

7. DATA REPORT: AUTOMATIC METHOD FOR ASSOCIATING LITHOLOGIC TYPE WITH LABORATORY MEASUREMENTS TAKEN ABOARD THE JOIDES RESOLUTION¹

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ABSTRACT

We present a method for automatically associating Ocean Drilling Program core sample observations with interpreted rock type and other lithologic parameters. Lithology data are obtained from the visual core descriptions (VCDs) prepared by sedimentologists and petrologists at sea. A database is created using the digital AppleCORE data, which form the basis for the VCDs. The database is then queried from spreadsheets containing laboratory data for rock type information using the standard "depth below seafloor" parameter used for all shipboard laboratory data reporting. This method facilitates rapid sorting, plotting, and analysis of sample data as a function of lithology.

INTRODUCTION

During Ocean Drilling Program (ODP) drilling legs, shipboard scientists collect many observations and measurements that document the recovered core. These measurements include lithology, age, physical properties, chemical properties, pore water properties, magnetic properties, and many others. Most of these observations and measurements are made on samples of the recovered core and are recorded to a shipboard database as a function of the depth of the sample in the hole.

Shipboard and shore-based scientists use subsets of these data in many ways to conduct research associated with the leg scientific objec-

¹Sawyer, D., and Fackler, D., 2007. Data report: automatic method for associating lithologic type with laboratory measurements taken aboard the *JOIDES Resolution*. In Tucholke, B.E., Sibuet, J.-C., and Klaus, A. (Eds.), *Proc. ODP, Sci. Results*, 210: College Station, TX (Ocean Drilling Program), 1–21. doi:10.2973/odp.proc.sr.210.109.2007

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Initial receipt: 18 January 2006

Acceptance: 31 August 2006

Web publication: 20 July 2007

Ms 210SR-109

tives and to conduct scientific research outside of the leg objectives. Tools that allow researchers to rapidly and easily display, combine, and compare data are key to these efforts. Some of these data comparisons are already very easy. For example, it is easy to access and display any of the measurements as a function of depth. Certain measurement suites are made on a common set of samples (e.g., measurements of bulk density, porosity, grain density, seismic velocity, etc., are often measured on the same samples in the Physical Properties laboratory) and can easily be cross-plotted for comparison and study.

Because many measurable physical and other properties vary strongly with lithology, being able to organize and interpret shipboard data as a function of lithology is often very important. At some ODP drilling sites, the material recovered in a hole is lithologically uniform, so organizing the measurements as a function of lithology is trivial. However, at many ODP drilling sites, including ODP Leg 210 Site 1276, the lithology is highly variable. At such sites, it is often desirable to study the variation of a particular physical property as a function of depth within a single rock type. This might be the case for looking at porosity as a function of depth for shale in order to model shale compaction. To do this, the researcher must be able to select all the shale samples on which porosity was measured. One can easily imagine many similar examples common to research activities on the drillship. At Site 1276, lithologic observations (including rock type) were made on all recovered cores, and porosity measurements were made on multiple samples from each core section. However, we found that there was not an automated way to combine these observations and measurements in order to select and analyze the samples of a particular lithology on which porosity had been measured.

During Leg 210, we developed a method to do this. Our method was used during the leg to analyze data acquired in the Physical Properties and Organic Chemistry laboratories. We suggest that it might be a prototype of a tool that should be developed further for routine shipboard and postcruise use.

METHOD

Our objective was to be able to easily and accurately associate sample measurements with the lithology of the sample. We considered several approaches to accomplishing this.

We considered simply noting the relevant lithologic properties for each sample as we collected it. There were problems with this approach:

1. The lithology identification skill of the laboratory scientists varied, so the identifications were sometimes wrong and frequently inconsistent.
2. We often did not know what lithologic property (i.e., rock type, grain size, presence of alteration, etc.) would be important to us later. This meant that when a question arose later in the leg, we needed to pull core from storage to do additional identifications.

To avoid these problems, we chose to use the core descriptions prepared by the shipboard sedimentologists and petrologists. They are the experts on lithologic description and they collaborate to produce a consistent, well-documented set of descriptions. We found that primary lithology data are recorded by the sedimentologists and petrologists on a

paper form called a Primary Core Description and commonly referred to as a barrel sheet. The barrel sheets contain the most information about lithology of any record generated routinely on the ship. They are available on the ship within days after they are created and may be obtained from the ODP data librarian for reference after the cruise. They would be the ideal source of information for our project if they were available in a digital form. They are not. Because they are available only on paper, determining the lithology for all our samples would be a time-consuming manual job. Thus, it was possible but unappealing.

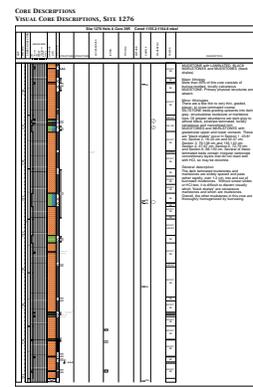
However, much of the information on the barrel sheets is entered into the AppleCORE system (Ranger, 2001) within a few days of its creation. The AppleCORE system stores this information in an internal database format and generates graphical records called Visual Core Descriptions (VCDs) (Fig. F1). The VCDs are available on the ship and are published as part of the *Initial Reports* volume after the leg (Tucholke, Sibuet, Klaus, et al., 2004). Unlike the barrel sheets, the AppleCORE database is a digital record of lithology and therefore could be used in an automated way for our project.

