Continuous Strata Section and Derivative Logs Module

Quick start guide and tutorials

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About the Continuous Strata Section & Derivative Logs Module

The Continuous Strata Section & Derivative Logs module is a cross-section tool converting a spatial sequence of digital logs (curves) into a **High-Resolution Continuous Strata Section** flattened on a selected stratum. The Continuous Strata Section module is capable of correlating thin and very thinly interbedded continuous ductile shale and stiffer tight sandstone/carbonate packages. Correlation can run in automatic, semi-automatic (guided), or manual mode, so you will always get a continuous subsurface image.

The application can also generate derivative logs in **Batch Mode** for further use in cutoff or Interval Statistics-based reservoir mapping packages. You have to point the Batch Processor to the source and destination LAS folders. The Batch Processor helps complete tasks in an automated way with as little human interaction as possible. Derivative LAS curves include: BIPOLE LOGS, VSHALE, effective porosity PHIE, all types of TOC (Total Organic Carbon), RADIASISTIVITY LOG, IONIC PERMEABILITY, Young's modulus, Poisson's ratio, etc.

The module is a 64-bit .NET desktop application written in C#. It also can be deployed in the cloud in DaaS (Desktop as a Service) mode.

Why the Continuous Strata Section Has Become Important Today

The Continuous Strata Section & Derivative Logs approach has become essential in modern geology and reservoir engineering for several critical reasons:

- Unconventional Reservoirs: Modern energy exploration targets tight sandstone, carbonate, and shale plays. These formations consist of thin, complex, and closely interbedded layers rather than massive, uniform rock packages.

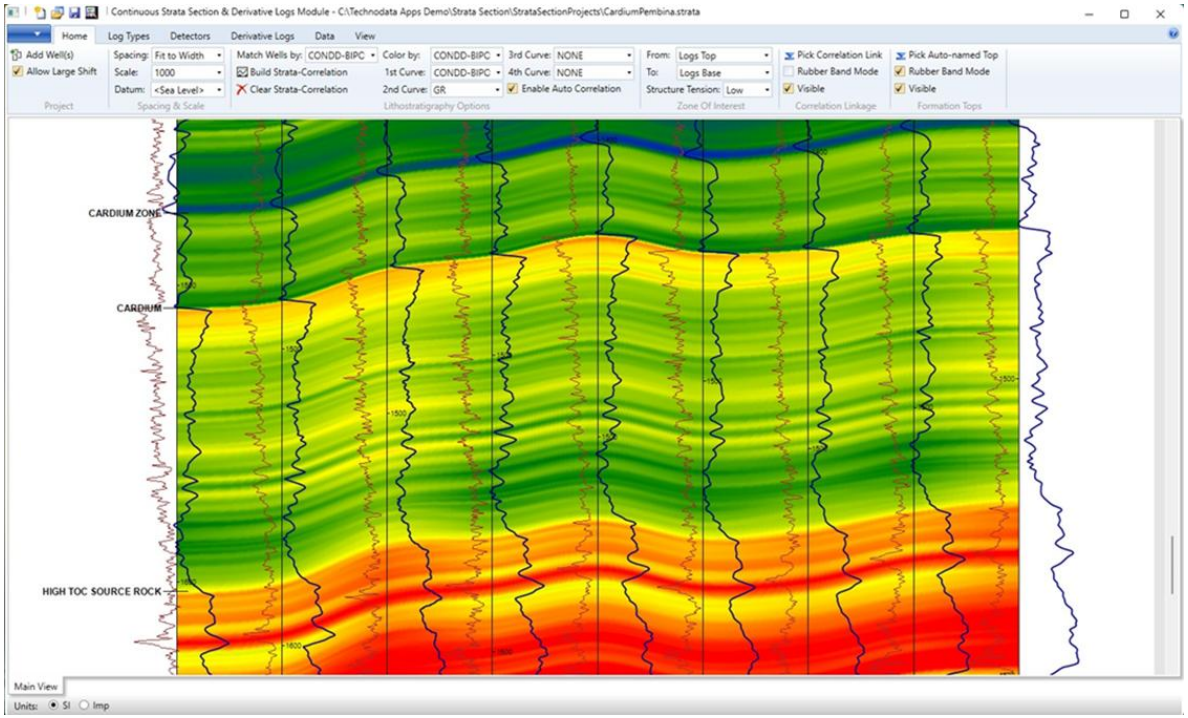
- Sweet-Spot Identification: Finding high-quality target zones requires high resolution. Traditional correlation methods smooth over these subtle variations, missing local anomalies and high-flow pathways.

- Geosteering and Drilling Accuracy: Landing horizontal wells accurately inside narrow reservoir windows demands continuous, ultra-high-resolution subsurface models.

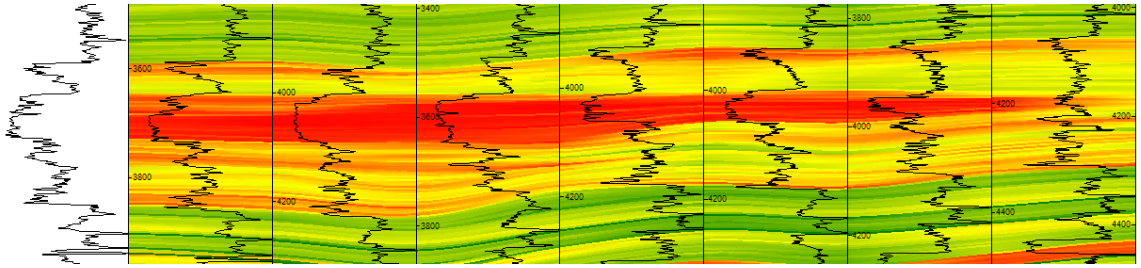
- Hydraulic Fracturing Design: Geomechanical properties like Poisson's ratio and Young's modulus change rapidly across thin layers. Mapping continuous strata prevents hazards like unintended fractures breaking into bounding "thief zones."

- Advanced Automation: Transitioning from manual, bed-by-bed matching to automated digital log correlation enables teams to process hundreds of wells instantly, shifting the focus from data compilation to rapid asset optimization.

The Continuous Strata Section module is capable of correlating thin and very thinly interbedded continuous ductile shale and stiffer tight sandstone/carbonate packages (mechanical facies), which can potentially complicate hydraulic fracturing and **lead to screened-out stages** (where the fracture cannot accept further sand or proppant, allowing only the fluid into the formation) or lead to **horizontal bedding plane failure** (where the fracture is more contained than expected due to difficulty propagating vertically across bedding planes). For example, "*The Cardium cannot be treated as a single mechanical unit that will fracture top to bottom as previously thought… rock fabric has a greater control on fracture patterns and breakdown pressure than composition*." (Page 77, Hill, D. W. 2016. Relationship Between Facies and Fracture Characteristics, Cardium Formation, Western Alberta, Canada. Master's thesis, University of Calgary, Calgary, Canada). Also, if you are going to drill a long horizontal lateral, it is worth building a Continuous Strata Section along the proposed trajectory beforehand using nearby vertical wells. You can also generate a High-Resolution Continuous TOC (Total Organic Carbon) Strata Section along proposed laterals as shown in Tutorial 3.

