LEGIBILITY NOTICE

A major purpose of the Technical Information Center is to provide the broadest dissemination possible of information contained in DOE's Research and Development Reports to business, industry, the academic community, and federal, state and local governments.

Although a small portion of this report is not reproducible, it is being made available to expedite the availability of information on the research discussed herein.

LA-UR -89-4215

JAN 05 1990

LA-UR--89-4215

DE90 004862

TITLE **WIRELINE SIDEWALL CORING**

AUTHOR(S) Ward L Hawkins, EES-1
Mark A. Mathews, EES-3
Peter H. Thompson, Fenix & Scisson Nevada
P.O. Box 940, Mercury, NV
Kent Jenkins, Schlumberger Well Services
7040 Salt Creek Highway, Casper, WY

SUBMITTED TO Third International Symposium on Borehole Geophysics for Minerals, Geotechnical, and Groundwater Applications

Los Alamos Los Alamos National Laboratory
Los Alamos, New Mexico 87545

MASTER

WIRELINE SIDEWALL CORING

Ward L. Hawkins, Los Alamos National Laboratory, MS F659, Los Alamos, NM 87545
Mark A. Mathews, Los Alamos National Laboratory, MS C335, Los Alamos, NM 87545
Peter H. Thompson, Fenix & Scisson of Nevada, Inc., P. O. Box 940, Mercury, NV 89023
Kent Jenkins, Schlumberger Well Services, 7040 Salt Creek Highway, Casper, WY 82601

ABSTRACT

In April 1989, Schlumberger Well Services, under contract to Fenix and Scisson of Nevada, Inc., ran a wireline sidewall coring machine in exploratory hole Ue4t at the Nevada Test Site for the Los Alamos National Laboratory. The sampling project goals were to recover material for geologic characterization and to determine the effectiveness of the tool for sampling various volcanic lithologies. If a wireline tool is found to be effective, fewer expensive continuously-cored holes will be needed.

The Schlumberger Sidewall Coredriller has a maximum diameter of 5.25 inches and, with the gamma-ray unit included for stratigraphic correlation, is approximately 40 feet long. It weighs 850 pounds. All the downhole mechanical systems are hydraulic including the anchor shoe, the coring motor, the pressure on the bit and the core extraction system. Sonde functions are monitored and controlled at the surface. The tool is designed to run in fluid with the waterways in the diamond bit creating circulation to keep the bit face clean. Up to 20 cores, measuring 0.91 inches in diameter by 2 inches long, can be recovered with each run. These cores are separated in the split-sleeve catcher tube by discs automatically inserted following each coring.

Sixty-seven coring attempts were made and forty-seven samples were recovered for a recovery rate of 70%. During the initial run the tool had to be worked through several tight spots in the hole. Suspended solids at the bottom of the hole probably caused the poor results (36% recovery) for the first run due to sand clogging the core catcher tube. Recovery was 90% on the subsequent runs.

OBJECTIVE

The objective of this project was to obtain high-quality sidewall core samples from a slim hole (<12 inch diameter) with a wireline tool. Several projects at the Nevada Test Site (NTS) would benefit from a dependable sidewall coring tool for sampling previously drilled holes without the expense of drill-rig support. For applications at the NTS the tool would have to recover samples from both soft rocks (poorly indurated alluvium and non- to partially-welded tuff) and hard rocks (densely-welded tuff). Because of the relatively deep water table in the region of the NTS the tool may have to function in air-filled holes.

BACKGROUND

Hole Ue4t (Fig. 1) was selected as the site to pursue a sidewall sampling program using the Schlumberger Sidewall Coredriller. The 9.875 inch diameter hole was rotary drilled using air-foam to a total depth (TD) of 2413 feet in early 1987. Stratigraphy at the Ue4t site was described by Drellack (1988) and, based on lithologic and geophysical log correlations with nearby holes, is typical for this portion of Yucca Flat. The lithologies sampled during this operation varied from friable to well-indurated tuff. Multiple samples were required from each depth interval. The samples were examined for mineralogy and petrology as well as physical properties.

