Field Processing Techniques used by U.S.G.S. 1991 Drilling Operations in the Upper Klamath Basin, Oregon and California

by

David P. Adam

U.S. Geological Survey

Open-File Report No. 93-20

1993

U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

FIELD CORE PROCESSING TECHNIQUES USED BY U.S.G.S. 1991 DRILLING OPERATIONS IN THE UPPER KLAMATH BASIN, OREGON AND CALIFORNIA

By

David P. Adam[1]

U.S. GEOLOGICAL SURVEY OPEN-FILE REPORT 93-20

[1]Menlo Park, CA 94025

Introduction

As part of a series of investigations designed to study the Quaternary climatic histories of the western U.S. and the adjacent northeastern Pacific Ocean, the Global Change Program of the U.S. Geological Survey collected a series of sediment cores near Klamath Falls, Oregon, in the fall of 1991. This report presents basic data concerning the drilling processes and core curation procedures for those cores.

Drilling operations

Coring was done using a conventional rotary drill rig, drilling mud, and a 3" (7.62 cm) core barrel, except at the top of the hole, where Shelby tubes were used. Most drilling was done with a 15-foot-long core barrel. Unless circumstances dictated otherwise, cores were recovered in 10-foot (3-meter) drives. Cores were split into sections ≤1.5 m long for transport and storage.

Core recovery and preservation

The generalized system used for recovering, logging, and preserving the cores taken on the 1991 Klamath Falls field operation is described below. Each trip down the drill hole is referred to as a *drive*; the same term is used to refer to the sediment recovered during a drive. Drives were numbered sequentially from the top of each hole. The shorter (≤1.5 m) sections into which drives were split after logging are referred to as *slugs*; slugs were designated A, B, and C, starting at the top of the drive.

At the conclusion of each drive, the drill stem and core barrel were removed from the hole. The core barrel liner (containing the core) was removed from the barrel and split in half to expose the core. The upper surface of the core was then scraped clean of drilling mud and any disturbed sediment using wet rags and/or a spatula as appropriate. The entire core was then transferred to a table for field description, still in the core liner half. Two sets of core barrel liners were used, so that one set could be used for drilling while the other set held the core from the previous drive for logging. The core logging table was covered for half its width by corrugated fiberglass roofing panels to provide a stable surface on which the core would not roll. The fiberglass surface was also easy to keep clean under field conditions.

Because drives were split into ≤1.5-m slugs for curation and storage, the first step in logging the drive was to determine where the drive would be cut into slugs. Breakpoints were chosen to avoid disturbing interesting features of the core. Drive and slug boundary data and related information were entered onto a preprinted form (Appendix A; a Postscript program to produce the form is also provided). Because our drilling equipment used feet as primary measurement units and the drillers maintained their records in feet and inches, the top and bottom depths for each drive were recorded in feet and inches as well. Once the core was handed over to the scientific crew, all further measurements used the metric system. The positions of the top and bottom of each slug were recorded as depths in centimeters below the top of the drive.

Slugs were logged on another preprinted form (Appendix B) for general lithology, color, sedimentary structures, and macrofossils. Small samples of any light-colored tephra layers were taken in the field, and any delicate units (such as fossils or thin tephra layers) that seemed

unlikely to survive the core-wrapping process were also sampled before the core was wrapped. The amount of detail recorded during logging was sometimes limited because of the imminent arrival of the next core drive or by failing light at dusk.

Decisions as to where to split a drive into slugs were made before logging began, so that each slug could be logged as it would be stored; both field logging and later measurements and observations could thus be made relative to the top of each slug. This system makes it relatively easy to refer back to the core descriptions and cores later without the need to reassemble each drive from its constituent slugs.

Each slug was wrapped in Saran Wrap as a vapor barrier and stored inside a *shell* made of PVC plastic pipe sawed in half lengthwise using a bandsaw. These shells were cut into 5-foot (1.5-m) lengths prior to going into the field. Each shell held up to 1.5 meters of core.

Before the core could be wrapped, it was necessary to remove it from the core barrel liner (which served as a tray during the logging). The first step in removing the core was to insert a spatula between the core and the inside of the liner along both sides of the core to loosen it as much as possible. Next, a piece of Saran Wrap as long as each slug and 11.5" wide (standard grocery-store Saran Wrap) was placed on top of each slug (Figure 1A) to prevent the slug from sticking to the next shell (described below) or getting it dirty.

