2. SITE 326

The Shipboard Scientific Party[1]

SITE DATA

Date Occupied: 5-6 April 1974

Time on Site: 30 hours, 9 minutes

Position (Satellite): 56° 35.0′S, 65° 18.2′W

Number of Holes: 1

Water Depth: 3812 corrected meters (echo sounding)

Bottom Felt at: 3822 meters (drill pipe)

Penetration: 9.5 meters

Number of Cores: 1

Total Core Recovered: 0.5 meters (5.2%)

Age of Oldest Sediment: Quaternary

Acoustic Basement: Not reached

Summary: Site 326 (Drake Passage) was drilled in 3812 meters of water about 150 km southeast of Cape Horn. Our main objective here was to check the magnetic-reversal dating of the opening of Drake Passage by determining basement age. Unfortunately, only one core was obtained before very bad weather, strong currents, and loss of 3800 meters of drill pipe caused the site to be abandoned.

BACKGROUND AND OBJECTIVES

Site 326 lies in 3812 meters of water in northern Drake Passage, 80 km off the South American continental margin southeast of Cape Horn (Figure 1). The site is located on a 500-meter thick pod of sediment, measuring 12 km along 310° by at least 20 km along 040° (Figure 2).

The main objective at the site was to assist magnetic anomaly dating of the opening of Drake Passage by obtaining a paleontological age for the basal sediments. The problem is of major paleooceanographic importance, because the opening, by separation of South America and the Antarctic Peninsula, allowed the completion of the circumpolar current system which is the main influence today on circulation and sedimentation over much of the Southern Ocean.

Older, poorly fixed magnetic data (Barker, 1972) show that magnetic anomalies in Drake Passage are aligned northeast-southwest and in some areas possess a crude symmetry about the centrally located double bathymetric ridge, but unambiguous correlation with part of the magnetic reversal time scale is not possible. Because the anomalies are malformed, the lesser quantity of newer, better-fixed profiles obtained to date has been no more productive as yet, and the site would assist magnetic anomaly identification by removing ambiguity at one point.

The R.R.S. *Shackleton* 73-4 reflection profile of Figure 2 shows that present-day sedimentation is controlled by strong bottom currents, but there seemed some prospect that, in addition to the main objective, the lower parts of the sediment column would yield information on variability of the circumpolar current and on the origin and migration of the Antarctic Convergence.

SURVEY AND OPERATIONS

Glomar Challenger left Ushuaia at 1600 on 4 April and geophysical measurements were started at 2050, when the ship was heading along 160° at 9 knots and had reached the South American continental margin. Since the site had been located on the most northerly of three R.R.S. *Shackleton* 73-4 reflection profiles (Figure 2), the northeastward extent of the sediment pod on which it lies was unknown so an approach was made along 210° from 0400 on 5 April (see Figure 3). In the face of strong but moderating winds the beacon drop was postponed and the approach track allowed to pass 5 km north of the site along the flank of the sediment pod (Table 1). On the return track (030° at 5 knots) a 13.5-kHz beacon was dropped at 1716 and the underway gear recovered. Water depth at the site was 3812 meters and the reflection profile showed about 0.5 sec of sediment.

In improved weather conditions (wind WNW, 20-30 knots, swell NW, 10 feet) the pipe was lowered towards the sea bed, but the winds then increased again, and it became difficult to maintain ship's position over the beacon. Therefore, after obtaining a single surface punch core with poor recovery at 1615 on 6 April, the bit was pulled above the sea bed, with the intention of waiting until the weather and positioning improved. At 2050 on 6 April, however, the drill string parted directly below the piccolo, with the ship 3000 feet off the beacon, winds NW 40 knots and swell NW 15-20 feet. Because of the strong winds, no certain estimate of current had been possible, but it seems likely that currents of up to 3-4 knots were being experienced. Thus the failure most probably resulted from the effects of weather conditions which were bad, but not exceptional, upon a drill string whose mean position was dis-

