

Play 4: Milky River Biogenic Gas (Plio-Pleistocene)

Geological Assessment

GRASP UAI: AAAAA HAE

Play Area: 50,710 square miles

Play Water Depth Range: 15-700 feet

Play Depth Range: 500-3,000 feet

Play Exploration Chance: 0.000

Play 4, the “Milky River Biogenic Gas” play, is the most extensive yet least prospective play in the North Aleutian Basin OCS Planning Area. Play 4 probably contains sizable in-place quantities of biogenic gas simply because of the vast area embraced by the play. However, very little of this gas is likely to be recoverable by conventional means, and the technically recoverable resource endowment is assessed as negligible.

Table 1 summarizes the volumetric input data developed for the GRASP computer model for North Aleutian basin play 4. Because play 4 was not quantified through the computer model, many data sets were not entered. Table 2 reports the risk model used for play 4. The location of play 4 is shown in figure 1.

The Milky River play sequence corresponds in the North Aleutian Shelf COST 1 well to the upper part of the Milky River Formation and overlying, unnamed Quaternary deposits. The play sequence ranges in age from early Pliocene to Holocene. In onshore areas, rocks correlative to play 4 were penetrated by 9 wells (David River 1/1A, Hoodoo Lake 1, Hoodoo Lake 2, Sandy River 1, Port Heiden 1, Ugashik 1, Becharof Lake 1, Great Basins 1, and Great Basins 2 wells). Offshore, in eastern St. George basin, correlative rocks were penetrated by the St. George Basin COST 2, Monkshood 1, and Bertha 1 wells. The principal point of

offshore control is the North Aleutian Shelf COST 1 well that was drilled by an industry consortium in 1983.

No pools of oil or gas were encountered in any wells penetrating the Milky River play sequence in the North Aleutian basin. Minor biogenic gas shows are associated with the Milky River sequence in the North Aleutian Shelf COST 1 well, several wells onshore, and in the Bertha 1 well in the St. George basin. In the Becharof Lake 1 well, cuttings headspace gas carbon isotopes for the Milky River Formation range from -67.9 to -80.2 ($\delta^{13}\text{C}$ [PDB]), clearly indicating gas of largely biogenic origin. Biogenic gas is primarily a product of bacterial fermentation of the organic matter buried within sediments.

In offshore areas, biogenic gas may be pooled in features emplaced by large alpine glaciers that invaded Bristol Bay from the south (Alaska Peninsula) and northeast (Alaska Range) during the Pleistocene epoch and then retreated during the last 10,000 years. The legacy of glaciation may include drumlins, eskers, and recessional moraines. These elevated landforms are gravelly, porous features that were later drowned in rising sea waters and are now draped and perhaps sealed by unconsolidated pelagic mud. Such features might pool biogenic gas, at least in southern parts of North Aleutian basin. Thick shelfal sandstone sequences of Pliocene age, presumably representing large-scale current-molded bedforms, also form candidates for stratigraphic traps for biogenic gas. Pools of biogenic gas in play 4 would be characterized by very low pressure (no more than 1,300 psi) and would not yield

significant fractions of the in-place gas to conventional development wells. The biogenic gas may occur in low saturations or be dissolved in formation waters. In either case, gas production might be accompanied by abundant formation water, a typical experience in biogenic gas production.

We note that most Cook Inlet gas fields are largely of biogenic origin with basin-wide original recoverable gas reserves of 8.6 Tcf. Cook Inlet clearly offers a successful example of a commercial biogenic gas province. However, the Cook Inlet gas fields occur in fold structures (often overlying oil fields) that gathered the gas from surrounding extensive areas of gas biogenesis. Cook Inlet gas field reference depths range from 1,935 feet to 10,000 feet (average, 5,790 feet) and are normally-pressured to over-pressured. The Cook Inlet gas field sandstone reservoirs (Miocene and Pliocene) are overlain by compacted shales that form competent seals. The Cook Inlet gas fields, though filled with biogenic gas, do not provide a useful analog for play 4. Because of similarities in trap type, burial depths, and reservoir and seal lithologies, the Cook Inlet biogenic gas fields are most analogous to the drape-anticline prospects of North Aleutian basin plays 1 and 2, which range in depth from 2,500 to 10,000 ft. However, the latter are expected to be charged with mostly thermogenic gas and condensate.