SCHLUMBERGER SIDEWALL COREDRILLER

The Schlumberger Sidewall Coredriller, which included a gamma ray module for depth correlation, has a maximum diameter of 5.25 inches and, as tested, was 39.5 feet long and weighed 850 pounds (Fig. 2). It is designed to cut 0.91 inch diameter by 2 inch long cores in holes from 6.25 to 12.75 inches in diameter. Twenty, two-inch long cores can be recovered per downhole run. Major components of the tool (Fig. 3) are: the anchor shoe, the coring motor, the core-pusher piston and the core-catcher tube.

The anchor shoe, the core pusher, the coring motor and the force on the bit are all hydraulically driven. Bit rotation is approximately 2000 rpm. Up to 3500 psi can be applied to the bit. Fluid in the hole is circulated by flutes on the side of the bit to cool and clean the bit face.

After the core sample is pushed into the core catcher, a marker disk is moved from the marker tube to the top of each sample to keep the samples separated and indexed. Should the bit become stuck in the formation the core barrel will shear from the coring motor to allow retrieval of the tool.

Surface equipment evaluates the hydraulics systems. The "weight on bit" and anchor shoe pressure are adjustable. Bit penetration from the initial contact with the hole wall to full travel is continuously monitored. Pressure in the coring motor indicates the amount of torque on the bit.

COREDRILLER OPERATIONS

The Schlumberger Sidewall Coredriller is assembled at the surface and then checked by drilling a test block. Tripping in the hole is accomplished in the travelling mode (Fig. 3a). Once the depth of interest is reached the anchor arm is extended, the core-pusher piston is pulled up out of the core barrel and the coring motor is rotated from the vertical traveling position to the horizontal (Fig. 3b). When the core bit reaches full penetration the coring motor tilts upward 5 degrees to break the core from the formation (Fig. 3c). The coring motor then returns to the vertical position and the core-pusher piston moves the sample from the core barrel to the core-catcher tube. A marker disk is kicked from the marker tube to the top of the sample following each sampling (Fig. 3d). The tool then resumes the traveling position and is moved to the next sample depth.

RESULTS

Sixty-seven coring attempts were made during five downhole runs (Table 1). Forty-seven samples were recovered. The samples ranged in length from 0.5 inches to 2.0 inches with the average length being 1.5 inches. Problems with suspended solids clogging the core catcher tube after the ninth coring attempt resulted in only 36% recovery for Run 1. Run 2 may also have been plagued with this problem (57% recovery), but as soon as there was an indication of trouble the tool was pulled from the hole and cleaned. Runs 3 and 4, which were higher in the hole where there was probably less suspended material in the fluid, obtained full recovery. Run 5 (80% recovery) was designed to test the tool in several different lithologies and in an air-filled hole.

Table 2 shows the recovery by lithology. Because the catcher tube clogged after the ninth coring attempt during Run 1, the lack of recovery for those attempts is not considered related to the lithology and they are excluded from Table 2. The effectiveness of the Schlumberger Sidewall Coredriller in the various volcanic lithologies is excellent.

An example of the application of data obtained from these samples is shown in Fig. 4 where bulk density measurements of the core are compared with geophysical log data. In this case the sample derived densities agree quite well with the log data.

CONCLUSIONS

The Schlumberger Sidewall Coredriller has proven its effectiveness in retrieving sidewall core samples from the various tuff lithologies below the fluid level in slim holes at the NTS. Problems with suspended solids clogging the core catcher could be avoided by cleaning the hole before the sampling operations begin.

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to the Field Test Division at Los Alamos National Laboratory, Schlumberger Well Services, Fenix and Scisson of Nevada, Inc., and Reynolds Engineering and Electric, Inc. for their support during these operations.

This work is supported by the United States Department of Energy.

REFERENCES

Drellack, S. L., Jr., 1988, Selected stratigraphic contacts for drill holes in LANL use areas of Yucca Flat, NTS: Fenix and Scisson, Inc., Geologic Report, DOE/NV/10322-33, 55 p.

