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EA Hydrocarbons Putting on a Show! – Development of a PNG Shows Database*

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Abstract

In Papua New Guinea (PNG) in 2013, an anniversary slipped by unnoticed and uncelebrated! It marked a century since the Upoia 1 bore was drilled in the Papuan region of what has become Papua New Guinea. Since that time, 652 wells have been drilled by numerous operators. Oil field practices have seen considerable evolution through the same period in two key areas for this study: drilling technology and basin modeling (source, maturity, expulsion and migration of hydrocarbons).

PNG's Papuan Basin (PB) has a proven petroleum system with the dominant hydrocarbon source interval being of Jurassic age. Associated oil and gas accumulations in the basin have been commercially exploited since the early 1990's, and many of these pioneer fields are now off plateau and in an advanced state of natural decline.

PNG's Eastern Fold Belt (EFB) is a much more lightly explored region. The discovery of the Antelope Gas Field has demonstrated that the EFB's previously identified, but poorly understood Late Cretaceous to Early Tertiary Petroleum System, has commercial significance. It also appears from seep data and shows in some wells (Iokea 1 and the Oiapu bores) in the Eastern Papuan Basin that there is a potential Petroleum System with a Middle Miocene source rock.

The early exploration of these petroleum systems was initially based on observed surface seeps which encouraged geophysical surveys, prospect delineation and drilling. These reports date back to 1911 for Europeans but customary landowners knew about them for much longer as they used oil for traditional skin decoration and as an item for trade. The early exploration records provide an often-overlooked reference set with often detailed, but highly variable descriptions of the observed hydrocarbons.

Hydrocarbons Show Database

This article describes an ongoing project in which we have systematically reviewed and catalogued over a hundred years' worth of hydrocarbon shows from wells that are captured in a database using a standardized show classification system developed by Oil Search's geochemistry consultant, Dr Andrew Murray.

The classification system enables the geoscientist to categorize shows into eight (8) groups:

- 1) Hydrocarbon flow tested to surface,
- 2) Hydrocarbons recovered to surface in wireline tools,
- 3) Hydrocarbons indicated from good multi-point and pressure gradients,
- 4) Hydrocarbons indicated from electric logging tools (FEWD/Wireline),
- 5) Hydrocarbons recovered from, or observed in, core barrels,
- 6) Hydrocarbons observed during mudlogging,
- 7) Hydrocarbons recovered from, or observed in, Side Wall Core (SWC), and
- 8) Hydrocarbons recovered from, or observed in, cuttings.

The categories above are in the order of highest confidence of the supporting data to the lowest. The highest confidence is from the actual recovery of a measured or a trace amount of hydrocarbon that has been flow tested to the surface mainly via a well test commonly known as a Drill Stem Test (DST). The lowest confidence is recorded from drill cuttings sample; these would have been recovered from the shale shakers where hydrocarbons can be observed physically from the cuttings or after running simple chemical tests. In the instance that hydrocarbons are observed with either limited supporting data or inconclusive data they are still recorded for future reference.

Key information about the shows are extracted from the well completion reports (WCRs) and composite logs. The evaluator reviews the composite log first, as a quick reference to observe: shows, if any, HC type, and depth. A review of the WCR then provides further detailed show descriptions, which allows the evaluator, to firstly categorize the show and secondly give a strength score accordingly (score range from 0 to 10 with 10 being the strongest). The show is recorded in a spreadsheet ([Figure 1](#)) which captures relevant information such as the formation name and lithology, its depth, main HC type and more. As a control measure for consistency, all formation picks from the WCR are checked against the Oil Search Ltd. (OSL) geoscience database for formation tops which have undergone an OSL technical team QC. At this point over 50% of the wells drilled in PNG have been captured onto the database.

Conclusions

While this process is ongoing, data is progressively being integrated into regional 3D basin models, these models rely on the shows database for calibration. In the software, show data is displayed in conjunction with seismically derived depth converted surfaces ([Figure 2](#)). The modeled hydrocarbon generation, expulsion and migration are then calibrated using the recorded shows, with their presence being described by the models in both space and time (4D space).

