I.O.S.

RRS DISCOVERY

CRUISE 135

30 MARCH – 24 APRIL 1983

GEOCHEMICAL SAMPLING IN THE NORTHEAST ATLANTIC AND THE MEDITERRANEAN

CRUISE REPORT NO. 160
1984

NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

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INSTITUTE OF OCEANOGRAPHIC SCIENCES

WORMLEY

RRS DISCOVERY

Cruise 135

30 March - 24 April 1983

Geochemical sampling in the northeast Atlantic and the Mediterranean

Principal Scientist

T.R.S. Wilson

CRUISE REPORT NO. 160

1984

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ITINERARY

Depart Funchal 30 March 1983

Arrive Patras 24 April 1983

SCIENTIFIC PERSONNEL

A.C. Braithwaite	I.O.S.
Miss J. Clancy	Southampton University
Mrs. S. Colley	I.O.S.
F. Culkin	I.O.S.
E. Darlington	I.O.S.
T.J.P. Gwilliam	I.O.S.
D.J. Hydes	I.O.S.
Miss H. Kennedy	Cambridge University
G. Knight	R.V.S.
G.A. Lake	I.O.S.
A.R. Lewis	R.V.S.
V.A. Lawford	I.O.S.
R.D. Peters	I.O.S.
W.R. Simpson	I.O.S.
Mrs. H.E. Sutherland	I.O.S.
P. Statham	Southampton University
J. Thomson	I.O.S.
R.F. Wallace	I.O.S.
T.R.S. Wilson	I.O.S. (Principal Scientist)

SHIP's OFFICERS

P.H.P. Maw	Master
E.M. Bowen	Chief Officer
P. Oldfield	2nd Officer
P. Pepler	3rd Officer
P. Bryne	Chief Engineer
D. Anderson	2nd Engineer
C. Phillips	3rd Engineer
K. Sullivan	4th Engineer
F.P. Sharpe	Electrical Engineer

B.A. Smith	2nd Electrical Engineer
M. Taperell	Radio Officer
R. Cridland	Purser/Catering Officer

OBJECTIVES

Geochemical investigations of the water column and sediment system in the area west of Portugal. Water column sampling for trace metals, including manganese and aluminium, with filtered particulates. Sediment and pore water studies in the same region. Sites of special interest were 'Discovery Gap', King's Trough, Torre Seamount and Mediterranean outflow water. Several minor sites in the Mediterranean were also occupied.

NARRATIVE

The scientific party was embarked and signed on by 1100 hrs local time, 29 March. After fitting out scientific equipment ship sailed 2330 hrs 30 March. The Precision Echo Sounder fish was deployed at 1000 hrs on the 31 March and the system was tested and found satisfactory. P.E.S. and scientific watches started 0000 hrs (GMT) 1 April 1983. The first station 10070 at 'Discovery Gap' was reached at 0826 hrs that day. This station was intended to study water column properties using the large volume in-situ filtration system (FIDO). Some noise problems on the CTD conductivity sensor signal were experienced, but the station was satisfactorily concluded at 2000 hrs that night. About one hours steaming was then made to obtain a suitable bottom for a PWS MkII and Kastenlot shakedown at station 10701. This was concluded by 1300 hrs 2nd April.

By 1102 hrs 4 April Discovery was hove-to at station 10702, near to King's Trough. After initial problems two Kastenlot cores were obtained but box coring proved difficult because of the hard substrate, and no box core was obtained. A long in situ pumping station was successful after initial minor problems, and also a MkII in situ sampler. A short circuit failure of the CTD rosette trigger deck unit resulted in its destruction. The first deep-sea test of the MkIII P.W.S. was unsuccessful because of a valve failure. Discovery was underway by 1236 hrs 6 April.

Freshening winds from the SW hampered work at Station 10703, at 0354 (GMT) on 8 April. Two attempts to obtain a Kastenlot core failed and a MkII PWS lowering was abandoned due to worsening sea state, which was giving slack-wire conditions at the main winch. A repaired CTD rosette system successfully acquitted itself, however.

