MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
FISHERIES LABORATORY, LOWESTOFT, SUFFOLK NR33 0HT, ENGLAND

1991 RESEARCH VESSEL PROGRAMME

REPORT: RV CIROLANA 4/91

STAFF:		
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	D S Kirkwood	a,b
	N D Pearson	c
	J Brown	a,b
	J M Rees	c
	J W Read	a,b
	S R Jones	a,b
	J Cooper	a,b,c
	M J Ives	b
	D B Sivyer	b,c
	A Reeve	a,b,c
	A Kenny	a(part)
	M Mason (UC)	c
	C Vincent (UEA)	c

DURATION: 12 April 1991-2 May 1991: (a) 12-19; (b) 19-23; (c) 23-2/5

LOCATION: Wash, Humber Estuary, North Sea, Irish Sea

AIMS:

1. To identify and quantify the fate of river-borne nutrients entering the Wash and Humber estuary, examining nutrient distributions and critical processes from the river inputs through to the North Sea in subtidal and intertidal sediments and the overlying water.

2. To measure factors affecting benthic nutrient cycling in subtidal sediments along a transect across the North Sea, in collaboration with the Netherlands Benthic Links and Sinks programme.

3. To recover the Tetrapod and current meter moorings from the north-east Irish Sea.

4. To deploy the Tetrapod at an anchor station next to STABLE in the north-east Irish Sea.

5. To conduct studies of *Amphiura* community related bioturbation in the north-east Irish Sea.

6. To conduct an anchor dredge survey of benthos at marine aggregate extraction sites near the Humber.

NARRATIVE: (all times are Greenwich Mean Time)

RV CIROLANA sailed from Lowestoft at 0820 h on Friday 12 April 1991 and steamed to the Wash collecting surface water samples. Five sites in the Wash were sampled as a shake-down for scientific staff and equipment.

On 13 April 1991 a grid of 32 stations in the Wash was sampled using the CTD-rosette array, water samples were collected for the determination of dissolved and particulate nutrients, salinity, suspended load and chloropigments.

A set of Day grab sediment samples was collected on 14 April to examine grain size distributions

in the outer Wash. CIROLANA anchored near to station A2 and a combined sediment trap and current meter mooring was laid. The poor weather, with winds from the north-north east, prevented the seatruck "Seeker" from reaching CIROLANA so the Kings Lynn pilot boat was used to take Juan Brown and an ill crewman ashore. The sediment trap mooring was recovered on the morning of 15 April before commencing a 12 hour tidal cycle anchor station at A2 in the Kings Lynn anchorage. The sediment trap mooring was relaid. A 'weather window' allowed the "Seeker" to transfer Juan Brown and Andrew Kenny to the ship.

The sediment trap was recovered and CIROLANA sailed out of the Wash on the morning of 16 April, into an increasing northerly wind. Six stations in the Humber Plume were sampled and anchor-dredging conducted at 6 sites in the Inner Dowsing area before operations had to stop. CIROLANA dodged until late morning on 17 April then entered the Humber, taking pilotage to the North Killingholme anchor site. As usual, there were problems due to lack of hold of the anchor. The searider transferred 3 scientific staff, 1 crewman and the pilot to North Killingholme jetty.

A 12 hour tidal cycle anchor station commenced on the morning of 18 April while the charter vessel "Brough Sounder" sampled the upper Humber. The 12 anchor station was repeated on 19 April while the charter vessel "Wyke" sampled the outer Humber. Staff and gear transferred via the "Wyke". Sediment samples were collected at the anchor station and CIROLANA left the Humber. Overnight CIROLANA steamed back to the Wash.

On 20 April, a selection of sites was sampled but as nothing appeared to have changed during the intervening week, the sediment sampling programme was brought forward and coring commenced at site WSP1. It proved difficult to sample this site and it was abandoned in favour of site WSS8. At this muddy sand site 7 Day grabs, 10 Reineck cores and a Calvert core were recovered. This material was used to sample for benthic macrofauna, sediment/water nutrient fluxes, sediment oxygen uptake, pore water chemistry, denitrification rate. X-ray photography and natural series radionuclides. CIROLANA then began the CTD and water sampling transect across North Sea, continuing throughout the following day, 21 April. Day grab samples were collected at a site to the east of Smiths Knoll.

