SOUTHAMPTON OCEANOGRAPHY CENTRE

CRUISE REPORT No. 5

RRS *DISCOVERY* CRUISE 225
24 FEB-07 MAR 1997

Studies of sediment mass wasting in the Agadir Basin and sediment transport in the Gulf of Cadiz - incorporating trials of the giant piston corer

Principal Scientist
P P E Weaver

1997

Contribution to EC Project CT94-0083

'SEDIMENT TRANSPORT ON EUROPEAN ATLANTIC MARGINS'

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ABSTRACT

This was the second cruise using the new SOC giant piston corer. The objectives were to complete the testing of the giant piston corer which was begun on cruise D219 in November/December, 1995 and to collect giant piston cores from the Agadir Basin, Gulf of Cadiz and Portuguese margin. We showed that the original problems with the ship's gantry have been overcome and that the ship is now capable of handling the loads experienced during deployment and especially pullout. A large number of relatively minor problems were experienced during the cruise with the design and configuration of the corer. We worked through these systematically until cores were being obtained on a regular basis. A total of 9 cores were obtained from 14 coring attempts. The longest core was 15.97 m long. The quality of cores recovered was excellent.

KEYWORDS

CANARY BASIN
CRUISE 225 1997
DISCOVERY/RRS
GIANT PISTON CORING
GULF OF CADIZ
SEDIMENTS

ISSUING ORGANISATION

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PAULSON, C.	SOC
REES, D.	SOC
ROBERTS, R.	SOC

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Name	Rank
HARDING, M.A.	Master
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OLDFIELD, P.T.	Second mate
REYNOLDS, P.C.T.	Third mate
DONALDSON, B.	Radio officer
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GREENHORN, A.	Second engineer
PERRIAM, R.J.	Third engineer
CONNOR, K.M.	Third engineer
DRAYTON, M.J.	C.P.O.D.
LUCKHURST, K.R.	P.O.D.
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DALE, J.E.	S.G.1A
DAY, S.P.	S.G.1A
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HEALY, A.	P.O.M.M.
NYE, N.J.	S.C.M.
PERRY, C.K.	Chef
THOMSON, C.R.M.	Mess steward
OSBORN, J.A.	Steward
SHIELDS, S.	Steward

ITINERARY

Sailed Funchal, Madeira	24th February, 1997
Arrived Vigo, Spain	7th March, 1997

CRUISE OBJECTIVES

The objectives were to complete the testing of the giant piston corer which was begun on cruise D219 in November/December, 1995 and to collect giant piston cores from the Agadir Basin, Gulf of Cadiz and Portuguese margin.

NARRATIVE

Cruise D225 was designed to carry out the piston coring operations that should have been completed on the previous cruise D219. Cruise D219 was abandoned after insurmountable problems were encountered with the ship's starboard gantry. A refit prior to D225 corrected these problems and the time interval between cruises allowed modifications to be made to the corer.

Day 55 (February 24th 1997). The time for departure was set at 1800 GMT. Before this the ship's first officer presented a safety briefing and tour of the ship. This was followed by a tour and explanation of the equipment to be used on the cruise. It was decided that the first coring operation would take place at first light on Day 56, thus a slow speed was set to the first site some 70 miles SE of Funchal.

Day 56 (February 25th 1997). The sheaves were prepared to take the Aramid cable and the cable was threaded during the early morning. Station D13070#1 was begun at 10.00 and the corer was in the water by 11.10. The first acoustic pinger did not operate correctly and had to be retrieved and replaced. At 12.30 with 1,200 m of cable out the engineers noticed a problem in the winch room. The kevlar had jumped out of one of the sheaves and about 15 metres of its protective sheath was damaged. A repair was made and we continued to veer at a slower rate. The same problem recurred twice causing considerable delays in the station. The problem was caused by poor lapping of the cable onto the storage drum. The corer eventually reached the seabed at 1902 but did not trigger properly. On recovery the

jaws in the tilt transfer unit failed to operate and so these were repaired causing a delay to beyond midnight.

Day 57 (February 26th 1997). The problems with the tilt transfer unit were finally solved and the corer was brought inboard for checking. The problem with the corer was linked to poor operation of the hydrostatic release which was cleaned and remounted. A second coring attempt was made at the same site (D13070#2) with the corer going overboard at 0525. No problems were encountered with the cable lapping this time. However, this core did not trigger properly either, and it had to be recovered again. This time we suspected one of the latches in the safety catch of the trigger arm had not released. A trigger arm was hung between deck and crane to test the effectiveness of the latch system under heavy loads. A problem was identified and corrected by machining the latch. The station was repeated in the same location with the corer going overboard at 1600 (D13070#3). When the wire out reached 2000 metres the winch recorded a momentary large load. When the dynamometer record was checked on the computer there was clear evidence of a pre-triggering in the water column. The corer was therefore retrieved and this was found to be the case. We decided to counteract this problem by doubling the weight of the trigger weight to 100 kg. This was the first recovery of the corer in a triggered mode and this necessitated use of the auxiliary winch. The auxiliary winch worked well with none of the problems experienced on cruise D219. The corer was reassembled for a further attempt at the same station and was relaunched at 2254.

Day 58 (February 27th 1997). This coring attempt (D13070#4) progressed well with a textbook record of penetration into the seabed seen on the dynamometer record. Maximum load on pullout was 10.5 tons. The corer was brought back to the ship and mud on the outside of the barrel suggested penetration of at least 14 metres. However, no core was retained in the liner because the core catcher had failed to hold the sediment. The catchers fingers had been ripped off. We attempted to remedy this situation by adding extra weld to the fingers, and adding a plastic sock around the catcher which we extended into the liner by 50 cms. The corer was relaunched at 0900. Another good dynamometer record was seen during penetration and the corer returned with 15.95 m of sediment (D13070#5). The core was split in the lab revealing a good quality core with a small amount of sediment stretching in the upper few metres. The diameter of the core was slightly less than the I.D. of the liner allowing a muddy soup to flow around the outside of the core. We moved position to a mudwave site 30 miles to the south and launched a similarly configured corer at 2000. The corer fired into the seabed at 2230 and this time the dynamometer record showed a load returning to the cable a few seconds after triggering. This load of about 2 tons remained while the corer was in the seabed but there was a good pullout force of 11.7 tons.

Day 59 (February 28th 1997). The corer returned to the surface at 0100 and was bent but nevertheless had mud up to 13 metres on the outside of the barrel and a 13.3 m core (D13071). 1.25 m of sediment in the middle of the core was lost when the pipe was cut off, but the rest of the core was of good quality. Part of the liner had been shattered due to liner implosion. We moved to the next site which was located on the floor of the Agadir Basin and launched a corer with similar configuration at 1450. It triggered at 1725 and showed a similar dynamometer record to the last one, and on recvovery was also seen to be was also bent. We managed to rescue 7 m of sediment core (D13072#1) but this was badly disturbed by an imploded liner and the pipe cutting. The sediment was soft turbidites which should have been easily cored and so we made another attempt at this site. We changed the piston by removing the neoprene seal thus copying the french "soft piston" idea. This allows some water to pass the piston during corer penetration and places less force on the liner. On the negative side it may produce a shorter core.

