Chapter SW

A SUMMARY OF TERTIARY COAL RESOURCES OF THE WIND RIVER BASIN, WYOMING

By R.M. Flores and C. W. Keighin

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INTRODUCTION

Coal in the Wind River Basin of Wyoming is mainly found in the Paleocene Fort Union Formation and subordinately in the Eocene Wind River Formation (figs. SW-1 and SW-2). These deposits have low importance in the current National Coal Resource Assessment because it is improbable they will be utilized in the next 20-30 years. This report is a brief summary of the geology, occurrence, quality, production history, and coal-bed methane potential of Fort Union coal. Coal in the Wind River Formation will not be assessed because it is generally less than 1 ft thick (Thompson and White, 1952; Glass and Roberts, 1978; Thaden, 1978, 1979, 1980a-c; Gregory and others, 1991).

STRATIGRAPHY

Figure SW-3 illustrates the general stratigraphy of the Fort Union Formation (using the terminology of Keefer, 1965) in the Wind River Basin. Isolated and widely scattered outcrops of Fort Union coal are found along the margins of the basin (Keefer, 1965; Glass and Roberts, 1978; Nuccio and Finn, 1994). The Fort Union Formation outcrops (fig. SW-1) include minor amounts of coal; the coaly facies is almost entirely in the subsurface (Johnson and others, 1994). Thompson and White (1952) report four coal beds, ranging in thickness from 2 to 3 ft, in the subsurface in the northwestern part of the basin. Outcrops of thin coal beds (a few inches to 2 ft thick) are in the Jenkins Mountain, Shotgun Butte, Little Dome, Hudson, and Signor Ridge areas (Flores and others, 1992; Flores and Keighin, 1993; Flores and others, 1993). Outcrops of thicker coal beds (as much as 15 ft thick) are in the Castle Gardens and Coal Bank Hills areas (Flores and others, 1992; Flores, 1997). Coal

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beds are contained in the lower member and Shotgun Member of the Fort Union Formation. (This terminology follows Keefer, 1965; "lower member" is an informal term). A cross-section (A-A') of the lower member and associated thick coal beds (5-15 ft thick) in the Castle Gardens areas is shown in figure SW-4 (modified from Flores and others, 1992).

DESCRIPTION OF COAL ZONE

The Paleocene Fort Union Formation is considered a minor coal-bearing formation in the Wind River basin; exposed coal is uncommon and thin, seldom reaching 3 ft in thickness (Hogle and Jones, 1991). Woodruff and Winchester (1912) reported a 4.5-ft-thick Paleocene coal bed near Castle Gardens (fig. SW-5). However, Johnson and Flores (1993), using geophysical logs, report that the Fort Union Formation contains, in aggregate, more than 100 ft (net total) of coal in the western part of the Wind River Basin. One coal bed in this coal zone is as much as 40 ft thick. Recent work by Flores and others (1992), Flores and Keighin (1993), and Flores (1997) shows coal beds 5-15 ft thick that are more than 2 mi in lateral extent.

A total net coal thickness isopach map of the lower member of the Fort Union Formation, modified from Johnson and others (1994) to include coal-bed thickness measurements from outcrops by Flores and others (1992), Flores and Keighin (1993), Flores and others (1993), and Flores (1997), is shown in figure SW-5. Lithofacies and coal-bed distribution in the Fort Union Formation along a south to north cross section (B-B') are shown in figure SW-6. The ovoid areal distribution of the lower member coal beds across the east-central part of the Wind River Basin was influenced by interchannel swamps related to east-northeast-flowing fluvial systems. A total (net) coal thickness isopach map of the Shotgun Member is shown

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in figure SW-7; lithofacies and coal-bed distribution are illustrated in cross section C-C' (fig. SW-8). The elongate areal distribution of the Shotgun Member coal beds across the west-central part of the basin was controlled by shoreline transgression accompanied by coastal regression of Waltman Lake.

COAL QUALITY

Tertiary coal in the Wind River Basin is generally considered to be subbituminous, but no analyses are available to verify its rank or coal quality (Glass and Roberts, 1978; Glass, 1981). Thermal maturity levels (Ro = 0.36-0.55%) of surface samples of Fort Union coal on the periphery of the basin are consistent with subbituminous rank (fig. SW-9; Nuccio and Finn, 1994). Thermal maturity levels of Fort Union coal may reach levels consistent with high volatile A bituminous rank (Ro as much as 0.99%) in deeper parts of the basin (Nuccio and Finn, 1994; Nuccio and others, 1996; Rice, 1993).

ORIGINAL RESOURCES

Because of limited, no resource calculations have been made of potential coal resources in the Fort Union Formation in the Wind River Basin.

PRODUCTION HISTORY

Coal mining in the Wind River Basin apparently started in approximately 1870, but Tertiary coal appears to have mined only from the Arminto field (T. 34 N., R. 90

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W., sec. 4) in about 1900. There is apparently no record of the amount of coal produced, but the quantity was probably very limited and for local use only.

COAL-BED METHANE

Tertiary coal of the Wind River Basin at depths less than 1,000 ft is normally of low rank and exhibits none of the maturation characteristics needed for significant methane generation (Rieke and Kirr, 1984). Coal-bed gases found in the structurally shallow areas of the basin (for example, within the Wind River Indian Reservation) are mixtures of biogenic and thermogenic gases. These coal beds are immature and were never buried deeply enough to have generated significant quantities of thermogenic gas. The thermogenic component may have migrated into the coal from a deeper, more thermally mature source sometime after the coal was buried in Paleocene time (Johnson and Rice, 1993).

