

Public-data File 86-96
Western Arctic Coal Study Proposal (1986)

By

R.D. Merritt

Alaska Division of Mining and
Geological and Geophysical Surveys

December 1986

THIS REPORT HAS NOT BEEN REVIEWED FOR
TECHNICAL CONTENT (EXCEPT AS NOTED IN
TEXT) OR FOR CONFORMITY TO THE
EDITORIAL STANDARDS OF DMGGS.

794 University Avenue, Basement
Fairbanks, Alaska 99709

ALASKA DIVISION OF MINING AND GEOLOGY

PROJECT PROPOSAL

Title:

Coal and Overburden Characterization of Selected Stratigraphic
Sections In Nanushuk Group Rocks of Western Arctic Alaska:
Prediction of Geologic Constraints To Mine Development, And
Application To Depositional Modeling, Mine Planning, And
Reclamation Potential

by R.D. Merritt
1986

Purpose

To select and sample in detail several stratigraphic sections containing multiple coal seams in Nanushuk Group rocks of western Arctic Alaska; to systematically perform a suite of geochemical and physical analyses to determine the main coal and overburden rock types; to relate the types of coals and overburden to their specific and diagnostic position in the deltaic depositional system (that is, lower, transitional, or upper delta plain environments); and to determine those factors a) influencing mine planning and minability, b) allowing the prediction of geologic constraints to mine development, and c) bearing on post-mining reclamation potential.

Project Location

Northern Alaska coal fields with priority given to sites in the western Arctic. Specific sites may be selected at Corwin Bluff, Cape Beaufort, or other areas on or near the Chukchi Sea, including the Utukok, Kokolik, and Kukpowruk Rivers.

Statement of Problem

The Northern Alaska fields constitute one of the largest coal reserves in the world (Tailleur and Brosge, 1976). The resource base is definitely not a limiting factor to future development, but mining in permafrost, reclamation, and transportation will likely pose formidable challenges to coal mine development in the region (Merritt, 1986).

Geologic study over the past decade has resulted in the development of a deltaic sedimentation model (Ahlbrandt and others, 1979; Stricker and Roehler, 1981; and Callahan and Martin, 1981) for the coal-bearing Cretaceous Nanushuk Group rocks and led to a greater understanding of coal character and ultimate development potential for the different facies. A very tentative interpretation is that coals of intermediate thickness and continuity in the transition zone between upper and lower delta plain deposits have the best future commercial potential. Thicker coal beds of the upper-delta-plain deposits preliminarily appear to exhibit poor lateral continuity, and coal beds of the lower-delta-plain environment seem to be relatively higher in sulfur and generally too thin to mine.

Detailed and systematic study of coal and overburden characteristics at sites representative of these specific depositional situations has not been done. This study will determine diagnostic types of coal and overburden as a function of their position in this river-dominated paleodepositional system. Once these types have been established, a demonstrational model can be developed to explain factors influencing mine planning, development, and post-mining considerations.

Objectives/Policies

Alaska contains large quantities of coal, perhaps as much as one-half of the United States resource base. Much of this resource is concentrated in the Northern Alaska coal fields. The quality of geologic information on this resource has eclipsed the reconnaissance stage, and currently more detailed study at specific locations (as proposed here) will better serve to stimulate future coal development in the region.

Because of the large resource base, State and Federal agencies, Native villages and regional corporations, industry, and Pacific-rim coal consumers are very interested in assessing the coal resources of the Northern Alaska fields, especially in areas of the western Arctic lying on or near coastal access of the Chukchi Sea. Assuming that transportational and other mine-related constraints can be bridged, mines can be developed in the region to supply high quality bituminous coal for export and in-State use. There has long been an interest by Native organizations in developing the coal resources to provide heat and power in remote Northern Alaska villages.

The State Department of Natural Resources will need detailed studies to help manage future coal leases and to regulate mine development in the region. Subsurface exploration by drilling, coring, and geophysical logging has been intense over the past several years in the Cape Beaufort and Deadfall Syncline areas of the western Arctic. The study proposed here will supplement information provided by these efforts and provide new, detailed, and systematically-derived coal and overburden characterization data at several sites (at least 3) in the region. This data will be applied directly to constructing demonstrational models that can be used to predict geologic constraints to development, minability, and reclamation potential.