Day 60 (March 1st 1997) This core was launched at 0554 and triggered at 0756. It showed an identical dynamometer record to the last two and when it was recovered it was also bent. It did produce an 8 m long core (D13072#2) which had penetrated a number of sandy units but the core quality was excellent throughout. The liner was not damaged and thus we believe the soft piston to be preferrable to a tightly sealing piston. However, the piston was not causing the lack of penetration and so we looked next at the cable rebound problem. The kevlar cable stretches under load and this is compensated for by contraction when the load is released. This could cause the dynamometer anomalies and so we added a further 5 metres to the pennant length for the next deployment on the same site. This core was launched at 1640 and reached the seabed at 1920. The dynamometer record showed a similar trace but with lower loads following triggering. It was also bent in a similar fashion to the previous two cores. We obtained a 7.09 m long core (D13072#3). We left this station at 1100 and steamed for a site on the top of the northern levee of the Agadir Canyon.

Day 61 (March 2nd 1997) We crossed the levee top at about 0430 and proceeded to a small rise on the north side of the levee which was expected to by composed of contourites. This time we added a further 10 metres to the pennant length to overcome any cable rebound problems. The corer was launched at 0745 and penetrated the seabed at 1004. This time the dynamometer record looked good - there was no weight on the winch when the corer was in the seabed. The pull-out force was 14 tons. The corer recovered 10 metres of sediment (Station D13073) but had penetrated 16 metres into the sediment according to the mudline on the outside of the barrel. When the core was split open we could see the last 40 cms of sediment at the bottom of the barrel formed a plug - short laterally compressed pieces of sediment. Thus we deduced that the piston had moved up the barrel either during lowering or

had moved too fast during the coring operation. When the piston reaches the top of the barrel it prevents the escape of any water beneath and thus no more core can enter the barrel. We then moved to a site on the Seine Abyssal Plain which we had cored previously to retest the 20 metre corer and then to step up to a 30 metre core. The transit took until 2108 and the corer was launched at 2210. To prevent the plugging problem we tied the piston with lashing string to the base of the barrel.

Day 62 (March 3rd 1997) The corer triggered at 0036 and again the dynamometer trace looked good. This time the corer had penetrated almost up to the head but contained only 8.65 metres of core (station D13074#1). The problem this time was with the catcher which had not been able to hold the sediment in the barrel - the fingers had inverted and some core had obviously slipped out. Nevertheless, the coring operation now seemed to be running smoothly and so we attempted a 30 metre core at the same site with an extra ton of lead. To improve the catcher we placed two catchers together separated by 2 cms of liner. The corer was launched at 1445 and reached the seabed at 1725. The dynamometer showed the load to reduce slowly i.e. no triggering and thus we brought the corer back to the ship where the original latch problem was again apparent. This problem had resurfaced because of the extra lead and showed that the latch needed further machining. No core was recovered and so we abandoned the site and steamed for the Gulf of Cadiz.

Day 63 (March 4th 1997) On passage all day to the Gulf of Cadiz. Heavy swell running.

Day 64 (March 5th 1997) Arrived at mudwave site in Gulf of Cadiz at 0400 and deployed 30 metre corer in 977 metres water depth. The dynamometer record showed a good trigger and unusual stepped pullout. When the corer was brought back to the ship a 90° bend was seen in the upper barrel. The corer was brought onboard and a 9.65 metre core was removed (D13075). The double catcher had worked properly and the liner was not imploded. The mud was soft and the barrel appeared to have penetrated about 20 metres. Thus we concluded that the piston was moving up the barrel faster than core was entering and water was passing the piston. When the piston reached the top of the barrel no more core could enter. To test this we prepared a "semi-soft" piston with the neoprene seal back in but containing slots for some water to pass. For our last core of the cruise we moved to a mudwave site in 726 metres of water, west of Faro on the western levee of the Portimao Canyon. The sediments here appeared very soft on the 3.5 kHz record which showed 75 metres penetration of sound. We rigged a 20 metre corer with semi-soft piston and removed one ton of lead. The corer triggered at 1948, but the dynamometer showed two rebound peaks and a slow fall off of load during pullout. The corer was bent half way down the top barrel. Mud on the outside of the

barrel showed a penetration of about 13 metres. Inside, the liner had imploded and was wedged so tight that the ship's capstan could not withdraw it. The barrel was therefore cut at approximately the level of the recovered sediment surface and 8.75 metres of core was retrieved (D13076). The difficulties in recovering this bent corer used most of the remaining time available for coring operations and thus we left this site at 1948 and headed directly for Vigo. We passed Cape St Vincent at 2200.

Day 65 (March 6th 1997) Steaming all day for Vigo. Cleaned the laboratories and packed the scientific gear.

Day 66 (March 7th 1997) Arrived Vigo and tied up ship at 0900. Offloaded cores into crates for transfer back to the UK. Disembarked scientific party at 1100.

PRINCIPAL RESULTS AND CONCLUSIONS

The cruise proved that the new giant piston corer works. The original problems with the ship's gantry have been overcome and the ship is now capable of handling the loads experienced during deployment and especially pullout. The increased safety precautions worked well and I congratulate the engineers for their dedication and hard work which really did pay off. A large number of relatively minor problems were experienced during the cruise with the design and configuration of the corer. We worked through these systematically until cores were being obtained on a regular basis. The chief problems which remain are the bending of barrels and the relatively short length of cores recovered. We believe both of these can be addressed by a small amount of redesign. The quality of cores recovered is excellent.