The next Station 10704 (1042 hrs, 9 April) was sited within the deep basin at the centre of the Torre Seamount. A complete set of samples was obtained by 1642 hrs 11 April and Discovery proceeded to an adjacent station on the Tagus Abyssal plain (10705 reached at 2254 hrs 11 April) where the sampling was repeated. However, the sediment sampling programme here was only moderately successful, a box core and a MkII Porewater sample being obtained. Discovery departed this station at 1824 hrs 13 April. An attempt to sample the water column at Station 10706 starting at 1712 hrs 14 April was terminated on the advice of the Master because of bad weather conditions (wind 35 kt from East) at 0425 hrs 15 April. The ship then proceeded to Gibraltar concluding the scientific programme for the first leg.

On leaving Gibraltar, Discovery proceeded to Station 10707 which was reached at 2310 hrs 17th April. CTD profiling and an overside test of the MkIII PWS were accomplished, but further work at this station, which was to include a gravity core for Professor Kelling of the University of Keele, was prevented by a complete failure of the 200 KVA supply to the main winch. The station was abandoned at 0830 hrs on 18 April. This fault was found to be irreparable at sea. However it was possible to run the main winch at reduced power on the 100 KVA auxiliary (Gloria) converter set. This supply was used to obtain a Kastenlot core and a MkIII Porewater sample at Station 10708, near DSDP site 372. CTD in situ filtration samples were also obtained, work at 10708 being concluded by 0745 on 20 April. Station 10709 was occupied at 2300 hrs on the same day, but only CTD sampling was undertaken here because a poor sea state and winds in excess of 35kt were thought likely to overload the main winch in its reduced power configuration. This station was concluded at 0525 on 21 April. An attempt to occupy a similar station at 1600 hrs the same day was defeated by bad weather conditions, the Master advising that it might not be possible to remain hove-to on Station. Discovery then continued to Patras, arriving on 24 April at 1100 hrs.

T.R.S. Wilson

PROJECT AND EQUIPMENT REPORTS

1. Hydrographic Sampling

Since R.R.S. Discovery Cruise 129 the Hydrographic Laboratory has been fitted with new flooring and bench surfaces and a Class 100 laminar flowhood has been installed in a panelled and curtained-off area. These alterations produced great improvements over previous conditions and allowed the careful processing of samples to be carried out with much greater ease.

Hydrographic work was performed at 9 stations (Table 1). Water samples were taken in bottles attached to a General Oceanics rosette deployed from the midships winch. A Neil Brown C.T.D. unit attached to the base of the rosette provided real-time acquisition of temperature, depth and salinity data from which the most interesting features of the water column were chosen for subsequent sampling. On several occasions the system required minor repairs. At Atlantic stations some deep water samples were taken with 1.2L Niskin bottles fitted with reversing thermometers to provide accurate temperature, salinity and dissolved oxygen data for physical oceanographic studies and for calibration of the C.T.D. unit. All other water samples were taken with 2.5L Go-Flo bottles which worked satisfactorily, although some had to be sent down open as their 10m trip valves proved ineffectual. A total of 20 casts provided 198 samples. At station 10702 the top part of the water column could not be sampled because of a component failure in the deck firing unit of the rosette. Fortunately it was possible to construct a substitute firing unit for use at all subsequent stations. Station 10706 was abandoned, after only part of the water column had been sampled, as high winds made maintaining position impossible.

Samples were processed as described below, according to the requirements of the different groups.

(a) I.O.S.

Unfiltered seawaters were drawn from the sampling bottles for determination on board of dissolved oxygen by the Winkler technique, salinity with a Guildline salinometer, and nitrate, phosphate and silicate using a Chemlab auto-analyser system. Unfiltered samples were also stored at ambient temperature in acid-leached linear polyethylene bottles for subsequent determination of aluminium at Wormley.

(b) Department of Earth Sciences, Cambridge University

In the Mediterranean Sea at station 10708 samples were taken at representative depths throughout the water column, using Go-Flo bottles, for rare earth element analysis. The 12 samples, each about 2L in volume, were pressure filtered through 0.4µm Nuclepore membranes directly from the bottles, and then preserved by addition of sub-boiling distilled hydrochloric acid prior to their transport and subsequent analysis at Cambridge. Unfiltered sub-samples of the sea waters were taken for nutrient and salinity determinations as described above.

