



شركة أبوظبي للعمليات البترولية البرية (أدكو)
Abu Dhabi Company for Onshore Oil Operations (ADCO)

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From Thin Section Analysis to Dynamic Modelling: An Integrated Reservoir Characterisation Approach to Match Water Saturation Profile in Shallow OWC Region

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- Evidence of Shallow OWC in Study Area
- Micro-Porosity Characterisation
- OWC & Sw Match: Methodology and Results
- Conclusions



Context of the Study

The importance of getting OWC & Sw profile right

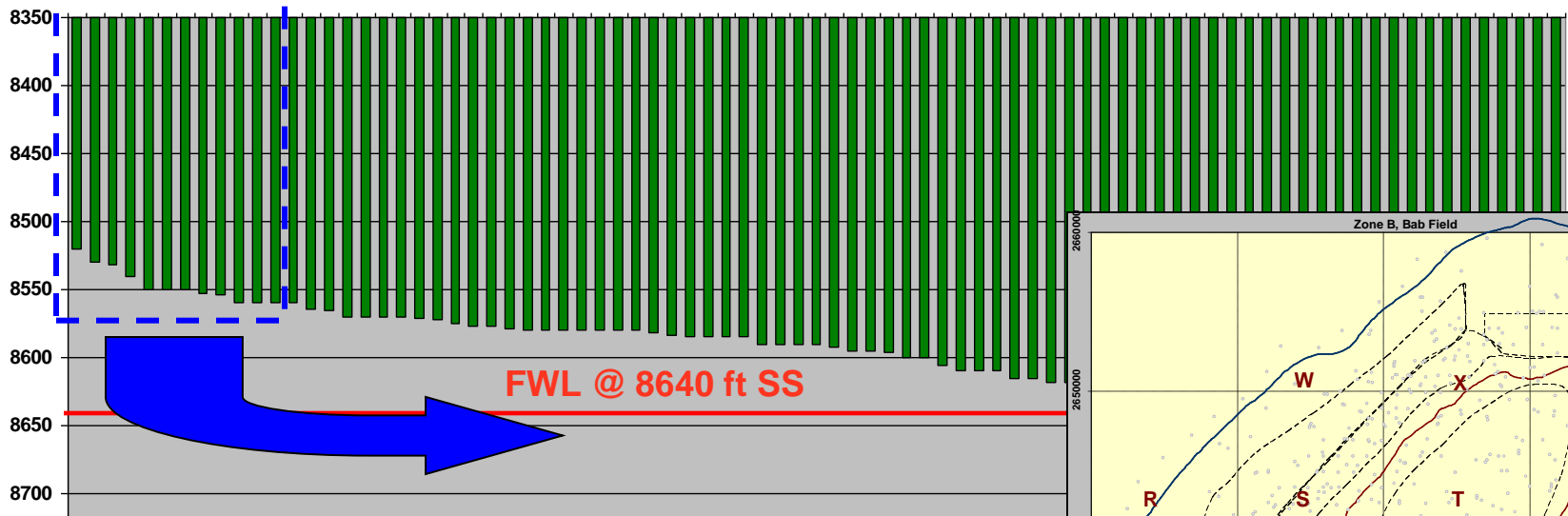
- Large Field in Abu Dhabi Onshore
- Field Area selected for EOR Pilot Study in Tertiary Conditions
 - Focus on near OWC region
 - Understand original Sw and evolution after massive waterflood
- Area of Interest shows Local Petrophysical Complexity
 - Requiring Construction of detailed Sector Model
 - With revised model initialisation to improve OWC & Sw match



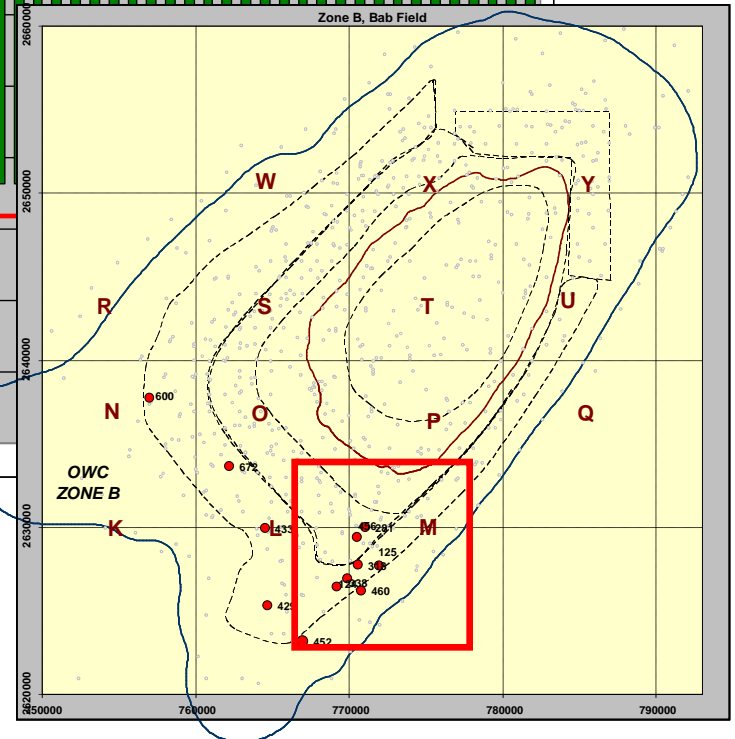
A Region with Shallower OWC

OWC Review - Well Locations

OOWC in the Field
(Wells sorted from shallowest to deepest OWC)