Nuccio and Finn (1994) reported thermal maturity levels of the Fort Union Formation vary from very immature (0.29% Ro) in outcrops (Nuccio and others, 1993) in the southern part of the basin, to mature (0.99% Ro) for the lower unnamed member in the deeper part of the basin. The higher level of thermal maturity is sufficient to generate thermogenic gas. Less-thermally mature coal (Ro < 0.6%) in shallow parts of the basin may serve as a source of biogenic gas. A summary of thermal maturity data available to the base of the Paleocene Waltman Shale Member of the Fort Union Formation shows the potential for thermogenic gas generation in the northern and central part of the Wind River Basin and biogenic gas in the southern and eastern part (fig. SW-8). Jones and de Bruin (1990), however, consider Tertiary Fort Union coal in the Wind River Basin to be too deeply buried to be a target for coal-bed methane production.

CONCLUSIONS

Fort Union coal is not economically minable today because the thick deposits are found only in the deep parts of the Wind River Basin, and they are not high enough in quality (based on normal Tertiary coal quality) to warrant development of large underground mines. However, thermogenic and biogenic gases from the Fort Union coal in the deep and shallow parts of the basin may serve as potential coal-bed methane resources. Much of the infrastructure for coal-bed methane transportation, such as gas pipelines, is in place in the basin. Rail systems for coal transportation from areas where the thickest coal accumulations exist is not available.

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_____1980a, Geologic map of the Birdseye Pass quadrangle, showing chronolithofacies and coal beds in the Wind River Formation, Fremont and Hot Springs Counties, Wyoming: U.S. Geological Survey Geologic Quadrangle Map GQ-1537, scale 1:24,000.

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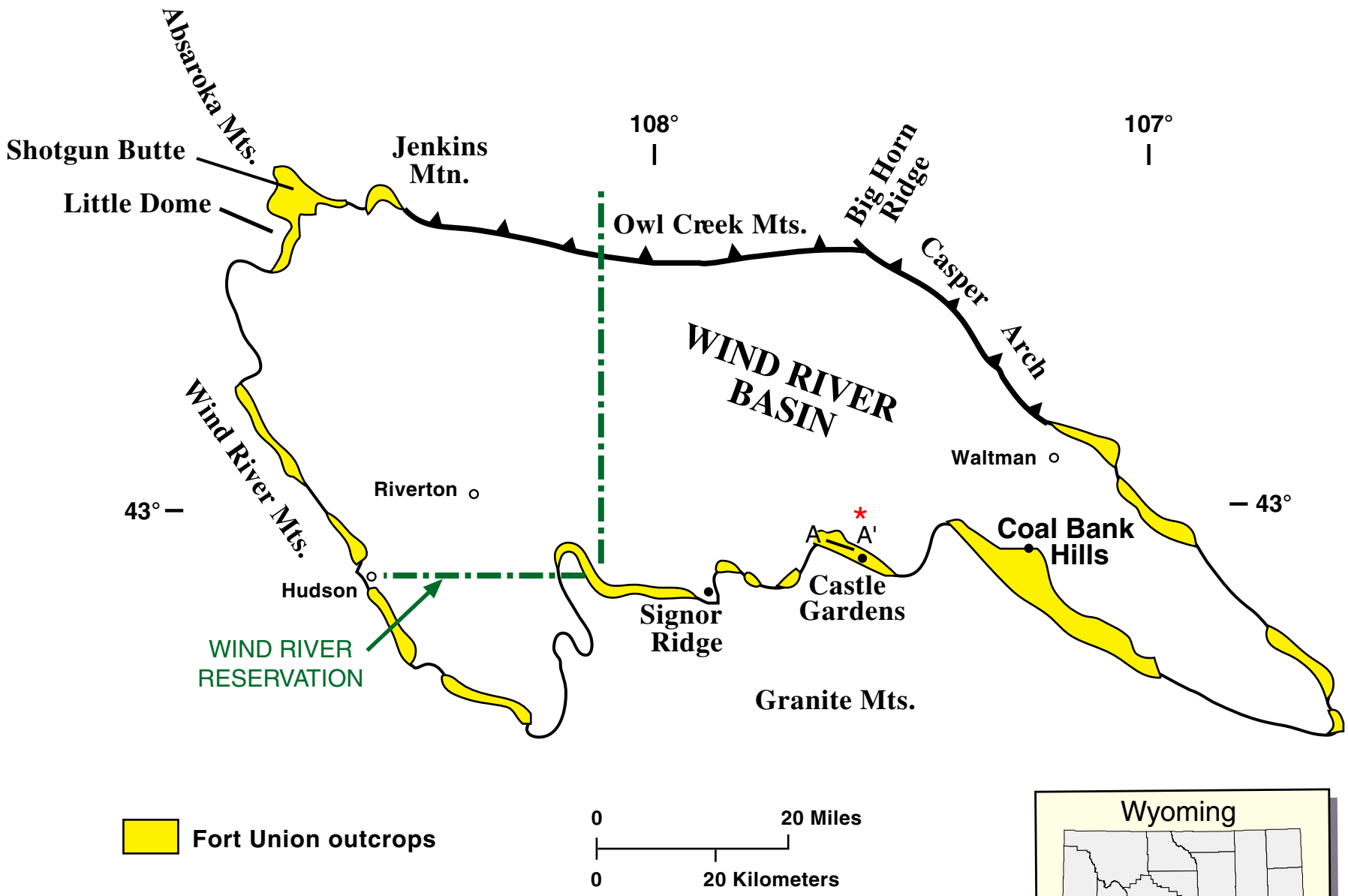

Figure SW-1. Map showing locations of outcrops of the Fort Union Formation on the periphery of the Wind River Basin, Wyoming. Approximate location of very limited mining of Fort Union coal from the Arminto field around the year 1900 is marked by *. Section A-A' is shown in figure SW-4.