The AppleCORE data are stored as binary records that we did not try to read, but these records can be exported from AppleCORE in easily readable ASCII format (Ranger, 2001, 2002). Each record contains information of a specific type about a single interval of the core. The information types available include lithology, grain size, age, structures, disturbance, diagenesis, and many more. Each record contains a flag indicating what type of data it contains and includes the core and section numbers of the interval it describes. It also contains the positions (depth in meters below seafloor) of the top and the bottom of the interval it describes. Finally, it contains the data value or values appropriate to the data type flag. Therefore, one can obtain a specific type of data for a particular depth in the core by searching the AppleCORE database for records of the selected type that pertain to an interval bracketing the desired depth.

We chose to convert relevant portions of the AppleCORE database into Excel format so that we could perform this search and report the results into the Excel spreadsheets commonly used for shipboard data. We considered using the entire AppleCORE database for our search, and this would be the preferred method for building a truly general data extraction tool. However, in the Physical Properties laboratory during Leg 210, we were only interested in a few specific types of the data that were available, and it was more efficient for us to write code to extract these specific data types from the larger database than for us to program a more general tool.

We were specifically interested in data regarding primary lithology, grain size, and whether a sample was altered to a concretion. Each of these related to a question that came up during analysis of some aspect of our measurements. Lithology data (primary rock type) were contained in AppleCORE records with data type flag LTH (Table AT1, see "Appendix A," p. 7). Grain size data were contained in AppleCORE records with data type flag GRS (Table AT2, see "Appendix A," p. 7). Concretion diagenesis data were contained in AppleCORE records with data type flag DIA and with a diagenesis type code for this particular type of diagenetic alteration (Table AT3, see "Appendix A," p. 7). Therefore, we first recoded all the ASCII AppleCORE records to reflect the source section for the observations (ODP standard leg, site, hole, core, section designations). Second, the ASCII records were sorted by data type flag. Third, we discarded those records in which we were not

F1. VCD for Core 210-1276A-39R, p. 13.



interested. Fourth, we separated the three types we did want into separate ASCII files. Each file was loaded into an Excel spreadsheet and the records were sorted by increasing depth. Examples of these spreadsheet data for Core 210-1276A-39R are shown in Tables AT1, AT2, and AT3 (see “Appendix A,” p. 7), and the full spreadsheets for Hole 1276A are available as part of an Excel workbook (see the “Supplementary Material” contents list, available for download). The records in Tables AT1, AT2, and AT3 (see “Appendix A,” p. 7) correspond to the VCD shown in Figure F1. More detail regarding the way these records were handled can be found in “Appendix A,” p. 7, and “Appendix B,” p. 10.

Each of these data records uses ASCII codes to represent text data. AppleCORE uses master lists to associate the ASCII codes with their text meaning. We added the master lists for lithology and grain size to our Excel workbook so that our functions could return results as text (i.e., rock type names, rather than numeric codes) (Tables T1, T2).

The lithology information about a particular sample depth can be extracted by searching from the top of the file until a depth interval bracketing the desired depth is located. We programmed Excel to do this by writing three functions (see “Appendix C,” p. 11). The first function obtains the major lithology name (function = MajorLithology-Name), the second obtains grain size name (function = GrainSize-Name), and the third returns a true/false value if the input depth is within a concretion (function = IsConcretion). Each function is called with one input parameter, which is the depth in meters below seafloor. Each function returns one character string or number (true/false value). These spreadsheet functions are programmed in Visual Basic and are available as part of an Excel workbook (see the “Supplementary Material” contents list). The use of this Excel workbook is described more fully in “Appendix A,” p. 7, and “Appendix B,” p. 10.

The Excel workbook allows the user to load physical properties or other data into the workbook and then create new spreadsheet columns with information provided by one or more of the above functions.

APPLICATIONS

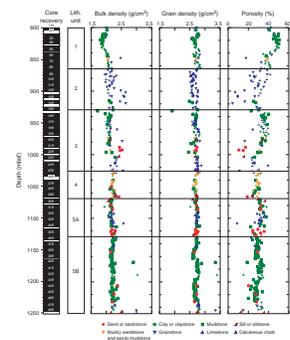
We found that there was significant value added in plotting the basic bulk density, grain density, and porosity measurements vs. major lithology (Fig. F2). It is easy to see that the sample lithology identifications correlate well with the lithologic units. We could see clear trends in the porosity depth functions associated with different lithologies. We also found that some lithologies stood out as anomalous (limestones and sandstones are examples). At this large scale, the plots were most useful for identifying patterns in physical properties of different lithologies. These patterns often did not stand out when looking at spreadsheet data or at plots without lithologic symbols. The variations often looked like noise in the data rather than meaningful patterns.

Discrimination of lithology was useful when we used porosity vs. depth data to determine parameters for an Athy’s law porosity-depth function for fine-grained clastic sediment (Fig. F3). We placed the observed porosities in perspective by removing the anomalous porosities associated with carbonate/siderite concretions, well-lithified carbonate-cemented sandstones, and those sediments that are hornfels and then plotting them together with a best-fit compaction curve. By fitting the measured porosity-depth data for claystones, mudstones, and siltstones, we estimated Athy’s law parameters $\phi_0 = 79\%$, and $k^{-1} =$

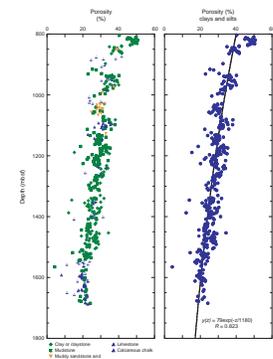
T1. Examples from the rock name master list, p. 17.

