Hopes Soarin

An industry struggles to be born offshore of British Columbia


James Haggart


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AFTER THE ELECTION in May 2001 of a business-friendly Liberal government in British Columbia, hydrocarbon exploration off the west coast rose to the top of the provincial agenda with a stated goal of activity under way by 2010. There have been 30 years of attempts by tenure holders, governments and local communities to lift federal and B.C. moratoria and to achieve consensus on the key exploration and development issues of environment, ownership and administration of oil and gas and the role of First Nations.

Of the four prospective B.C. offshore sedimentary basins, the north coast Queen Charlotte Basin (QCB) stands out. It provides a touchstone for a variety of geological, legal and policy issues. All intersect spatially and temporally, resulting in a mix that, if addressed successfully, may be a template for other B.C. coastal basins.

What follows are two articles written by professionals with first-hand knowledge of the B.C. offshore. The first, by Dr. Jim Haggart of the Geological Survey of Canada, reviews the geology and hydrocarbon potential of the Queen Charlotte Basin. In the second article Tony Fogarassy of the Vancouver law firm Clark, Wilson, summarizes a trilogy of issues likely to define the creation and implementation of an offshore exploration regime in B.C.: environmental law, jurisdiction and ownership of oil and gas, and the role of First Nations.

No absolute determination of the resource potential of the QCB nor resolution of a legal issue or matter will all by itself make petroleum exploration happen. Frontier geology and the interlocking nature of environmental issues, First Nations support or lack thereof, and the uncertainty of jurisdiction and ownership of QCB offshore resources foreshadows a lengthy and complex process leading to an initial exploration program.

Some history needs to be understood. The Queen Charlotte Basin region is the most attractive offshore basin of western Canada. The area contains the landmasses of Queen Charlotte Islands (QCI) and northern Vancouver Island (NVI), as well as the adjoining interior continental shelf areas of Dixon Entrance, Hecate Strait, and Queen Charlotte Sound. Government assessments suggest that the basin holds an estimated 9.8 billion barrels of oil and 25.9 trillion cubic feet of gas.

PHOTO: JOEY PODLUBNY

Most of the region is underlain by continental shelf and varies from quite shallow depths in the Hecate Strait region (typically less than 60 metres), to about 450 metres in the western Queen Charlotte Sound area. The region is subject to seismic risk, and the open-ocean setting allows periodic storms of significant intensity.

Nine onshore exploration wells tested the QCB between 1913 and 1971. Shell Canada drilled eight wells in Hecate Strait and Queen Charlotte Sound between 1965 and 1969. The 50 or more oil, tar and natural gas seeps on Queen Charlotte Islands likely enticed early explorationists.

Soon after the Shell drilling program, a suite of federal and provincial legal and administrative moratoria were placed on offshore exploration. In the late 1980s the Geological Survey of Canada carried out a mapping initiative under the auspices of the Frontier Geoscience Program (FGP) in concert with renewed interest by tenure holders Shell and Chevron. The late 1980s and early 1990s publications of FGP researchers continued to refine the geology and hydrocarbon potential of the QCB.

With renewed interest in the 1980s, a federal environmental assessment panel produced what is to this day the key report of B.C. offshore hydrocarbon exploration. However, the Exxon Valdez tanker and Nestucca barge spills in 1989 effectively scuttled government interest, placing the offshore in abeyance until the late 1990s.

Pressed by aggressive lobbying from Prince Rupert businesses, the former NDP government of B.C. commenced science reviews and public consultations. The current B.C. Liberal government moved the exploration agenda along and initiated contact with the federal government, local communities, First Nations and industry. At the time of this writing, the federal government had established various panels to review scientific, technical, and related issues as part of its deliberations on whether to lift its offshore moratorium.