[1]Peter Barker (Co-chief scientist), The University of Birmingham, Birmingham, England; Ian W.D. Dalziel (Co-chief scientist), Lamont-Doherty Geological Observatory, Palisades, New York; Menno G. Dinkelman, The Florida State University, Tallahassee, Florida; David H. Elliot, The Ohio State University, Columbus, Ohio; Andrew M. Gombos, Jr., The Florida State University, Tallahassee, Florida; Alberto Lonardi, CONICET, Buenos Aires, Argentina; George Plafker, U.S. Geological Survey, Menlo Park, California; John Tarney, University of Birmingham, Birmingham, England; Robert W. Thompson, Humboldt State College, Arcata, California; R.C. Tjalsma, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts; Christopher C. von der Borch, The Flinders University, Bedford Park, South Australia; Sherwood W. Wise, Jr., The Florida State University, Tallahassee, Florida.

Figure 1. *Bathymetry of Drake Passage in the vicinity of Site 326 with* Shackleton *73-4 track; Contour interval 250 cm.*

placed from the vertical by a current the strength of which was not appreciated.

The remaining pipe was recovered and the ship sailed for more sheltered water at 2325 on 6 April, to allow fresh pipe to be brought up from the hold. No geophysical measurements were made on passage to Bahia Aguirre, on the northern shore of the eastern end of the Beagle Channel, where the ship anchored at 1900 on 7 April.

As a result of the loss of pipe, DSDP laid down additional regulations to govern future drilling operations:

1. Operations should not continue if pitching or rolling regularly exceeds 7° or if occasional pitches or rolls exceed 9°.
2. Ship should not offset more than 3000 ft with pipe extended.
3. When moving ship with pipe extended, bending of pipe should not exceed 7° and pipe should be moved vertically to spread stress.
4. If positioning is marginal, pipe should be pulled.

LITHOLOGIC SUMMARY

Description

Site 326 is located in the Drake Passage at a water depth of 3822 meters. Due to adverse sea conditions and positioning problems, only one core (0 to 9.5 m) was attempted at this site and 50 cm of sediment of Quaternary age were recovered.

Two lithologies predominate in the upper 35 cm of core: (1) light olive-gray (5y 5/2) detrital sandy silt; (2) yellowish-gray (5y 7/2) detrital clayey silt. These occur interbedded in layers of about 10-15 cm in thickness. The silts consist principally of angular to subangular quartz (40%-60%) and partially altered feldspar (10%-15%) along with a matrix of clay minerals and devitrified volcanic glass (20%-40%). Heavy minerals constitute about 4% of the total sediment; among these, light green hornblende is most common with lesser amounts of epidote, augite, opaques, and titanite in order of decreasing abundance. Trace amounts of garnet, hypersthene, biotite, and zircon are present. Aggregates of clay and palagonitized ash are common in the silt and sand fractions.

Gravel set in a sandy silt matrix occurs in the upper and lower 5 cm of the core and predominates in the core catcher. The gravel ranges in size from 0.2 to 5 cm in diameter and is mainly angular to subrounded. A wide range of lithologies is present in the gravel (Table 2). Most abundant are manganese-coated aggregates of partially altered (and palagonitized) volcanic glass. The manganese rinds range up to 5 mm in thickness. These plus basalt pebbles, some of which are olivine-bearing, comprise most of the coarser gravel. Other lithologies present, primarily within the finer gravel fraction, in-

