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Preliminary Utah Oil Shale Database

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Abstract

This database includes information on core and rotary-drilled boreholes drilled to evaluate the oil shale deposits of the Eocene Green River Formation in the Uinta Basin, Utah. The database includes the depth, thickness, and grade of oil shale as determined by the modified Fischer assay method, as well as lithologic and geophysical logs, and stratigraphic tops of selected zones and beds of oil shale and volcanic tuff.

Introduction

The data presented herein is part of a larger collection of oil shale information on the Eocene Green River Formation in Utah, Colorado, and Wyoming collected by the U.S. Bureau of Mines (USBM) and the U.S. Geological Survey (USGS), especially during the 1970s and 1980s, when the Federal Government and industry made a major attempt to develop the Green River oil shale deposits.

This preliminary database is also part of a more comprehensive database on Utah oil shale currently being prepared under a cooperative agreement between the USGS and the Utah Geological Survey (UGS). This database is being made publicly available because of renewed interest by industry in developing the oil shale resources of the Green River Formation in Utah.

Most of the Fischer assays were performed by the USBM at its laboratories in Laramie, Wyoming, between 1946 and 1984. These analyses were collected by the USGS and were supplemented with many assays performed by private laboratories for companies active in the development on oil shale lands in Utah. The USBM originally released its collection of digitized Fischer assay data for Utah, Colorado, and Wyoming in ASCII format on 8-track magnetic tapes through the National Technical Information Service (NTIS) of the U.S. Department of Commerce. The USGS released much of the same data on magnetic tapes in 1974 and 1982 through NTIS, including assays by private laboratories for the Colorado deposits (Pitman, 1974, 1982). Over a period of the time, the tapes stored by NTIS deteriorated to the point that the data were no longer readable. In the early 1990s, the USGS and the U.S. Department of Energy signed a cooperative agreement for the USGS to redigitize the entire collection of Fischer assays into one complete database. At the same time, the laboratory assay data sheets and lithologic descriptions of drill cores were digitally imaged. The Fischer assay data for Colorado was published on a CD in 1998

(Dyni, 1998). In 2005, a cooperative program was initiated between the UGS and the USGS to create a digital database of information on the oil shale deposits of the Green River Formation in the Uinta Basin, Utah, using the USGS data and additional information gathered by the UGS.

Database

Shale oil assays for 581 Utah oil shale core holes and oil and gas tests are included in this database. Each borehole is referenced by a three-digit number preceded by the letter “U” (for Utah), ranging from U001 to U692. The database includes Fischer assays from 268 core holes, 311 rotary-drilled oil and gas wells, and two outcrops.

The oil shale information is divided into six folders and files: Drill Hole Reference File, Fischer Assay Images, Digitized Fischer assays, Stratigraphy, Geophysical Log Images, and Lithologic Log Images.

The digitized assays are in ASCII format for easy transfer to computer programs of the user’s choice. Computer images of the laboratory assay reports and lithologic logs for 165 holes are in Adobe PDF format and the geophysical logs for 127 holes are imaged in TIFF format. The stratigraphic data are in a Microsoft Excel spreadsheet. An inventory of geophysical logs for an additional 300 boreholes (mostly oil and gas tests) that penetrate the Green River Formation in the Uinta Basin is available in the UGS’s library in Salt Lake City, Utah. J.R. Dyni provided the digital assay data and the lithologic and geophysical logs for this report and John Donnell determined most of the tops of the stratigraphic units from bar graphs of the Fischer assays. Some stratigraphic tops were published by Trudell, Beard, and Mason (1983). The data were entered into the different formats for this report by Michael Vanden Berg.

Drill Hole Reference File

This file is a Microsoft Excel spreadsheet that lists: (1) Utah boreholes by U number, and their (a) locations in UTM and geodetic coordinates (latitude and longitude) and by county, township, range, and section, (b) elevation, and (c) total depth; (2) depths of stratigraphic, cored, and assayed intervals; (3) number of Fischer assays and laboratories where assayed; (4) available geophysical logs of cored and (or) sampled wells; and (5) locations of stored drill core. Those boreholes assigned API numbers are oil and gas tests, whereas those without are exploratory oil shale boreholes.