No resolution of a particular issue or matter will alone catalyze B.C. offshore petroleum exploration. The interlocking nature of environmental issues, First Nations support, or lack thereof, and the uncertainty of jurisdiction and ownership of QCB offshore resources foreshadow a lengthy and complex process leading to exploration. ■

The Queen Charlotte Basin

Beneath gorgeous seascapes and islands, enticing geology

By **JAMES W. HAGGART**—Geological Survey of Canada, Pacific Division

BASIN STRATIGRAPHY

To date, principal exploration interest in the west coast Canadian offshore has focused on the Tertiary Queen Charlotte basin, a clastic-dominated succession that formed in a strike-slip or rifted margin setting. This basin lies in the offshore region roughly between Queen Charlotte Islands, northern Vancouver Island and the British Columbia mainland (Figure 1).

In contrast, the somewhat more widely-distributed Mesozoic rocks of the region comprise an older basinal sequence tectonically distinct from the younger Queen Charlotte basin succession, termed the Hecate basin. Hecate basin rocks crop out on central and eastern Queen Charlotte Islands and northern Vancouver Island, and are inferred to underlie much of the Tertiary Queen Charlotte basin, especially in the western part of Hecate Strait and Queen Charlotte Sound.

Figure 2 summarizes the geological succession of the Queen Charlotte Islands and provides an overview of both the Hecate and Queen Charlotte basinal successions, as well as older, underlying rocks. Economic basement to both basinal successions is the Upper Triassic Karmutsen Formation, a four-kilometre (13,120-feet) thick and widespread succession of island-arc pillow basalts, volcanic flows, and interstratified shales and reefal limestones. None of the exploratory wells penetrated any of these basement rocks. The Karmutsen basalts are conformably overlain by a widely-distributed Upper Triassic to Lower Jurassic sedimentary sequence which exceeds 1,000 metres (3,280 feet) in thickness and consists mainly of platform carbonates, organic-rich shale, sandstone, siltstone, and tuff deposited in shelf to slope environments. These strata are unconformably overlain by the approximately 800-metre (2,625-feet) thick succession of Middle Jurassic arc volcanics and associated epiclastic strata of the Yakoun and Moresby groups. These rocks reflect onset of volcanism, possibly associated with development of a subduction zone regime; associated sedimentary basins were typically small and restricted.

In contrast, the Cretaceous package is widespread across the region and consists of up to 2,500 metres (8,200 feet) of strata of variable lithology, primarily coarse- to fine-grained clastics and minor volcanics. The Cretaceous rocks are typically lithic wackes, but locally include subarkoses and even arenites. These shallow-water, principally shelf-depth strata are oriented in widespread and linear facies belts, reflecting sedimentation in a fore-arc setting west of an active magmatic arc. The western part of the Queen Charlotte Islands region, as well as the Queen Charlotte Sound area, likely experienced relatively continuous sedimentation during much of Cretaceous time. However, the eastern part of the islands and the adjacent Hecate Strait area were mostly a highland for much of that interval, subject to marine deposition for only short intervals at times of higher sea-level.

Tertiary rocks in the region comprise the Queen Charlotte basin. On northern Queen Charlotte Islands, Neogene volcanic rocks of the Masset Formation are widespread, and intertongue on the east with clastic strata of the Skonun Formation, concentrated in the offshore region and forming most of the Queen Charlotte basin fill. The Skonun consists largely of poorly consolidated feldspatholithic sandstone, mudstone, minor coal, and interstratified volcanic rocks. In the offshore, this succession reaches approximately six kilometres (19,680 feet) in thickness and consists of an upper, Miocene-Pliocene package of interstratified sandstone and shale up to 4,500 metres (14,760 feet) thick and a lower, 1,500-metre (4,920-feet) thick package of Eocene-Miocene volcanic rocks and sandstone, correlated in part with the onshore Masset Formation.