- Review of all 83 wells with representative OOWC
- Closer look at wells with shallowest OWC ●
- Most of them are located in the area selected for EOR Pilot Study

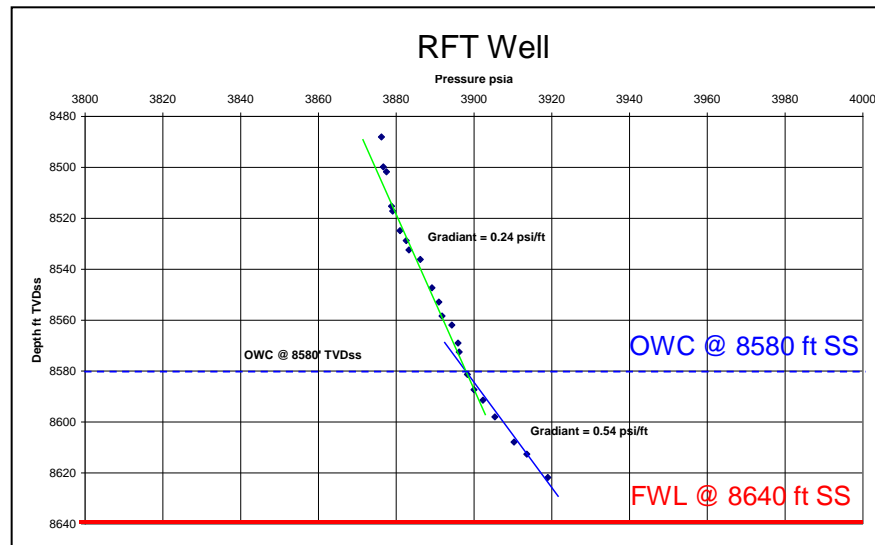




A Region with Shallower OWC

OWC Review – Quality Assurance Process

- South-Eastern part of the field consistently shows shallow OWC
- Evidenced from:
 - MDT / RFT data (intersection of fluid gradients)
 - Open Hole Logs (resistivity)
 - Pulse-Neutron Logs (TDT, RST, RPM)



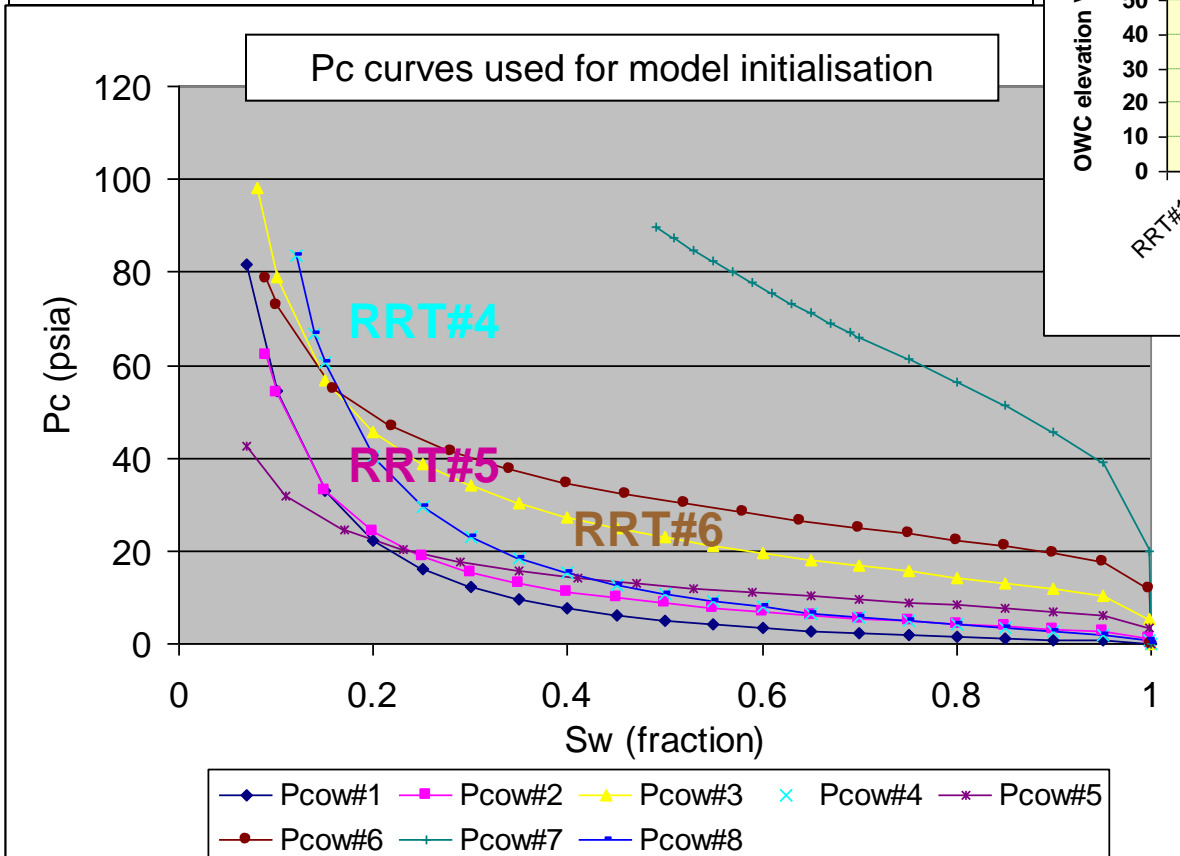
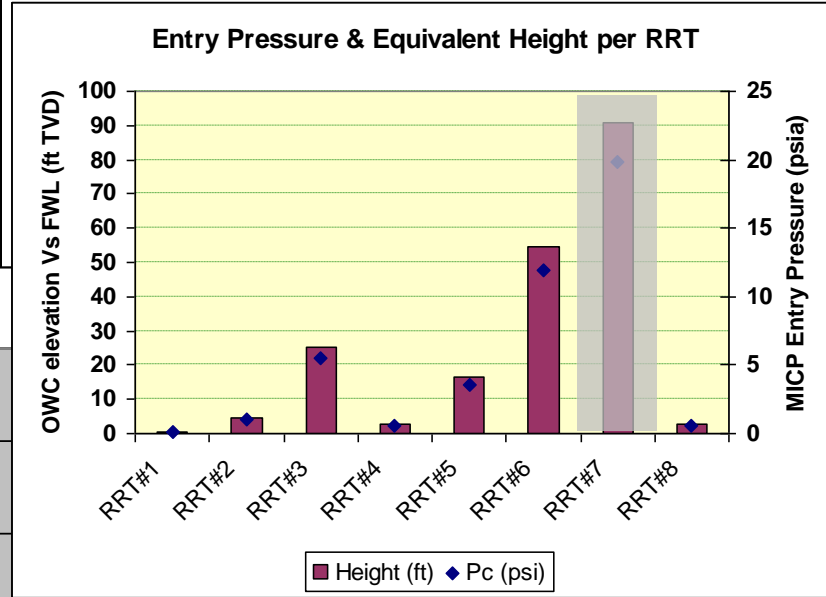
Example of shallow OWC @ 8580 ft SS, i.e. 60 ft above FWL