T2. Grain size master list as used on Leg 210, p. 18.

F2. Density and porosity data for the upper 450 m of Hole 1276A, p. 14.



F3. Porosity vs. depth for a select set of lithologies in Hole 1276A, p. 15.



1.18 km. The parameters we obtained are similar to values obtained for mudrock (shale) compaction in the literature. Many of the porosity values that lie to the low side of this curve were measured on grainstones, sandstones, and chemically cemented rocks. In each case, these rocks are expected to be less porous than burial-compacted mudrocks.

These methods were also useful when looking at closely spaced observations within a single section or core (Fig. F4). Here, natural gamma ray and velocity data observations were characterized by major lithology. The plots clearly show the relationship between lithology variation related to turbidite sedimentation and the associated physical properties.

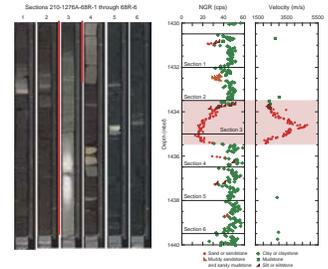
CONCLUSIONS

During ODP Leg 210, we developed a method to automatically associate lithologic data recorded in AppleCORE with laboratory measurements on samples. This capability is not otherwise available, and we have found it to be very useful. We suggest that this capability be incorporated in this way or another more robust way into the standard database tools available to shipboard and other scientists.

ACKNOWLEDGMENTS

This research used samples and/or data provided by the Ocean Drilling Program (ODP). ODP is sponsored by the U.S. National Science Foundation (NSF) and participating countries under management of Joint Oceanographic Institutions (JOI), Inc.

F4. Core 210-1276A-68R digital core images, p. 16.



REFERENCES

- Ranger, M.J., 2001. AppleCORE User Guide (Version 8).
Ranger, M.J., 2002. Appendix to AppleCORE User Guide (Version 8).
Tucholke, B.E., Sibuet, J.-C., Klaus, A., et al., 2004. *Proc. ODP, Init. Repts.*, 210: College Station, TX (Ocean Drilling Program). [doi:10.2973/odp.proc.ir.210.2004](https://doi.org/10.2973/odp.proc.ir.210.2004)

APPENDIX A

Instructions for Preparing the Database Records

An Excel workbook called “lithpick” is provided in the volume Supplementary Material that has the data from Hole 1276A already loaded (see the “[Supplementary Material](#)” contents list). You may load data from AppleCORE records for other holes in place of the data that are there. This is not as complicated as it sounds, and during a leg it can be done as new AppleCORE descriptions are entered. We suggest collaboration with the shipboard computer group. The steps are as follows:

1. Use the AppleCORE program to dump the records for each core of a hole in ASCII format. Extraction of ASCII text records from AppleCORE barrel sheets is a manual process: one file at a time. (Batching support can be developed using AppleScript or a third-party macro recorder utility.) The process is as follows:
 - a. AppleCORE relies on significant amounts of reference data. These data define display patterns, names, and identification codes against which all descriptions are keyed. These reference data may be exported to an external file, a “custom” file, for longitudinal preservation.
 - b. Before textually exporting data from barrel sheets, be sure that the custom file associated with that data set is first loaded into AppleCORE (on the **Special** menu, click **Load Custom File**).
 - c. Using a mismatched custom file may result in complete misrepresentation of the barrel sheets. Check it.
 - d. Double-click to open, or drag-and-drop the barrel sheet file onto AppleCORE.
 - e. On the **File** menu, click **Export to ASCII**.
 - f. Click **Continue** on any error messages regarding undescribed regions.
 - g. Click **OK** to accept export of depth ranges in meters.
 - h. The first time through: select the directory in which to store the textual barrel sheets.
 - i. Provide a file name. For ODP-related naming conventions we recommend using the form: site-hole-core-type.asc (e.g., 1276a03r.asc). If a series of files is being exported, save some typing by using the copy command (apple or CTRL+C) to store the basic name pattern for your files. Use the paste key (apple or CTRL+V) to retrieve it each time this step is repeated.
 - j. Click **Save** to generate the new file.
 - k. Press CTRL+W to close the current barrel sheet.
 - l. Take a look at the ASCII files. A bit of data cleanup will ease later data analysis by ensuring a baseline of consistency and predictability.
 - m. The record structure of AppleCORE ASCII files is defined in Ranger (2002). Use this document and the barrel sheet legends to interpret the data content.
 - n. A recoding step was performed on the AppleCORE data. An AWK (text processing language) script was run to read and prepend the leg-site-hole-core-type identifiers to the front of each line in every file. The script (originally saved and named **recodeAC2PP.awk**):

```
BEGIN { RS = "[\r\n] + "; }
FNR==9 { leg = $2;
        site = $4;
        hole = $6;
        core = strtonum($8);
        ct = substr($8, length($8), 1);
}
      { printf "%d\t", leg;
        printf "%d\t", site;
        printf "%c\t", hole;
        printf "%d\t", core;
        printf "%c\t", ct;
        printf "%s\n", $0;
}
```

- o. Read lines of each file. On the ninth line (FNR==9), pick out the leg, site, hole, core, and core type information. For all subsequent lines in that file, apply the current leg, site, hole, core, and type as a prefix to the record. Lines prior to line nine are prepended with zeroed identifiers or values from the previous file run (a reason why those eight leading records are stripped).