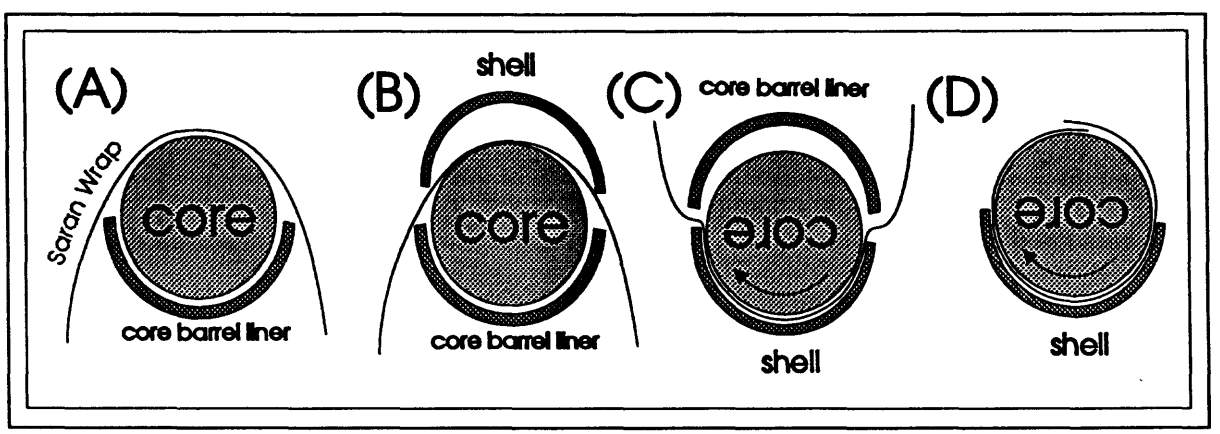


Figure 1.--Schematic cross-section of the first stage in wrapping a core slug.

Once the 11.5" Saran Wrap was in place, a shell half was placed over the core (Figure 1B). For a single slug, the shell half simply needed to cover the slug completely before the core barrel liner was inverted to dislodge the slug (Figure 1C). In the case of a drive split into two slugs, a separate shell was placed over each slug, and the two shells were butted together at the point where the slugs met. Extra caution was needed in inverting the core barrel with two shells to avoid dropping the shells or cores. In the case of three-slug drives, the two end slugs were covered with shells as above, and the third (middle) shell was then perched on

top of the other two, overlapping a bit at each end. Inverting such an arrangement generally required four people because of the number of pieces of shell and the weight of the long core.

Inverting the core barrel liner was never a problem. Getting the core to separate from the liner with a minimum of damage was often far more difficult. Sometimes the core could be dislodged by banging on the outside of the core barrel liner with a hammer; long spatulas were also sometimes inserted between the core and the liner while the core was hanging "upside down" in the inverted liner. However, unless the core came out of the liner in a single piece, some disturbance of the core related to the fracturing usually resulted. The initial wrapping step was completed by overlapping the two sides of the Saran Wrap across the top of the core (Figure 1D).

After the slug was transferred to its shell, it was wrapped tightly in heavy-duty Saran Wrap 17.5" wide using a wrapping procedure that takes longer to describe than to perform (see Figure 2). A strip of Saran Wrap about 30-40 cm longer than the core slug was laid along the

