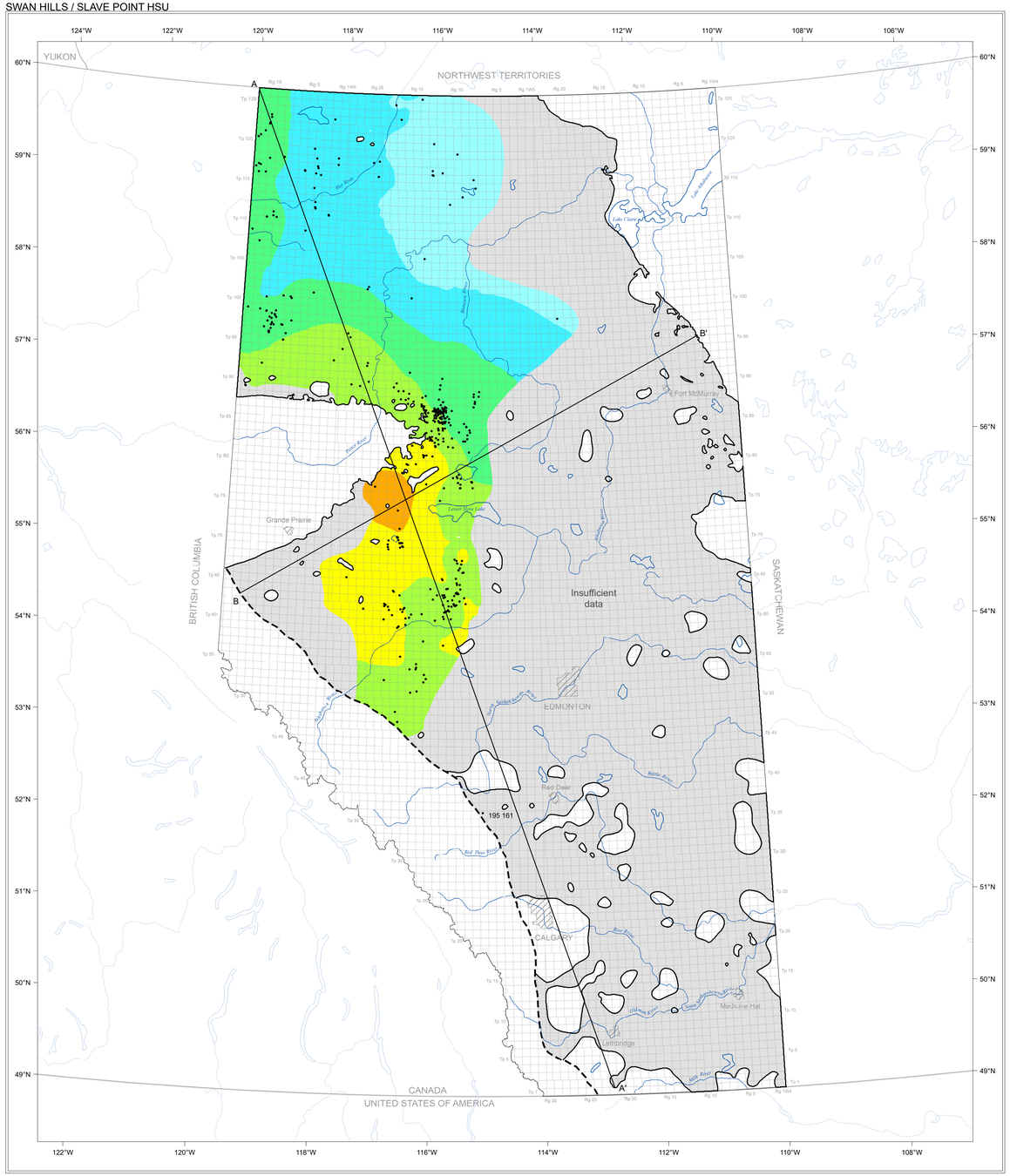
TOTAL DISSOLVED SOLIDS
SWAN HILLS / SLAVE POINT HSU



SYMBOL LEGEND

Total dissolved solids (mg/L)