SOURCE ROCKS

Occurrences of oil and tar seeps are well known on Queen Charlotte Islands and dead oil has been noted on northern Vancouver Island. Oil stains in Neogene rocks in one of the Hecate Strait wells, as well as many of the onshore seeps, are sourced from Upper Triassic and Lower Jurassic kerogen. Types II and I kerogen predominate in the Upper Triassic and Lower Jurassic strata on Queen Charlotte Islands

Figure 2

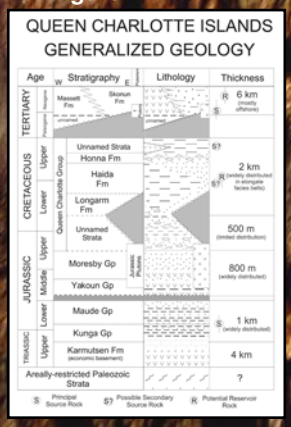


Figure 1

(Sandilands and Whiteaves formations), which locally contain up to 11 per cent TOC, and these rocks are considered to be the principal oil source in the region.

In contrast, the uppermost Jurassic to Upper Cretaceous succession has a relatively low source-rock potential, containing Type III organic matter, usually in small amounts and with TOC values around one per cent or less, although locally reaching 5.3 per cent.

Tertiary strata have a poor to moderate source-rock potential. They are characterized by Type II and III kerogen, with TOC values averaging one to 1.5 per cent, and locally higher in coal-bearing zones. Tertiary carbonaceous mudstones with good to excellent source rock potential have been identified in many of the wells in the basin. Although the Tertiary rocks are somewhat restricted to the area of Hecate Strait, the Upper Triassic-Lower Jurassic and the Cretaceous source rock packages are relatively widespread.

RESERVOIR STRATA

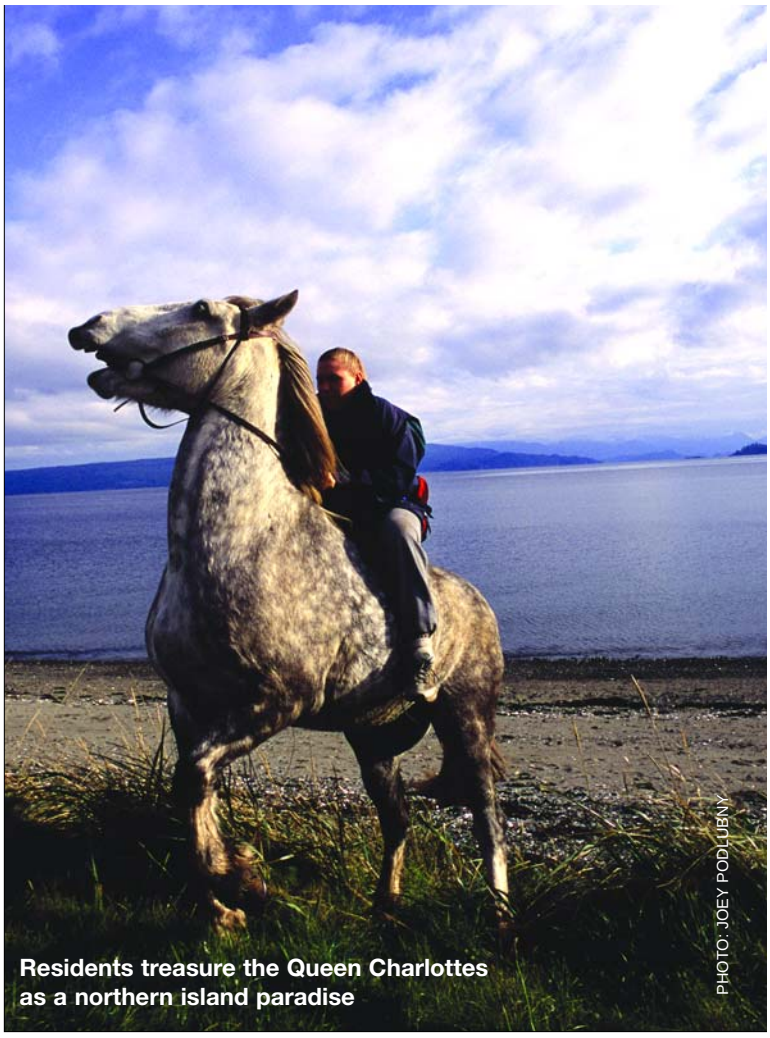
Until recently, the primary target of exploration interest in the basin has been the Tertiary succession of the offshore area. Most of the exploration effort to date has consequently been focused on the northern part of the region. Offshore Tertiary strata of the Skonun Formation include delta-front, tidal-shelf, and storm-shelf facies. Primary porosity in these rocks is up to 35 per cent locally, with fair to good permeability in disconnected sandstone lenses. However, the lateral extent of many of these sandstone bodies is poorly known and extensive diagenetic clays within them may degrade the porosity.