The main BELS sampling site was occupied on 22 April. Seven Day grabs and 10 Reineck box cores were collected for benthic macrofauna and for sediment process study. The Reineck had problems in retaining the sample without serious drainage which always occurred in the same corner of the box. Water samples were collected before CIROLANA steamed back to Lowestoft for the morning tide on the 23rd. CIROLANA docked at 0500 h on 23 April to exchange scientific staff and equipment and sailed at 1500 h in very calm weather *en route* for the Irish Sea. Surface water samples were collected along a transect through the Thames plume for nutrient and chlorophyll determinations.

The passage to the Irish Sea was uneventful with fair weather all the way. Work commenced to recover the various moorings at 0500 h on 26 April. Mooring T was recovered first. The Tetrapod was in good condition. Mooring S was recovered intact. Mooring W was, however, 1.3 nmiles away from its original site. Three current meters, the subsurface buoy and a ground anchor were missing from this rig. A report from the "Solway Protector" suggests that the array had been in the nets of at least 2 fishing vessels. The current meter wire had been cut. Mooring P was also off site by about 8 cables but this rig was recovered whole. The recovery operations had gone very smoothly due to the skill of the officers and crew, helped by the good weather. The stern first approach, under bow thrust control, was very successful. Sediment samples were collected at Bio Site "S" off St Bees Head. The mud/muddy site was sampled for benthic macrofauna and sediment process study.

CIROLANA steamed to the STABLE site, having confirmed this with RRS CHALLENGER, and anchored. The Tetrapod was deployed and a 25 hour tidal cycle anchor station began. CHALLENGER lay nearby throughout this period.

On the evening of 27 April the Tetrapod was recovered, interrogated and redeployed in the

mouth of the Solway Firth. A Day grab sample was obtained and the bottom observed via the underwater video camera before commencing a 12 hour tidal cycle anchor station. The Tetrapod was finally recovered at 0500 h on Monday 29 April and CIROLANA sailed for Lowestoft, docking at 2302 h on 1 May 1991.

RESULTS:

Sampling in support of Aims 1, 2, 3 and 4 was fully completed. Sampling in support of Aim 6 had to be abandoned due to bad weather and only one station in the north-east Irish Sea was sampled in support of Aim 5 due to the withdrawal of staff from the cruise.

Aim 1

As the spring bloom of phytoplankton develops during the April/May period in the Wash it had been hoped to examine its time course. High nutrient concentrations and very low chlorophyll concentrations clearly showed that production had not yet started in the Wash and nor had it started a week later. Such is the importance of productivity as a temporary nutrient sink, it is essential to follow the development of the phytoplankton (as chemical components) throughout the year. An inexpensive monitoring scheme was devised and has subsequently been put in place.

Water column sampling was carried out at 30 stations in the Wash, 18 stations offshore in the Humber Wash plume and 65 stations along transects in the Great Ouse and Humber using charter vessels in a linked operation. The usual seaward decrease of nutrient concentrations was observed along each transect, the offshore concentrations clearly reflecting the lack of productivity. Interpretation of the data awaits completion of all analyses and their entry to the JoNuS database. Although as much of the basic information as possible is entered at sea there remain some items for which delays are inevitable. Salinity is a key parameter here. It would be desirable to have a sea-going salinometer, as this would allow much of the preliminary data interpretation to be done at sea.

On a single transect nutrient concentrations were at an undetectable minimum in mid North Sea and increased towards the Dutch and British coasts. Concentrations were similar to those measured in April 1989 during the NERC North Sea programme.

Day grab sediment samples were collected at a grid of stations in the Wash to test the validity of BGS published sediment distribution maps which are based on information collected in the late 1960's and early 1970's. A further set of Day grabs were collected in a transect to the east of Smiths Knoll as a reconnaissance for future sediment sampling.

Complementary nearshore sediment sampling was conducted both before and during the cruise in the Wash and Humber. The analysis of this data is continuing.