In combination, digital hydrocarbon show data, along with software derived geospatial displays enables rapid visualization, assisting explorers as they seek to identify new patterns, seek to prioritize focus areas and test potential migration pathways - they provide a calibrated predictive tool to assist explorers risk hydrocarbon charge.

	Category	Show Code	Strength	Description	Oil and Gas Score
<i>Hydrocarbons flow tested to surface</i>	HS FLOW	G5	10	Measured flow rate of gas	0
	HS FLOW	L5	10	Measured flow rate of clean oil	0
	HS FLOW	G2	8	Unmeasured volume or flow of gas observed or solution gas recovered from water during flow test	0
	HS FLOW	L2	8	Oil scum, globules or emulsion or unmeasured volume of oil recovered during flow test	0
<i>Hydrocarbons recovered to surface in wireline tools</i>	HS RECOVERY	G3	10	Discrete recovery of gas	0
	HS RECOVERY	L3	10	Discrete recovery of clean oil	0
	HS RECOVERY	G2	8	Recovered an unmeasured volume of gas (validity confirmed by chemical analysis)	0
	HS RECOVERY	L2	8	Oil scum, globules or emulsion or unmeasured volume of oil recovered (validity confirmed by chemical analysis)	0
<i>Hydrocarbons indicated from good, multi-point, pressure gradients</i>	HS PRESSURE SURVEY	G2	8	Pressure measurement clearly shows a gas zone	0
	HS PRESSURE SURVEY	L2	8	Pressure measurement clearly shows an oil zone	0
<i>Hydrocarbons indicated from electric logging tools (FEWD or wireline)</i>	HS LOG	G2	10	Gas zone (water saturation less than approximately 80%)	0
	HS LOG	L2	10	Oil zone (water saturation less than approximately 80%)	0
	HS LOG	G1	7	Residual gas (water saturation greater than approximately 80%)	0
	HS LOG	L1	7	Residual oil (water saturation greater than approximately 80%)	0
<i>Hydrocarbons recovered from or observed in barrel core</i>	HS CORE	G1	9	Gas bubbles observed bleeding from core (validity confirmed by chemical analysis)	0
	HS CORE	L2	9	Oil spontaneously flowing from core (validity confirmed by chemical analysis)	0
	HS CORE	L0	8	Visible oil or bitumen in core or measured residual oil from solvent extraction or pinpoint or minor oil bleeding (validity confirmed by chemical analysis)	0
	HS CORE	L1	7	Greater than 30% bright fluorescence with strong cut at fast rate	0
	HS CORE	L1	6	Greater than 30% bright fluorescence with strong cut at slow to medium rate or moderate cut at fast rate	0
	HS CORE	L0	5	Nil to medium cut	0
	HS CORE	L0	4	Nil to approximately 30% bright fluorescence or any dull to moderate fluorescence with or without cut	0
	HS CORE	L0	3	Oil staining without fluorescence	0
<i>Hydrocarbons observed during mudlogging</i>	HS MUD LOGGING	G2	7	Gas readings more than approximately 10 times background or total gas greater than 1% (50 units) with C4 and/or C5	0
	HS MUD LOGGING	G1	6	Gas readings between approximately 5 and 10 times background or total gas greater than 1% (50 units)	0
	HS MUD LOGGING	G0	5	Gas readings less than approximately 5 times background or total gas less than 1% (50 units)	0
	HS MUD LOGGING	NS	4	Trip gas or connection gas	0
	HS MUD LOGGING	L1	6	Oil observed in mud (after confirmation by chemical analysis this might ascend to the status of HC recovery/trace oil)	0

Figure 1. Shows ranking system with hydrocarbons shows, categories, strength and description.