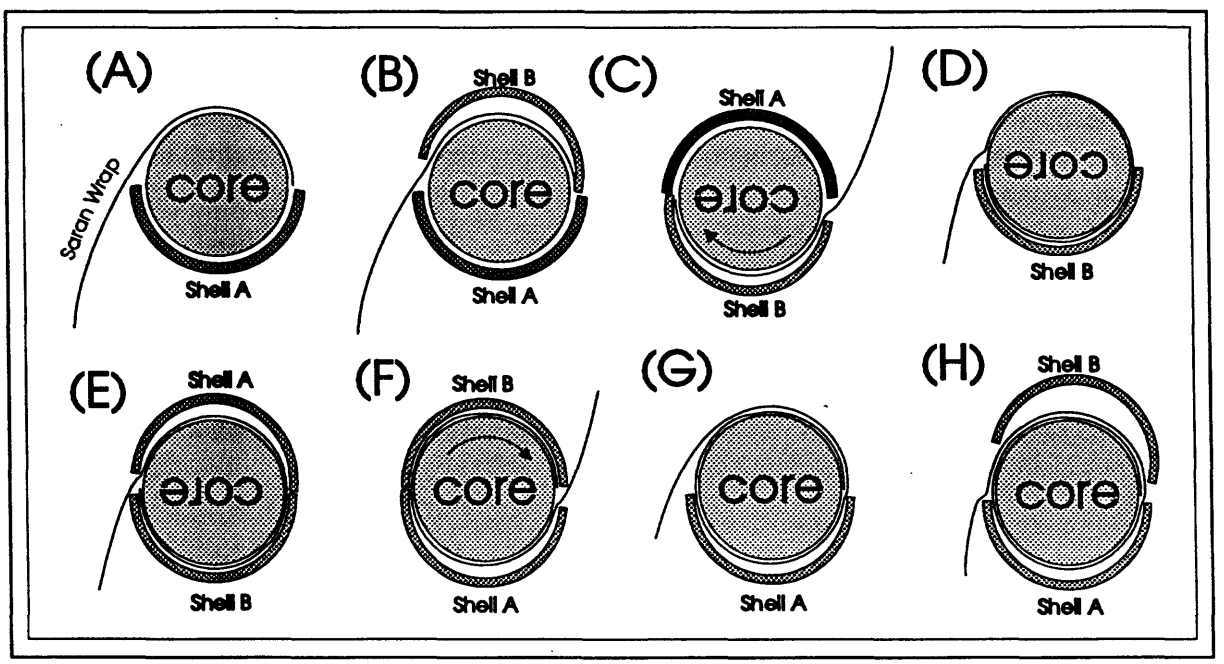


Figure 2.--Schematic diagram of steps used during second stage of wrapping core slugs (seen in cross-section). The inner layer of Saran Wrap from the first stage is not shown here.

core lengthwise so that one edge covered the core and the other end hung loose (Figure 2A). The other half of the shell was then placed over the core (Figure 2B) and the core was rotated into it, with the top of the core moving away from the loose side of the Saran Wrap (Figure 2C). The shell half that first held the core was now on top. It was removed (Figure 2D), the loose end of the Saran Wrap was wrapped tightly across the core, the shell was replaced (Figure 2E), and the core was then given another half turn (Figure 2F). This process was repeated until the wide Saran Wrap was wrapped tightly around the core. Just before the last half turn, the ends of the Saran Wrap were folded over the end of the core to form a vapor seal.

Once the core was completely wrapped, a label (Appendix C) was fastened to the outside of the Saran Wrap and covered with label-protection tape; two duplicate labels were prepared for the outside of the shells. Blank labels for each site were prepared and bound into pads before going into the field. The binding was well worth the effort, particularly on windy days. Labels were coded with a separate color for each site.

Once the wrapped core was labeled, the two halves of the shell were taped tightly together using glass-fiber tape every 50 cm or so. It was also necessary to place an "X" of tape across each end of the assembled shell to keep the core from sliding out, but the exposed adhesive facing the core could not be allowed to touch the Saran Wrap, lest it tear. Rags, paper towels, or polystyrene cups were used as protective barriers between the wrapped cores and the wrapping tape. Labels on the outside of the shell were placed in at least two locations, and each such label was covered with label-protection tape.

The final taping process was rather awkward at first, and required one person to hold the core slug while another person did the taping. To make this part of the operation simpler and more efficient, we made a wooden rack or *wrapping horse* (see Figure 3). This device was easy to construct and well worth the small effort required.