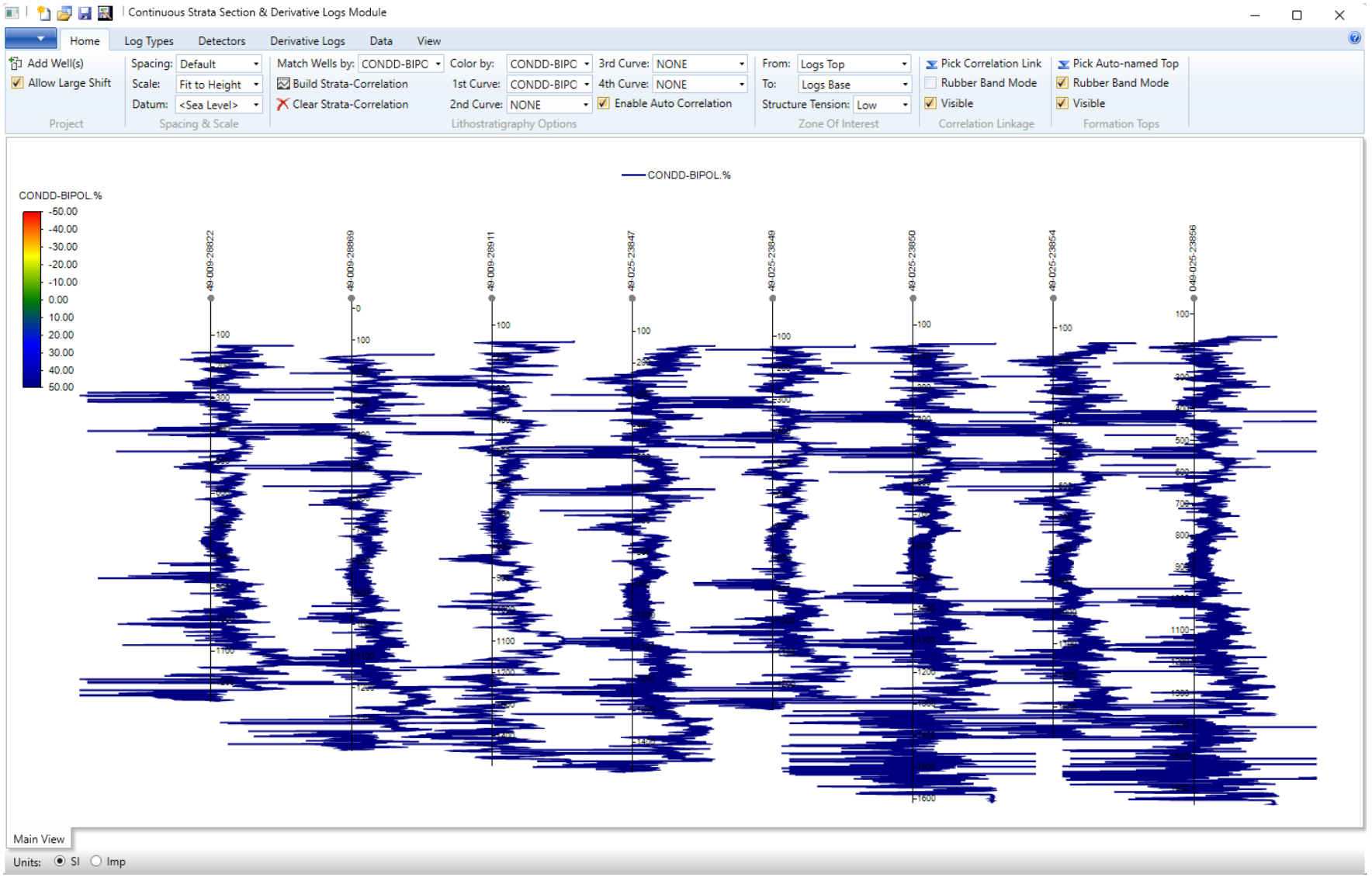


A High-Resolution Continuous Subsurface Image allows you to delineate gradually shaled **"cul-de-sacs", "dead-ends", "pinch-outs",** and facies changes which can affect a water injection program. Potentially, it can also be used to locate new, subtle traps (**lithologic stratigraphic traps**).



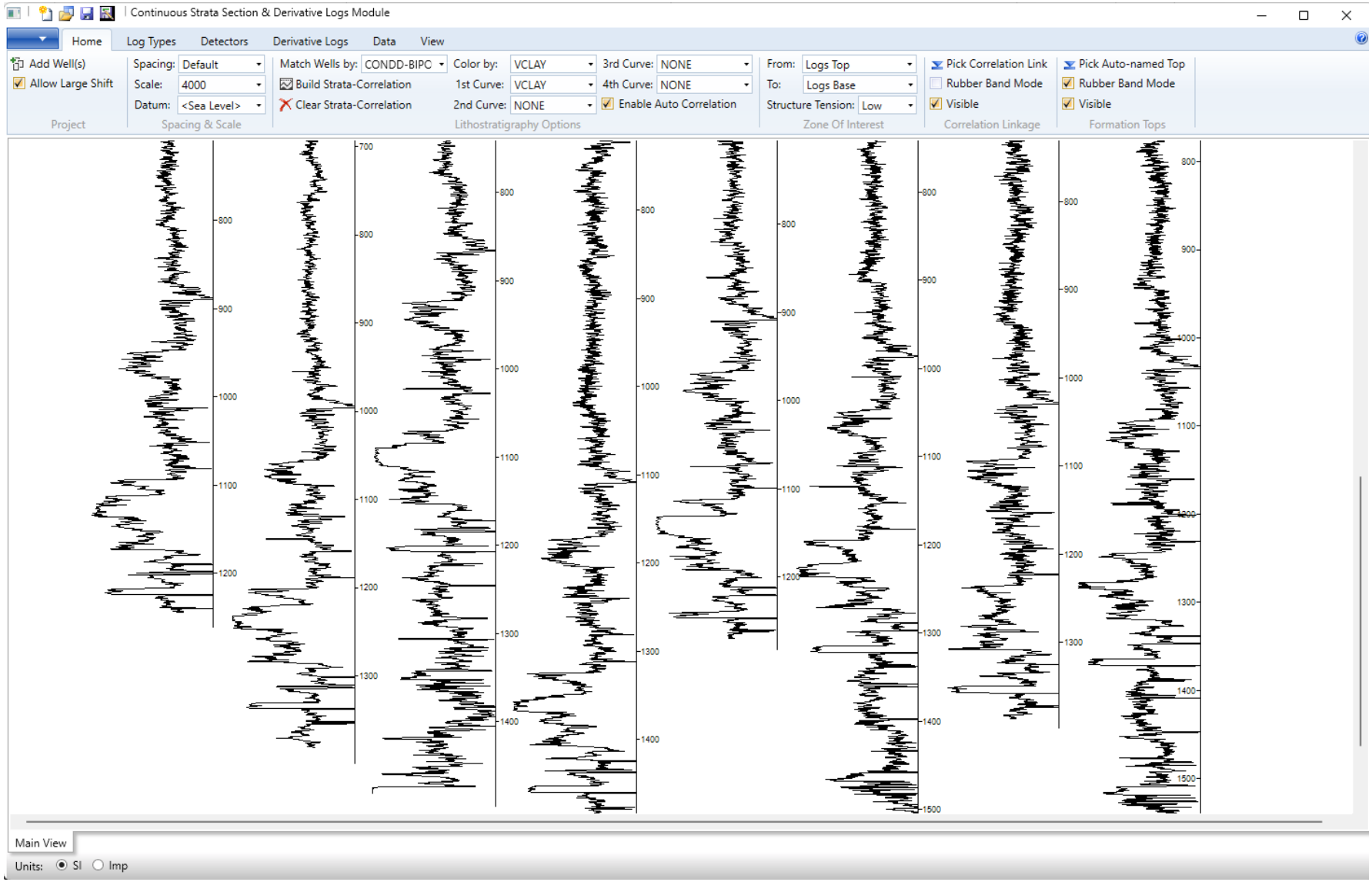
Bringing LAS Data into a Project (Tutorial 1)

Launch the Strata Section module and, using the "**Add Well(s)"** button, bring your LAS wells on a "one-by-one" basis into the project in spatial order. Or, you can select multiple LAS files and then reshuffle the wells using "**Move Well to the Left/Right**" from the context menu. The application supports LAS 2.0 and is also perfectly paired with Composite LAS 2.0 files. In this tutorial, navigate to the supplied tutorial LAS folder …Tutorials\Strata Section\BROOKS RANCH LAS, select all files, and click Open. You should see the rendered derivative curves CONDD-BIPOL (generated "on-the-fly" from Deep Conductivity CONDD < Deep Resistivity RESD) as shown below..



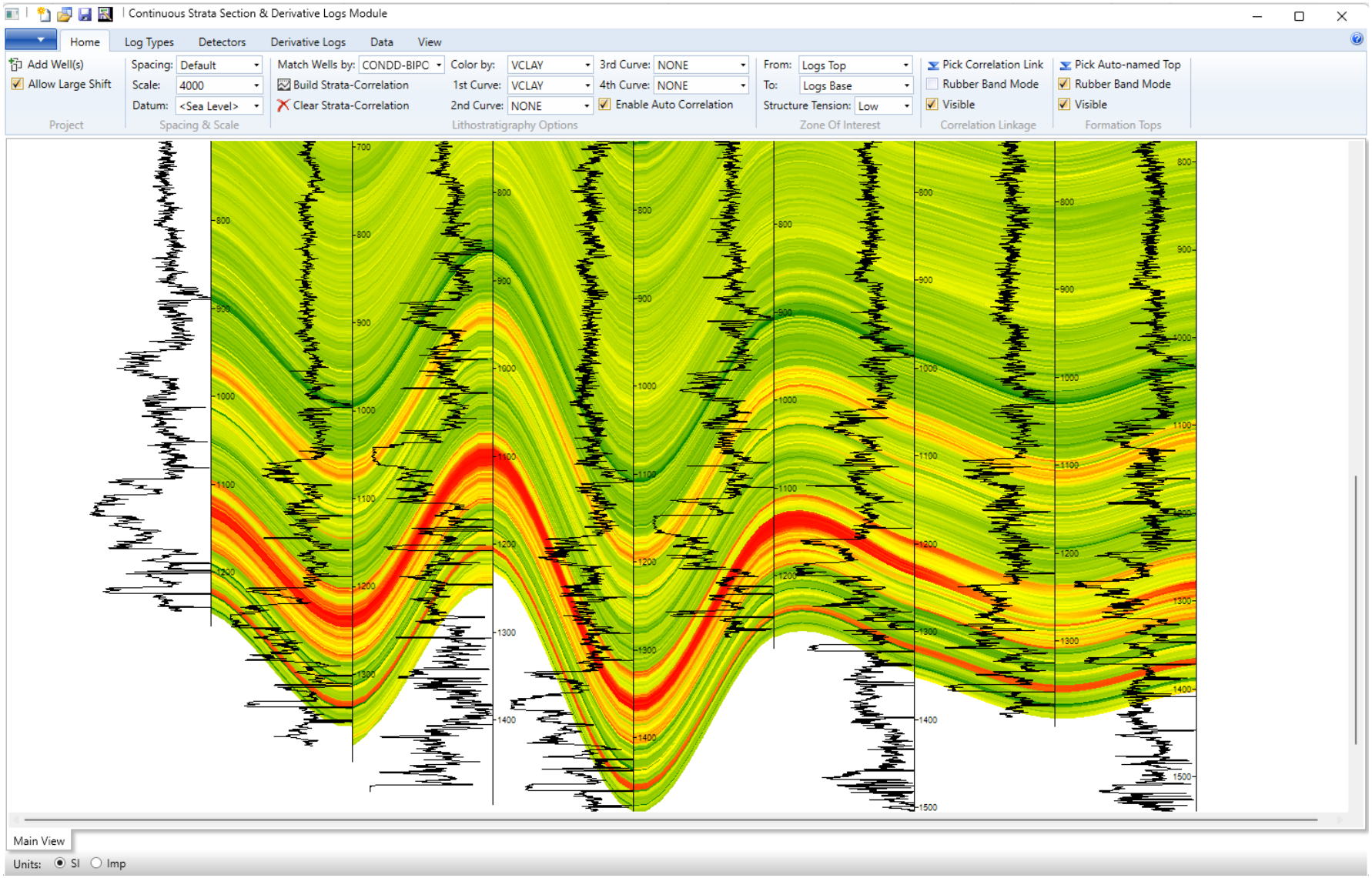
Changing the Scale and Rendered Curve Type

