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UPCOMING STRATIGIC STUDIES AND MAPPING IN THE BROOKS RANGE FOOTHILLS OF THE CENTRAL NORTH SLOPE

by David L. LePain and Charles G. Mull

In the late 19th and early 20th centuries, the U.S. Navy's fleet of warships was fueled by coal. This changed in the early 20th century, when the Navy converted its ships from coal to oil. In anticipation of the Navy's long-term need for oil, President Warren Harding set aside several strategic petroleum reserves, including what is known today as the National Petroleum Reserve in Alaska (NPRA), situated north of the Brooks Range on Alaska's North Slope. Until the 1970s, Alaska's reserve was officially known as the Naval Petroleum Reserve No. 4 (NPR-4), and unofficially referred to as "Pet-4." In the 50 to 60 years following Harding's act, several small oil and gas fields and numerous hydrocarbon shows were reported from the NPRA (table 1).

Past discoveries and reports of hydrocarbon shows combined with ARCO and Anadarko's recent discovery of the 365-million-barrel Alpine oil field beneath the Colville Delta, and ARCO's discovery of the Tarn oil field east of the Colville Delta, have generated significant exploration interest in the eastern NPRA. Adding to the excitement is the recent discovery of hydrocarbon shows south of Umiat, where a 12-mile-long, east-west-trending belt of oil-stained rocks and a solid hydrocarbon dike are present in sandstones of the Lower Cretaceous Torok Formation. We do not know whether these sandstones were once in a trapping configuration, thereby representing an exhumed oil field, or simply served as a permeable pathway for the secondary updip migration of hydrocarbons toward the north. Geochemists with the U.S. Geological Survey (USGS) have determined that the oil is similar to Prudhoe Bay oil, indicating derivation from a similar source in the Shublik Formation and/or Kingak Shale. Given the southerly position of the oil-stained rock and the regional south dip of the sedimentary rocks on the North Slope, one can conclude that those source rocks extend at least as far south as the oil-stained exposures, and are probably widespread in the

Table 1. *Oil and gas discoveries in the NPRA. See Kornbrath and others (1997) for data sources.*

Accumulation Name	Estimated Recov. Reserves	Discovery Well Name	Stratigraphic Unit	Age
Sikulik	12 bcf*	South Barrow NSB-5	Barrow Sandstone	Early Jurassic
Walakpa	180 bcf	Walakpa No. 1	Walakpa Sandstone	Neocomian
East Kurupa		East Kurupa No. 1	Torok/Fortress Mountain	Aptian/Albian
East Barrow	12.6 bcf	South Barrow No. 12	Barrow Sandstone	Early Jurassic
East Umiat	4 bcf	East Umiat No. 1	Nanushuk Group	Albian-Cenomanian
Square Lake	58 bcf	Square Lake No. 1	Seabee Formation (Colville Group)	Turonian-Coniacian
Gubik	600 bcf	Gubik Test No. 1	Prince Creek/ Chandler Formation	Late Cretaceous
Wolf Creek		Wolf Creek No. 1	Chandler Formation (Nanushuk Group)	Albian-Cenomanian
Simpson	12 mmbo*	Simpson No. 26	Nanushuk Group	Cretaceous
Meade	20 bcf	Meade No. 1	Nanushuk Group	Cretaceous
Umiat	70 mmbo and 5 bcf	Umiat No. 4	Grandstand Formation (Nanushuk Group)	Albian
Fish Creek		Fish Creek No. 1	Nanushuk Group	Cretaceous
South Barrow	25.9 bcf	South Barrow No. 2	Barrow Sandstone	Early Jurassic

*bcf = billion cubic feet; mmbo = million barrels of oil

(continued on page 2)