The above script is executed against a batch of AppleCORE ASCII files:

```
gawk -f recodeAC2PP.awk *.asc >out.unsorted
```

The **gawk** utility (or its relatives **awk**, **nawk**) are available on all UNIX platforms (including Mac OS X) and are generally available in open-source communities for the PC platform. The file resulting from this processing step (e.g., `out.unsorted`) was then sorted on the record code (also known as data type, columns 41–44) using a text editor. Then all rows with these record types were deleted:

WNM, LAT, ELV, UNT, DAT, TOP, COL, RMK, Leg, BOX

AppleCORE allows free-form textual remarks. Because of the variability in these fields, they needed to be manually reviewed and deleted using a text editor.

2. Import the LTH records into the LTH spreadsheet in the lithpick workbook (Table [AT1](#)).
3. Import the GRS records into the GRS spreadsheet in the lithpick workbook (Table [AT2](#)). Note that if you are not interested in grain size, you can skip this.
4. Import the DIA records into the DIA spreadsheet in the lithpick workbook (Table [AT3](#)). Because diagenesis records are not created for all recovered core, add a false record at the beginning of the record (see lithpick workbook for an example) showing zero or negative depth. This allows the Excel Vlookup function to work properly. We used only DIA records with code 1702, which signified general concretions. One can select for any other value and could write a function to return the diagenesis code as well as the true/false value. Note that if you are not interested in diagenesis, you can skip this.

[AT1](#). Modified lithology data records, Core 210-1276A-39R, p. 19.

[AT2](#). Modified grain size data records, Core 210-1276A-39R, p. 20.

[AT3](#). Modified diagenesis data records, Core 210-1276A-39R, p. 21.

5. Create or modify the named variable "lith_lookup_table." Assign to this variable the Excel range that covers columns containing the depths and the major lithology code, and rows from the beginning of records to the end of the records. If you use the procedure we have described and model in the provided lithpick workbook, this will be columns I–Q. If there are 25 records in the spreadsheet, rows will be 1–25, then the variable will be set to LTH!\$I\$1:\$Q\$25.
6. Create or modify the named variable "grs_lookup_table." Assign to this variable the Excel range that covers columns containing the depths and the grain size code, and rows from the beginning of records to the end of the records. If you use the procedure we have described and model in the provided lithpick workbook, this will be columns I–K. If there are 25 records in the spreadsheet, rows will be 1–25, then the variable will be set to GRS!\$I\$1:\$K\$25.
7. Create or modify the named variable "concretion_lookup_table." Assign to this variable the Excel range that covers columns containing the depths, and rows from the beginning of records to the end of the records. If you use the procedure we have described and model in the provided lithpick workbook, this will be columns I–J. If there are 25 records in the spreadsheet, rows will be 1–25, then the variable will be set to DIA!\$I\$1:\$J\$25.
8. The named variables "lith_names" and "grain_size_names" are already set to 'Lithology Name Codes'!\$A\$2:\$B\$575 and 'Grain Size Codes'!\$A\$2:\$B\$11, respectively. You will not need to change these unless you change the association of lithology or grain size code numbers to names.

APPENDIX B

Instructions for Users

Open the Excel workbook called “lithpick,” which is available in the volume Supplementary Material (see the “[Supplementary Material](#)” contents list). Lithpick contains data for Hole 1276A. Lithpick also contains a spreadsheet called “Demo” (see the “[Supplementary Material](#)” contents list), which shows examples of the use of each of the functions. If you want to use data from a different hole, see “[Appendix A,](#)” p. 7, for information about how to load the relevant data.

Each of our functions takes a depth (in meters below seafloor) as input. The functions MajorLithologyName and GrainSizeName return a text string as the result. The function IsConcretion returns a one or zero, representing true or false, respectively.

To pair your sample data with lithologic identifications, create a new spreadsheet in the lithpick workbook and copy your sample data as a function of depth into that sheet. Your sample measurement(s) and the sample depth can be in arbitrary order and columns. Our functions are entered in exactly the same way as other Excel functions. They will show up in the “User Defined” function category.

After you have the lithologic information associated with each sample, you can copy your spreadsheet results to any other workbook that is convenient. Use **Paste Special** and **Copy Values**. If you do a regular **Paste**, it will copy the formulas and they will not be able to reference the databases.

At this point, you can use the Excel sort feature to separate your data according to lithology or grain size or whether it was a concretion or not. You can transfer the spreadsheet data to Kaleidagraph or other plotting or analysis software. You can now plot or analyze data from a single lithology or to plot some or all lithologies, each with a different symbol.

APPENDIX C

The following Excel function macros were written in Visual Basic to extract lithology data from AppleCORE ASCII records. The use of these functions is described in detail in “Appendix A,” p. 7, and “Appendix B,” p. 10.

MajorLithologyName Macro

```
Function MajorLithologyName(depth) As String
'
' Find Major Lithology ascii code for the given depth in the LTH worksheet
'
' If depth > WorksheetFunction.VLookup(depth, Range("lth_lookup_table"), 2, True) Then
'     MajorLithologyName = "No Record"
' Else
'     maj_lith_code = WorksheetFunction.VLookup(depth, Range("lth_lookup_table"), 3, True)
'     If maj_lith_code = 999 Then
'
'     999 is ascii code used for "unidentified" on Leg 210
'
'         MajorLithologyName = "Unidentified"
'     Else
'
'     Lookup ascii code in the Lithology Name Codes worksheet
'
'         MajorLithologyName = WorksheetFunction.VLookup(maj_lith_code,
Range("lith_names"), 2, True)
'     End If
' End If
'
' Return Major Lithology name
'
End Function
```