Cretaceous marine sandstones on the Queen Charlotte Islands include cross-stratified marine lithic arenites with secondary-porosity values of up to 15 per cent locally, and fair to good permeability. Cretaceous strata persist laterally for many tens of kilometres on Queen Charlotte Islands and, locally, directly overlie the Tr-J source package. This facies is typically thin onshore, but both thickness and porosity of the unit increase to the southeast across the islands and towards the offshore.

Neogene volcanic strata of the Masset Formation are widespread both onshore and in the offshore and form an effective hydrocarbon seal. The low permeability of the Skonun Formation may also result in a regional seal. The Cretaceous reservoir facies are in a favourable position between source rocks below and cap rocks above. Cretaceous and Tertiary reservoir strata are both interstratified with shales, mudstones, and volcanic rocks which also provide effective local seals.

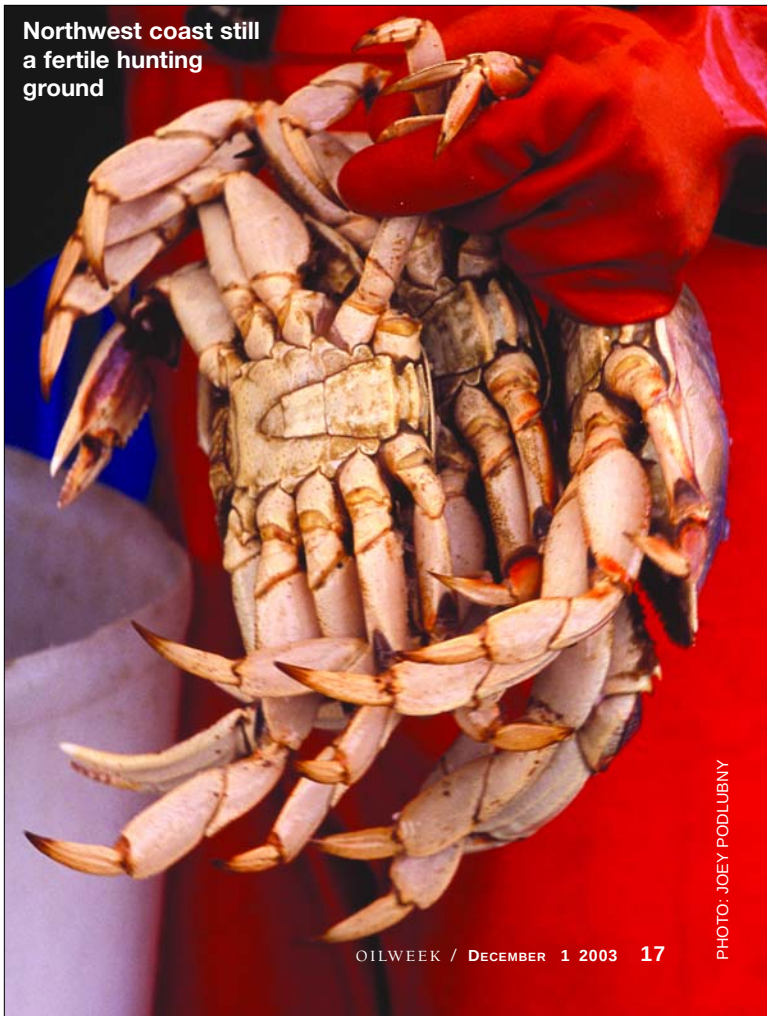
STRUCTURES

Triassic and Lower Jurassic strata on the Queen Charlotte Islands and on northern Vancouver Island were strongly deformed in early Middle Jurassic compression, while subsequent Late Jurassic structural activity consisted of high-angle block-faulting. Flat-lying Cretaceous strata blanket the horsts and grabens on both Queen Charlotte Islands and northern Vancouver Island, reflecting a long-lasting period of late Mesozoic tectonic stability in the region. The geometry of the offshore Queen Charlotte basin was likely influenced by these pre-exising Mesozoic fault networks, as well as by contractional deformation in latest Cretaceous-earliest Tertiary and late Neogene times; thus, both contractional and extensional traps are expected. Some Tertiary structures offshore appear to be characteristic of some strike-slip faulting with significant dip-slip components and these displacements may also contribute to the block-like structure of the Tertiary ▶



Residents treasure the Queen Charlottes as a northern island paradise

PHOTO: JOEY PODLUBNY



Northwest coast still a fertile hunting ground

PHOTO: JOEY PODLUBNY

basin, creating numerous depocenters of varying sizes and depths.

THERMAL MATURATION