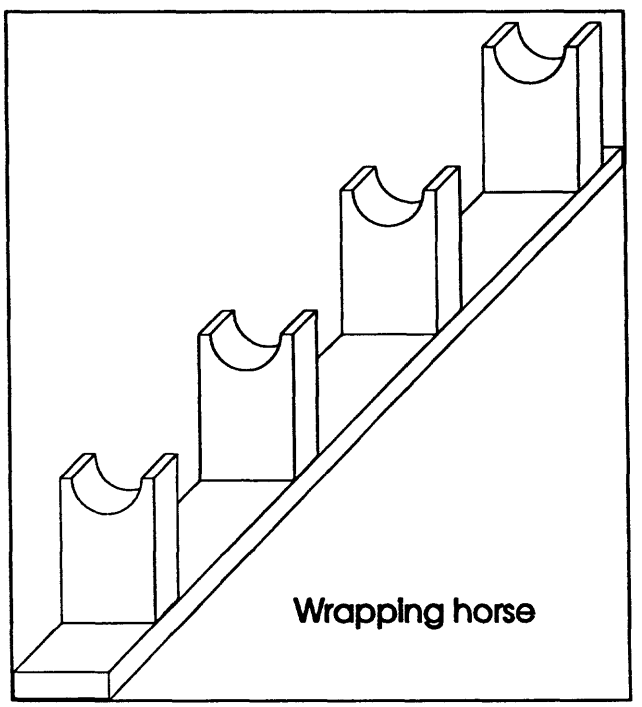


Figure 3.--Schematic drawing of a core wrapping horse.

APPENDICES

Appendix A. Sheet for recording drive information.

Appendix B. Sheet for recording slug log.

Appendix C. Example of sheet of labels.

Each Appendix includes an example of a data sheet, followed by a listing of the Postscript program that produced it. Each program may be used by typing it into an ASCII file and sending that file to any Postscript printer. As listed, each program can produce a sheet for any one of a number of sites by modification of the "/sitename (...) def" lines. The character string between the parentheses is used to produce the site name on the data sheet. Any characters on a line following a percent character ("%") are considered to be comments and are ignored by the printer. Different site names can be implemented by deleting the leading "%" from the "/sitename .." lines in the program; the last such line without a leading "%" will be the one used by the program. Drive and slug sheets were color coded (see lower left corner of each form). Color coding simplifies record keeping; if copies are only made onto white paper, it is easy to distinguish between colored originals and white copies.

Buck Lake, Klamath County, Oregon

Core____ Drive_____ Number of slugs____ Date_____

Logged by_____ Time_____

Driller's depths:

Top of drive: _____ feet

Bottom of drive: _____ feet

Slug boundaries:

	TOP	BOTTOM
Slug A		
Slug B		
Slug C		
Slug D		
Slug E		

Slug boundaries are measured in centimeters below the top of the drive

Comments:_____

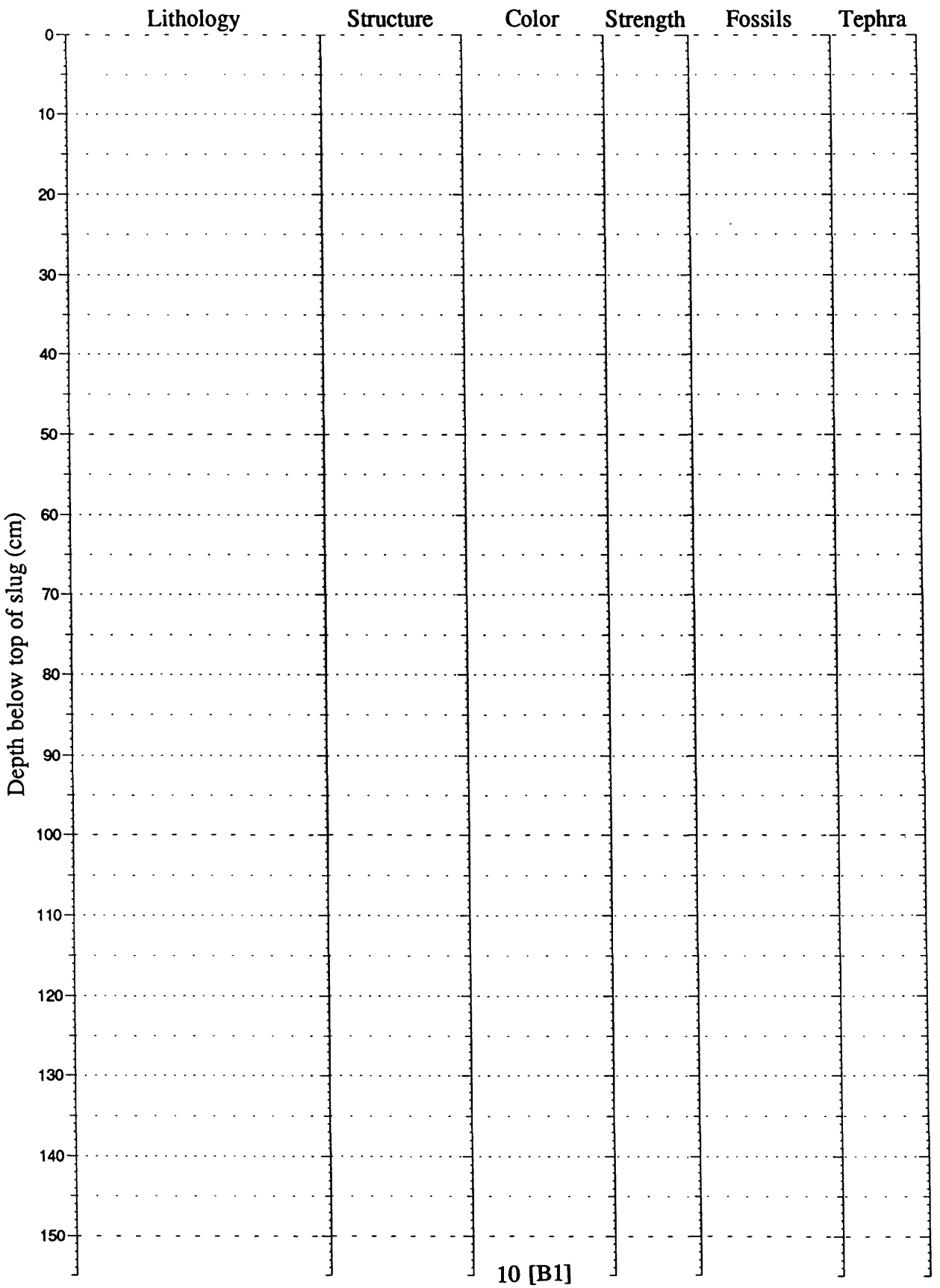
```
(PS Jet accepting data...\r\n) print flush
/inch {72 mul} bind def
/height 8 def
/dingbats /ZapfDingbats findfont height scalefont def
/roman /Times-Roman findfont height scalefont def
/midroman /Times-Roman findfont 10 scalefont def
/buff 10 string def
/#copies 1 def

/y_scale_factor 30 def
/x_scale_factor  1 def

/centerstring
  { dup   %make a copy of the string
 stringwidth %find its length
 pop   %discard y part of length
 2 div  %take half of x part
 neg  %change its sign
 0 rmoveto show } def  %end definition of center_string

/sitename (Buck Lake, Klamath County, Oregon) def
% /sitename (Caledonia Marsh, Klamath County, Oregon) def
% /sitename (Wocus Marsh, Klamath County, Oregon) def
% /sitename (Round Lake, Klamath County, Oregon) def
% /sitename (Butte Valley, Siskiyou County, California) def
% /sitename (Grass Lake, Siskiyou County, California) def

/ublank
 { 2 -2 rmoveto 0 rlineto 12 2 rmoveto } def

/Times-Roman findfont 24 scalefont setfont
gsave
4.25 inch 10.0 inch translate
0 0 moveto
sitename centerstring
/Helvetica-Bold findfont 15 scalefont setfont
0.01 setlinewidth
-3 inch -0.4 inch moveto
(Core) show 0.4 inch ublank
(Drive) show 0.5 inch ublank
(Number of slugs) show 0.4 inch ublank
(Date) show 0.8 inch ublank
-3 inch -0.8 inch moveto
(Logged by) show 3 inch ublank
(Time) show 1 inch ublank
-2.3 inch -1.2 inch moveto
(Driller's depths:) show
-1.6 inch -1.6 inch moveto
(Top of drive:) show
0.2 inch -1.6 inch moveto
1 inch ublank (feet) show
-1.6 inch -2 inch moveto
(Bottom of drive:) show
0.2 inch -2 inch moveto
1 inch ublank (feet) show
stroke
-2.3 inch -2.5 inch moveto
(Slug boundaries:) show
-1.6 inch -2.7 inch moveto
0 -2.3 inch rlineto
3.2 inch 0 rlineto
0 2.3 inch rlineto
closepath
2 setlinewidth
stroke
-1.6 inch -3 inch moveto
3.2 inch 0 rlineto
```

```
1 setlinewidth
stroke
-1.5 inch -3.3 inch moveto
(Slug A) show
-1.6 inch -3.4 inch moveto
3.2 inch 0 rlineto
-1.5 inch -3.7 inch moveto
(Slug B) show
-1.6 inch -3.8 inch moveto
3.2 inch 0 rlineto
-1.5 inch -4.1 inch moveto
(Slug C) show
-1.6 inch -4.2 inch moveto
3.2 inch 0 rlineto
-1.5 inch -4.5 inch moveto
(Slug D) show
-1.6 inch -4.6 inch moveto
3.2 inch 0 rlineto
-1.5 inch -4.9 inch moveto
(Slug E) show
0.5 setlinewidth
stroke
-0.7 inch -2.7 inch moveto
0 -2.3 inch rlineto
0.45 inch -2.7 inch moveto
0 -2.3 inch rlineto
stroke
/Helvetica findfont 12 scalefont setfont
-0.125 inch -2.9 inch moveto
(TOP) centerstring
1.025 inch -2.9 inch moveto
(BOTTOM) centerstring
0 -5.3 inch moveto
(Slug boundaries are measured in centimeters) centerstring
0 -5.55 inch moveto
(below the top of the drive) centerstring
grestore

/Helvetica-Bold findfont 15 scalefont setfont
0.01 setlinewidth
gsave
1 inch 4.0 inch translate
0 0 moveto
/y 0 def
(Comments:) show
2 -2 rmoveto
6.5 inch -2 lineto
1 1 8
 { pop /y dup load 0.35 inch sub def
   0 y 2 sub moveto 6.5 inch 0 rlineto } for
stroke
grestore

/Helvetica findfont 6 scalefont setfont
18 20 moveto
(DRIVELOG -- 9/2/91 -- Original is PINK) show

(Processing is complete!\r\n) print flush
showpage
```