Go to the ribbon "**Spacing & Scale**" group and change the scale to **4000**. Then, from the "**Color by**" drop-down box, select the rendered curve type "**VCLAY**".



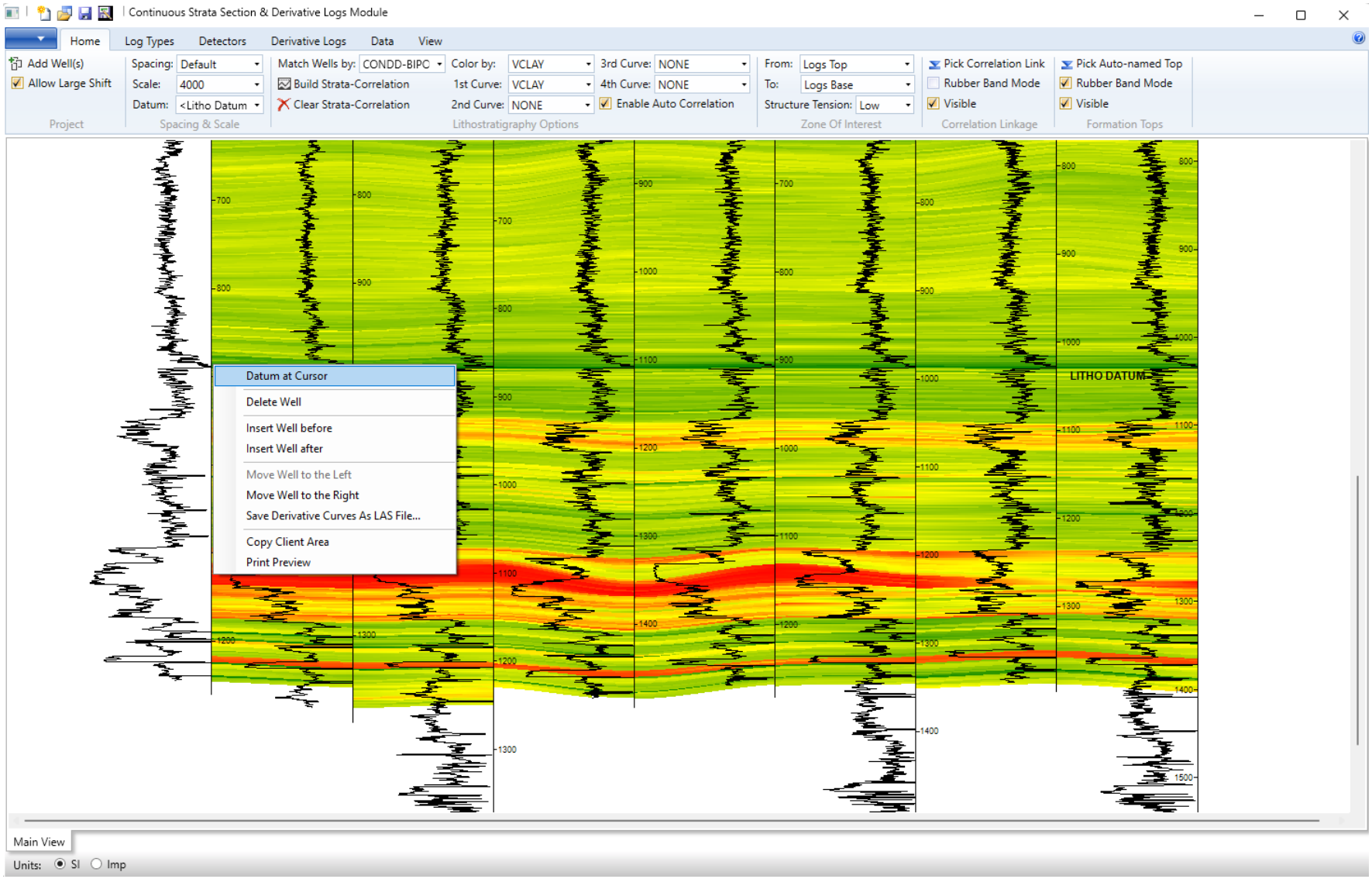
Building a Strata Correlation

Click "**Build Strata-Correlation**" to start the correlation process running in parallel on multiple cores. The correlation will be done using the curve selected from the "**Match Wells by**" combo box. The default is the derivative curve **CONDD-BIPOL** (generated "on-the-fly" from Deep Conductivity CONDD < Deep Resistivity RESD).



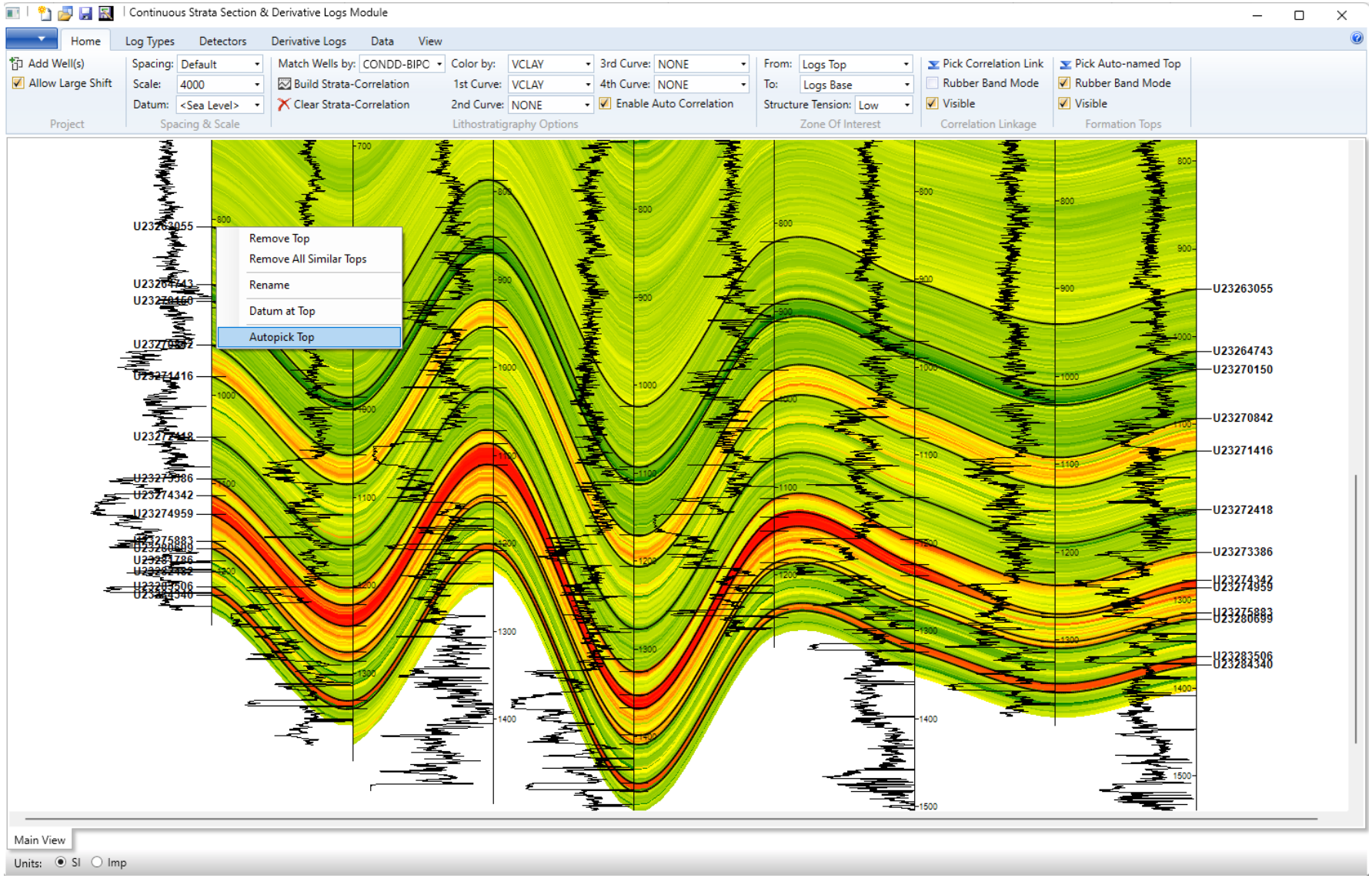
Flattening on the Cursor (“Litho Datum”)

Once you build the strata correlation, you can flatten the strata section even if no tops have been picked yet. Place the cursor near the borehole line on a laterally continuous stratum, right-click, and, from the context menu, choose “**Datum at Cursor**”. You should see the “**LITHO DATUM**” label appear on the right side of the strata section after flattening the strata section, as shown below.