The opportunity was taken to sample the Thames plume during the passage to the Irish Sea. Surface water samples were collected for the determination of nutrients and chlorophyll 'a'.

Throughout continuous flow instruments were operated to determine salinity, temperature and chlorophyll 'a' fluorescence distribution along the cruise track. Serious problems arose shortly after leaving Lowestoft on the first leg and on the second leg when the logging system on the HP1000 crashed. The Guildline continuous CTD and the Aquatracka fluorometer were logged as voltages using a PC equipped with some general purpose data acquisition software. This data will need conversion to real units post-cruise.

Aim 2

Detailed sediment sampling was conducted at 2 sites as part of the BELS collaboration. One site in the Wash was in muddy sand containing a fauna dominated by ophiuroids while the other (53°N 3.5°E) was in slightly muddy sand containing a fauna dominated by echinoids and

amphipods. Each site was sampled for sediment/water nutrient flux, sediment oxygen uptake (incubation), interstitial water chemistry, denitrification rate, X-ray photography and natural series radionuclides. Work up of the samples will be completed after the cruise. Particular problems were encountered in sampling the more sandy site. It is essential that DFR purchases a new box corer capable of providing samples of both sands and muds to replace the ageing Reineck.

Aim 3

The Tetrapod was recovered after its long deployment (laid during CIR.2/91) and found to be in good order. Only one storm event had occurred during the deployment on 23 February 1991. The tetrapod went into adaptive sampling mode for 24 hours. Significant wave heights during this storm were just of 2 m (Fig. 1) compared with over 6 m during deployment 70 on the NE coast. All sensors had worked correctly showing 4 spring/neap cycles (Fig. 2). "Pumping" of the eastern Irish Sea at springs is shown by the increases in temperature (Fig. 3) as warm water is injected from St Georges Channel. The transmissometer data generally agreed with the wave activity but there was a gradual degradation due to fouling by marine growth (Fig. 4). Current meter moorings T, S and P were recovered intact. Current meter mooring W had unfortunately been trawled with the loss of 3 of 4 current meters and a subsurface buoy. The Solway Protector passed on the local view that mooring W was in a vulnerable place and that our toroids are not easily seen. I suggested that consideration be given to a coat of day-glo orange or pink on the toroids.

Aim 4

The Tetrapod was deployed just under 1 nmile south of the STABLE rig to compare estimates of bed shear stress from the two instrumented platforms. There was little wave activity (maximum height a few centimetres) during the deployment. Resuspension was dominated by the tides (maximum velocity 35 cm/s). As the work was running ahead of schedule it was decided to deploy the Tetrapod on some non-cohesive sediments in the tidally energetic mouth of the Solway Firth. After some initial difficulties the Tetrapod was deployed and recorded tidal velocities up to 55 cm/s. This sandy bottom data will be used in a comparison with the muddy Sellafield site, and as input to the Solway Firth model.

Aim 5

Day grab and Reineck box core samples were collected at just one site off St Bees Head. The sediment was found to be a fine muddy sand containing a fauna dominated by ophiuroids, as expected. Samples were preserved for sorting in the laboratory.

Sediment samples were collected for sediment/water nutrient flux, sediment oxygen uptake, interstitial water chemistry, X-ray photography, denitrification rate and natural series radionuclide determinations.

Aim 6

The anchor dredge samples at Inner Dowsing were sieved and examined for benthic fauna. The gravel contained little of biological interest, making this site unsuitable for studying the effects of dredging on the sediment communities.

