

## Chapter 6

# **Fischer Assay Histograms of Oil-Shale Drill Cores and Rotary Cuttings from the Great Divide, Green River, and Washakie Basins, Southwestern Wyoming**

By Michael E. Brownfield, Jesse G. Self, and Tracey J. Mercier

Chapter 6 of 6

## **Oil Shale Resources of the Eocene Green River Formation, Greater Green River Basin, Wyoming, Colorado, and Utah**

By U.S. Geological Survey Oil Shale Assessment Team

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# Fischer Assay Histograms of Oil-Shale Drill Cores and Rotary Cuttings From the Great Divide, Green River, and Washakie Basins, South-Central Wyoming

By Michael E. Brownfield, Jesse G. Self, and Tracey J. Mercier

## Abstract

This chapter was originally published as chapter 2 of U.S. Geological Survey Open-file Report 2008–1152. It has been slightly modified so that references to the original report are clarified, and some minor phrasing was updated. This chapter presents oil yield histograms of samples of drill cores and cuttings from exploration holes drilled in the Eocene Green River Formation in the Great Divide, Green River, and Washakie Basins of southwestern Wyoming. A database was compiled that includes about 47,000 Fischer assays from 186 core holes and 240 rotary drill holes. Most of the oil yield data was analyzed by the former U. S. Bureau of Mines oil shale laboratory in Laramie, Wyoming, with some analyses made by private laboratories. Location data for 971 Wyoming oil shale drill holes are listed in a spreadsheet and included in this report.

These Wyoming Fischer assays and histograms are part of a much larger collection of oil-shale information including geophysical and lithologic logs, water data, chemical and X-ray diffraction analyses of the Green River oil-shale deposits in Colorado, Utah, and Wyoming held by the U.S. Geological Survey. Because of an increased interest in oil shale this report containing Fischer assay data and oil-yield histograms for the Green River oil-shale deposits in southwestern Wyoming is being released to the public.

Microsoft Excel spreadsheets included with this chapter contain the Fischer assay data from the 426 holes and data containing the company name and drill-hole name, and the drill-hole location. Histograms of the oil yields obtained from the Fischer assays are presented in both Grapher and PDF format.

Fischer assay text data files are also included in the chapter folder.

## Introduction

For several decades, the U.S. Geological Survey (USGS) has collected drill cores and cuttings and subsurface data from

bore holes drilled in the Eocene Green River Formation oil-shale deposits in the Great Divide, Green River, and Washakie Basins of Wyoming (fig. 1). These core hole and cuttings data were collected and preserved for use by researchers and industry in anticipation of the time when Green River oil-shale deposits would become an economic alternate source of fossil energy.

In Wyoming, the Green River Formation (fig. 2) was deposited in Lake Gosiute during the early to middle Eocene. The richest oil-shale deposits are in the Wilkins Peak Member, Tipton Shale Member, and Laney Member (Roehler, 1992). As many as 77 persistent beds of oil shale were identified in the Wilkins Peak Member by Roehler (1992).

