LATERAL CONTINUITY OF THE BLARNEY CREEK THRUST, DOONERAK WINDOW, CENTRAL BROOKS RANGE, ALASKA

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EXPANDED ABSTRACT

Centrally located in the Brooks Range fold and thrust belt of northern Alaska, the Doonerak Window (fig. 1) exposes Lower Paleozoic rocks overlain by a relatively thin section of Carboniferous through Permo-Triassic strata. The Lower Paleozoic sequence, here informally called the Apoon Assemblage, consists of south-dipping thrust sheets containing phyllites and argillites, and mafic volcanic and volcanogenic rocks, which are intruded by mafic dikes dated by K-Ar and Ar-Ar methods on hornblende at between 520 and 373 Ma (Late Cambrian through Middle Devonian: Dutro et al., 1976). Reports of fossils in the Apoon Assemblage are sparse, but include Middle Cambrian trilobites and paraconodonts (Dutro et al., 1984), and Early Silurian and Ordovician(?) graptolites, (Moore and Churkin, 1984). Along the northeastern margin of the Doonerak Window is a narrow tract of north-dipping, imbricated Carboniferous rocks which, in ascending stratigraphic order, are the Kekiktuk Conglomerate, Kayak Shale, and carbonates of the Lisburne Group. The Doonerak Window is framed by thrust sheets which carry Devonian clastic rocks of the Endicott allochthon. North of the window, these Devonian rocks dip to the north, whereas south of the window they dip to the south. Around the eastern end of the Doonerak Window, the Devonian Hunt Fork Shale, which is the structurally lowest unit of the Endicott allochthon north of the window, depositionally interfingers with the underlying Devonian Beaucoup Formation which is in contact with the window along its southern margin.

We were initially attracted to the Doonerak Window in order to study pre-Carboniferous structures reportedly developed there. Proposed mid-Paleozoic tectonism was held responsible for the existence of a postulated angular unconformity between the Apoon Assemblage and the overlying Carboniferous rocks (Brosgé and Reiser, 1971; Dutro et al., 1976; Mull, 1982). Based on this interpretation, it was proposed that the rocks of the Doonerak Window had a similar depositional and structural history as exposures in the Romanzof uplift of the northeast Brooks Range, and as in the subsurface of the North Slope of Alaska. In the northeast Brooks Range and under the North Slope, Devonian tectonism resulted in a penetrative deformation associated with low-grade metamorphism prior to deposition of the Carboniferous Kekiktuk Conglomerate and overlying clastic and carbonate rocks.

Our work, which involves detailed mapping and structural analysis in and around the eastern part of the Doonerak Window, has uncovered no structural evidence of pre-Carboniferous tectonism within the Apoon Assemblage (Oldow et al., 1984). Three generations of folds and associated structures are recognized throughout the study area (Julian et al., 1984). The earliest generation of structures, D_1, is represented by a penetrative metamorphic foliation, S_1, which is axial planar to rarely preserved isoclinal folds of bedding. In the Apoon Assemblage, S_1 dips moderately to the southeast, whereas in the overlying Carboniferous section S_1 dips gently to the north. A second generation of structures, D_2, consists of asymmetric kink folds and crenulations of the S_1 foliation. D_2 structures are identically oriented in both the Apoon Assemblage and in the Carboniferous section, with dominantly northwest-dipping axial planes and subhorizontal fold axes. A consistently steep, north-northwest striking crenulation cleavage which overprints all other structures is developed locally and assigned to D_3. Since all three generations of structures are found to be developed in all rocks exposed in the study area, including rocks of Carboniferous age, they must have been formed after that time.