A total of 48 small volume (about 20ml) samples of filtered water were taken at stations 10707 and 10708 in the Mediterranean Sea, and stored under cool conditions in glass, for subsequent analysis at Cambridge for dissolved iodine species.

(c) Southampton University

Sample processing was performed in essentially the same way as during Discovery Cruises 125 and 129. Sea water samples for dissolved trace metal analysis were pressure filtered directly from the Go-Flo bottles through an in-line 0.4µm Nuclepore filter into acid leached polyethylene bottles. A 500ml aliquot of the filtrate was preserved by acidification with sub-boiling distilled nitric acid, and stored at ambient temperature for subsequent processing at Southampton. A further 78 samples of filtered water were processed onboard to separate and concentrate a range of trace metals in a stabilized form suitable for transport and analysis at the shore laboratory. The procedure consisted of complexing the dissolved metals with a mixed dithiocarbamate reagent, extracting these complexes into Freon TF (1,1,2-trichloro-1, 2, 2-trifluorethane), and finally back extracting the metals into dilute nitric acid solution. Including blanks and calibrations, a total of 132 extractions were performed, and the metals in these back extracts are to be determined by graphite furnace atomic absorption spectrophotometry at Southampton. The method was calibrated for a range of metals, with interest being centred on Mn and Cd.

Vertical profiles of these metals should improve our knowledge of their distribution in the Mediterranean Sea, where few reliable data are currently available, and indicate the effect of Mediterranean Outflow Water on dissolved trace metal distributions in the eastern Atlantic Ocean.

A series of 13 surface samples were taken at locations extending from Atlantic Ocean waters to well into the Mediterranean Sea, using the non-toxic seawater supply on the ship. Samples were collected in a Go-Flo bottle, pressure filtered through 0.4µm Nuclepore filters, acidified, and stored at ambient temperature ready for the subsequent determination of dissolved Mn at Southampton.

Separate aliquots of water taken directly from the Go-Flo bottles were filtered through pre-heated glass fibre filters, and stored frozen for later dissolved organic carbon analysis at Southampton.

J. Clancy
F. Culkin
E. Darlington
T.J.P. Gwilliam
P.J. Statham

2. In situ Filtration (FIDO)

Deployments of the deep water particle sampler.

A resume of the stations worked is presented in Table 1.

Station 10700 was the shakedown station. There was a minor problem on the flow meter for the particle cell that was solved before station 10702. Also, warping of the base plates of the new filter stacks may have led to water by-passing the filters; 'O' rings were added to improve the seals.

The two casts on station 10702 ran smoothly with 2094L of water pumped at the deepest filtration depth (5-10m off bottom by the N.B.E.S.).

On series 3 of station 10704 the cast was aborted due to loss of synchronisation to the computer. The fault was found to be seawater seepage into the sea cable connector that caused a short between the pins.

The deepest sample on 10704#7 was taken 8m off the bottom of 5474m inside the basin formed by Torre seamounts. The failure of the instrument battery pack at 4000 m caused total loss of signal, hence only two filtration depths were sampled.

On 10705#2 intermittent loss of synchronisation for odd cycles was traced to a second leak on the sea cable connector. During the deep cast (#6) a ramping in channel 1 was noted as on station 10704 and this was traced to a partial component failure in the channel 1 comparator. As a result the channel 1 data was excluded from the subsequent casts and all previous casts replayed using the double-speed play-back facility on the Gwilliam demodulator.

The deep cast on 10704#2 concluded the Atlantic programme and one further dip was carried out at 43m in the Mediterranean (10708) to test filter arrangements. On passage to Patras replays were run and some modifications to the software made. By the end of the cruise the data summaries at the filtration depths and the 16sec outward-cast data averages were completed.

Although the casts were not without some problems these were of a less serious nature than those encountered on Cruises 125 and 129. More samples and hand-copy physical data were collected than on the previous cruises combined.

Thanks are due to Marine Physics for the loan of the transmissometer and C.T.D. deck unit.