A Region with Shallower OWC

OWC Review – Limitations of Existing Model

- Review of existing Pc curves
- Current set of Pc allows elevation of OWC of 0.5 to 55 ft above FWL
- Except of non-reservoir dense zones (90 ft)
- ⇒ Vs. OWC in area is 60 – 120 ft above FWL





Integrated Reservoir Characterisation

Micro-porosity signature – Evidences

- Despite of geological / structural complexity, no evidence of compartmentalization to explain possible local higher FWL
- Micro-porosity behavior evidenced from:
 - Thin Section Analyses
 - Different Sw readings between PNL & Resistivity Logs
 - MICP data (high Hg entry pressures & double-porosity)



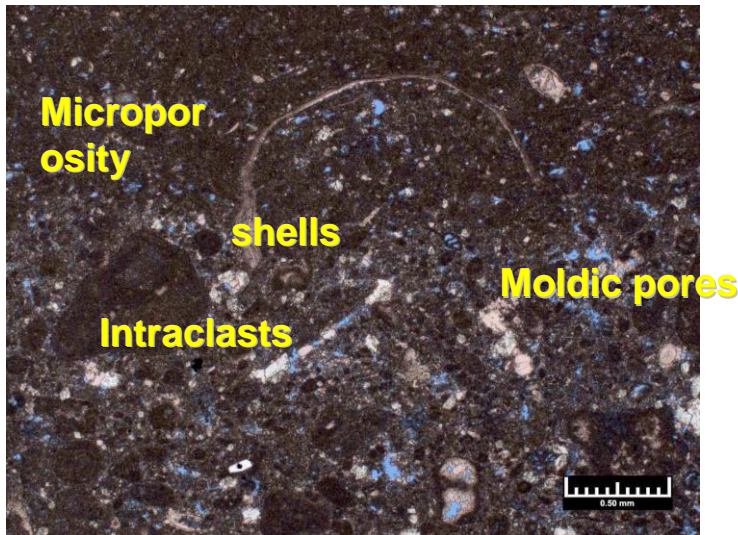
Integrated Reservoir Characterisation

Micro-porosity signature – Thin Sections & Logs

Thin Section Analysis

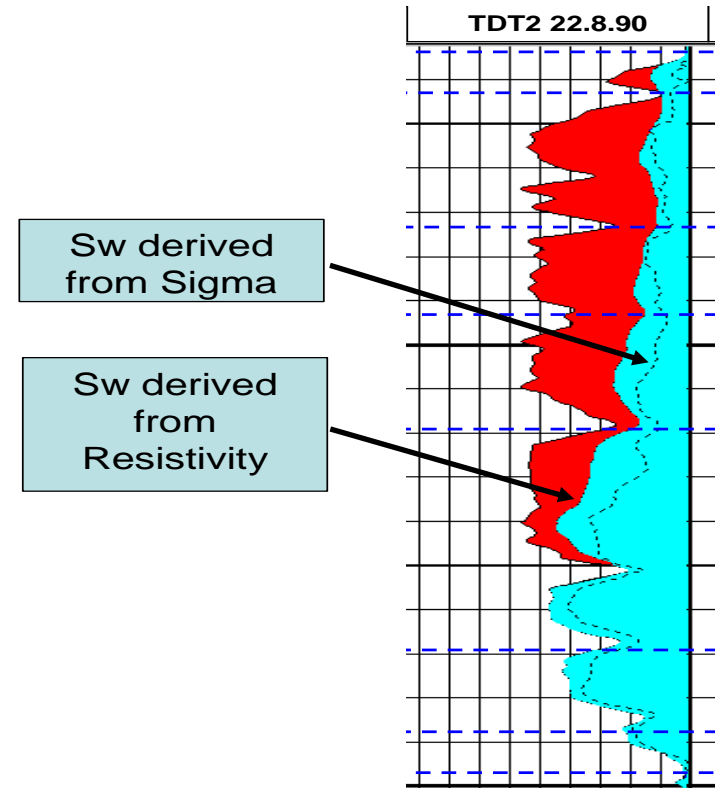
Peloidal wackestone
packstone (SPWP)

$\Phi = 24\%$
 $K=6$ mD



SPWP -(8515.5'): Muddy matrix, with diverse grain types (e.g. peloids, shell fragments, and intraclasts). Microporosity is dominant.

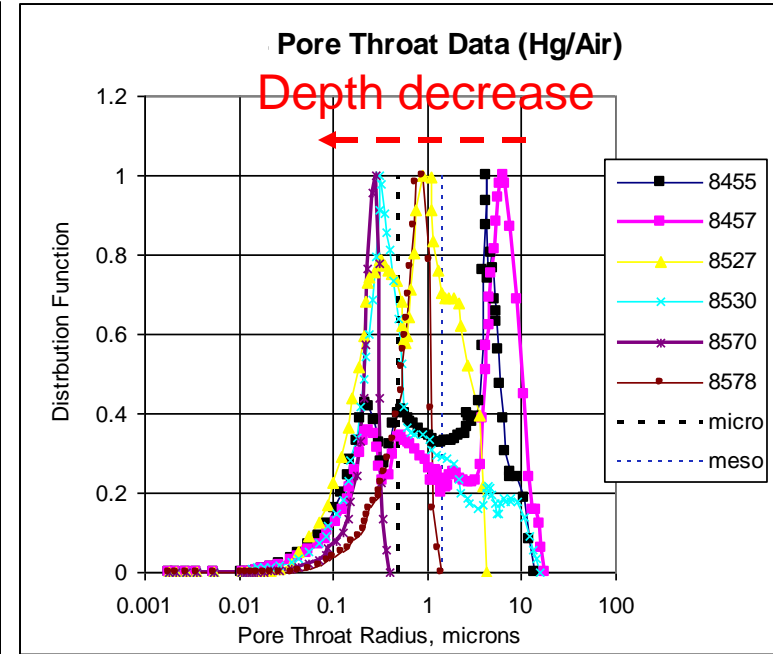
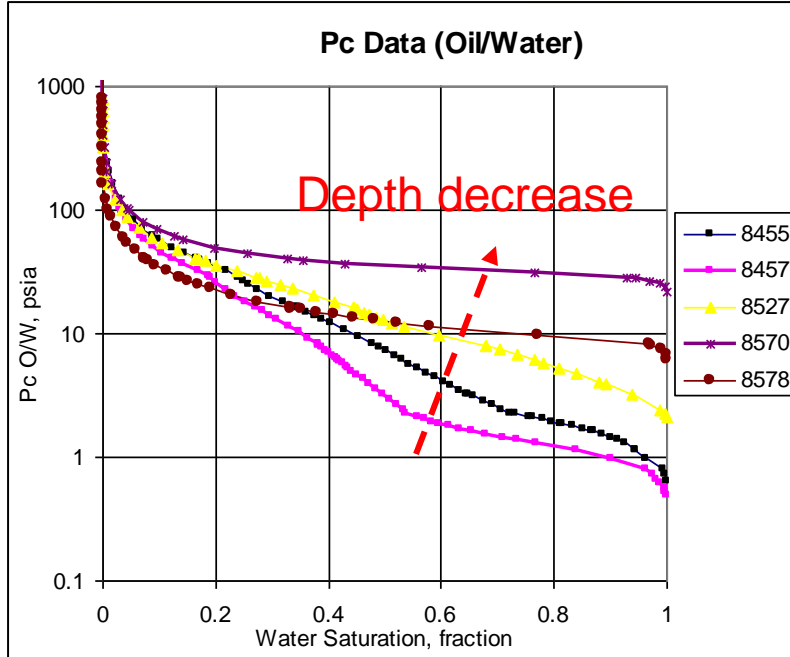
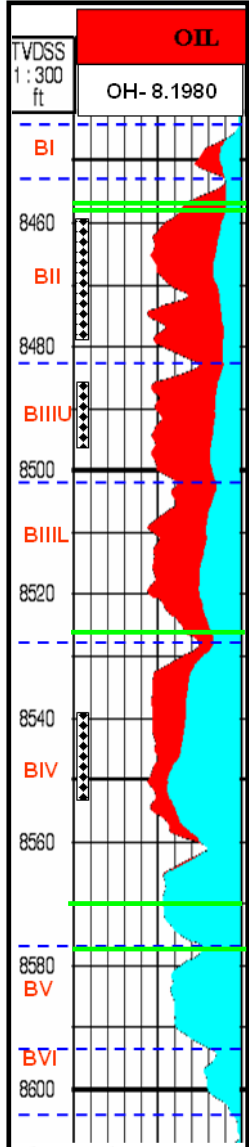
Resistivity Vs. Pulsed Neutron Logs