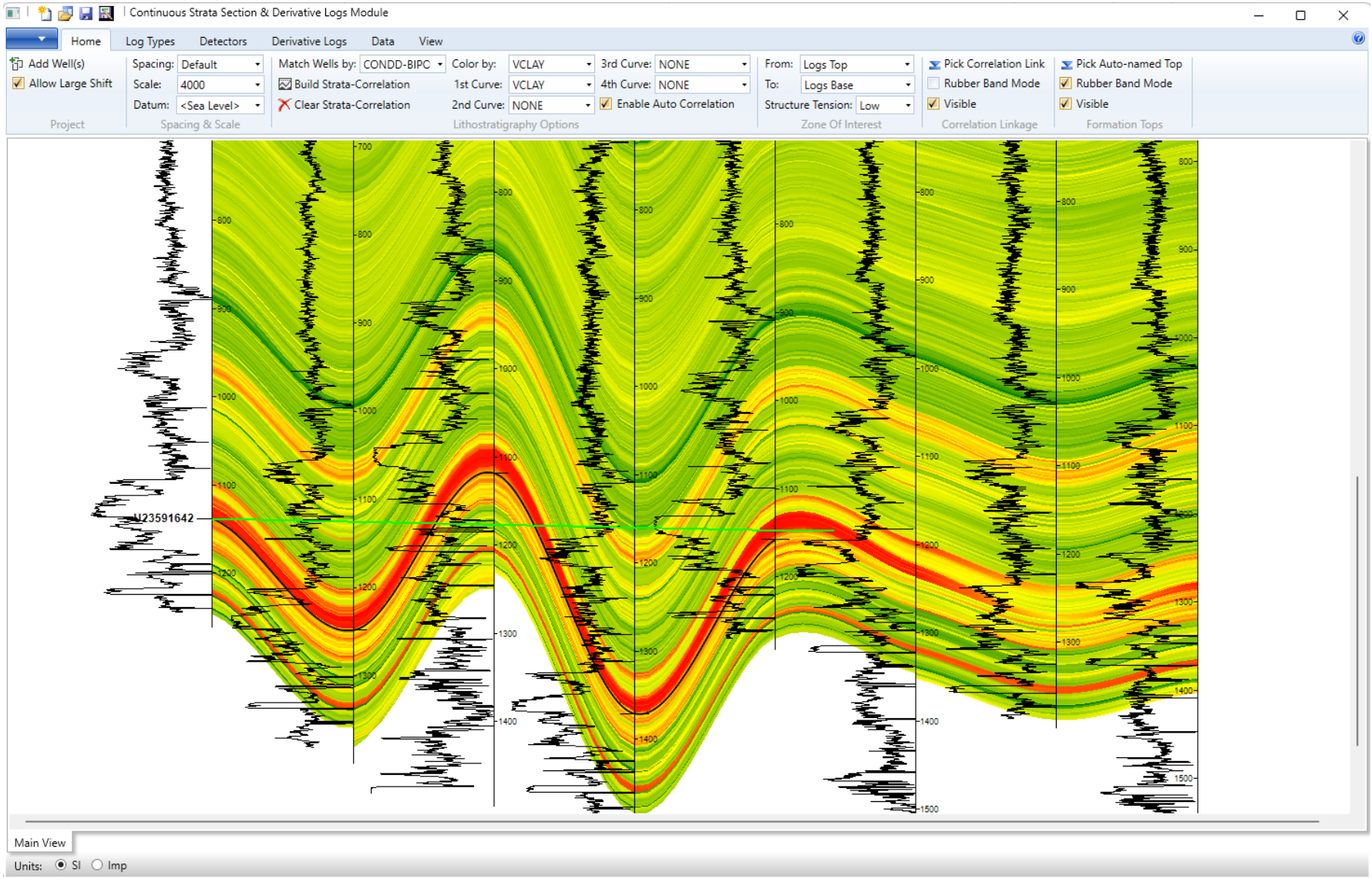
Picking Tops in Automated Mode

Once you build the strata correlation, tops can be picked in an automated way. Click "**Pick Auto-named Top**" and place a top within a single well, right-click on it, and, from the top context menu, select "**Autopick Top**" to populate tops across the strata section. It is a quite useful feature, especially when you are trying to build a detailed, high-resolution stratigraphic framework. Auto-named tops can be renamed at any time using the top right-click context menu.



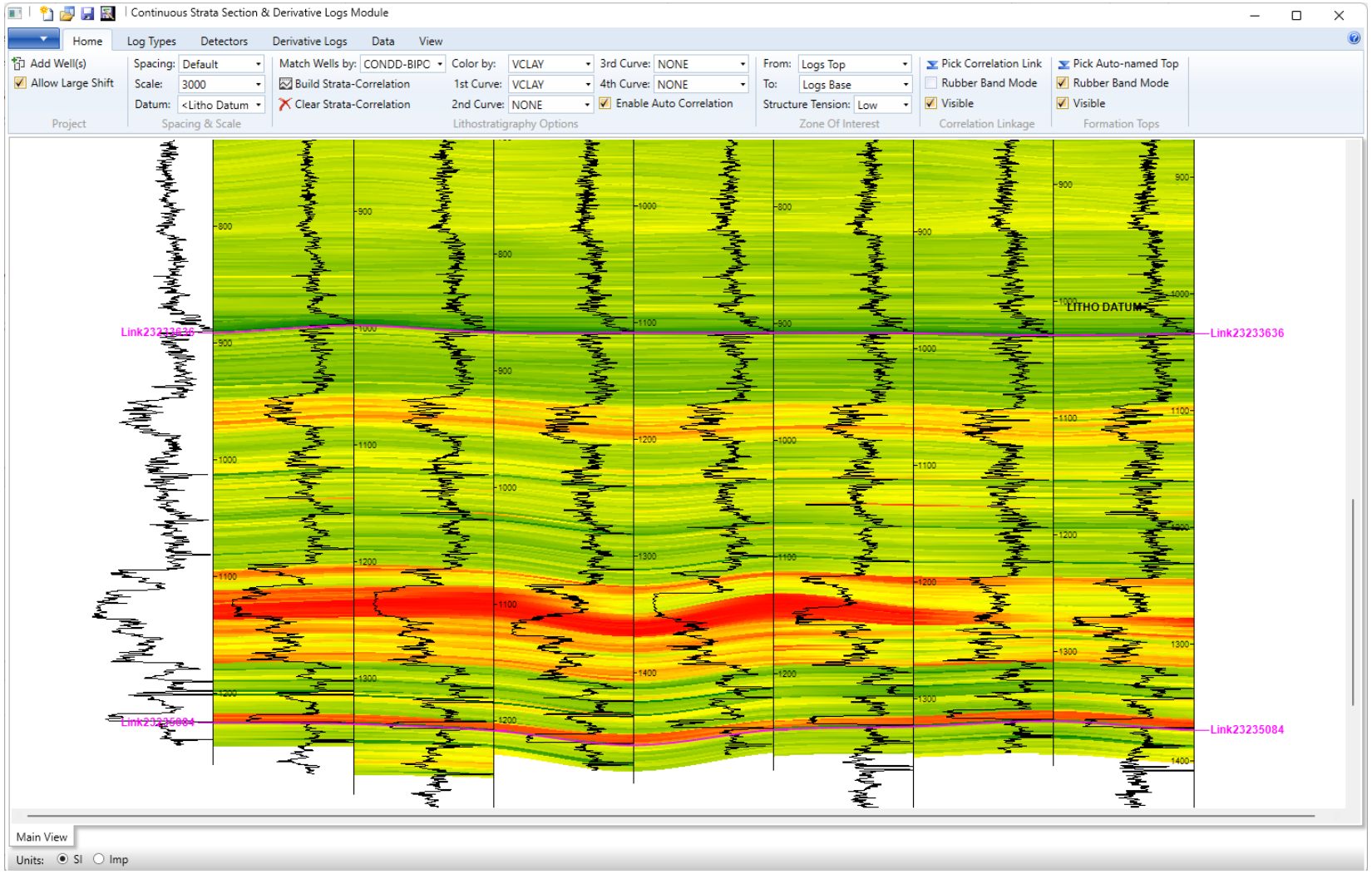
Picking Tops in Rubber-Band Mode

Once you build the strata correlation, tops can also be picked in Rubber-Band Mode. Click “Pick Auto-named Top” and place a top within a single well. Using the mouse, drag this top onto the right side of the destination well (while dragging, you should see a green rubber-band line) and release the mouse regardless of the depth. Tops will be auto-populated between the source and destination wells as shown below. If necessary, adjust the last pick and drag it to the next wells.