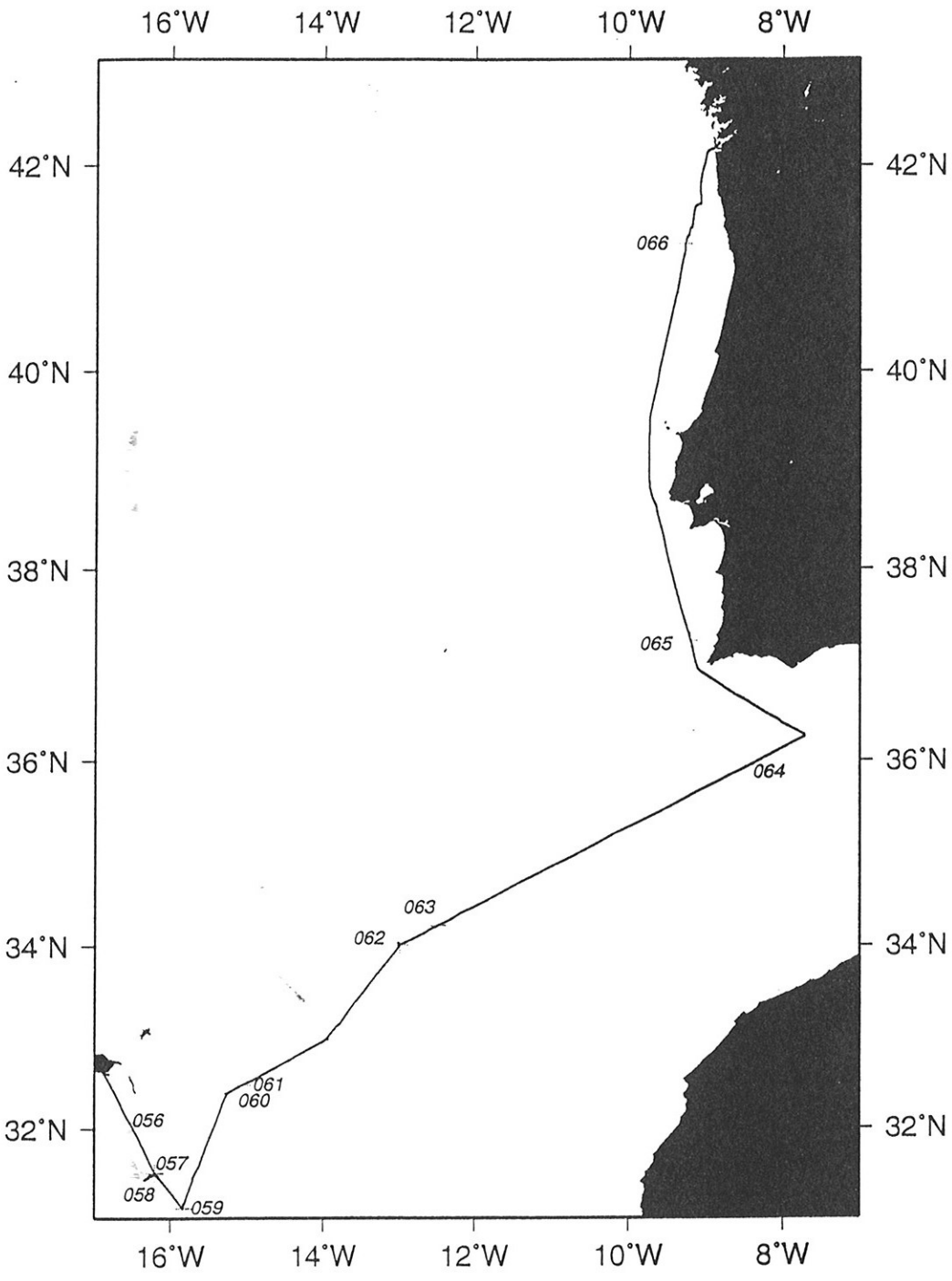


Figure 1. Track line with day numbers for cruise D225

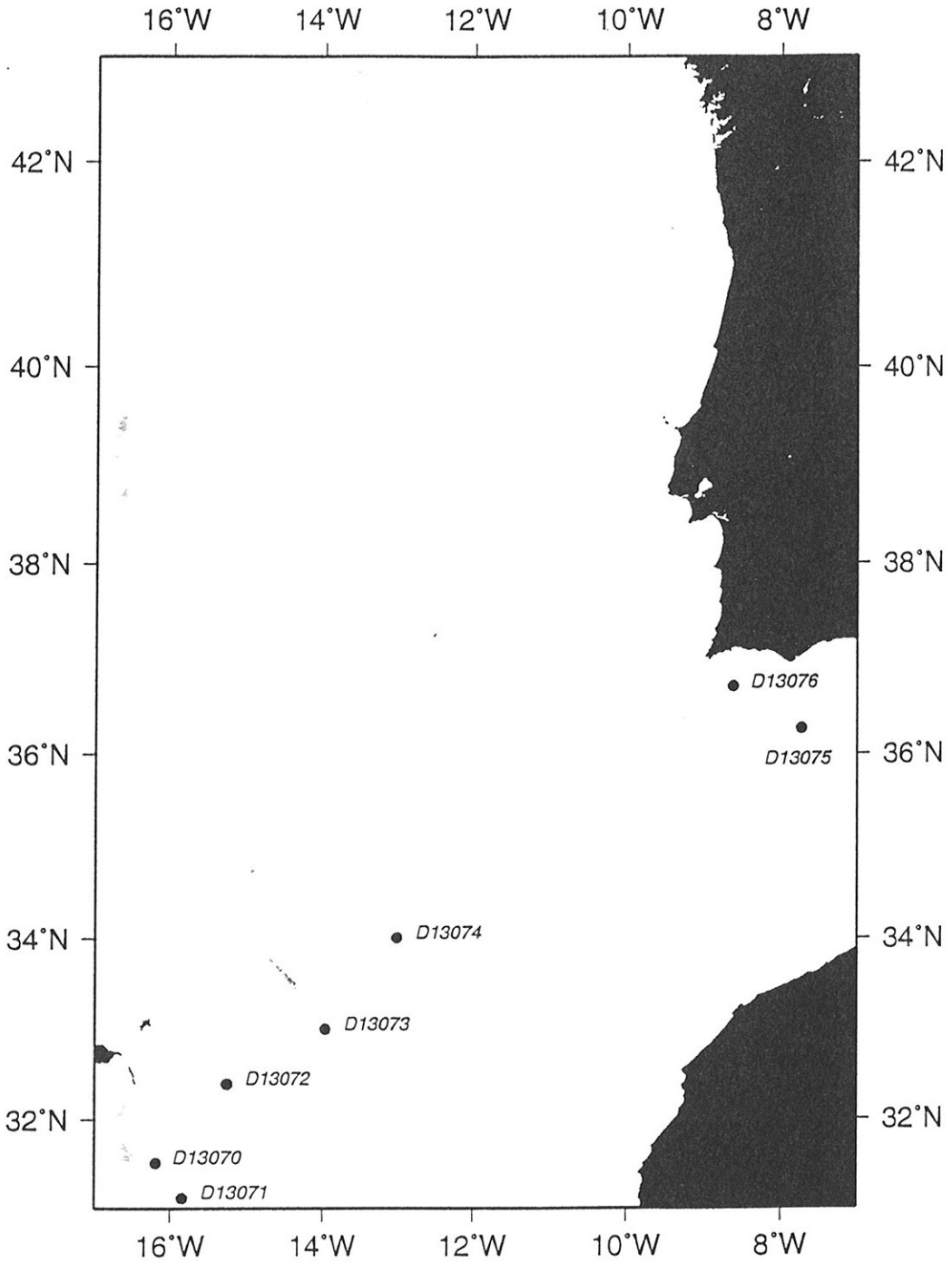


Figure 2. Cruise D225 core positions

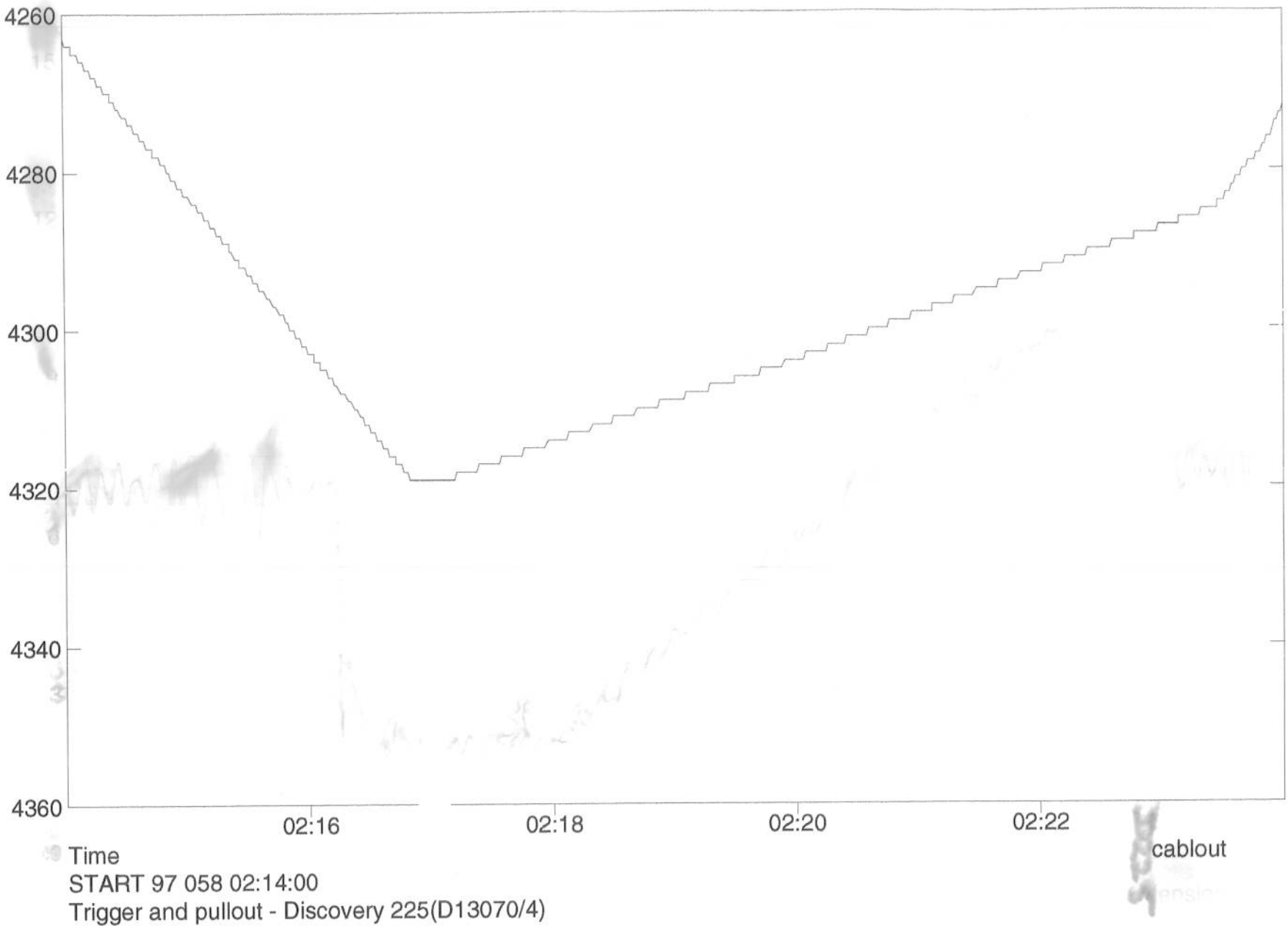
Core Positions

Core No	Lat °N	Long °W	Water Depth uncorr m	Recovered core
D13070#1	31° 30.03'	16° 11.94'	4404	-
D13070#2	31° 30.03'	16° 11.94'	4404	-
D13070#3	31° 30.03'	16° 11.94'	4404	-
D13070#4	31° 30.03'	16° 11.94'	4404	-
D13070#5	31° 30.03'	16° 11.94'	4404	15.97
D13071#1	31° 6.84'	15° 50.81'	4311	13.31
D13072#1	32° 23.04'	15° 16.91'	4366	9.30
D13072#2	32° 23.13'	15° 17.27'	4365	8.02
D13072#3	32° 23.01	15° 17.00'	4366	7.09
D13073	32° 59.31'	13° 56.80'	4315	10.00
D13074#1	34° 00.42'	13° 00.07'	4411	8.65
D13074#2	34° 00.20'	12° 59.98'	4411	-
D13075	36° 15.03'	7° 43.97'	977	9.59
D13076	36° 41.42'	8° 37.97'	726	7.5

Table 2 Corer Setup Data

Core No	barrel length (m)	trigger chain (m)	freefall length (m)	rebound (m)	Pennant length (m)	total weight (tns)	Pull out force (tns)	Recovered core (m)	Remarks
D13070#1	22.5	24.5	1.5	1.5	26	5	-	-	Trigger safety release did not work. Hydrostatic release repaired