Development of Northern Alaska mines will provide new sources for high quality bituminous coal on the Pacific rim,

create new mining and reclamation technologies, demonstrate that Arctic coal mining is feasible in Alaska, and provide new avenues for employment in the region.

Interest Groups Affected

State and Federal government agencies; Alaska Native Villages and Regional Corporations; the North Slope Borough; industry; shipping (barging) and other contractors; Pacific-rim coal consumers; Alaska residents.

Project Description

This is a two-year project that will ultimately produce a set of summary sheets showing the detailed stratigraphy at several selected coal-bearing sections in the Nanushuk Group of western Arctic Alaska. Each sheet will be representative of geologic strata diagnostic of specific positions in the deltaic depositional system (that is, lower, transitional, and upper delta plain environments). Coal and overburden rock types characteristic of these environments will be demonstrated. Stratigraphic sections will be chosen which contain multiple coal seams. Each sheet will contain detailed and site-specific data derived from coal and overburden characterization research that will bear on quality, quantity, minability, marketing, and environmental aspects.

This will require the selection of sites in the western Arctic based on previous geologic studies and depositional modeling. Among the specific sites that may be selected are Corwin Bluff, Barabara Syncline, Ninuluk Bluff, Killik Bend, Kokolik Warp Anticline, Coke Basin, and/or South Limb Snowbank Anticline (Ahlbrandt and others, 1979). It is expected that three sites at a minimum will be selected that are representative of certain diagnostic positions in the river-dominated depositional system. It will require detailed study, description, and sampling at those sites selected. A surficial geologic map will be developed for the area in the immediate vicinity of diagnostic stratigraphic sections. Analytical tests on the coal and overburden samples will be conducted either in-house or at consultant laboratories specializing in certain analyses. It is expected that field operations will require helicopter transport to, from, and between the sites selected. The project will require the assistance of 2-3 geologists and a geochemistry technician. It will also likely require one RSA contract and one professional services contract.

Specific Types of Analyses To Be Conducted

1. Total sulfur and sulfur forms on coal and overburden
2. Illite/kaolinite ratios
3. Munsell color values
4. Grain size analysis---particle size and texture
5. Fossil types---body, plant
6. Trace element analysis on whole coal (elements of environmental concern)
7. Trace element analysis (elements of environmental concern) and major oxide analysis on overburden
8. Suite of overburden characterization analyses---including acid and neutralization potentials, potential acidity, paste pH, base saturation, cation exchange capacity, ammonium acetate extractable cations, extractable nutrients, lime percentage, organic matter, bulk density, exchangeable sodium percentage, sodium adsorption ratio, saturation extract cations, saturation percentage, and electrical conductivity
9. Coal petrology and vitrinite reflectance
10. Selected proximate and ultimate analyses of coal

Products

Three or more summary sheets describing the geology, coal resources, and mine-related considerations at each selected demonstrational site; a surficial geology map (inset on each sheet or separate) of each site; a summary report analyzing practical applications of and conclusions drawn from the detailed coal and overburden characterization data presented on the sheets.

References

- Ahlbrandt, T.S., Huffman, A.C., Jr., Fox, J.E., and Pasternak, Ira, 1979, Depositional framework and reservoir-quality studies of selected Nanushuk Group outcrops, North Slope, Alaska, in Ahlbrandt, T.S., ed., Preliminary geologic, petrologic, and paleontologic results of the study of Nanushuk Group rocks, North Slope, Alaska: U.S. Geological Survey Circular 794, p. 14-31.
- Callahan, J.E., and Martin, G.C., 1981, Coal occurrences of the Nanushuk Group, western Arctic Alaska---an update, in Rao, P.D., and Wolff, E.N., eds., Focus on Alaska's coal '80, Alaska Coal Conference, 2nd, Fairbanks, October 21-23, 1980, Proceedings: University of Alaska Mineral Industry Research Laboratory Report 50, p. 32-50.
- Chapman, R.M., and Sable, E.G., 1960, Geology of the Utukok-Corwin region, northwestern Alaska: U.S. Geological Survey Professional Paper 303-C, p. 47-174.
- Huffman, A.C., Jr., Ahlbrandt, T.S., Pasternak, Ira, Fox, J.E., Bartsch-Winkler, Susan, May, F.E., Scott, R.A., and Materna, W.L., 1981, Measured sections of the Cretaceous Nanushuk Group undivided, western North Slope, Alaska: U.S. Geological Survey Open File Report 81-176, microfilm.
- Huffman, A.C., Jr., Ahlbrandt, T.S., Pasternak, Ira, Stricker, G.D., Bartsch-Winkler, Susan, Fox, J.E., May, F.E., Scott, R.A., and Materna, W.L., 1981, Measured sections in the Cretaceous Nanushuk and Colville Groups undivided, central North Slope, Alaska: U.S. Geological Survey Open File Report 81-177, microfilm.

