

Exploring for Atlantic Canada's next giant petroleum discovery

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The Canadian Atlantic Coast has become an important petroleum province with: 1) production from world-class oil and gas fields: Hibernia, Terra Nova (together 350,000 bopd) and Sable gas project (450 Million cubic feet per day); 2) future developments at White Rose, Deep Panuke and possible at Hebron-Ben Nevis, and 3) committed future exploration in excess of \$1.5 Billion Canadian dollars. An exciting and costly exploration race is now taking place within the Mesozoic basin trend for the discovery of Atlantic Canada's new giant field (Figure 1).

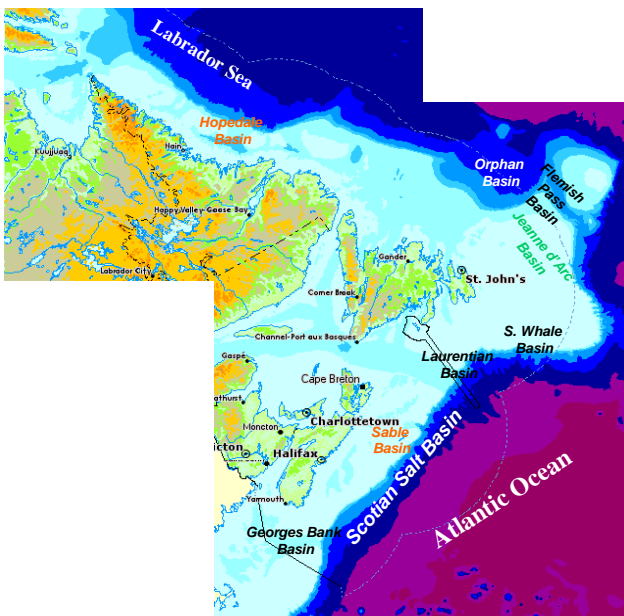


Figure 1. East Coast Canada bathymetry (after NRCan) and main Mesozoic basins.

In the **Scotian Basin** exploration recently took place on a number of distinct exploration trends: a) on the Jurassic carbonate bank, exploration drilling followed-up the 1999 Deep Panuke discovery; b) in the Sable sub-basin, exploration is ongoing on the existing geopressure trend around the present Sable gas development and c) targeting Cretaceous and Tertiary turbidite reservoirs (Figure 2). Several deepwater wells in the Scotian Salt Province, in water depths ranging from 700 to 1700 metres, were drilled for sandstones reservoirs associated with movement of Argo halite. No commercial discoveries were made either on the shelf or on the slope. Annapolis G-24 was the only well that encountered significant gas in a slope fan play, but the delineation Crimson well has not been successful (Figure 2). Mariner I-85 and Onondaga B-84 wells, located in the Sable Sub-basin were not tested. While recent drilling was disappointing, Offshore Nova Scotia is a very large, under-explored basin which contains significant potential if the key to successful exploration is found by concerted industry-government-academia

efforts and synergetic scientific research. Great gas reserve potential exists on both shelf and slope pending identification of quality reservoir fairways. Many active licenses remain to be validated (Figure 3) and many play-types to be drilled.

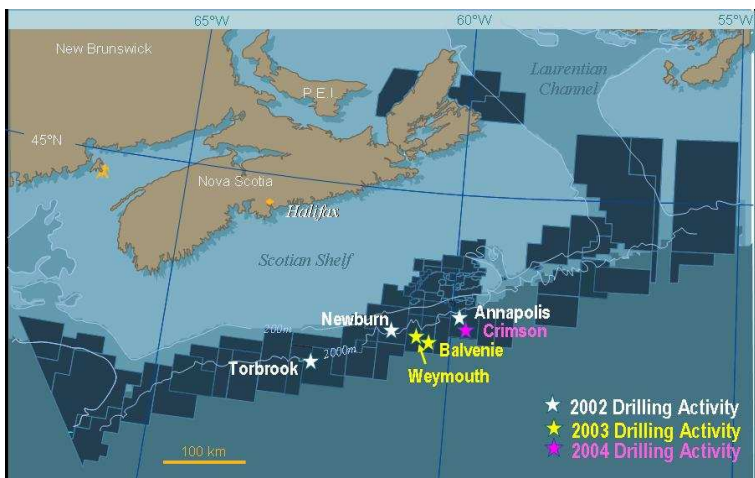


Figure 2. Location of recent deepwater drilling activity in the Scotian Slope Salt Province (courtesy of EnCana Corp.)

