

PRUDHOE BAY, PRUDHOE OIL

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Prudhoe Bay, Prudhoe Oil Pool

Summary

Prudhoe Bay is the largest oil field in North America, and it ranks among the 20 largest fields in the world. Original oil in place is estimated to be about 25 billion barrels, and gas in place is estimated to be 46 trillion cubic feet. As of December 2004, the field has produced about 10.7 billion barrels.¹ Most of the associated produced gas is currently re-injected to maintain reservoir pressure.

The Prudhoe Bay State No. 1 exploratory well discovered this pool in 1968. In that well, DST No. 12 (a 48-1/2 hour production test that began June 1, 1968) produced oil at a maximum rate of 2,415 barrels per day, with an average estimated rate of about 2,025 barrels per day.²

Regular oil production began in April 1969, exceeded an average rate of 1,000,000 barrels per day in March of 1978, and then peaked in January 1987 at 1,627,036 barrels per day. In March 1994, oil production from the pool dropped below 1,000,000 barrels per day. Since 2000, production has declined at an average rate of 8% each year. During December 2004, daily oil production averaged 361,946 barrels.³ Associated produced water and most of the associated produced gas are currently re-injected to maintain reservoir pressure.

Production was lower than expected during August and September 2004. BP took the field down for maintenance in early August 2004, and had difficulties bringing it back on line.⁴ The total estimated impact was a deferral in production of about 2.5 million barrels of oil.⁵

Geology

The Prudhoe Oil Pool is defined as the accumulations of oil that are common to and which correlate with the accumulations found in the Atlantic Richfield - Humble Prudhoe Bay State No. 1 well between the depths of 8,110 and 8,680 feet.⁶ The Prudhoe Bay, Prudhoe Oil Pool encompasses, in ascending order, the Sadlerochit, Shublik and Sag River Formations. The Sadlerochit Formation is Triassic-aged, and it consists of 300 to 600 feet of sandstone and conglomerate.⁷ The lower part of the Sadlerochit consists of a basal, prodelta marine unit that grades upward into a marginal marine coastal sequence consisting of interbedded sandstone and shale. The upper part was deposited by rivers and braided streams in a nonmarine alluvial

¹ BP, 2003, North Slope Oil Fields, published as [alaska_north_slope_oilfields\[1\].pdf](http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/publications/reports/STAGING/local_assets/alaska/PDFs/alaska_north_slope_oilfields.pdf) available online at http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/publications/reports/STAGING/local_assets/alaska/PDFs/alaska_north_slope_oilfields.pdf

² Alaska Oil and Gas Conservation Commission, 2005, Well File No. 1670110, Prudhoe Bay State No. 1; available online at: <http://www.state.ak.us/local/akpages/ADMIN/ogc/publicdb.htm>

³ Alaska Oil and Gas Conservation Commission, 2005, Well and Production Information Database

⁴ Petroleum News, 2004, AOGCC Studying Prudhoe Production Problems; in Petroleum News, Vol. 9, No. 40, October 03, 2004 available online at: <http://www.petroleumnews.com/pnads/572740897.shtml>

⁵ Regg, J., 2005, email communication dated 4/12/2005.

⁶ Alaska Oil and Gas Conservation Committee, 1977, Conservation Order No. 145, Prudhoe Bay Field, Prudhoe Bay Oil Pool

⁷ Van Poolen and Associates, Inc. and State of Alaska Division of Oil and Gas, 1974, In Place Volumetric Determination of Reservoir Fluids, Sadlerochit Formation, Prudhoe Bay Field

environment. Most of the recoverable reserves of the Sadlerochit occur in these braided stream sediments, where porosity ranges from 20 to 24% and permeability ranges from 300 md to several darcys.⁸ The Shublik Formation is also Triassic-aged, and it consists of organic- and phosphate-rich sandstone, muddy sandstone, mudstone, silty limestone, and limestone.⁹ These sediments were deposited in a low energy marine environment¹⁰ with high biologic productivity.¹¹ The Sag River Formation consists of a lower sandstone member and an upper shale member. The sandstone member consists of uniform, well-sorted, fine-grained sandstone and siltstone that were deposited within a barrier beach complex. The Sag River Formation forms a relatively continuous reservoir over a large part of the Prudhoe Bay Field. The sandstone member thickens from 20' in the south to about 70' in the north, and reservoir conditions improve toward the northeast.¹² Porosity and permeability average about 25% and 270 md, respectively.¹³ The overlying shale member consists of shale and mudstone. This member thins from about 70' in the west to about 10' in the main field area.¹⁴ Original oil in place is estimated to be about 25 billion barrels, and gas in place is estimated to be 46 trillion cubic feet.¹⁵ Associated produced water and most of the associated produced gas are currently re-injected to maintain reservoir pressure.

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⁸ Morgridge, D.L. and Smith, W.B., Jr., 1972, Geology and Discovery of Prudhoe Bay Field, Eastern Arctic Slope, Alaska, in King, R.E., editor, Stratigraphic Oil and Gas Fields; American Association of Petroleum Geologists Memoir No. 16, p. 489 - 501.

⁹ Parrish, J.T., Whalen, M.T., and Hulm, E.J., 2001, Shublik Formation Lithofacies, Environments, and Sequence Stratigraphy, Arctic Alaska, U.S.A., in Houseknecht, D.W., NPRA Core Workshop, SEPM Core Workshop No. 21.

¹⁰ Jones, H.P. and Speers, R.B., 1976, Permo-Triassic Reservoirs of the Prudhoe Bay Field, North Slope, Alaska; in Braunstein, J., editor, North American Oil and Gas Fields; American Association Petroleum Geologists Memoir 24, p. 23 - 50.

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¹² Jones, H.P. and Speers, R.B., 1976, Permo-Triassic Reservoirs of the Prudhoe Bay Field, North Slope, Alaska; in Braunstein, J., editor, North American Oil and Gas Fields; American Association Petroleum Geologists Memoir 24, p. 23 - 50.

¹³ Jamison, H.C., Brockett, L.D. and McIntosh, R. A., 1980. Prudhoe Bay - a Ten-Year Perspective; American Association of Petroleum Geologists, Memoir No. 30, p. 289 - 314.

¹⁴ Jones, H.P. and Speers, R.B., 1976, Permo-Triassic Reservoirs of the Prudhoe Bay Field, North Slope, Alaska; in Braunstein, J., editor, North American Oil and Gas Fields; American Association Petroleum Geologists Memoir 24, p. 23 - 50.

¹⁵ BP, 2003, North Slope Oil Fields, published as [alaska_north_slope_oilfields\[1\].pdf](http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/publications/reports/STAGING/local_assets/alaska/PDFs/alaska_north_slope_oilfields.pdf) available online at http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/publications/reports/STAGING/local_assets/alaska/PDFs/alaska_north_slope_oilfields.pdf