The Queen Charlotte Islands region experienced two major pulses of magmatic heating, in Jurassic and Tertiary time, and roughly correlative magmatic episodes are represented on northern Vancouver Island. A significant heating event likely also occurred during Late Tertiary rifting. Consequently, potential source rocks on Queen Charlotte Islands vary systematically in their maturation: many rocks adjacent to Jurassic and Tertiary plutons are overmature while others, particularly those in more northerly parts of the islands, were minimally affected by the magmatism. Thus, the numerous seeps noted on the islands may reflect local oil generation and release. On northern Vancouver Island, the overall geologic similarity with Queen Charlotte Islands, as well as Triassic(?)-sourced pyrobitumen in outcrop, suggest that similar conclusions may apply there.

Offshore, the Skonun Formation ranges from thermally immature to overmature. Burial-related heating may have been sufficient to push parts of the Skonun into the oil window in the late Cenozoic. In a similar fashion, burial of the Upper Triassic and Lower Jurassic package under some three kilometres (9,840 feet) of younger Mesozoic overburden may have caused oil generation during the Cretaceous.

Based on the presence of strong magnetic anomalies, large plutons are deduced to also lie beneath eastern Queen Charlotte Sound. The age of these plutons is uncertain, but they may be an extension of Neogene volcanics found on the mainland, suggesting a Miocene age for the plutons. The magmatism in Queen Charlotte Sound may thus be coeval with Masset volcanism on Queen Charlotte Islands.

POSSIBLE HYDROCARBON PLAYS

The discontinuous deltaic-shelf sands of the Skonun Formation underlying Hecate Strait have been considered the conventional play for the basin. However, these rocks are likely underlain by a partly-eroded Tr-J source-rock package throughout Hecate Strait and eastern Queen Charlotte Sound, and Cretaceous strata are probably absent across much of the northern Hecate Strait region as well, due to non-deposition. In addition, given the facies composition of the Skonun, primarily discontinuous sandstone bodies, it is a distinct possibility that none of the strata beneath Hecate Strait are likely to include a regional-scale reservoir. Consequently, a comprehensive exploration program must look at all areas of the offshore.