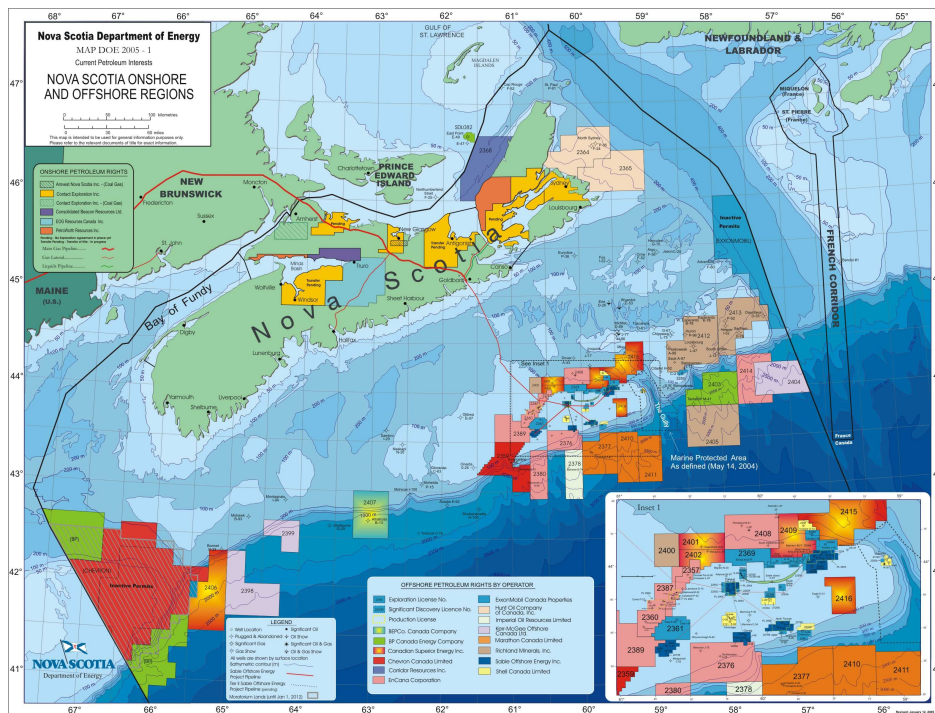


Figure 3. Exploration and Production Licences offshore Nova Scotia (2005; courtesy CNSOPB)

Offshore Newfoundland exploration was concentrated in Jeanne d'Arc Basin and the deep water Flemish Pass and Carson-Salar basins and it recently focused on a large area in Orphan Basin (Figures 4 to 6). While source rocks and quality reservoirs were drilled, the Flemish Pass Basin remains elusive to its first commercial discovery. Still to be drilled is an atypical structural trap in the South Whale Basin, on the Southern Grand Banks. Within the oil prolific Jeanne d'Arc Basin retargeted by a recent landsale, potential for oil discoveries exists in deeper structural plays, stratigraphic traps in the southern part and combination traps in the eastern side of the basin, while gas plays are still to be tested. Seismic acquisition and regional geoscience studies are setting the scene for the next exploration cycle in the Labrador Sea basins that may include drilling for gas toward the end of this decade and beginning of infrastructure development (CNG, pipelines, LNG or GTE).

The next focus of the Atlantic exploration is the East Orphan Basin, a highly attenuated Mesozoic-Tertiary sedimentary area situated north and northeast of the Grand Banks of Newfoundland in water depths ranging between 1500 and 3500m and occupying an area of over 160,000 km² (Figures 4). The Petroleum system of the East Orphan Basin should include: a) Kimmeridgian and probably Albian source rocks; b) Late Jurassic, Early and Late Cretaceous and Tertiary reservoirs; c) large roll-over anticlines, rotated fault blocks and submarine fans and d) source maturation, generation and short distance migration of oil and gas from large sub-basins into existing antiforms and submarine fans. Presently eight exploration blocks have been licenced with an area of 21,000 km². 3D seismic acquisition and mapping is ongoing on several exploration blocks that contain large antiforms (200-400 km²) resulting from extensional anticlines being modified by transtension and inversion (Figures 4 and 5).