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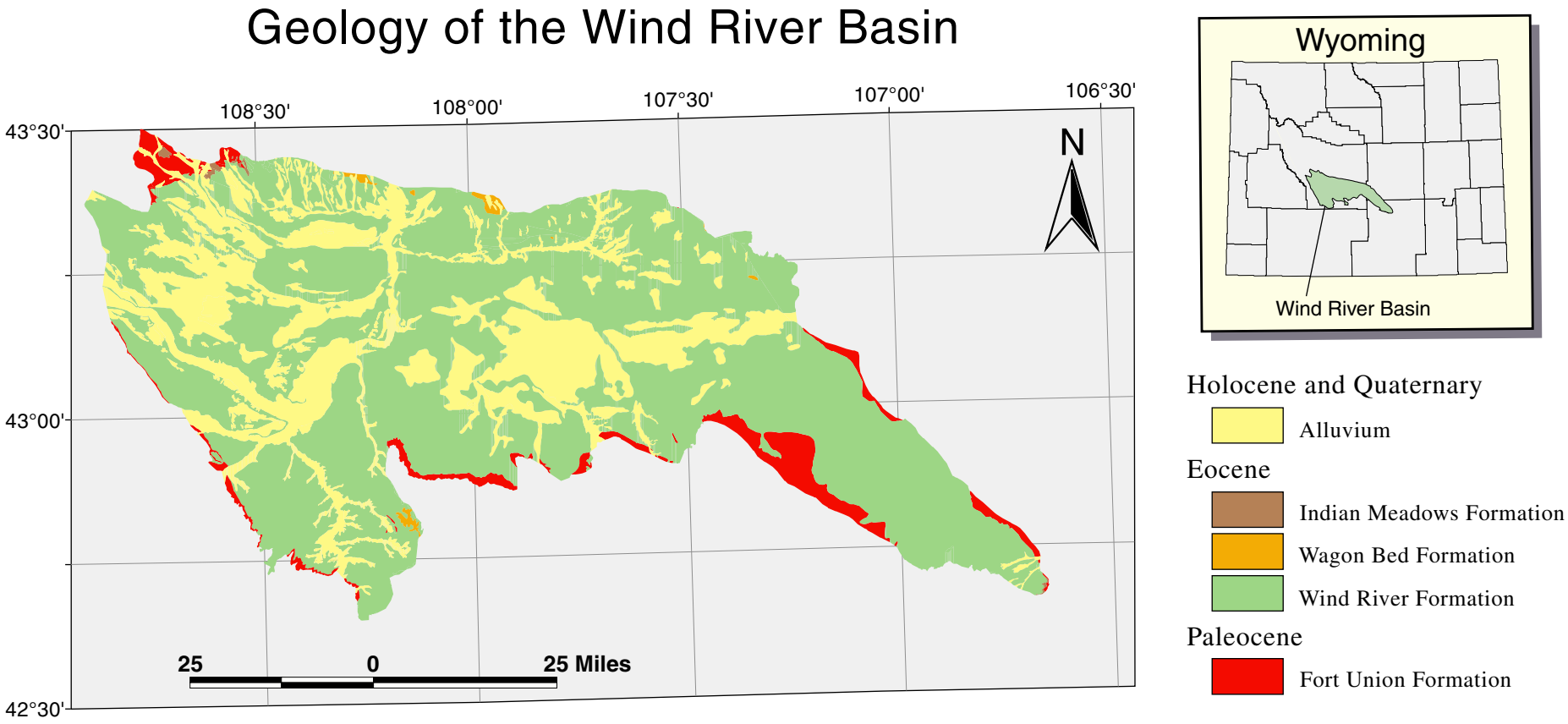

Figure SW-2. Generalized geologic map of the Wind River Basin showing distribution of Tertiary rocks. Adapted from Green and Drouillard, (1994).

