

Class VI Porosity Determined

CTV IV

Porosity determination

Porosity, facies (sand and shale), and clay volume are derived from the open hole well logs. These values, that have a one-foot resolution, are upscaled into the geological model and distributed using Gaussian random function simulation (kriging). Capillary pressure permeability and porosity data from core analysis and NMR logs constrain the permeability function (Figure 2).

Formation porosity is determined one of three ways: from bulk density using 2.65 grams per cubic centimeter (g/cc) matrix density as calibrated from core grain density and core porosity data, or from compressional sonic using 55.5 microseconds per foot ($\mu\text{sec}/\text{ft}$) matrix slowness and the Wyllie time-average equation or the Raymer-Hunt equation. See Table 1 for explanation of which equations were used in each zone.

Porosity and permeability are populated in the static model with the function utilizing the upscaled porosity and clay volume as inputs. Comparison of the calculated porosity and permeability transform to log generated permeability (Timur-Coates method) from a nuclear magnetic resonance (NMR) log in the [REDACTED] is almost 1:1 and matches rotary sidewall core permeability (Figure 3).

A log plot for the [REDACTED] well is included in Figure 4, showing the calculated model curves within the AoR.

TABLES

Table 1. Sonic porosity equations by zone

Zones	Sonic Porosity Equation	Wyllie Compaction Factor
[REDACTED]	Wyllie	1.6
[REDACTED]	Raymer-Hunt	--
[REDACTED]	Wyllie	1.2

