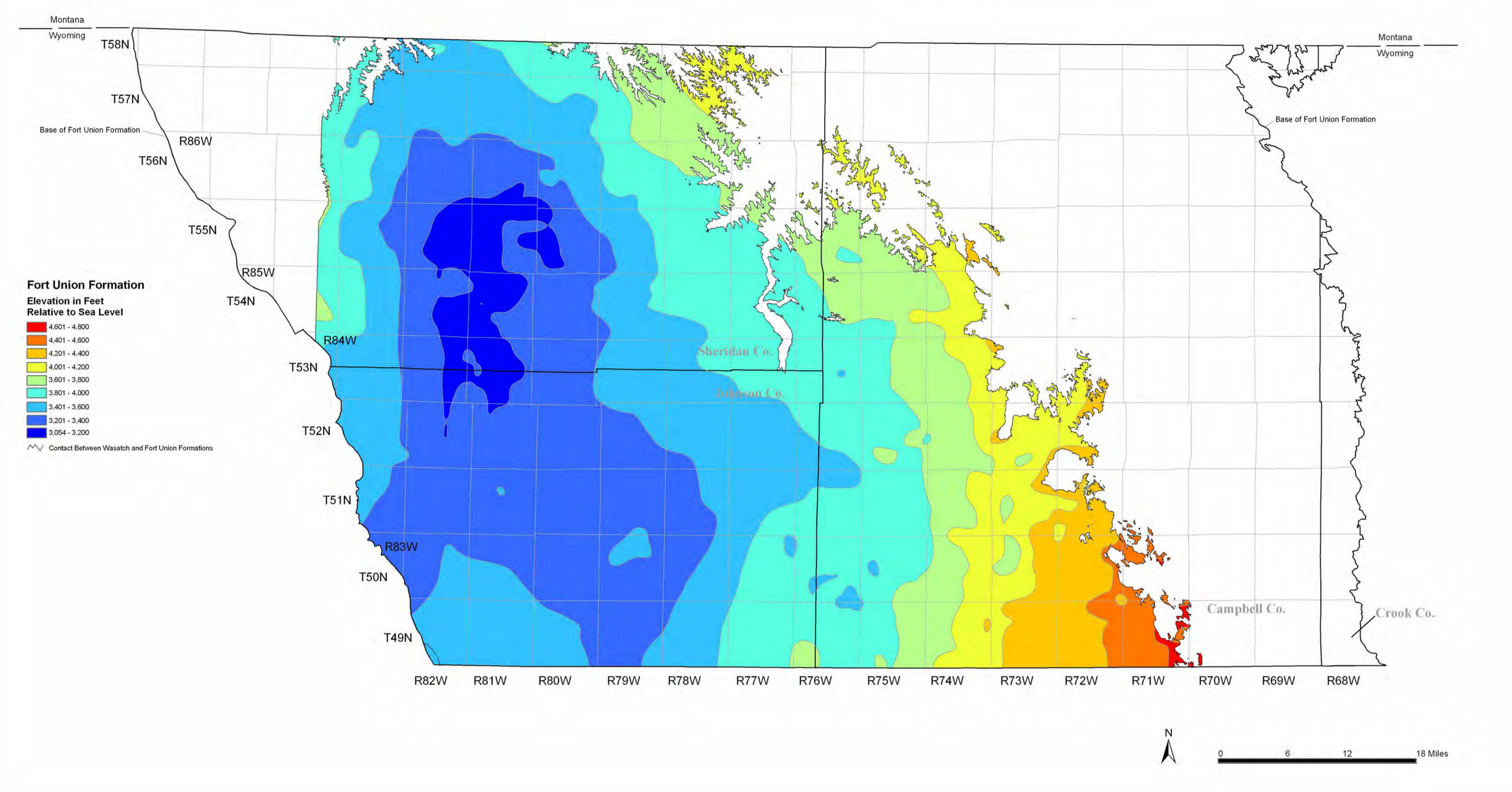


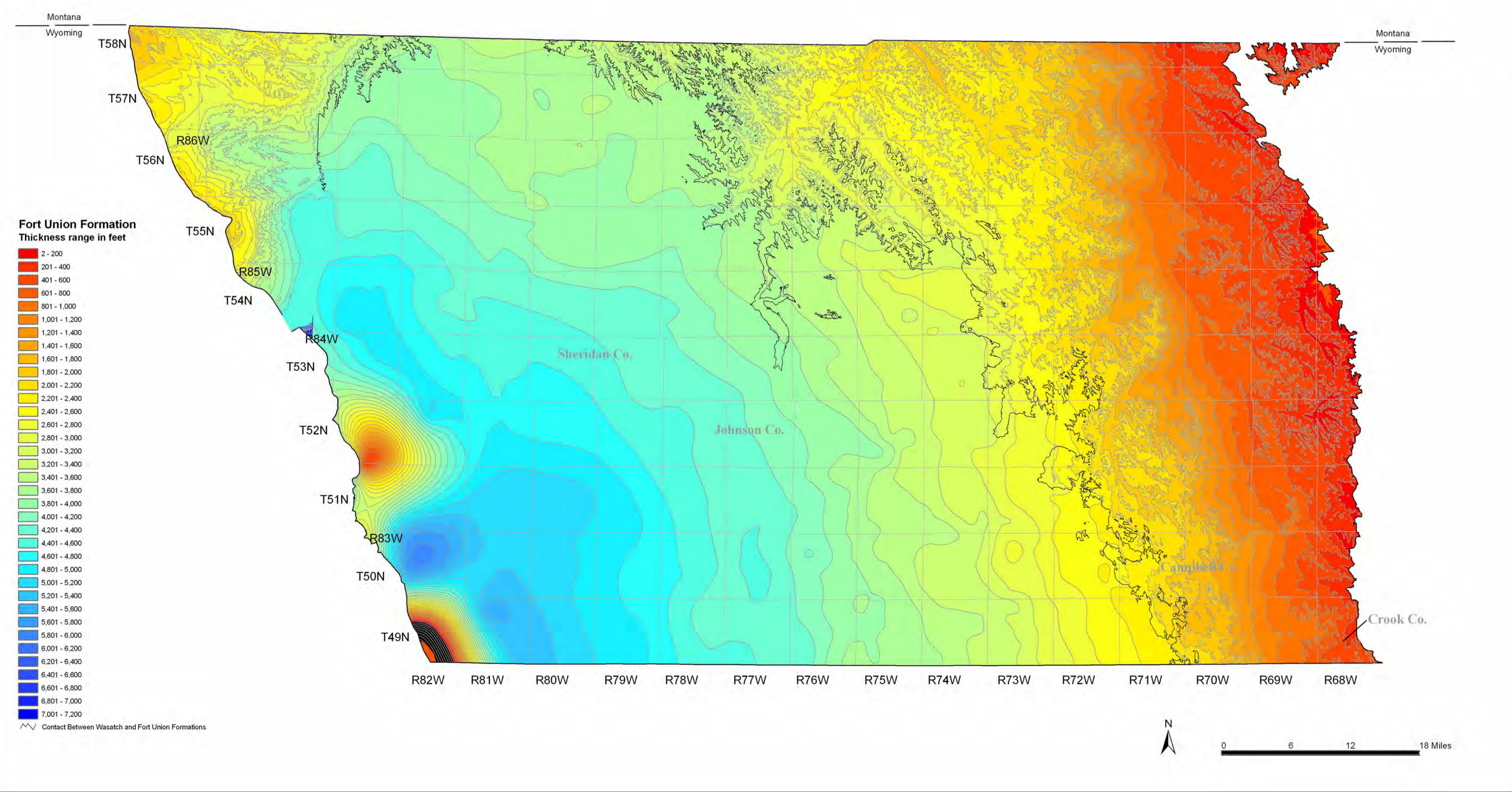
# Structure contour and isopach maps of the Fort Union Formation northern Powder River Basin, northeastern Wyoming

by: Nicholas R. Jones, Robert M. Lyman, Alan J. Ver Ploeg, Rodney H. De Bruin, James C. Case, and Jeffrey C. Baxter  
2003