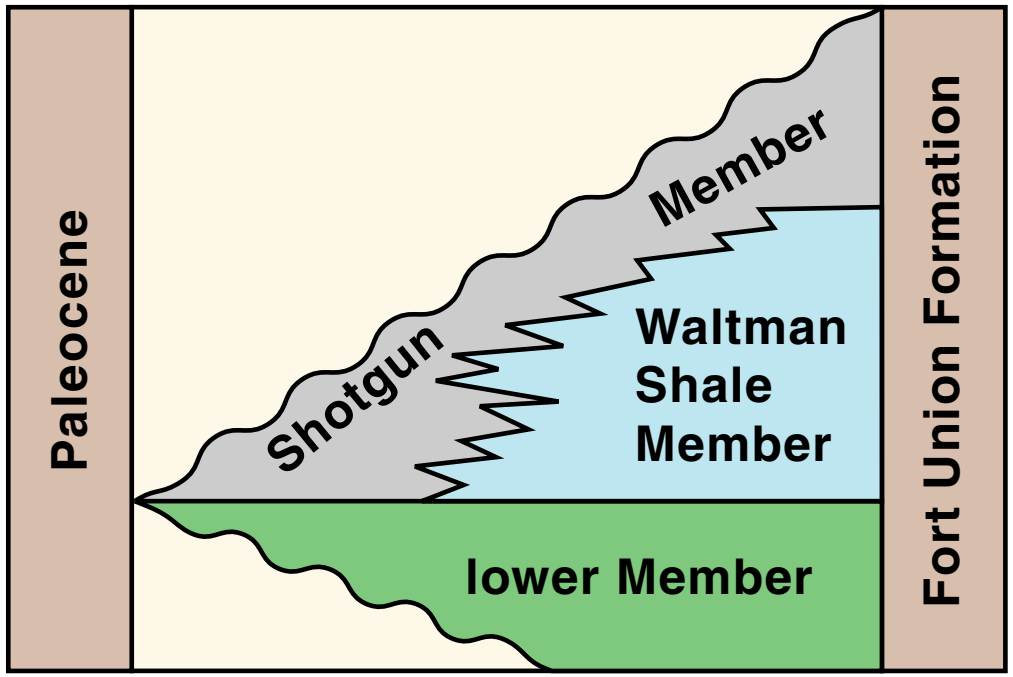

Figure SW-3. Generalized stratigraphic chart for the Paleocene Fort Union Formation, Wind River Basin. The term "lower member" is informal.

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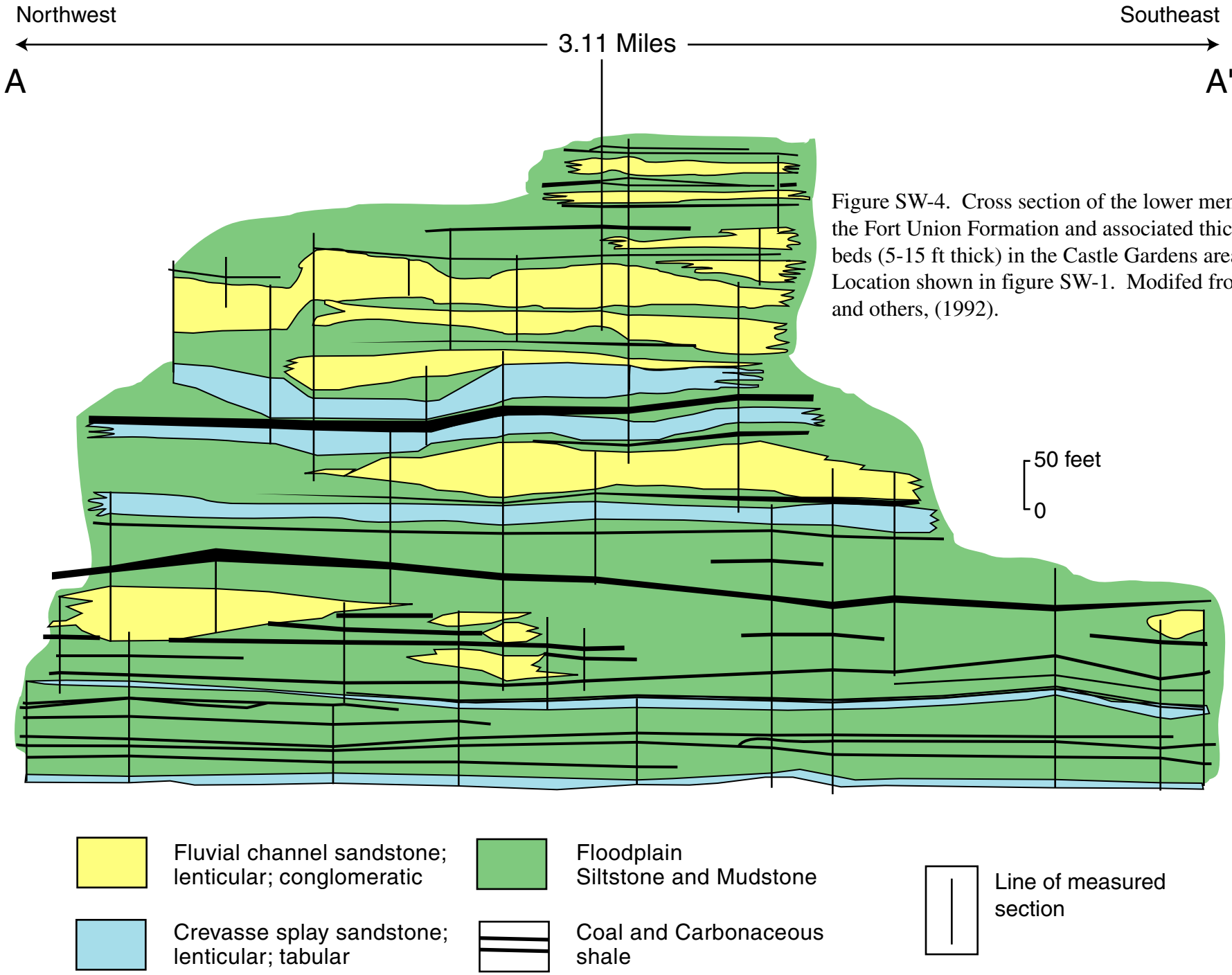

Figure SW-4. Cross section of the lower member of the Fort Union Formation and associated thick coal beds (5-15 ft thick) in the Castle Gardens area. Location shown in figure SW-1. Modifed from Flores and others, (1992).