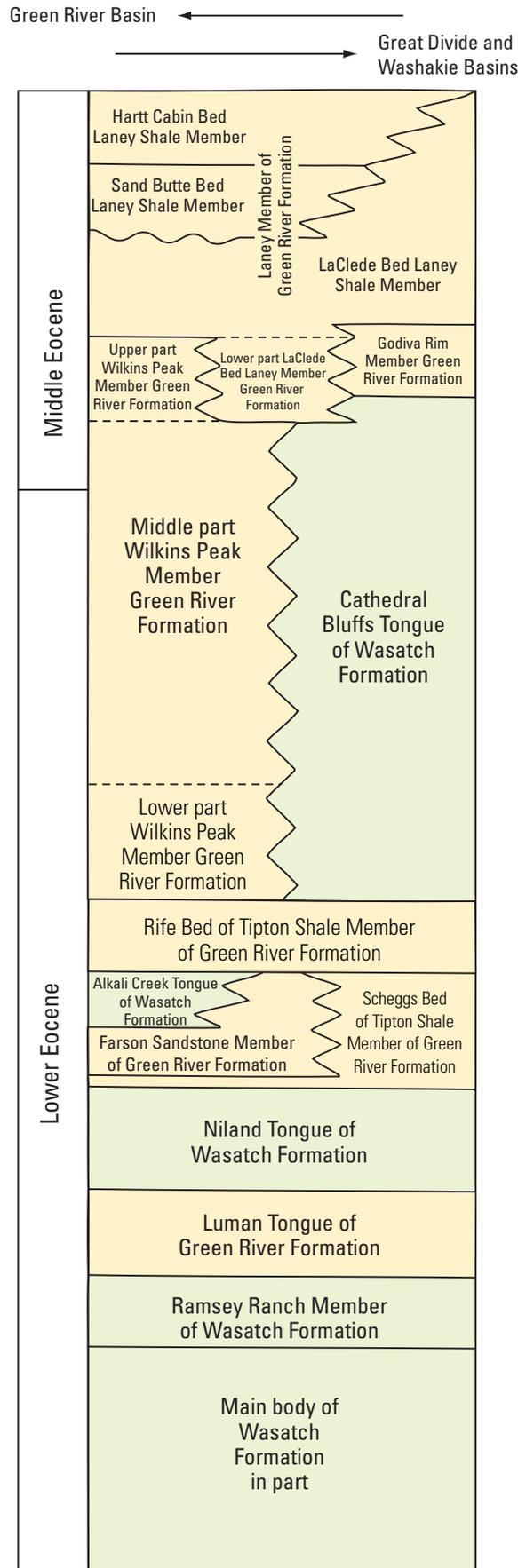
The types of data collected include: (1) thousands of Fischer (shale-oil) assays (American Society for Testing and Materials, 1980) of core holes and cuttings from rotary-drilled holes; (2) geophysical and lithologic logs of drill holes; (3) chemical, water-quality, and X-ray diffraction analyses; (4) rock mechanics data; and (5) other types of information. Fischer assay data and histograms for 426 drill holes, of which 186 were cored, are included in this report. Figure 3 shows the general locations of these drill holes and 481 drill holes without analyzed samples. More than 47,000 samples were analyzed. Although this collection of data is far from complete, it most likely represents the largest single source of subsurface information on the Green River Formation oil-shale deposits in southwestern Wyoming.

Most of the Fischer assays on oil-shale samples were analyzed by the former U. S. Bureau of Mines (USBM) laboratory in Laramie, Wyoming (Dyni, 1998), but some analyses are from private laboratories. From the late 1940s to the early 1980s, the USBM analyzed core splits and drill cuttings from holes drilled by Federal agencies and by private industry in the Green River Formation oil-shale deposits in Wyoming, Colorado, and Utah. A large amount of data for exploratory holes drilled in the Green River Formation was also obtained from energy companies that hold private or leased oil-shale lands in the region. Many of these companies generously donated analytical data as well as drill cores and cutting samples that are being stored by the USGS.

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**Figure 1.** Boundary of the Greater Green River Basin in red and the Green River, Great Divide, Washakie and Sand Wash Basins, counties, and major structures and uplifts in Wyoming, Colorado, and Utah. Modified after Finn and others (2005).



**Figure 2.** Lower and middle stratigraphic units in the Green River, Great Divide, and Washakie Basins, Wyoming, Colorado, and Utah. Eocene oil-shale bearing Green River Formation shown in tan. Modified from Roehler (1992).

## Report Chapter

This chapter is divided into five folders: Assays, Histograms, Images, Spatial, and Spreadsheets. The Assays folder contains column-delimited and text files for 426 holes with Fischer assay data. Drill-hole name, location, and operator data for each hole are in record 1. Definitions for data fields included in these files can be found in table 1 and Dyni and others (2008). The Histogram folder contains plot files for the Fischer assay oil-yield data in Adobe PDF format (Adobe Systems, Inc., San Jose, Calif.). Spatial data are included in the chapter 6 folder (Spatial folder) for these drill holes and 481 holes that have no analyzed samples. The majority of the locations were digitized in ArcGIS v. 9.1 (ESRI, Redlands, Calif.) based on footage measurements east and west of Public Land Survey System (PLSS) section corners contained in the original database. A custom tool that combined the distance and sketch tools was used to measure and plot points. Source PLSS files used for plotting locations were obtained from Wyoming BLM and projected to North American Datum 27 (NAD27). Where footage measurements were not available, the location was digitized in the center of the quarter-quarter section, quarter section or the center of the section. In short, the best location data available in the original database were used. In a minimal number of cases where location data in the original database were questionable, locations were verified using the State of Wyoming Oil and Gas Conservation Commission’s online database (<http://wogcc.state.wy.us>). The Spreadsheets folder includes two Microsoft EXCEL spreadsheets ([WY\\_Borehole\\_Info.xls](#); [WY\\_Oil\\_Shale\\_Assays.xls](#)) and one Microsoft Access database ([Wy\\_Oil\\_Shale\\_Assays.mdb](#)).