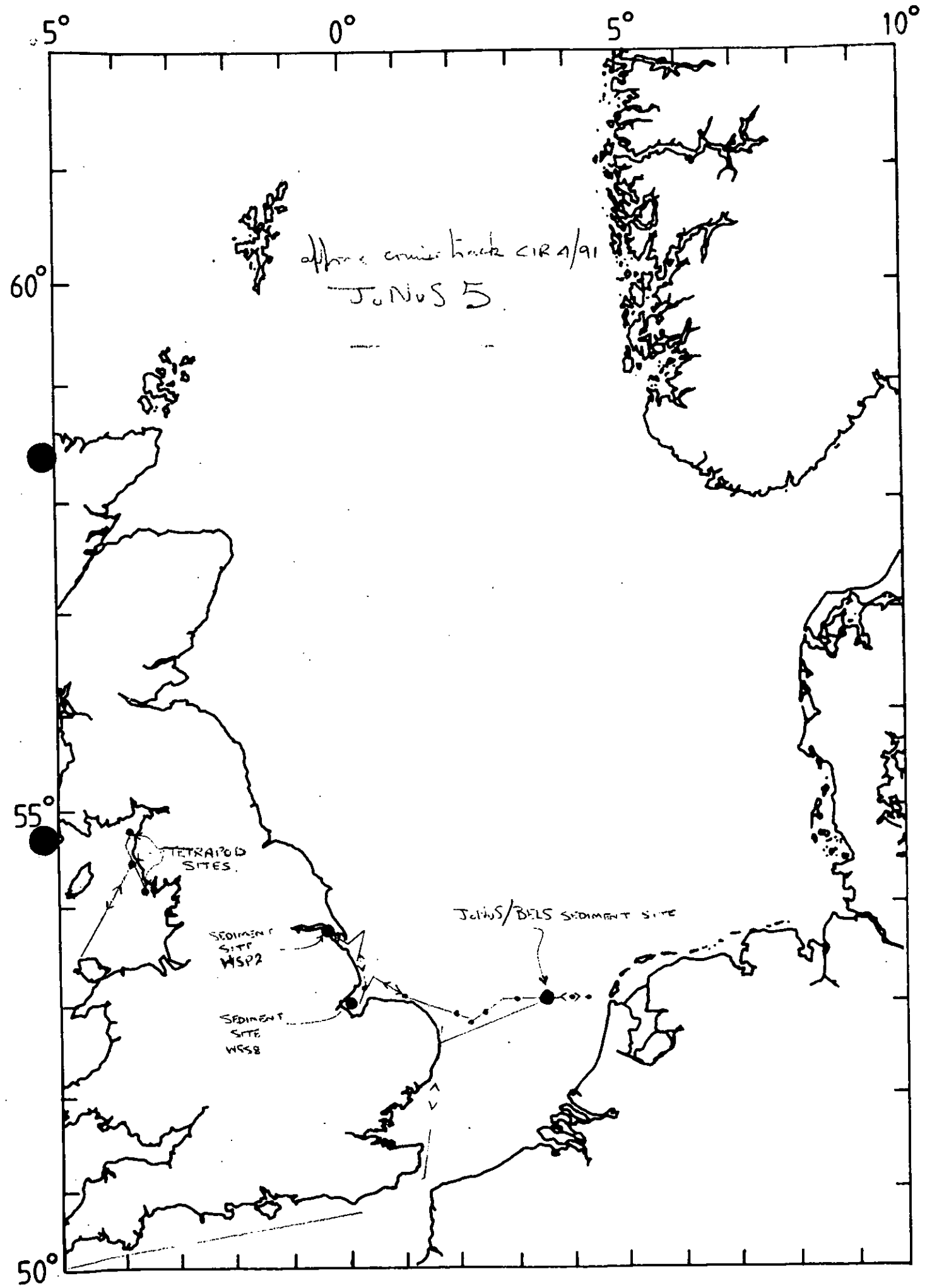
Stephen J Malcolm
9 May 1991

Seen in draft: J R French (Master)
P McKay (Senior Fishing Mate)

Initialled: CEP

Distribution:

Basic List +
S J Malcolm
D S Kirkwood
N D Pearson
J Brown
J M Rees
J W Read
S R Jones
J Cooper
M J Ives
D B Sivyer
A Reeve
A Kenny
D J Swift
M Mason (UC)
C Vincent (UEA)
W van Raaphorst (NIOZ)


5°
0°
5°
10°
60°
55°
50°
offshore cruise track CIR 4/91
JONUS 5
TETRAPOD SITES
SEDIMENT SITE WSP2
SEDIMENT SITE WSS8
JONUS/BELS SEDIMENT SITE

