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EXPANDED ABSTRACT

The National Petroleum Reserve in Alaska (NPRA) has figured prominently in North Slope petroleum exploration since its establishment in 1923 (Gryc, 1985). This paper focuses on the southerly portion of the reserve, approximately between latitudes 69° to 70°N., known as the Foothills Fold Belt. The Belt is typified by large, well developed concentric folds involving Cretaceous rocks and extending up to several townships. Some folds are 40 miles (64 km) long and 10 miles (16 km) wide and have the potential to contain significant hydrocarbon reserves.

The most widespread units containing potential reservoir rocks are the Torok Formation and the Nanushuk Group. The Torok Formation of Aptian-Albian age is comprised mostly of pro-deltaic shales and siltstones with thin sands interbedded locally. These marine, generally fine-grained clastics grade upward into and interfinger with the generally coarser marginal marine to fluvial clastics of the Nanushuk Group. Although the overall succession is regressive, the transition from the upper part of the Torok to the lower part of the Nanushuk can be quite complex involving many local cycles of transgression. The Torok may grade upward into intervals with better quality and more numerous sands thought to be deposited as near shore bars or strand-line bodies. Alternatively, the transition may be represented by poorer quality, "dirty" units with little reservoir potential grading upward directly into fluvial and lacustrine sediments. The important question about the transition then becomes, "How can better reservoir potential be predicted?"

The U.S. Geological Survey embarked in 1981 on a major reprocessing project involving modern, multifold seismic data displayed in a horizontally compressed format. This database was utilized to address the question from a seismic stratigraphic standpoint. The Torok interval is usually characterized by well defined sigmoid or complex sigmoid oblique clinoforms and contrasts markedly with the parallel or sub-parallel reflections of the overlying Nanushuk (Molenaar, 1981). The key to addressing the question of reservoir potential is to closely examine the seismic character at the top of the clinoform sequence. The clinoforms merge with the overlying sequence in two ways. They extend updip, over a "shelf edge" in a roughly parallel manner and continue laterally into the parallel reflections of the topset beds. Alternatively, they terminate abruptly updip in a zone of convergence, truncation, or top lap. Where the clinoforms terminate abruptly, they are unconformably overlain by the parallel reflections. These two character styles are fully gradational between one another, but it is nevertheless possible to map subdivisions of the clinoform sequence based on the character style of the transition interval. I refer to these subdivisions informally as "subsequences".

A basic assumption of the seismic stratigraphic method is that physical processes of deposition are reflected in seismic character. The sigmoid clinoforms merging in a parallel manner from a prodelta slope up dip, continuously over a shelf edge and into topset beds is suggestive of uniform deposition under stable conditions. Truncated or abruptly convergent clinoforms suggest active erosion, sediment pass through, and reworking of shelf sediments. The latter reflection character will be produced under higher energy depositional conditions, where winnowing and reworking can serve to improve reservoir quality. Defining the subsequences as portions of the sequence exhibiting truncation, convergence, and top lap associates them with higher energy deposition and, therefore, better reservoir potential. They are usually separated by portions of the sequence which lack truncation and top lap and which underly units having poorer reservoir potential. The subsequences within the Torok represent large deltaic lobes or coalescing lobes. The trends of these lobes indicate general shoreline progradation from southwest to northeast in the southernmost part of the study area swinging around to nearly due east in the easterly part of the study area. Area-wide, the subsequences represent fairways of reservoir potential and by conventional interpretation methods can be correlated with outcrops and wells. Ten wells penetrate the Nanushuk-Torok transition in the study area. Wells corresponding with subsequences exhibited shows varying from free oil to organic staining on cuttings. Wells not corresponding with subsequences had no shows in the transition interval. In the southernmost part of the area, Nanushuk outcrops correlated with subsequences contained sands with typical porosities of 15 to 18 percent and permeabilities up to 80 to 200 millidarcies.

Subdividing the Torok clinoform sequence is a useful approach which may enable the explorationist to define new prospects based on stratigraphic traps. Structural traps could be evaluated and ranked based on reservoir potential, thus reducing one element of exploration risk.

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REFERENCES CITED

- Gryc, George, 1985, The National Petroleum Reserve in Alaska: U.S. Geological Survey Paper 1240-C.
 Molenaar, C.M., 1981, Depositional history and seismic stratigraphy of lower Cretaceous rocks, National Petroleum Reserve in Alaska and adjacent area: U.S. Geological Survey Open-File Report 81-1084.

REPORT
OF THE
INTERNATIONAL POLAR EXPEDITION

TO
POINT BARROW, ALASKA,

IN RESPONSE TO
THE RESOLUTION OF THE HOUSE OF REPRESENTATIVES
OF DECEMBER 11, 1884.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1885.

ORDERS AND INSTRUCTIONS.

[Special Orders No. 102.]