D13070#2	22.5	24.5	1.5	1.5	26	5	-	-	Trigger safety release did not work. Safety latch modified
D13070#3	22.5	24.5	1.5	1.5	26	5	-	-	Pretriggered at 2000 m. Trigger weight of 50kg too small.
D13070#4	22.5	24.5	1.5	1.5	26	5	10.4	-	Catcher failed to hold in core
D13070#5	22.5	24.5	1.5	1.5	26	5	9.7	15.97	Good core. some disturbance in upper few metres
D13071	22.5	24.5	1.5	3.5	28	5	11.7	13.31	Corer bent but core quality good. Liner shattered near top
D13072#1	22.5	24.5	1.5	3.5	28	6	11.4	9.30	Corer bent with disrupted core. Liner shattered near base
D13072#2	22.5	24.5	1.5	3.5	28	6	11.7	8.02	Corer bent. Used soft piston - no liner problems. Excellent core quality
D13072#3	22.5	25.5	2.5	7.5	33	6	11.5	7.09	Corer bent. Soft piston. Core quality good.
D13073	22.5	25.5	2.5	17.5	43	6	14	10.00	Good core. Barrel penetrated 16m. Core plugged in lowest 34 cms.
D13074#1	22.5	25.5	2.5	17.5	43	6	12	8.65	Good core. Barrel penetrated fully but c11 metres had fallen out due to catcher problem
D13074#2	32	35.5	2.5	17.5	53	7	-	-	Trigger safety release did not work
D13705	32	35.5	2.5	17.5	53	7	14.5	9.59	Good core. Barrels bent.
D13706	22.5	25	2.5	3	28	6	11.5	7.5	Good core. Barrels bent Semisoft piston - imploded liner.