Buck Lake, Klamath County, Oregon

Core____ Drive____ Slug____ Date_____ Time_____

Described by _____



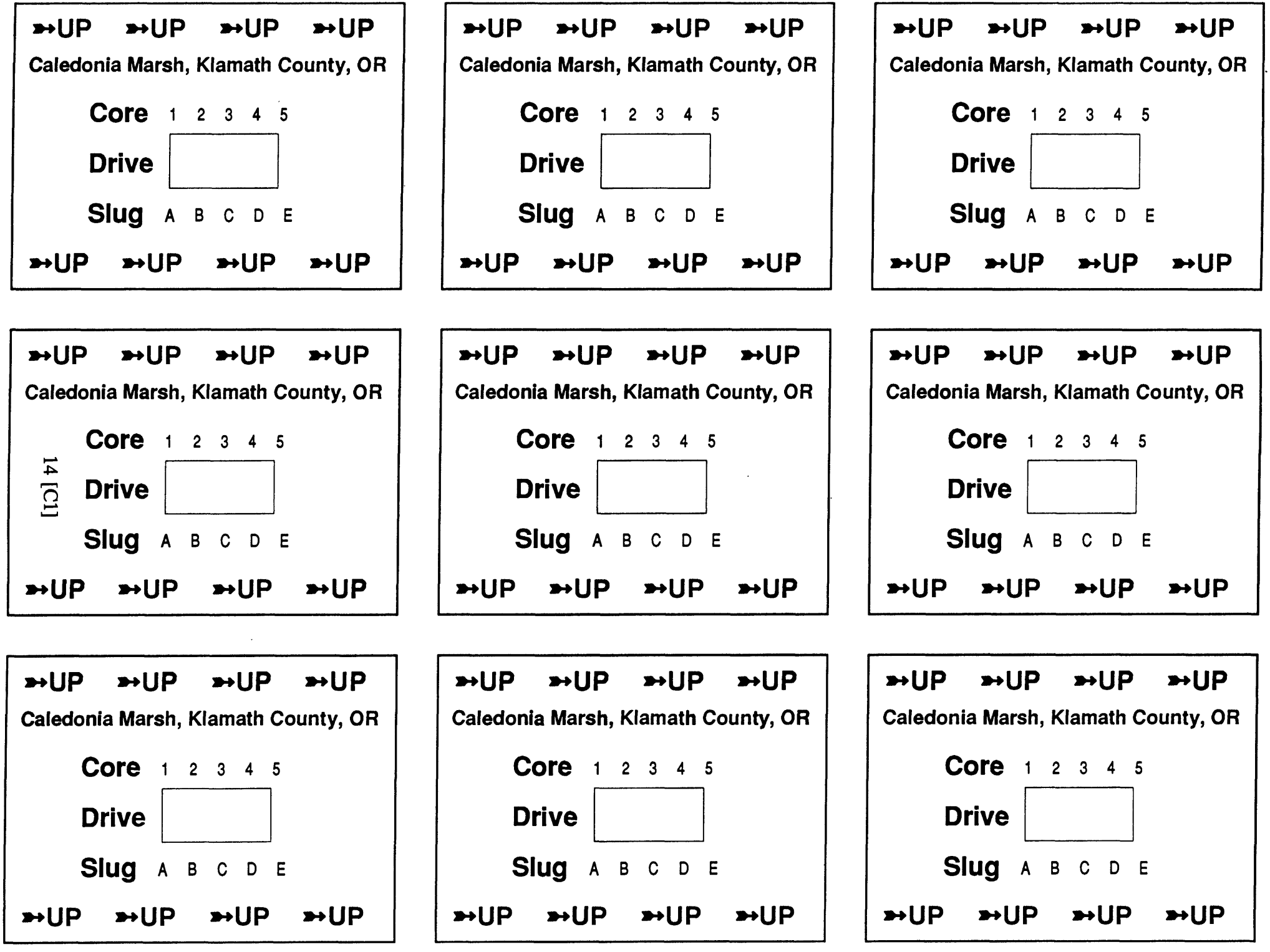
10 [B1]