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL OFFICER,
Washington, D. C., June 24, 1881.

[Extract.]

IV. By direction of the Secretary of War, the following-named officers, civilians, and enlisted men are assigned to duty as the expeditionary force to Point Barrow, Alaska Territory, viz: First Lieut. P. Henry Ray, Eighth Infantry, Acting Signal Officer; Acting Assistant Surgeon, George Scott Oldmixon, U. S. Army; Sergt. James Cassidy, Signal Corps, U. S. Army, observer; Sergt. John Murdoch, Signal Corps, U. S. Army (A. M., Harvard), naturalist and observer; Sergt. Middleton Smith, Signal Corps, U. S. Army, naturalist and observer; Capt. E. P. Herenden, interpreter, storekeeper, &c.; Mr. A. C. Dark, astronomer and magnetic observer (Coast Survey); one carpenter; one cook; one laborer.

V. First Lieut. P. H. Ray, Eighth Infantry, Acting Signal Officer, is hereby assigned to the command of the expedition, and is charged with the execution of the orders and instructions given below. He will forward all reports and observations to the Chief Signal Officer, who is charged with the control and supervision of the expedition.

VI. As soon as practicable, Lieutenant Ray will sail with his party from San Francisco for Point Barrow, latitude $71^{\circ} 27'$ north, longitude $156^{\circ} 15'$ West (Beechey), and establish there a permanent station of observation, to be occupied until the summer of 1884, when he will return here, unless other orders reach him. On the way out and back, a stoppage of a few days only will be made at Plover Bay (latitude $64^{\circ} 22' 0''$ north, longitude $173^{\circ} 21' 32''$ west), for the purpose of

determining the error and sea rate of his chronometers. The vessel conveying him to his destination will not be detained at the permanent station longer than is necessary to unload the stores.

W. B. HAZEN,
Brigadier and Brevet Major-General, Chief Signal Officer, U. S. Army.

Official:

LOUIS V. CAZIARC,
First Lieutenant, Second Artillery, Acting Signal Officer.

[Instructions No. 76.]

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL OFFICER,
Washington, D. C., June 24, 1881.

The following general and detailed instructions will govern in the establishment and management of the expedition organized under Special Orders No. 102, War Department, Office of the Chief Signal Officer, Washington, D. C., dated June 24, 1881.

The permanent station will be established at the most suitable point in the vicinity, and, if practicable, at or in the immediate neighborhood of Point Barrow, Alaska Territory, (latitude $71^{\circ} 27'$ north; longitude $156^{\circ} 15'$ west, as determined by Beechey).

The chronometers will be rated at San Francisco, and will have their sea rates determined by an observation of time at the United States Coast and Geodetic Survey station at Plover Bay (latitude $64^{\circ} 22' 0''$ north; longitude $173^{\circ} 21' 32''$ west).

The vessel should, on arrival at the permanent station, discharge her cargo with the utmost dispatch, and at once be ordered to return to San Francisco, Cal. Before permitting the vessel to leave, a careful examination of the vicinity will be made and the exact site chosen for the permanent station will be located in latitude and longitude, chronometrically, both by Lieutenant Ray and by the navigator of the vessel independently, and a report in writing will be sent by the returning vessel. By the same means will be sent a transcript of all meteorological and other observations made during the voyage, and also a list of apparatus and stores known to be broken, missing and needed, to be supplied next year.

After the departure of the vessel, the energies of the party should first be devoted to the erection of the houses required for dwellings, stores, and observatories.

Special instructions regarding the meteorological, magnetic, tidal, pendulum, and such other observations as were recommended by the Hamburg International Polar Conference, are transmitted herewith.

Careful attention will be given to the collection of specimens of the animal, mineral, and vegetable kingdoms. These collections are to be made as complete as possible, and are to be considered the property of the Government of the United States, and are to be at its disposal. The collections in natural history and ethnology are made for, and will be transferred to, the National Museum.

It is contemplated that the permanent station will be visited in 1882, 1883, and 1884 by a steam or sailing vessel, by which supplies for, and such additions to, the present party as are deemed needful will be sent. Lists of stores required to be sent by the next season's vessel will be forwarded by each returning boat.

The subject of fuel and native food-supply, its procurement and preservation, will receive full and careful attention, as soon after the establishment of the post as practicable. Full reports upon this subject will be expected.

A special copy of all reports will be made each day, which will be sent home each year by the returning vessel.

The full narrative of the several branches will be prepared with accuracy, leaving the least possible amount of work afterwards to prepare them for publication.

In case of any fatal accident or permanent disability happening to Lieutenant Ray, the command will devolve on the officer next in seniority, who will be governed by these instructions.

W. B. HAZEN,
Brigadier and Brevet Major-General, Chief Signal Officer, U. S. Army.

Official:

LOUIS V. CAZIARC,
First Lieutenant, Second Artillery, Acting Signal Officer.