The orientation of S_1 allows rocks of the Doonerak Window to be divided into two structural domains: a northern domain consisting of Carboniferous rocks in which S_1 dips gently to the north, and a southern domain in which S_1 dips moderately to the southeast. The southern domain is dominantly composed of the Apoon Assemblage, capped in places by a thin rind of Kekiktuk Conglomerate which appears to be in depositional contact with the lower Paleozoic rocks. The primary contact between these two domains is a major thrust fault called the Blarney Creek thrust, which has been traced and studied in detail along the northeastern margin of the Doonerak Window over a distance of 16 miles (26 km), from Kuyuktuvuk Creek in the east to Wien Mountain in the west part of the field area (fig. 1). The Blarney Creek thrust is also identified farther west at Bombardment Creek, where Apoon Assemblage rocks are structurally mixed with Carboniferous rocks, thus extending the fault 4.3 miles (7 km) west of Wien Mountain. The absence of pre-Carboniferous deformational structures in the southern domain casts doubt on the interpretation that this contact is a profound angular unconformity. In most places the contact is a major thrust fault which appears to have followed what was originally a depositional disconformity or low-angle unconformity. The tectonic nature of the majority of the exposed contact is demonstrated by: (1) the large angular discordance in orientation of S_1 foliation; (2) omission of stratigraphic units above and below the contact; (3) thrust faults developed in both the northern and southern structural domains which merge into but do not cut the contact; and (4) complex structural interleaving of Apoon Assemblage and Kekiktuk Conglomerate in a narrow zone lying immediately below the contact. There is no doubt that rocks of the Apoon Assemblage were intimately involved in Brookian deformation. In many places, the Blarney Creek thrust is obscured by late-stage, east-west-striking high-angle faults which show both vertical and strike-slip motion.

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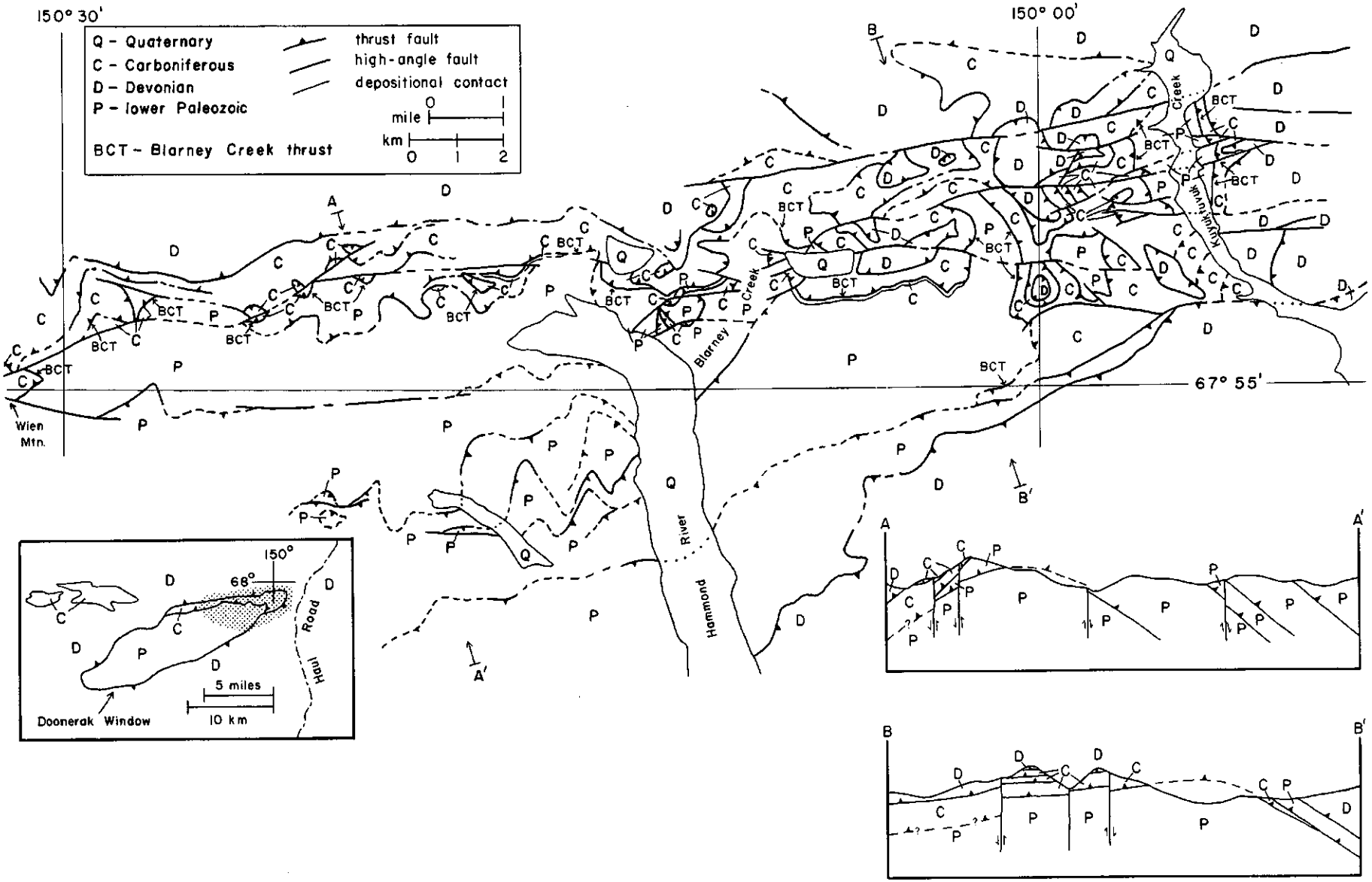

Figure 1 Simplified geologic map and cross-sections of the northeastern Doonerak window. Inset shows entire window, with area covered by map indicated by stippled pattern.