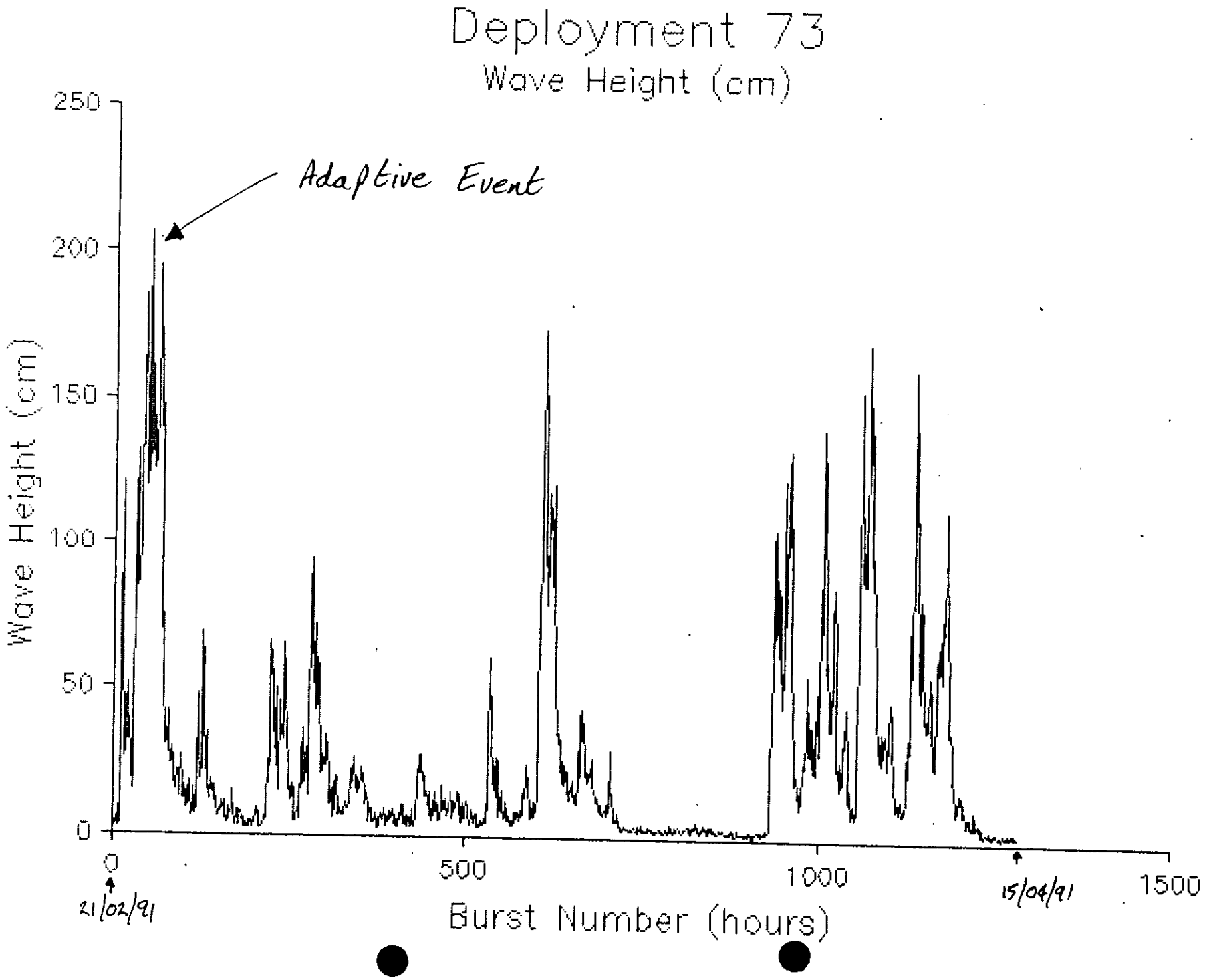

Deployment 73
Wave Height (cm)
Adaptive Event
250
200
150
100
50
0
Wave Height (cm)
0
500
1000
1500
21/02/91
15/04/91
Burst Number (hours)