FIGURES

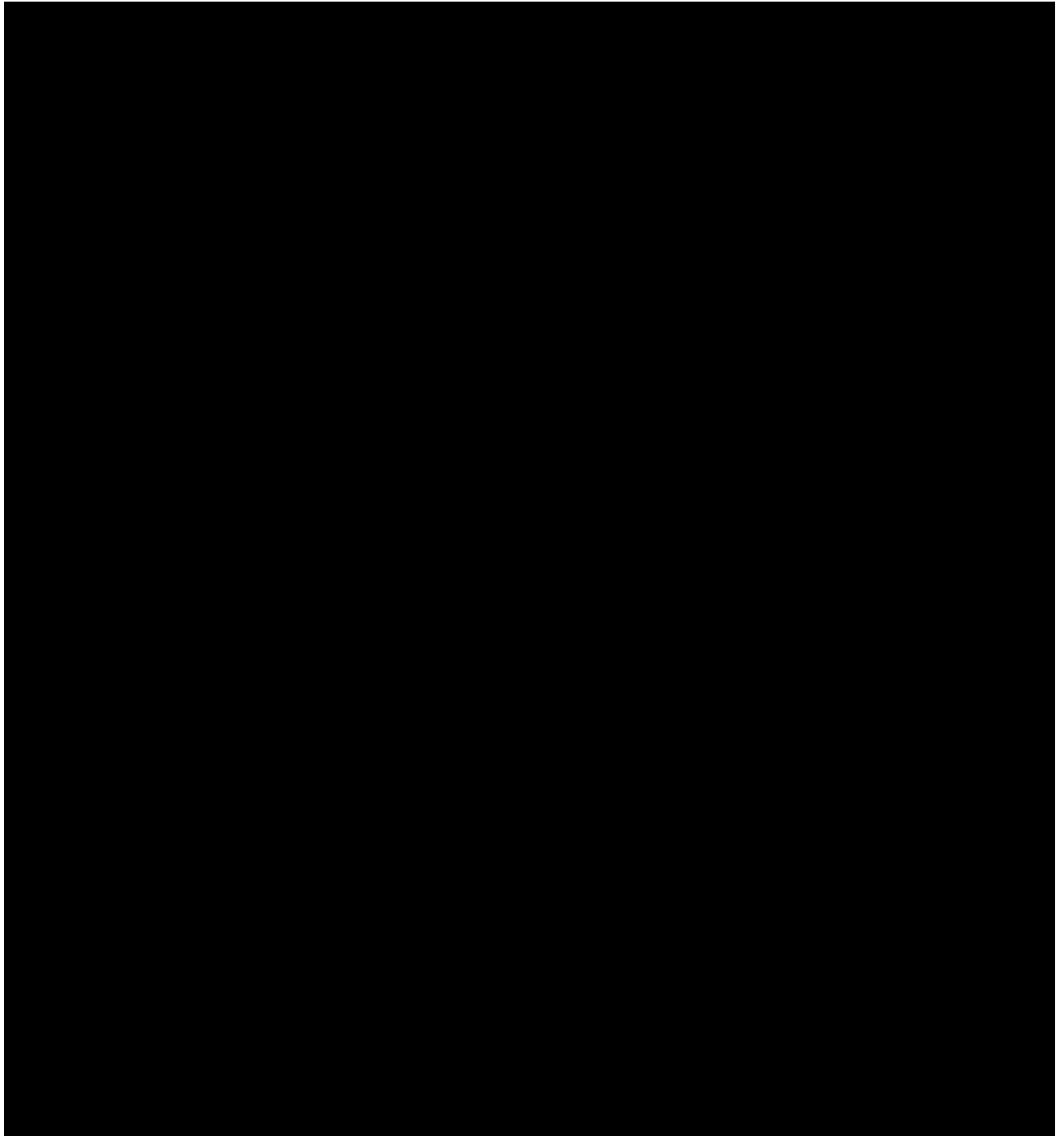


Figure 1. Map showing location of wells relative to the AoR.

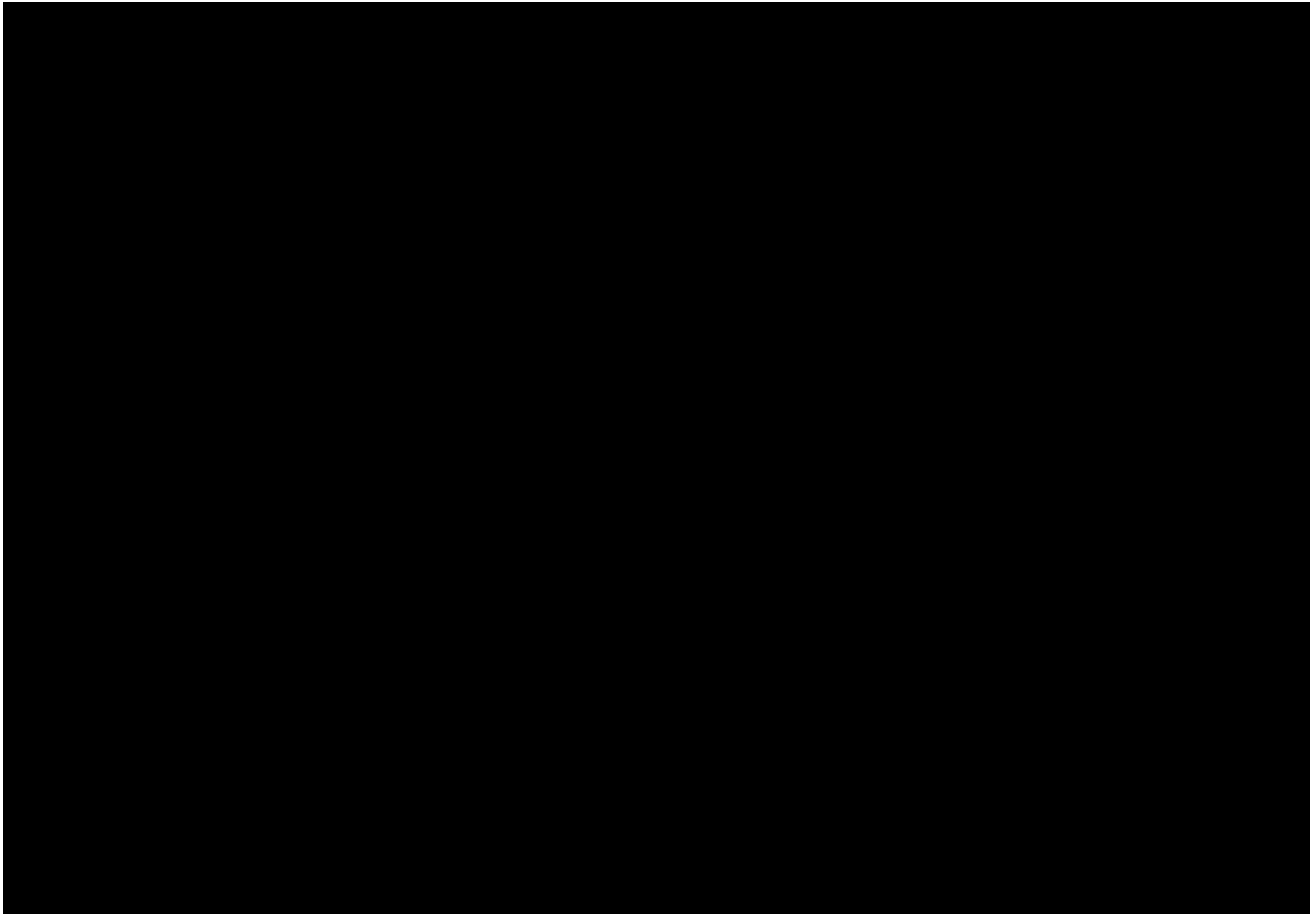


Figure 2. Permeability transform for [redacted] zones.