SLUGLOG – 10/2/91 – Original is YELLOW

```
/inch {72 mul} bind def

/centerstring
  { dup stringwidth pop 2 div neg 0 rmoveto show } def

%  statusdict
%    begin
%      /manualfeed true def
%    end

(PS Jet accepting data...\r\n) print flush
/buff 10 string def
/#copies 1 def

/y_scale_factor 4.0 def
/x_scale_factor 1 def
/xlength 6.0 inch def
/label_axis true def
/y_heading (Depth below top of slug (cm)) def

/scale_to_points
  { 1 x_scale_factor div
 -1 y_scale_factor div
 scale
 } def

/scale_to_user_space
  { x_scale_factor
 y_scale_factor -1 mul
 scale
 } def

/bigtick
 { gsave -5.00 0 rlineto stroke grestore } def

/mtick
 { gsave -3.00 0 rlineto stroke grestore } def

/stick
 { gsave -1.00 0 rlineto stroke grestore } def

/tickit { y 10 mod 0 eq
  { bigtick }
  { y 5 mod 0 eq
   { mtick }
   { stick }
    ifelse }
  ifelse } def

/ylabel
 { y 10 mod 0 eq
    { scale_to_points
      y buff cvs dup stringwidth pop 6 add neg -3 rmoveto show
      scale_to_user_space
      x y moveto } if
 } def

/axinc
 { pop
   [] 0 setdash
   /y dup load 1 add def
   x y lineto
   tickit
   label_axis { ylabel } if
 } def

/daxis
```

```
 { /y 0 def
   /x 0 def
   x y moveto
   label_axis { ylabel } if
   bigtick
   1 1 155 { axinc } for
   stroke } def

/gl { 0 y moveto xlength 0 rlineto stroke } def

/gridlines
 { /y 0 def
   0 5 150
    { /y exch def
      y 50 mod 0 eq
        { [2 8] 0 setdash }
        { y 10 mod 0 eq
          { [0.5 4.5] 0 setdash }
          { [0.5 9.5] 0 setdash }
          ifelse }
        ifelse
      gl } for
 } def

/heading
 { /header exch def
   /colwidth exch def
   header stringwidth pop
   scale_to_points
   colwidth 2 div 4 moveto header centerstring
   scale_to_user_space
   colwidth 0 translate
   daxis } def

gsave
1.3 inch 9.3 inch translate
scale_to_user_space
0 setlinewidth
/Helvetica findfont 8 scalefont setfont
daxis
gsave
-0.35 inch 77.5 moveto
scale_to_points
90 rotate
/Times-Roman findfont 12 scalefont setfont
y_heading centerstring
grestore
/label_axis false def
gridlines
/Times-Roman findfont 12 scalefont setfont
1.8 inch (Lithology) heading
1 inch (Structure) heading
1.0 inch (Color) heading
0.6 inch (Strength) heading
1.0 inch (Fossils) heading
0.6 inch (Tephra) heading
grestore

/Helvetica findfont 6 scalefont setfont
18 24 moveto
(SLUGLOG -- 10/2/91 -- Original is YELLOW) show
/sitename (Buck Lake, Klamath County, Oregon) def
% /sitename (Wocus Marsh, Klamath County, Oregon) def
% /sitename (Round Lake, Klamath County, Oregon) def
% /sitename (Butte Valley, Siskiyou County, California) def
% /sitename (Grass Lake, Siskiyou County, California) def
% /sitename (Caledonia Marsh, Klamath County, Oregon) def
```

```
/ublank
 { 2 -2 rmoveto 0 rlineto 12 2 rmoveto } def

/Times-Roman findfont 20 scalefont setfont
gsave
4.25 inch 10.2 inch translate
0 0 moveto
sitename centerstring
/Helvetica findfont 15 scalefont setfont
0.01 setlinewidth
-3 inch -0.3 inch moveto
(Core) show 0.4 inch ublank
(Drive) show 0.5 inch ublank
(Slug) show 0.4 inch ublank
(Date) show 0.8 inch ublank
(Time) show 0.8 inch ublank
-2.25 inch -0.55 inch moveto
/Helvetica findfont 12 scalefont setfont
(Described by) show 3.5 inch ublank
stroke

(Processing is complete!\r\n) print flush
showpage
```