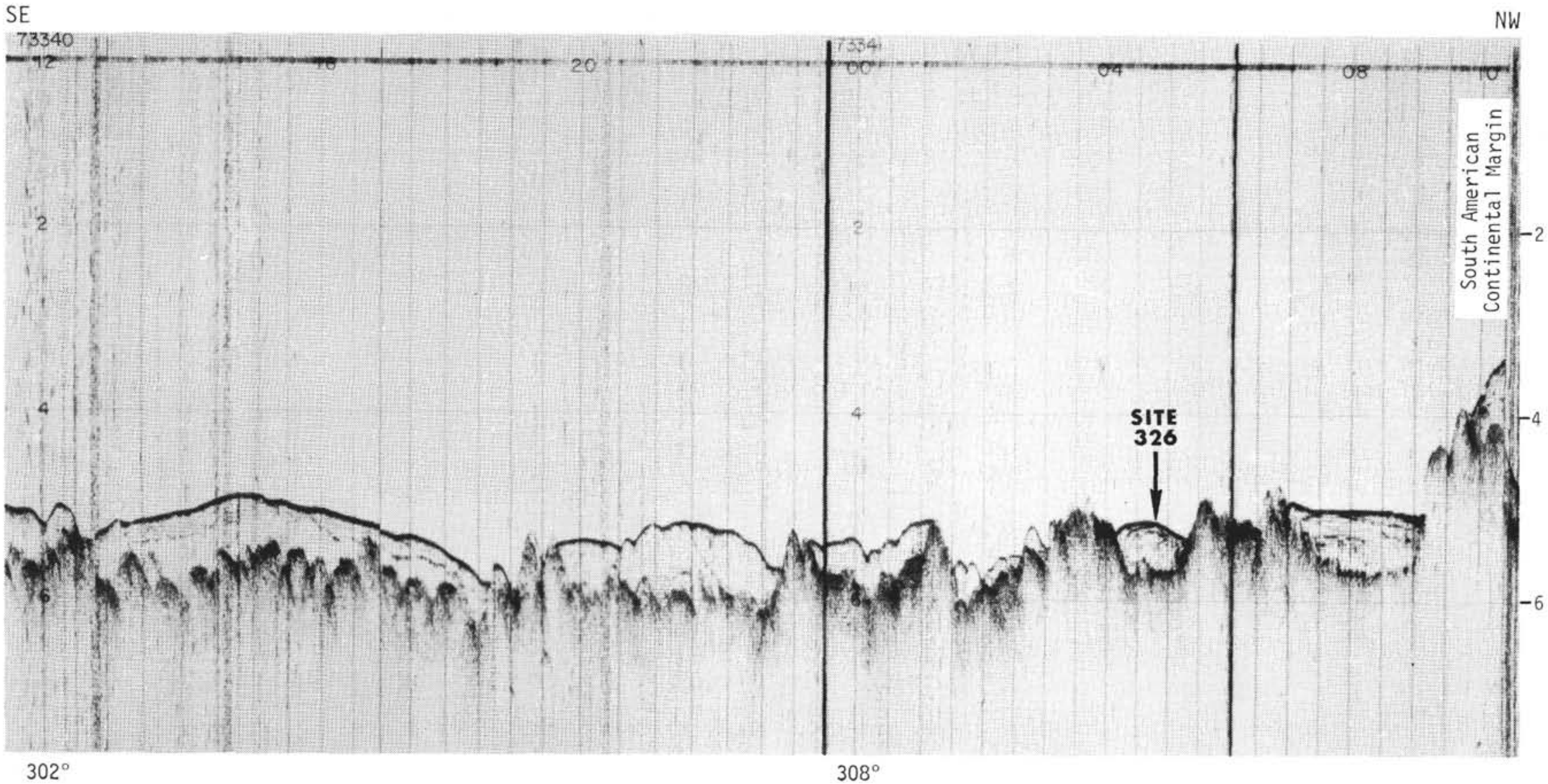


Figure 2. Shackleton *73-4 reflection profile in the vicinity of Site 326 (see Figure 1 for track).*