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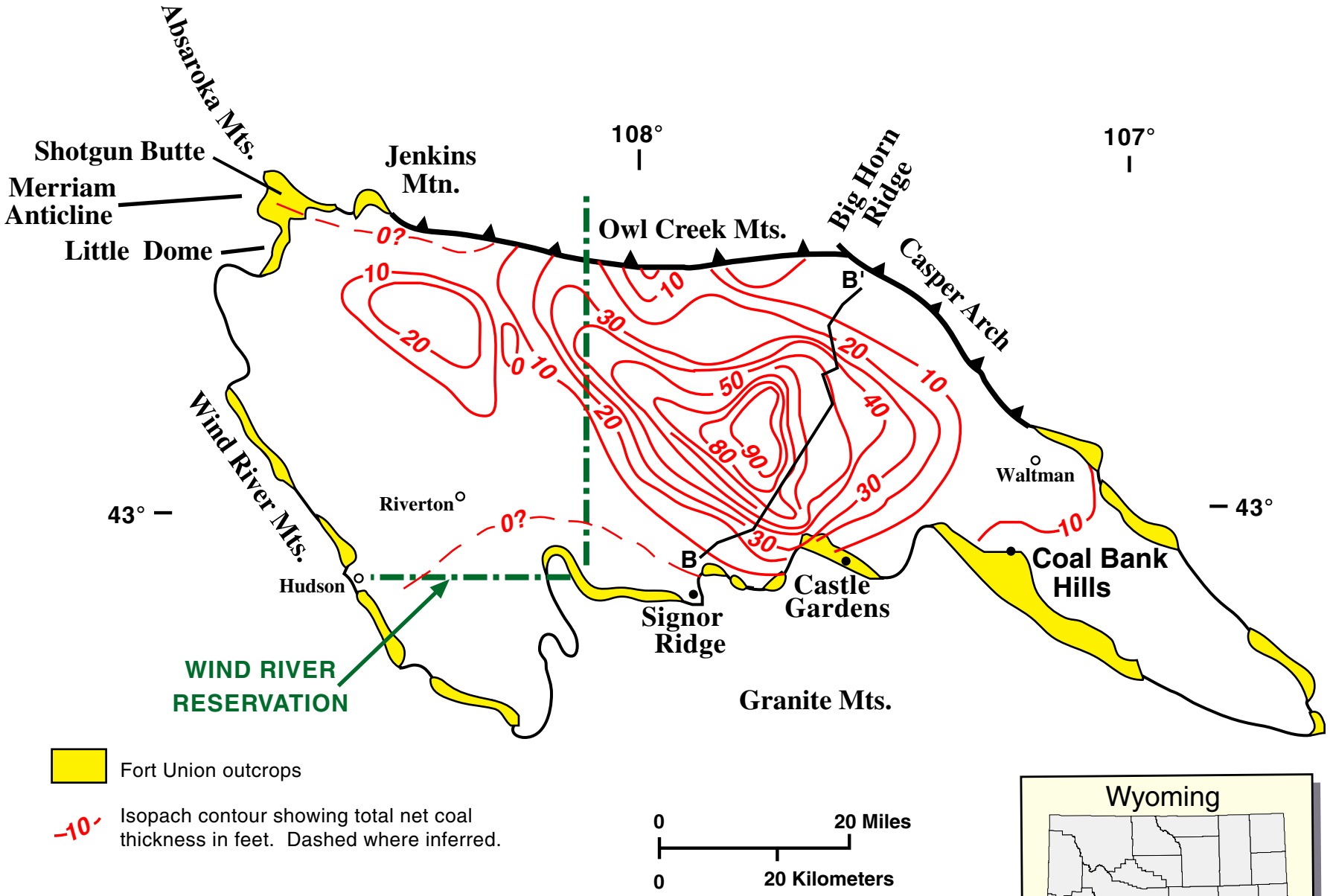


Figure SW-5. Total net-coal-thickness isopach map of the lower member of the Fort Union Formation (modified from Johnson and others, 1994) that includes coal-bed thickness measurements from outcrops (Flores and others, 1992, 1993; Flores and Keighin, 1993; Flores, 1997). Lithofacies and coal-bed distribution along a south to north cross section are illustrated in figure SW-6.

