAR surface grid (Figure 2A) was used to constrain the upper extents of the models. A satellite image of the site was subsequently draped over the LIDAR-based surface grid (Figure 2D) to provide a better spatial understanding the of the plume extents.



Case Study Continued

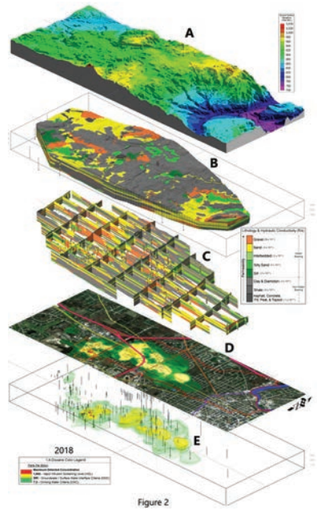


Figure 2

An automated limiting-polygon tool was used to limit the annual contamination models based on the wells that were sampled during the associated time frame. For example, the extents of the 1990 model is smaller than the 1995 model because the 1990 model was based on fewer monitor wells.

Based on this case study as well as other consulting projects, the benefits of the RockWorks Playlist capability include;

- self-documenting automation that eliminates the tedium and error-prone repetition of opening, adjusting, and executing individual program menus,
- an audit trail that can be used to refresh a user's memory,
- a detailed record of all steps, algorithms used, and other menu settings suitable for use during the discovery process during litigation,
- a turn-key deliverable to clients (such as ours) who want to be able to process future data,
- a strategy for processing other sites without being forced to start from scratch, and
- a tool that can be used by entry-level geoscientists that was designed by senior-level geologists.

Hydraulic conductivities were assigned to each of the lithology types in order to create a hydraulic conductivity model. This model was then filtered to create a Boolean (true/false) model which was subsequently used to constrain the annual contamination models.

A maximum water level surface was created to serve as an upper confining surface for the geochemical modeling. Bedrock data, as determined by a seismic survey and a handful of wells, was also supplied by the client to act as a lower confining surface.

Tables and graphs were created to show the annual changes in the contaminant volumetrics based on three cutoff levels; 7.2ppb for drinking water, 280ppb for groundwater/surface water, and 1,900ppb for vapor intrusion screening level. These graphs provided a quantitative, non-spatial alternative to the time-based 3D animations in terms of showing the historical dissipation of the contamination.

Over the course of the project additional items (e.g., adding sub-sites) were added to the Playlist resulting in a list that currently contains over 248 different items. The playlist was crucial in both time management and QA/QC. Instead of having to go through each individual step as data was updated, the workflow now only consisted of updating the data and running the playlist.

Based on this case study as well as other consulting projects, the benefits of the RockWorks Playlist capability include;

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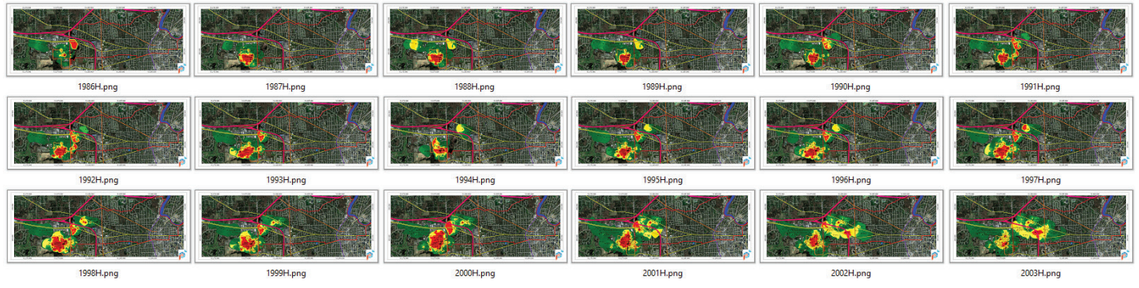
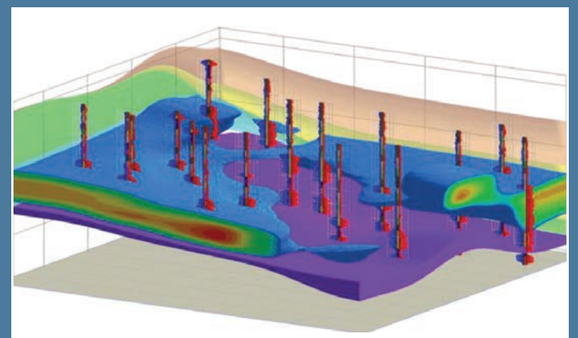


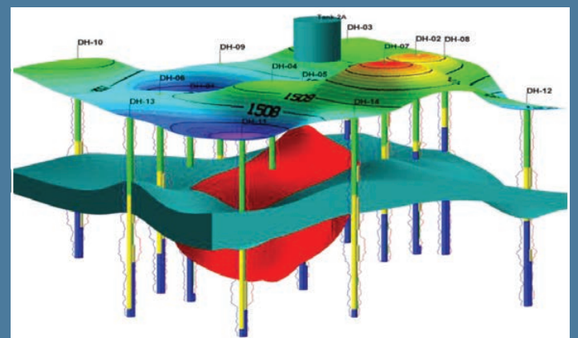
RockWare Consulting Continued

You provide the data, we'll provide the...

Three-Dimensional Diagrams

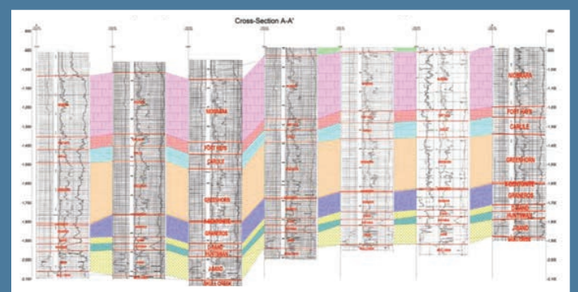


Hydrocarbon Reservoir

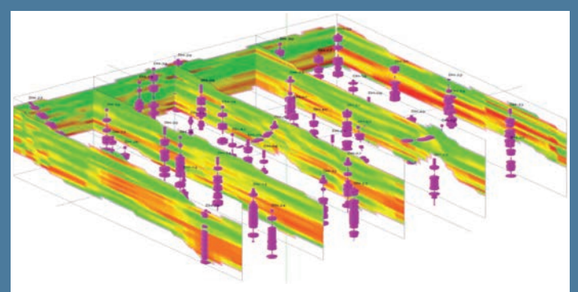


Contamination Plume from Leaking Surface Tank

Cross-Sections

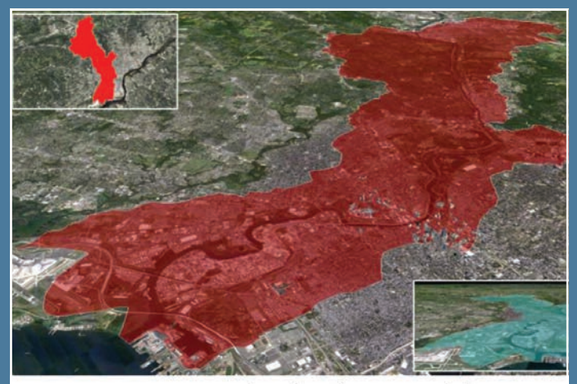


Correlated Petroleum Logs

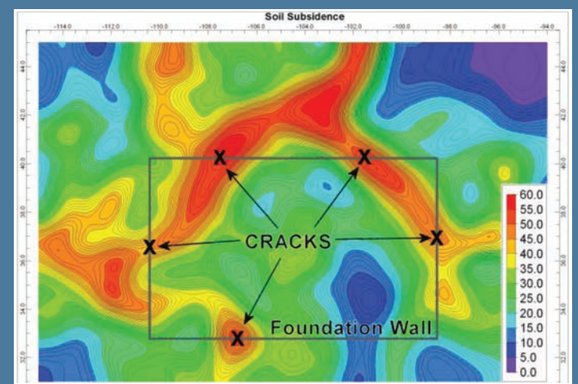


Cross-Sections within Formation Porosity Model

Maps



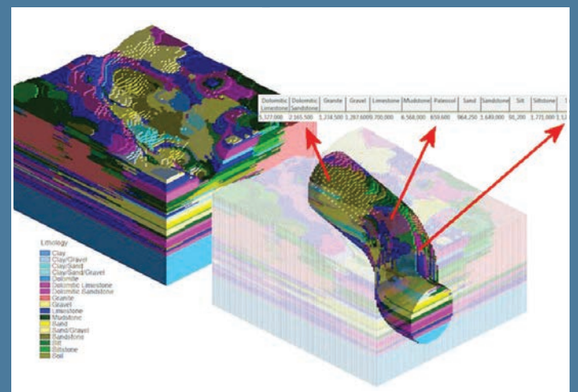
Insurance Risk – Flood Susceptibilities



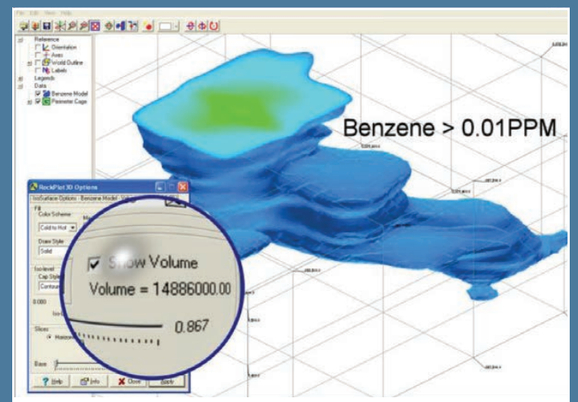
Foundation Cracks Caused by Poor Site Preparation

RockWare Consulting Continued

Volumetric Computations

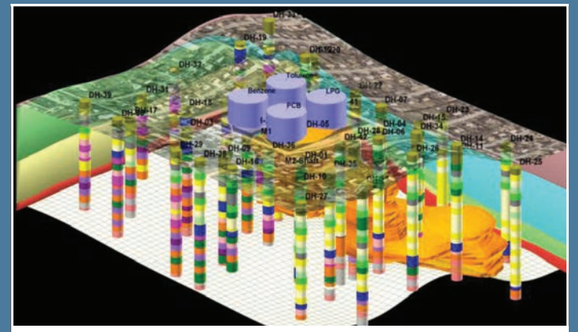


Material Volumetrics – Subway Tunneling Project

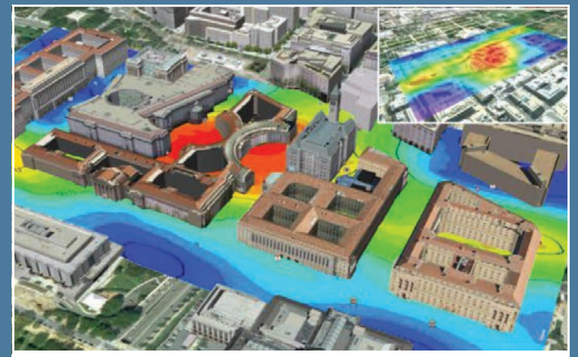


Contaminant Plume Volumetrics

Video Animations



Site Overview: Viewer is gradually introduced to site via draped airphoto, followed by storage tanks, boreholes, stratigraphy and plume.



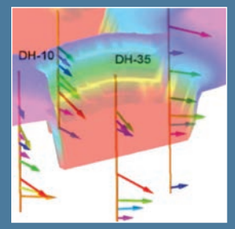
Time-Based Animation Depicting Changes in Foundation Level Moisture

Please contact Consulting@RockWare.com, or call us at 1.800.775.6745 extension 4, for help with any of your consulting needs.

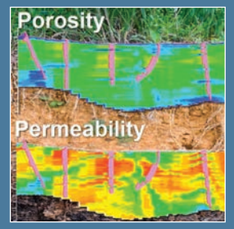
RockWare YouTube Videos

Visit the RockWare YouTube Channel at www.youtube.com/user/RockWaresoftware and watch hands-on training exercises, industry specific applications, new features, webinars, and instructions. Whether you own a license for RockWorks or are using the trial version, these instructional movies will get you started in the program.

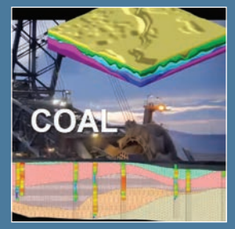
No time to come to the RockWorks workshops in Golden, Colorado, USA? No worries! Visit the RockWare YouTube Channel and watch the sequence of Hands-On Training Exercises which take you through much of the in-person class. Whether you own a license for RockWorks or are using the trial version, these instructional videos will get you started in the program!



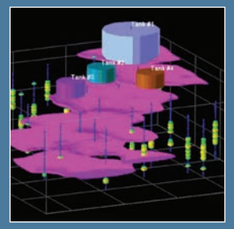
Dam Sites



Geotechnical Soil Investigations

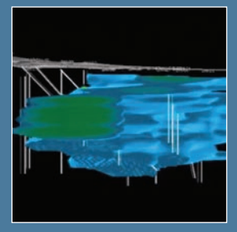


Coal Multi-Seam / Multi Attribute Modeling

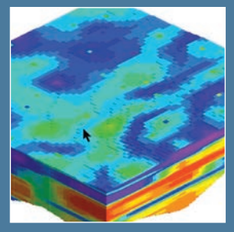


Contaminant Plume Modeling

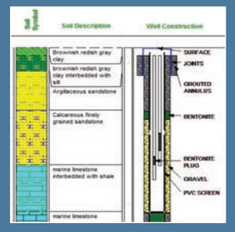
Cone Penetration Testing



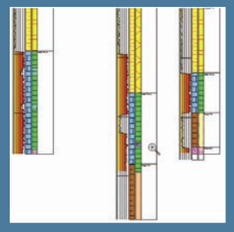
RockWare Litigation Support



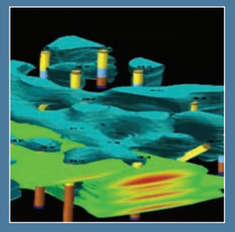
RockWorks Overview



LogPlot 8 Overview



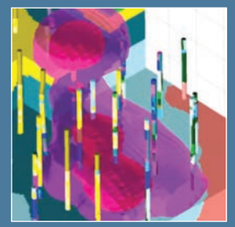
Training Videos



RockWorks New Features

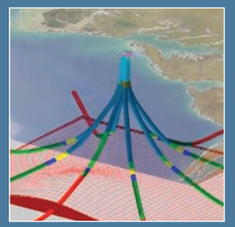
Mining

Tunneling

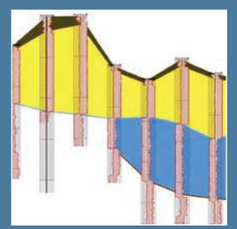


Landfills

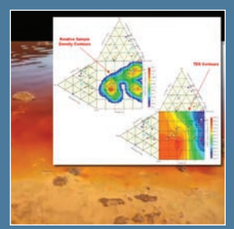
Groundwater Contamination



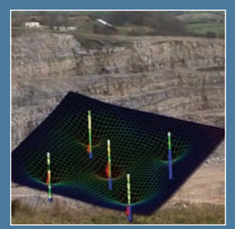
Oil & Gas Production



Hydrocarbon Exploration

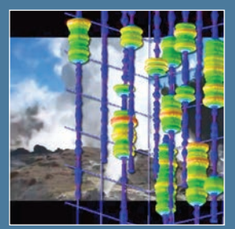


Hydrochemistry



Groundwater

Industrial Minerals



Geothermal

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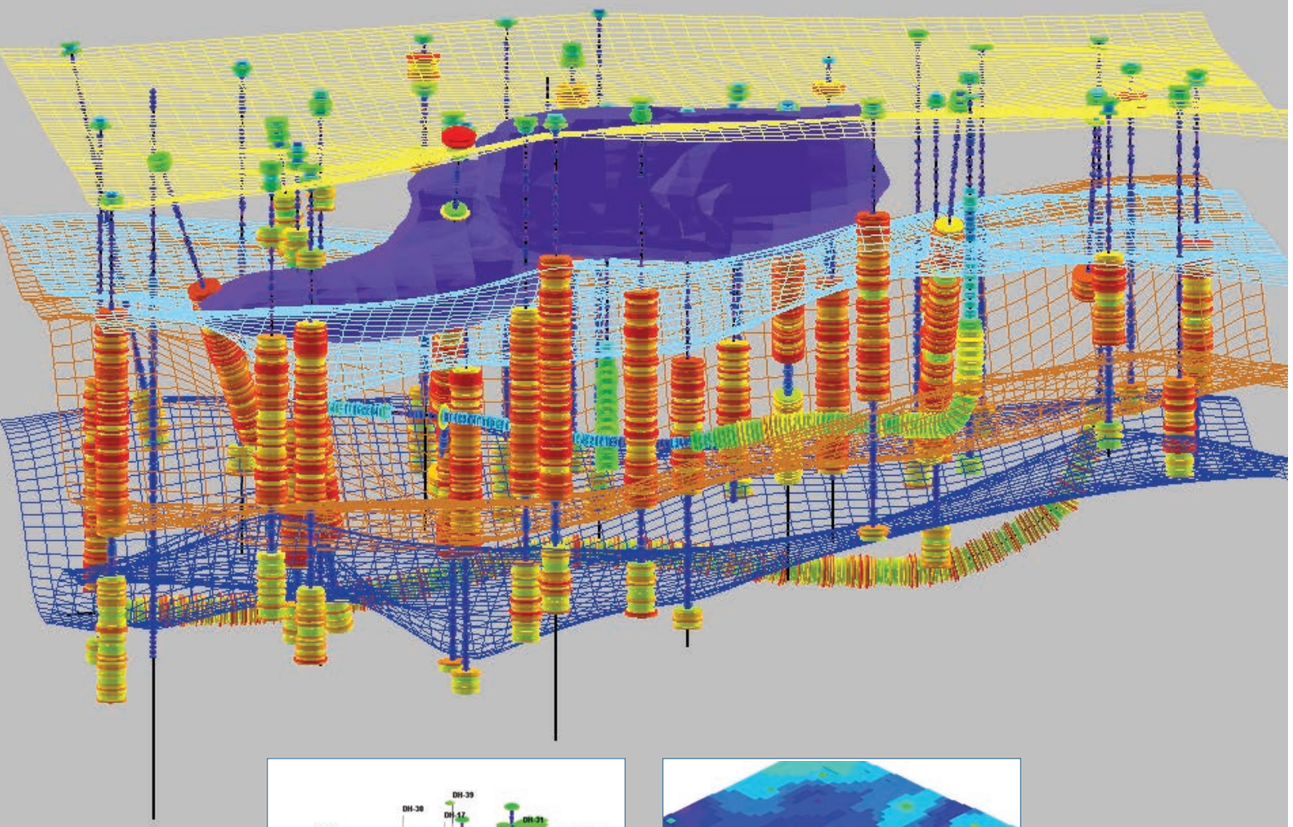
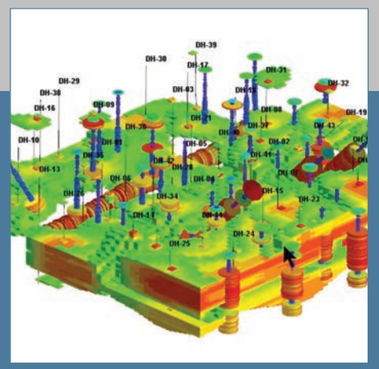
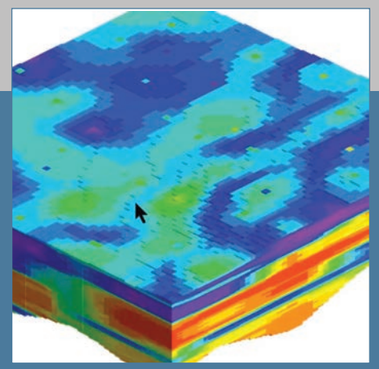
RockWorks 2022®







RockWorks is a comprehensive program that offers visualization and modeling of spatial data and subsurface data. Whether you are a petroleum engineer, environmental scientist, hydrologist, geologist or educator, RockWorks has what you need.