Unfortunately, given the limited drilling that has been undertaken in the offshore, little is known directly about the rocks underlying both Hecate Strait and Queen Charlotte Sound. However, on-strike projections of the Triassic-Jurassic source-rock package on southern Queen Charlotte Islands trend southeasterly, into the northwestern part of Queen Charlotte Sound. Of course, the presence of these units in the Sound and the Hecate Strait regions cannot be proven without further drilling, but no available data suggest that these areas were highlands in Late Triassic and Early Jurassic time. Similarly, Cretaceous rocks on southern Queen Charlotte Islands strike southeasterly into the offshore, and reappear again on northern Vancouver Island, where essentially the same stratigraphic succession is preserved. This invites speculation that the intermediate western Queen Charlotte Sound area was also depressed and receiving sediments during Cretaceous time, and that the older rocks in this area would have been sheltered from erosion.

Regional correlations suggest that the three main sedimentary packages—Triassic-Jurassic source rocks, Cretaceous reservoir rocks, and Tertiary reservoirs and seals—are all present in western Queen Charlotte Sound, where large Bouguer and isostatic gravity lows are also found. Magnetic data suggest the presence of large Tertiary plutons in eastern Queen Charlotte Sound, which may further degrade the prospects there; these plutons do not appear to extend into western Queen Charlotte Sound, however. Cretaceous strata beneath western Queen Charlotte Sound may thus represent a prime exploration target.

Now, there are several points to keep in mind. Both burial-related and magmatic heating likely affected the region, and hydrocarbon generation probably occurred multiple times. As well, the regional scale of oil generation is uncertain and igneous heating may have caused parts of the Upper Triassic-Lower Jurassic and Tertiary source packages to lose their oil potential completely, although many of these strata may still be within the gas window. In addition, the extent of possible reservoirs in the offshore is presently uncertain, although facies trends onshore suggest favourable settings offshore. And finally, the timing of hydrocarbon migration is poorly constrained. Neogene structures may postdate hydrocarbon migration, and may also have degraded Tertiary seals. In addition, older oil accumulations may have been destroyed by Cenozoic tectonism and magmatism. ■

Industry will have to get along with fishery

PHOTO: JOEY PODLUBNY

Legal Shoals

Course to promised $500-billion resource bonanza lies through maze of unresolved issues

By **TONY FOGARASSY,** M.Sc., LL.M. —Clark, Wilson, Barristers & Solicitors, Vancouver B.C.

PHOTO: JOEY PODLUBNY

Wildlife large and abundant

WHILE OFFSHORE oil and gas exploration and development projects are highly regulated around the world, regulation in the offshore arena of British Columbia may herald a new global best practices standard. It will be for environmental assessment and unique approaches in determining jurisdictional and resource ownership, likely with the participation of coastal Aboriginal peoples. There are case histories to be examined from other Canadian offshore basins for environmental and jurisdiction-ownership issues. But there is little guidance as to the scope of tangible participation of First Nations save for fleeting comments by the Supreme Court of Canada and certain appellate courts over the last five years.

ENVIRONMENTAL

Recent concerns over seismic acquisition impacts on marine mammals in Atlantic Canada and the Gulf of Mexico may translate into some form of environmental assessment for seismic acquisition, particularly waters where the federal government asserts jurisdiction. In the last year, there has been a flurry of federal and B.C. legislative activity regarding environmental management and assessment laws.

In B.C., the Environmental Assessment Act (BCEAA) was repealed in late 2002 and replaced with a new regime under the same title. The Reviewable Projects Regulation promulgated under the BCEAA clearly encompasses offshore drilling activities. What is not so clear is the Regulation's application to seismic acquisition programs. Even if the Regulation does not kick-start a provincial environmental assessment, the BCEAA itself vests the minister responsible with the authority to designate an offshore project, including a seismic program, as "reviewable" and subject to an assessment.

In July 2003 the federal government enacted regulations requiring environmental assessments for seismic surveys in the Newfoundland and Nova Scotia offshore waters. Presumably similar regulations will be enacted for seismic acquisition in the B.C. offshore. The B.C. government has targeted the first quarter of 2005 for commencement of seismic studies.