GrainSizeName Macro

```
Function GrainSizeName(depth) As String
'
' Find grain size ascii code for the given depth in the GRS worksheet
'
' If depth > WorksheetFunction.VLookup(depth, Range("grs_lookup_table"), 2, True) Then
'     GrainSizeName = "No Record"
' Else
'     grain_size_code = WorksheetFunction.VLookup(depth, Range("grs_lookup_table"), 3, True)
'
' Lookup ascii code in the Grain Size Codes worksheet
'
'     GrainSizeName = WorksheetFunction.VLookup(grain_size_code, Range("grain_size_names"), 2,
True)
' End If
'
' Return grain size name
'
End Function
```

IsConcretion Macro

```
Function IsConcretion(depth) As Integer
'
' Checks if input depth is within the top/bottom range of a concretion record in DIA spreadsheet
'   If not, the function returns false (0)
'   If so, the function returns true (1)
'
If depth > WorksheetFunction.VLookup(depth, Range("concretion_lookup_table"), 2, True) Then
    IsConcretion = 0
Else
    IsConcretion = 1
End If
End Function
```


Figure F2. Density and porosity data for the upper 450 m of Hole 1276A (Tucholke, Sibuet, Klaus, et al., 2004). Symbols represent major lithology obtained using the method described here. Note the correlation of lithology with lithologic units and the ease with which general bulk density and porosity vs. depth trends can be discriminated for distinct lithologies.

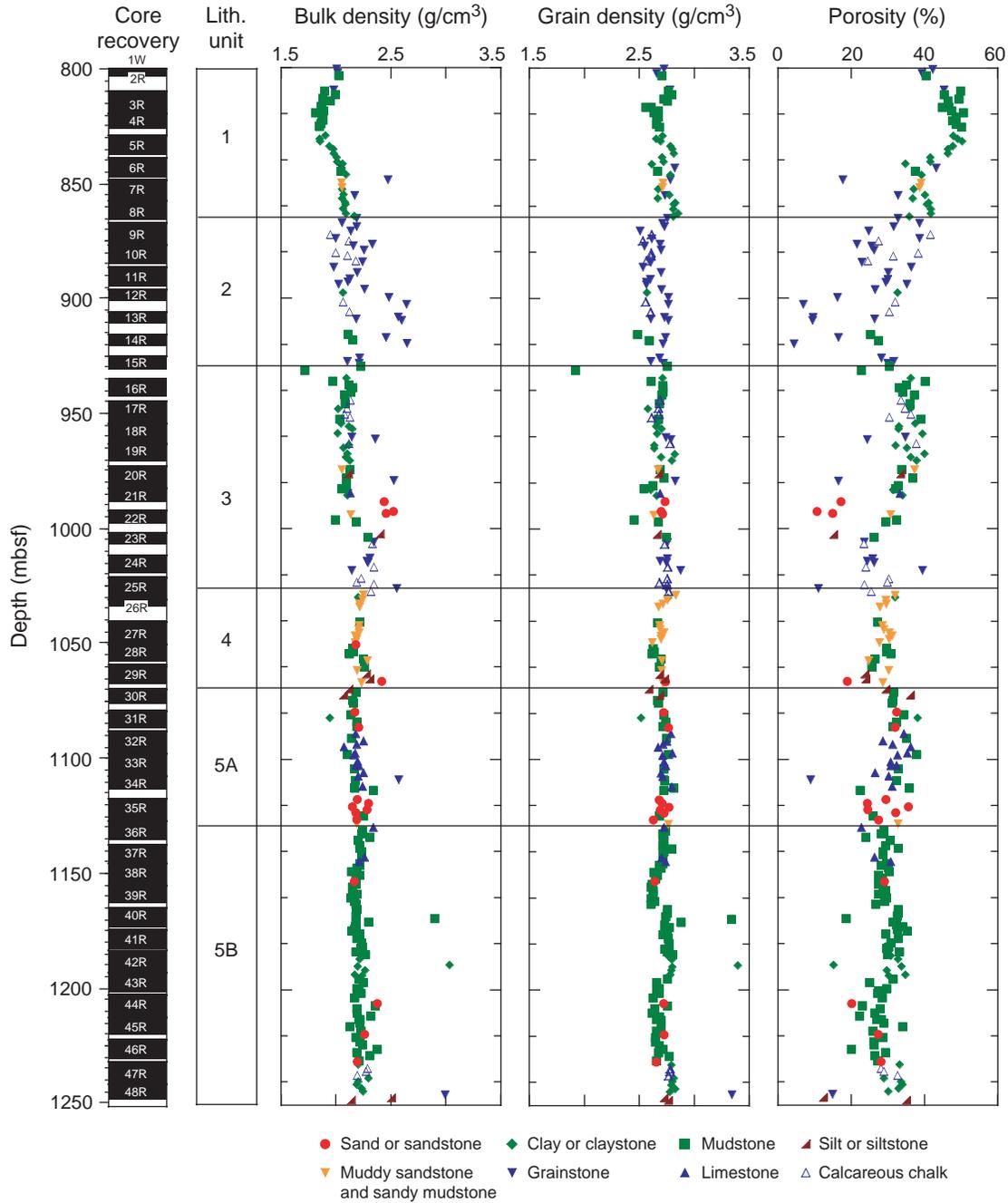


Figure F3. Porosity vs. depth for a select set of lithologies in Hole 1276A. Best-fit (Athy's law) porosity vs. depth for the general lithologies recovered in the hole (except carbonate/siderite concretions, well-lithified carbonate-cemented sandstones, and those sediments that are hornfels) are shown in blue (Tucholke, Si-buet, Klaus, et al., 2004).