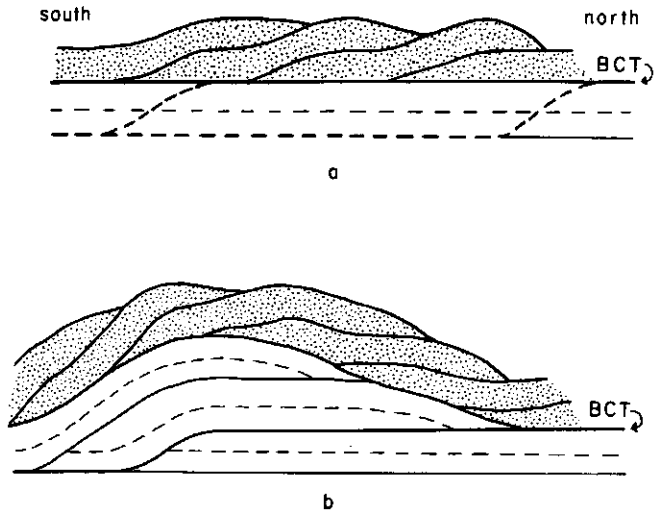

Figure 2. Schematic representation of duplex development. Solid heavy lines represent thrust faults. Dashed heavy lines represent incipient thrust faults. Light dashed line is a reference marker horizon. BCT is the Blarney Creek thrust.
(a) Initial thrusting occurs above a detachment surface (BCT) and imbricates the Carboniferous section (stippled pattern).
(b) Continued deformation involves deeper rocks (lower Paleozoic Apoon Assemblage) in the thrusting. The younger and deeper thrust faults ramp up and merge with the pre-existing detachment surface (BCT). This rotates the overlying, previously imbricated Carboniferous section into an antiform.
Note that the detachment surface (BCT) is active during both periods of thrusting: it acts as a basal décollement in (a) and as a duplex roof thrust in (b).

We propose that the Blarney Creek thrust was formed initially within the Kayak Shale as a basal decollement above which Carboniferous rocks were imbricated during an early stage of Brookian contraction that was probably related to emplacement of the overlying Endicott allochthon (fig. 2). During continued progressive deformation, deeper thrust faults involving the lower Paleozoic Apoon Assemblage ramped up into the Kayak Shale and merged with the pre-existing Blarney Creek thrust to form a duplex structure; the Blarney Creek thrust represents the roof thrust during duplex development. Imbrication of Apoon Assemblage rocks in the lower plate of the duplex resulted in folding of the imbricated Carboniferous section of the roof complex into an antiform (fig. 2), accounting for the observed distribution of bedding and S_1 cleavage, which dip north above but which dip south below the Blarney Creek thrust. The duplex model also explains juxtaposition of younger over older rocks at the thrust fault. The Kekiktuk Conglomerate is a thin competent unit which was sometimes caught up in early imbricate stacking of the Carboniferous section, but more commonly it remained attached to the subjacent Apoon Assemblage during this early stage of tectonism. At that time, detachment was apparently more easily accommodated just above the Kekiktuk in the Kayak Shale. During later duplex development, the Kekiktuk Conglomerate locally became interleaved with thin slices of Apoon Assemblage in the Blarney Creek thrust zone.

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REFERENCES CITED

Brosgé, W. P., and Reiser, H. N., 1971, Preliminary bedrock geologic map, Wiseman and eastern Survey Pass quadrangles, Alaska, scale 1:200,000: U.S. Geological Survey, Open-File Map OF-479.

Dutro, J. T., Jr., Brosgé, W. P., Lanphere, M. A., and Reiser, H. N., 1976, Geologic significance of Doonerak structural high, central Brooks Range, Alaska: American Association of Petroleum Geologists Bulletin, v. 60, p. 952-961.