Areas of significant risk to play 4 include: **1) gas recoverability** (low reservoir pressure and high formation water production); **2) poor seal** (poor integrity of the unconsolidated pelagic mud that may seal glacial features); **3) reservoir** (poor reservoir continuity); and **4) charge** (lack of aquifer structure that would concentrate and convey biogenic gas to stratigraphic traps). Play 4 is assessed to have an exploration

chance of zero and negligible undiscovered technically recoverable oil and gas resources.

Play 4 is the most regionally extensive yet least prospective play in the North Aleutian Basin OCS Planning Area. Play 4 probably contains sizeable in-place quantities of biogenic gas. However, all hypothetical prospects (none are identified) are related to stratigraphic isolation of sandstone or glacial-moraine bodies within unconsolidated marine mud. Any gas production might be accompanied by high water production because of low gas saturations, a common experience in biogenic gas production. Formation pressures are low owing to shallow burial depths and recovery efficiencies will accordingly be quite low. The recoverable biogenic gas endowment of play 4 is therefore assessed as negligible.

GRASP Play Data Form (Minerals Management Service-Alaska Regional Office)

Basin: North Aleutian Basin
 Play Number: 4
 Play UAI Number: AAAAA HAE

Assessor(s): K.W. Sherwood, D. Comer, J. Larson
 Play Name: Milky River Biogenic Gas (Plio-Pleistocene)

Date: December 2004
 Not Assessed

Play Area: 50,706 mi² (32.45 million acres)
 Reservoir Thermal Maturity: 0.20%-0.26% Ro

Play Depth Range: 500-3,000 feet
 Expected Oil Gravity: 35^o API
 Play Water Depth Range: 15-700 feet

POOLS Module (Volumes of Pools, Acre-Feet)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Prospect Area (acres)	Play 4 Not Quantified; Assessed to Have Negligible Undiscovered Technically Recoverable Biogenic Gas Resources												
Fill Fraction (Fraction of Area Filled)													
Productive Area of Pool (acres)													
Pay Thickness (feet)													

MPRO Module (Numbers of Pools)

Input Play Level Chance	0	Prospect Level Chance	0	Exploration Chance	0
Output Play Level Chance					

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
	0	Gas recoverability (low pressure; water production)	0
	0	Seal (unconsolidated mud)	0
	0	Reservoir (poor continuity)	0
		Charge (No Structured Fetch to Potential Traps)	

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	No Identified Prospects												
Numbers of Pools in Play													

Minimum Number of Pools	0	Mean Number of Pools	0	Maximum Number of Pools	0
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POOLS/PSRK/PSUM Modules (Play Resources)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Oil Recovery Factor (bbl/acre-foot)	Play 4 Not Quantified; Assessed to Have Negligible Undiscovered Technically Recoverable Biogenic Gas Resources												
Gas Recovery Factor (Mcfg/acre-foot)													
Gas Oil Ratio (Sol'n Gas)(cf/bbl)													
Condensate Yield ((bbl/Mmcfg)													

Pool Size Distribution Statistics from POOLS (1,000 BOE):	μ (mu)= NA	σ^2 (sigma squared)= NA	Random Number Generator Seed= 255,476
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BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0
Probability Any Pool is 100% Oil	0	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	NA
Probability Any Pool is 100% Gas	1		

Table 1. Input data for North Aleutian basin play 4, 2006 assessment (most areas left blank because play 4 was assessed with negligible technically recoverable resources).