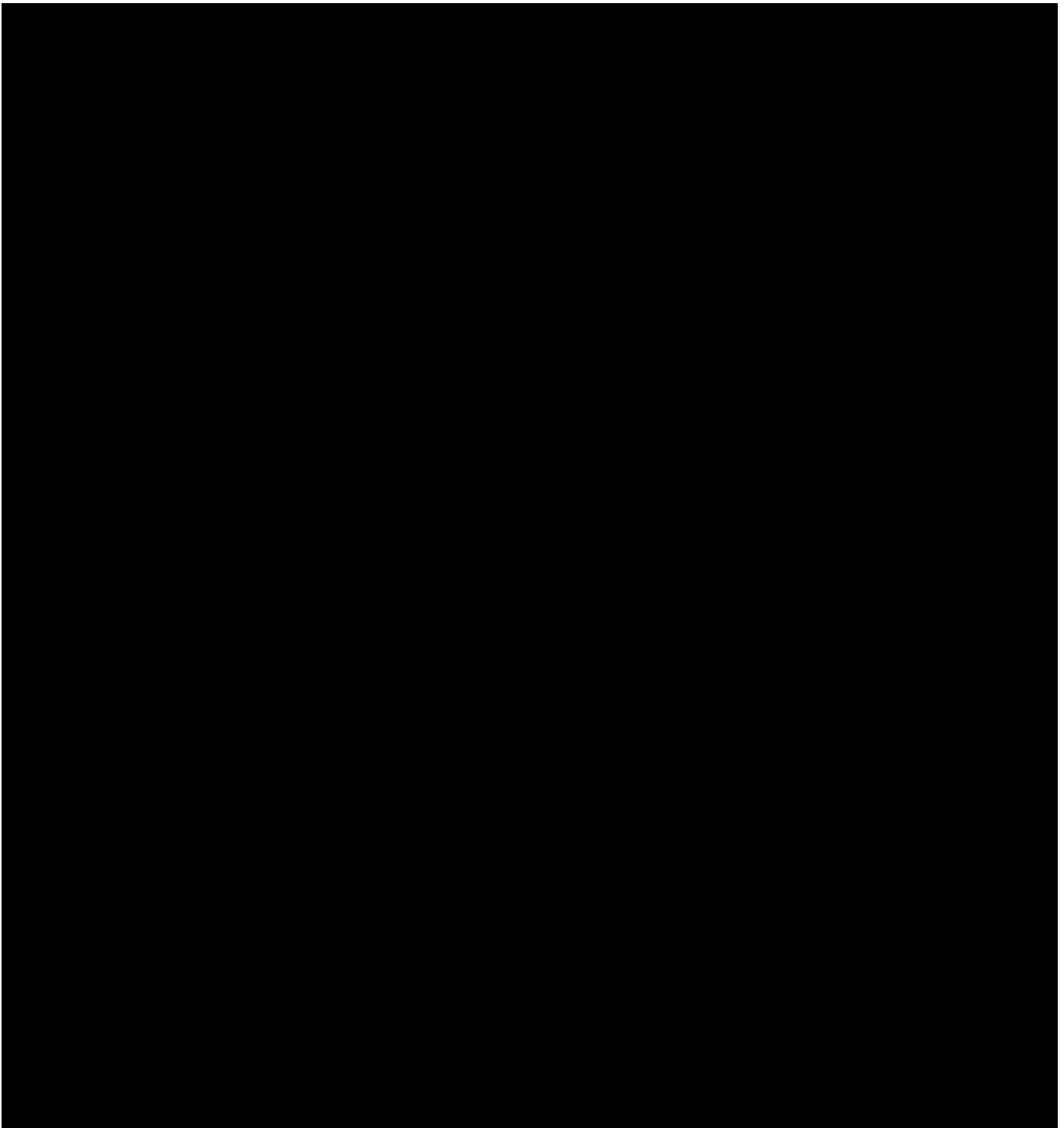


Figure 3. Example log from the [REDACTED] The last track shows a comparison of the permeability calculated from the transform (black) shown in **Figure 2.4-2** to permeability calculated from an NMR log (green) and rotary sidewall core permeability (red dots). Track 1: Correlation and caliper logs. Track 2: Measured depth. Track 3: Vertical depth and vertical subsea depth. Track 4: Zones. Track 5: Resistivity. Track 6: Compressional sonic, density, and neutron logs. Track 7: NMR total porosity and bound fluid. Track 8: Volume of clay. Track 9: Porosity calculated from density and NMR total porosity (green). Track 10: Permeability calculated using permeability transform and NMR Timur-Coates permeability (green).