Dutro, J. T. Jr., Palmer, A. R., Repetski, J. E., and Brosgé, W. P., 1984, Middle Cambrian fossils from the Doonerak anticlinorium, central Brooks Range, Alaska: Journal of Paleontology, v. 58, p. 1364-1371.

Julian, F. E., Phelps, J. C., Seidensticker, C. M., Oldow, J. S., and Avé Lallemant, H. G., 1984, Structural history of the Doonerak Window, central Brooks Range, Alaska [*abs.*]: Geological Society of America Abstracts with Programs, v. 16, p. 291.

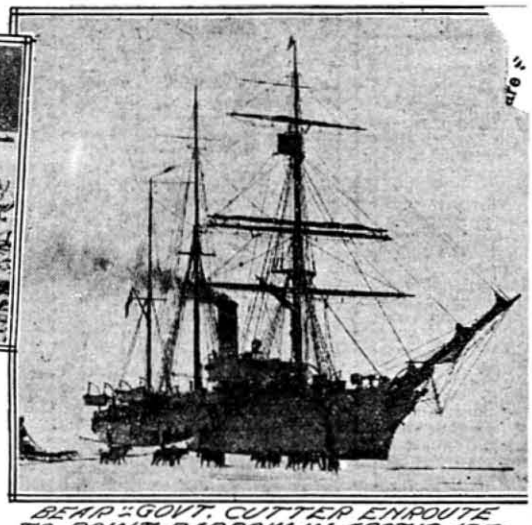
Moore, T. E., and Churkin, M. Jr., 1984, Ordovician and Silurian graptolite discoveries from the Neruokpuk Formation (*sensu lato*), northeastern and central Brooks Range, Alaska: Paleozoic Geology of Alaska and Northwestern Canada Newsletter, Alaska Geological Society, v. 1, p. 21-23.

Mull, C. G., 1982, Tectonic evolution and structural style of the Brooks Range, Alaska: an illustrated summary, *in* Powers, R.B., ed., Geologic Studies of the Cordilleran Thrust Belt, Volume 1, Denver, Colorado, 1982: Rocky Mountain Association of Geologists, p. 1-45.

Oldow, J. S., Avé Lallemant, H. G., Julian, F. E., Seidensticker, C. M., and Phelps, J., 1984, The Doonerak Window duplex: regional implications [*abs.*]: Geological Society of America Abstracts with Programs, v. 16, p. 326.

OIL in the Frozen North

CARIBOU CROSSING SOUTH FORK OF KOYAKUK



BEAR — GOVT. CUTTER ENROUTE TO POINT BARROW IN ARCTIC ICE

Lakes of "Liquid Millions" Near Point Barrow—Area Affected Covers Immense Amount of Territory—Discovered By Accident

BY VICTORIA HEWITT WRIGHT

OIL discoveries near Point Barrow on the Arctic Ocean begin in an enthusiastic hopeful period of Alaska. Active operations are scheduled to commence this spring with the opening of navigation. A number of investigators went to the district during last winter by dog team. And these were followed by geological experts during the summer. These survey parties made extensive examinations and also locations. Others filed for prospecting permits at the United States Land Office for the District of Alaska. Representative men and well known geologists who investigated the oil seepage report favorably on these discoveries.

The existence of these vast oil deposits in the Point Barrow region has been known for years. But only recently has there been any effort to investigate the field. Point Barrow is now anticipating an oil stampede that will equal the gold rush to Nome in 1900, when 50,000 people rushed there in search of the precious metal. This time the stampede will be for "Liquid Millions". Notwithstanding the promising character of the oil reports, no one can estimate the value of the Arctic oil fields until wells have been put down. They may strike it rich or they may not. Arctic oil is a gamble as was the oil prospects of Texas, Kansas and Oklahoma were in the early days. No one expected such great fields as have been developed there, although they also had evidence of oil.

Two lakes of oil seepage at Cape Simpson, on the Arctic Coast, have been surveyed. One contains ten and one-half acres and the other seven and one-quarter. Claims for this section have been staked in the names of the old "Sourdoughs". In other words, the claims were entered by men who reside in the territory, and are interested in the development of the country for the benefit of people living in Alaska, instead of leaving the resources to be exploited by outside capitalists. The land of white silence is now awakening to a new era, which helps to give the lie to the old verse:

"Alaska is a land of ice and snow;
That is all we need to know."