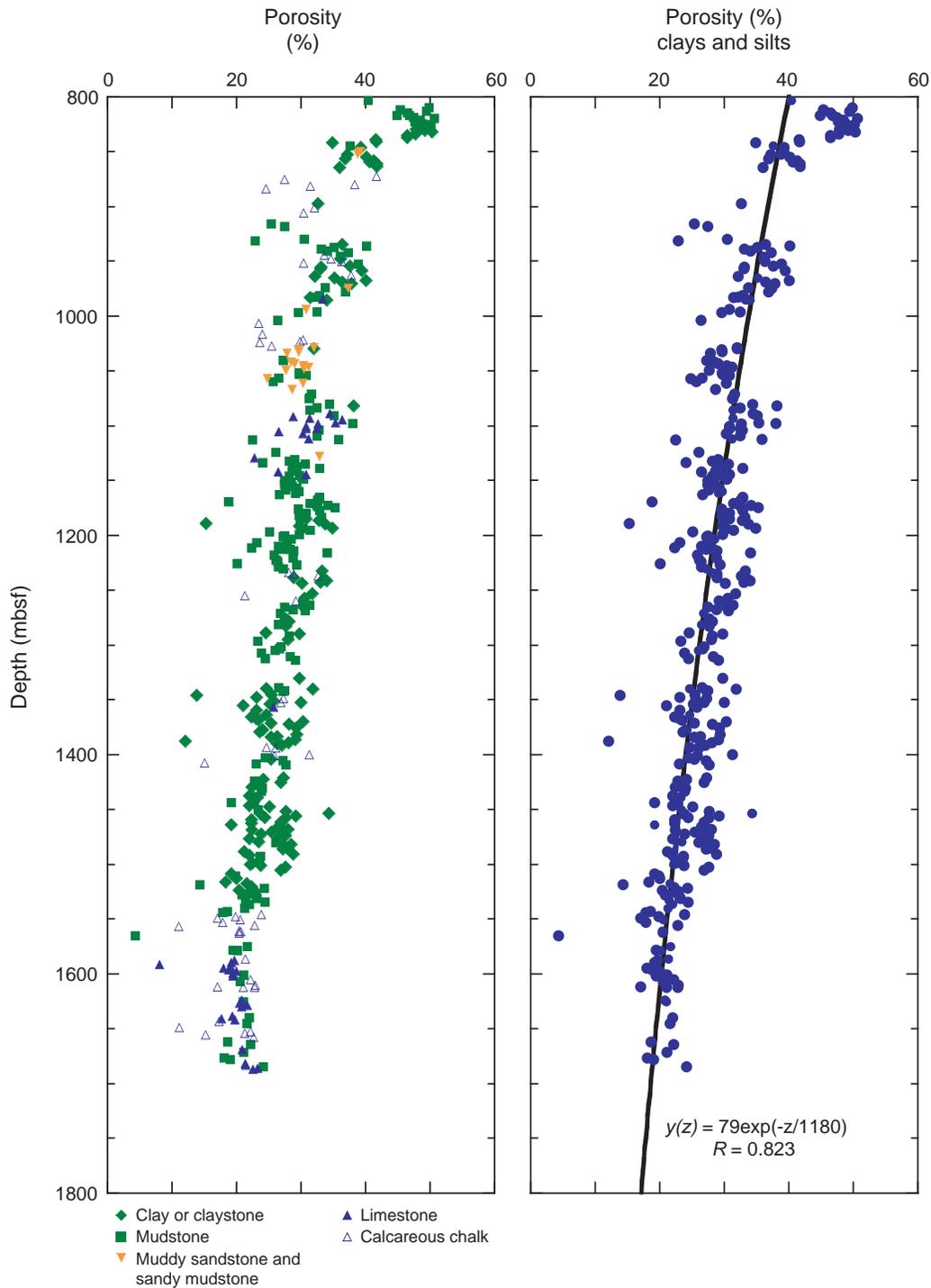


Figure F4. Digital core images (Core 210-1276A-68R) and associated natural gamma ray (NGR) values and x-direction velocity. Major sand-rich turbidites (red dots) are characterized by low NGR values, whereas clay-rich units (green squares and diamonds) correlate with high NGR values (Tucholke, Sibuet, Klaus, et al., 2004). The shape of the NGR response appears to be a function of grain size distribution within the upper part of the turbidite but not the base. In contrast, velocity probably is affected by both grain size and carbonate cementation.