What's New in RockWorks 2022®

RockWorks contains tools that will save time and money, increase profitability and provide you with a competitive edge through high-quality graphics, models and plots. See what's new!

New Features

Mapping

- New raster symbols added to many programs, including borehole location maps, point maps, statistical diagrams and RockPlot3D.
- New contour map color schemes and color legend options are available, including a greatly improved color pallet creator.
- New dynamic filled scalebars are available for RockPlot2D maps.
- Create a total depth grid and contour map through the Borehole Manager based on the base elevation of boreholes.
- Improved spatial filtering for Borehole Manager maps plotting downhole stratigraphic, water level and I/T-Data labels has been added.

Logs, Sections and Profiles

- Improved vertical scalebars can now plot labels showing depth below a datum, and with different settings for the left and right axes.
- Well construction striplogs are now drawn based on the order defined in the well construction type table, making it easier to display overlapping well components.
- Contoured sections and profiles are now drawn much faster.
- Water levels in 2D and 3D striplogs can now be colored based on the aquifer types table.

Borehole Manager Database

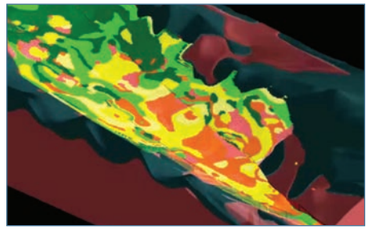
- New backup project tools are available.
- The adjust borehole elevations based on a grid feature now provides options for updating the collar elevation field.
- The Excel, text and CSV data Import options for water levels and I/P/T Data now more easily append data from new sampling events to the database.
- It is now possible to import point Shapefiles into the Borehole Manager database to create new boreholes.

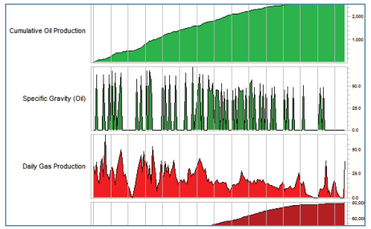
Stratigraphy/Lithology

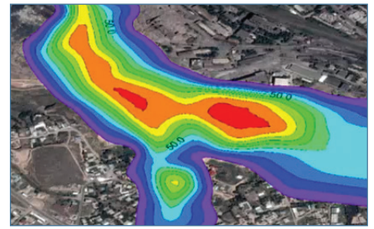
- Use contact data defined in an RwDat file during stratigraphy model creation such as surface contact information (dip angle and direction), geophysical data, seismic data, etc.
- The Stratigraphy Picker now has the option to snap to existing lithology contacts.
- Improved lithology isopach creation, now offering both grid-based and voxel-based tools.

I/P/T Data

- Improvements to the I-Data length composite weighting program, including options to limit the calculations to data between two gridded surfaces and to specify a background grade for missing intervals.
- Improvements to the time graph tools, including the additional spatial and time filters.







What's New Continued

Grid Models

- New Pinchout Filter for limiting the extent of stratigraphic units based on a minimum thickness or polygon file.
- New GeoTIFF import tools to convert DEMs to RwGrd files.
- Redesigned Grid Math interface with new equation options and multi-step calculations.
- New grid data extraction tool extracts data from an RwGrd file based on a list of XY points stored in the datasheet.
- Better null replacement value options are now available during grid creation.

Solid Models

- The Volume 'Extract Via Surface Extraction' program has been redesigned and improved to better calculate stripping ratios for floating cones.
- New resample (fine-to-coarse) program that converts high-resolution solids to low-resolution solids based on chosen options (high, low, average, etc.).
- New fade with depth program decreases model values (i.e., concentrations) below a specific elevation or user-defined surface.
- Redesigned solid math Interface with new equation options and multi-step calculations.
- New solid data extraction tools extract data along a borehole trace or based on a list of XYZ points stored in the datasheet.
- Better null replacement value and smoothing order options are now available during solid model creation.

Faulting

- New 2D Faults for faster modeling and visualization of vertical faults.
- Improved display of contours in faulted sections, profiles and maps.
- New fault import options, including triangulated surfaces and the conversion of contours to a fault surface.

Miscellaneous

- New QAPF Diagram program creates diagrams and igneous rock classifications based on relative mineral abundance data stored in the datasheet.
- The lateral Geo-Steering program has been redesigned to work in conjunction with the Borehole Manager database and datasheet.

RockPlot2D

- New lockable layers, for easier editing of complex diagrams.
- Greatly improved raster and PDF exports.
- Improved shapefile Import that now imports/labels contour lines based on elevations for 3D polylines or attributes.

RockPlot3D

- New copy and paste functionality allow for easily create duplicates of isosurfaces or other items.
- RockPlot3D now stores and uses relative file paths for images, making it easier to share projects or provide RW3D deliverables.
- Grid and solid Metadata is now stored and accessed through RockPlot3D.
- Improved OBJ File export for use with Sketchfab, 3DPDFs and other graphics tools.
- New option to offset items or groups of items in the X, Y or Z directions.

The Playlist

Program Automation

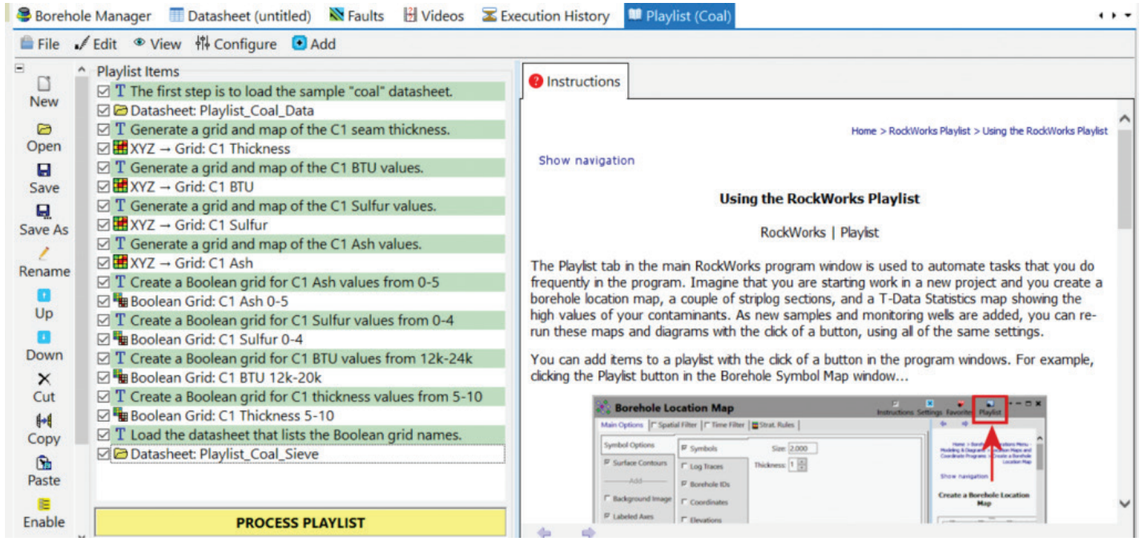
The new RockWorks Playlist offers easy automation – just click a button to add a program to the current Playlist. Then, click a button to run your Playlist to create models, maps, diagrams while you have lunch. Available for Basic (5 items), Standard (5 items) and Advanced (unlimited items).

The Playlist provides:

- **Turn-key tools** for colleagues or clients who need to use RockWorks capabilities without any downtime spent learning how to use it.
- **A memory aid** for projects that are infrequently re-visited.
- **An audit trail** to serve as a record of what was done and all of the associated menu settings.
- **Automation of data processing** in which new data is being introduced on an ongoing basis (e.g. resampling and monitoring).
- A **template** for processing different data sets/sites using a streamlined workflow.

Recent Playlist Improvements:

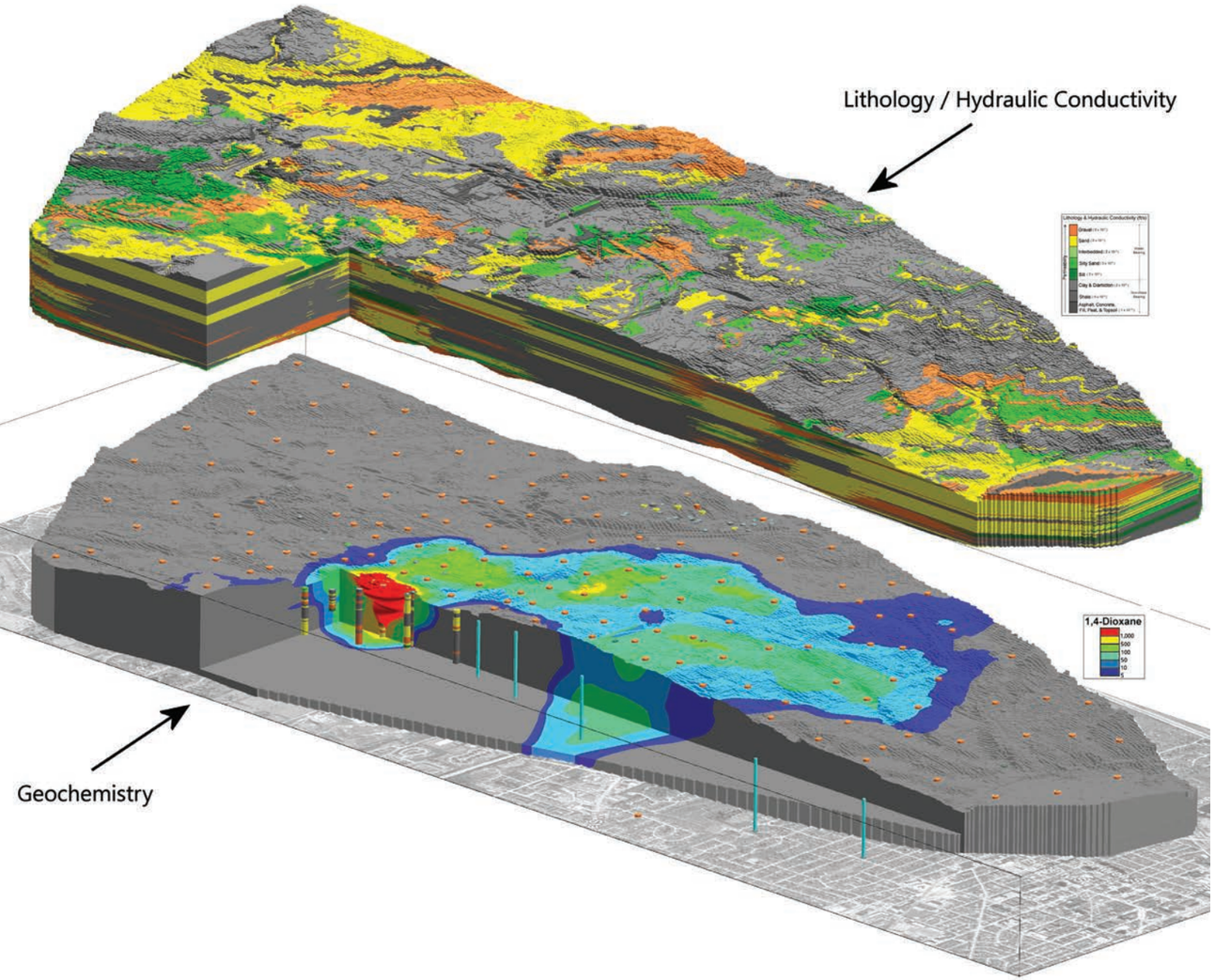
- Improved **Navigation**, with new drag, drop, copy, paste, delete and enable/disable tools.
- Better **Error Handling**, with an option to cancel processing when an error is encountered, or during a standard model run.
- New **Commands**: now includes a tool to Change Project Dimensions and a new Copy File command to create duplicates of existing files in the project.
- New **Manual Editing** tools that allow the user to search and replace through a Text Editor.



