



## Displaying Well Control Incident Data in Petrel; a Workflow for Promoting Rig Safety Across Disciplines

*Kurt D Armbruster, P. Geol.*

### Summary

Rig safety begins in the office. Well control incidents such as kicks and blowouts can be catastrophic. Kicks are commonly controlled, however, in the last 40 years in British Columbia, 16 out of 894 (1.7%) of the well control incidents reported to the BC Oil and Gas Commission (OGC) have resulted in blowouts. In the worst cases, these can lead to loss of rigs or loss of life.

On the Engineering side of well planning, it is a common practice in the Oil and Gas industry to mitigate the risk of kicks and blowouts by preparing Pore Pressure and Fracture Gradient (PPFG) predictions prior to drilling the well. The PPFG process should include a tabulation of any lost circulation, kick, and blowout incidents. PPFG data are ultimately used to provide a window for the mud weights while drilling, and may dictate additional casing runs.

This paper will demonstrate one Petrel workflow in which a Geologist can contribute to the safety culture of the rig crew. By preparing a simplified cross section depicting the precise stratigraphic location of well control incidents and posting the cross section in the doghouse, OSR shack, or wellsite geologist shack, the author intends to empower rig crews to anticipate zones which may be problematic. With annotated cross sections, rig workers will be able to see a visualization of offset well control incidents in stratigraphic space, in addition to the tabular format generated during the PPFG process. For best results, the geologist should collaborate with their drilling and reservoir engineers during the entire well planning process.

This paper utilizes BC data as a case study. The workflow may be applied to any basin in which well control incident data are available.

### Data:

This paper focuses specifically on kicks and blowouts reported to the BC Oil and Gas Commission (OGC). Pending data availability, the methodology may also be applied to lost circulation events. The methodology may be used in any basin, provided incident data are available. This paper assumes that the reported bit depth of the incident is the well depth from which the incident-related flow originated. Well control data are also available from several private vendors in Canada.

The OGC requires operators to report Kicks and Blowout incidents. The OGC database includes data collected since 1976. As of August, 2018, nearly 900 incidents have been recorded, including 878 kicks, and 16 blowouts. The Kicks and Blowout data are tabulated into a spreadsheet, which is hosted and available to access, free of charge, on the OGC's website at:

[https://iris.bcogc.ca/generic\\_ogc/Ext\\_Accnt.Logon](https://iris.bcogc.ca/generic_ogc/Ext_Accnt.Logon)

A free account for the OGC Website is required to access the data, and can be created at:

[https://iris.bcogc.ca/generic\\_ogc/Ext\\_Accnt.Welcome](https://iris.bcogc.ca/generic_ogc/Ext_Accnt.Welcome)

Once a user has logged into the website, select the link to the "Drilling Kicks and Blowouts by Area" CSV file, and input the date range. The author recommends inputting a large date range to ensure no incidents are missed.

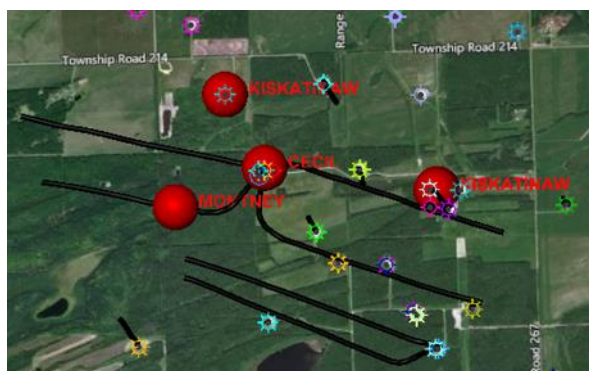
Data included in the report are: Incident Type, Well Area Name, Well Authorization (WA) Number, Well Name, Drilling Event, Confidential Flag, Incident Date, Depth, Numerical Formation Code, Formation Description (Formation Name), Influx Size (m3), SIDPP (KPa), SICP (KPa), Kick Control Mud Density (kg/m3), Occurrence Mud Density (kg/m3), and comments (usually a written description of the event). For the purposes of this paper, many of the columns have been hidden in screen-captures of the workflow.