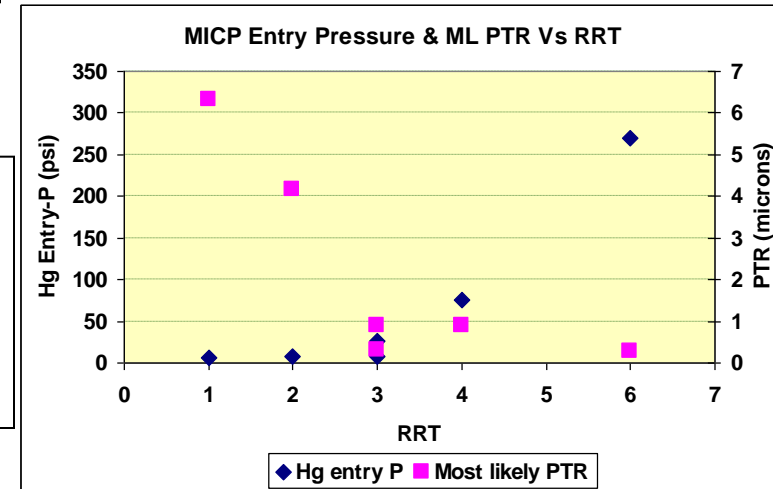


Integrated Reservoir Characterisation

Micro-porosity signature – MICP Data Review



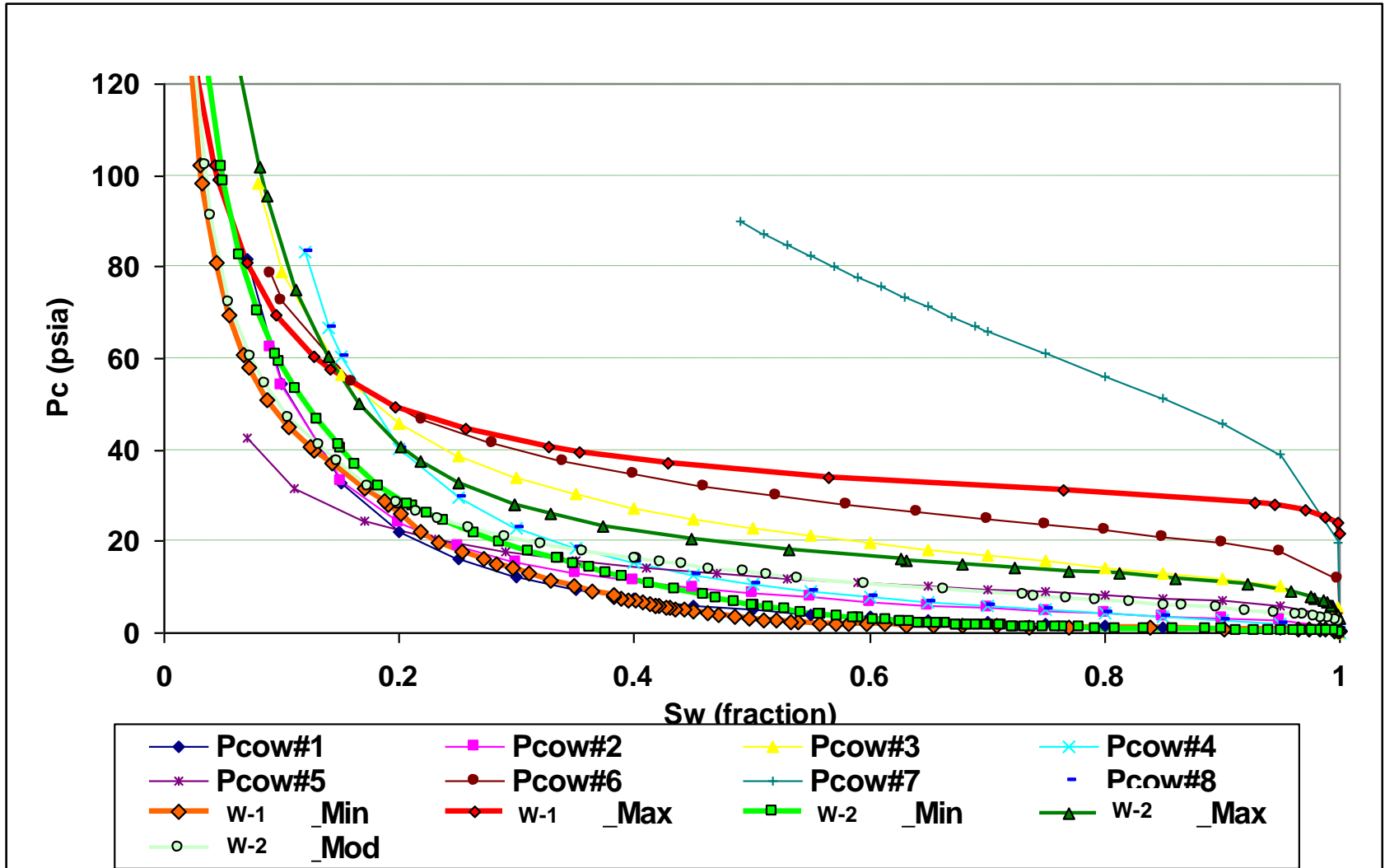
- Hg Entry Pressure increases & Pore Throat Radius decreases with poorer RRT