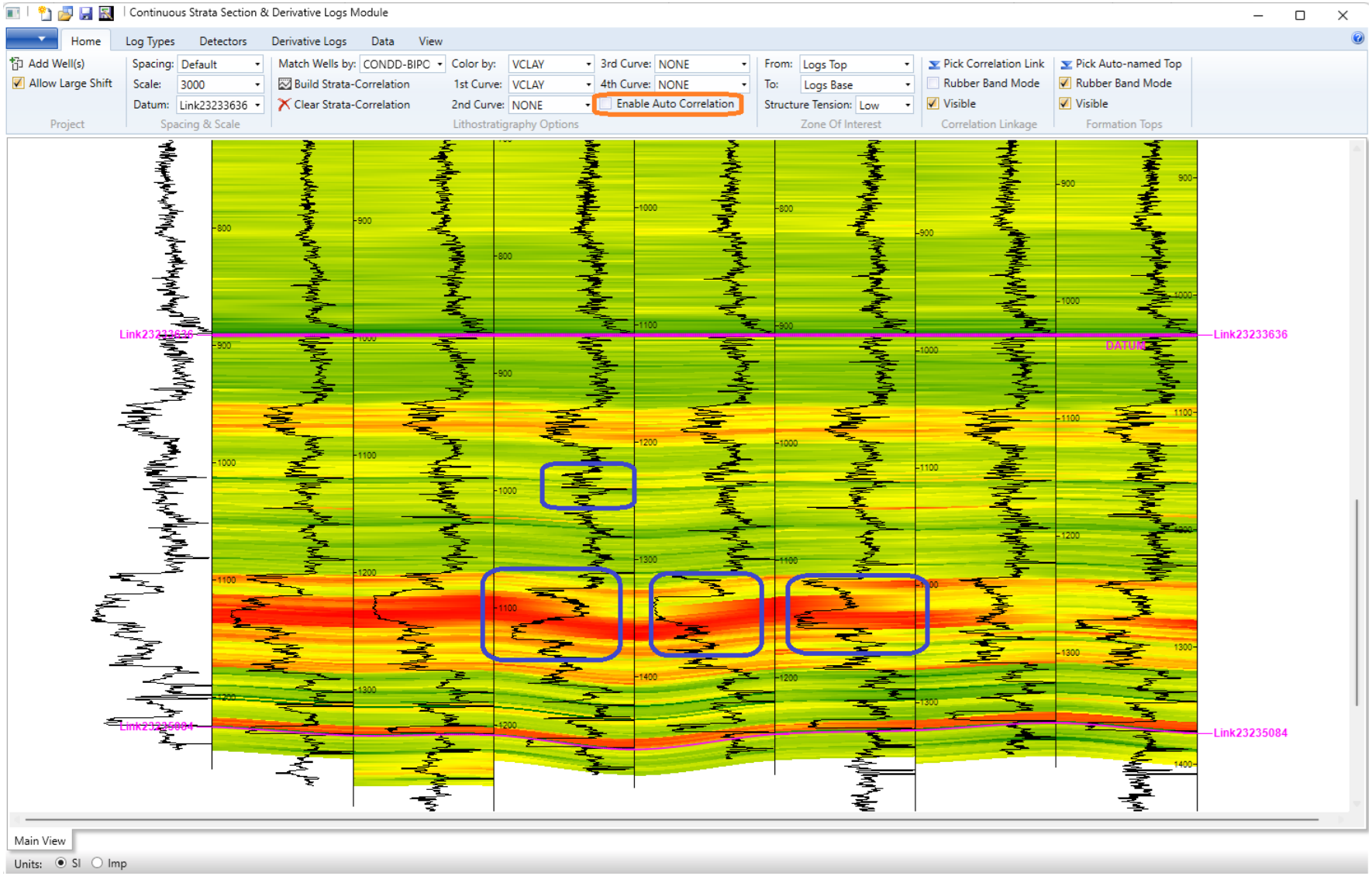
Building a Strata Correlation in Semi-Automatic (Guided) Mode

If the app fails to create an acceptable correlation within the zone of interest, use the semi-automatic (guided) mode. Build the strata correlation in automatic mode and flatten it on the LITHO DATUM using “Datum at Cursor” from the context menu. Click the “Pick Correlation Link” button and place at least 2 long, continuous pink correlation links at the top and bottom of the ZOI (Zone of Interest) using the Autopick, Rubber-Band, or Manual Mode. To see the results, click “Build Strata-Correlation” and then flatten the view again using “Datum at Cursor”, or select the upper long link from the Datum combo box. The application will apply auto-correlation between the upper and lower long links. In this tutorial, you should not see a big difference between the automatic and semi-automatic results, because there are no large subsea shifts between neighbouring wells, and the lithostratigraphy is simple enough to handle in an automated way.



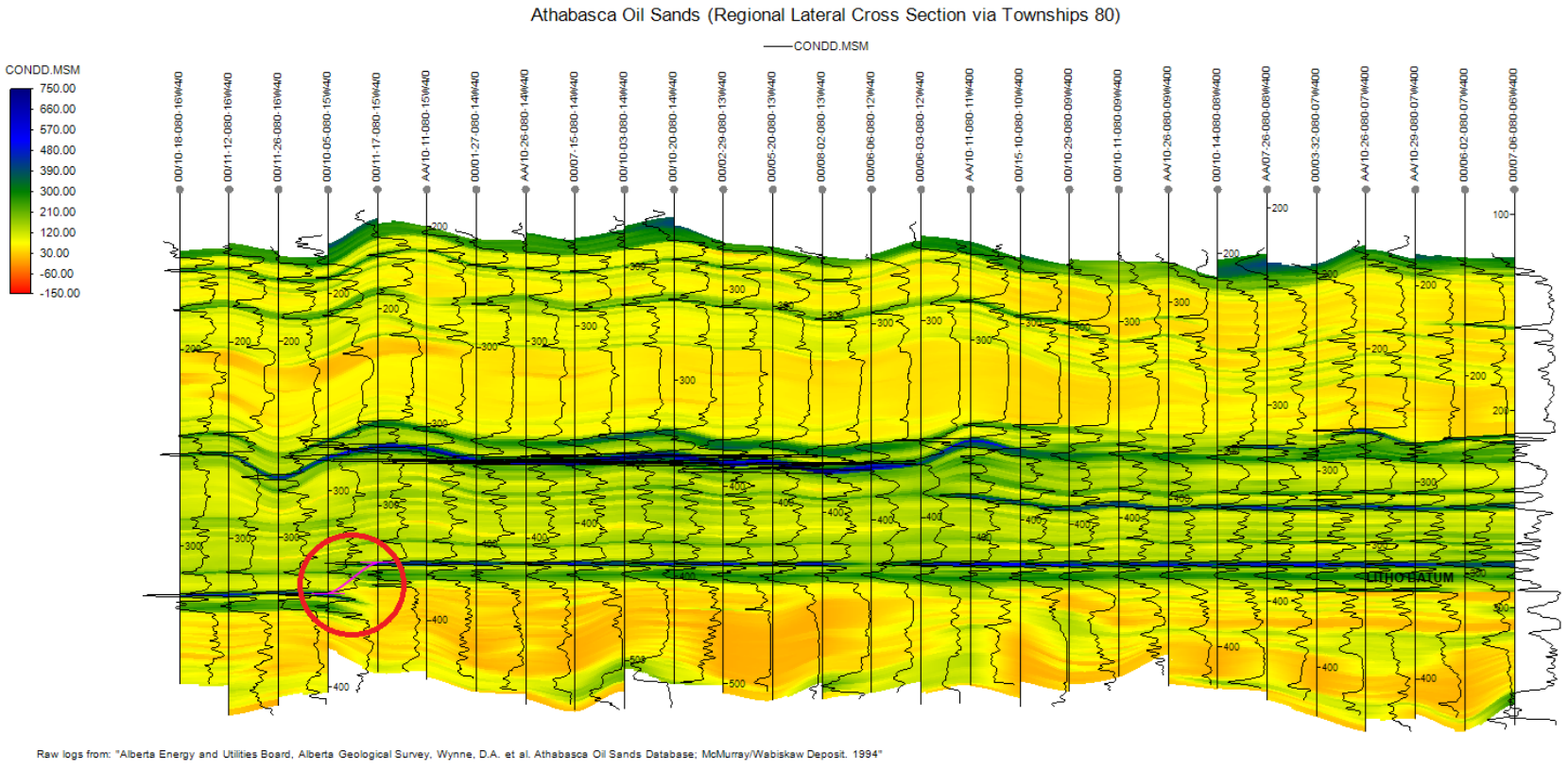
Building a Strata Correlation in Manual Mode

Place **at least 2 long, continuous pink correlation links** at the top and bottom of the ZOI (Zone of Interest). Select the upper long link from the Datum combo box. Uncheck the box "**Enable Auto Correlation**" and click "Build Strata-Correlation". Sometimes, you will see incorrect inter-well color fills as shown below (within the blue rounded rectangles). In this case, you have to add more links within the ZOI. However, if you check "Enable Auto Correlation" and click "Build Strata-Correlation" again, the majority of the incorrect inter-well color fills will go away. **That is why we developed this automated geological tool to drive productivity gains for time-consuming workflows**.



