GIS-based Interpretation of Rock, Oil, Gas and PVT Data to Predict New Well Outcomes – Virtual Well Examples from the Montney, Doig, Second White Speckled Shale and Cardium Formations of the Western Canada Sedimentary Basin

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GIS technology coupled with highly detailed geological, geochemical and reservoir engineering data allows prediction of drilling outcomes for source-rock reservoirs (e.g., Doig), hybrid reservoirs (e.g., Bakken) and conventional reservoirs ahead of the bit. The resulting values comprise a *Virtual Well*, which allows comparison of predicted well quality over several scale ranges.

Measured and derived data are subjected to rigorous Quality Control procedures to create GIS maps for each required parameter. The maps are then digitally overlaid. After selection of a location, the GIS layers return the following values for each *Virtual Well*:

- For source-rock reservoirs, present-day and restored TOC (total organic carbon), present-day HI (hydrogen index) and PI (production index), VRE (vitrinite reflectance equivalent), and quantity of generated hydrocarbons in bbl/acre-foot (Figure 1)
- For conventional reservoirs, porosity, permability and fluid saturations
- Oil family and sub-family based on multivariate statistical analysis of biomarker and stable carbon isotope data (Figure 2)
- Gas molecular composition and C1-C3 carbon isotopic composition
- Predicted rock, oil and gas thermal maturities from multiple techniques, to include GC-Triple Quad Mass Spectrometry (GeoMark QQQ analysis)
- PVT data (reservoir temperature, reservoir pressure, bubble/dew point pressure, degree of undersaturation, GOR (gas-oil ratio), fluid density, viscosity and API gravity from both measured PVT and from GOR correlations with carbon isotope data (Figure 3)

Each of the individual approaches to obtain these types of information is derived from publications in the peer-reviewed literature. Integration of all data types is required, which must at a minimum consider data density and resulting GIS edge effects, and potential hydrocarbon migration and tectonic overprints. Close coordination among petroleum disciplines allows iterative interpretation of the *Virtual Well* outcomes. New geochemical and reservoir engineering data can readily be input into the GIS structure and well outcomes re-determined.

The Triassic Montney and Doig formations and Cretaceous Second White Speckled Shale and Cardium formations of the Western Canada Sedimentary Basin illustrate the *Virtual Well* concepts and outcomes compared to wells in existing fields.
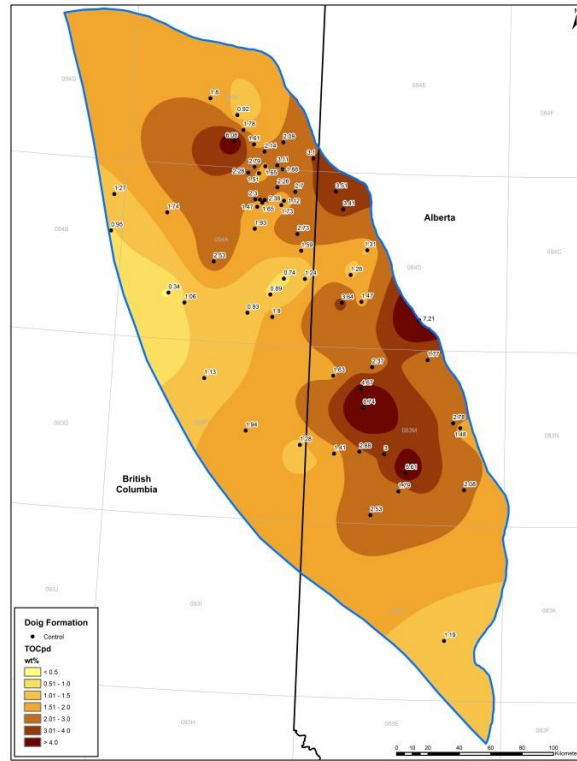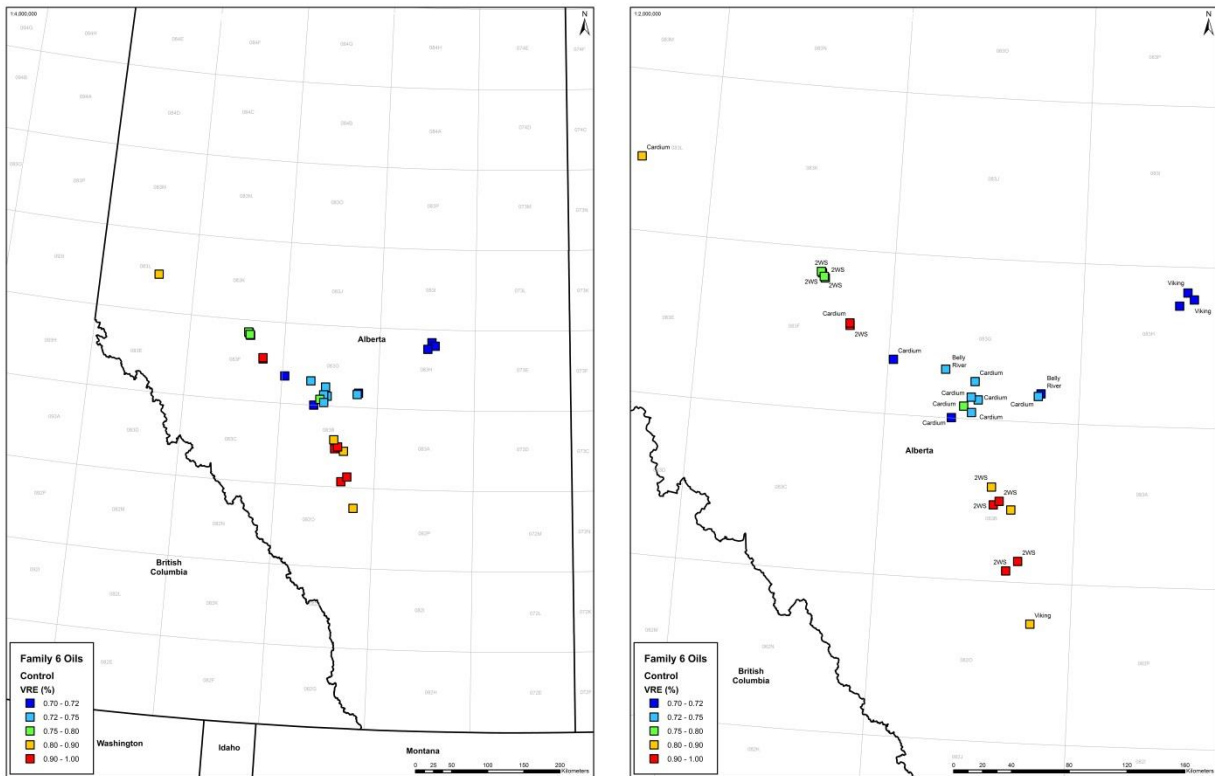
Figure 1   Example Source Rock GIS Layer

Figure 2 Example Oil Family GIS Layer

Figure 3 Example PVT Layer