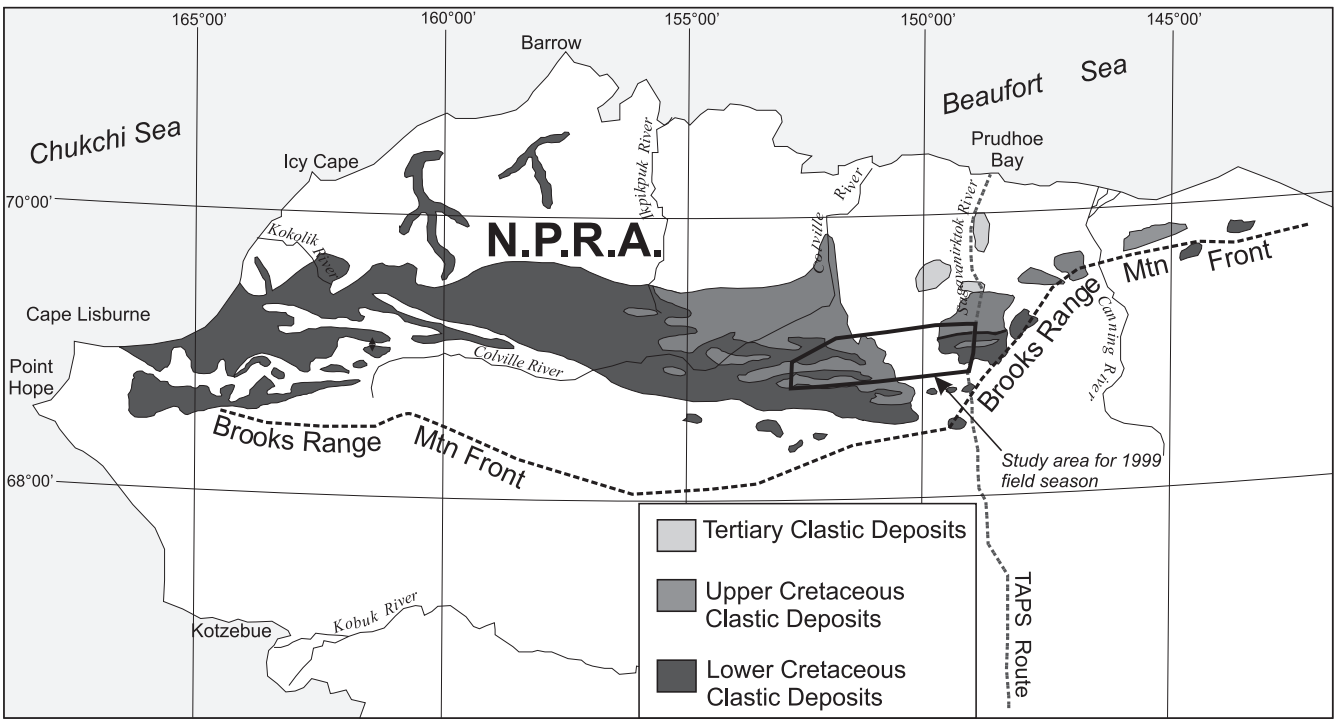
subsurface of the North Slope south of the oil-stained exposures. This is further indicated by DGGS studies on the southwestern part of the North Slope that have revealed exposures of oil-prone source rocks in the Shublik derived from the southern part of the Colville basin.

Until recently, the NPRA has been overshadowed by interest in the 1002 Area located on the coastal plain of the Arctic National Wildlife Refuge (ANWR). In their recent petroleum assessment of the 1002 Area, the USGS estimated that 5.7 to 16.0 billion barrels of oil are recoverable with currently available technology. However, with the likelihood that ANWR will remain off limits to exploration for the foreseeable future, the NPRA and surrounding lands are some of the most promising onshore areas for oil and gas exploration in the continental United States. NPRA has recently received renewed interest because of the decision by the Bureau of Land Management to offer land in the petroleum reserve for lease.