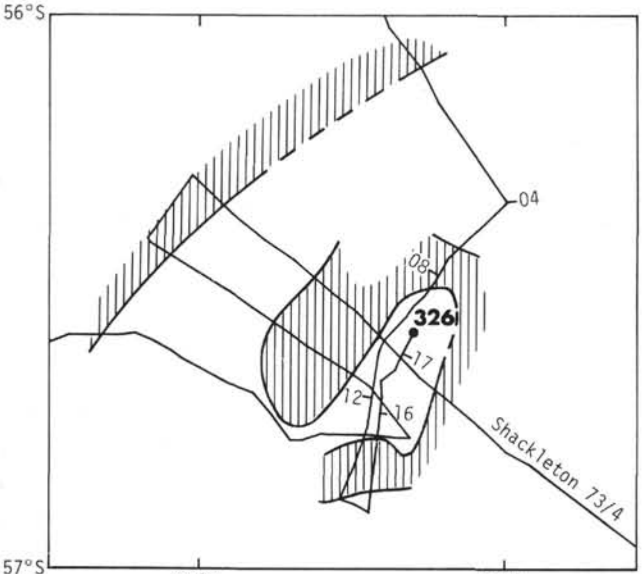


Figure 3. Shackleton *73-4 and* Glomar Challenger *tracks in the vicinity of Site 326. In shaded areas basement crops out on sea floor.*

clude: rhyolite, granite and granodiorite, argillite, schist, metavolcanic (?), and graywacke siltstone.

Interpretation

Conclusions are difficult to draw from a very short core segment such as this. We do not know where from within the 9.5-meter interval cored the recovered sediment came or whether in fact the layers present are in true stratigraphic order. Assuming the layers are in order, their nature and sequence imply marked fluctuations either in bottom current conditions or in sediment supply.

The gravels include a variety of lithologic types and a number of clasts show evidence of faceting although none of these facets are definitely striated. Ice rafting therefore seems a likely mechanism for supplying a substantial fraction of the coarser materials. These are mixed with locally formed manganese nodules and pebbles of basalt which, judging from their more rounded appearance and lack of faceting, may also be of local origin. The occurrence of manganese nodules, manganese-coated pebbles, and fresh, uncoated pebbles suggests the presence of rafted materials of various ages which are concentrated together as a lag deposit by the winnowing action of strong bottom currents known to occur in this area. This interpretation finds support in the associated foraminiferal fauna which is restricted to a few large forms, many of which are partially dissolved.

The presence of finer grained sediments, particularly the clayey silts, within the section implies either much ameliorated current conditions which allow settling and accumulation of hemipelagic clay and silt, or rapid influx of terrigenous sediment by some alternative mechanism. The sparsity of pelagic microfossils within the silts would seem to support the latter alternative. The tentative conclusion is reached therefore, that the clayey and sandy silts are largely the product of turbidi-

TABLE 1
Coring Summary, Site 326

Core	Date (April 1974)	Time	Depth From Drill Floor (m)	Depth Below Sea Floor (m)	Length Cored (m)	Length Recovered (m)	Recovery %
1	6	1615	3822.0-3831.5	0-9.5	9.5	0.5	5.2

TABLE 2
Gravel Fraction Lithologies, Hole 326

%	Lithology	Size	Color and Staining	Luster	Surface Relief	Roundness	Sphericity	Other
65	Mn-coated nodules of sandy palagonite? clay	3.1 cm max	Yellow cores (8/8, 7/8, 7/6, 8/6) Blk rinds mottled with brn & rusty brn	Dull, sooty, earthy	Rough, pitted	Ang to rdd	Equant to sub-equant	Mn rinds to 4 mm thick but irregular thickness
10	Olivine basalt and basalt	3 cm max	Blk (2.5/1, 2.5/2)	Dull	Smooth	Sub-equant to discoid	Sub-angular to sub-rdd	Fresh rock. Patchy mn rinds to 1 mm thick
8	Rhyolite or quartz latite flows & tuffs		Lt gy (7/2)	Dull to polished	Smooth, faceted?	Ang to sub-rdd	Equant, sub-equant, discoid	Many clasts with one or more flat, probably striated surfaces. Except for mono-minerallic frags (qtz & feldspar), most clasts are Fe-stained and some have thin rinds of mn less than ½ mm thick
7	Orthoclase-bearing e.g. granite, f.g. granodiorite, and large qtz & feldspar grains		Gy to pinkish gy & white	Dull to polished	Smooth	Ang to sub-rdd	Equant	
3	Argillite or shale	2.1 cm max	Grnsh gy & gy to dk gy	Dull	Smooth, faceted?, striated?	Ang to sub-rdd	Discoid	
3	Pelitic schist (qtz-mica)		Gy to dk gy	Dull & micaceous	Smooth	Ang to sub-rdd	Equant, sub-equant	
2	Meta-volcanic (?) (Chlorite-plag)		grn, gy grn	Dull	Smooth, faceted?			
2	Gywackesilt (v.f.g.)		grnsh gy	Dull				
Tr	Pyrite-coated qtzite(?)		White	Dull & metallic				

ty currents from the adjacent continental margin. Spasmodic sediment supply from this source combined with rafting by icebergs and reworking by bottom currents would seem to account for most of the observed characteristics of this core.