Fig 1

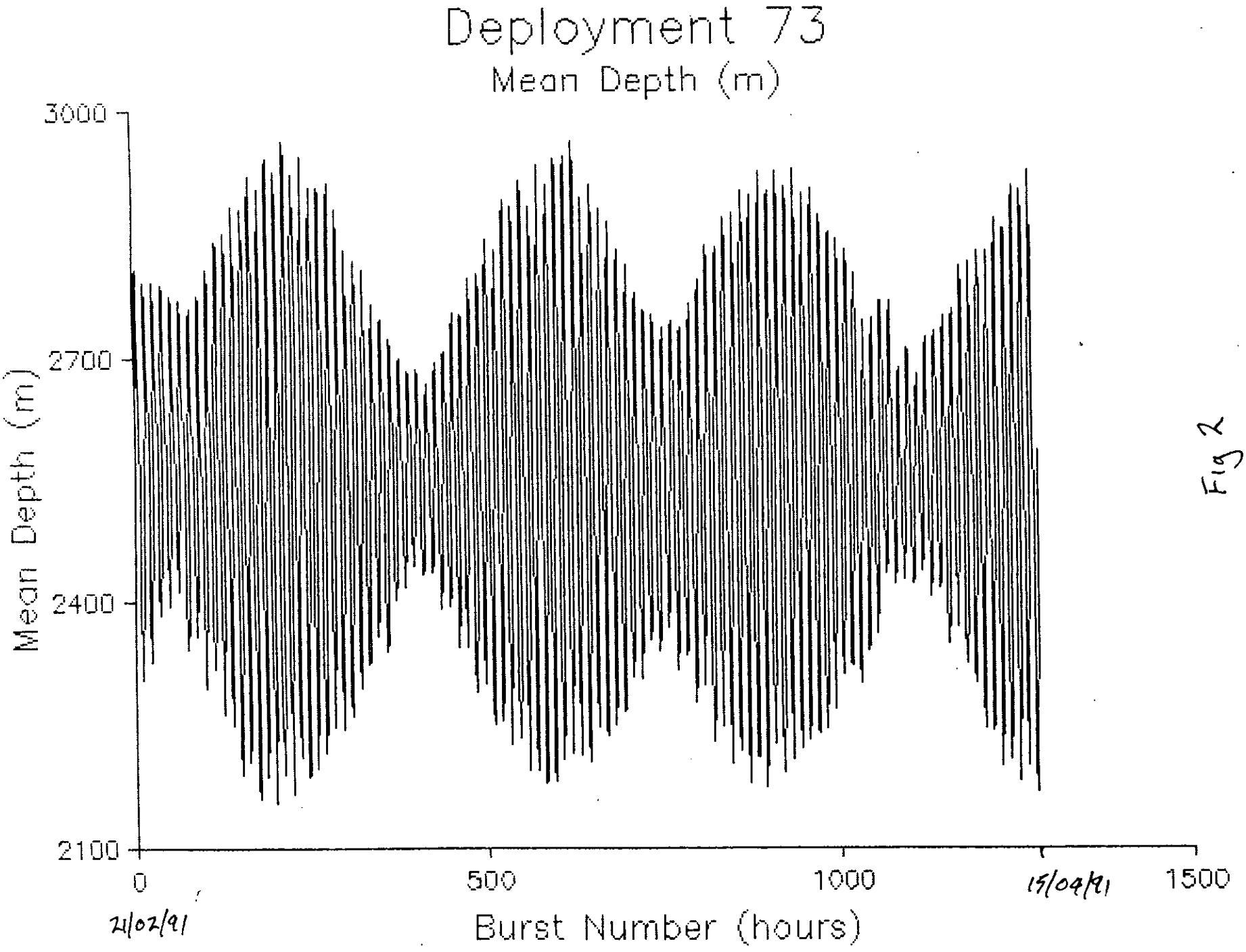

Deployment 73
Mean Depth (m)
3000
2700
2400
2100
Mean Depth (m)
0
500
1000
1500
21/02/91
15/04/91
Burst Number (hours)