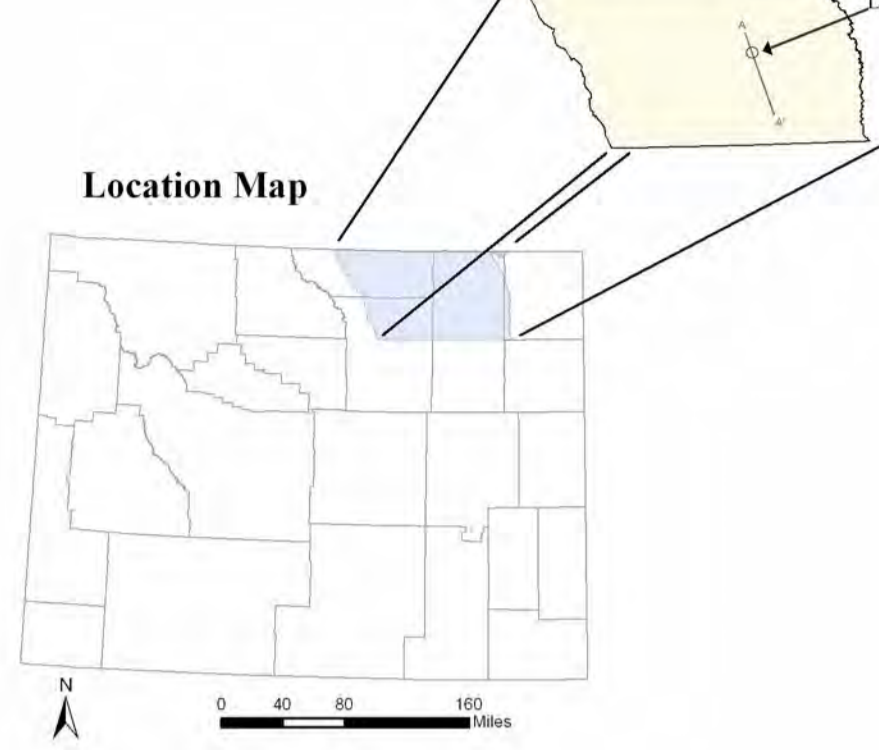
Structure Contour Map, Top of Fort Union Formation



Isopach Map of the Fort Union Formation



Location Map



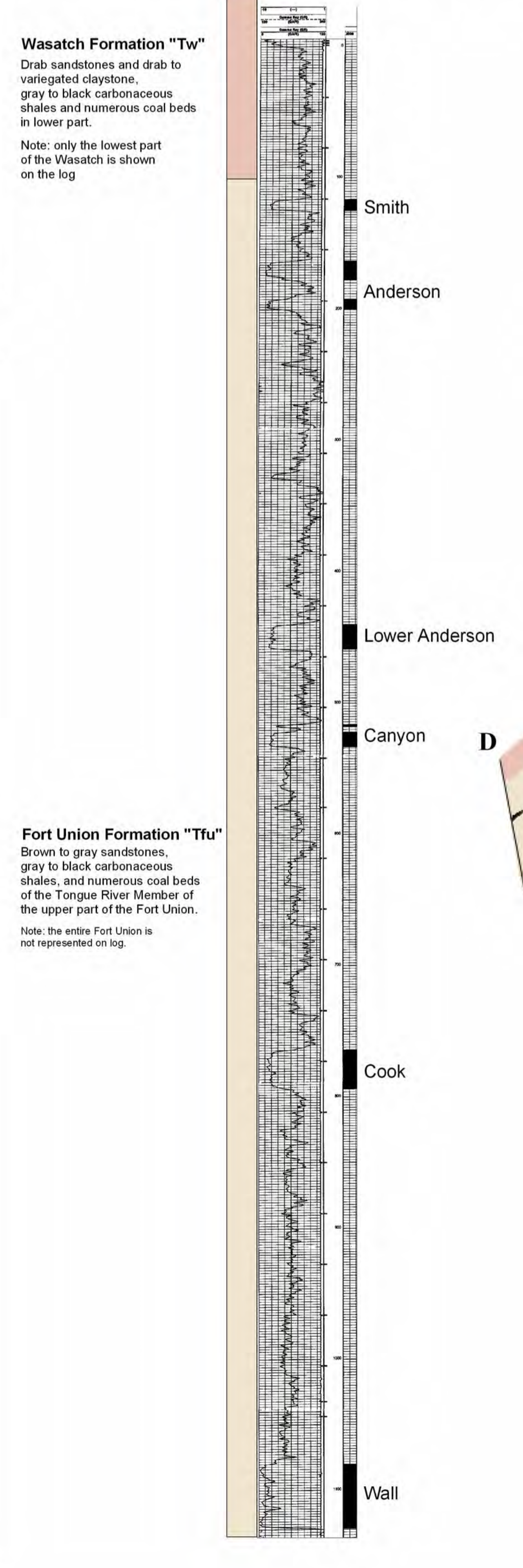
Coordinate System: Lambert Conformal Conic  
GCS\_North\_American\_1983  
Datum: D\_North\_American\_1983  
Prime Meridian: 0