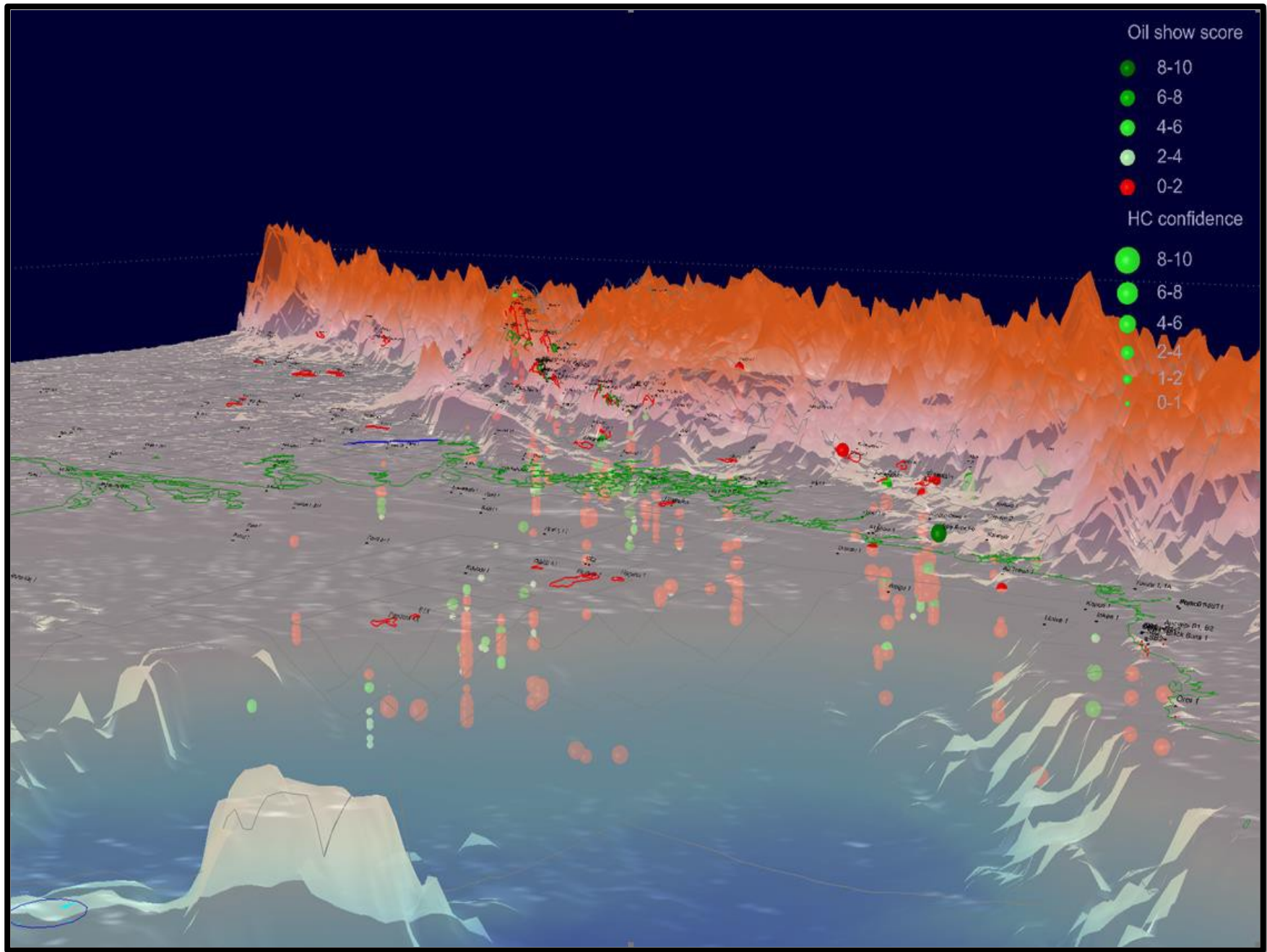


Figure 2. The data from the Shows Database utilized in Trinity.