

## Structural Division

### Exploring in the Western Canada Sedimentary Basin for Oil and Gas in Naturally Fractured and Weathered Precambrian Basement

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Location: CEGA Classroom, +15, 2<sup>nd</sup> Floor Aquataine Tower

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June 1, 2023 | 12:00pm – 1:00pm (MST)

#### ABSTRACT

Major volumes of oil and gas are produced from reservoirs in fractured and weathered basement in China, Vietnam, Indonesia, India, Libya, Venezuela and Russia. Rather surprisingly, although the WCSB (Western Canada Sedimentary Basin) is one of the most prolific sedimentary basins in the world, no oil or gas has ever been produced from basement in the WCSB.

The volumes of oil and gas produced from the basement fields worldwide varies from barely economic volumes to giant-size fields. For example, oil is produced from Jurassic schists in California with some of basement-reservoired oil pools having reserves as little as only 2 million barrels of oil. On the other end of the scale are basement fields like Auguila - Naafora in Libya with estimated reserves of 1.8 billion barrels of oil in basement. The Bach Ho-White Tiger oil field, offshore Vietnam has approximately 1.4 billion barrels of oil produced from basement. Other "high-end" examples include the Suban gas field in South Sumatra which has reserves of over 5 TCF gas. Suban is in an area where 8 gas fields were found in basement with gas reserves totalling 15 TCF. The Renqiu oil field onshore China has reserves of approximately 2.3 billion barrels of oil and is the world's largest oil field in basement.

The basement lithologies of some of these fields includes fractured Precambrian granite in Libya's Auguila-Naafora oil field. In Vietnam's Bach Ho field oil production is from fractured Precambrian granites. The gas production from the Suban field in South Sumatra is from fractured pre-Tertiary age granites. Oil production from China's Renqiu field is from Cambrian and Ordovician basement dolomitic carbonates located in a "buried hill" type of structural closure.

Production from these fields is mainly from natural fractures in the basement. These are the result of regional or local tectonism. The La Paz field in Venezuela which has produced over 300 million barrels of oil from basement. Fractures in the basement of La Paz are associated with a prominent reverse fault. The Auguila-Naafora oil field in Libya has fracturing associated with normal faulting. The Suban field is the result of regional wrench (strike-slip) faulting. With some basement oil and gas fields like Auguila-Naafora and Suban, weathering at the top of basement has also created excellent basement reservoirs.

I have always been perplexed that there has never been oil or gas produced from the basement in the WCSB. I believe this is because this play is little known within the Calgary "oil patch" which is entirely focused on the WCSB and know little about an "exotic" play like oil and gas in basement. Also, most exploration wells avoided basement since it was traditionally known as "tight" or "tombstone". Consequently, there has never been a deliberate, basement-focused exploration program in the WCSB. The closest to this was an exploration well drilled in 1994 just west of Fort McMurray, AOC Granite 7-32-8-W4 which drilled through over a mile of granite 1,822 meters (5,978 feet) to a total depth of a total depth of 2,363 meters (7,688 feet). This well was also known as the "Hunt Well" since it was promoted by Calgary geologist Charles Warren Hunt. The Hunt Well will be reviewed in my presentation as an example of a basement exploration well which I would have never recommended. In my view, a better area to explore for oil or gas in Precambrian basement in the WCSB is the Red Earth - Nipisi area where oil is produced from Devonian-age Gilwood sands overlying Precambrian basement. This is an area where the focus of the geologists was on the Gilwood and the potential of oil and gas in basement was unrecognized.



Granitic core from the deepest section of the Hunt Well (below 2,300 m). The diameter of the core is 4 inches (10 cm). From: Majorowicz, J., et al, 2014, *Geophysical Journal International*.

## BIOGRAPHY



I am Holland-born but Alberta-raised with a B.Sc. in 1971 from the University of Alberta and a B.A. in Economics in 1981 from the University of Calgary. I first learned about basement oil and gas reservoirs forty years ago when I worked in Sumatra on the development of the Beruk Northeast field which produced oil from fractured basement. I subsequently published on Beruk Northeast in the 1984 proceedings of the Annual Convention of the Indonesia Petroleum Association in Jakarta and in a special publication "*Hydrocarbons in Crystalline Rocks*" of the Geological Society of London published in 2003. I have continued to closely follow basement oil and gas activity for over four decades and have presented and written on it at numerous conferences,

conventions, and symposiums worldwide. Locations have been in Asia: Jakarta and Singapore, Middle East: Istanbul, Europe: London and Kazan-Russia, Africa: Lagos, Abuja, Luanda and Cape Town, and North America: Calgary, Houston, and Pittsburgh.

I worked for 30 years worldwide with Texaco. I worked for 15 years in Canada, mainly in Calgary but I initially spent 2 years working as a mud-logger on the drilling rigs offshore Newfoundland. I lived and worked for 30 years in Sumatra, Nigeria, and Angola. In Angola, I worked for Texaco and consulted for Tullow Oil and the American-British consultancy of Gaffney, Cline & Associates. I am a long-term member of the CEGA-CSPG, CSEG, AAPG and APEGA having maintained membership for over forty years in these organizations.