- 30 500 - 50 000
- 50 001 - 100 000
- 100 001 - 150 000
- 150 001 - 200 000
- 200 001 - 250 000
- 250 001 - 268 500

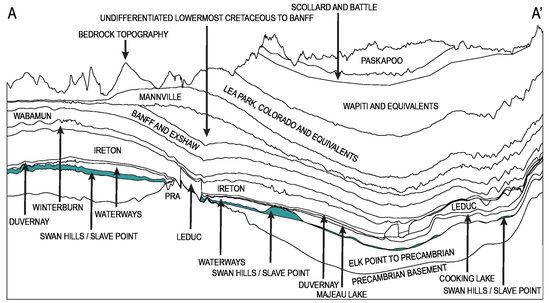
- Well data point
- Hydrostratigraphic unit extent
- Eastern limit of main Cordilleran deformation
- Cross-section line A — A'
- Insufficient data

This map depicts the distribution of total dissolved solids (TDS) in groundwater in the Swan Hills / Slave Point hydrostratigraphic unit (HSU). The horizontal and vertical extent of the unit was adopted from the 3D Provincial Geological Framework Model of Alberta, Version 2 (Alberta Geological Survey, 2019a). The Swan Hills and Slave Point formations are partly equivalent, shallow-water, and open-marine carbonates (Hauck, 2014), and were mapped together as one HSU. The relationship of the Swan Hills / Slave Point HSU with the units above and below as well as its geometry can be seen in Figures 1 and 2.

Methodology

The TDS distribution map is a result of an empirical Bayesian kriging technique using publicly available data from 421 water chemistry analyses from oil and gas wells. A screening process modified from Jensen et al. (2013) was used to ensure that only representative formation water chemistries were used. Measured TDS values range from 22 870 mg/L to 276 570 mg/L. The final gridded map surface was clipped based on the spatial distribution of representative chemistry data. Where data density was insufficient to generate a TDS grid, data points are plotted with TDS labels only. Residual values are plotted at each location (Figure 3) to indicate where underprediction or overprediction occurs compared to the measured TDS values.

Additional formation-scale hydrogeological maps for the Swan Hills / Slave Point HSU are shown in Figures 4 and 5. Figure 4 illustrates the distribution of hydraulic head in the Swan Hills / Slave Point HSU, with hydraulic heads calculated using fresh water density. Figure 5 shows the water driving force (WDF) vector map for the Swan Hills / Slave Point HSU. The WDF vector map allows identification of areas where the buoyancy effect of formation water density has the potential to change the inferred magnitude and direction of groundwater flow (Singh et al., 2017). For the majority of the Swan Hills / Slave Point HSU, buoyancy does not appear to have a significant effect on groundwater flow. However, buoyancy appears to have some influence in the central and southern portions of the Swan Hills / Slave Point HSU, where larger angles (dark orange areas) between the WDF vector and hydraulic gradient vector are observed.



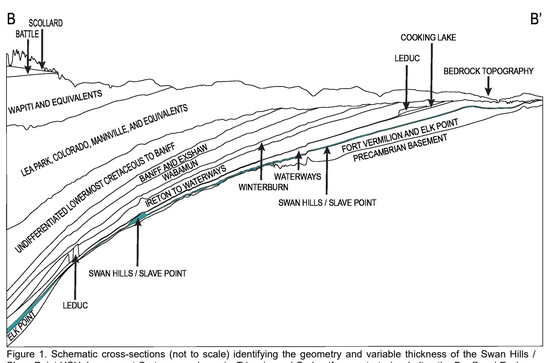


Figure 1. Schematic cross-sections (not to scale) identifying the geometry and variable thickness of the Swan Hills / Slave Point HSU. Lowermost Cretaceous, Jurassic, Triassic, and Carboniferous strata (excluding the Banff and Exshaw formations) have not been subdivided at the scale of these cross-sections. The location of the Peace River Arch (PRA) is shown on cross-section A-A'.

Acknowledgements

Data processing support by S. Stewart. Water driving force vector map created by A. Singh. Base data from the Atlas of Canada (Natural Resources Canada, 2012) and Spatial Data Warehouse Ltd.