The following pages contain diagrams that were removed from the original report before it was scanned.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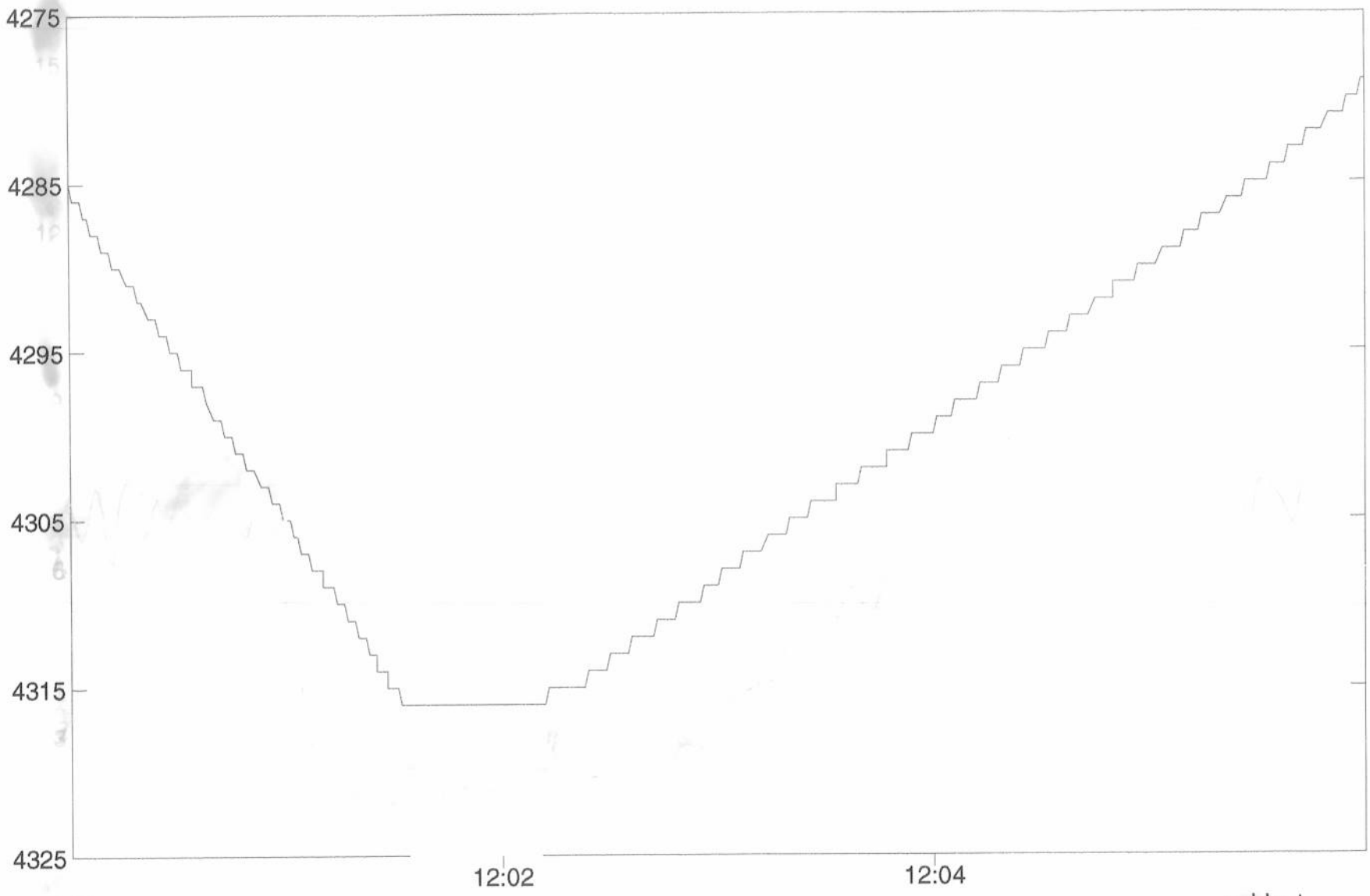