Fig 2

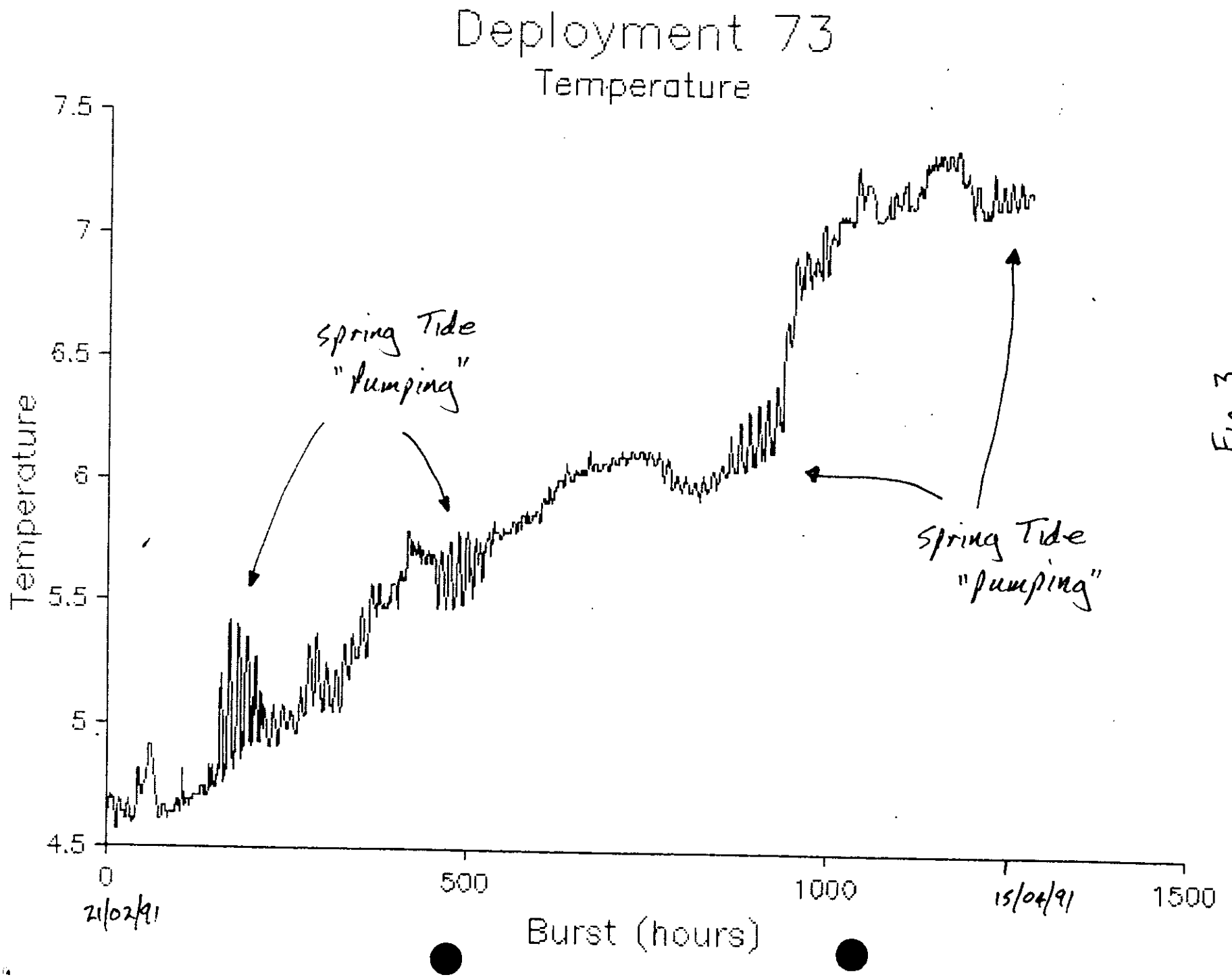

Deployment 73
Temperature
7.5
7
6.5
6
5.5
5
4.5
Temperature
Spring Tide
"pumping"
Spring Tide
"pumping"
0
21/02/91
500
1000
15/04/91
1500
Burst (hours)