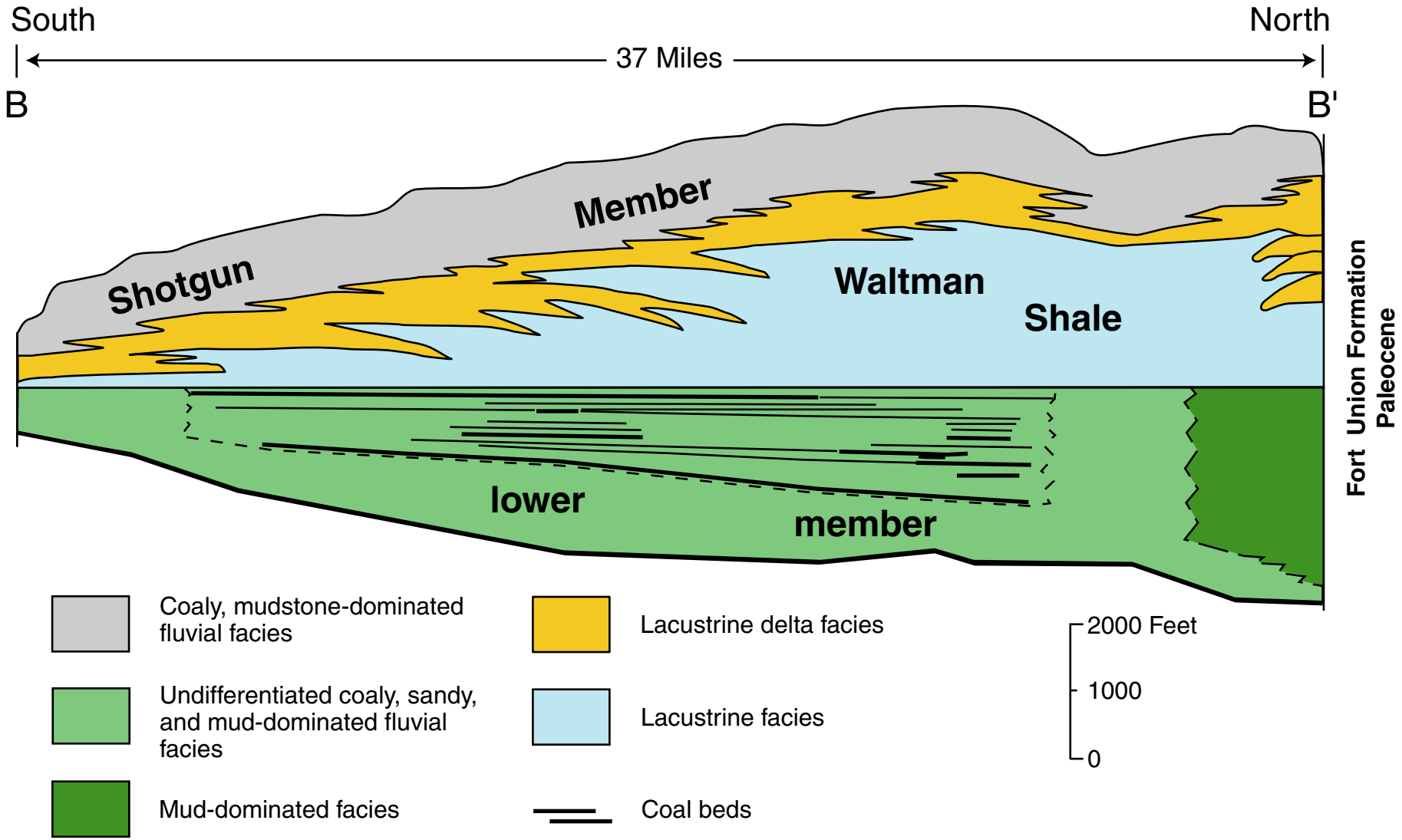


Figure SW-6. Lithofacies and coal distribution in the Fort Union Formation along a south to north line (see fig. SW-5) across the Wind River Basin.