Mapping over environmental assessment legislation is a 1999 federal cabinet directive on the use of strategic environmental assessment (SEA). Designed as a filter for proposed federal policies, plans or programs, an SEA is conducted before a full environmental assessment is undertaken. If used on the west coast, the SEA would likely be one tool to determine the discontinuance of legal or administrative moratoria and re-issuance of offshore tenures. Whether the current federal panel consulting with coastal B.C. communities qualifies as an SEA is unknown. The effort is headed by Roland Priddle, former chair of the National Energy Board, with assistance from the Royal Society of Canada and its Expert Panel conducting a science review of B.C. offshore oil and gas. If the current panel does not qualify, then an SEA followed by specific federal, provincial or combined federal-provincial environmental assessments may have to be undertaken before any exploration takes place in the offshore.

The Laurentian Subbasin was the subject of an SEA with a draft report released earlier this year. Additionally federal decision-makers may have to consider cross-boundary environmental effects of projects as the QCB is bordered to the north by Alaska.

The wild card in the legislative deck is the new federal Species at Risk Act (SARA). Protection of wildlife species at risk and their habitat may provide opportunities for opponents of offshore exploration to either postpone or curtail exploration in some or all of the B.C. offshore. Wildlife species is a very broadly defined phrase in SARA and includes all living species, sub-species, varieties or genetically distinct populations ▶

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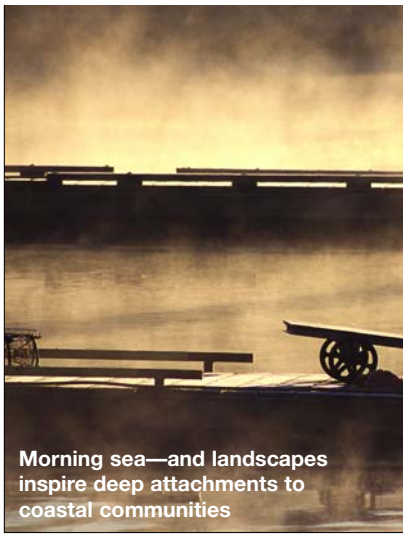
(other than a bacterium or virus). Nimble application of SARA by opponents may have detrimental impacts in all phases of offshore exploration and development.

The administration and interlocking nature of legislation such as SARA, Oceans Act, Canadian Environmental Assessment Act, Migratory Birds Convention Act, 1994, Canada National Marine Conservation Areas Act, and B.C. environmental laws will likely be integral to any regulatory regime negotiated in the form of a "Pacific Accord" between the federal and B.C. governments. Offshore explorationists familiar with the 2001 regulatory roadmaps of offshore oil and gas approvals in Atlantic Canada (produced by Erlandson & Associates and the Atlantic Canada Petroleum Institute) can expect to see an environmental regulatory structure in the B.C. offshore that mimics the Atlantic Canada offshore but promises to be of Herculean proportions. The Centre for Offshore Oil and Gas Environmental Research (established November 2002 by Fisheries and Oceans Canada) may assist in providing data through its Canada-wide research on environmental and oceanographic impacts of offshore exploration, development and transportation.

JURISDICTION AND OWNERSHIP

Legally, the most vexing issue regarding the B.C. offshore may be resolving which level of government has ownership and jurisdiction of offshore resources in the various areas of the Queen Charlotte Basin. While the west coast of the Queen Charlotte Islands appears to fall into jurisdiction of the federal government, the status of Dixon Entrance, Hecate Strait and Queen Charlotte Sound are not so clear.

Application of boundary demarcation definitions from international law treaties and federal and B.C. legislation



Morning sea—and landscapes inspire deep attachments to coastal communities

provide for both the levels of government to assert jurisdiction and ownership. The A-B Line is a boundary which demarcates B.C. from Alaska. While recognized by Canada as an international boundary, in the United States the A-B Line is viewed as a much more informal designation to be utilized for maritime purposes only, and the international boundary is much further south in Dixon Entrance. The U.S. has disputed the boundary in Georges Bank (and lost at the International Court of Justice) and continues to dispute other offshore boundaries with Canada including the Beaufort Sea, Juan de Fuca Strait in southern B.C. (casting in doubt Canadian ownership of gas hydrate deposits announced last summer by University of Victoria researchers, southwest of Vancouver Island).