Additional copies of this map can be obtained from:  
Wyoming State Geological Survey  
P.O. Box 3008, Laramie, WY 82071-3008  
Phone: (307) 766-2286 Fax: (307) 766-2605  
E-mail: sales@wsgs.wyo.edu  
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Data Sources:  
Goolsby, Finley & Associates, LLC  
Wyoming Oil & Gas Conservation Commission  
Wyoming State Geological Survey

Special Credits:  
This project was made possible through funding provided by the Wyoming Water Development Commission

Gamma Ray Type Log Illustrating Coal Signatures



**Discussion**

This characterization of the Fort Union Formation is part of a larger study that provides a stratigraphic framework for the Wasatch Formation and its coal beds, the Fort Union Formation and its many coal beds, the Lance Formation, the Fox Hills Sandstone, and the Bearpaw Shale / Pierre Shale. That larger study, when completed, will include information about the water quality of various coal aquifers as well as aquifers in sands in the Wasatch and Fort Union formations. The study will be available from the Wyoming State Geological Survey through the University of Wyoming's Water Resource Data System as an interactive product on the Internet. The present study encompasses approximately 5,450 square miles in the northern Powder River Basin of Wyoming and extends from Township 49N to 58N and from Range 69W to 87W (see Location Map).

The Powder River Basin of northeastern Wyoming and southeastern Montana is a deep, asymmetric, mildly deformed trough that is about 250 miles long and 100 miles wide. This Laramide foreland basin is bordered on the west by the Bighorn Mountains and the Casper arch, on the south by the Laramie Mountains, on the east by the Hartville and Black Hills uplifts, and the north by the Miles City arch in Montana. The axis of the basin trends northwest-southeast as expressed on the structure contour map of the Fort Union Formation. The basin axis is close to the more steeply dipping western margin of the basin. Paleozoic, Mesozoic, and Cenozoic rocks are present in the basin and have a total thickness that exceeds 18,000 feet along the basin's axis.

The Fort Union Formation is early Tertiary (Paleocene) in age and consists of three members, the Tullock Member, Lebo Shale Member, and the Tongue River Member. The lowest member of the Fort Union, the Tullock, is composed of brown iron-stained sandstone ledges interbedded with siltstones and shales. The middle Lebo Shale Member is composed of gray shales interbedded with fine-grained gray siltstones and claystone. Carbonaceous shales, sandstones, and coals dominate the upper Tongue River Member. The coals in the Fort Union range in thickness from a few inches to 225 feet in thickness. The coal is dominantly Subbituminous C in rank (coals containing from 8300 to 9500 Btu's per pound on a moisture-ash-free, (MAF), basis, as received). Some Lignite is present on the periphery of the basin. The massive deposit of coal in the Tongue River is known as the Wyodak coal zone. Because of the complex nature of a fluvial-dominated depositional environment, the Tongue River coals exhibit a dynamic nature of rapidly thickening and thinning. Drill hole data, in the form of geophysical logs, shows the existence of an ancient braided river system that bisects the massive coal deposit, causing splitting and applying within the extensive coal deposit (see Schematic Cross Section A-A' and Fence Diagram Below).