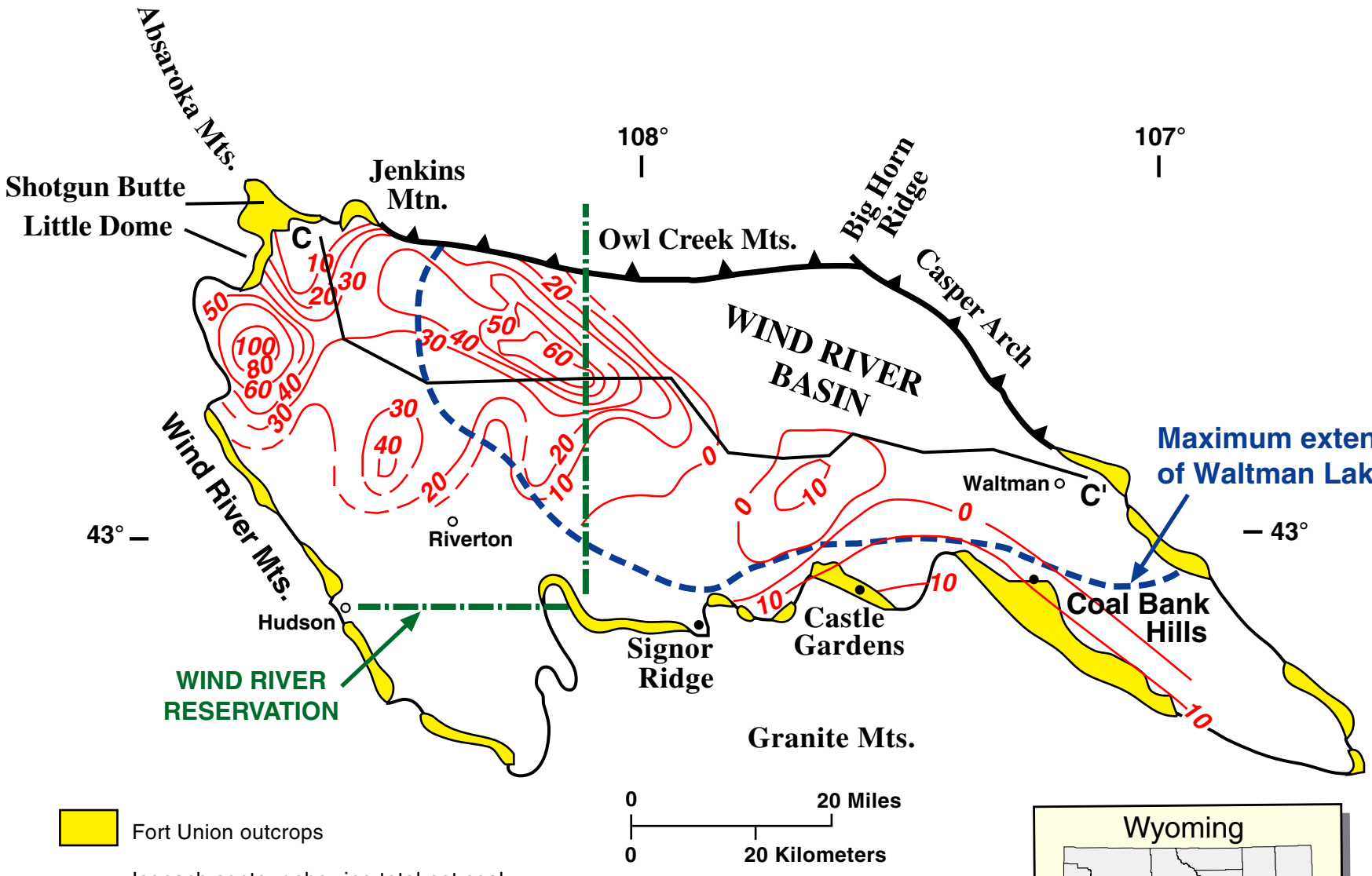


Figure SW-7. Total net-coal thickness of the Shotgun Member, Fort Union Formation, Wind River Basin. Lithofacies and coal-bed distribution are shown in figure SW-8.