The WY\_Oil\_Shale\_Assays.xls spreadsheet includes 47,003 assays from the original laboratory assay reports, such as those shown as images in the Images folder found in the chapter 6 folder, this report. The WY-Borehole\_Info.xls spreadsheet contains information for 971 core and rotary holes and oil and gas tests, as well as a few surface sections of oil shale. The file includes well locations, operator and well name, elevation, core location when known, depths of lithologic log units, geophysical logs, and other data. The approximate locations of 906 drill holes included in the assay data file are shown in figure 3.

The Fisher assay data (Assay folder) are included in this chapter in spreadsheet format (WY\_Oil\_Shale\_Assays.xls). In a few cases, there are two data sets listed for the same drill-hole number in the spreadsheet. Rotary-drilled holes are

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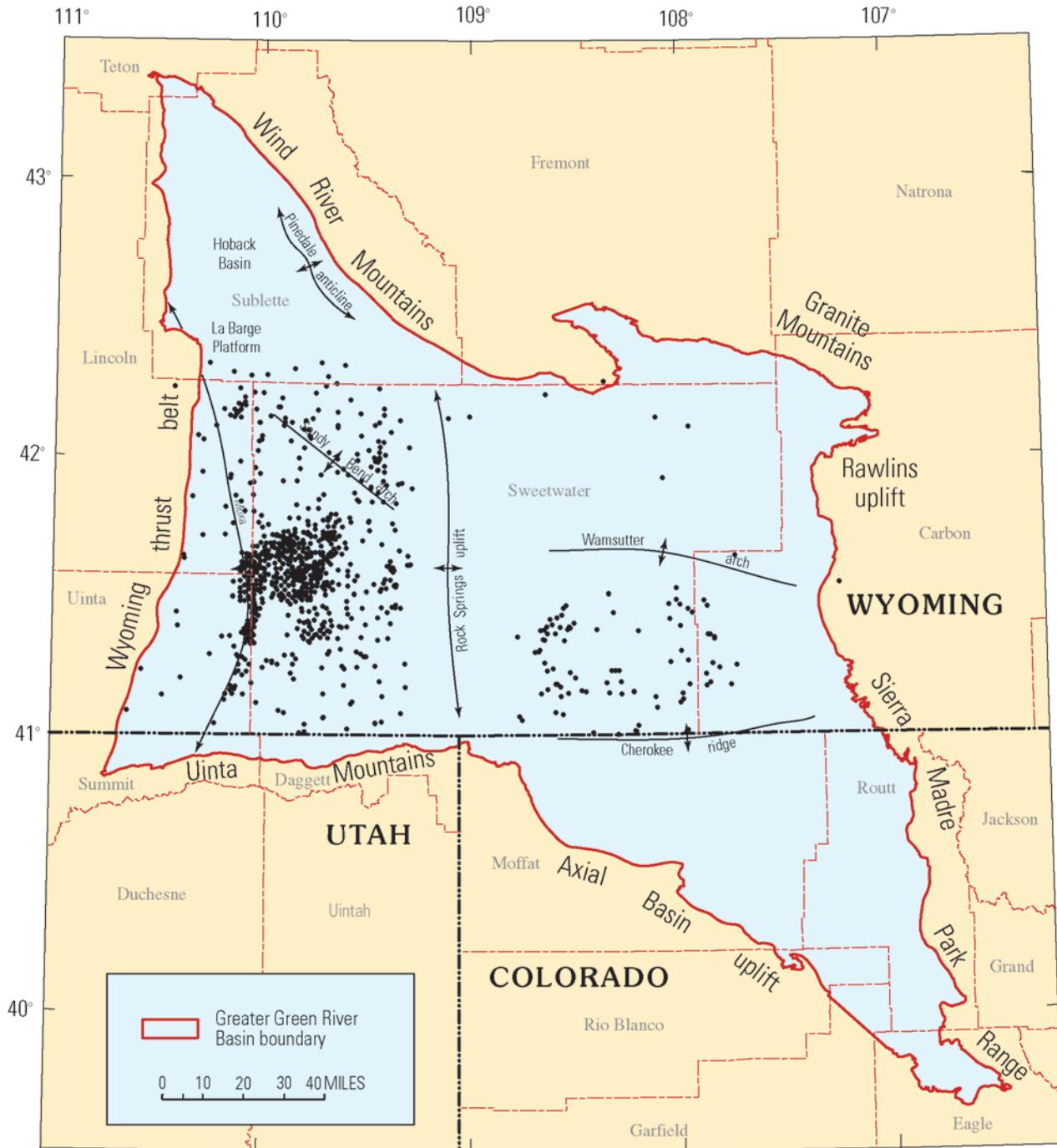