DISCLAIMER

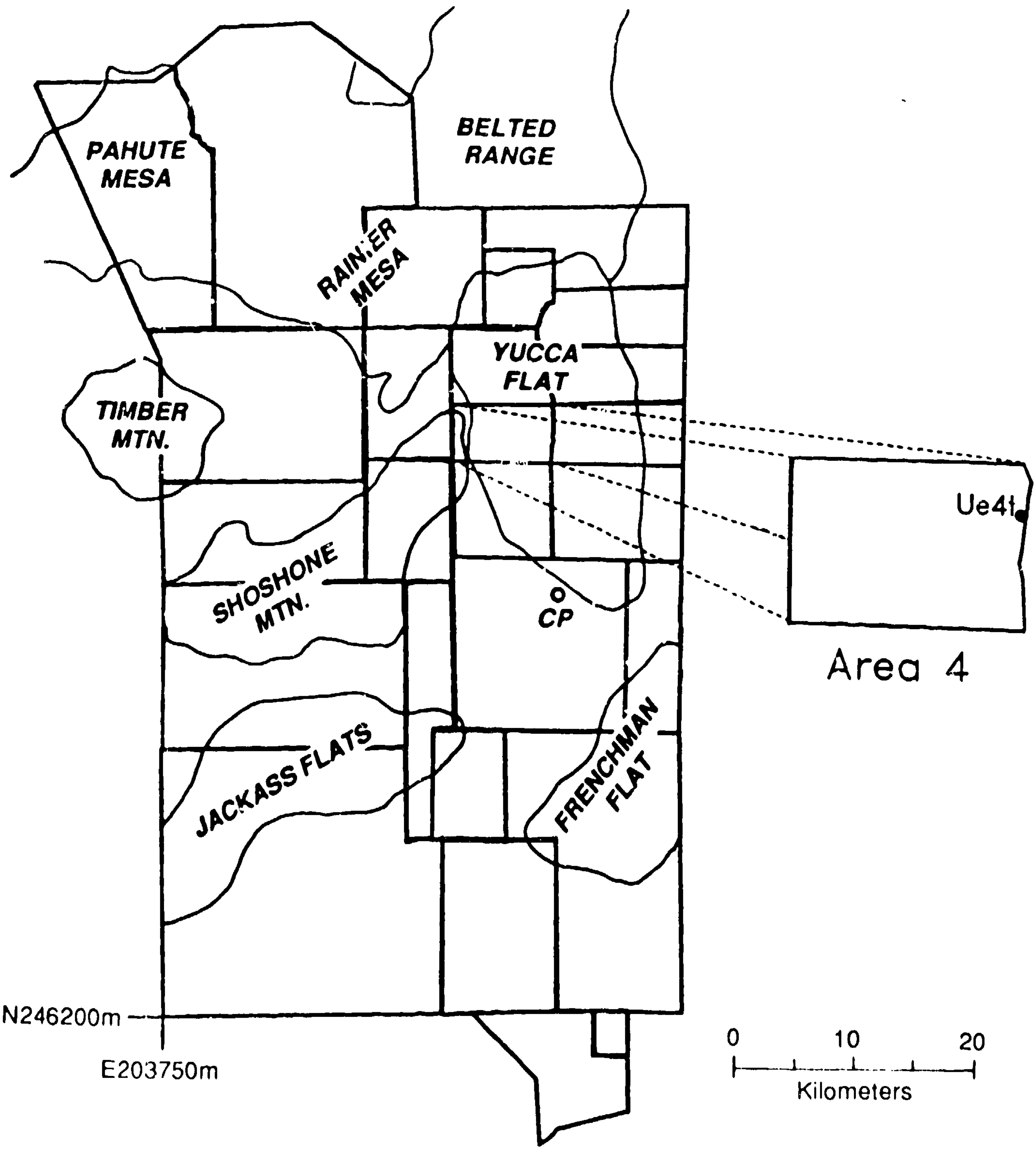

Fig. 1. Location of Ue4t within the Nevada Test Site.

