Alaska Oil and Gas Basins

Oil & Gas Basin

Bristol Bay

Alaska Peninsula

Oil Production

Oil & Gas Basin
RESERVOIRS - good Tertiary strata

SEALS - 250-2,500 feet hydrocarbon column; intra-reservoir seals (Cook Inlet-like)

STRUCTURES & TRAPS - numerous; structural, strat.

SOURCES - THERMOGENIC GAS @ Port Moller hot springs
Mz source in SW basin & Oil seep
TOC: 5.3; HI 756
Tert. / K coals; Carb-shales

MATURITY – Tertiary strat./ Bear Lake Fm. Ro = 0.5 – 0.8
Mz source @ Puale Bay (Ro= 0.4-0.7)

GAS RESOURCES (assume Cook Inlet-like system) = ?? TCF
Collaborators

AKDGGGS

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Ken Ridgway
Emily Finzel
Overview

New Public Data
Regional Elements
Stratigraphy, Reservoir char.
Maturity, Seals
Hydrocarbon Typing
Thermogenic gas & Oil Seep
Mapping / X-section & Seismic
Summary
Alaska DNR Bristol Bay Products:

All Web-accessible

- 2004 Field program results
- 2005: Surface-subsurface interpretations
- 2005 Field program results
- 2006 Field program results
- 2006 AKDOG Reservoir quality report

3 CD-ROM Data compilation:
  - Digital seismic & well logs/mud logs
  - Quad. maps: Geology, Gravity, & Magnetics; Regional info.

Biostratigraphy Study:
  - 10 of 11 wells in sale area + North Aleutian COST 1

www.dog.dnr.state.ak.us/oil
www.dggs.dnr.state.ak.us/publications
Drilling Show Summary

- **No shows**
- **Trace gas shows**
- **Gas shows**
- **Gas, trace oil shows**
- **Oil & gas shows**

325 miles

**Alaska Peninsula Areawide Sale - 2007**

Puale Bay

Bristol Bay
COST well (approx. Puale Bay)

Port Moller

High-grade Mz rocks

OIL-window Mz rocks

Bruin Bay Fault

Google Earth - New Placemark

Image © 2007 TerraMerics
Bristol Bay Basin Regional Tectonic Elements

Existing 2-D seismic defines structure in OCS

Existing onshore aeromag
<table>
<thead>
<tr>
<th>Age (Ma)</th>
<th>Period</th>
<th>Epoche</th>
<th>Formation</th>
<th>Source or Reservoir Rocks</th>
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**AK Pen. Strat.**

- **Bear Lake Fm.**
- **Milky River Fm**
- **Tolstoi Fm**
- **Chigik Fm Coal**
- **Kamishak Fm. biohermal limestone**
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Alaska Peninsula Areawide Sale - 2007

Puale Bay

Bristol Bay

Port Moller Area

Sandy River Federal 1

Cathedral River Unit

David River 1/1A

Hoodoo Lake Unit

Hoodoo Lake Unit 2

Great Basins 1

LaHoe 1

Alaska

McNulty 1

Facilit 1A2

Bristol Bay

North Aleutian COST 1

325 miles
Bear Lake Fm. Chronostratigraphy
Bristol Bay Basin: selected wells, by formation

Porosity (%) vs. Permeability (md)

- Milky River
- Bear Lake ss
- Bear Lake oc
- Tachilni
- Unga
- Belkofski
- Stepovak
- Tolstoi
- Chignik
- Herendeen
- Naknek
- Shelikof
- Kialagvik
- Kaguyak
- Ugashik
Phi-K Trend

Unconventional Reservoirs

Sandstone Reservoirs

Porosity (%) vs. Permeability (md) graph showing various reservoirs and their characteristics.
Scanning Electron Microscope (SEM) Images
COST Well Samples

Amoco Becharof State #1
2734.5' MD; Milky River Fm.
Φ = 36.9%; K = 3470 md

Amoco Becharof State #1
3678.4' MD; Bear Lake Fm.
Φ = 34.0%; K = 1550 md

ARCO N. Aleutian COST #1
5234.0' MD; Unga Fm.
Φ = 34.2%; K = 1697 md

ARCO N. Aleutian COST #1
8087.0' MD; Stepovak Fm.
Φ = 31.6%; K = 348 md
The image shows a microscopic view of feldspars, with specific chemical compositions at different points labeled with ellipses. The table below lists the compositions of different feldspar types in weight percent (Wt %) and their chemical oxides.

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<th>SiO₂</th>
<th>Al₂O₃</th>
<th>MgO</th>
<th>FeO</th>
<th>K₂O</th>
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Rock-Carbon Maturity

Mature

Immature

Legend
- Bear Lake Formation
- Tolstoi Formation
- Chignik Formation
- Naknek Formation
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Alaska Peninsula Areawide Sale - 2007
Organic Geochemistry

Puale Bay

Kamishak Formation
Kialagvik Formation

10 Kilometers

Karluk Quadrangle
Kamishak Limestone
~reef, TOC=5.28%
Hydrogen versus TOC

Outcrop samples
Puale Bay
Kialagvik Fm-
Lower Jurassic
Kamishak Fm-
Triassic
Thermal Maturity

Kialagvik Formation

Kamishak Formation

Tmax (degrees C)

TOC (wt %)

Mature

Under Mature

Kialagvik Formation - Lower Jurassic
COST well Hydrogen vs. Oxygen Indices

Hydrogen Index (mg HC/g TOC)

Oxygen Index (mg CO2/g TOC)

Type I Kerogen

Type II Kerogen

Type III Kerogen

Stepovak Formation

Tolstoi Formation
(Types I & II will generate oil, type III gas; type IV little or no hydrocarbons)
Oil Creek oil seep

Oil is heavily biodegraded “normal” crude w/ heavy hydrocarbons

API gravity : 15.7° & 21.4°
Oil seep ½ BOPD
Gas: 91% methane 7% nitrogen 2% carbon dioxide
Alaska Peninsula Petroleum System?

Photograph courtesy of Robert Blodgett
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Port Moller Area

Alaska Peninsula Areawide Sale - 2007

325 miles
Gas sample: Thermogenic
Coal: Mine Harbor, Herendeen Bay
Field-generated geologic map
3-D View of Sapsuk Lake Anticline
top of Kamishak Formation
Seal Capacity: Hydrocarbon

- Bear Lake Fm.
- Staniukovich Fm.
- Stepovak Fm.
- Tolstoi Fm.

Hydrocarbon Column Height (feet): 0 to 5000
Public seismic available
largely negative, local positive anomalies

Ugashik sub-basin (Quaternary cover)

mountains, uplands (abundant outcrop)

Tbl & other Tertiary sedimentary sub-basin fill

Ugashik Narrows

pos neg positive

Ji? or Js/Jn?

Tbl

Js

Jn

Js and older sedimentary units

basement
Bristol Bay Seismic Interpretation

1. **Quaternary**
2. **Bear Lake Fm**
3. **Milky River Fm**
4. **Unga equiv**
5. **Stepovak Fm**
6. **Tolstoi Fm**

**N Aleutian/COST #1**

**Black Hills Uplift**

**Bristol Bay Basin**

MMS-75-17-09 (~155 mi shown)
Well log cross section
RESERVOIRS - good Tertiary strata

SEALS - 250-2,500 feet hydrocarbon column; intra-reservoir seals (Cook Inlet-like)

STRUCTURES & TRAPS - numerous; structural, strat.

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