The most recent estimate of undiscovered petroleum resources in the NPRA was completed by the USGS in 1980. This appraisal includes estimates that the NPRA contains 800 million to 15.4 billion barrels of oil in place (mean volume of 6 billion barrels of oil in place) and 2.4 to 27.2 trillion cubic feet of gas in place (mean volume of 11.3 trillion cubic feet of gas in place). Significantly, this assessment does not take into account the recent drilling results from the Colville Delta and nearby lands farther east.

Reflecting the promise of the NPRA, at a Federal lease sale held on May 5, 1999, six companies leased over 800,000 acres of land in the eastern NPRA. ARCO Alaska and Anadarko Petroleum, bidding together and independently, acquired the most acreage, spending a combined total of $76.3 million on leases for over 635,000 acres. BP Exploration, Chevron, and Phillips, bidding together and independently, acquired over 300,000 acres, spending a combined total of just under $50 million. On a smaller scale, R3 Oil, a small company based in Colorado, was successful in acquiring the lease for the Umiat oil field for $37,470.

In an effort to provide up-to-date information to State and Federal policy makers, private land owners, and to petroleum companies interested in exploring this vast region, the USGS and DGGS have begun multi-year studies of the geology of the NPRA and adjoining lands. For DGGS, this is a resumption of studies adjacent to the NPRA that it began in the 1980s. The USGS project began in 1998 and focuses primarily on the subsurface geology, but will also entail study of key outcrops to help interpret stratigraphic and structural relations observed on seismic lines. The DGGS field effort is made possible by funding from an industry consortium consisting of Anadarko, ARCO, and BP. The project will focus primarily on surface geology, and will carry out detailed stratigraphic studies and continue bedrock mapping across southern NPRA and on adjoining State, Federal, and Arctic Slope Regional Corporation lands. While DGGS and the USGS are pursuing separate but complementary projects, we anticipate scientific and logistical collaboration. DGGS will begin in July by examining outcrops of the Cretaceous Torok Formation, Nanushuk Group, and Colville Group between the Dalton Highway and the Chandler River in the central North Slope. During subsequent years, depending on the level of funding available, DGGS will shift the study area westward to the west-central Arctic Slope, and finally back to the western Arctic Slope where its studies have been concentrated in recent years. Anticipated DGGS products from the first year of this work include completion of a geologic map of the northern half of the Chandler



Lake Quadrangle and of an area at the eastern part of the quadrangle. Detailed measured sections from key exposures of the Torok Formation and Nanushuk Group, a preliminary sequence stratigraphic framework, and preliminary petrography of potential reservoir sandstone bodies are also planned.

DGGS's work will build on previous studies of the geology of the NPRA and adjoining lands. Some of the more significant studies have been published by the U.S. Geological Survey, including USGS Professional Papers 303, 305, and 1399, and USGS Bulletin 1614. Additional significant studies include DGGS mapping in the Killik River area to the west and uncompleted mapping of the Chandler River region, which provides a framework for understanding the stratigraphy and structure of the area. These publications are excellent sources of information; however, significant advances in sedimentology and stratigraphy have been made since completion of the fieldwork summarized in these documents. For example, since their publication no detailed studies addressing the sequence stratigraphy and reservoir geometry of Cretaceous strata in the NPRA have been published. The USGS and DGGS projects will help update the publicly available dataset on this important frontier petroleum province.❖

Dear Readers:

On June 30, DGGS will say Godspeed to long-time staff members Ann-Lillian Schell and Shirley Liss. Ann-Lillian, recipient of several awards for her cartography, has helped DGGS geologists present their work to our customers for over 24 years. Ann-Lillian will continue her creative ways as the proprietress of Silver Fox Studios, a custom shop for quilters that will be located in Kasilof. Shirley joined DGGS 15 years ago to work on a comprehensive inventory of the state's geothermal energy resources. Following the successful conclusion of that project, Shirley has participated in a wide variety of DGGS studies. Always one of the first to volunteer for field assignments, Shirley's love of rural Alaska has been a hallmark of her tenure at DGGS. All of us at DGGS wish these two colleagues the best of everything in their new endeavors.

