Emerald's proprietary software

Emerald Resources Limited ("Emerald" hereafter) is a private Canadian company that specialize in the exploration of unconventional resources. Emerald was incorporated in 2015 in Calgary, Canada by Dr Madi.

Dr Madi was the co-founder of three Canadian oil companies: Emerald Petroleum Ltd in 2003, *SDX Energy Ltd*. (formerly Madison PetroGas Ltd.) in 2006 to explore and develop assets in Cameroon and Egypt, and *Allied Petroleum Exploration Inc*. (APEX) in 2011 to explore Block 36 in the Sultanate of Oman.

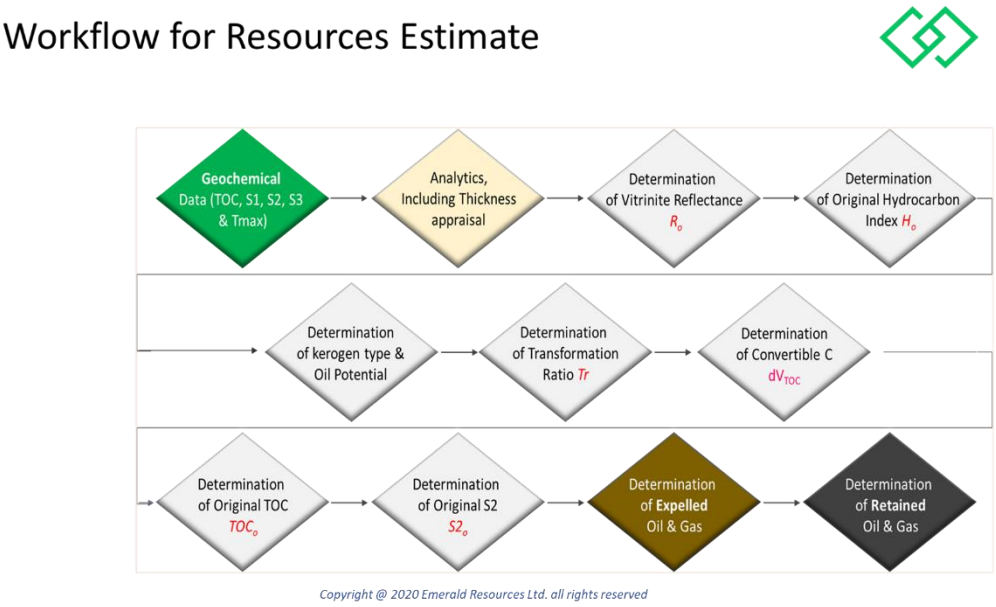
Prior to 2015, Emerald Petroleum was more and more involved in unconventional plays, principally tight oil/gas plays, and was involved in western Canada, USA, and Oman. For better efficiency, Emerald invested time, and money in the development of three software, powered by artificial intelligence and machine learning. These proprietary software's for the exploration of unconventional plays are developed by Emerald Resources with software developer and artificial intelligence experts from Montreal, Canada.

a) Resources/Reserves Assessment

The main goal for shale resource characterization is usually the identification of sweet spots which have the highest production recovery rate, and thus represent the most favorable drilling targets. Sweet spots are not necessarily areas with high organic richness as the highest TOC zones are more efficient expellers of hydrocarbons, while retaining the least mobile petroleum, thereby affecting productivity. The most profitable part of a fairway can often be defined by the intersection of brittle and highly pressured organically rich zones in the proper petroleum window, especially if siltstone/sandstone or limestones beds are present within the source rock.

We perform Resources/Reserves Assessment of unconventional plays by estimating the oil or gas retained within the source rock or contained in tight plays of each analyzed well that have geochemical data *(TOC, S1, S2, S3, HI, and maturity proxy (Tmax, Vitrinite, and or SCI)*.

Our methodology was inspired by Jarvie's (2007) and Talukdar (2010) - see our paper published in Society of Petroleum Engineers in 2015 (J.A. Madi & E.M. Belhadj, 2015. SPE-172966-MS- https://doi.org/10.2118/SPE-172966-MS). Since then, we have revisited our work to address all types of source rocks, geological contexts, elaborated modeling of key parameters to stick as much as possible to the geological setting and source rock type…



When all the cited information and data are gathered and integrated (which is part of the database building), it takes couple minutes to obtain the below results.

Input Data:

Resources estimate | TOC estimation

Select project:

Project name: NE Algeria

Location (name of well, coordinates):

Age of studied interval: Cretaceous

Formation (name):

System type: Semi Close

Kerogen type: 2

Thickness (meters): 55

Process | Save

	Depth	TOC	S1	S2	S3	HI	TMAX	RO
1	2755.00	1.95	2.15	6.29	1.00	323	439	
2	2760.00	1.64	2.00	5.64	1.08	344	439	
3	2765.00	1.55	2.28	6.30	1.13	406	440	
4	2775.00	1.38	2.15	6.33	1.03	459	439	
5	2785.00	1.28	1.66	4.52	1.27	353	440	
6	2795.00	1.46	2.66	4.50	0.96	308	440	
7	2800.00	1.40	2.42	3.84	1.02	274	441	
8	2805.00	2.48	4.06	12.85	1.19	518	442	
9	2810.00	3.43	3.68	16.96	1.25	494	442	
10	2810.10	8.23	2.75	43.19	0.48	525	442	