New & Improved

Color Legend: NEW IMPROVED

- **Borehole-Related Operations**
  - **Maps**
    - Borehole Symbols
    - Optional Fields
    - Striplog Map
    - Striplogs - Plan View
    - Total Depth Grid
    - Google Earth BH Map Simple
    - Google Earth BH Map Advanced
  - **Striplogs**
    - 2D Striplog
    - 2D PDF Striplog
    - 2D Striplog Profile
    - 2D Striplog Section
    - 2D Projected Log Section
    - 3D Striplog
    - Stratigraphy Fence - Simple
    - Google Earth Logs - Simple
    - Google Earth Logs - Advanced
    - Endpoint Comparison
    - Surface Intersections
    - Lithology Picker
    - Stratigraphy Picker
    - Borehole Survey
    - Datasheet → Borehole Survey
    - Pay Zone → Optimum Path
    - XYZ → Optimum Well Path
    - Lateral Geosteering
  - **Lithology**
    - Lithology Types
    - Solid
    - Surface Map
    - Plan Map
    - 2D Isopach
    - 3D Isopach
    - Superface Grid
    - Subface Grid
    - Profile
    - Section
    - Projected Section
    - Fence
    - Multivariate Map
    - Volumetrics
    - Lithology → I-Data
    - Lithology → I-Data (Table)
    - Consolidate
    - Lithology/Stratigraphy By XY
  - **Stratigraphy**
    - Stratigraphy Types
    - Layered Model
    - Surface Map
    - Plan Map
    - Structure Grid
    - 3D Stratigraphic Contacts
    - Isopach
      - Isopach Map
      - 3D Isopach Diagram
    - Profile
    - Section
      - Linear Correlations
      - Model-Based
    - Projected Section
    - Fence
      - Model-Based
      - Hole-to-Hole
      - ESRI - Model-Based
      - ESRI - Hole-to-Hole
    - Grids Volumetrics
    - Solid Volumetrics
    - Consolidate
    - Fill
    - Grids > 3D Strat. Diagram
    - 3D Exploded Stratigraphy
    - 3D Stratigraphic Quadrants
    - Grids > 3D Stack Diagram
  - **I-Data**
    - I-Data Types
    - Solid
    - Profile
    - Section
      - Hole-to-Hole Interpolations
      - Model-Based
    - Projected Section
    - Fence
    - Surface Map
    - Plan Map
    - Statistics
    - Histogram
    - Statistics Map
    - Volumetrics
    - Length Composite Weighting
    - GT Compositing
    - Resample
  - **T-Data**
    - T-Data Types
    - Solid
    - Multiple Solids
    - Profile
    - Section
      - Hole-to-Hole Interpolations
      - Model-Based
    - Projected Section
    - Fence
    - Surface Map
    - Plan Map
    - Statistics
    - Histogram
    - Statistics Map
    - Time Graph
    - Time Graph Map
    - Billboards
    - Volumetrics
  - **P-Data**
    - P-Data Types
    - Solid
    - Profile
    - Section
      - Hole-to-Hole Interpolations
      - Model-Based
    - Projected Section
    - Fence
    - Surface Map
    - Plan Map
    - Statistics
    - Histogram
    - Histograms by Lithology
    - Statistics Map
    - Standardize
    - Add Random Numbers
    - Logarithmic Conversion
    - CPS → eU3O8 → I-Data
    - GT Compositing
    - Resample
    - Create Predictive Model
    - Apply Predictive Model
  - **Fractures**
    - Solid
    - Surface Map
    - Plan Map
    - Profile
    - Section
    - Projected Section
    - Fence
    - Rose Diagram
    - Rose Map
    - Stereonet
    - Stereonet Map
  - **Aquifers**
    - Aquifer Types
    - Grid-Based Model
    - Plan Map
    - Profile
    - Section
    - Projected Section
    - Fence
    - Hydrograph
    - Hydrograph Map
    - Hydrograph Billboards
  - **Colors**
    - Solid
    - Surface Map
    - Plan Map
    - Profile
    - Section
    - Projected Section
    - Fence
    - Comments → Colors
    - Imagery → Colors
  - **Vectors**
    - Solid
  - **Production**
    - Graph
    - Graph Map
    - Proportional Map
    - 3D Diagrams
    - Billboards
- **Model-Based Operations**
  - **Grid**
    - Create
      - XYZ → Grid
      - XYZ & Dips → Grid
      - Lineations → Grid
      - Polygon List → Grid
      - Single Elevation/Dip → Grid
      - ASCII LIDAR → Grid
      - XYZ → Google Earth Cell Map
      - Grid → 2D Map / 3D Diagram
    - Profile
      - Single Grid
      - Multiple Grids
    - Grids → Profile
    - Section
    - Grid → Fence
    - Grids → Fence
      - Single Grid
      - Multiple Grids
    - Directional
      - Flow Path Map
      - 3D Flow Diagram
      - Flow Table
      - Upgradient Drainage Area
      - Slope Grid
      - Aspect
      - Second Derivative
      - Slope/Aspect Analysis
      - Gradient Vector Map
      - Strike & Dip Map
      - Rose Diagram
      - Stereonet
      - Trend Surface Report
      - Trend Surface Residuals
    - Math
      - Grid Math
      - Grid Intersections
      - Thickness → Mass
      - Resample
    - Statistics
      - Stats - Single Grid
      - Stats - Multiple Grids
      - Grid Metadata
      - Histogram
      - Scattergram
      - Residuals
      - Normalize
      - Standardize
      - Correlate
      - Extract Values From Grid
      - Multivariate Anomalies
    - Grid Filters
      - Boolean
      - Distance Clipping
      - Fill Sinks
      - Gradational Margins
      - Truncate
      - Minimum Area
      - Polygon Clip
      - Range Filter
      - Replace
      - Round
      - Smooth
      - Pinchout Filter
    - Import
      - ASCII (Text)
      - Bitmap (BMP,PNG,JPG,etc.)
      - Digital Elevation Model (DEM)
      - ESRI ASCII Grid
      - Geosoft GXF
      - GeoTiff
      - RockWorks15
      - RockWorks7
      - Surfer
      - ZMAP
      - Custom
    - Export
      - ASCII Matrix
      - ASCII XYZ
      - DXF Matrix
      - GeoSoft
      - ESRI ASCII
      - ESRI Shape File
      - Ohio Scientific
      - RockWorks7 RTM
      - RockWorks Datasheet
      - RockWorks/7 BIN
      - Surfer ASCII
      - Surfer/6 Binary
      - Surfer/7 Binary
      - Surfer/8 Binary
      - VistaPro
      - Grids → GWV Matrix
    - Edit
      - Grids → Strat
      - Grids → Solid
      - Mosaic
  - **Solid**
    - Create
      - XYZG → Solid
      - ASCII XYZG → Solid
      - Faults → Boolean Solid
      - Fractures → Solid
      - Images → Solid
      - Polygons → Solid
      - Survey → Solid
    - Display
      - Display as IsoShells
      - Paper Solid
    - Profile
    - Section
    - Projected Section
    - Fence
    - Plan Map
    - Math
      - Solid & Solid
      - Solid & Grid
      - Resample (Coarse-to-Fine)
      - Resample (Fine-to_Coarse)
    - Statistics
      - Report
      - Multiple Solid Statistics
      - Solid Metadata
      - Histogram
      - Normalize
      - Standardize
      - Residuals
      - Scattergram
      - Extract Values From Solid
      - Volumetrics
    - Filters
      - Range Filtering
      - Geobody
      - Surface Stripping
      - Distance Clipping
      - Gradational Margins
      - Fade With Depth
      - Polygon Clipping
      - RockPlot Polygon Filter
      - Solid && Grid(s)
      - Solid && Boolean Grid
      - Merge
      - Replacement Table
      - Replace Nodes
      - Round
      - Smooth
      - Tube
      - Borehole Clipped Solid
      - Fill Voids
    - Logic
      - Solid → Boolean Solid
      - Min. Ore Zone Thickness
      - Min. Total Ore Thickness
      - Maximum Waste
      - Max. Stripping Ratio
      - Mass
    - Extract Grid(s)
      - Solid → Grid
      - Solid → Grids
      - Solid + Grids → Zone Grids
      - Total Ore Thickness Grid
      - Solid → Total Waste Grid
      - Solid Layer → Grid
      - Solid → GT Grid
    - Import
      - microMODEL
      - Other ASCII
    - Grid
    - Export
      - GWV Matrix
      - Other Formats
        - ASCII XYZG
        - NOeSYs
        - Slicer Dicer
        - Voxel Analyst
        - ESRI Shape Point
    - Initialize
      - Grids → Stratigaphic Solid
      - Edit - Slice-By-Slice
      - Edit - As Block Model
  - **Volume**
    - Triangulation Volumetrics
    - Ore Grid
    - Thickness → GT Grid
    - Elevations → GT Grid
    - Extract via Surface Excavation
    - Time-Based Volumetrics
    - Time-Based Math
- **Utilities**
  - **Maps**
    - Point Symbols
    - Triangulation Contours
    - Barcharts
    - Faults (From 2D Fault Table)
    - Infrastructure
    - Land Grid
    - Lineations/Arrows
    - Mining Claims
    - Oil Leases
    - Piecharts
    - Spider Diagrams
    - Starburst Diagrams
    - Single Polyline
    - Multiple Polylines
    - Seismic Shotpoints
    - Single Polygon
    - Polygons
    - Polygons From Table
    - 3-Point Contours
  - **3-D**
    - Points
    - Triangulation Surface
    - Cage
    - Connected Polygons
    - Extract Values From Solid
    - Oriented Samples
    - Perimeter/Wall
    - Polyline/Pipeline
    - Tubes
    - Horizontal Tubes
    - Vertical Tubes
    - LIDAR → Triangle Mesh
    - Triangle Mesh
    - SpherePlot
      - 2D Cylindrical - Points
      - 2D Cylindrical - Polylines
      - 2D Spherical - Points
      - 2D Spherical - Polylines
      - 3D Sphere - Points
      - 3D Sphere - Polylines
  - **Earth**
    - Sample Point Icons
    - Circles
    - Cones
    - Cylinders
    - Lines/Arrows
    - Mining Claims
    - Oil & Gas Leases
    - Parabolic Arrows
    - Parabolic Lines
    - Parabolic Tubes
    - Pipeline - Single
    - Pipelines - Multiple
    - Polyline - Single
    - Polylines - Multiple
    - Polygon - Single
    - Polygons - Multiple
    - Predefined Polygons
    - Tubes
    - Public Land Grid
  - **Hydrology**
    - Drawdown Calculator
    - Drawdown Surface
    - Hydrograph
    - Flowpath Tubes
  - **Hydrochem**
    - Durov
    - Ion Balance
    - Piper
    - Stiff
    - Stiff Map
    - Total Dissolved Solids
  - **Linears**
    - Rose (Frequency)
    - Rose (Length-Based)
    - 2D Endpoints → Bearing, Etc.
    - 3D Endpoints → Bearing, Etc.
    - 3D PrismGram
    - 3D Urchingram
  - **Planes**
    - Stereonet
    - Strike & Dip Map
    - 3D Strike & Dip Discs
    - Google Earth Dip Symbols
    - Google Earth Dip Discs
    - 3-Points → Dip
    - Beta Intersections
    - Beta Pairs
    - Polylines → Planes
    - Rotate Dips
    - Strike → Dip Direction
    - XYZ & Dips → Profile
  - **Stats**
    - Univariate
    - Normalize
    - Standardize
    - Histogram
    - Histogram Matrix
    - Scattergram
    - Ternary
    - Ternary Map
    - XYZ Analysis
    - Variography
    - Sieve Analysis
    - QAPF Diagram
    - Volcanic Classification
    - Random
  - **Survey**
    - XYZ
    - Map
    - 3D
    - Panels
    - Tubes
    - Survey Data → KMZ Points
    - Survey Data → KMZ Polygons
    - Triangulation
    - Setup XY Stations
    - Interpolated Points Along Line
    - Movement Analysis
    - Mining Claim Area
    - Oil Lease
  - Coords
    - Quick Locator
    - Convert Point
    - Convert Points
    - Polar → XY
    - XY → Polar
    - XYZ → Polar
    - Azimuths → Quadrants
    - Quadrant → Azimuth
    - Rescale XY Data
    - Rotate XY Data
    - Shift XY
    - Public Land Survey → XY
    - Local Origin Lon/Lat
    - Dates → Stardates
    - Merge Time-Stamped Data
  - **Widgets**
  - **Misc**
    - Copy Files
    - HTML Builder
- **Graphics**
  - Embellish
    - 3D Diagram
    - Chart
    - Map
    - Profile or Section
  - **2D Tools**
    - Clip
    - Reproject
    - Montage
    - Rescale
    - Import
      - AGL
      - DLG
      - DXF
      - Shape
    - Export
      - DXF
      - EMF
      - KMZ Export
      - MIF
      - PDF - Single
      - PDF - Multiple
      - Raster
      - RP3D
      - Shape
      - WMF
  - **3D Tools**
    - Combine
    - Merge 2 Files
    - Merge 2+ Files
  - **Animate**
    - XYZ → Contour Map Animation
    - XYZ → 3D Surface Animation
    - Grids → Contour Map Animation
    - Grids → 3D Surface Animation
    - Solids → 3D Animation
    - Solids → 3D IsoShell Animation
    - Solid Reveal
    - RockPlot3D File → Animation
    - Images → Animation
    - Slideshow
    - Google Earth Flyovers
      - Camera Looking Forward
      - Camera Looking At Midpoint
      - Spiral From Space
      - Flyover - Simple Tour
      - Command Driven
      - Circular
      - Golf Ball Flight Simulation
      - Clipboard → Circular Flyover
      - Clipboard → Forward Flyover
      - Google Earth Drape Animation
      - Google Earth Float Animation
      - Google Earth Sea-Level Change
  - **Images**
    - Image → Map
    - Drape
    - Float
    - Vertical
      - Single
      - Multiple
      - Single Curved
      - Multiple Curved
      - Vertical Images → XYZG
    - Image Cube
    - Georeference
    - Digitize
    - Reformat/Enhance
    - Google Earth
      - Drape - Single Midpoint
      - Drape - Two Corner Points
      - Drape - Raster Labels
      - Float - Single Midpoint
      - Float - Two Corner Points
      - Vertical - Single Midpoint
      - Vertical - Two Pts. Simple
      - Vertical - Two Pts. Advanced
      - Vertical - 90-Degree Images
      - Legend: Add Image As Legend
  - **Borehole Manager / Import**
    - ADO (ActiveX Data Object)
    - AGS
    - CSV/ASCII Text
    - Colog → P-Data
    - Database Import
    - Excel
    - Fugro CPT
    - Geoprobe DI (Direct Image)
    - gINT
    - GDS
    - IHS Energy Group
    - Kansas Geological Survey
    - LAS (Log ASCII Standard)
    - LogPlot
    - SHP (ESRI Shapefile)
    - Spectrum SC900 CPT
    - Tobin WCS
  - **Datasheet / Import**
    - ASCII (Text)
    - CSV
    - Database Import
    - DBF (dBase,ArcGIS)
    - DXF (AutoCAD) Lines
    - DXF (AutoCAD) Lines & Points
    - Excel
    - Garmin TXT
    - Geonics EM38
    - Google Earth (Clipboard/KML/KM
      - XYZ Coordinates
      - Lineation Coordinates
      - Single Polyline Coordinates
      - Multiple Polyline Coordinates
      - Single Polygon Coordinates
      - Multiple Polygon Coordinates
      - Polygon Corner Coordinates
    - GPL
    - GPX Track
    - GPS Points
    - GSM-19
    - Laser Atlanta (Survey)
    - LAS (Log ASCII Format v1.2-2.0)
    - ModPath (Particle Flowpaths)
    - NEIC (USGS Seismic)
    - SEG-P1 (Shotpoint Locations)
    - SHP (ESRI Shapefile)
    - WCS (Tobin Well Locations)
    - Create File List
  - **Datasheet / Export**
    - ASCII (Text)
    - DBF (dBase,ArcGIS)
    - XLS (Excel)
  - **Fault Manager**
    - 2D Map
    - 3D Diagram
    - Import Dips
    - Import Grid
    - Import Line 2D
    - Import Line 3D
    - Import Polyline 2D
    - Import Polyline 3D
    - Import Contours
    - Import Triangles
    - Import XYZ
    - Export to Triangles
  - Playlist
  - **RockPlot2D / Import**
    - AGL (ASCII Graphics Language)
    - ALG (USGS Digital Line Graph)
    - AXF (AutoDesk Data eXchange Fmt)
    - AOO (ESRI Arc/Info)
    - AHP (ESRI ArcView Shape File)
    - Raster Image (BMP,JPG,PNG,etc.)
  - **RockPlot2D / Export**
    - BMP (Microsoft BitMaP)
    - JPEG (Joint Photo. Experts Group)
    - PNG (Portable Network Graphics)
    - TIFF (Tagged Image File)
    - PDF (Portable Document Format)
    - ESRI Shape Files (shp,shx,dbf)
    - MIF (MapInfo MIF/MID)
    - KMZ (Google Earth Map,Section,etc.)
    - EMF & WMF (MicroSoft Metafile)
    - ReportWorks
    - RockPlot3D
    - Paint Program
  - **RockPlot3D / Import**
    - DXF (AutoDesk Data eXchange Form
  - **RockPlot3D / Export**
    - AVI (Video)
    - Animated GIF
    - Raster (BMP,JPG,PNG,TIF)
    - PDF (Portable Document Format)
    - DXF (AutoDesk Data eXchange Form
    - ESRI Shape Files (shp,shx,dbf)
    - KMZ (Google Earth)
    - DAE (Collada)
    - OBJ (Wavefront/Sketchfab)
  - ReportWorks

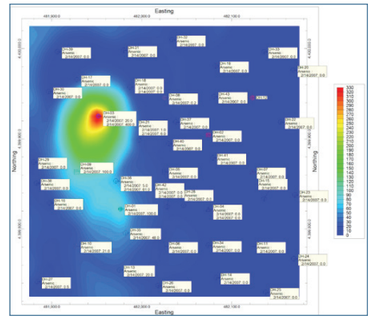


Borehole logs, cross sections, concentration maps, plume models, geology models, time-based animations, geochemistry diagrams and more. RockWorks will help the environmental professional along the path from site characterization to remediation planning and execution.