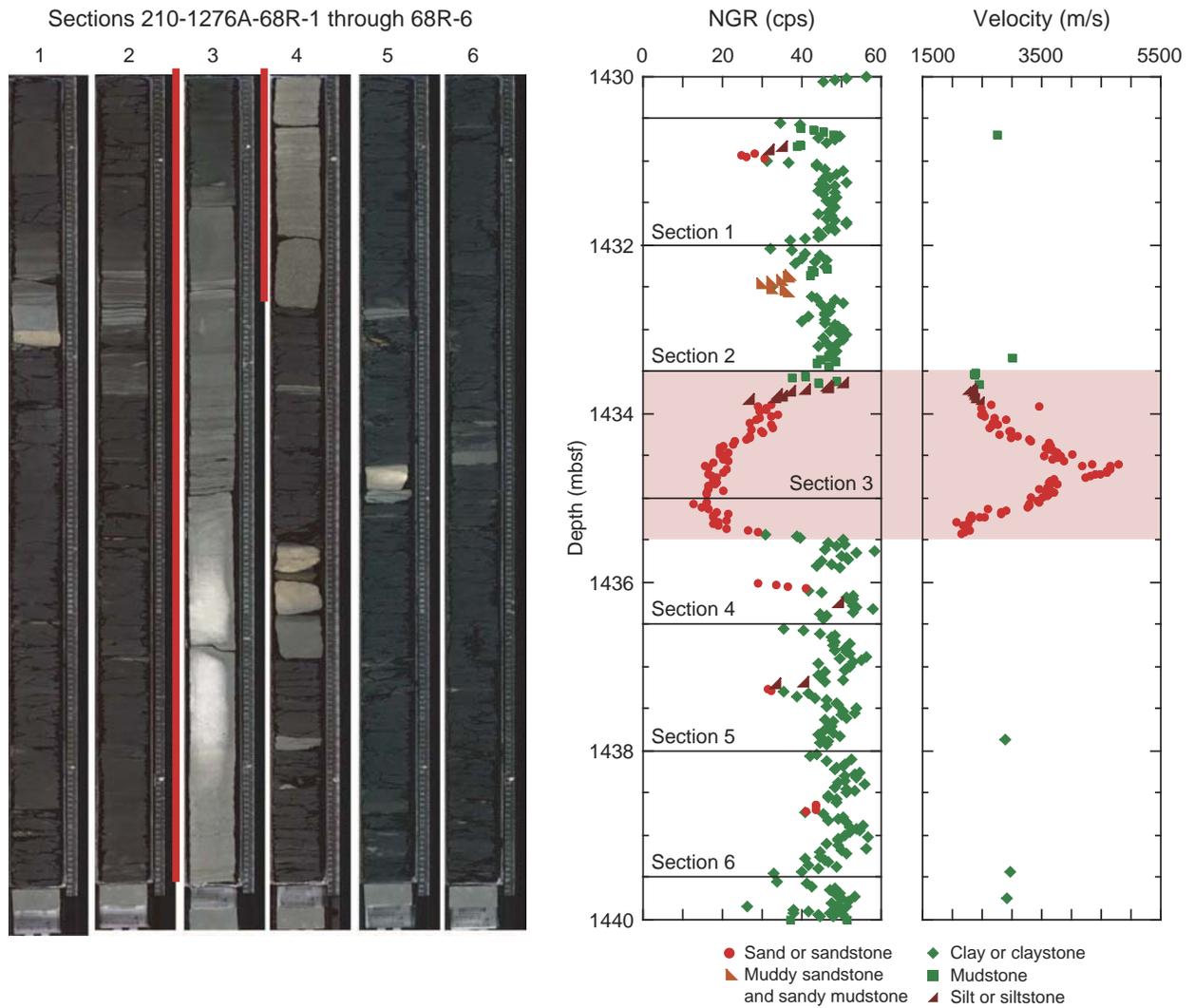


Table T1. Example of a few items from the rock name master list (Ranger, 2002).

ASCII code	Rock name
1286	Sand or sandstone
1287	Silty sand
1288	Clayey sand
1289	Silt or siltstone
1290	Sandy silt
1291	Clayey silt

Note: The entire list has hundreds of entries.

Table T2. Grain size master list as used on Leg 210 (Ranger, 2002).

ASCII code	Grain size name
0	Cobble
1	Pebble
2	Granule
3	Very coarse
4	Coarse
5	Medium
6	Fine
7	Very fine
8	Silt
9	Clay

Table AT1. Modified lithology (LTH) data records from AppleCORE for Core 210-1276A-39R (Ranger, 2002).

Leg	Site	Hole	Core	Coring method	Data record type code	Core	Section	Depth (mbsf)		Major lithology		Minor lithology		Third lithology		Contact code
								Top of interval	Base of interval	Code	Bedding thickness code	%	Code	%	Code	
210	1276	A	39	R	LTH	39	1	1155.32	1155.36	1289	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	1	1155.36	1155.74	3299	999	0	999	0	999	392
210	1276	A	39	R	LTH	39	1	1155.74	1155.79	1289	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	2	1155.79	1156.77	3299	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	2	1156.77	1156.79	1286	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	2	1156.79	1156.87	1304	1	50	1295	0	999	999
210	1276	A	39	R	LTH	39	2	1156.87	1156.89	1286	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	2	1156.89	1156.94	3299	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	2	1156.94	1157.12	1304	1	50	1295	0	999	999
210	1276	A	39	R	LTH	39	3	1157.12	1158.84	3299	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	3	1158.84	1159.21	1304	1	50	1295	0	999	999
210	1276	A	39	R	LTH	39	4	1159.21	1160.03	3299	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	4	1160.03	1160.23	1295	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	4	1160.23	1160.49	3299	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	4	1160.49	1160.51	1289	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	5	1160.51	1162.17	3299	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	5	1162.17	1162.21	1304	1	50	1295	0	999	999
210	1276	A	39	R	LTH	39	5	1162.21	1162.25	3299	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	5	1162.25	1162.29	1304	1	50	1295	0	999	999
210	1276	A	39	R	LTH	39	6	1162.29	1162.93	3299	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	6	1162.93	1162.96	1304	1	50	1295	0	999	999
210	1276	A	39	R	LTH	39	6	1162.96	1163.41	3299	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	6	1163.41	1163.43	1289	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	6	1163.43	1163.81	3299	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	6	1163.81	1163.83	1304	1	50	1295	0	999	999
210	1276	A	39	R	LTH	39	6	1163.83	1164.03	3299	999	0	999	0	999	999
210	1276	A	39	R	LTH	39	7	1164.03	1164.13	999	999	0	999	0	999	999

