CHINOOK
CONSULTING SERVICES

WELLSITE GEOLOGY

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Responsible wellsite geological supervision based on basin knowledge and thorough understanding of drilling procedures

Professional wellsite geological supervision

Service includes:

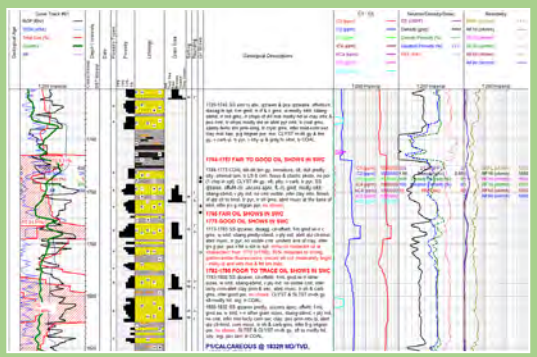
- Cuttings sample preparation, description, logging, interpretation
- Directional drilling and MWD supervision
- Mudlogging and gas detection supervision
- Special geological operations supervision

Petrographic cuttings analyses

Cuttings sample preparation, description, logging, interpretation

- **Preparation**: wash, vial and label dry cuttings samples, index for ulterior analyses
- Petrographic **descriptions** of samples
- Primary **lithology**
- Main constituents
- Grain size
- Cementation (type and degree)
- Accessory minerals
- **Porosity** type, porosity estimates
- **Permeability** estimates (Sneider/Archie classification)
- Fluorescence and fluorescent cut description

StripLogs



Drafting of striplogs: including curves (geology and drilling curves, chromatography, wireline logging), directional surveys, mud data, bit data, engineering comments

- Measured depth striplogs for vertical wells
- Measured depth striplogs for deviated wells and build sections (includes directional data)
- TVD gamma logs for formation tops correlation on build sections of horizontal wells
- Lateral logs detailing well cross-section and directional wellpath
- Composite logs including chromatograph curves and ratios
- Composite logs including wireline porosity and induction; or tailored to specific logs

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Interpretation

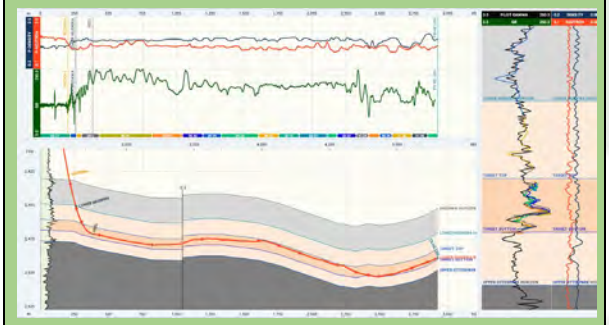
Porosity estimation
- o porosity type
- o porosity percent estimation

Permeability estimation
- o Sneider class for clastic reservoirs
- o Archie class for carbonate reservoirs

Chromatography ratios interpretation
- o Hydrocarbon type identification

Wireline logs basic interpretation (identification of porous zones, tight stringers, gas windows, etc)

Directional drilling supervision



- Plotting actual well path against design well trajectory
- Identification of **wellpath** relative to stratigraphic markers (wellpath with TVD gamma and formation tops)
- Constant **communication** with directional drillers to ensure wellpath follows optimal trajectory
- best **reservoir** or
- best wellbore **placement** or
- optimal **drill path**
- MWD/LWD supervision: data stream monitoring
- **Geosteering** and **reservoir navigation** based on MWD/LWD parameters, gas ratios or ranging

Mudlogging supervision

The advances in un-manned chromatographs/spectrographs eliminate the need for a dedicated mudlogger; data collection and interpretation can be added to the duties of the wellsite geologist. The wellsite geologist can rig in, set up, supervise and maintain the gas detector.

- Lag time calibration, maintain dryer system
- Data collection
- Chromatography curves plotted into composite logs
- Ratio analyses in real-time
- Geosteering / reservoir navigation aided by gas ratios
- Gas shows logging (gas show tally) and interpretation (formation gas vs produced gas)
- Supervise gas detector for abnormal high gas values, set alarm, alert rig personnel when safety boundaries are crossed
- Collection of mud gas samples (isotubes, mud jars, raw cuttings)

Special geological operations supervision

DST supervision:

- Operations supervision and coordination
- Data collection
- Data transmittal
- Pressure gage curve plotting

Coring supervision:

- Core recovery supervision
- Correct labeling of core boxes or core tubes (for sleeved core)
- Spot core description based on core plugs/tube end samples

Special sampling:

- Iso-tubes collection for gas/isotopes identification
- Geo-jars collection for mud sample/wet cuttings sample, free oil/bitumen analysis
- Sidewall coring supervision
- XRD/XRF sample collection and analyses

Wireline logging supervision:

- Confirming of logging program with loggers
- On site QC of logging process (timing, log quality, tracking lost time)
- Basic interpretation of wireline logs (formation tops, identification of porous zones and gas cross-over, identification of tight stringers)
- Consistent report templates detailing logging operations

Communication

Constant **communication** with all involved personnel along established protocol and command chains:

- Operator geologist (operations or play geologist);
  - Daily Reporting (reports, striplogs, data files)
  - Communicate issues and deviations from prog
  - Receive instructions and disseminate reports
- Drilling supervisor/coordinator: communicate geological requirements, receive drilling operations update, alerts about drilling challenges and restrictions
- Directional driller and MWD operator: communicate targets, supervise data stream, communicate interpretation of data
- DST/Coring personnel: communicate requirements, QC operations, collect data
- Wireline loggers: communicate program requirements, QC logs, collect data

Reporting

Comprehensive reporting, consistent formats, along established requirement guidelines

- Daily Reports: files sent at convened times, also updates at critical stages of the well
  - **Striplogs** (Build MD logs, TVD Gamma, Lateral horizontal logs, Core logs, composite logs)
  - Operations reports (daily **operations summary**, gas shows, formation tops, events, etc)
  - **Data** files (MWD data, surveys, chromatography data, curve data)
  - Cuttings **photos**
- Special geological operation reports:
  - **Coring** reports
  - **Wireline** logging reports
  - **DST** reports
  - **Special sampling** reports (iso-tubes, geo-jars, sidewall cores, mud samples, XRD, etc)
- Final Reports
  - **Striplogs** (Vertical log, Vertical (build) striplog, Horizontal (lateral section) striplog, TVD Gamma log, Composite logs)
  - Final **geological report** (Well Data Summary; Formation Tops; Gas Shows; Daily Drilling Summary; Bit Record; Wireline Logging Report; Directional Surveys, Reservoir Breakdown, Gas shows summary, Coring report, Vertical Section chart, Plan View chart; Build Chart, Lateral section chart, Lithological descriptions, Well synopsis
  - **Data** files (Gas and ROP, Drilling parameters, Wireline data, Chromatography gas components and ratios, Surveys, Slide sheets)
  - Cuttings **photos**

Safety

All Chinook geologist have up to date safety tickets:

- **H2S Alive, First Aid/CPR, WHMIS, TDG**
- Optional defensive driving, PST, wildlife awareness, etc

All Chinook geologists are trained to wear Personal Protective Equipment at all times in or around drilling and service rigs.

- Fire retardant coverall (Nomex or equivalent) with reflective stripes, Top impact hard hat , Steel toed boots, Goggles, Rubber lined gloves

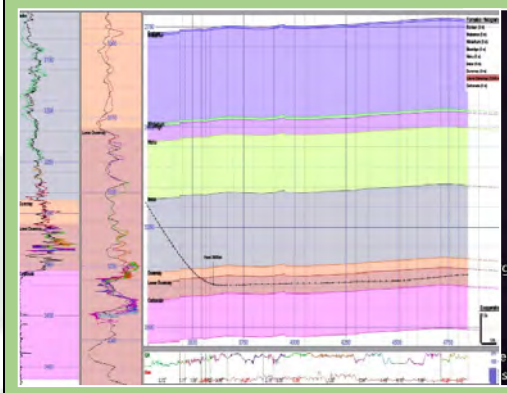
For cuttings sample preparation at invert mud wells, geologists are required to wear:

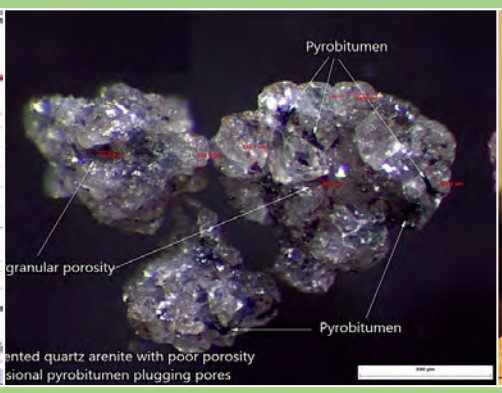
- Goggles, Coverall or apron, Non-latex gloves, Respirator mask, Sample preparation areas should be well ventilated

Chinook geologist follows safety procedures:

- Established travel protocol
- Observe health, safety and environmental requirement imposed by the operator
- Report safety hazards and environmental concerns

CHINOOK SERVICES





Wellsite Geology	• Petrographic analysis of drill cuttings • Porosity/Permeability estimation • Directional and wireline supervision • Mudlogging • SAGD and Oil Sands Delineation Services
Remote Geosteering	• Monitoring of drilling, MWD, Mud gas • Assessment of stratigraphic location • Optimal placement of wellpath • Reporting
Reservoir Evaluation	• Basin Analytics • Reservoir Evaluation • Prospect Generation
Petrographic studies	• Petrography striplogs • Petrographic features • Reservoir evaluation • Digital photography • Digital data exports
Field and Laboratory Geochemistry	• XRF Analysis and Quantitative interpretation • XRD Analysis • GCMS (Gas Chromatography Mass Spectrometry)
Drilling and Completions	• Drilling Engineering and Operations • Drilling Performance Optimization • Abandonment Studies • Manpower Services
International Operations	• Project Management • Geoscience projects • Drilling and completion projects • Safety and compliance

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