Figure 3. Approximate locations of 906 holes included in the Wyoming oil-shale database (WY-Oil\_Shale\_Assays.xls), Greater Green River Basin, Wyoming.

**Table 1.** Names and definitions for the column headers for the Fisher assay data spreadsheet ([WY\\_Oil\\_Shale\\_Assays.xls](#)).

Column name	Column definition
USGSID	Unique drill-hole number assigned by the USGS
LABNO	U. S. Bureau of Mines, Laramie, WY laboratory number
TOPFT	Depth, in feet, measured from surface datum to top of sampled interval
BOTFT	Depth, in feet, measured from surface datum to base of sampled interval
SHLOILPT	Amount of shale oil in weight percent
WATERPT	Amount of water in weight percent
SHLRSDPT	Amount of shale residue in weight percent
GASPLSLSPT	Amount of “gas plus loss” in weight percent
OILGLTON	Shale oil in U.S. gallons per short ton of rock
WTRGLTON	Water in U.S. gallons per short ton of rock
SPCFGRAV	Specific gravity of shale oil
CIJTEBD	Tendency for spent shale to coke

identified by the suffix “R” following the USGS drill-hole number, whereas core holes have no suffix after the drill-hole number. Table 1 defines the column headers in the Fisher assay data spreadsheet.

Where samples were not analyzed the Fisher assays data fields are represented by “0.0” to allow for a continuous histogram to be created. Missing sample intervals can be detected in the database by the lack of a USBM laboratory number (LABNO, table 1) followed by “0.0” in all of the Fisher assay data fields.

Column-delimited and text data files (Assays folder) included in this chapter contain Fisher assay data and information on the drill hole including company name and drill-hole name and the drill-hole location. In the text data files, samples not analyzed are represented by “0.0B” in all of the Fisher assay data fields. Missing sample intervals can be located in text files by the lack of a USBM laboratory number followed by “0.0B” in all of the Fisher assay data fields.

## Oil Yield Histograms

Oil-shale-yield histograms were created for 426 holes in Grapher 7 (Golden Software, Inc., Golden, Colo.) and included in this DVD as PDF (W0001\_grf.pdf) file format. The histograms were created using the “Step Plot” feature in Grapher 7 and a renamed copy (WY\_Assays.xls) of the assays database (WY\_Oil\_Shale\_Assays.xls). This database is necessary to access the Grapher plot files with the Grapher

7 software (Golden Software, Inc., Golden, Colo.). The step plots (histograms) were then exported in PDF (W0001\_grf.pdf) format (Grapher folder) and imported in Adobe Illustrator where the histograms were scaled vertically to 1 in. equals 50 ft and exported in PDF (w0001.pdf) format (Histogram folder). In one instance, two histograms were created because the plots would not fit the maximum page size in Adobe Illustrator (W0341R\_part1.pdf; W0342R\_part2.pdf). As with the Fisher assay data, the rotary-drilled holes are identified by the suffix “R” following the USGS drill-hole number and the core holes have no suffix after the drill-hole number.

If errors or omissions of data are found in this chapter, users are encouraged to contact Michael E. Brownfield at [mbrownfield@usgs.gov](mailto:mbrownfield@usgs.gov), Ronald C. Johnson at [rcjohnson@usgs.gov](mailto:rcjohnson@usgs.gov), or John Dyni at [jdyni@usgs.gov](mailto:jdyni@usgs.gov).

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