Notes: Leg, site, hole, core, and coring method are derived from the remark (RMK) record of the base AppleCORE dump. Data record type code is from Column 1 of the AppleCORE record. The second core column is from Column 2 of the AppleCORE record (optional output in base AppleCORE dump, not described in latest AppleCORE manual, but present in records). Section is from Column 3 of the AppleCORE record (optional output in base AppleCORE dump, not described in latest AppleCORE manual, but present in records). Top and base of interval depth are from Columns 4 and 5 of the AppleCORE record, respectively. Major lithology code and bedding thickness code are from Columns 6 and 7 of the AppleCORE record, respectively. Minor lithology percent and code are from Columns 8 and 9 of the AppleCORE record, respectively. Third lithology percent and code are from Columns 10 and 11 of the AppleCORE record, respectively. Contact code is from Column 12 of the AppleCORE record.

Table AT2. Modified grain Size (GRS) data records from AppleCORE for Core 210-1276A-39R (Ranger, 2002).

Leg	Site	Hole	Core	Coring method	Data record type code	Core	Section	Depth (mbsf)		Major grain size code	Unused data				
								Top of interval	Base of interval						
210	1276	A	39	R	GRS	39	1	1155.2	1155.31	8	999	999	999	999	999
210	1276	A	39	R	GRS	39	1	1155.31	1155.36	7	999	999	999	999	999
210	1276	A	39	R	GRS	39	1	1155.36	1155.74	8	999	999	999	999	999
210	1276	A	39	R	GRS	39	1	1155.74	1155.79	7	999	999	999	999	999
210	1276	A	39	R	GRS	39	2	1155.79	1156.77	8	999	999	999	999	999
210	1276	A	39	R	GRS	39	2	1156.77	1156.79	7	999	999	999	999	999
210	1276	A	39	R	GRS	39	2	1156.79	1156.87	9	999	999	999	999	999
210	1276	A	39	R	GRS	39	2	1156.87	1156.89	7	999	999	999	999	999
210	1276	A	39	R	GRS	39	2	1156.89	1156.94	8	999	999	999	999	999
210	1276	A	39	R	GRS	39	2	1156.94	1157.12	9	999	999	999	999	999
210	1276	A	39	R	GRS	39	3	1157.12	1158.84	8	999	999	999	999	999
210	1276	A	39	R	GRS	39	3	1158.84	1159.21	9	999	999	999	999	999
210	1276	A	39	R	GRS	39	4	1159.21	1160.03	8	999	999	999	999	999
210	1276	A	39	R	GRS	39	4	1160.03	1160.23	9	999	999	999	999	999
210	1276	A	39	R	GRS	39	4	1160.23	1160.49	8	999	999	999	999	999
210	1276	A	39	R	GRS	39	4	1160.49	1160.51	7	999	999	999	999	999
210	1276	A	39	R	GRS	39	5	1160.51	1162.18	8	999	999	999	999	999
210	1276	A	39	R	GRS	39	5	1162.18	1162.20	7	999	999	999	999	999
210	1276	A	39	R	GRS	39	5	1162.20	1162.26	8	999	999	999	999	999
210	1276	A	39	R	GRS	39	5	1162.26	1162.30	7	999	999	999	999	999
210	1276	A	39	R	GRS	39	6	1162.30	1162.93	8	999	999	999	999	999
210	1276	A	39	R	GRS	39	6	1162.93	1162.96	9	999	999	999	999	999
210	1276	A	39	R	GRS	39	6	1162.96	1163.41	8	999	999	999	999	999
210	1276	A	39	R	GRS	39	6	1163.41	1163.44	7	999	999	999	999	999
210	1276	A	39	R	GRS	39	6	1163.44	1163.81	8	999	999	999	999	999
210	1276	A	39	R	GRS	39	6	1163.81	1163.84	9	999	999	999	999	999
210	1276	A	39	R	GRS	39	6	1163.84	1164.03	8	999	999	999	999	999

Notes: Leg, site, hole, core, and coring method are derived from the remark (RMK) record of the base AppleCORE dump. Data record type code is from Column 1 of the AppleCORE record. The second core column is from Column 2 of the AppleCORE record (optional output in base AppleCORE dump, not described in latest AppleCORE manual, but present in records). Section is from Column 3 of the AppleCORE record (optional output in base AppleCORE dump, not described in latest AppleCORE manual, but present in records). Top and base of interval depth are from Columns 4 and 5 of the AppleCORE record, respectively.

Table AT3. Modified diagenesis (DIA) data records from AppleCORE for core 210-1276A-39R (Ranger, 2002).

Leg	Site	Hole	Core	Coring method	Data record type code	Core	Section	Depth (mbsf)		Abundance code	Major/Subordinate code	Icon code
								Top of interval	Base of interval			
210	1276	A	39	R	DIA	39	3	1159.09	1159.10	5	1	1702

Notes: Leg, site, hole, core, and coring method are derived from the remark (RMK) record of the base AppleCORE dump. Data record type code is from Column 1 of the AppleCORE record. The second core column is from Column 2 of the AppleCORE record (optional output in base AppleCORE dump, not described in latest AppleCORE manual, but present in records). Section is from Column 3 of the AppleCORE record (optional output in base AppleCORE dump, not described in latest AppleCORE manual, but present in records). Top and base of interval depth are from Columns 4 and 5 of the AppleCORE record, respectively. For abundance code, 9 = pervasive through 1 = rare. For major/subordinate code, 0 = major and 1 = subordinate. Icon code specifies the type of diagenesis (1702 = nodule/concretion, general).