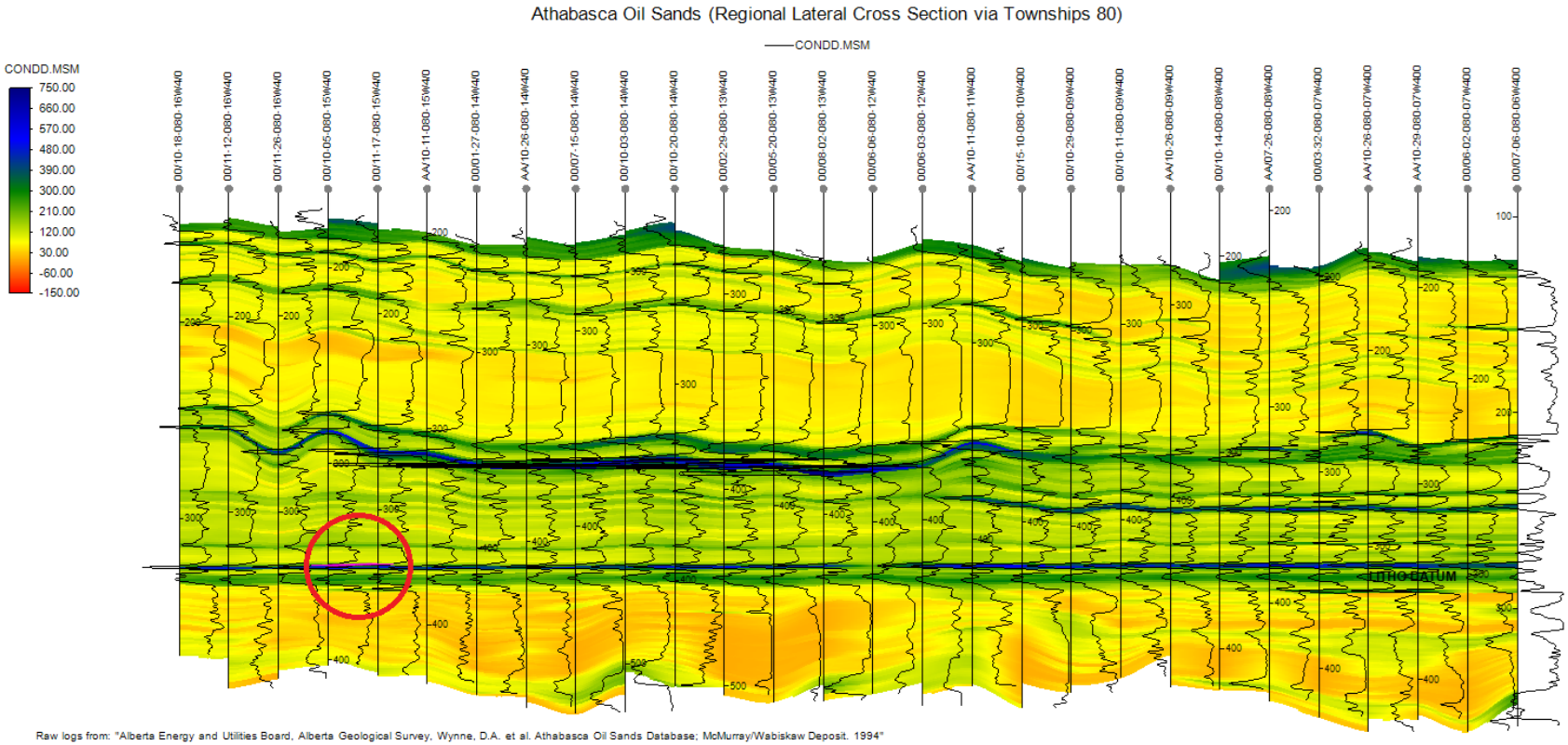
Fixing Minor Miscorrelations or Faulting (Tutorial 2)

It is not mandatory in the semi-automatic guided mode to create a long pink correlation link across all wells. You can use **short links** to fix minor issues. In this tutorial, launch the Strata Section module, click Open Project, and navigate to the supplied prebuilt tutorial project …\StrataSectionProjects\Athabasca-T-080.strata. Build the strata correlation in automatic mode and flatten it on the LITHO DATUM using "Datum at Cursor" from the last well's context menu (**already done in the tutorial**). Human intervention is required when you detect abrupt changes associated with miscorrelation or tectonic faults. Place a pink correlation link within the left well and then drag and drop it into the next well to anchor an identical stratum between neighboring wells (**Note:** sometimes 2 linkages located at different depths are required for the same pair of wells).



Raw logs from: "Alberta Energy and Utilities Board, Alberta Geological Survey, Wynne, D.A. et al. Athabasca Oil Sands Database; McMurray/Wabiskaw Deposit. 1994"

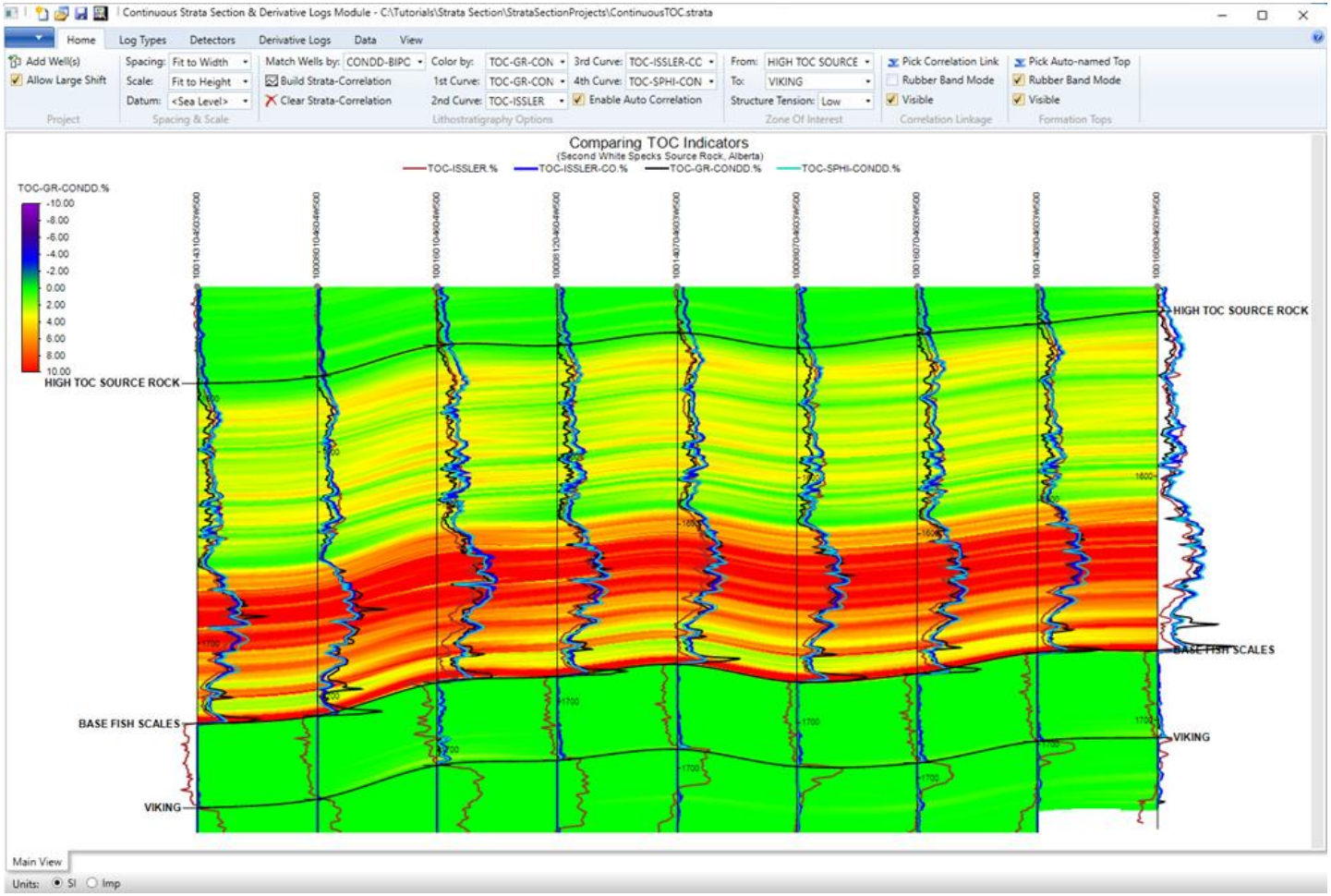
To see the results, click “Build Strata-Correlation” and then flatten the view again using “Datum at Cursor” from the context menu. So, short links allow you to quickly create continuous lithostratigraphy without picking pink correlation markers across all wells. **These cross-section wells can be correlated in a fully automated way without human intervention. We intentionally unchecked the ribbon box “Allow Large Shift” to simulate a minor miscorrelation just to teach you how to quickly fix a minor issue.**