Overlying domestic and international boundary disputes is the assertion by a variety of coastal First Nations to ownership and jurisdiction of the B.C. offshore within their traditional territories. The embryonic area known as the "law of ocean spaces" has catalyzed the Haida Nation to commence a court action seeking declaration of ownership of the waters surrounding the Queen Charlotte Islands. The Constitution of the Haida Nation states that Haida offshore territories include "the entire Dixon Entrance, half of the Hecate Straits, halfway to Vancouver Island and

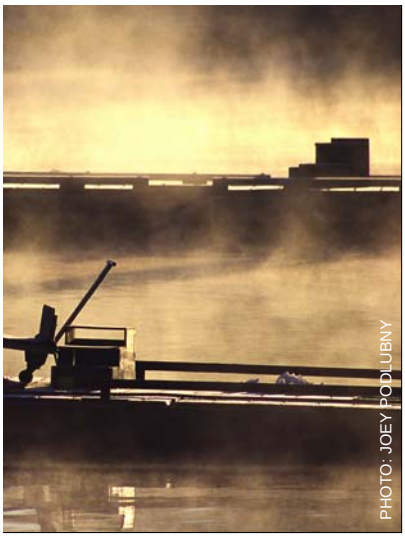


PHOTO: JOEY PODLUBNY

Westward into the abyssal ocean depths."

Even when jurisdiction and ownership of resources in the offshore are settled, B.C. is likely to be mindful of recently expressed views of those with experience in federal-provincial relations in the offshore. A recent Newfoundland and Labrador Royal Commission concluded that notwithstanding the Canada-Newfoundland Atlantic Accord, the province was receiving a minority share of offshore oil and gas revenues and was not a "principle beneficiary," due in part to the offset of equalization payments by the federal government. B.C., of course, is a "have-not" province. One would expect that offshore revenues in favour of B.C., in whatever form, would be protected.

FIRST NATIONS

No issue defines and sets apart B.C. from its provincial and territorial counterparts more than that of First Nations and their assertions of rights and title to land, including the offshore and resources therein. Unlike northeast B.C., where Treaty No. 8 sets out the respective rights of signatory First Nations and the Crown, the entire B.C. offshore has not been subject to treaty.

While a controversial province-wide referendum on B.C. government treaty negotiation principles was held in 2002, the B.C. government has changed its Aboriginal relations and treaty negotiating policy dramatically since the February 11, 2003 Speech from the Throne. This document in effect apologized for B.C. government failures, mistakes and flawed polices which have adversely impacted First Nations for more than a century.

The Supreme Court of Canada and a number of appellate courts have advocated over the years the need for reconciliation between the federal and provincial governments and First Nations. It appears that B.C. is the first province to express its desire and intent to conduct meaningful reconciliation.

In 2002 The Ministry of Energy and Mines and Ministry for Competition, Science and Enterprise created the B.C. Offshore Oil and Gas Team. The team, with its own web page, is a proactive measure on the part of the B.C. government to move offshore exploration ahead. The Team has extensive First Nations, technical, and yes, legal experience. Recognizing the importance of Aboriginal peoples to the successful creation and implementation of an offshore exploration regime, the team has commenced meeting southern coastal First Nations to discuss offshore and possible co-operative activities.

The response of First Nations located in the QCB to government overtures will be the crucial litmus test for the B.C. government in offshore oil and gas exploration. The Haida Nation has placed oil and gas ownership before the courts. However, legal proceedings are preliminary at this stage. Members of the Haida Nation and the Tsimshian Nation (located on the mainland opposite the Queen Charlotte Islands) have in the past publicly voiced opposition to offshore exploration. That said, the opportunity to participate in a potential $500-billion resource development (as estimated by the B.C. government) may result in some form of reconsideration. ■

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