Fig 3

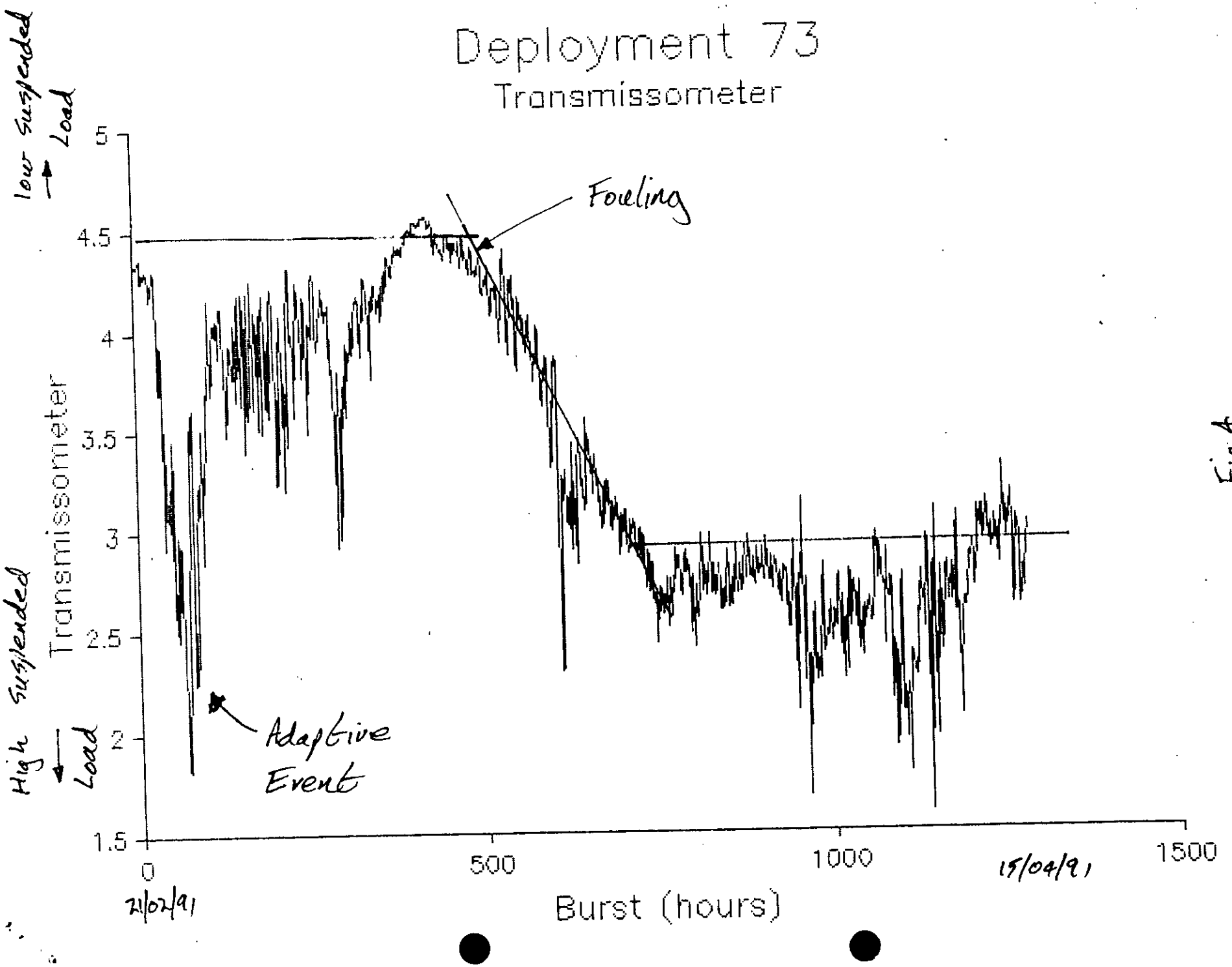

Deployment 73
Transmissometer
low suspended
→ Load
High suspended
← Load
Transmissometer
5
4.5
4
3.5
3
2.5
2
1.5
Fouling
Adaptive
Event
0
500
1000
1500
21/02/91
15/04/91
Burst (hours)

Fig 4