Building a Continuous TOC (Total Organic Carbon) (Tutorial 3)

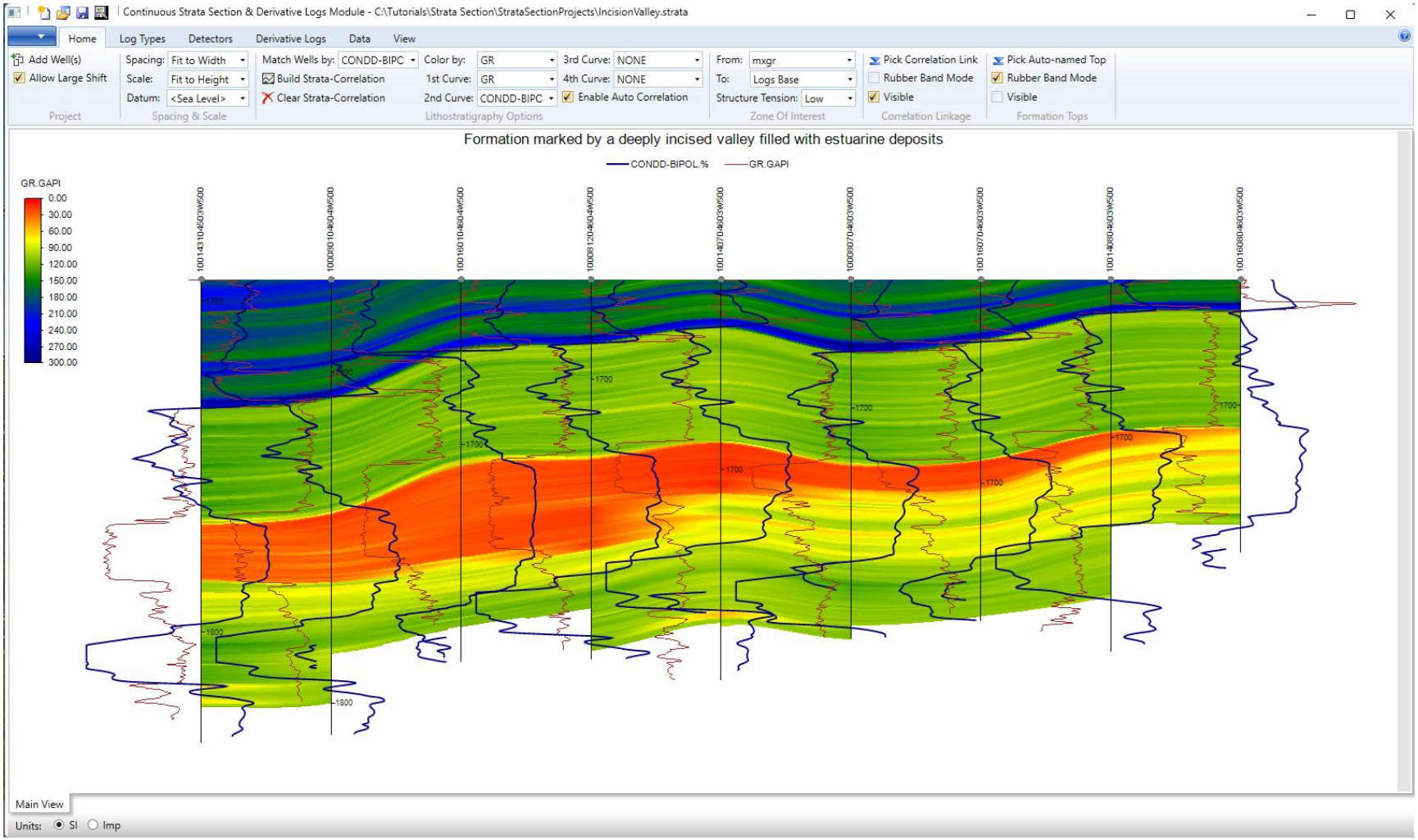
In this tutorial, launch the Strata Section Module, click Open Project, and navigate to the supplied prebuilt tutorial project: …\StrataSectionProjects\ContinuousTOC.strata.Issler's TOC estimation method, which is based on Cretaceous Colorado Group shale core samples, is preferred because no baselines are needed. We are now automatically detecting the shift and drift of the TOC-ZERO-LINE in the TOC-ISSLER curve, caused by a resistivity shift in some wells or rock compression and lithification with depth. After compensating the TOC for shift and drift, the TOC is finally multiplied by a Regularization Function, which uses VCLAY estimation to gently compensate TOC values for non-clay minerals. The final curve is named in the app as "TOC-ISSLER-CO" (see the dark blue curve below).

The application widely uses "on-the-fly" generated derivative "BIPOLE LOGS" based on a "binary grain mixture" or "bipole grain mixture" sedimentary rock model. BIPOLE LOGS are generated from source logs by removing the depth trend associated with rock compaction and lithification and converting values into a percent scale between two poles. Because all BIPOLE LOGS are in the same percent units, the separation between two BIPOLE LOGS can now be converted into TOC curves: **TOC-GR-CONDD** (from GR-BIPOL and CONDD-BIPOL < Deep Resistivity), **TOC-SPHI-CONDD** (from sonic SPHI-BIPOL and CONDD-BIPOL < Deep Resistivity), etc. The separation between BIPOLE LOGS is calibrated to match Issler's TOC within the Cretaceous Colorado Group, because Issler's TOC estimation method is quite robust and supported by shale core samples. Even though TOC curves from BIPOLE LOGS demonstrate a close similarity to TOC-ISSLER-CO, they have their own advantages. For example, **because GR and Resistivity are available in almost every well, using TOC-GR-CONDD (from GR-BIPOL and CONDD-BIPOL < Deep Resistivity) you can now generate a Continuous TOC Strata Section for any area as shown below, or using the Batch Processor, generate spatially dense Derivative LAS (containing TOCs) datasets for TOC mapping or 3D modelling.**



Working with Incision Valley (Tutorial 4)

In this tutorial, launch the Strata Section Module, click Open Project, and navigate to the supplied prebuilt tutorial project: …\StrataSectionProjects\IncisionValley.strata. Generally, the application can handle an unconformity like an incised valley; however, you have to understand how the app generates a laterally continuous underground image.
As shown below, you should see the sedimentary siliciclastic formation, which is marked by a deeply incised valley filled with estuarine deposits. The Strata-Correlation is built using the "**Match Wells by**" **CONDD-BIPOL** curve (generated "on-the-fly" from Deep Conductivity CONDD < Deep Resistivity RESD), because conductivity perfectly delineates the entire package. The palletized color fill is generated using lateral interpolation of GR along correlation chains stored in memory, **because GR is quite sensitive to incision due to the replacement of interbedded sandstone-shale parasequences with cleaner conglomerates and sandstones.**