Results Display:

km²

	Summary of Shale Oil/Gas Properties and Resources	unit	value
1	Total Retained Oil in the C/T source rock	(MMbbl/km²)	12.4820
2	Total Retained Gas in the C/T source rock	(bcf/km²)	13.1118
3	Total expelled Oil from the C/T source rock	(MMbbl/km²)	9.3093
4	Total expelled Gas from the C/T source rock	(bcf/km²)	9.7790
5	Average Depth	m	2796
6	Type of Source Rock (kerogen)		2
7	Average Source Rock thickness (in feet)	feet	180.46
8	Average Source Rock thickness (in metres)	meter	55.00
9	Average Present-day TOC	%	3.18
10	Average Original TOC	%	3.78
11	Average Original HC Potential (S2o)	mgHC/g rock	26.32
12	Average Original HC Index (HIo)	mgHC/g rock	691.96
13	Maturity % Ro	%	0.82
14	Maximum % of TOC convertible for Kerogen type	%	48.20
15	Average Oil Potential	%	85.15
16	Transformation ratio of OM	%	33.13
17	Estimated expulsion efficiency	%	42.72
18	Secondary Cracking	%	0.00
19	System Type based on geological setting (Close, semi-close, open)		Semi Close

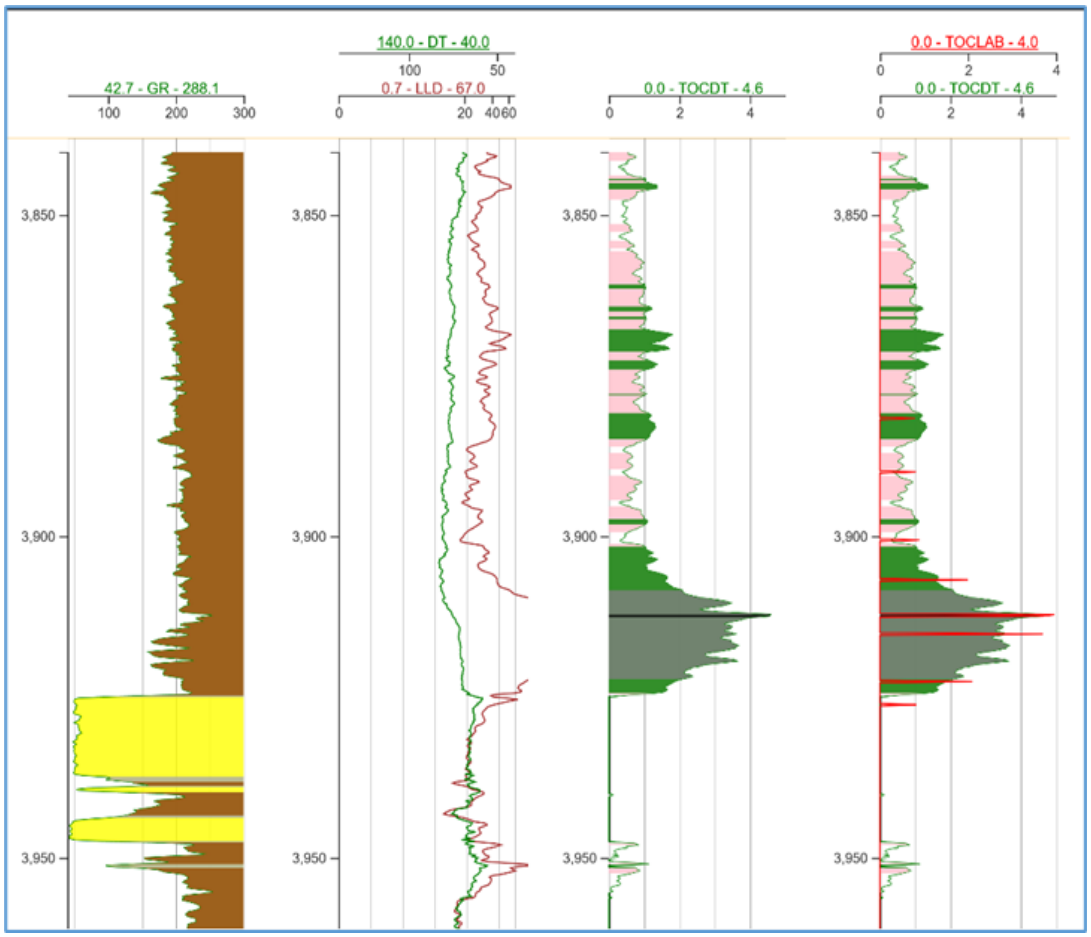
Close | Export

b) Identification of Source Rock intervals from Logs

Determination of *TOC* and *thickness* from logs using a modified Passey et al. (1995) ΔlogR technique and GR/Rt techniques.

After calibration with lab data in a well where geochemical analysis was previously performed, we calculate the TOC in any well that have log data (GR, Resistivity, Sonic and/or Density).

Since most of wells do not have lab data or at the best have it done only in selected intervals, therefore not only we can estimate very accurately the TOC in the hole well but more importantly identify the horizons that have real source rock potential and their respective thicknesses…



c) Identification of Tight Oil Plays

Gas chromatography analysis of mud gas while drilling assists the identification of pay-zones in conventional reservoirs and (unconventional) tight plays.

- It does give a strong indication of the type of hydrocarbon present in reservoirs and source rocks
- It does give a strong indication of the maturity stage the source rocks
- Tight Oil Play is identified when a given bed, with lithology closer to a reservoir than a source rock, shows "higher TOC values" and higher mud gas readings…