The Barrow oil region lies in latitude somewhat farther North than the Fort Norman oil fields. This district of oil seepage, on top of the world, if placed on the map of the United States would cover more area than the combined states of Texas, Oklahoma, Wyoming, Montana, Arkansas and Louisiana. Only a small portion of the section has been entered. It is expected that the petroleum fields of this section will rival those in the northern part of Canada. Even with the handicaps of far northern latitudes it is presumed that oil may be available with less difficulty than other subterranean wealth.

Friendly Arctic

The discovery of this valuable resource may do much for the economic future of the Far North. As the ocean steamships travel, Point Barrow is four and one-half days nearer the Orient than San Francisco. People who do not know the Arctic regard it as "inhospitable". But people who know the country call it the "Friendly Arctic". The discovery of oil probably means more to the development of the territory than further discoveries of useful metals. For various manufacturing enterprises are springing up in the territory, and Alaska already has a large permanent citizenry. Point Barrow is known only as an almost inaccessible Eskimo village, on the Arctic Ocean, and is the northernmost port for Arctic explorers, fur traders and venturesome whalers.

The Government cutter "Bear" makes the trip up from Nome at the opening of navigation, bringing mail and provisions for the entire population. The climate is extremely healthy. The natives enjoy outdoor life summer and winter, often going for weeks at a time without lighting a fire.

There is no timber in this locality and poles for making the stakes with which to mark the oil claims for the "Sourdough" group were brought in from the Mead River—one hundred miles away.

How Discovered

Alexander Malcolm Smith, known as "Scotty Smith," because of his "Scotch burr," stumbled knee deep into a lake of oil in this locality about five years ago. It was with considerable difficulty that he scrambled out again. The smell of oil and the drip from his clothes caused him to investigate. After prospecting, he reported the discovery to Washington. Rumors of this oil seepage spread all over the territory. But no steps were taken toward development until our Canadian neighbors began to open up their far north oil fields. Now sincere efforts are being made to develop the petroleum seepage on our side of the International boundary line.

"Scotty" Smith is not only identified with the oil, but his name appears many times on the map of Alaska, made by the U. S. Geological Survey. Smith Bay, Smith Lake and Smith River are each named for him. He is now sixty years young. For thirty-seven years this naturalized American (citizen of Alaska), has mushed over the northern trails. Sometimes prospecting, sometimes exploring new regions or dealing in furs, and at other times just enjoying life in the open. He knows the perils of pioneering. In an interview with him a few days ago he said he would rather be broke in Alaska than in any other place in the world. This demonstrates the fraternal spirit that prevails in Alaska. Smith's love for his adopted country, his indomitable will and his high minded ambition compel admiration. Because of his record in traversing the trails, he is called in Alaska, "The Ace of the Trail". With his parka and muck lucks on, he is ready for any venture on the trail.

OIL SEEPAGE, CAPE SIMPSON, ALASKA, 40 MILES FROM POINT BARROW

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"Slim"

Dog teams are used for freighting and transportation in the far north. "Slim" is the name of one of Smith's dogs. He is a special breed with long legs, which enable him to mush through deep snow with considerable ease. He is a powerful dog, cross between a McKenzie River Huskie and an English Boar Hound.

We have all heard about the pot of gold at the end of the rainbow. But few people ever dreamed of finding a lake of "Liquid Millions" at the end of Uncle Sam's northermost trail. About seven hundred miles south of these oil fields is Fairbanks, the metropolis of Interior Alaska, situated in the center of a rich agricultural district and industrial region. The new Government railway that extends into the Matanuska coal fields, also connects with Fairbanks. This six hundred and one miles of new railway will be completed in the spring. Another branch of railway extending north from Fairbanks would solve the problem of marketing the oil from the north. Although piping this distance seems like a formidable undertaking, it will no doubt be done.

Obtaining oil in the territory for power and locomotion will have a beneficent effect on the forests of Alaska that should be conserved for uses to which timber alone is fitted, instead of wasting it, as at the present time, for fuel. In Fairbanks, one plant alone consumed thirty thousand cords of wood last winter.

Herd Of Caribou

There is no appearance of desolation on the tundra in the summer time. Beautiful wild flowers bloom everywhere. The tundra is carpeted with acres of crimson, blue and gold—often rising and falling in the breeze like a silk coverlet. There is an abundance of fish in the streams. Thousands of ducks and geese have their breeding grounds in the Arctic North. This is indeed a hunter's paradise. One frequently sees caribou crossing the tundra. Often the entire herd will plunge into the river or lakes, that are so numerous, in order to protect themselves from gnats and mosquitoes.