T.J.P. Gwilliam
V.A. Lawford
W.R. Simpson

3. Sediment Porewater Sampling

Pore water samples were obtained both by in-situ extraction in the sea bed and by squeezing material from cored sediment. Squeezed pore waters were collected at stations 10701, 10702, 10704 and 10708. At station 10704 a comparison of the two methods used on this cruise for extracting pore water from cored sediment - squeezing and high speed centrifugation - was made. In-situ samples were collected using both the I.O.S. MkII and MkIII pore water samplers. The MkIII is a new sampler designed to obtain pore water samples for later analysis of trace metals which are uncontaminated; it also collects a 10cm diameter sediment core to the same depth as the water samples. The sampler was deployed 5 times. It was modified during the cruise and the fifth lowering was successful (10708) - a total of 235ml of pore water was collected at the 14 sampling depths. Cores were obtained at stations 10704 and 10707. The MkII sampler was deployed 7 times on this cruise and was not as successful as on Cruise 129. On the first lowering the bottom detector failed. On the three subsequent lowerings the ram arm which controls the descent of the sample probes into the mud locked up and prevent the probes entering the mud. The MkII sampler operated successfully at stations 10704 and 10705.

A.C. Braithwaite
S. Colley
D.J. Hydes
H. Kennedy
G.A. Lake
T.R.W. Silson

4. Nutrient Analysis

On this cruise a continuous flow system ("Chemlab") for the analysis of micronutrients - ammonia, nitrate, nitrite, phosphate and silicate - was used. This system proved to be much more reliable than the discrete sample automated analyser ("Pye Unicam AC1") used on Cruises 108, 125 and 129. The quality of the results obtained was not anyway compromised by ship's motion. The analyser was mounted in the Chemistry Group's new container laboratory which provided an excellent working environment. The only problem encountered with the system was with the determination of ammonia. We found much higher blank values than in tests prior to the cruise. Silicate, phosphate and nitrate determinations were carried out, on 142 pore water samples, and 195 water column samples.

N.C. Higgs
D.J. Hydes

5. Sediment Sampling

There were requirements on this cruise for solid phase material from the sediment/water interface downwards for sediment characterisation and dating studies, for pore waters squeezed from core sub-samples for comparison with the *in situ* pore water samples, and for squeezed pore waters for detailed profiles. The corers used were the I.O.S. 30cm x 30cm box corer (to sample the near-surface sediments) and a Kastenlot gravity corer with 2m or 4m 15cm x 15cm square section barrels (to sample to greater depth).

A modified I.O.S. 10kHz beacon, with a more powerful signal and an in-built near-bottom echo sounder, was used on most corer runs. This device gave good bottom return echoes on all stations. As described in Cruise Report No. 138 (R.R.S. *Discovery* Cruise 129), the near-bottom echo sounder was used primarily to monitor the corer-to-beacon distance on box corer runs, and a shear-pin retractor assembly was used on the box corer no-load release. On this cruise the box corer had only one pre-trip failure (at 4500m on station 10705) which was clearly due to a sustained short period of intense swell.

Considerable difficulties were experienced with the Kastenlot corer, which had six failures in eleven runs. It appears at present that this was due to two factors, first some wear on the catcher door mechanisms, and second the fact that the stiff carbonate and hemipelagic sediments encountered on this cruise prevented the core catcher doors from closing when tripped. This latter fact meant that the cores could be pulled from the sediment without core recovery. In one instance a complete door assembly was missing on retrieval.

Two metre (nominal) Kastenlot cores were recovered at Atlantic stations 10701, 10702, 10703, 10704 and Mediterranean station 10708. At station 10702 (King's Trough Flank) a 4m Kastenlot core was also recovered, but two box core runs retrieved short (5-10cm) sections which suffered from washout. This is thought to be due to the inability of the box corer to penetrate the coarse carbonate sediment, despite the use of full weights and a high run-in speed on the second attempt. Other box cores were taken on stations 10704 and 10705. A planned run with a R.V.S. (Barry) gravity corer on station 10707 for Keele University had to be abandoned when the ship's 200kVA power supply failed.

H.E. Sutherland
J. Thomson

SAFETY

An exercise called during a boat drill highlighted a number of safety deficiences, some connected with recent modifications to the vessel. The exercise involved a supposed fire in the starboard container, with a simulated casualty. Muster of the scientific party to the poop was requested instead of the more usual forecastle. The following points emerged.

a) A man in the starboard container failed to hear any of the alarm signals: there is no bell or P.A. system in the container. These should be provided.

b) Several of the scientific party reported to the normal station because of their inability to understand the instructions on the ship and scientific P.A. systems. In particular, the P.S. who was writing in his cabin at the alarm, could not distinguish the message. There is no P.A. repeater in the P.S. cabin, and the system is old and prone to bad distortion. P.S's should be instructed to check the required muster position on reporting to the bridge on alarm, and consideration should be given to P.A. system improvement.

c) There is no fire extinguisher in either container. It is recommended that extinguishers suitable for electrical and solvent fires should be held on the ship for fitting in the containers for the duration of each cruise.