RockWorks 2022®–Environmental

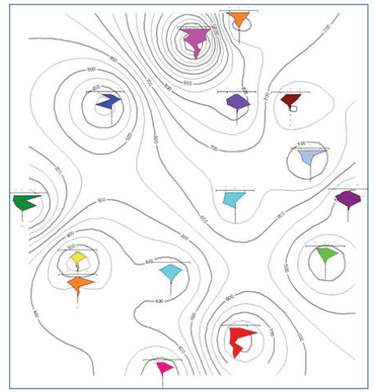
Mapping Tools

- Borehole location maps with detailed data labels
- Contaminant concentration maps with lines and color fills, custom color tables, date filters
- Plan- and surface-based slices from 3D models
- Stiff diagram maps
- Time-graph maps for user-selected analytes
- Potentiometric surface maps
- Flow maps in 2D and 3D
- Coordinate systems/conversions: lon/lat, UTM, State Plane, local, custom



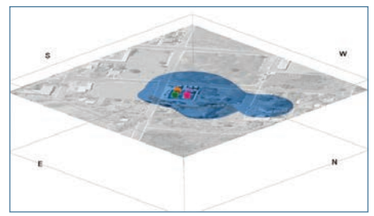
Borehole Database Tools

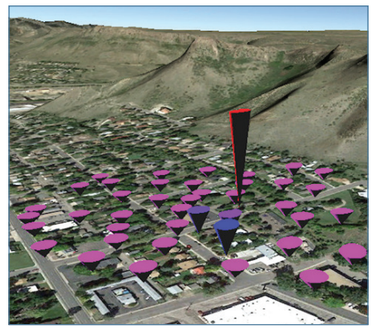
- Cross sections: multi-panel projected and hole to hole, with borehole logs and/or interpolated panels
- Correlations: model-based and “EZ” panels, snapping tools for hand-drawn correlations
- Borehole logs in 2D and 3D
- 3D fence diagrams
- Surface modeling of stratigraphic layers and water levels
- Plume modeling of analytical data, with display as voxel or isosurface diagrams, 2D plan and section slices
- Solid modeling of lithologic materials, geophysical and geotechnical measurements
- Volume reports of lithologic and stratigraphic models, contaminant extraction models
- Bulk data imports from Excel, text, LAS, other databases



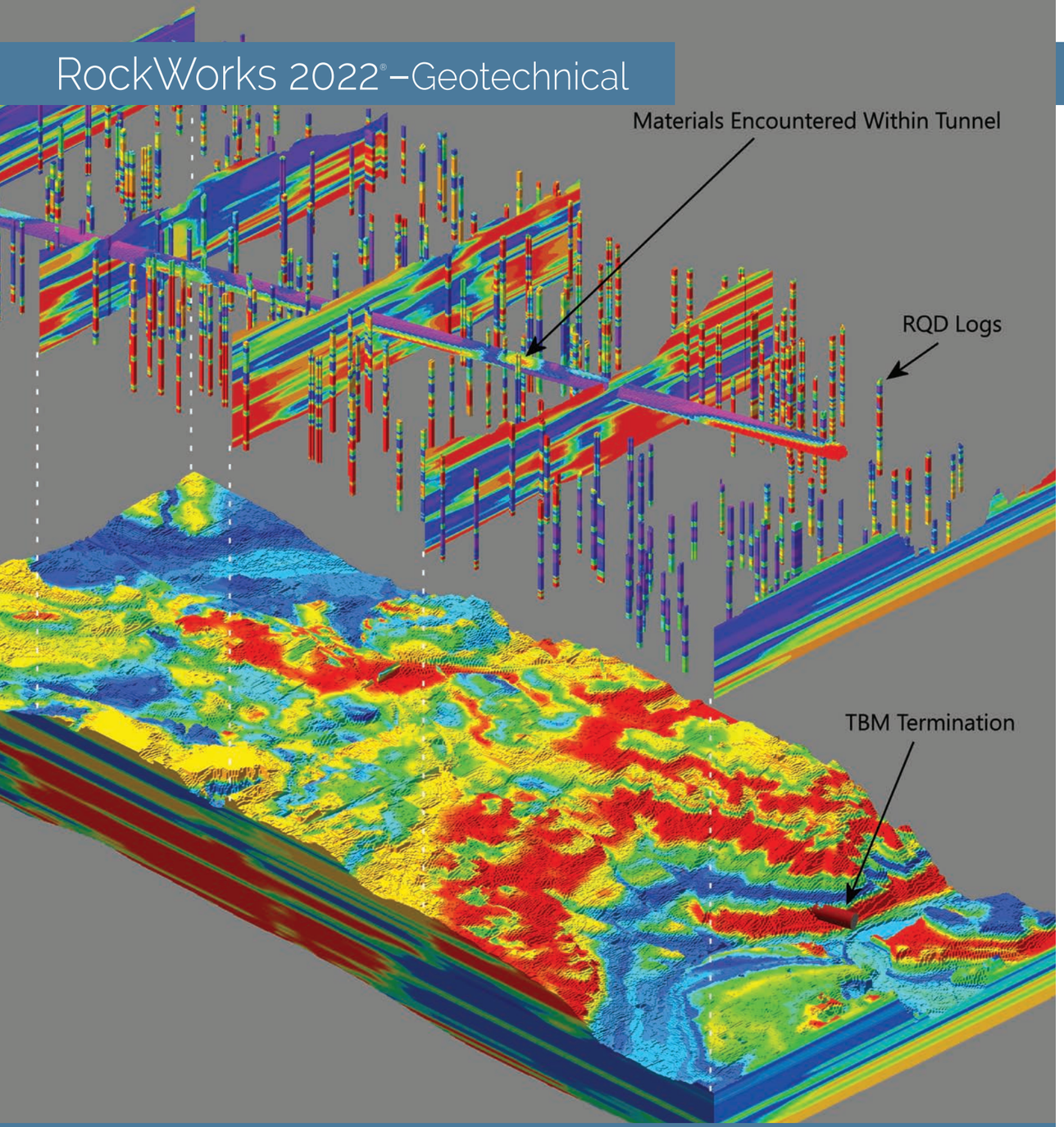
Other Tools

- Time-based animations
- Piper and Durov diagrams with TDS circles, Stiff diagrams for multiple samples
- Water level drawdown diagrams and surfaces
- 2D editing tools: contour lines, text, shapes, legends, images
- Composite scenes in 3D with maps, logs, surfaces, solids, panels, surface objects
- Page layout program for small to large format presentations and posters
- Exports to GIS Shapefiles, CAD DXF, raster formats, Google Earth
- Image import and rectification
- Program automation
- Google Earth output directly from data: points, cones, lines, polygons, images, flyovers





RockWorks 2022®–Geotechnical

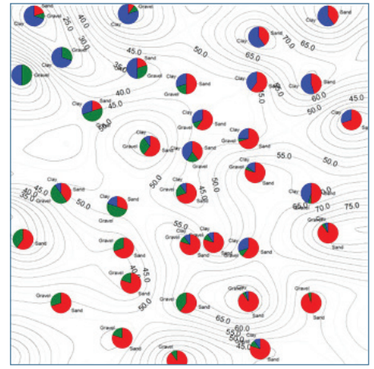


RockWorks offers geotechnical and civil engineers graphical and analytical tools for evaluating construction and excavation sites. Create borehole logs and cross sections, dozens of different types of maps, structural diagrams, geological/geotechnical/fracture/color models, volume reports and more.

RockWorks 2022®–Geotechnical

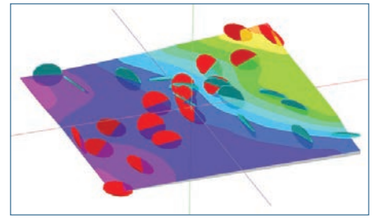
Mapping Tools

- Multiple components in piechart, spider maps
- Point maps with detailed data labels
- Topographic contour maps with lines and color fills, custom color tables
- 3D surface displays
- Strike and dip maps in 2D and 3D
- Coordinate systems/conversions: lon/lat, UTM, State Plane, local, custom



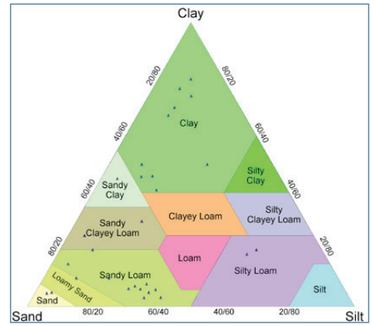
Borehole Database Tools

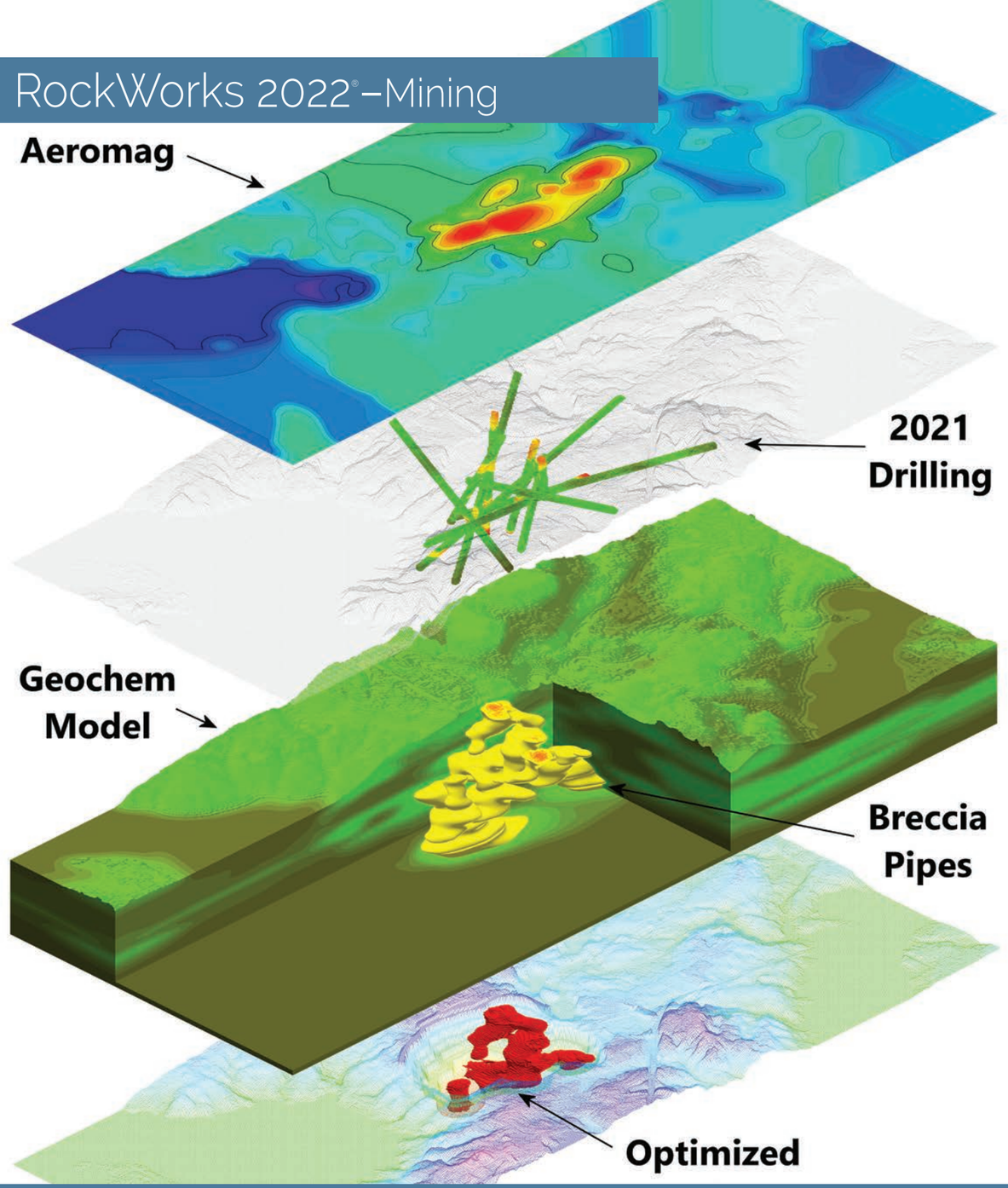
- Cross sections: multi-panel projected and hole to hole, with borehole logs and/or interpolated panels
- Correlations: model-based and "EZ" panels, snapping tools for hand-drawn correlations
- Borehole logs in 2D and 3D
- 3D fence diagrams
- Surface modeling of stratigraphic layers and water levels
- Solid modeling of lithologic materials, fractures, and geophysical, geotechnical, geochemical data, with display as voxel or isosurface diagrams, 2D plan and section slices
- Geology maps: plan slices from stratigraphy or lithology models
- Volume reports of lithologic, stratigraphic, excavation models
- Fracture display and modeling, stereonet maps, rose diagram maps
- Munsell colors for display in logs and interpolation into color models
- Data imports: Excel, AGS, Colog, Fugro CPT, gINT, LAS, Penetrometer, other databases



Other Tools

- Sieve diagrams, ternary diagrams with classification overlays
- Stereonet and rose diagrams
- Slope/aspect analysis on grid models
- Predictive tools: lithology materials from curves, interval data (porosities, strength, cohesion) from lithology
- 2D editing tools: contour lines, text, shapes, legends, images
- Composite scenes in 3D with maps, logs, surfaces, solids, panels, surface objects
- Page layout program for small to large format presentations and posters
- Exports to GIS Shapefiles, CAD DXF, raster formats, Google Earth
- Image import and rectification
- Program automation
- Google Earth output directly from data: points, cones, lines, polygons, images, flyovers





Mining professionals rely on RockWorks point and contour maps, 2D and 3D log displays, projected sections, block model interpolating and editing, detailed volume calculations, and import/export tools in both exploration and production phases of their projects.

RockWorks 2022®–Mining

Mapping Tools

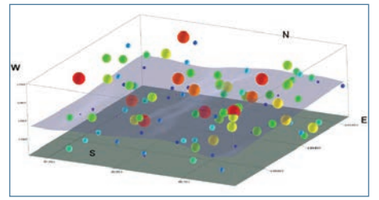
- Drillhole location maps with detailed data labels
- Assay, concentration maps with lines and color fills, custom color tables
- 3D surface displays: topographic surfaces, stratigraphic units
- 3D point maps
- Geology maps: plan or surface-based slices from block models
- Multivariate maps: pie chart, bar chart, starburst, spider maps
- Coordinate systems/conversions: lon/lat, UTM, State Plane, local, custom

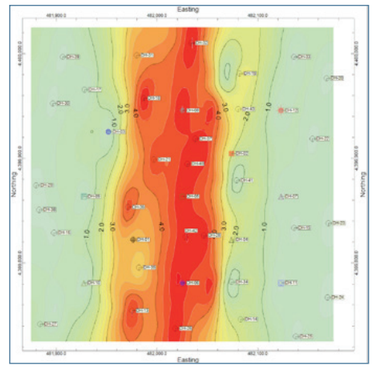
Borehole Database Tools

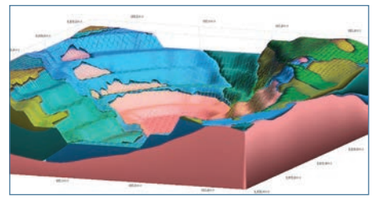
- Projected cross sections showing drillhole orientation
- Correlation panels: stratigraphy, lithology, grade/concentration, geophysics
- Drillhole logs in 2D and 3D with lithology, stratigraphy, bargraphs/disks, curves, color intervals, text
- Block model interpolation from XYZG point or drillhole data, display as voxels, isosurfaces, fence diagrams, 2D plan and section slices
- Surface model interpolation of stratigraphic units
- Downhole fracture display and modeling—closest fracture and closest fracture intersection
- Volume reports of lithologic, stratigraphic models
- Data imports: Excel, LAS, acQuire, Newmont, other databases

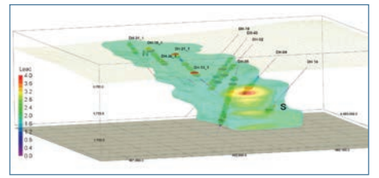
Other Tools

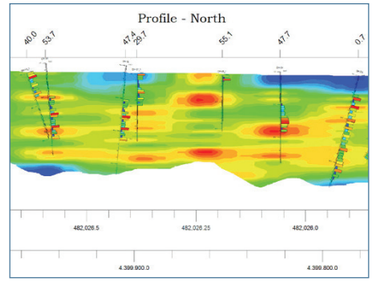
- Block model editor: 3D voxel/polyhedron editor or slice-based
- Volume calculations: grade statistics by level, extraction reports, GT calculators, floating cones model extraction tools
- Fracture display and modeling, stereonet and rose diagrams
- Ternary diagrams, frequency histograms for source data and models
- Graphic output: 2D and 3D output to RockWorks, Google Earth
- 2D editing tools: contour lines, text, shapes, legends, images
- Composite scenes in 3D with maps, drillhole logs, surfaces, blocks, panels
- Page layout program for small to large format presentations and posters
- Exports to GIS Shapefiles, CAD DXF, raster formats, Google Earth
- Image import and rectification
- Program automation

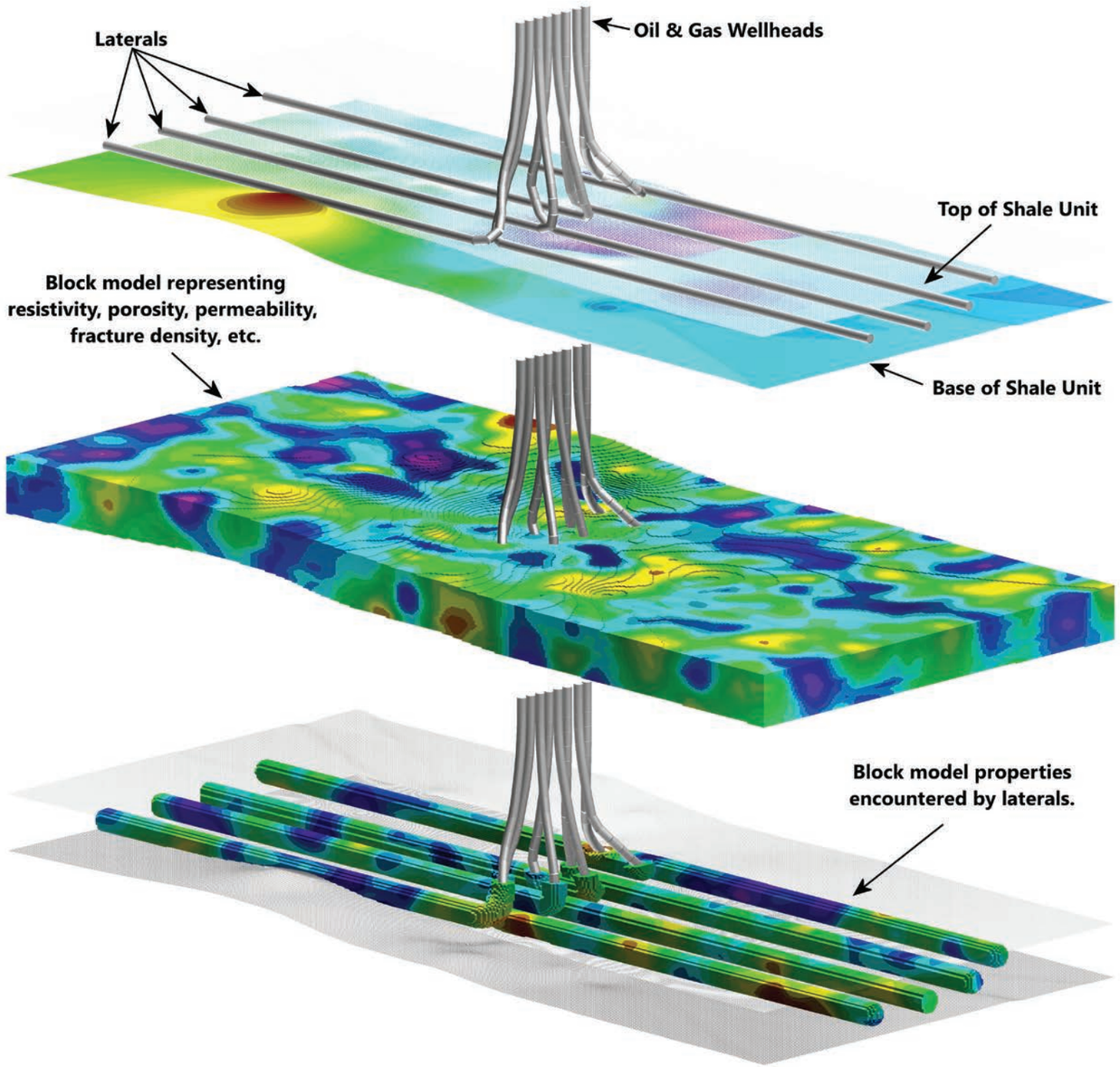












RockWorks gives the petroleum geologist the tools to get the job done: well spotting, mapping (bubble, structure, isopach, land grid, log maps), cross sections, stratigraphic modeling, reservoir modeling and much more.