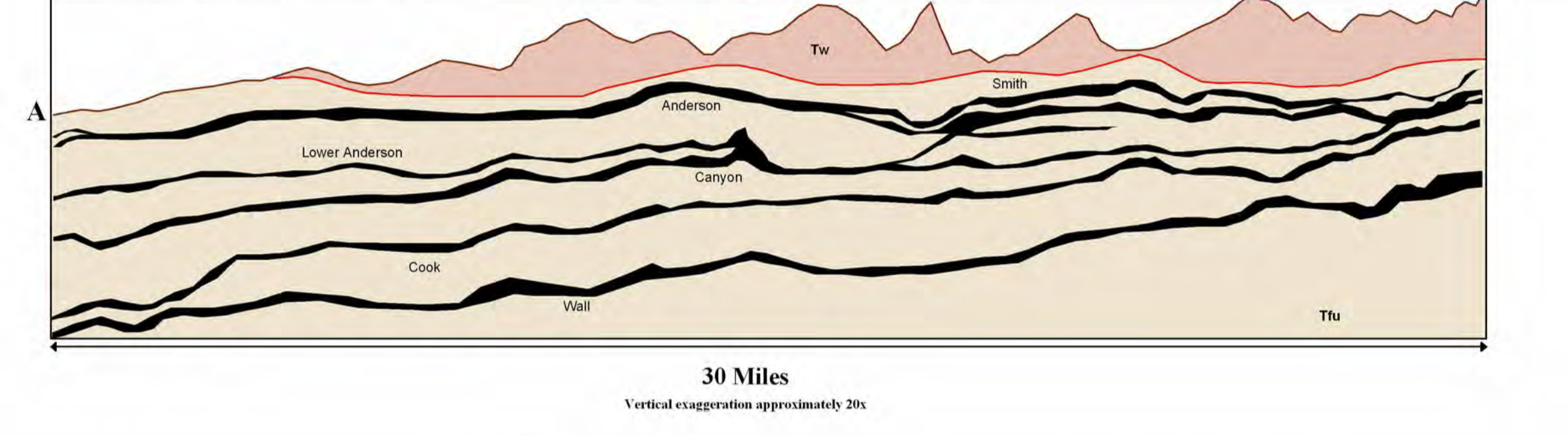
The Wyodak coal zone is the most important coal deposit in the U.S. for its exploitable resources; it is mined and supplies the fuel to generate approximately 35% of the nation's coal-fired electricity. The Tongue River Member also contains the lion's share of recoverable coalbed methane resources in the Wyoming part of the Powder River Basin, currently estimated to be 25.2 TCF (trillion cubic feet).

The Fort Union is overlain unconformably by the Eocene Wasatch Formation. The Wasatch is composed of tan to light-gray fine sandstones, shales, and lenticular lenses of conglomeratic sandstones. In some places a marker bed of coquina limestone and / or conglomeratic sandstone marks the contact between the Wasatch and the Fort Union (Hose, 1955). The Fort Union Formation conformably overlies the Late Cretaceous, nonmarine Lance Formation. The Lance - Fort Union contains (or Cretaceous - Tertiary, designated K-T) a very thin layer of material containing ash and shocked quartz that was deposited as the result of a bolide impact.