T.R.S. Wilson

ACKNOWLEDGEMENTS

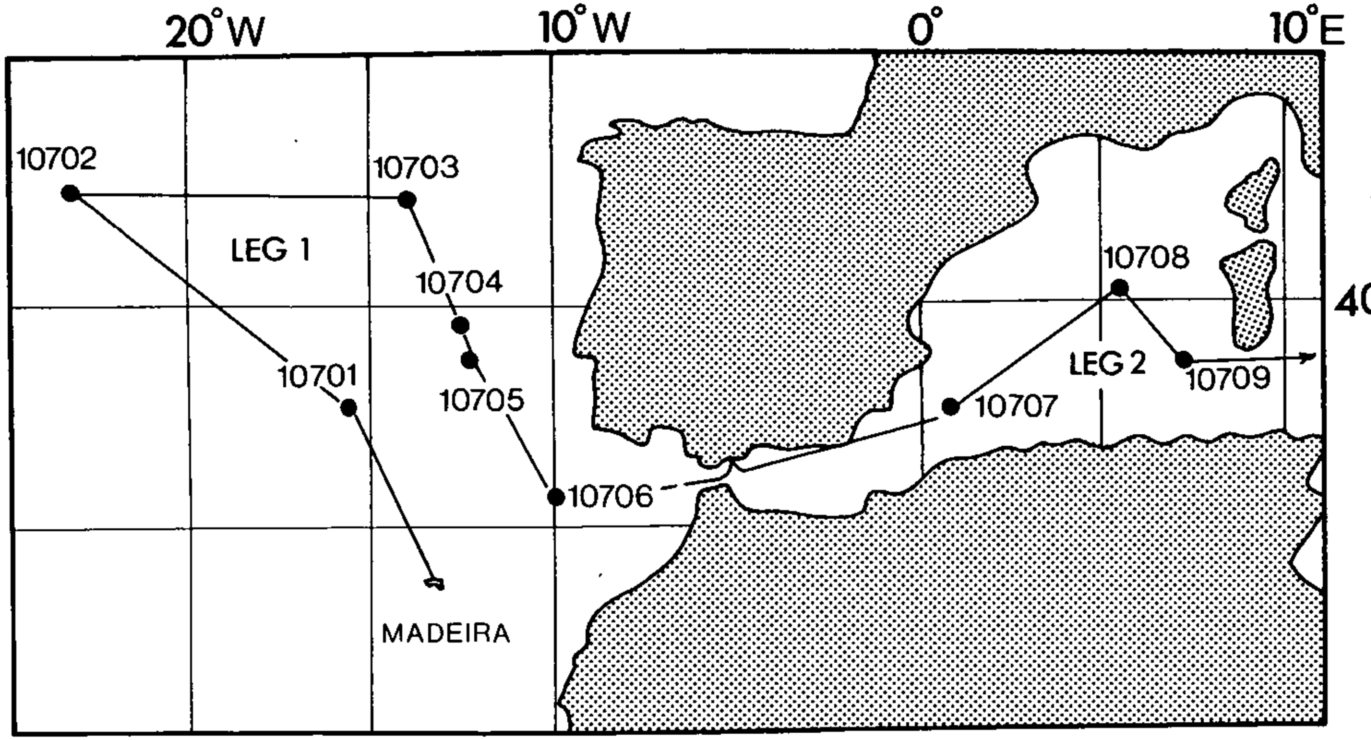
Our work at sea depends in large part on the skill and professionalism of the Master, Officers and crew of the Discovery, to whom our grateful thanks are expressed.

Some of the research described in this report has been carried out under contract for the Department of the Environment, as part of the radioactive waste management research programme. The results will be used in the formulation of Government Policy, but at this stage they do not necessarily represent Government Policy.