Integrated Reservoir Characterisation

Micro-porosity signature – MICP Data Review





OOWC & Sw Match

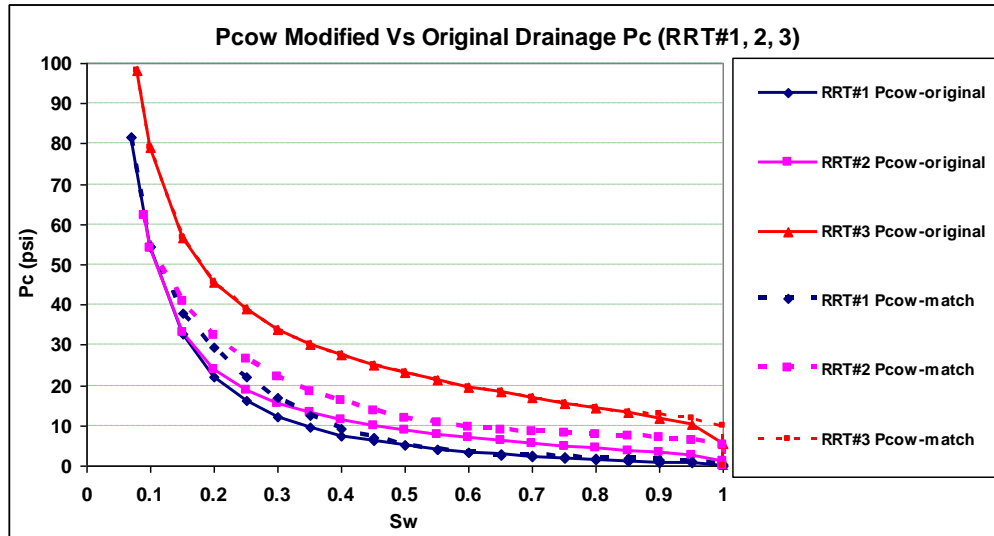
Methodology

- Modified PCs based on measured MICP and micro-porosity observations entered in reservoir model for area of interest
- Iterative process of Pc modifications for different RRT to get a representative match of OWC and Sw profile Vs. wells
- Drivers:
 - Stay as close as possible to hard data (MICP / BOCP)
 - Rock-types exhibiting micro-porosity tuned in priority
 - Rock-types with no micro-porosity have little adjustments

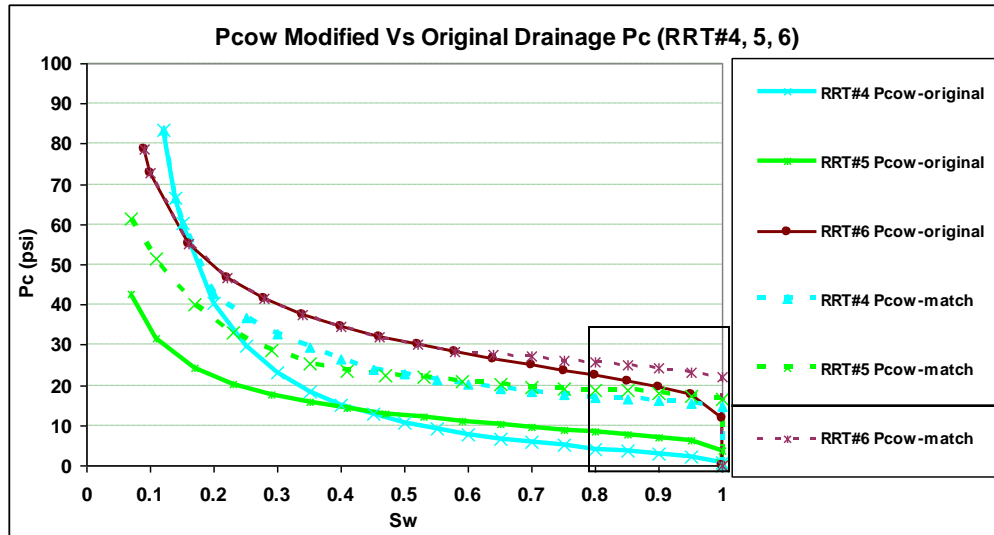


OOWC & Sw Match

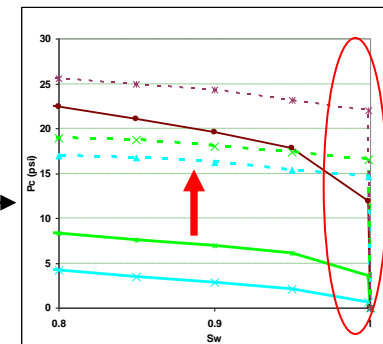
Methodology – Modified Vs Original Pc Curves