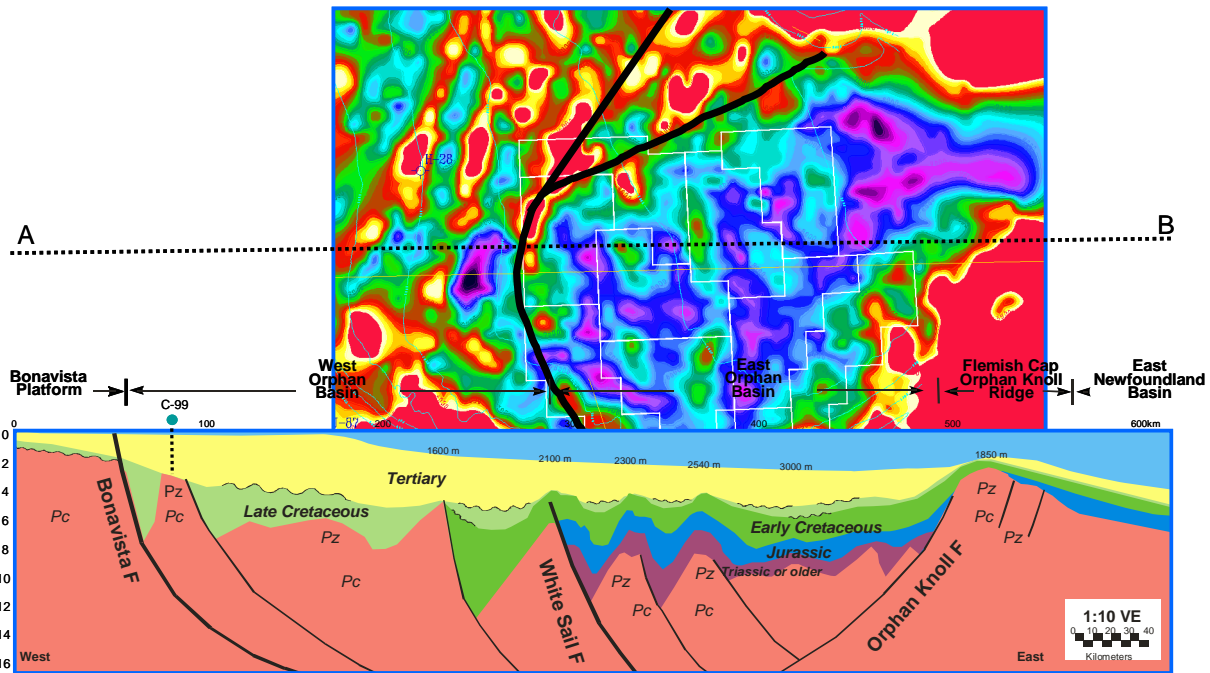


Figure 4. Map and schematic geological cross-section showing main structural and tectonic features in the Orphan Basin. Map legend: light green/yellow/red=structural highs; dark green/blue/purple=structural lows.

In spite of high commodity prices, a low level exploration activity is predicted for the Atlantic Canada during the next decade. In the quest for area's next large discovery, exploration drilling, performed mostly in deep and ultra-deep water, will test large structural traps in the Orphan Basin and stratigraphic traps (turbidites) in the Scotian Slope Basin. Shallow water exploration will continue on the Deep Panuke carbonate trend, Listric fault domain around Sable Island, Paleozoic platform and triangle zone of Western Newfoundland and within structural-stratigraphic plays in the Jeanne d'Arc Basin, close to oil field developments.

As in any Frontier area, exploration success will depend on improved seismic imaging technology, regional geoscience evaluation, quality of prospects drilled, long range commitment to the area and sustained tempo of drilling. As exploration results during the NEP of the early eighties and the following major oil and gas discoveries has demonstrated, increasing the annual drilling rate is the principle way to record new field discoveries and maintain a sustainable East Coast petroleum industry. Significant changes to the present fiscal regime of exploration in Atlantic Canada are suggested, including a) royalty holidays for wildcats in high geological risk basins coupled with solid provincial benefits and b) limitations of the terms and duration given to significant discovery area (SDA).