Martin, G.C., and Callahan, J.E., 1978, Preliminary report on the coal resources of the National Petroleum Reserve in Alaska: U.S. Geological Survey Open File Report 78-1033, 23 p.

Merritt, R.D., 1986, Paleoenvironmental and tectonic controls in major coal basins of Alaska, in Lyons, P.C., and Rice, C.L., eds., Paleoenvironmental and tectonic controls in major coal-forming basins of the United States: Geological Society of America Special Paper 210 (in press).

Mull, C.G., 1979, Nanushuk Group deposition and the late Mesozoic structural evolution of the central and western Brooks Range and Arctic Slope, in Ahlbrandt, T.S., ed., Preliminary geologic, petrologic, and paleontologic results of the study of Nanushuk Group rocks, North Slope, Alaska: U.S. Geological Survey Circular 794, p. 5-13.

Rao, P.D., 1980, Petrographic, mineralogical and chemical characterization of certain Arctic Alaskan coals from the Cape Beaufort region: University of Alaska Mineral Industry Research Laboratory Report 44, 66 p.

Rao, P.D., and Smith, J.E., 1983, Petrology of Cretaceous coals from northern Alaska: University of Alaska Mineral Industry Research Laboratory Report 64, 141 p.

Roehler, H.W., and Stricker, G.D., 1979, Stratigraphy and sedimentation of the Torok, Kukpowruk, and Corwin Formations of Cretaceous age in the Kokolik-Utukok River region, National Petroleum Reserve in Alaska: U.S. Geological Survey Open File Report 79-995, 84 p., 2 sheets.

- Sable, E.G., 1956, New and redefined Cretaceous formations in western part of northern Alaska: American Association of Petroleum Geologists Bulletin, v. 40, no. 11, p. 2635-2643.
- Smiley, C.J., 1969, Floral zones and correlations of Cretaceous Kukpowruk and Corwin Formations, northwestern Alaska: American Association of Petroleum Geologists Bulletin, v. 53, p. 2079-2093.
- Stricker, G.D., and Roehler, H.W., 1981, Deltaic coals and sediments of the Cretaceous Torok, Kukpowruk, and Corwin Formations in the Kokolik-Utukok region, National Petroleum Reserve in Alaska, in Rao, P.D., and Wolff, E.N., eds., Focus on Alaska's coal '80, Alaska Coal Conference, 2nd, Fairbanks, October 21-23, 1980, Proceedings: University of Alaska Mineral Industry Research Laboratory Report 50, p. 61.
- Tailleur, I.L., and Brosge, W.P., 1976, Coal resources of northern Alaska may be nation's largest, in Focus on Alaska's coal '75: University of Alaska Mineral Industry Research Laboratory Report 37, p. 219-226.
- Warfield, R.S., Landers, W.S., and Boley, C.C., 1966, Sampling and coking studies of coals from the Kukpowruk River area, Arctic northwestern Alaska: U.S. Bureau of Mines Report of Investigations 6767, 59 p.
- Warfield, R.S., and Boley, C.C., 1969, Sampling and coking studies of several coal beds in the Kokolik River, Kukpowruk River, and Cape Beaufort areas of Arctic northwestern Alaska: U.S. Bureau of Mines Report of Investigations 7321, 58 p.