

Comparing Montney and Duvernay chemostrat (XRF) data from different laboratories

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Summary

Over the past two decades, numerous service companies and universities have offered chemostratigraphic analysis for correlations and mechanical profiling. The advantage of XRF analysis is that data collection can be relatively fast and does not require elaborate and time-consuming preparation or extensive data modeling such as XRD mineralogy. Energy-dispersive XRF systems (ED-XRF) allow elemental measurements from a few ppm to 100% concentrations. Hence, core scanning and detailed chemostratigraphic analysis have become a common tool in the world of unconventional shale exploration and assessments. In exploration and research studies, XRF chemostrat- and mineral model-profiling combined with downhole lithologs appear to present an attractive package potentially providing information such as mineral phase, brittleness and/or other mechanical property changes along horizontal or vertical wells. The information is used to better identify zones with different rock properties in order to optimize well stimulations and hence production.

Despite the increase in usage of XRF data and modeled output, the fundamentals of XRF data acquisition, precision and accuracy as well as proper use is poorly communicated from providers. Issues associated with XRF analysis and chemostratigraphic interpretations include topics such as:

- XRF data output versus “modeled” data output
- XRF calibration
- Chemostratigraphic interpretations across various formations and deposits

XRF geochemistry identifies the elemental compositions of rocks/minerals but unfortunately does not provide any information in respect to the mineral phases present. Therefore, XRF-derived “mineral models” rely on additional information input about the material’s “true” mineralogical composition. Mineral phases can be identified through measures such as optical (petrography, SEM) or XRD analyses. Once the mineral phases are identified, the phase chemistry is used to calculate mineral concentrations from the XRF dataset. It is paramount therefore that any new material is analyzed using different methods to obtain high-quality mineral model output from XRF analysis.

The process of XRF data collection appears straightforward and simple. In reality, the collection of “good” ED-XRF data is a challenge. All benchtop and handheld XRF instruments need a matrix-specific calibration and some manufacturers have built-in calibration for so-called “representative” rock types (i.e. iron-ores, metals, soils, “shale”, etc). These built-in calibration instruments provide “general” compositions but have very limited data accuracy and provide qualitative results instead of quantitative.

In contrast, instruments from manufacturers that allow the end-user to develop rock- or formation-specific calibrations result in much better and more accurate geochemical data. However, this is true only if the elemental concentrations of the material have been processed through a material-specific calibration.

Here we present XRF and chemostratigraphic data for both the Duvernay and the Montney formations and illustrate the importance of calibration output. Calibration of the handheld ED-XRF instrument was performed with the help of a wavelength-dispersive XRF unit (WD-XRF) and USGS shale standards and various other rock types are used for daily data comparison. Handheld XRF calibration output of critical elements, such as the very light element sodium (Na) as well as sulfur and iron (S, Fe) are discussed and illustrated, together with some of the major elements and trace elements.

More importantly, we show Montney and Duvernay XRF profiles obtained by two different local laboratories that provide XRF analysis and compare the data to Trican Geological Solution's data of the same wells. We illustrate that some local laboratories have calibration issues that need to be addressed in order to provide more accurate and reliable data. For example, comparing silicon-concentrations downcore, a difference of up to 9 wt-% Si is observed while some trace elements have a difference of up to 300% (V; >100 ppm (TGS) vs 3100 ppm (Calgary Lab 1)).

The result of poor data collection has significant implications for any exploration company as such datasets end up with unrealistic mineral models and mechanical profiles. Result outputs of modeled mineral compositions of both Duvernay and Montney dataset are presented.