PALEONTOLOGY

Biostratigraphic Summary

Rare specimens of poor to moderately well preserved Quaternary microfossils are present in the single 50-cm core recovered at the sediment/water interface at Site 326. The core is composed of fine clastics, sandy silts and gravels (see Lithologic Summary).

Foraminifera

Planktonic foraminifera indicating a Quaternary age are moderately common in the sandy silt sampled at 118-120 cm in Section 1, Core 1. Species include *Globorotalia truncatulinoides, G. inflata, Globigerina pachyderma* (sinistral form), and *G. bulloides*. Although general preservation is good, the assemblage has been affected by rather strong dissolution as indicated by many broken specimens and the fact that the earlier septa of many individuals have been dissolved.

Two samples from the lower portion of the core (clayey silt, 128-130 cm; sandy silt, 143-145 cm) are almost devoid of foraminifera. The sandy silt from the core catcher contains a similar assemblage as at 118-120 cm except that the smaller size specimens are absent.

Other Microfossils

Rare calcareous nannofossils recovered from the sandy silt at 118-120 cm include *Coccolithus pelagicus, Cyclococcolithina leptopora*, and small forms which may be the upper Pleistocene marker, *Emiliania huxleyi*.

Two samples (326-1-1, 116-117 cm and 326-1-1, 124-125 cm) examined for diatoms from this core were barren. A slide prepared from the core catcher contained four specimens of *Nitzschia kerguelensis* suggesting a Quaternary age for the sediment. The few radiolarians recovered are fragmentary and unattributable to species.

SUMMARY AND CONCLUSIONS

None of the site's objectives was attained. Some 3800 meters of drill string, including four bumper subs, were lost, and the combination of continued poor weather and strong currents could well have rendered the hole impossible even had this not occurred.

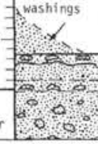
The single short core obtained was of Quaternary sediment, probably derived in large part by turbidity currents from the adjacent continental margin, with subsidiary amounts of ice-rafted debris. The sediment was reworked by strong bottom currents as the reflection profile had suggested.

REFERENCES

Barker, P.F., 1972. Magnetic lineations in the Scotia Sea. *In* Adie, R.J. (Ed.), Antarctic geology and geophysics: Oslo, Universitetsforlaget, p. 17.

Lonardi, A. and Ewing, M., 1971. Bathymetric chart of the Argentine Basin (Map, no scale). *In* Physics and chemistry of the earth, v. 8: London (Pergamon Press).

Site 326 Hole Core 1 Cored Interval: 0.0-9.5 m

AGE	ZONE: FORAMS	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE		LITHOLOGIC DESCRIPTION
					0						
LATE PLEISTOCENE	*Globorotalia truncatulinoides*	F	F	P	1	0.5 1.0	mostly empty- some sand washings		124 130	5Y 5/2 5Y 7/2 5Y 5/2, 5Y 7/2	SANDY AND CLAYEY SILT Interbedded light olive gray SANDY SILT and yellowish gray CLAYEY SILT. GRAVEL in sandy silt matrix in upper and lower 5 cm of core and in core catcher.
					Core Catcher					5Y 5/2	