Better Rock-types
Micro-porosity not dominant



Poorer Rock-types
Micro-porosity more dominant



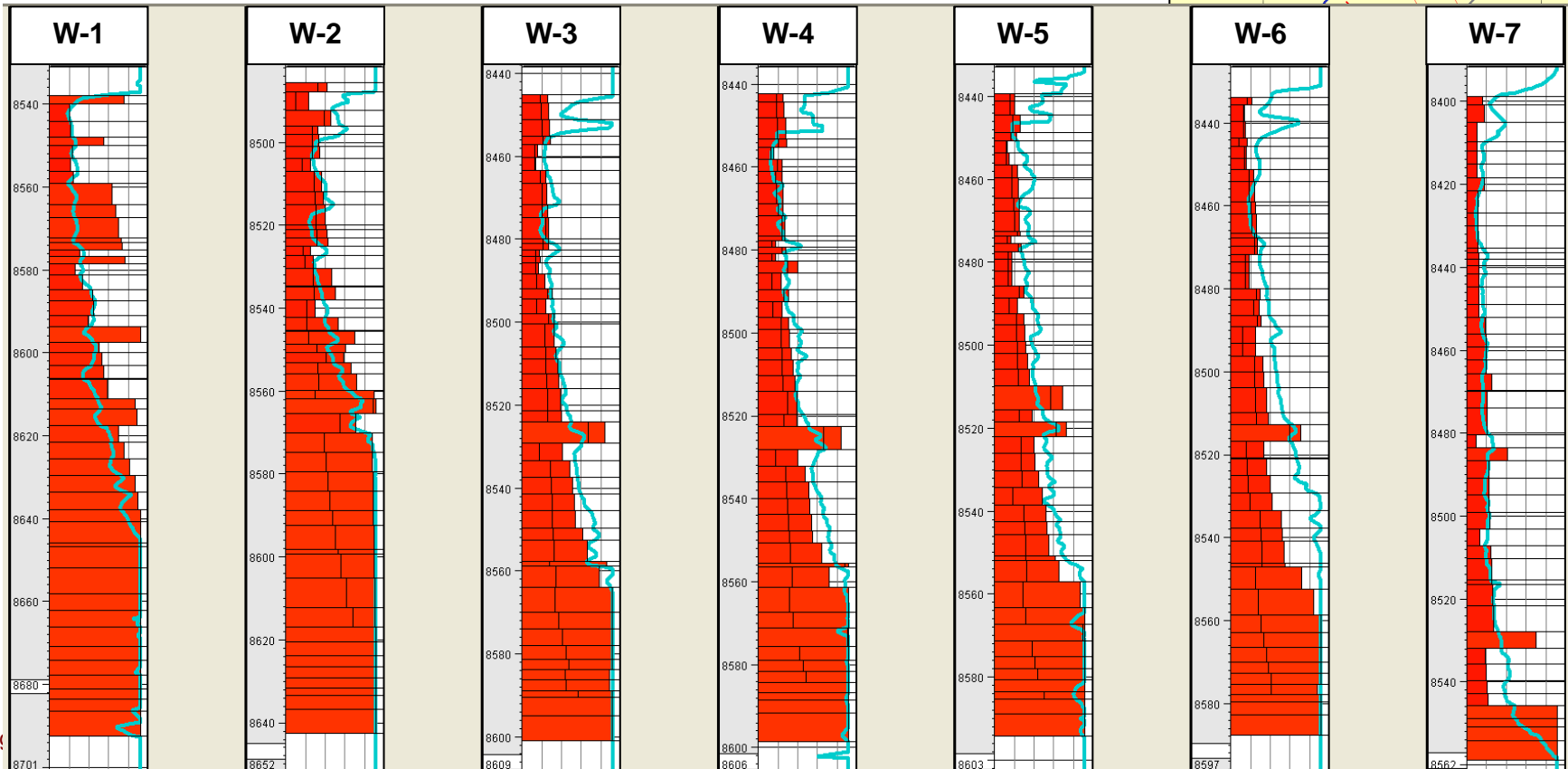
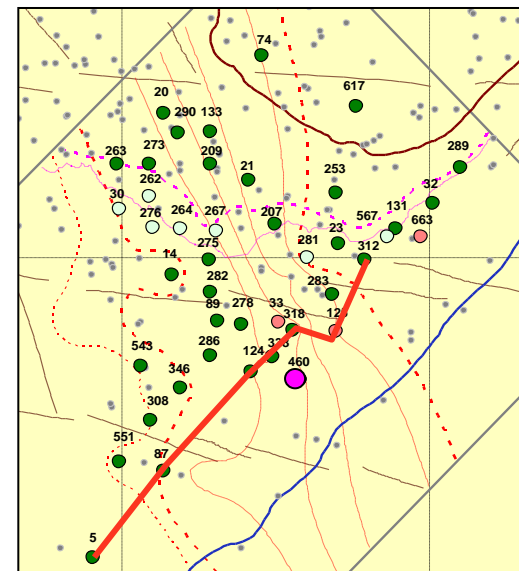
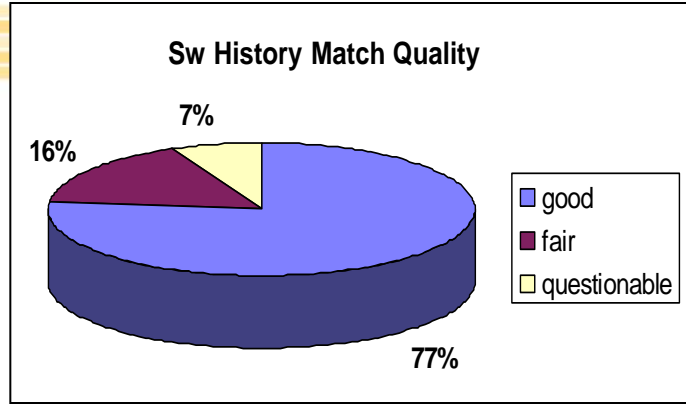
OOWC & Sw Match