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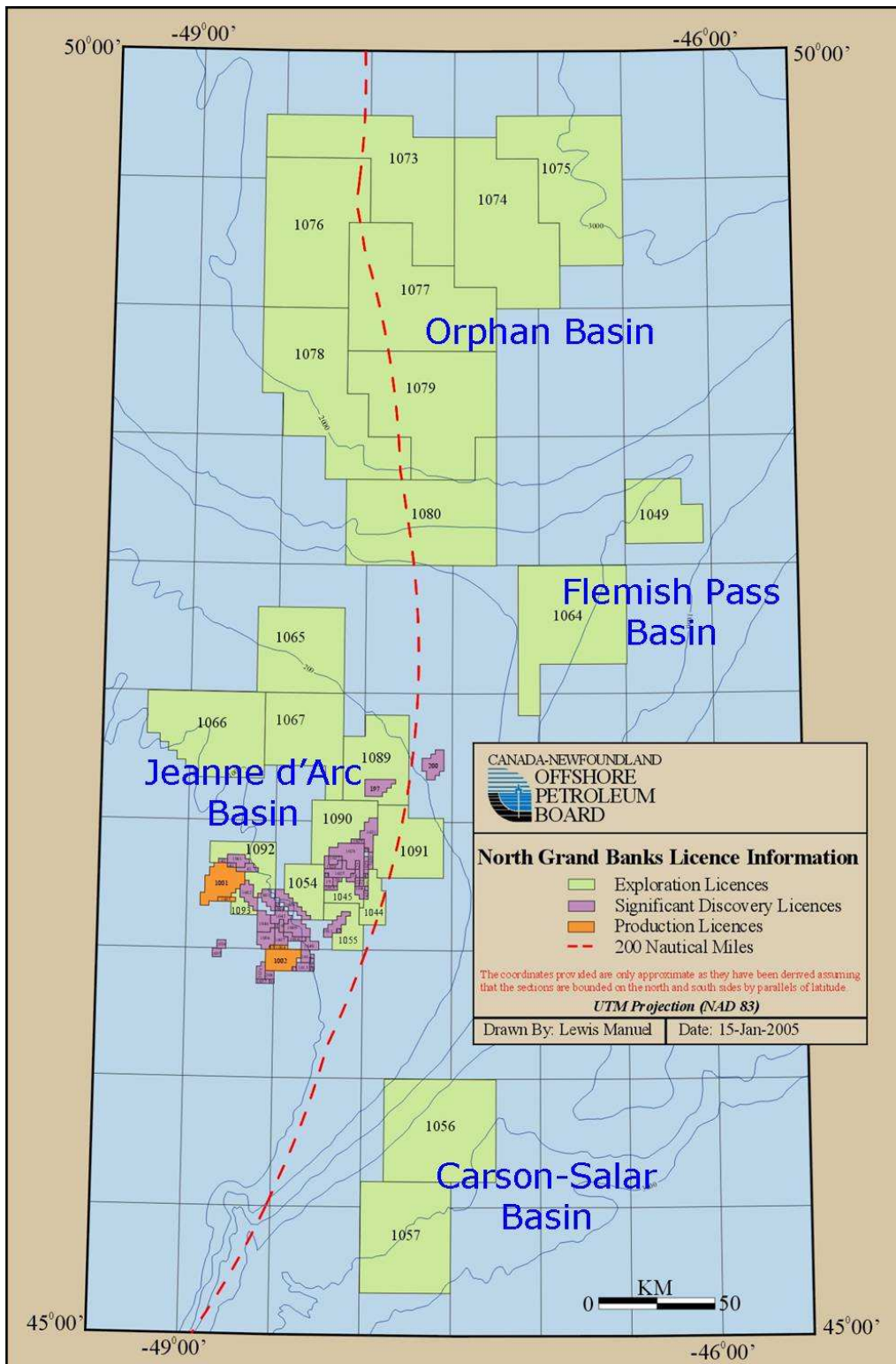


Figure 5. Land tenure and location of recent exploration activity offshore Newfoundland

Authors' Biographies

Dr. Michael Enachescu is a graduate of University of Bucharest, Romania. He is now Husky Energy Senior Fellow in Exploration Geophysics at Memorial University of Newfoundland, a research and teaching staff of the Department of Earth Sciences, Pan-Atlantic Petroleum Systems Consortium (PPSC) and Oil and Gas Development Partnership (OGDP) and an advisor to several oil

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John Hogg earned his B.Sc. in Geology from McMaster University in Hamilton, Ontario Canada in 1981. After graduation, John joined Gulf Canada Resources in 1981 and work for three years exploring for oil and gas in the Sverdrup Basin, and has worked the Atlantic and Arctic oceans as an explorationist and researcher for over 20 years. His scientific interests are rift basin tectonics, passive margin sedimentation, and sequence and stratigraphy of the North Atlantic Margins. John started as an Exploration Geologist in Atlantic Canada in 1984 with Husky Oil Operations. Since then, he has been directly involved in the drilling of more than three dozen offshore exploration and delineation wells on the Scotian Shelf and the Grand Banks with Husky Oil, Petro-Canada, PanCanadian and now EnCana. John is currently New Ventures Manager for EnCana Corporation's Chinook Business Unit and is responsible for a multidisciplinary team that is working on new resource plays in the Western Canada Sedimentary Basin. For the last seven years, John worked for PanCanadian and EnCana Corporation as the leader of an exploration team that work a variety of exploration plays on the Scotian Shelf and Grand Banks of Newfoundland, and offshore Western Greenland. John's volunteer activities include IODP, AAPG, PRAC and is 2004 Past President of CSPG. E-mail john.hogg@encana.com