PLAY 4: MILKY RIVER BIOGENIC GAS (Plio-Pleistocene)

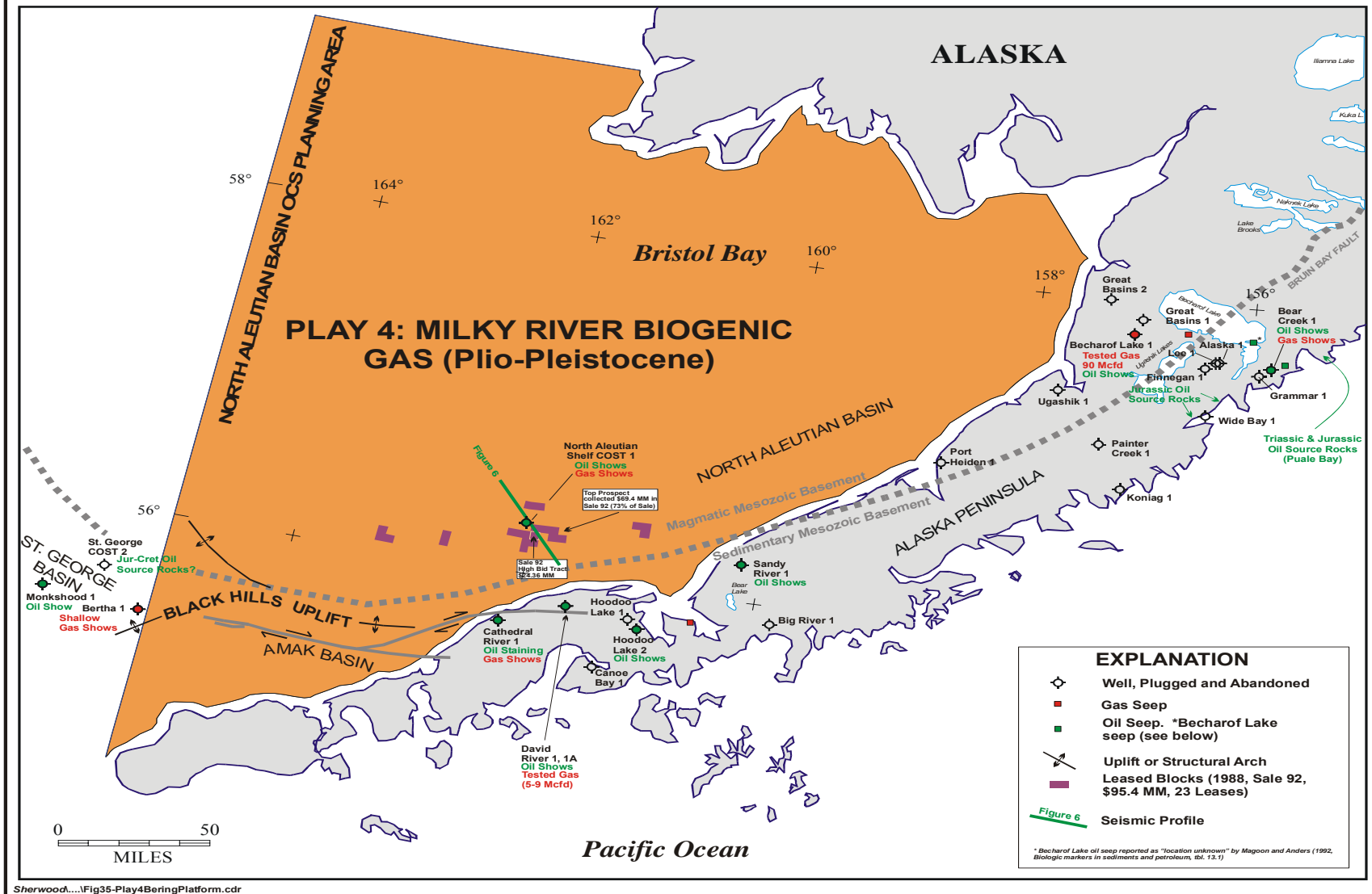


Figure 1. Map location of North Aleutian basin play 4, 2006 assessment.