Results

Sw Legend:

- █ Sw with Revised Model
- █ Sw with Original Model
- █ Sw from OHL





Conclusions & Way Forward

- Firm evidence of shallow OWC & micro-porosity behavior
- Implementation of new set of Pc in reservoir model with more representative shapes and entry pressure.
- Successful match of OWC & Sw Profiles
- Demonstrates importance of integrated approach between petrophysicist, geologist and reservoir engineer
- Way forward:
 - Revised geological model and Reservoir Rock Typing (done)
 - Improved workflow between reservoir rock typing, SCAL modelling and Sw matching (in progress)

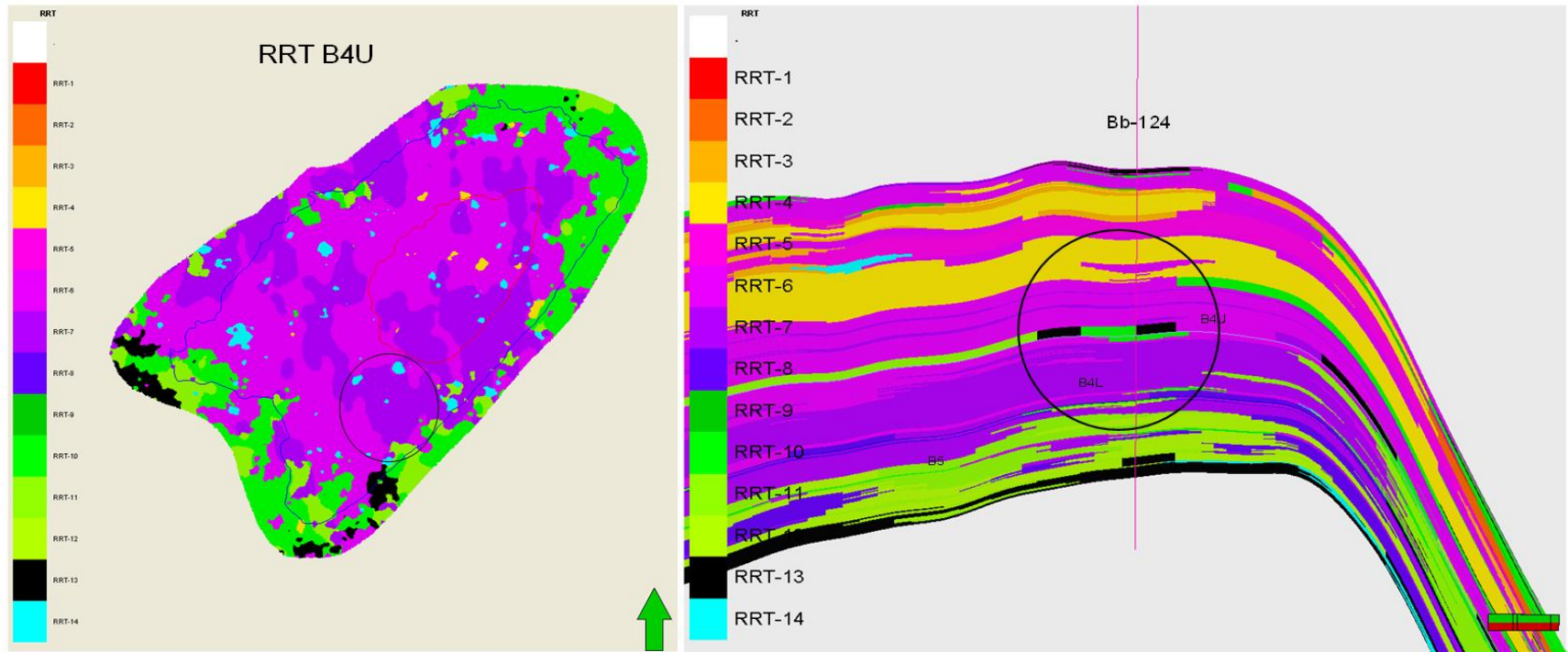


Thank You !



Revised Geological Modelling

Improved Reservoir Rock Typing



Revised Geological Model has a Reservoir Rock Type distribution that indicates abundance of micro-porosity RRT (RRT-7 composed of facies association #5 and PG1).