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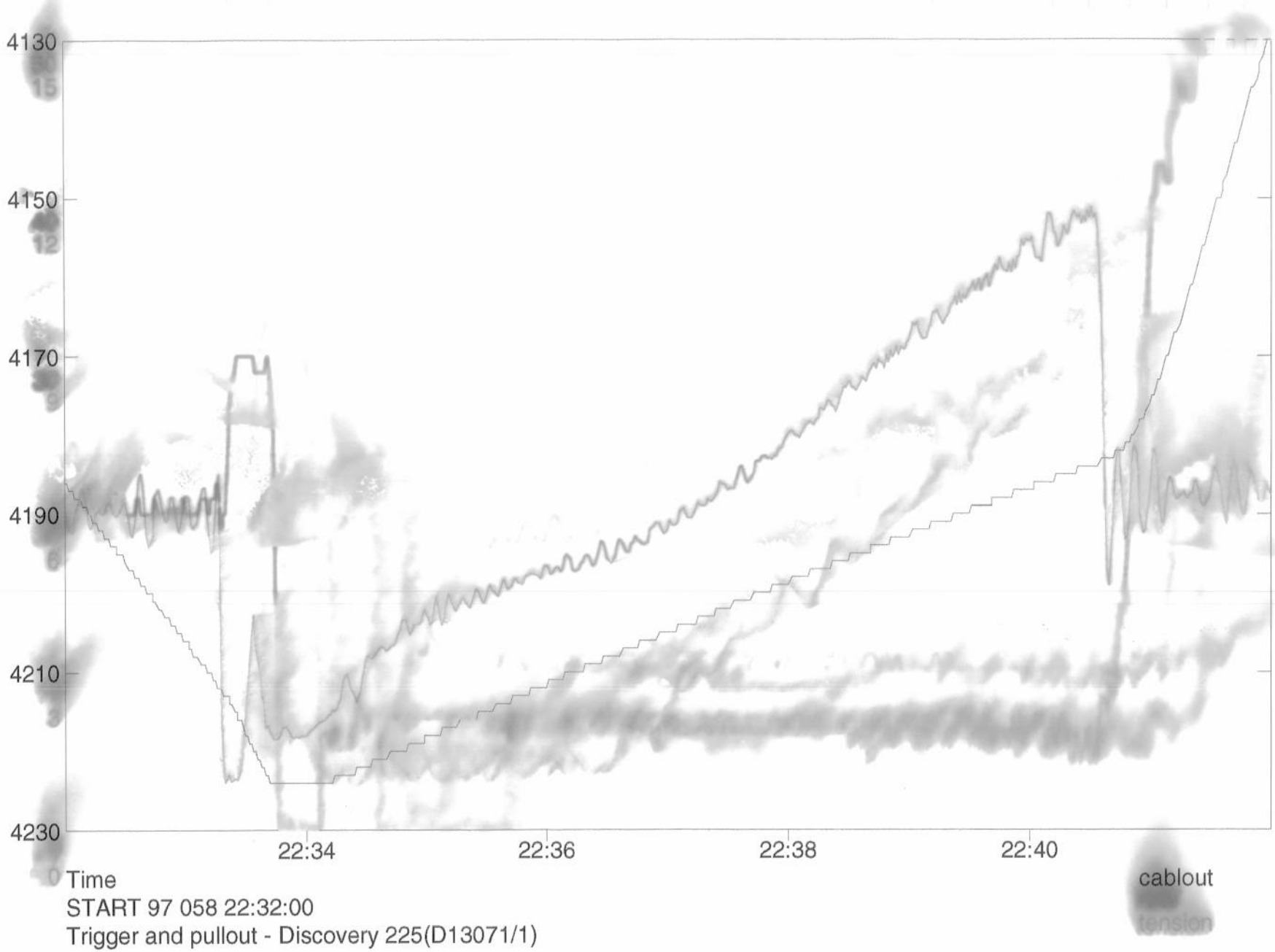
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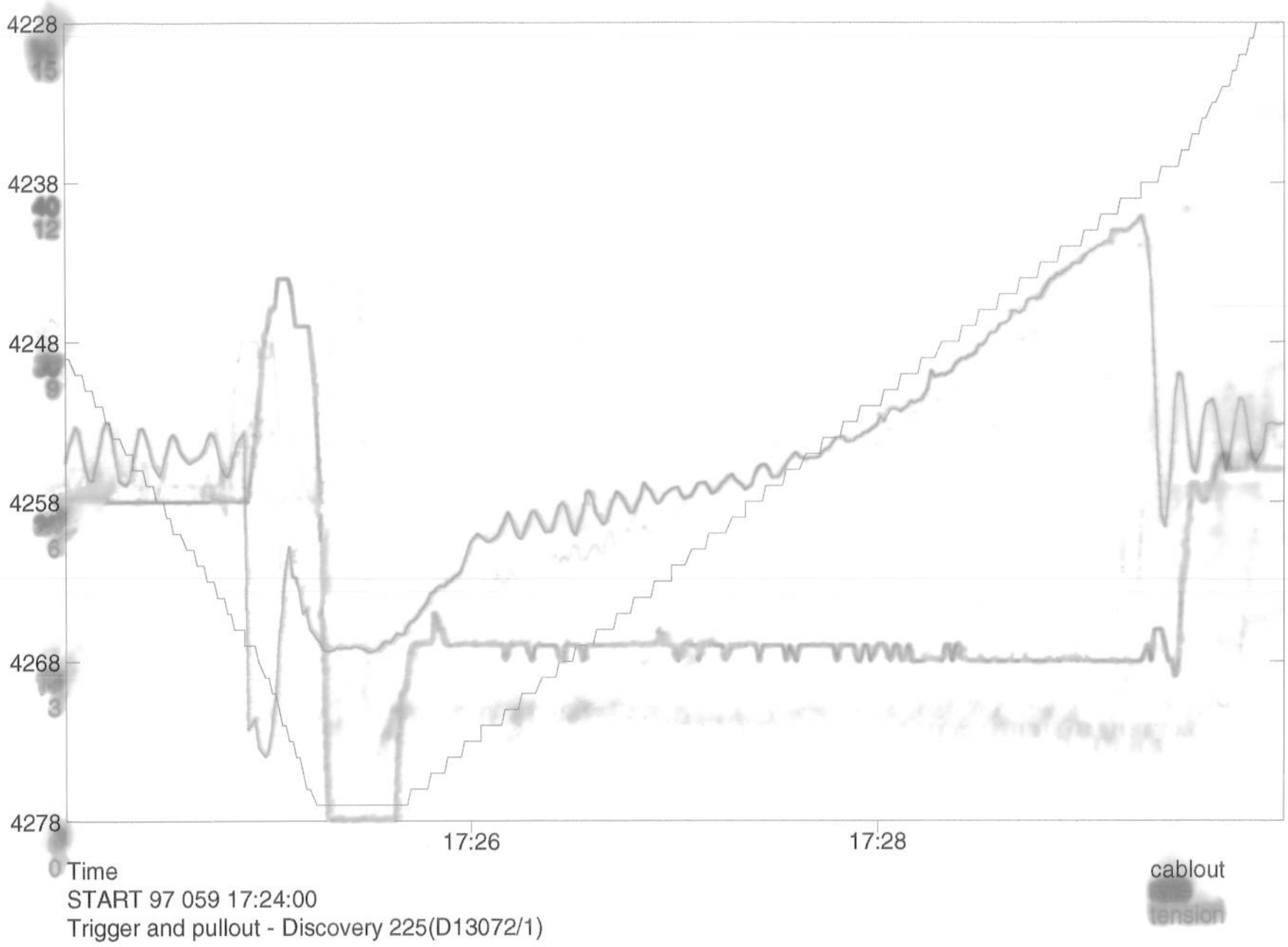
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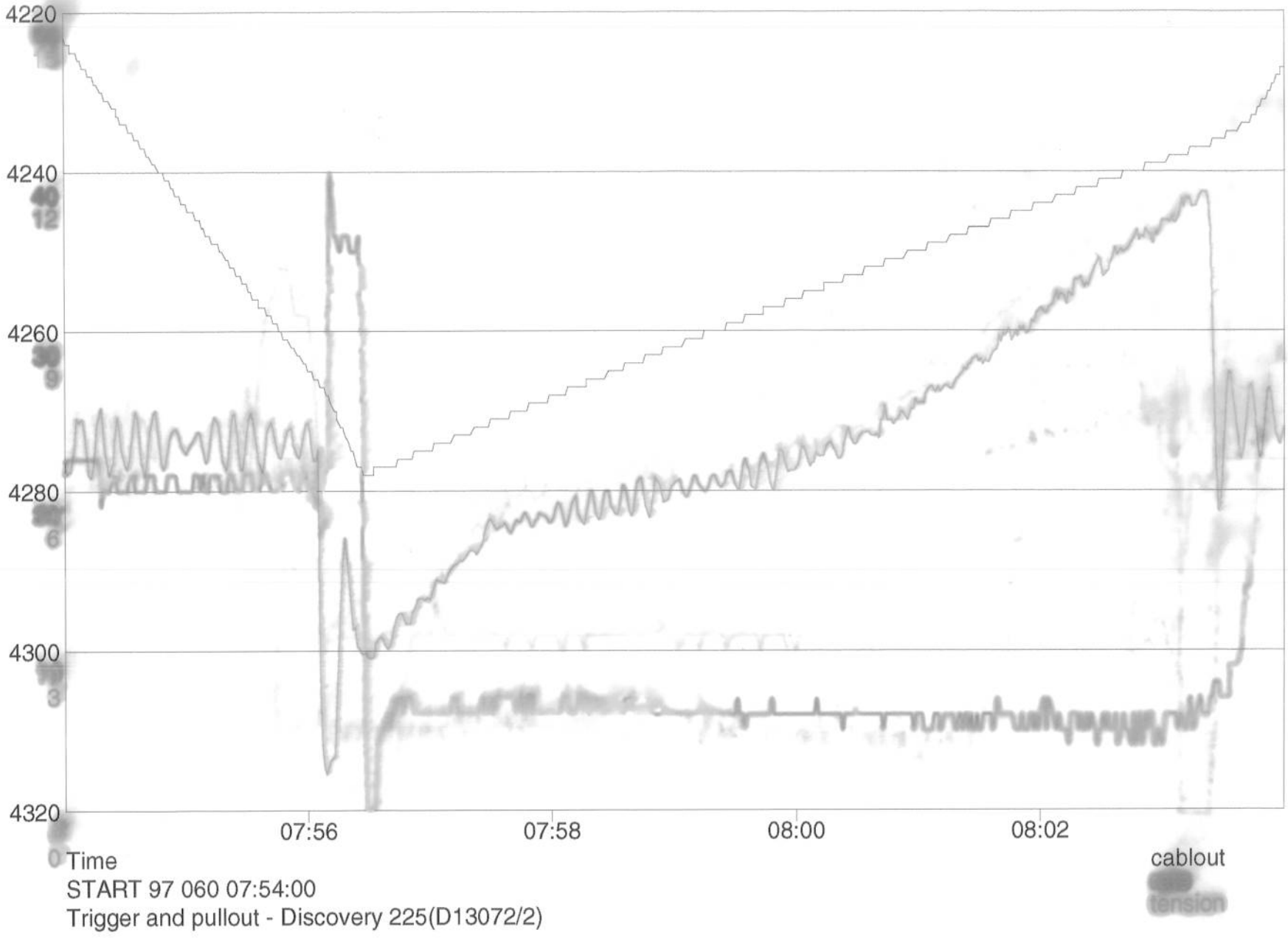