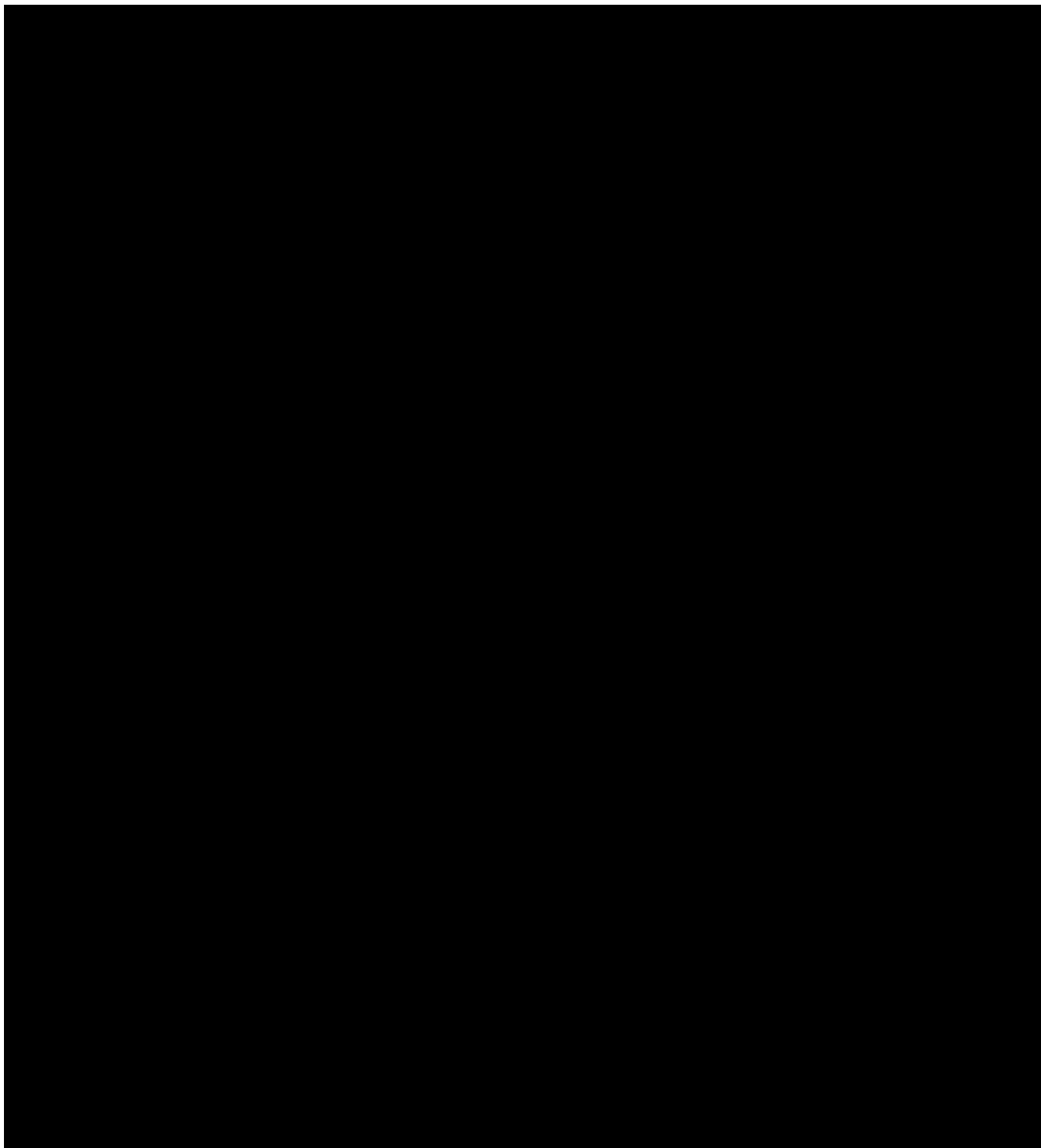


Figure 4. Log plot for well [REDACTED] showing the log curves used as inputs into calculations of clay volume, porosity and permeability, and their outputs. Track 1: Correlation and caliper logs. Track 2: Measured depth. Track 3: Vertical depth and vertical subsea depth. Track 4: Zones. Track 5: Resistivity. Track 6: Compressional sonic, neutron, and density logs. Track 7: Volume of clay. Track 8: Porosity calculated from log curves. Track 9: Permeability calculated using transform.