This spring DGGS was involved in organizing two geological gatherings in Fairbanks. The first was a technical symposium for the Alaska Geological Society (AGS) held Friday, April 23, with field trips on Saturday, April 24. The second was the Annual Meeting of the Association of American State Geologists (AASG) held June 5-9.

Rocky Reifenstuhl was a co-convener for the AGS symposium and worked with Paul Layer, Chairman of the UAF Geology Department, to make the April meeting a success. The conference was first class all the way. Rocky did a great job organizing the events. The conference featured a well-balanced mix of mineral- and energy-related papers during the morning session and very well presented poster sessions in the afternoon. On Saturday, participants had the choice of four field trips. DGGS was a major participant in the poster session with contributions from Ellen Harris, Jim Clough, Dave LePain, Rod Combellick, Gil Mull, Melanie Werdon, Dave Szumigala, Gail Davidson, and Karen Clautice. Ann-Lillian Schell was on hand at an attractive DGGS booth featuring several of our latest publications.

The AASG meeting was the 91st gathering of directors of the nation's state geological surveys. Thirty-eight State Geologists were in attendance. In his welcoming remarks to the membership, Governor Tony Knowles proclaimed the second full week in October as Alaska's Earth Sciences Week. Also present were the Director of the U.S. Geological Survey and management-level representatives of ten other federal and professional organizations. AASG holds a unique position in the nation's geologic community because it is a formally organized body that receives direct input from the Directors of the country's 50 state geological surveys. The Association's effectiveness in educating national policymakers on high-priority state-level geological issues is widely recognized. This year's meeting allowed our colleagues from other states and the Association's federal guests to acquire a better understanding of Alaska's unique needs. It was a pleasure to have them visit.

Sincerely,

Milton Wiltse

Milton Wiltse
Director and State Geologist

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MP 35. **Color scheme variations of the total field magnetics for part of the Fortymile mining district,** by L.E. Burns, 1999, 1 sheet, scale 1:250,000. $13.

MP 36. **Different coplanar resistivities and color schemes for part of the Fortymile mining district,** by L.E. Burns, 1999, 1 sheet, scale 1:250,000. $13.

MP 38. **Map of prospective mineral areas and significant mineral resources of Alaska,** by D.J. Szumigala, 1999, 1 sheet, scale 1:250,000. $13.

RI 98-12. **Geologic Map of the Horn Mountains area, Sleetmute C-7, C-8, D-7, and D-8 quadrangles, southwestern Alaska,** by T.K. Bundtzen, E.E. Harris, M.L. Miller, P.W. Layer, and G.M. Laird, 1999, 38 p., 1 sheet, scale 1:63,360. Full color plot from electronic file, 400 dpi. Printed on request. $30.

RI 99-7. **Reconnaissance map of glacial limits in the Petersville (Yentna) mining district, Alaska,** by R.D. Reger, 1999, 1 sheet, scale 1:63,360. $13.

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PDF 98-43. **Lead isotopic ratios, ICP and XRF analyses, and fluid inclusion data from the Kady Zn-Pb-Cu-Ag vein-breccia prospect, northern Brooks Range, Alaska,** by M.B. Werdon, December 1998, 9 p. $2.

PDF 99-21. **Water quality study of Richardson Clearwater Creek near Big Delta, Alaska,** by M.A. Maurer, March 1999, 28 p. $2.80

PDF 99-22. **Hydrologic and water quality investigations related to placer mining in interior Alaska; summer 1998**, by Jim Vohden, May 1999, 43 p. $15.10

PDF 99-23. **Land status and mining claims of the Eagle A-2 Quadrangle, Alaska,** by E.W. Hansen, J.L. Mayer, D.J. Szumigala, and D.S. Pinney, June 1999, 1 sheet, scale 1:63,360. $13.

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