## Workflow Description

When the spreadsheet has been downloaded, perform a quality control (QC) check to look for incidents in which the comments are spread over several rows. The comments must be combined into a single row by either combining the comments into a single cell, or multiple comment cells in the same row.

Following the initial QC, the wells in the spreadsheet must be matched to the wells in the user's Petrel project. If the user's Petrel wells are identified by UWI, there is an extra step, as the OGC's spreadsheet lacks UWI information. If the Petrel well database includes the WA numbers, copy both the WAs and the UWIs into a new tab in the spreadsheet. Otherwise, a software database such as AccuMap or GeoScout will be required to source the WA and UWI Data for the wells in the target area of interest. After the UWI and WA data have been imported into the OGC spreadsheet, perform a VLOOKUP command to merge the UWI data into the OGC dataset as a new column.

When the UWIs have been integrated into the Kicks and Blowouts spreadsheet, the next step is to QC the remainder of the spreadsheet. It is critical to ensure that units in the spreadsheet match with the units in the Petrel Project. Any missing data cells must be represented as null values. The author suggests adding at least one extra column, providing a numerical code for kicks (1) and blowouts (2). This provides a simple method for



displaying them on a petrophysical well log as point data. QC of stratigraphy must be done once the data are in Petrel, as they can easily be cross-referenced against the user's tops picks and/or geological model. Check for missing mud weight data. If the incident mud weight, control mud weight, or incident depth is missing in the spreadsheet, look in the drilling tour sheets to find the data.

The spreadsheet can then be loaded into Petrel using the Point Well Data import functionality.

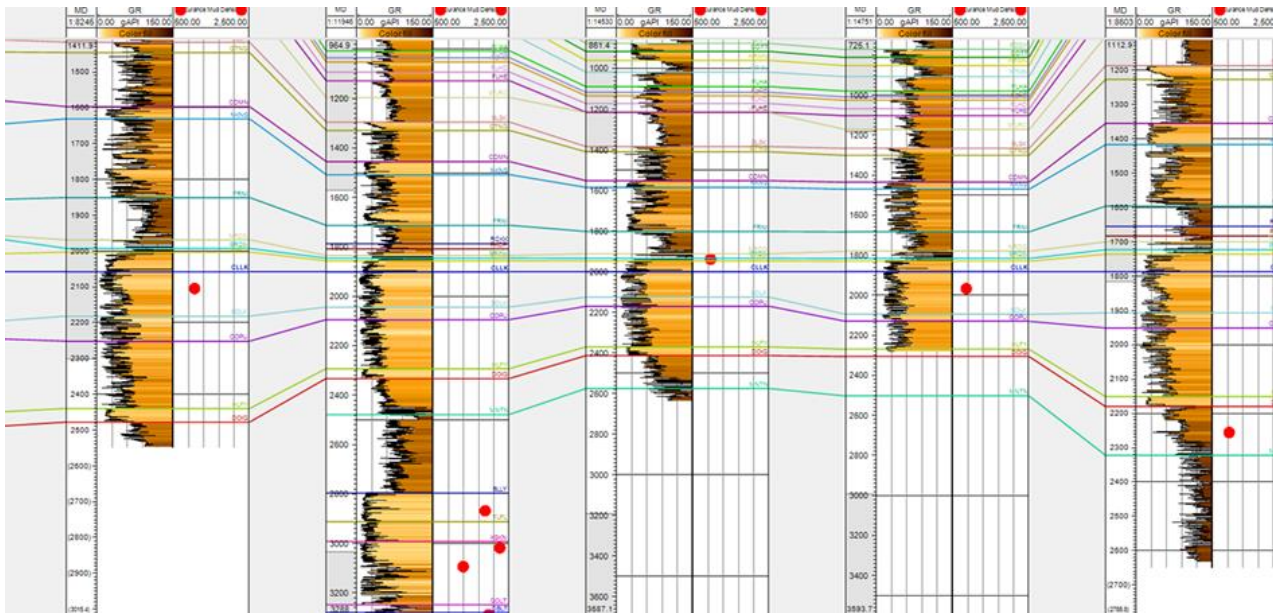
Point Well Data (PWD) can import any spreadsheet into Petrel, and allows the user to determine the types of data imported by column (ie: text, continuous or discrete numerical data, dates, etc.). The two most critical columns in the spreadsheet for the PWD import are the Well Identifier (commonly the UWI) and the depth. Assign and name the columns in the import dialogue box. When the data are imported, Petrel will assign the data points to the associated measured depth (MD) along the wellbore. Perform a QC of the data in Petrel's database. Any data from the spreadsheet can then be displayed or modeled by Petrel.