Digitized Fischer Assays

The Fischer assay folder contains 586 sets of Fischer assays in ASCII format. Most of the assays were made by the modified Fischer assay method as described by Stanfield and Frost (1949) and later adopted by the American Society for Testing and Materials (1980). This method was developed primarily for evaluating the Green River oil shale resources.

Generally, the assays of drill cores were made on crushed samples prepared from 1- or 2-ft lengths of quartered core, although some samples were prepared using longer lengths. Assays from rotary-drilled oil and gas tests were made on drill cuttings that represent mostly 10-ft-depth increments.

The order of data reported in the assay in this folder is the same as that shown on the imaged assay data sheet. The field for an individual assay lists a USBM laboratory number; depths of the top and base of the drill core or sample of rotary cuttings analyzed; weight percents of shale oil, water, spent shale (mineral residue), and “gas plus loss”; shale oil and water yields in U.S. gallons per ton of rock; specific gravity of the shale oil; and tendency of spent shale to coke. Missing data are indicated by “0.0B”.

Although useful for shale oil resource evaluation and stratigraphic studies of oil shale deposits, the modified Fischer assay does not give a complete picture of the energy available in the organic fraction of the oil shale. The method does not measure the composition of the gases released, only “gas plus loss”, which is computed by subtracting the sum of the weights of oil, water, and spent shale from 100 percent. Gas plus loss includes all noncondensable gases released in the Fischer assay, which may include light hydrocarbons, hydrogen, carbon dioxide, and analytical errors.

The Fischer assays of rotary drill cuttings should be used with caution because of contamination by mixing of cuttings and cavings, and inaccuracies of travel-time lag of cuttings returns in the drill hole. Because of these uncertainties, assays of rotary cuttings from oil and gas tests is not recommended for making quantitative shale oil resource estimates.

Fischer Assay Images

The laboratory data sheets for the Fischer assays in Adobe PDF format are included in this folder. Because of the possibility of mistakes in data entry of the digitized assay data, these files offer a way of checking the digitized data against the original laboratory assay reports. Furthermore, remarks on the laboratory reports may provide useful additional information about the data.

Geophysical Log Images

This folder contains scanned images of a variety of geophysical logs for 127 boreholes. The most useful logs for determining the stratigraphy and assessing the resources of the oil shale deposits are sonic and density logs. Other types of logs, such as electric logs, are also included in this folder.

Stratigraphy file

The stratigraphy file is organized by well number, and includes information on the well location in UTM coordinates, elevation, total depth of the borehole, followed by the depths of many thin high-grade oil shale beds informally numbered 2 through 76 in ascending order (fig. 1) that are interbedded with several thin beds of tuff, low-grade oil shale, marlstone, siltstone and fine-grained sandstone in a sequence about 300 ft thick above the Mahogany oil shale zone. The Mahogany zone, about 60 to 140 ft thick, is the richest of oil shale in the Uinta Basin and is likely to be the first zone to be developed by an oil shale industry. Shale oil resources of the Mahogany zone in the

Uinta Basin have been published by several researchers (Cashion, 1964; Trudell and others, 1983; Dyni and others, 1991).

The tops of several prominent units including the “A” and “B” grooves (units of kerogen-poor marlstone), the Mahogany zone and several zones of oil shale underlying the Mahogany—including in ascending order, the R-3, L-3, R-4, L-4, R-5, L-5, and R-6 zones—are also listed (fig. 2). A few of these zones contain oil shale of fair quality. The sequence from the top of the R-3 zone to the top of the R-6 zone is about 560 ft thick.

The thin numbered oil shale beds, the “A” and “B” grooves, and the Mahogany zone can be easily identified on bar graphs of shale oil yields and on sonic and density logs. Oil shale zones below the Mahogany zone can be recognized in a few boreholes in the eastern part of the Uinta Basin, but relatively few core holes penetrate these deeper units; these need further exploratory drilling and study to confirm their lateral distribution, thickness, and grade.