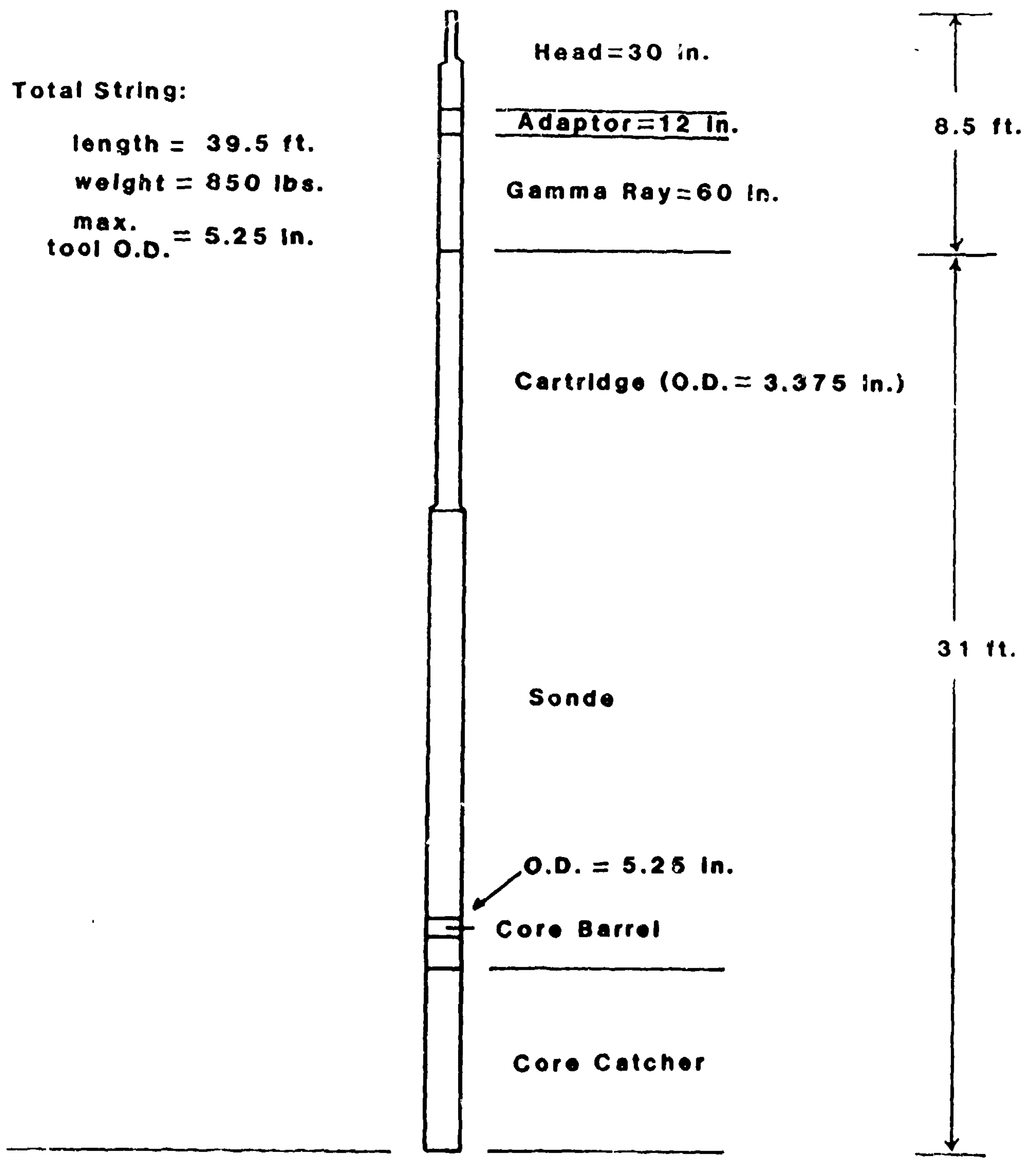

Fig. 2. Schlumberger Sidewall Coredriller (as tested)