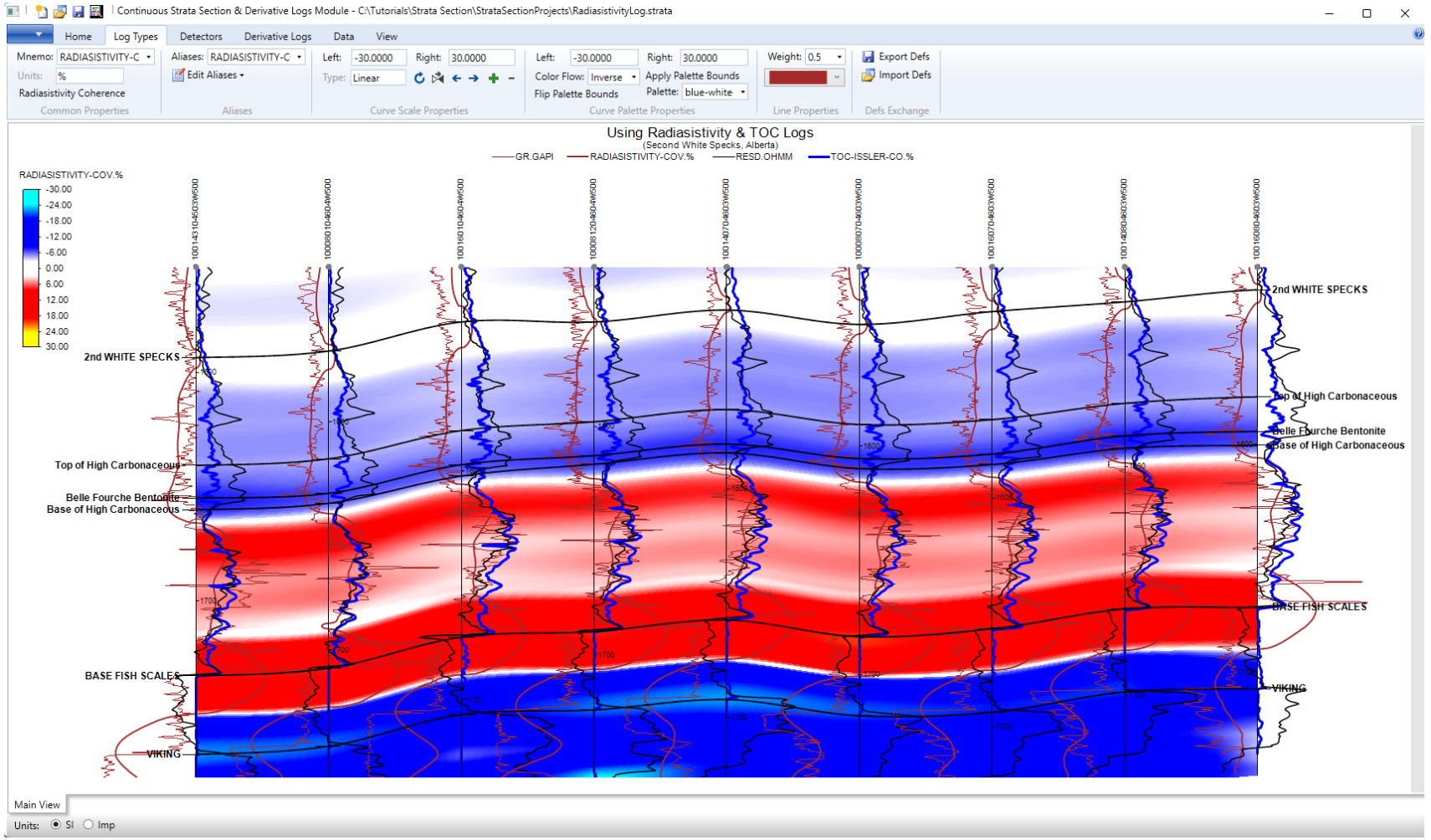


Using Radiasistivity Logs (Tutorial 5)

In this tutorial, launch the Strata Section Module, click Open Project, and navigate to the supplied prebuilt tutorial project: …\StrataSectionProjects\RadiasistivityLog.strata.The Radiasistivity log RADIASISTIVITY-COV (coined from **Radia**tion and Re**sistivity**) is a measure of the joint variability of two logs: GR-BIPOL and deep resistivity RESD-BIPOL (or CONDD-BIPOL).

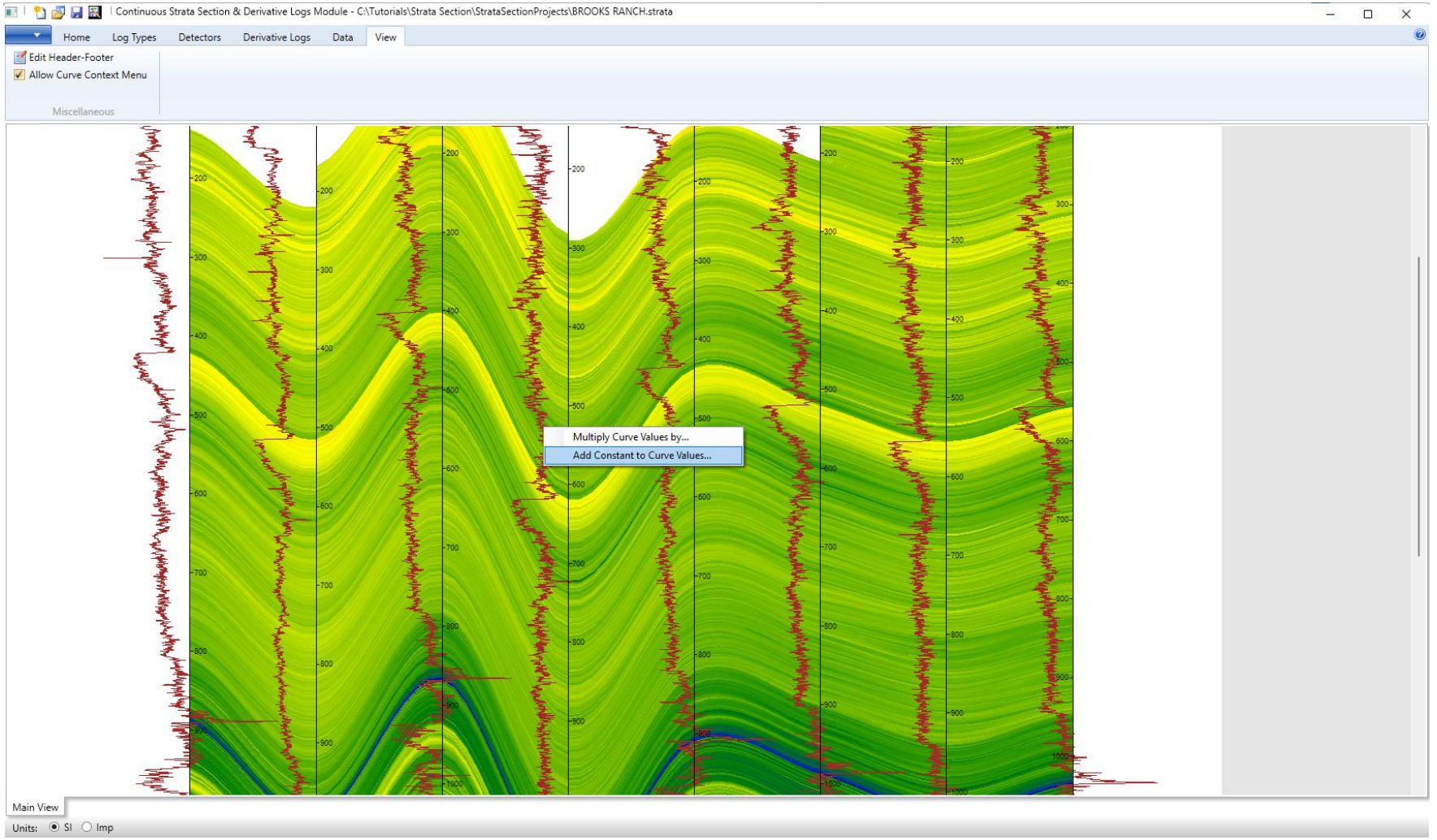
You have to use the Radiasistivity log in combination with the TOC indicator curve. The Radiasistivity Log highlights low-carbonaceous source rocks with **fluctuating** Total Organic Carbon (shown below in red). Once the carbonate content increases to 30–50%, even if TOC remains high, positive Radiasistivity values (**red**) will be converted into negative values (**blue**). So, the combination of Radiasistivity and TOC allows for the detection of stiffer carbonaceous mudstone pay units—similar to the one shown below between the "Top of High Carbonaceous" and "Base of High Carbonaceous"—in the absence of detailed mineralogical analyses. This self-sourced lithostratigraphic unit is not productive in this area, but it has produced significant commercial volumes in other parts of the basin.

For more information about the multi-mineral model for the Second White Specks and underlying Belle Fourche Formations, see: *Kienan P. Marion & Burns A. Cheadle, "Solving the Second White Specks: Integrating petrophysics and allostratigraphy to find sweet spots", GeoConvention, Calgary, May 2017.*



Editing Raw Logs

You can shift or multiply raw curve values. To do this, go to the ribbon's "**View**" tab and check "**Allow Curve Context Menu**". Hover the cursor over a curve and, from the curve's right-click context menu, select "**Multiply Curve Values**" or "**Add Constant to Curve Values**" as shown below..



Batch Processor and Derivative Logs

While opening a LAS file or an existing project, the application “on-the-fly” generates derivative logs: BIPOL LOGS, VSHALE, PHIE, TOC (Total Organic Carbon), etc.

The application can also generate derivative logs in **Batch Mode** for further use in cutoff or Interval Statistics-based reservoir mapping packages or 3D modeling. You have to point the Batch Processor to the source and destination LAS folders. Derivative LAS curves include: BIPOL LOGS, VSHALE, effective porosity PHIE, all types of TOC (Total Organic Carbon), RADIASISTIVITY LOG, IONIC PERMEABILITY, Young’s modulus, Poisson's Ratio, etc.

The Batch Processor helps complete tasks in an automated way with as little human interaction as possible.

Note: We would advise that there is ample storage space in your destination LAS folder prior to starting the Batch Processor.