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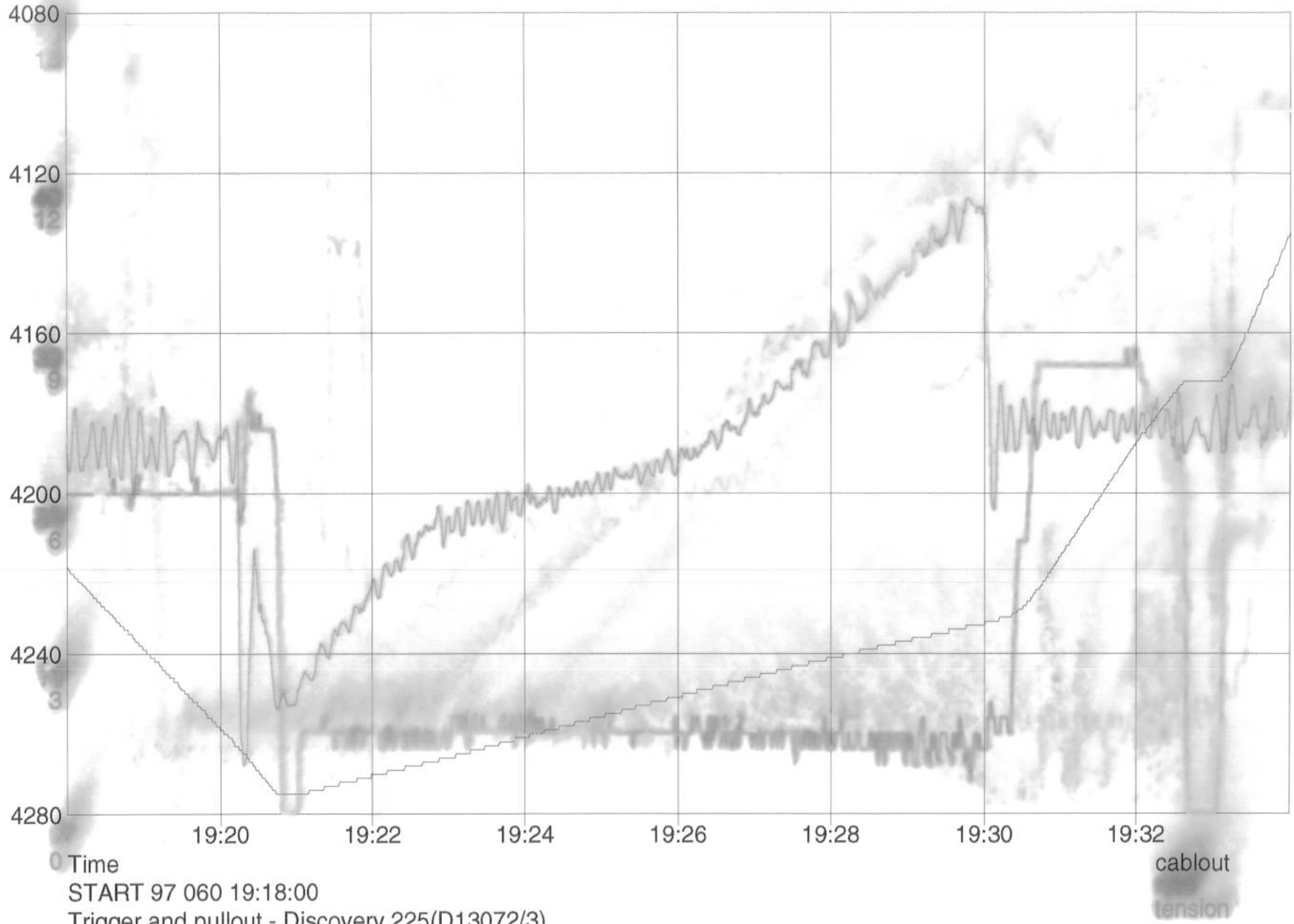
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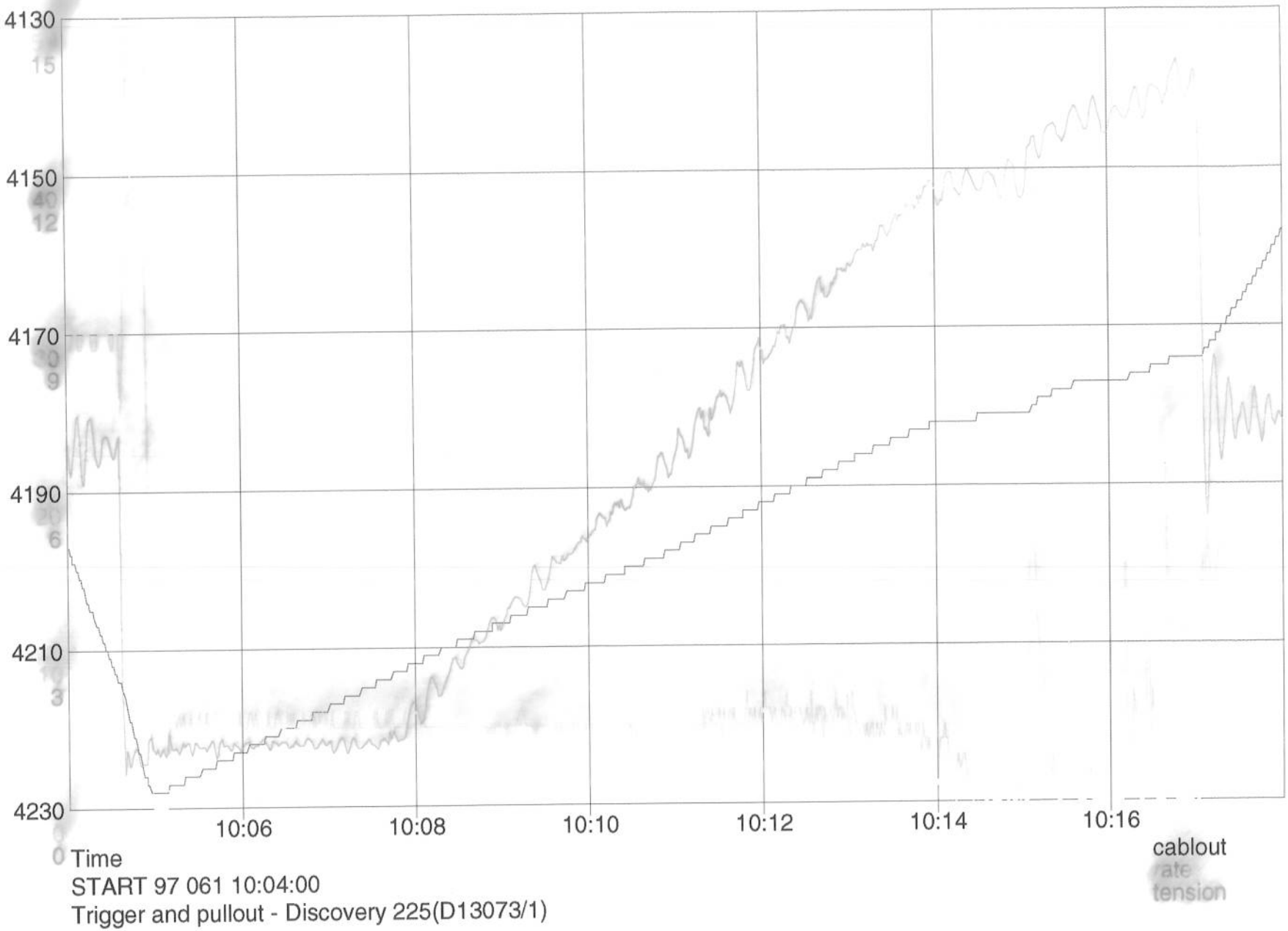