RockWorks 2022®–Petroleum

Mapping Tools

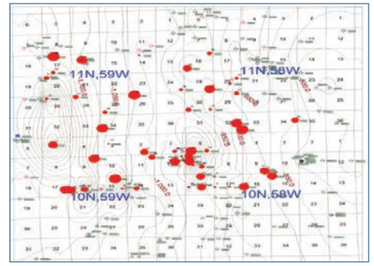
- Structure and isopach maps: contour maps with lines and color fills, custom color tables
- 3D surface displays
- Bubble maps of any well data (production, etc.)
- Well and lease spotting from Range, Township, Section descriptions
- Land grid and lease maps with section boundaries
- Coordinate systems/conversions: lon/lat, UTM, State Plane, local, custom
- Well location maps: customized symbols (e.g. well status), plan-view horizontal well traces
- Gridding algorithms: kriging, triangulation, inverse-distance, trend polynomial
- Grid model tools: filters, math operations, editor, imports and exports

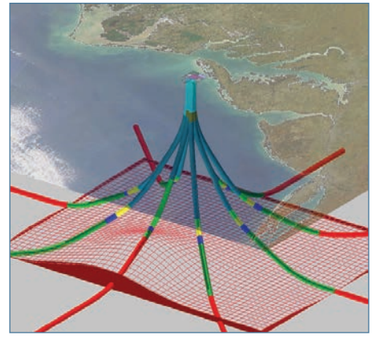
Well Database Tools

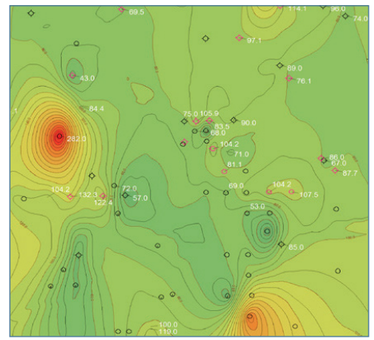
- Cross sections: hole to hole and projected
- 3D fence diagrams
- Correlations: model-based and “EZ” panels
- Horizontal and vertical wells: 2D and 3D, flexible log layout
- Stratigraphic modeling of all/selected formations
- Solid modeling of lithologic, geophysical, geotechnical, geochemical data, with display as voxel or isosurface diagrams
- Geosteering: optimal well paths based on target formations, lateral and 3D displays
- Well database for well locations and miscellaneous well data, formation contacts, raster images, geophysical data, lithology, well construction and production
- Data imports—Excel, LAS, LogPlot, IHS, KGS, Tobin, other databases
- Stratigraphic contacts from digital elog data or raster logs

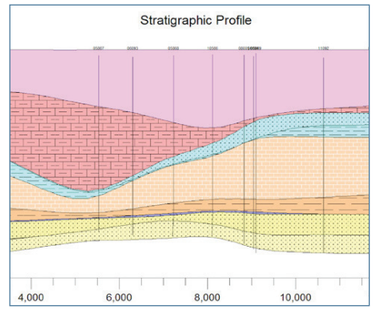
Other Tools

- Structural geology diagrams
- Graphic output: 2D and 3D output to RockWorks, Google Earth
- 2D editing tools: contour lines, text, shapes, legends, images
- Snapping tools for hand-drawn correlations
- Composite scenes in 3D with maps, logs, surfaces, solids, panels, surface objects
- Page layout program for small to large format presentations and posters
- Exports to GIS Shapefiles, CAD DXF, raster formats, Google Earth
- Image import, rectification, depth-registration
- Program automation using the new Playlist feature

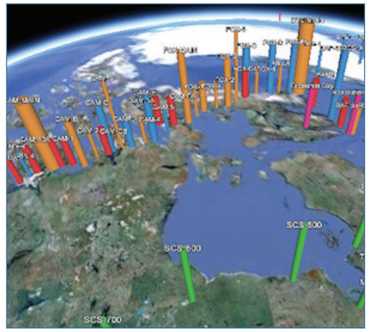








RockWorks 2022® Feature Levels

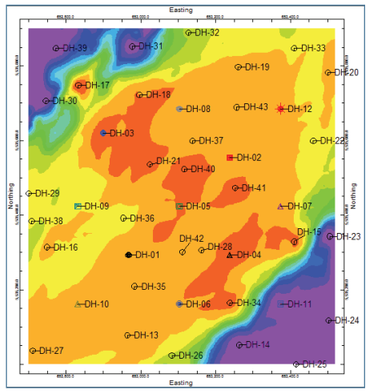


RockWorks is offered with three different feature levels: Basic, Standard, and Advanced.

All three levels include the RockWorks Datasheet and the ModOps, Utilities and Graphics menus. These menus offer numerous programs for mapping XYZ data, modeling XYZG points, creating stereonets and rose diagrams, creating Piper, Stiff and Durov plots, and much more.

All feature levels also include the three Graphic Output programs: RockPlot2D, RockPlot3D and ReportWorks.

All three levels also include the Borehole Manager and its local database for storing and managing borehole-based data.



RockWorks Basic

With Basic, the borehole processing tools are limited to observed data—no modeling: Borehole location maps, 2D and 3D strip logs, and striplog profiles and cross sections. Simple correlation panels are offered for Stratigraphy, I-Data and P-Data in 2D section diagrams. 5 items per playlist and 3 faults.

RockWorks Standard

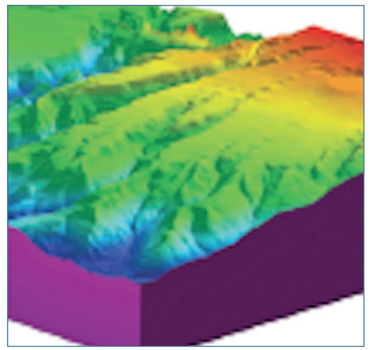
All Basic level tools, plus Borehole Manager modeling: lithology, stratigraphy, geophysical/geochemical/geotechnical, aquifers, colors, fractures. 5 items per playlist, 3 faults.

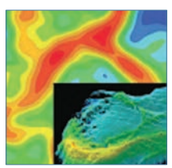
RockWorks Advanced

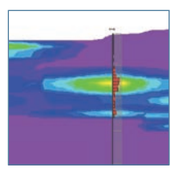
All Standard level tools, plus SQL-server database support, program automation (scripting), Borehole Manager petroleum production diagrams. Unlimited items per playlist, unlimited faults.

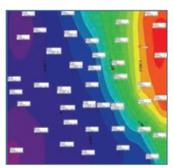
Academic

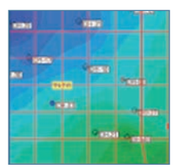
Ask us about our free college curriculum datasets, exercises, and significant academic discounts (see web site). These "canned" classes represent extended versions of the RockWorks training exercises tailored for educators. A great teaching resource. .

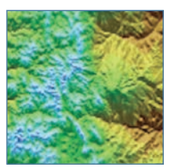


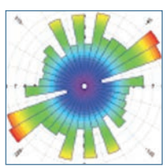








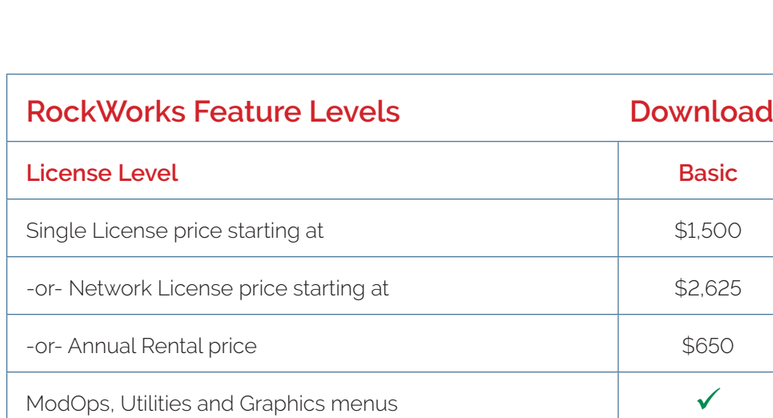


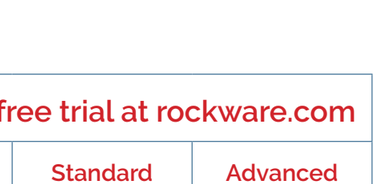


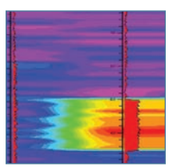
RockWorks 2022® Pricing

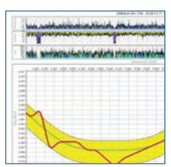
RockWorks Feature Levels	Download free trial at rockware.com		
License Level	**Basic**	**Standard**	**Advanced**
Single License price starting at	$1,500	$3,000	$5,000
-or- Network License price starting at	$2,625	$5,250	$8,750
-or- Annual Rental price	$650	$1,300	$2,200
ModOps, Utilities and Graphics menus	✓	✓	✓
Logs and Sections	✓	✓	✓
Borehole-Based Modeling	—	✓	✓
SQL Server; Command Script Automation	—	—	✓
Playlist Automation	5 items	5 items	unlimited
3D Faults	3 faults	3 faults	unlimited

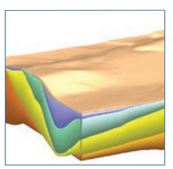
See https://www.rockware.com/product/rockworks/ for Academic Pricing

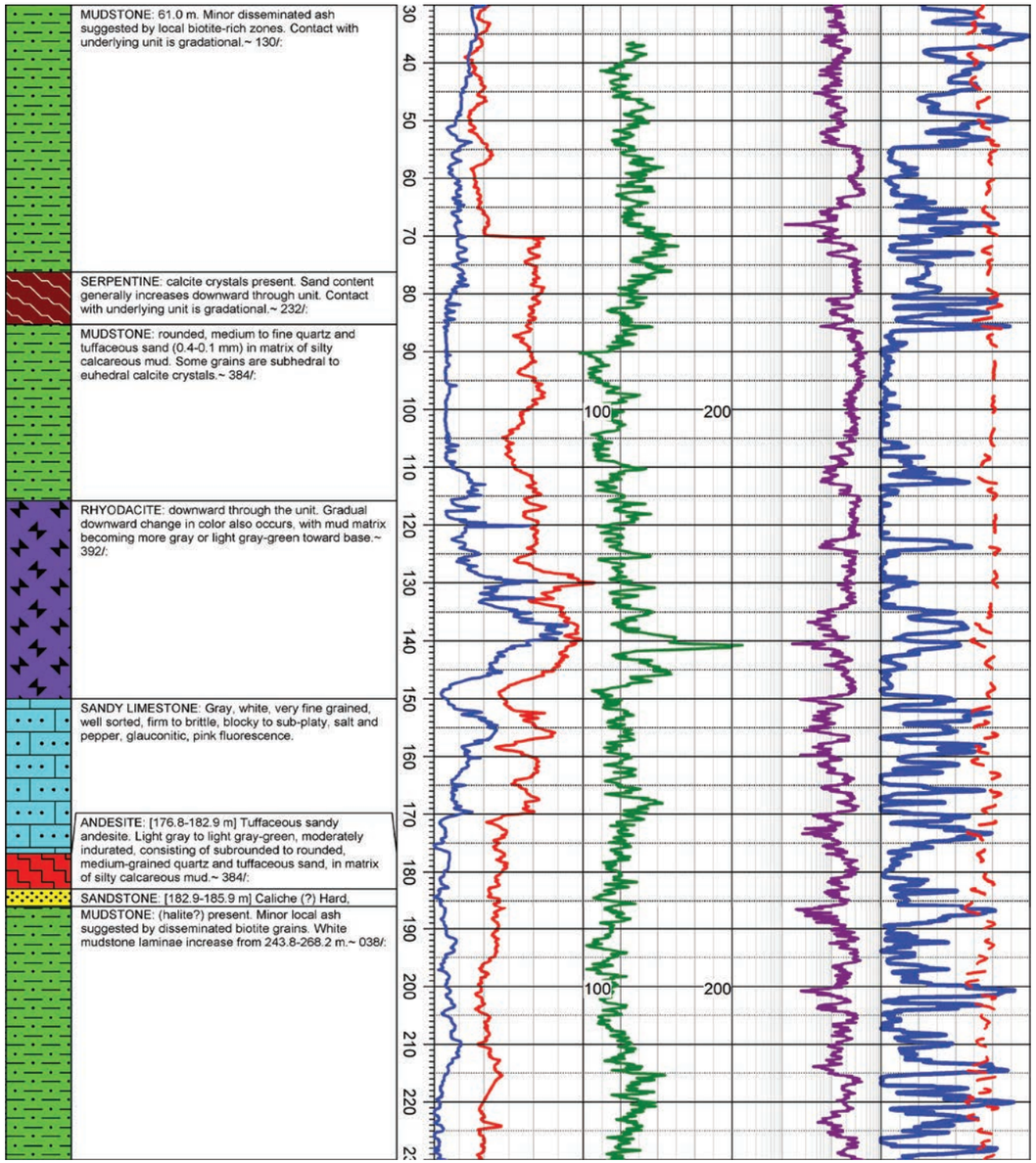












New Streamlined Interface

The LogPlot Data Editor, Log Designer and LogViewer have been Redesigned for use on Multiple Monitors and to make the creation and modification of logs easier than ever. Improvements to many of the import/export tools (PDF, Excel Multi-sheet, LAS)

Single $899 Network $1,573 Academic $299
Download free trial at rockware.com

The Log Designer

The Log Designer allows you to quickly design borehole and well logs and modify existing design templates.

- Easy to use, with point, click, multiple-select and alignment capabilities
- Multi-pane re-vamped design window displays headers, footers and log body
- Two header and footer designs, full page report header
- Well information linking between data file and header/footer fields
- Macros for dates, page numbers and well locations
- Header/footer images, patterns, symbols, curve and bargraph legends, notes and text
- The log body can include any number and combination of columns, including lithology patterns and descriptions, cuttings percent columns, single and cross-plot curves, bargraphs, interval and point-based text, tadpoles, fracture traces (NEW), well construction, raster images, fillbars, water levels and other symbols and scale bars

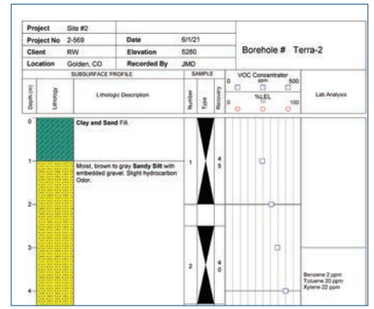
The Data Editor

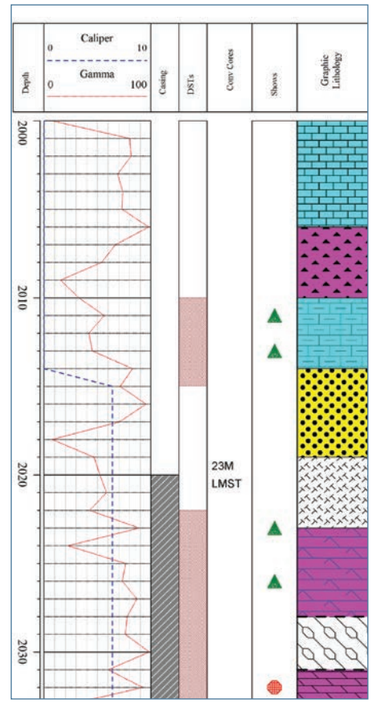
Type, copy/paste and or import your log data into the Data Editor.