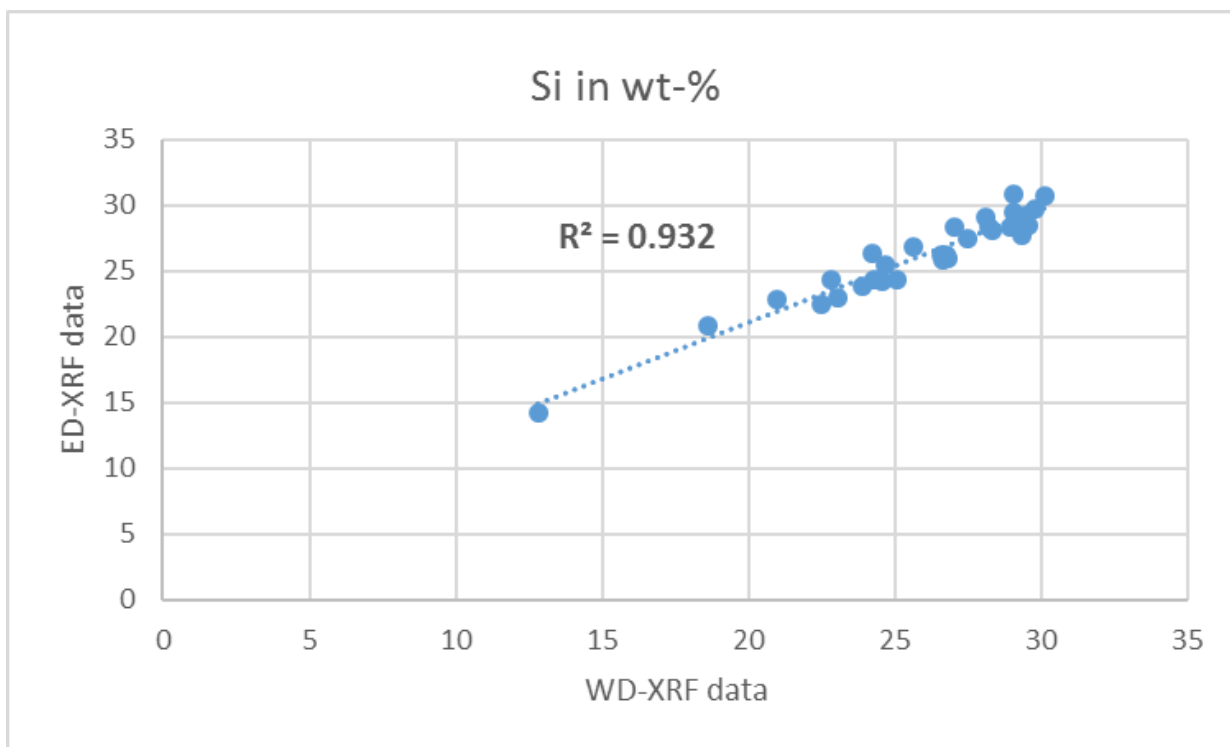


Fig. 1; Comparison of calibrated ED-XRF data versus WD-XRF data from one core illustrating a linear fit with a value of $R^2=0.93$.

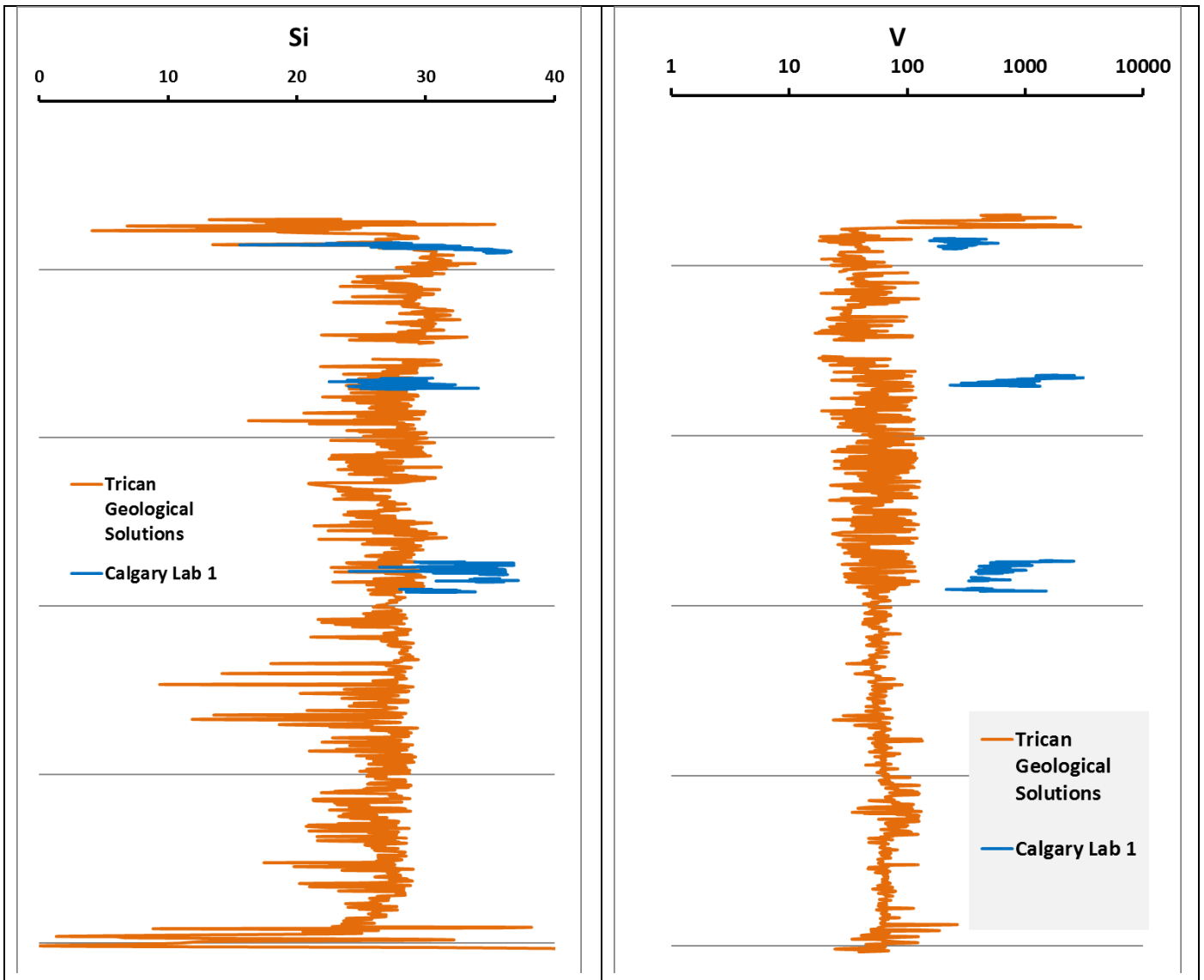


Fig. 1; Calibrated ED-XRF results of silicon (Si) (left) and vanadium (V) (right) data of Trican Geological Solutions in comparison with another Calgary Laboratory. Some of the data have a marked difference.