The author also recommends that a user request the PFFG and mud density data for wells owned by their company from their reservoir engineer, and loads these data into Petrel as well-log curve data. The PFFG and mud weight plots can then be incorporated into a well-section window template for well planning purposes.

The kicks and blowouts data may be displayed many formats, including, but not limited to:

1. Well-Section window. Display the kick and control weight information as a point log, preferably with the Gamma Ray (GR) track as the GR log is the most common log in MWD tools. Include key tops in the well, especially strata that are problematic for well control. Print out (or PDF) a copy of the well-section, and provide it to the drillers and wellsite geologists.

2. Map view. Display points on a 2-D map or 2-D window to get a visual representation of where incidents are relative to the proposed well. The incident formation name or other data may be posted alongside the well points.
3. Intersection window. Include the geological model (tops surfaces), nearby incident wells (with GR logs), and display the desired incident data on the wells.



## Workflow outline

1. Obtain well incident data from preferred vendor.
2. Quality control check and edit the spreadsheet so it can be imported as Point Well Data.
  - a. Ensure the Well Identifiers on the spreadsheet match Petrel's Well Identifiers.
  - b. Consolidate "comments" to single row.
  - c. Ensure all units match the project units.
  - d. Other typical cleanup so it can be imported as point well data. I.e:
    - i. Missing the incident mud weight or other cells. With thorough investigation into the drilling tour sheets, many of these missing data points can be found.
    - ii. Assign a designated null point (such as -999.99) to cells without data.
3. Import as "Point Well Data." QC imported data.
4. Display data points on a log in a well section window.
  - a. Select a track to display data. Either on the gamma track, or create a new track:
    - i. If all wells have incident mud weight, display in mud weight space.
    - ii. If some mud weights are missing, use a numerical value, 1=kick, 2=blowout
    - iii. Include a point set for the incident control mud weight.
    - iv. Alternatively, use different symbols for Kicks and blows to differentiate.
  - b. If possible, acquire copies of the drilling tour sheets, and create a mud weight log for each incident well. Display point data along a mud weight track.
  - c. If possible, annotate with linear distances from planned well to incident wells.
5. Display incident points on 2D-Map. If desired, include 5, 10, and 15 km radius polygons from planned well. Data may also be displayed in a 3D window.
6. Create 2D intersection window that intersects all nearby incidents and planned well. Load base geological stratigraphic model, incident wells (with GR, and other desired curves), and kicks point data.

7. Print and/or export the maps, intersection windows, well section windows, etc. via pdf, PowerPoint, or other preferred delivery method. Include in planning documentation/well files.
8. Deliver exported diagrams to well delivery team, including mudlogger/wellsite geologist, drilling engineer, and OSR on Rig.

## Conclusions

Providing easy to understand data on well control incidents to front-line rig staff empowers them to be proactive with regards to potential well control incidents. Diagrams and cross sections annotated with well incident information are an easily understood method for communicating between disciplines. A visual reference point of where incidents have occurred in local wells offers a clear way to proactively gauge when a zone in which an incident has occurred is approaching. This workflow is intended to augment a thorough PFG examination of the surrounding wells, not replace it. The author recommends this workflow also be followed to display any lost circulation events alongside kick and blowout events.

## Acknowledgements

Petrel access and screen captures courtesy of Tom Cox  
Well data from IHS  
Peter Wallis– Editing