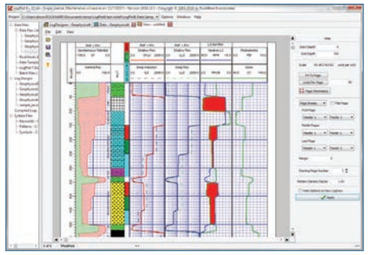
- Tabbed data sheets with a flexible layout, for easy data entry
- Data sheets added on the fly, or automatically updated from the log design
- Double-click access to RockWorks borehole records, data can now be extracted from and written directly to the RockWorks database
- Data import from LAS, Excel, DBF, AGS and text
- Data export to LAS, Excel and RockWorks
- Data types: lithology/stratigraphy, interbeds, cuttings percentages, curves, interval and point-based data and text, general comments, header/footer text and notes, symbols, fillbars, downhole survey, tadpoles, fractures and well construction
- Easy linking of keywords ("sandstone") to graphic patterns and colors

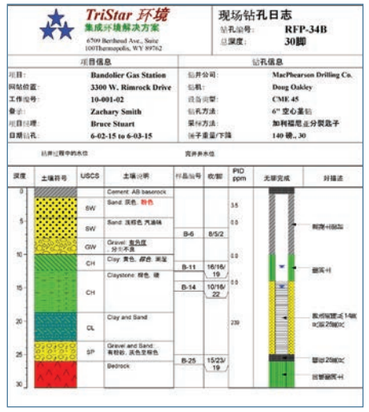
The Log Viewer

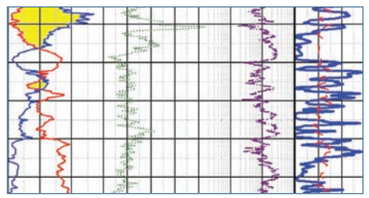
- Create paginated or continuous logs
- Compile and display multiple logs at once
- Quickly re-display logs at any scale and adjust header/footer settings
- Use your mouse to view depth/elevation at any point on the log
- Graphic export options include PDF, HTML (for display online), BMP, JPG, TIFF and PNG
- Print your log, export an image of a single page or export all pages in a single image

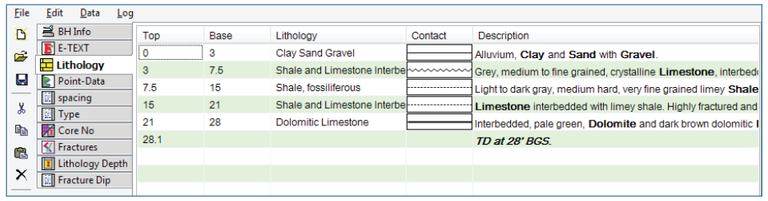












Other New Features in LogPlot8

New Patterns

The LogPlot Pattern Editor now supports the new pattern library with filled shapes and an unlimited number of items.

New Streamlined Interface

The LogPlot Data Editor, Log Designer and LogViewer have been redesigned for use on multiple monitors and to make the creation and modification of logs easier than ever.

New Log Data Tools

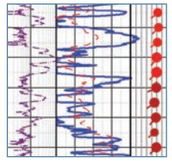
- New text formatting for text descriptions—bold, italic, underline, color, superscript, subscript or symbols
- New wavy and thick contact lines for display in Lithology pattern columns
- LogPlot now supports Unicode for non-Latin characters
- New tools add increased flexibility when defining data page names and columns
- New Data Templates to store customized data entry forms

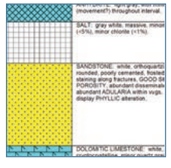
New Log Display Tools

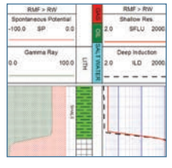
- Header/Footer symbol and pattern legends
- Log body fracture columns and water level symbols
- Offset options for interval text columns
- New color gradient options for log body curves
- New static text macros
- Curve/bargraph headers that can move when the column location is adjusted
- Rotated Header text and notes

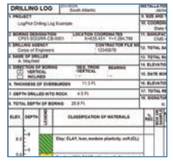
New Network License Manager

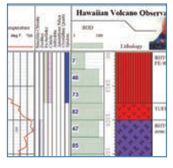
- Easy to set up
- Borrow a license for use in the field

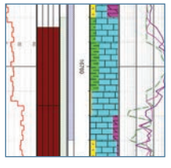










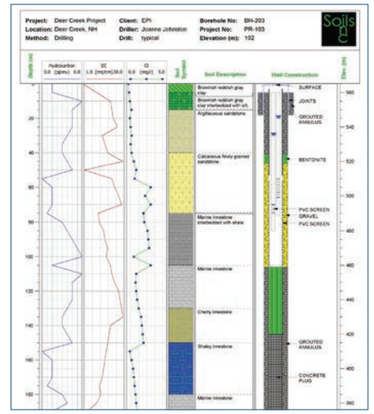


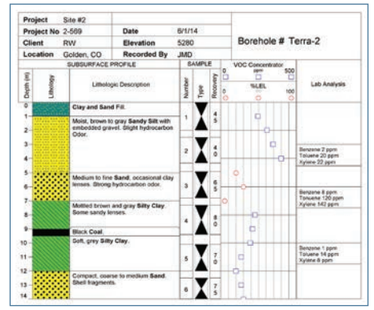
Environmental

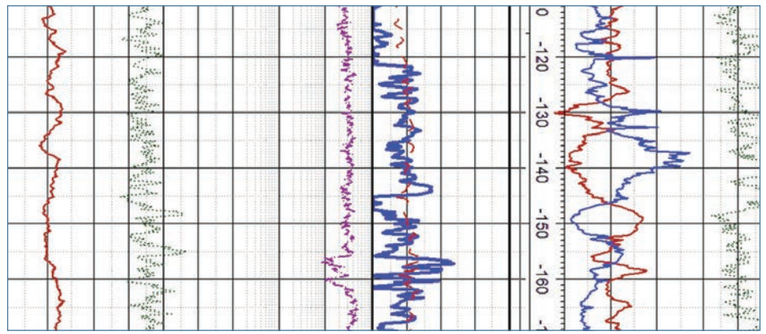
- Soil and rock type symbols and descriptions
- Sample symbols, names, descriptions and data
- VOC data collected from MIP or other sampling devices
- OVA/PID data
- Borehole geophysics
- Detailed well construction diagrams, including nested wells
- Water level data
- Water and soil contamination information
- Blow counts, RQC and other geotechnical parameters

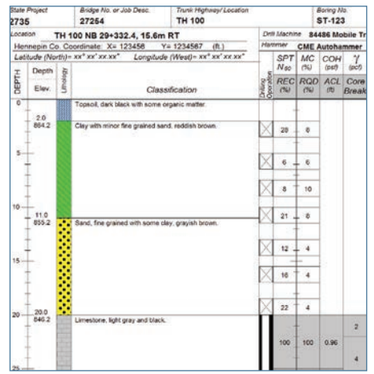
Oil & Gas

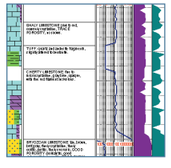
- Well/borehole geophysics
- Gas curves
- Drilling rate, RPM and Weight on Bit
- Lithologic Cuttings data
- Formation tops and descriptions
- Casing and perforation diagrams
- Drill Stem Test intervals
- Fossils
- Core data, including intervals and fractures
- Pay zones and show intervals

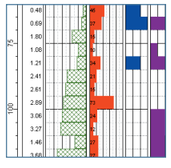


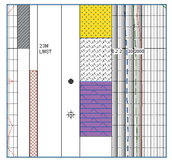


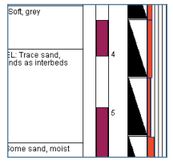


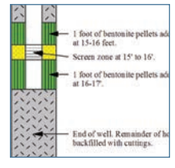


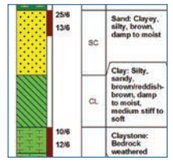




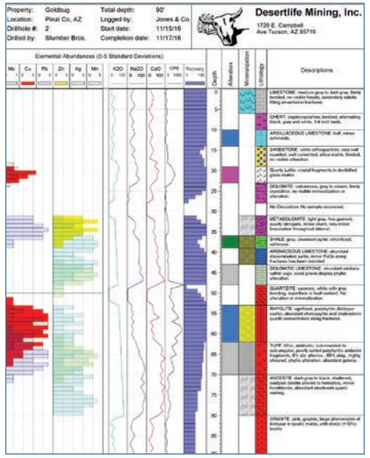


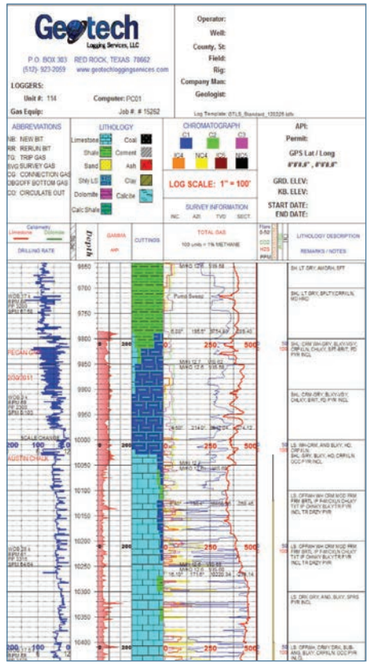






LogPlot® Continued



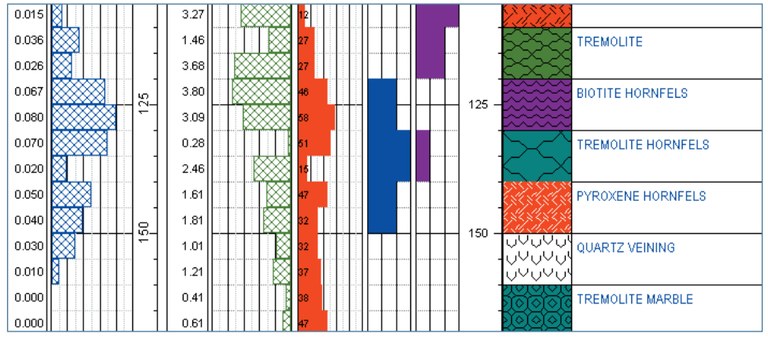


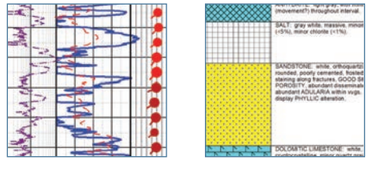
Mining

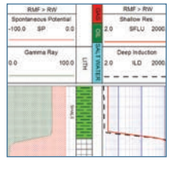
- Soil and rock type symbols and descriptions
- Core symbols and data, including Recovery and RQD
- Assay results
- Munsell Color Codes
- Fracture spacing, filling and orientation
- Alteration, mineralization and oxidation values
- Casing and well construction
- Water level data

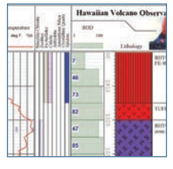
Geotechnical

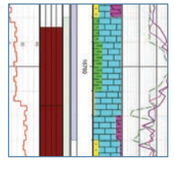
- Soil and rock type symbols and descriptions
- Blow counts, RQD and other geotechnical parameters
- Core symbols and data, including Recovery and RQD
- Fracture information, including spacing, orientation and aperture
- Sample symbols, names, descriptions and data
- Borehole geophysics
- Atterburg Limits
- Grain Size and sieve analysis results
- Water level data
- Water and soil contamination information
- CPT data, plotted as curves or colored intervals











AqQA™

$349

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Still storing your water analysis in Excel®? AqQA was created with water engineers and aqueous geochemists in mind—or for that matter, anyone who keeps water chemistry data in a spreadsheet. Analyzing your water testing data is as easy as 1, 2, 3 with AqQA:

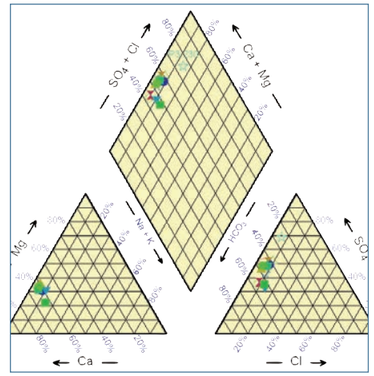
1) Paste your water analysis data in the "Data Sheet" tab
2) Click on the "Data Analysis" tab to check water testing data for internal consistency, and view other calculated water properties
3) Use the "New Graph" tab to create publication quality graphics—includes Piper diagram, Stiff diagram and nine other plot types

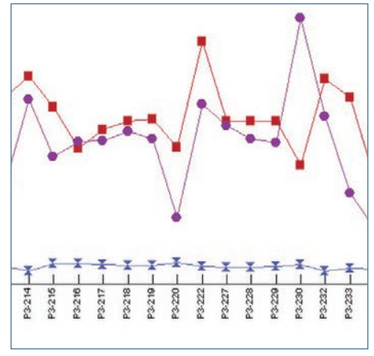
AqQA features

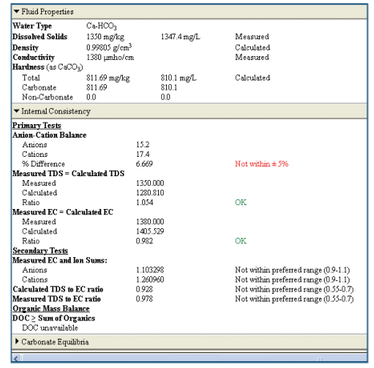
- Six tests for water data consistency according to AWWA 1030-E Standard Methods
- 11 plot types: Series, Time Series, Cross Plot, Ternary, Stiff, Piper diagram, Durov, Schoeller, Ion Balance, Pie Chart and Radial Plot
- Calculates carbonate equilibria, TDS, density, conductivity, hardness and more
- Flags violations of water quality standards
- Check replicates and standards
- 200 pre-defined analyte types—inorganic, organic, biological assay, radioactivity, isotopes—or define your own

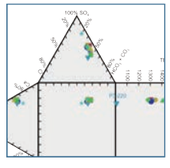
With the AqQA spreadsheet, you can:

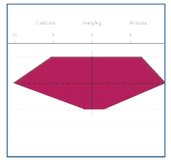
- Paste data directly from Excel
- Convert units with a mouse click—no more keying in mole weights
- Use common spreadsheet tools such as copy, paste, transpose, sort and many others
- Compare replicate analyses and check standards
- Mix samples
- Flag exceedances of regulatory limits
- Check for internal consistency against AWWA standards
- Calculate fluid properties such as water type, TDS, hardness, conductivity and carbonate speciation
- Calculate calcite saturation and CO2 fugacity
- Quickly create Piper, Stiff, Ternary, Durov and seven other plot types

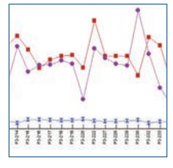


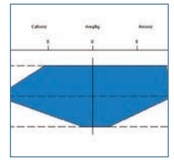


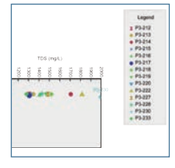


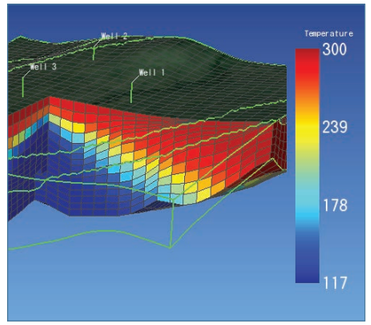


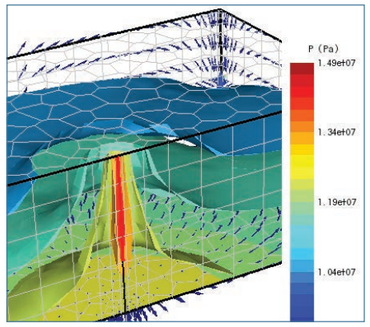


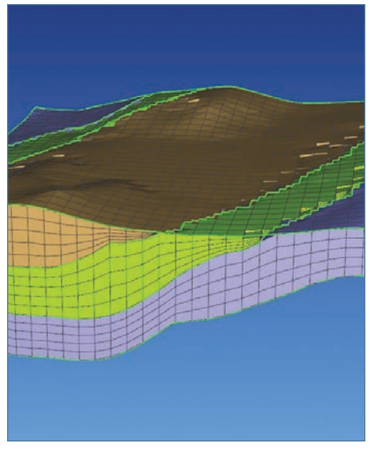












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Solve Challenging Subsurface Flow Problems with PetraSim

PetraSim is the graphical interface for the TOUGH family of simulators. Developed at Lawrence Berkeley National Laboratory, TOUGH2 and its derivatives are recognized for their broad range of subsurface simulation capabilities, including heat and multi-phase flow and reactive transport. PetraSim helps you access the power of TOUGH2 in an integrated 3D environment that includes mesh generation, parameter definition, execution and display of results. Save valuable time and increase model reliability with PetraSim.

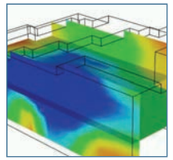
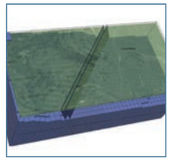
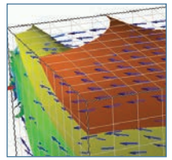
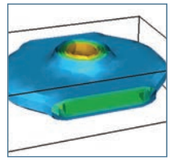
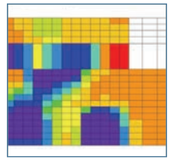
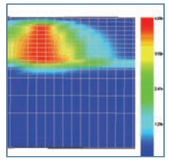
Interfaces

- **TOUGH2/TOUGH3***– for multi-phase fluid and heat flow in porous and fractured media
- **T2VOC**– for 3-phase flow of water, air and a volatile organic compound
- **TMVOC**– for 3-phase flow of water, gas and a multicomponent mixture of volatile organic compounds
- **TOUGHREACT***– for coupled modeling of subsurface multiphase fluid and heat flow, solute transport and chemical reactions

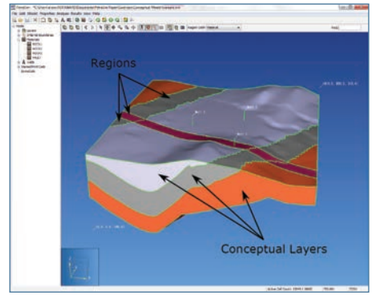
*Use of TOUGH v2.1 or v3 and TOUGHREACT v2 or v3.32 requires the purchase of the simulator through Lawrence Berkeley National Laboratory in addition to the PetraSim interface.