UP UP UP UP
Caledonia Marsh, Klamath County, OR
Core 1 2 3 4 5
Drive
Slug A B C D E
UP UP UP UP
14 [C1]

```
/inch {72 mul} bind def

/centerstring
  { dup stringwidth pop 2 div neg 0 rmoveto show } def

%  statusdict
%    begin
%      /manualfeed true def
%    end

(PS Jet accepting data...\r\n) print flush
/height 24 def
/dingbats /ZapfDingbats findfont height scalefont def
/roman /Times-Roman findfont height scalefont def
/midroman /Times-Roman findfont 10 scalefont def
/bold /Helvetica-Bold findfont height scalefont def
/HB18 /Helvetica-Bold findfont 18 scalefont def
/HBN16 /Helvetica-Narrow findfont 16 scalefont def
/buff 10 string def
/#copies 1 def

  /sitename (Buck Lake, Klamath County, Oregon) def
/sitename (Caledonia Marsh, Klamath County, OR) def
% /sitename (Wocus Marsh, Klamath County, Oregon) def
% /sitename (Round Lake, Klamath County, Oregon) def
% /sitename (Butte Valley, Siskiyou County, California) def
% /sitename (Grass Lake, Siskiyou County, California) def

/ublank
 { 2 -2 rmoveto 0 rlineto 12 2 rmoveto } def

/labelbox
 { gsave
   20 20 moveto
   358 0 rlineto
   0 268 rlineto
   -358 0 rlineto
   closepath
%  0.8 setgray
   stroke
   grestore } def

/labeltext
 { gsave
   2.75 inch 3.1 inch translate
   0 0 moveto
   sitename centerstring
   bold setfont
   -1.5 inch -0.65 inch moveto (Core) show
   HBN16 setfont 1 1 rmoveto
   (     1     2     3     4     5) show
   bold setfont
   -1.5 inch -1.30 inch moveto (Drive) show
   15 -15 rmoveto
   100 0 rlineto
   0 50 rlineto
   -100 0 rlineto
   0 -50 rlineto
   0.02 setlinewidth
   stroke
   -1.5 inch -1.95 inch moveto (Slug) show
   HBN16 setfont 1 1 rmoveto
   (     A     B     C     D     E) show
   grestore } def

/uparrow
 { moveto
```

```
    dingbats setfont
    (\374) show
    bold setfont
    (UP) show
  } def

/arrows
 { 0.50 inch 0.5 inch uparrow
   1.70 inch 0.5 inch uparrow
   2.90 inch 0.5 inch uparrow
   4.10 inch 0.5 inch uparrow
   0.50 inch 3.55 inch uparrow
   1.70 inch 3.55 inch uparrow
   2.90 inch 3.55 inch uparrow
   4.10 inch 3.55 inch uparrow
 } def

gsave
8.40 inch 0.10 inch translate
90 rotate
0 0 moveto
0.650 0.650 scale

/label
 { gsave
   translate
   0 0 moveto
   labelbox
   /Helvetica-Bold findfont 18 scalefont setfont
   labeltext
   arrows
   grestore } def

  0   0 label
396   0 label
792   0 label
  0 306 label
396 306 label
792 306 label
  0 612 label
396 612 label
792 612 label

grestore

(Processing is complete!\r\n) print flush
showpage
```