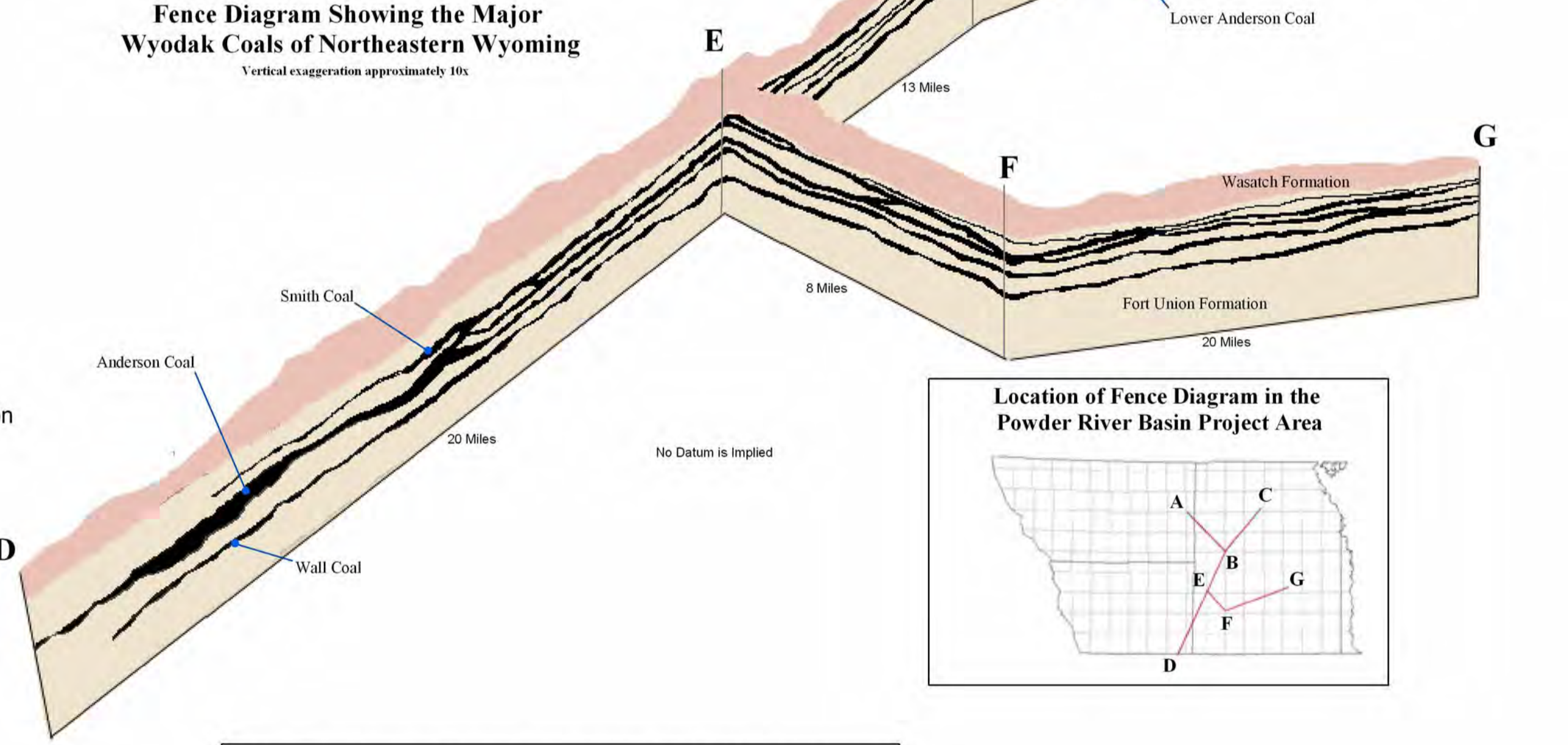
The Fort Union structure contour map was constructed by utilizing previously established relationships between coals in the upper Fort Union and lower Wasatch formations (e.g., the Felix coal bed resides approximately 275 feet above the base of the Wasatch ), mainly because the Fort Union - Wasatch contact as defined above cannot be picked from geophysical logs.

The structure contour map for the Fort Union is only shown for areas where it is overlain by the Wasatch Formation. Outside this area, the top of the Fort Union has been removed by erosion. Similarly, the isopach map of the Fort Union outside the areas where it is overlain by the Wasatch only represents the present, or remaining thickness after erosion.

Schematic Cross Section A-A' Showing Major Coals of the Fort Union Formation



Fence Diagram Showing the Major Wyodak Coals of Northeastern Wyoming



Major Coal Beds in the Tongue River Member of the Fort Union Formation in the northern Powder River Basin

| Formation  | Coal Zone                    | Eastern Coals (Roland)                                    | Western Equivalents (Roland (Baker) Roloff (Tul)) |
|------------|------------------------------|---|---|
| Fort Union | Wyodak Rider Coal Zone       | Smith   | Smith   |
| Fort Union | Upper Wyodak Coal Zone       | Anderson, Lower Anderson, Canyon                          | Dietz 1, Dietz 2, Dietz 3                         |
| Fort Union | Lower Wyodak Coal Zone       | Cook, Gates, Wall B, Wall C, Wall D, Pounce, Lower Pounce | Monarch, Casco                                    |
| Fort Union | Knobloch Coal Zone           | Moyer, Lower Moyer  |   |
| Fort Union | Sawyer Coal Zone             | (Unnamed Local)   | Dunbar  |
| Fort Union | Basal Tongue River Coal Zone | Tarot, Burke, Browder                                     |   |

**References:**

Hose, R. K., 1955. Geology of the Crazy Woman Creek area Johnson County, Wyoming. U.S. Geological Survey Bulletin 1027-B. 75 p.

Pierce, F. W., Johnson, E. A., Molina, C. L., Sigleo, W. R., 1990. Cross sections showing coal stratigraphy of the southeastern Powder River Basin, Wyoming. U.S. Geological Survey Miscellaneous Investigations Series Map I-1959-B, sheet 2.