Applications for PetraSim and the simulators it supports include:

- Coupled process modeling (thermal, hydrologic, chemical, mechanical, biological)
- Carbon sequestration and hydrocarbon recovery
- Performance assessment of nuclear waste repositories
- Geothermal reservoir studies
- Vadose zone hydrology
- Fate and transport of volatile organic compounds
- Design and analysis of laboratory and field experiments

PetraSim Features

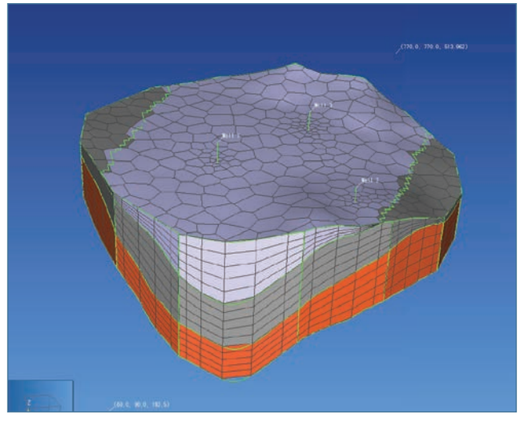
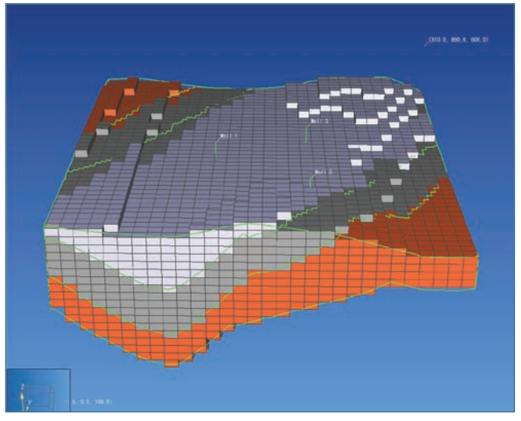


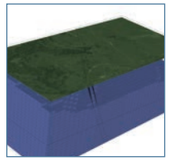
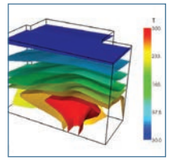
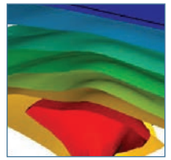
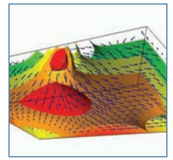
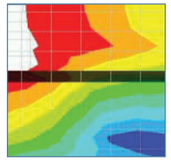
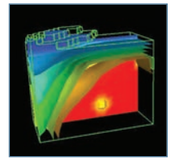
3D Conceptual Model Creation

- Define LAYERS and REGIONS as high level geometric entities
- Layers can be broken up into regions using INTERNAL BOUNDARIES, which are surfaces or planes that typically intersect many layers
- Use Layer and Regions to define material properties and physical and chemical initial conditions and spacing of cells in the Z direction
- Create wells to represent well completions through multiple adjacent cells.
- Flow in or out of the model can be evenly apportioned across the cells that intersect the completion interval evenly, or based on thickness and permeability

Mesh Generation and Editing

- Create rectangular, polygonal and simple radial meshes
- Vary the spacing of rectangular meshes in the X and Y directions using a spacing factor or a list of cell dimensions
- Define the dimensions of polygonal meshes based on maximum area and refinement areas around wells or other user-define refinement points
- Create meshes with flat cell layers, or warp cell layers to match conceptual model layer boundaries
- Create non-geometric "Extra" cells to represent special boundary conditions
- Use numerous interactive cell selection tool to assign cell-based properties, including sinks/sources, material type, permeability, porosity, cell volume, print properties and TOUGHREACT zones
- Cell selection tools include layers, regions, statistics regions, intersection with well lines or internal boundaries, material type, sinks/source, print or fixed state cells, and cell layers, columns, rows or vertical columns

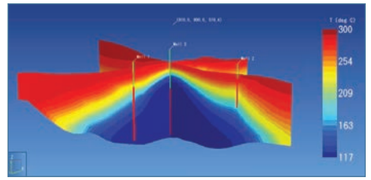



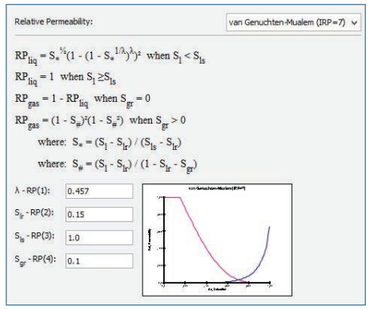







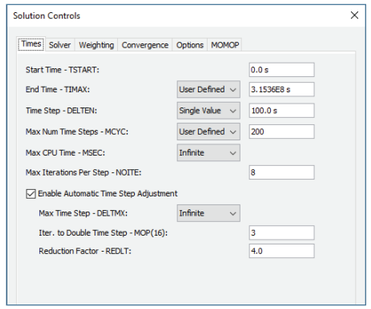
PetraSim Features continued

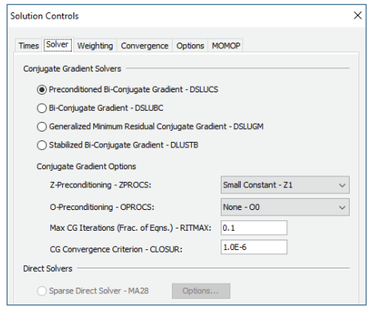
Intuitive Simulation Input

- Define material types/properties, simulation options and solver settings through an intuitive interface
- Dynamic previews of most Relative Permeability and Capillary Pressure curves
- Use a hierarchical system to establish global, layer-based or cell-based initial conditions
- Supports manual entry of new TOUGH3 blocks including the OUTPU and MOMOP tools
- Easily restart model by loading a SAVE or INCON files as cell-based initial conditions
- Link to a TOUGHREACT thermodynamic database to create water chemistry and mineral zones



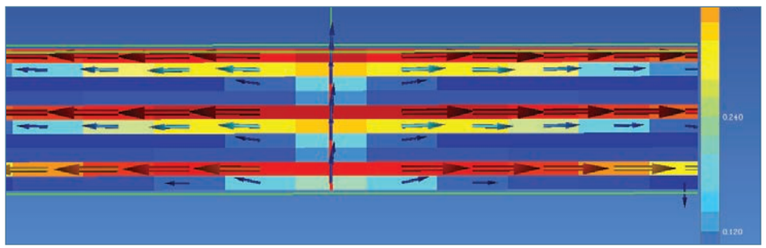


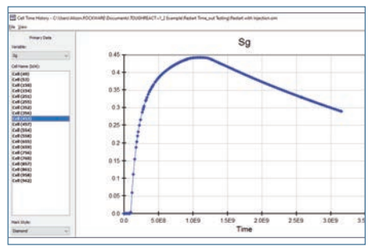


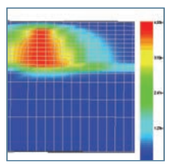


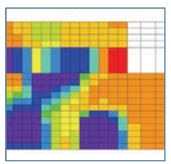
Integrated Result Visualization

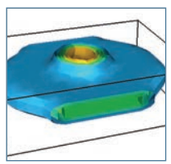
- View 3D model results as isosurfaces, cell plots, slices and vectors
- 2D plots include cell-history plots, well plots and connection plots
- Create line-plots along wells or user-defined traces
- Export data as CSV files for visualization in Excel, TecPlot or other programs

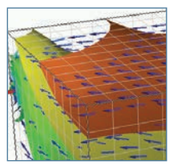


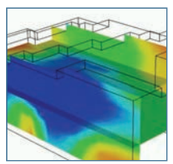


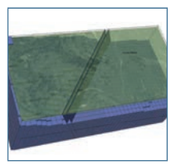




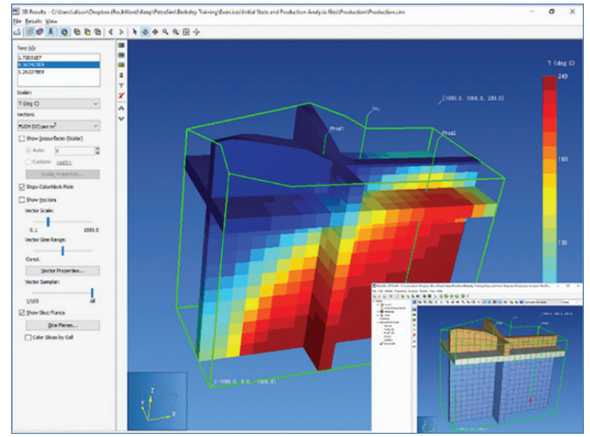








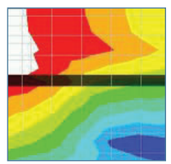
With PetraSim you can:

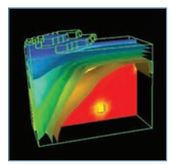


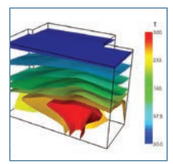
- Create complex flow, reactive transport and heat transfer models
- Dramatically reduce TOUGH2 model creation time
- Eliminate TOUGH2 input errors
- Use the intuitive toolbar for step-by-step guidance
- Select from the many fluid property options for your model
- Use enhanced TOUGH2 simulators available only with PetraSim
- Import well data in batch ASCII files
- Interactively create and edit 3D and axisymmetric grids
- Import rotated XYZ layer geometry and define conforming grids, or import Petrel/Eclipse grids
- Define irregular model boundaries and grids using Voronoi tessellation
- View graphs of relative permeability and capillary pressure functions
- Use dialogs to define solution and output controls
- Seamlessly run TOUGH simulators using the executables integrated into PetraSim
- Graphically monitor the solution progress
- Display 3D iso-surfaces, 3D block plots and vertical and horizontal slices
- Create time history plots of individual cell results, connections and wells
- Use line plots to display results along any 3D line or well trace
- Export result data in comma separated variable format

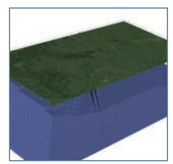
Fluid Properties Modules

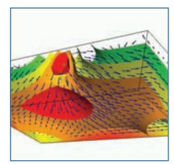
Fluid Property Module	Module Description	Simulator
EOS1	Two Phase Water	TOUGH and TOUGHREACT
EOS2	Water and CO2	TOUGH and TOUGHREACT
EOS3 and EOS4	Water and Air	TOUGH and TOUGHREACT
EOS5	Water and Hydrogen	TOUGH
EOS7	Water, Brine and Air	TOUGH
EOS7R	Water, Brine, Air and Radionuclides	TOUGH
EOS8	Water, Air, "Dead" Oil	TOUGH
EOS9	Saturated/Unsaturated Flow	TOUGH and TOUGHREACT
EWASG	Water, NaCl, Non-Condensible Gas	TOUGH
ECO2N	Water, CO2 and NaCl	TOUGH and TOUGHREACT
ECO2M	Water, CO2, and NaCl, including super- and sub-critical conditions, and phase change between liquid and gaseous CO2	TOUGH (V2.1/V3 only)
EOS7C	CO2 or Nitrogen in natural gas (methane) reservoirs	TOUGH (V2.1/V3 only)
T2VOC	Water, Air, and Volatile Organic Compound	T2VOC
TMVOC	Water, Air, and up to 19 Volatile Organic Compounds	TMVOC

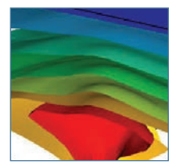




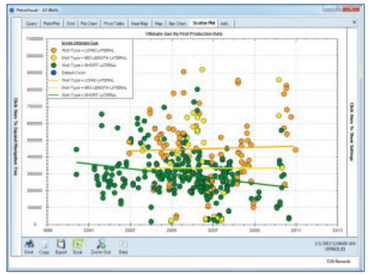








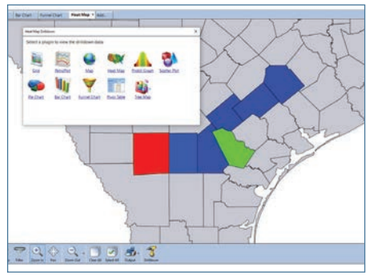
PetroVisual™



$5,000 per year
Download free trial at rockware.com

Well Data Analysis & Visualization

PetroVisual is an analysis and visualization tool for oil and gas data. It connects to a cloud database, updated monthly, that has current well header and production data from 14 states, allowing you to create queries and analyze results with a rich collection of maps, grids, charts, pivot tables, and drill-down trees. States currently supported: CA, CO, KS, LA, MT, NE, NM, ND, OK, PA, SD, TX, UT and WY. PetroVisual licensing is payable each year (annual license).

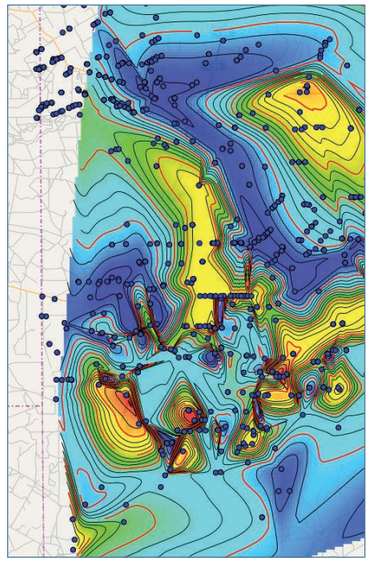


Petrovisual Query Tools

- With PetroVisual's powerful ad-hoc query tool, you can ask detailed questions about your data without the need for complicated query languages or arcane scripting tools. Set filters for each of your data fields using English commands.

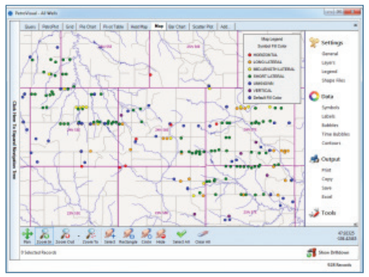
Building Petrovisual Query Filters

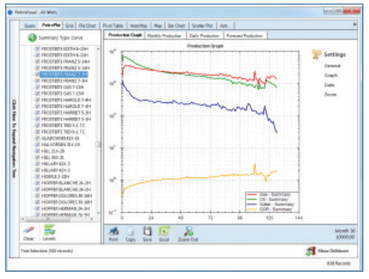
- Build query filters quickly and easily using intuitive drilldown windows and cascading filters which display only the data applicable to the current constraints of the query.

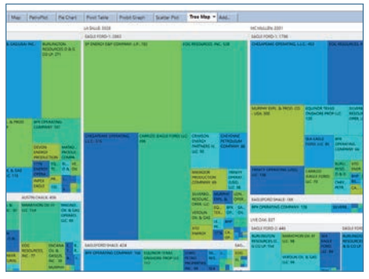


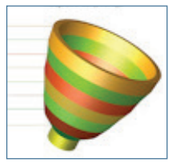
Petrovisual Grids

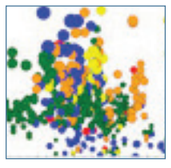
- Grids are a fundamental tool for viewing and analyzing your data. Organize information in rows and columns, select which columns are visible and their order, sort and subtotal grid data, and move grid data into other applications like Microsoft Excel.

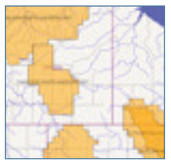


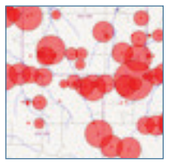












PetroVisual™ Continued

Petrovisual Maps

- The PetroVisual map presents your well locations on a spatially indexed, fully interactive GIS map with a variety of powerful ways to visualize the data.

Petroplot

- PetroPlot combines flexible drilldown trees with graphs and grids to view your time-based data. Organize your wells with levels that you define. Click wells to view production data, tests, type curves, peak rate type curves, and other time data.

Petrovisual Probit Graphs

- Probit Graphs represent the probabilistic distribution ("bell curve") of the selected data values. PetroVisual is then able to fit the data and calculate the P90, P50 and P10 values needed for analysis.

Petrovisual Pivot Tables

- Pivot tables summarize data in a grid by automatically sorting, averaging, counting, and totaling. The PetroVisual pivot table offers an intuitive drag-and-drop interface to quickly and easily transform your data into meaningful summaries.

Petrovisual Bar Charts

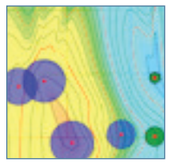
- Bar charts organize data into rectangular bars with lengths that illustrate proportion. Any number in your database can be visualized as a bar chart, and you can group these numbers using any date, text, or numeric database value..

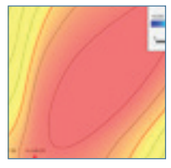
Petrovisual Heat Maps

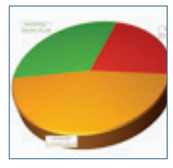
- Heat maps represent your data using color intensities on a map. Group any numeric value in your database by country, state, or county and assign a color range that corresponds to low and high values in your data.