Representative smear slides

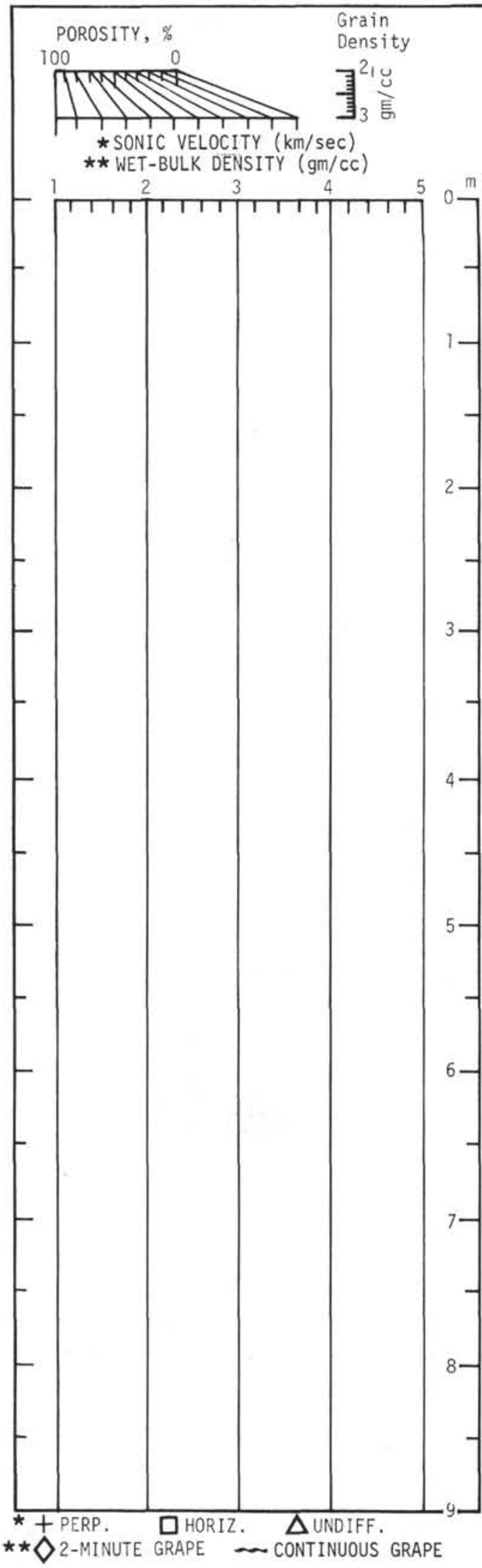
	1-124	1-130
qtz.	60	46
clay	20	40
feld.	15	10
heavies	4	3
palagonite	1	1

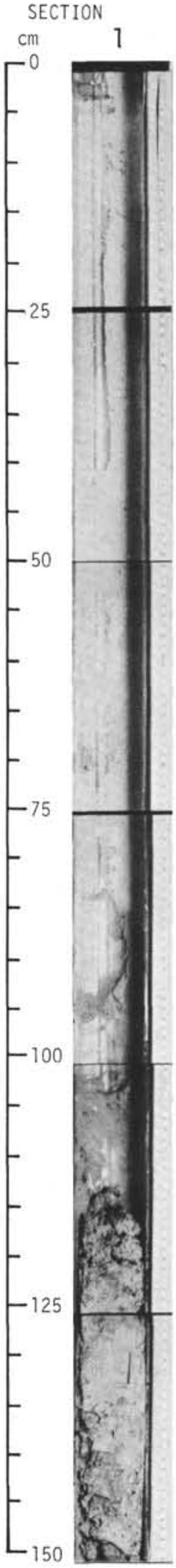
Gravel from core catcher in order of decreasing abundance

managanese nodules	argillite
basalt	schist
rhyolite	metavolcanic(?)
granitic rocks	graywacke

Explanatory notes in Chapter 1

326-1


POROSITY, %
100
0
Grain Density
2
3
gm/cc
* SONIC VELOCITY (km/sec)
** WET-BULK DENSITY (gm/cc)
1
2
3
4
5
m
0
1
2
3
4
5
6
7
8
9
* + PERP.
□ HORIZ.
△ UNDIFF.
** ◇ 2-MINUTE GRAPE
CONTINUOUS GRAPE


SECTION
1
cm
0
25
50
75
100
125
150