Lithologic log images

Most of the lithologic logs in this folder are from descriptions of drill cores from 131 oil shale boreholes. Many of logs were prepared by the USBM, including some by the USGS and private companies. The logs are in Adobe PDF format.

References

- American Society for Testing and Materials, 1980, Standard test method for oil from oil shale (resource evaluation by the USBM Fischer assay procedure): ASTM Designation D 3904-80, 1980 Annual Book of ASTM Standards, Part 25, p. 513-525. (This method has since been discontinued by ASTM).
- Cashion, W.B., 1964, The distribution and quality of oil shale in the Green River Formation of the Uinta Basin, Utah-Colorado: USGS Professional Paper 501-D, p. D86-D89.
- Dyni, J.R., Donnell, J.R., Grundy, W.D., Cashion, W.B., Orlowski, Louis A., and Williamson, Courtney, 1991, Oil-shale resources of the Mahogany zone in eastern Uinta Basin, Uintah County, Utah: U.S. Geological Survey Open File Report 91-0285, 62 p., with appendices A-1 to A-4.
- Dyni, J.R., 1998, Fischer assays of oil-shale drill cores and rotary cuttings from the Piceance Creek Basin, Colorado, version 1: U.S. Geological Survey Open-File Report 98-483 (disc).
- Pitman, J.K., 1974, Magnetic tape containing oil-shale Fischer assay data for coreholes in the Piceance Creek Basin, Colorado: National Technical Information Service Report PB 230 607/AS.
- Pitman, J.K., 1982, Magnetic tape containing oil-shale Fischer assay data for selected core holes drilled since 1974 in the Piceance Basin, Colorado National Technical Information Service Report PD 134-875.
- Stanfield, K.E., and Frost, I.C., 1949, Method of assaying oil shale by a modified Fischer retort: U.S. Bureau of Mines Report of Investigations 4477, 13 p.
- Trudell, L.G., Smith, J.W., Beard, T.N., and Mason, G.M., 1983, Primary oil-shale resources of the Green River Formation in the Eastern Uinta Basin, Utah: U.S. Department of Energy Report, DOE/LC/RI-82-4, 58 p.

SHALE OIL, GALS/TON

DEPTH, FEET

0 10 20 30 40 50 60 70 80

0

50

100

150

200

250

300

350

400

450

500

76

74

72

70

68

66

64

62

58

56

54

52

50

48

46

44

42

40

39

38

36a

36

34

32

30

28

26

24

22

21

20

12

10

6

4

2

"A" groove

Stillwater zone

4 senators

Big 3

Mahogany oil shale bed

Mahogany Oil Shale Zone

8

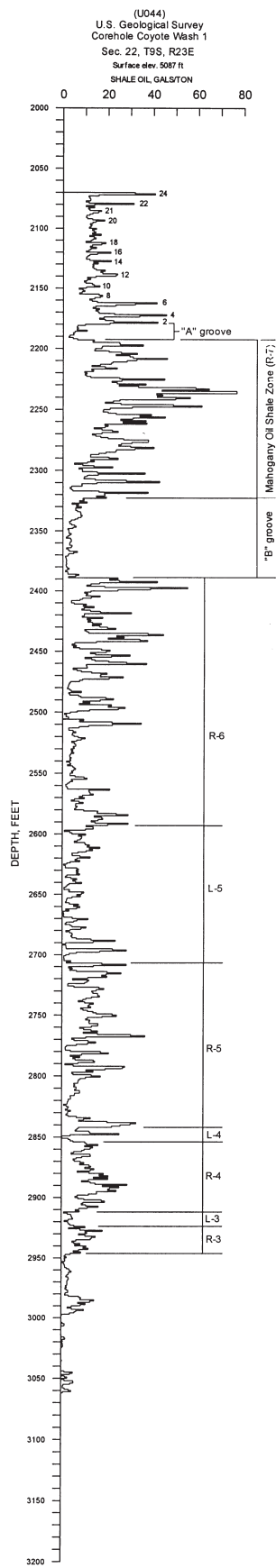


Figure 2