Table 1 Summary of Sampling Operations Discovery Cruise 135

Station + Series No.		Date	Lat. N deg	Lat. N min	Long. W deg	Long. W min	Operation	Time GMT	Remarks
10700	1	1 IV	37	29.0	15	27.3	CTD	0826	
	2		37	28.0	15	28.3	FIDO	1348	
10701	1	1 IV	37	40.0	15	20.9	MkIII	2154	
	2	2 IV	37	40.1	15	20.5	CTD	0234	
	3		37	41.0	15	21.0	KASTEN	0540	116cm 4870m
	4		37	41.0	15	21.6	MkII	0905	
10702	1	4 IV	42	06.0	23	31.1	KASTEN	11.00	
	2		42	04.5	23	32.5	KASTEN	1417	161cm
	3		42	04.3	23	33.7	FIDO	1706	
	4		42	02.5	23	34.8	BOX	2156	
	5	5 IV	42	02.3	23	36.6	CTD	0134	
	6		42	01.3	23	36.9	MkII	0417	
	7		42	05.4	23	30.2	CTD	0840	
	8		42	04.6	23	30.1	KASTEN	1100	301cm 3551m
	9		42	03.9	23	30.4	MkIII	1342	
	10		42	03.5	23	29.8	MkII	1730	
	11		42	00.9	23	32.0	FIDO	2030	
	12	6 IV	42	06.0	23	31.1	BOX	0530	Small sample
	13		42	05.3	23	28.7	CTD	0910	
10703	1	8 IV	41	59.8	14	20.3	KASTEN	0419	
	2		41	59.7	14	16.4	CTD	0853	
	3		41	59.4	14	16.0	KASTEN	1056	
	4		41	59.1	14	15.2	MkII	1437	aborted - bad conditions
	5		41	59.1	14	15.2	CTD	1558	
10704	1	9 IV	39	22.0	12	50.5	CTD	1042	
	2		39	22.0	12	51.0	KASTEN	2036	202cm 5450m
	3	10 IV	39	19.3	12	51.2	FIDO	0044	
	4		39	19.1	12	51.2	MkII	0317	
	5		39	22.2	12	51.0	FIDO	0937	
	6		39	22.0	12	51.1	BOX	1056	43cm 5453m
	7		39	21.6	12	50.2	FIDO	1610	
	8		39	22.2	12	51.5	MkII	2220	
	9	11 IV	39	22.5	12	51.0	CTD	0326	
	10		39	22.5	12	51.0	MkIII	0520	core obtained
	11		39	22.0	12	51.0	CTD	1130	

10705	1	11 IV	38	29.8	12	30.4	KASTEN	2320	
	2	12 IV	38	31.4	12	31.9	FIDO	0313	
	3		38	30.2	12	30.1	BOX	1252	Pretrip marginal weather
	4		38	30.8	12	33.1	CTD	1640	
	5		38	33.7	12	31.4	MkII	2030	
	6	13 IV	38	35.1	12	30.9	FIDO	0034	
	7		38	35.1	12	32.1	BOX	0627	51cm 4825m
	8		38	34.9	12	31.2	MkII	1122	
	9		38	34.9	12	32.1	KASTEN	1532	
10706	1	14 IV	35	59.1	10	00	CTD	1727	
	2		36	01.2	09	58.2	FIDO	2149	bad weather conditions
LEG 2				N		E			
10707	1	17 IV	37	33.9	00	46.7	CTD	2330	
	2	18 IV	37	33.7	00	46.8	MkIII	0131	
	3		37	32.6	00	47.8	CTD	0427	200 KVA failure
10708	1	19 IV	40	11.8	05	21.7	CTD	1124	
	2		40	13.2	05	20.9	KASTEN	1316	
	3		40	14.1	05	19.9	MkIII	1844	
	4		40	15.5	05	19.1	FIDO	2254	
	5	20 IV	40	16.2	05	18.9	CTD	0045	
	6		40	17.3	05	21.3	KASTEN	0305	53cm 2741m
	7		40	17.9	05	21.5	CTD	0555	
10709	1	21 IV	38	28.75	07	00.4	CTD	2330	
	2		38	27.4	07	01.8	TEST	0246	Mini-FIDO test
	3		38	25.1	07	02.2	CTD	0419	



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