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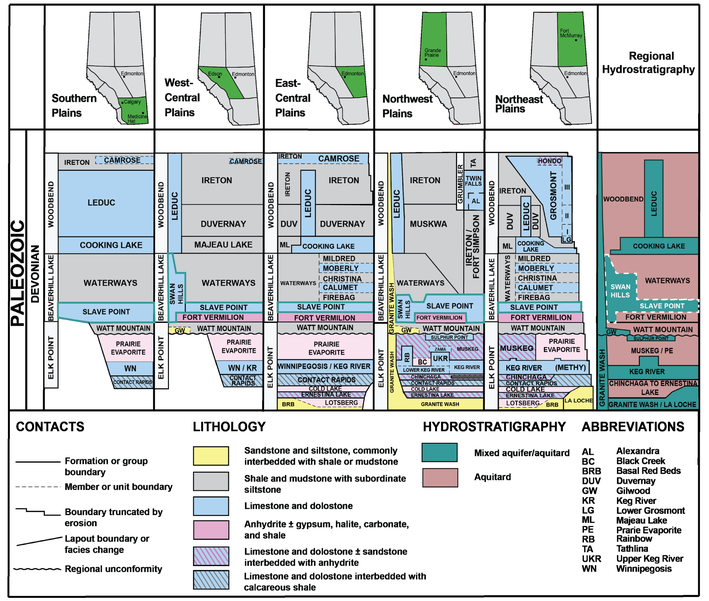

Figure 2. Regional lithostratigraphy and hydrostratigraphy (based on Alberta Geological Survey, 2019b). Solid teal lines highlight the contiguous Swan Hills and Slave Point formations. Dashed white lines depict the Swan Hills / Slave Point HSU within the regional hydrostratigraphy. Strata above the Ireton Formation and below the Elk Point Group are not shown.

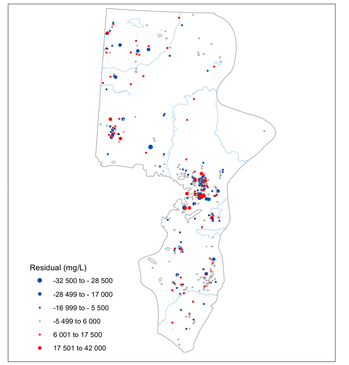

Figure 3. Calculated residuals between the modelled distribution of TDS and measured values. Symbol classes are based on the standard deviation of the calculated residuals.

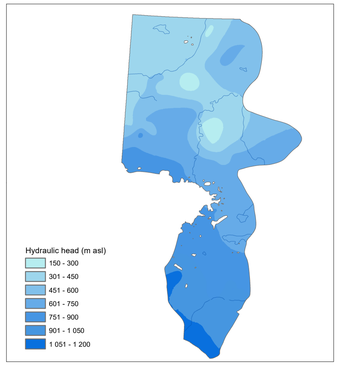

Figure 4. Distribution of hydraulic head in the Swan Hills / Slave Point HSU (Brinsky, 2023). The map extent is based on the spatial distribution of hydraulic head and differs from the extent of the main map.

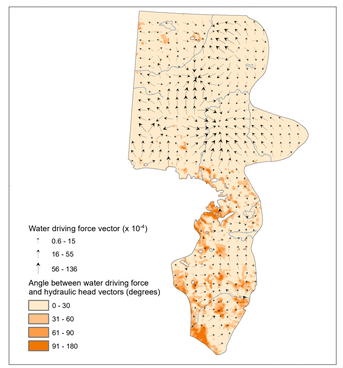

Figure 5. Water driving force vector map of the Swan Hills / Slave Point HSU. The map covers only the area where the hydaulic head and TDS gridded sufaces overlap.

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Map 638

Distribution of Total Dissolved Solids in the Swan Hills / Slave Point Hydrostratigraphic Unit

Hydrogeology by: J. Brinsky and A. Rabbani

Scale 1:3 000 000

100 50 0 100 200 Kilometres
50 25 0 50 100 miles

Projection: 10 Degree Transverse Mercator
Datum: North American Datum, 1983

Recommended Reference Format

Brinsky, J. and Rabbani, A. (2023): Distribution of total dissolved solids in the Swan Hills / Slave Point hydrostratigraphic unit; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Map 638, scale 1:3 000 000.

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