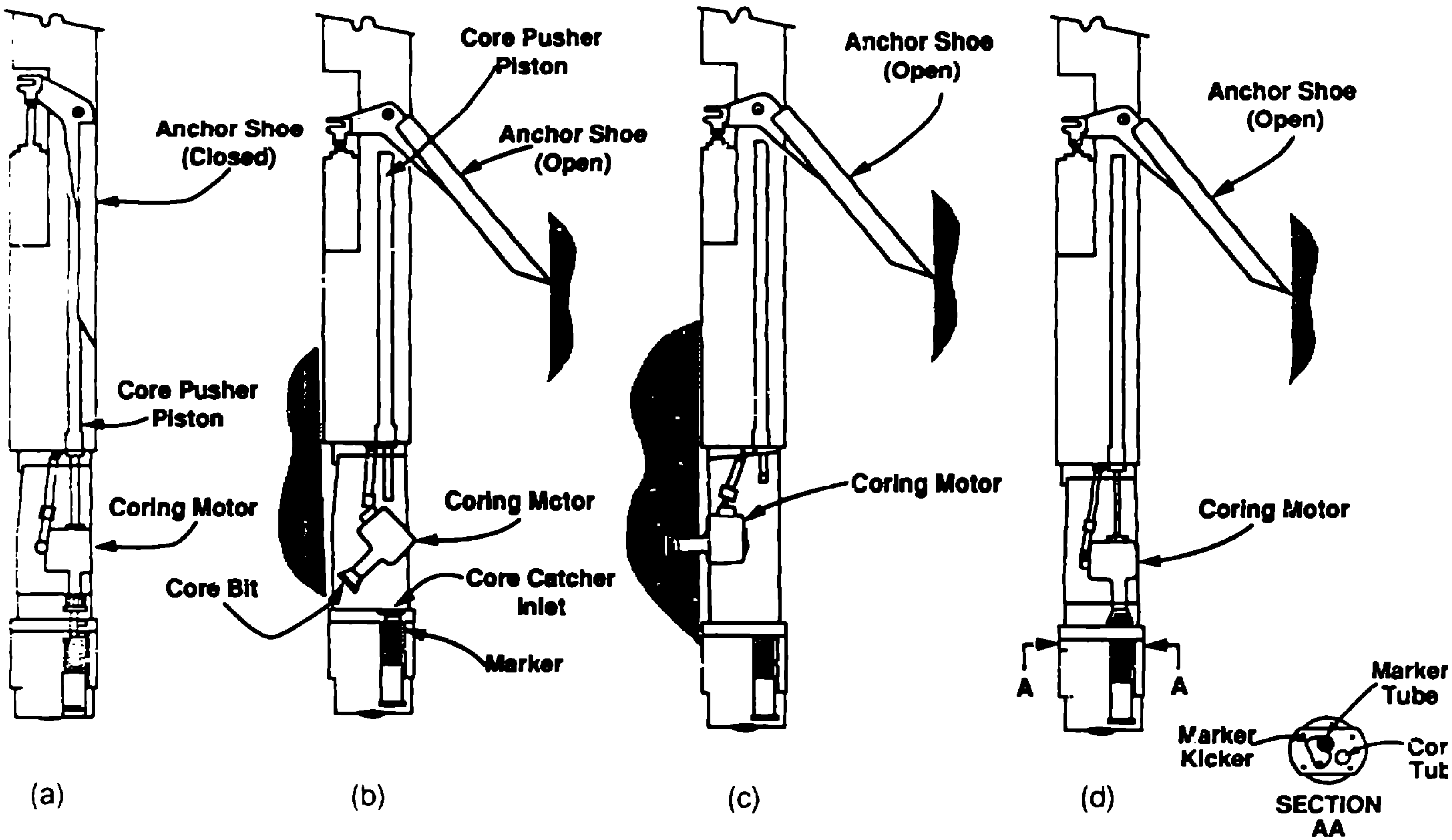

Fig. 3. Schlumberger Sidewall Coredriller operational configurations: (a) traveling position; (b) anchor shoe open and coring motor rotating to horizontal; (c) coring completed and motor tilting to break sample from formation; (d) core being pushed from core barrel into catcher.