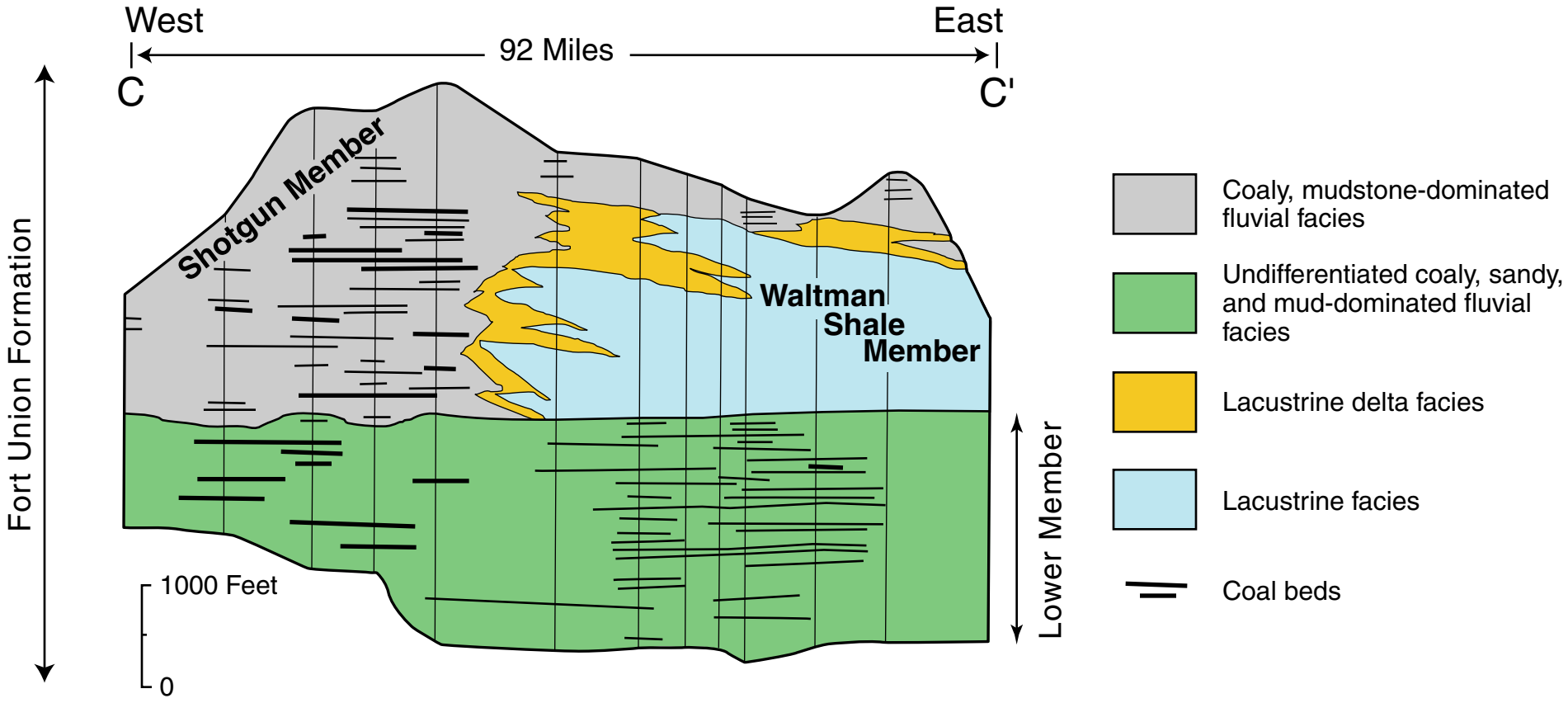
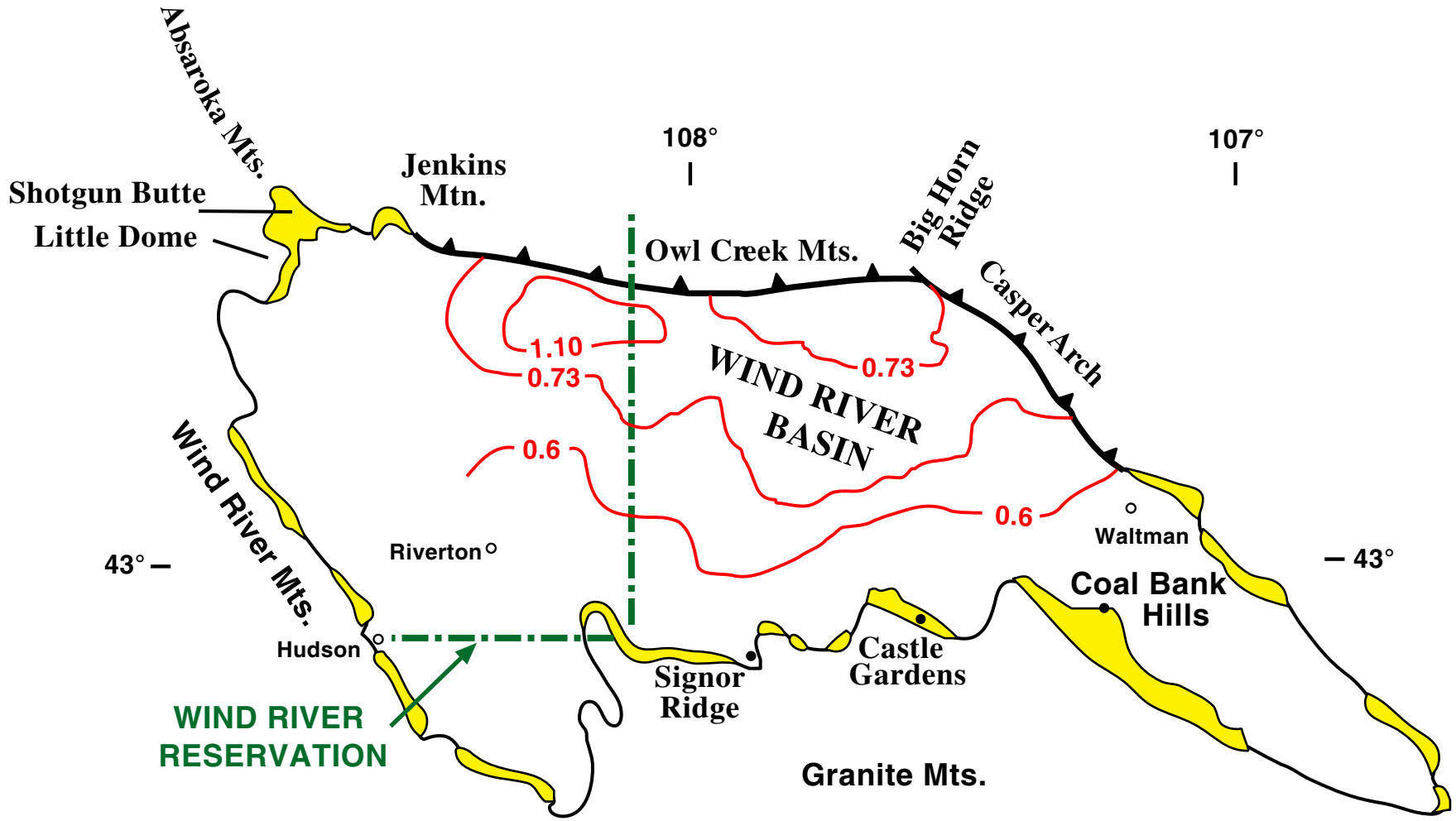


Figure SW-8. Lithofacies and coal distribution in the lower member and Shotgun Member of the Fort Union Formation along a west to east cross section, Wind River Basin. Location shown on figure SW-7.



Fort Union outcrops

0.6 Thermal maturity expressed as vitrinite reflectance levels (Ro)

0 20 Miles

0 20 Kilometers

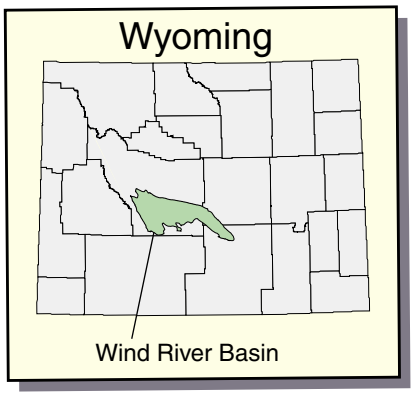


Figure SW-9. Summary of thermal maturity data to the base of the Paleocene Waltman Shale Member of the Fort Union Formation, Wind River Basin. Modified from Nuccio and others, (1996).