Petrovisual Scatter Plots

- Scatter plots display data as a collection of XY points on a graph. Scatter plots excel at showing relationships between data variables, illustrating data outliers that fall outside the norm, and showing trends with curve fits through the data.







WellCAD®

Starting at $3,682
Download free trial at rockware.com

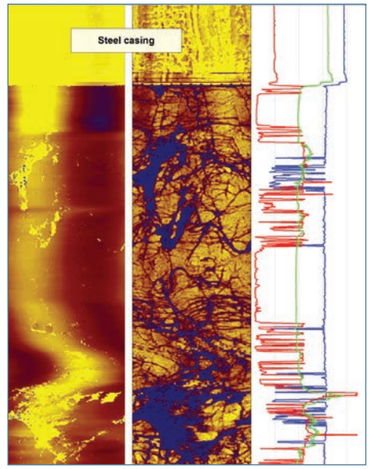
WellCAD is a PC-based composite log package, which combines comprehensive graphic editing mechanisms and data processing tools. Combining technically excellent display, editing and analysis capabilities for well data, WellCAD has become the standard log composite software in the Mining, Oil and Gas and Geotechnical industries and is used in a wide range of applications.

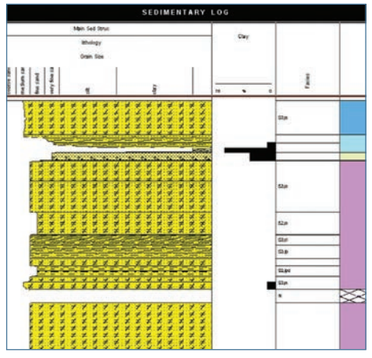
Features

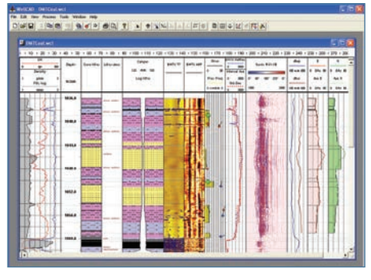
- **Import/Export** – ASCII, CSV, TXT, LAS, BMP, JPG, TIF, GIF, plus many more industry specific formats
- **Data Presentation** – 2D and 3D borehole display of images, curves, intervals, points, lithology, stratigraphy, text, symbols, stacking patterns, biostratigraphy, engineering details and more
- **Depth Management** – Multiple depth management (time, depth, TVD) plus an advanced depth matching tool
- **Editing** – Slice, shift, merge, resample, and filter curves with results displayed alongside the original data
- **Computations** – Formula parser (curve calculator with multiple discriminators)

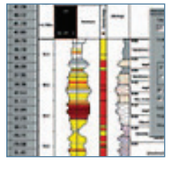
Optional Modules

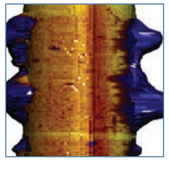
- **Image & Structure Interpretation Module** – Borehole Image and Structure/ Breakout Analysis
- **CoreCAD** – Interactive digital core description
- **Full Wave Processing Module** – Sonic Data Processing and Velocity Analysis
- **LIS/DLIS Module** – Import LIS/DLIS data
- **Deviation Module** – 3D well path visualization
- **Multiwell Module** – Borehole and correlated cross-sections
- **ODBC Connector Module** – Load and save data from/to ODBC compatible databases
- **Automation Module** – Automate your workflow using COM components
- **Casing Integrity Module** – Process multi-finger caliper and ultrasonic televiewer data
- **NMR Data Processing Module** – Derive total porosity, fluid volumes, and permeability from T2 distribution data

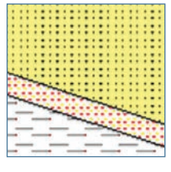


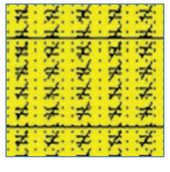


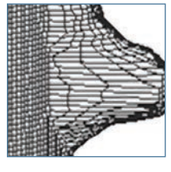


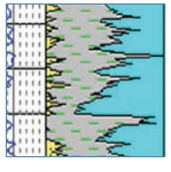








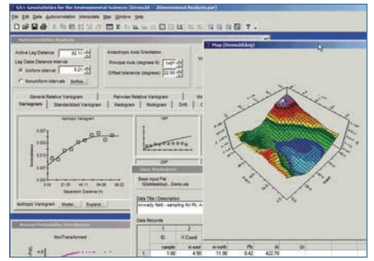




GS+™

$399
Download free trial at rockware.com

The best 2D Geostatistics Software Available.



GS+ provides multiple interpolation options:

- Ordinary Kriging
- Simple and Indicator Kriging
- Cokriging
- Conditional Simulation
- Inverse Distance Weighting (IDW)

GS+ works for you

GS+ is geostatistics, which provides a way to better understand the autocorrelation inherent in spatial data — and to use this knowledge to create optimal, unbiased maps with known error.

GS+ provides easy access to these computationally intensive analyses. Whether analyzing oil deposits, plankton distributions, sun spot patterns, infectious disease outbreaks, or soil resources, GS+ provides the power of geostatistics.

- Powerful variogram models with full user control
- Fast kriging and conditional simulation
- Customized maps, easily exported
- Over 1 million input records

Mapping

GS+ provides 3D, 2D, and 1D maps of interpolated spatial data. Display maps with different contouring schemes, rotate 3-dimensional maps on the fly, and zoom in to view a transition or other map feature. Display estimation error as variance or standard deviation of interpolated means and display original data locations as sample postings.

Semivariance Analysis (Variograms and Semivariograms)

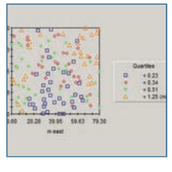
GS+ provides semivariance analyses as both isotropic and anisotropic variograms (also called semivariograms). Take complete control over separation intervals to create optimal variograms. Choose constant interval classes or define different breakpoints for every lag class. Anisotropic directions can be individually targeted, and variograms can be scaled to sample variance.

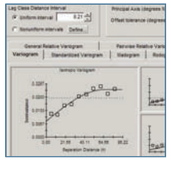
Quick Geostatistical Analysis

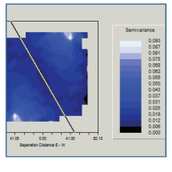
Whether analyzing oil deposits, plankton distributions, sun spot patterns, infectious disease outbreaks, or soil resources, GS+ allows ready access to the power of geostatistics.

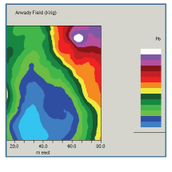
Import Export Flexibility

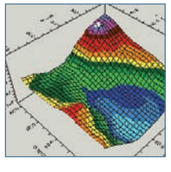
GS+ interpolation files can be read by many other types of mapping programs. Enter data using Excel spreadsheets, database files, or cut and paste from your favorite source. The GS+ data worksheet accepts over a billion records. Output is written to ASCII files that can be subsequently used by GS+, ArcView®, RockWorks®, or other mapping and GIS programs.

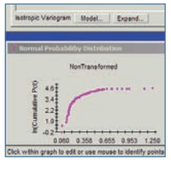








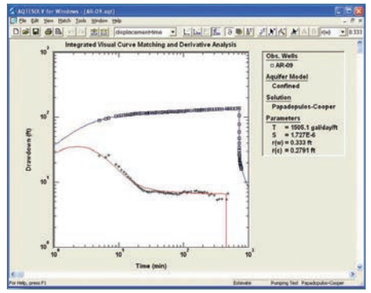




AQTESOLV™

Starting at $500
Download free trial at rockware.com

AQTESOLV is the original all-in-one package for the design and analysis of aquifer tests. From entry of field data to test analysis and report generation, AQTESOLV offers a complete and easy-to-use set of tools for the interpretation of pumping tests, slug tests and constant-head tests. AQTESOLV is the only aquifer testing package to feature an important new solution by Tartakovsky and Neuman (2007) for pumping tests in unconfined aquifers including effects from the unsaturated zone.



Recently Added Features:

- Agarwal method for recovery analysis, distance drawdown plots, horizontal wells, groundwater mounding tools
- Automatic image well generation for bounded aquifers

A Complete Package

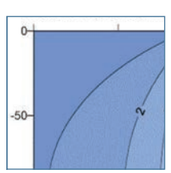
- Data entry wizards
- Import wizard
- Diagnostics and derivative analysis
- Solution expert
- Visual curve matching
- Automatic curve matching
- Interactive sensitivity analysis
- Statistical analysis of results
- 17 plots and reports
- Contouring
- Test design and drawdown prediction
- Context-sensitive help

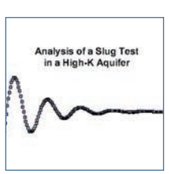
Comprehensive Test Methods

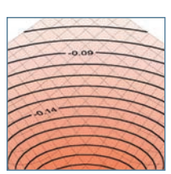
- Pumping tests
- Variable-rate tests
- Recovery tests
- Intermittent pumping tests
- Injection tests
- Step-drawdown tests
- Single-well tests
- Slug tests
- Constant-head (constant-drawdown) tests

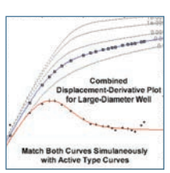
Advanced Solutions

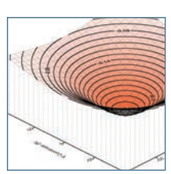
- Double-porosity models
- Single-fracture models
- Generalized radial flow model
- Horizontal wells
- Interceptor trenches
- Confined/unconfined conversion
- Water-table aquitard
- Wedge-shaped aquifers
- Channel aquifers
- Nonuniform aquifers
- Oscillatory slug tests
- Groundwater mounding

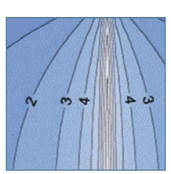












MapInfo Pro®

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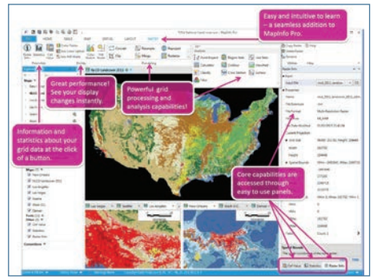
MapInfo Professional® is a powerful mapping and geographic analysis application. Designed to easily visualize the relationships between data and geography, MapInfo Professional helps business analysts, planners, GIS professionals—even non-GIS users—gain new insights into their markets, share information-rich maps and graphs and improve strategic decision-making.



MapInfo Professional expands location intelligence

- Discover trends hidden in spreadsheets and charts
- Perform powerful data analysis and calculations
- Create custom maps and diagrams for analysis
- Now 64 bit for faster computing, better graphics and larger files

Use geographic insights to innovate business processes

- Manage location-based assets, people and property
- Optimize service and sales territories for greater efficiencies
- Deploy networks, infrastructure and utilities with confidence
- Map resources, plan logistics and prepare for emergencies

Display

Map display options are a key function of MapInfo Professional. You can instantly shade, change style or mark key map items. Items include territories, boundaries, highways, fiber lines or points based on any tabular data values through a simple wizard using static symbols, graduated symbols, charts or graphs.

Data access

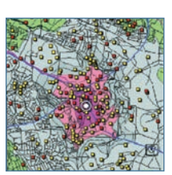
MapInfo Professional provides built-in support to access and view a variety of data formats directly. View your Microsoft Excel®, Microsoft Access®, Oracle®, Microsoft® SQL Server and other file formats directly. You can also view images of virtually any format.

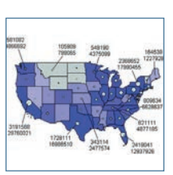
Data creation and editing

MapInfo Professional provides CAD data creation and editing tools to edit your tabular data such as values and names. Make all of your map and data changes in one application.

Data and map publishing

MapInfo Professional provides a spectrum of options for this purpose. From the ability to export data to any format, to publishing large maps with legends and charts, MapInfo Professional seamlessly integrates across applications. In addition, MapInfo Professional is Web-enabled to publish static or interactive maps through easy-to-use wizards.





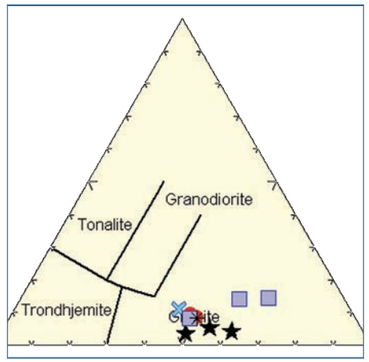
IgPet™

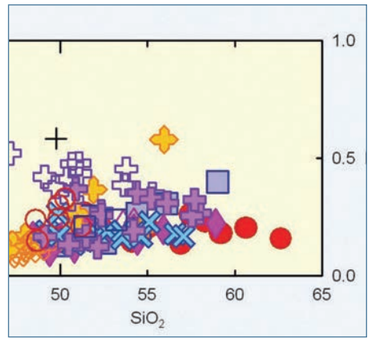
Single $299 Academic $199

Igpet provides tools for teaching and research in Igneous Petrology, allowing users to develop their own data files and use graphics routines to discover and interpret patterns of geochemical variation.

Igpet comes with several data sets, including low pressure cotectic data, moderate pressure cotectic data, MORB glasses, and several suites of calc-alkaline rocks from Central American volcanoes.

Igpet draws most types of petrologic diagrams, including Harker, Fenner, triangular and log plots. A calculator includes (- / *), Log, square, square root, ppm and chondrite functions. Special purpose diagrams, e.g. the Irvine and Baragar (1971) rock classification scheme, are stored in control files that can be expanded easily. CMAS projections include O'Hara, Walker, Grove, Baker and Eggler etc. Spider diagrams include REES, Wood, Thompson, Sun and McDonough, etc.



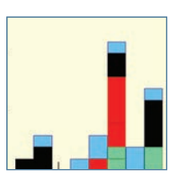
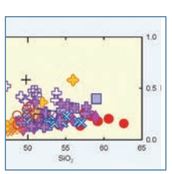
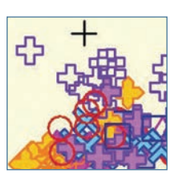
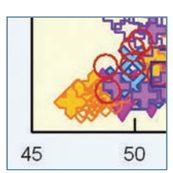


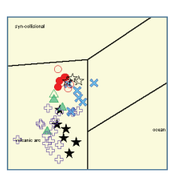
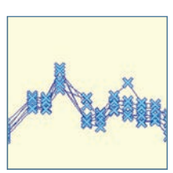
Here are a few of Igpet's Features

- Discrimination diagrams for rock types and tectonic settings
- Publication quality output for transfer to draw programs
- Simple data format with easy transfer of data to/from Excel
- Igpet draws most types of petrologic diagrams, including Harker, Fenner, triangular and log plots. Spider diagrams include REE element ratio plots, Wood, Thompson, Sun and McDonough etc.
- CIPW norms within Igpet; fractional crystallization and magma mixing calculations in Mixing.exe
- Simple X-Y plots that allow Melt modeling, AFC modeling, hyperbolic mixing, linear regression
- Mixing, Melting and AFC modeling of multiple elements and isotope ratios simultaneously using the element suite in popular spider-diagrams — this is where Igpet gets powerful!

Available for PC or Mac users.

- The latest versions of Mac OS Catalina, Big Sur, and Monterey are supported.
- The new version of Igpet for Windows is compiled simultaneously from the source code using XoJo which improves graphics output and eases installation.

Notes

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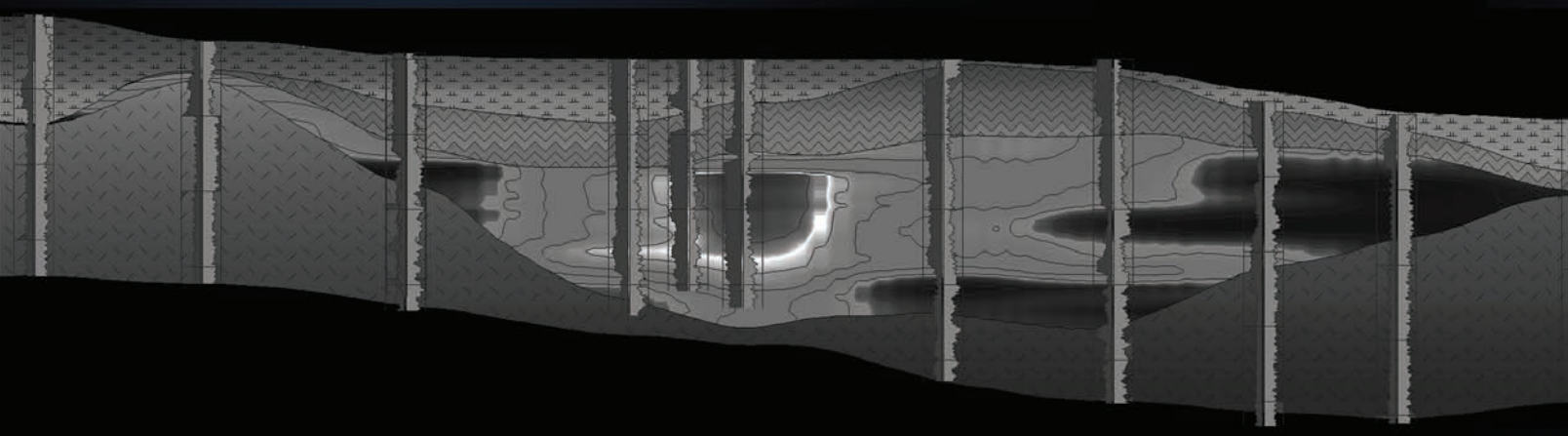

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