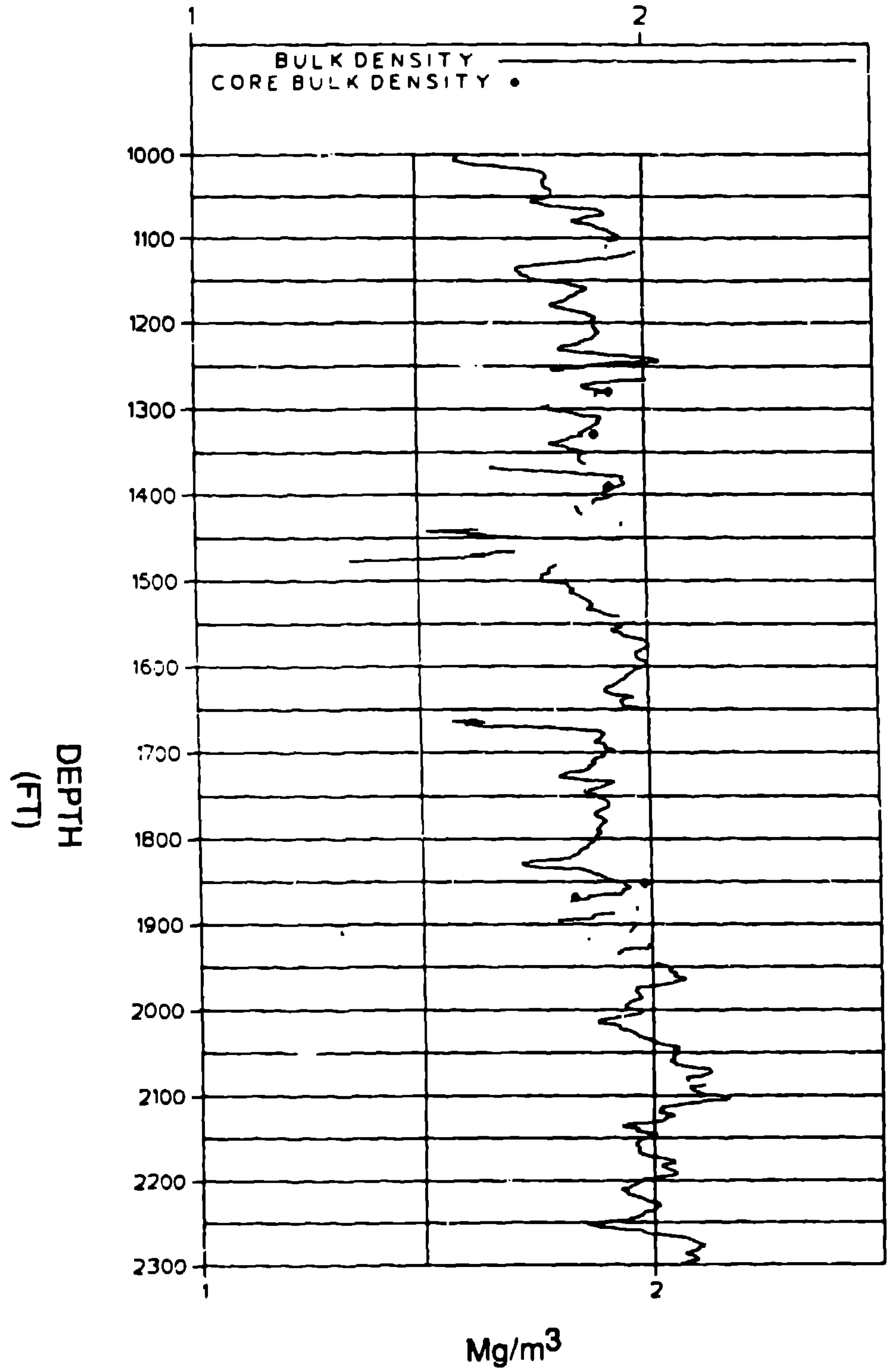

Fig. 4. Comparison of geophysical (gamma-gamma) log bulk density and core bulk density in Ue4t.

RUN	DEPTH (ft)	ATTEMPTS	SAMPLES RECOVERED	PERCENT RECOVERY	LENGTH RECOVERED (in)
1	1990-2031	25	9	36	15.5
2	1987-1992	7	4	57	6.1
3	1927-1930	8	8	100	11.9
4	1280-1870	22	22	100	32.4
5	710-940	5	4	80	4.0

Table 1. Sidewall core sample recovery per run from Ue4t

LITHOLOGY	INDURATION	ATTEMPTS	SAMPLES RECOVERED	PERCENT RECOVERY
Air-fall Tuff	Well	18	15	83
Air-fall Tuff	Moderate	8	8	100
Bedded Tuff	Moderate	8	8	100
Bedded Tuff	Fair	2	2	100
Bedded Tuff	Friable	4	4	100
Reworked Tuff	Moderate	2	2	100
Reworked Tuff	Fair	4	4	100
Ash-flow Tuff	Welded	2 *	1	50
Ash-flow Tuff	Friable	3	3	100

*Above fluid

Table 2. Sidewall core sample recovery by lithology from Ue4t