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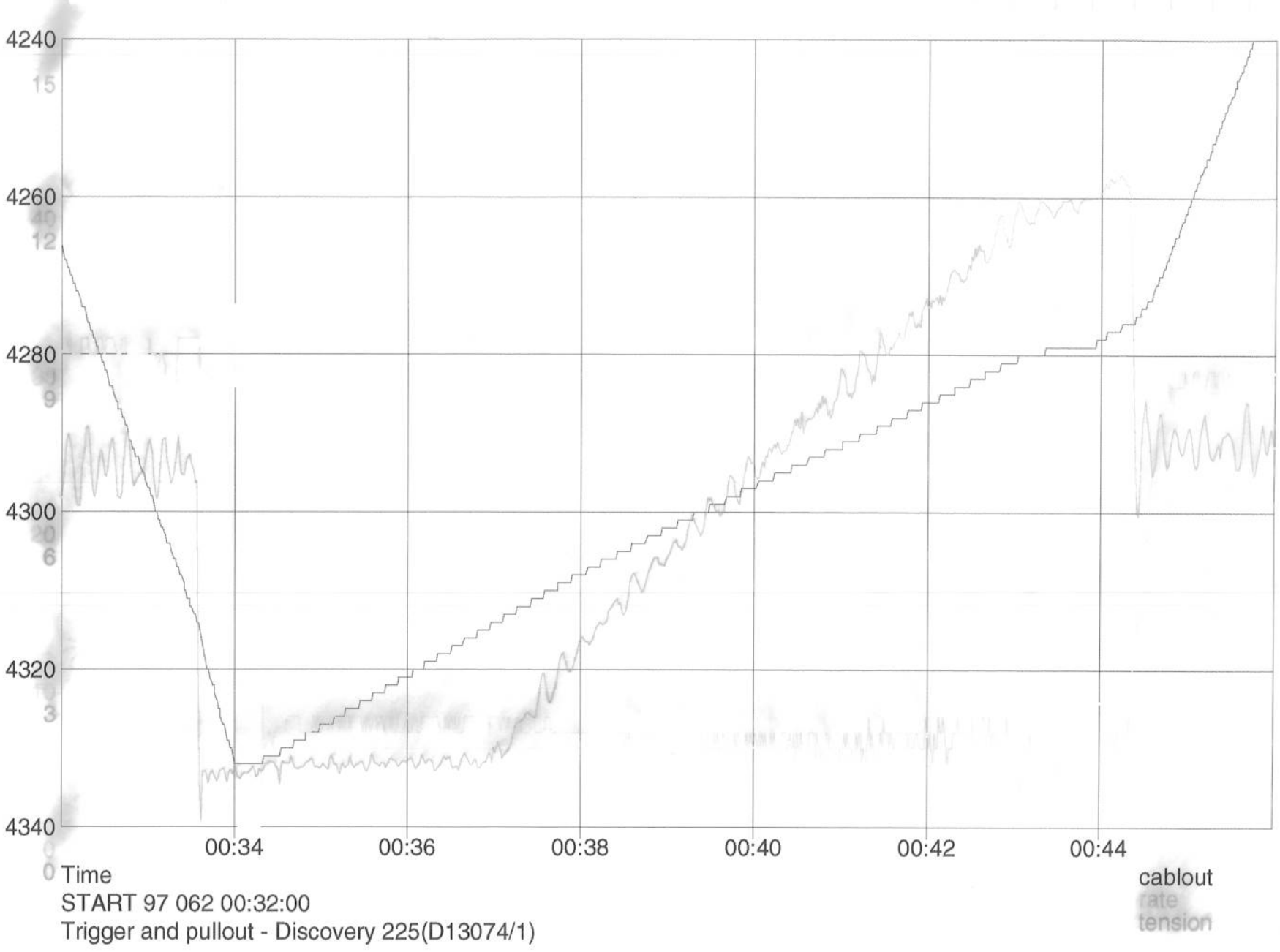
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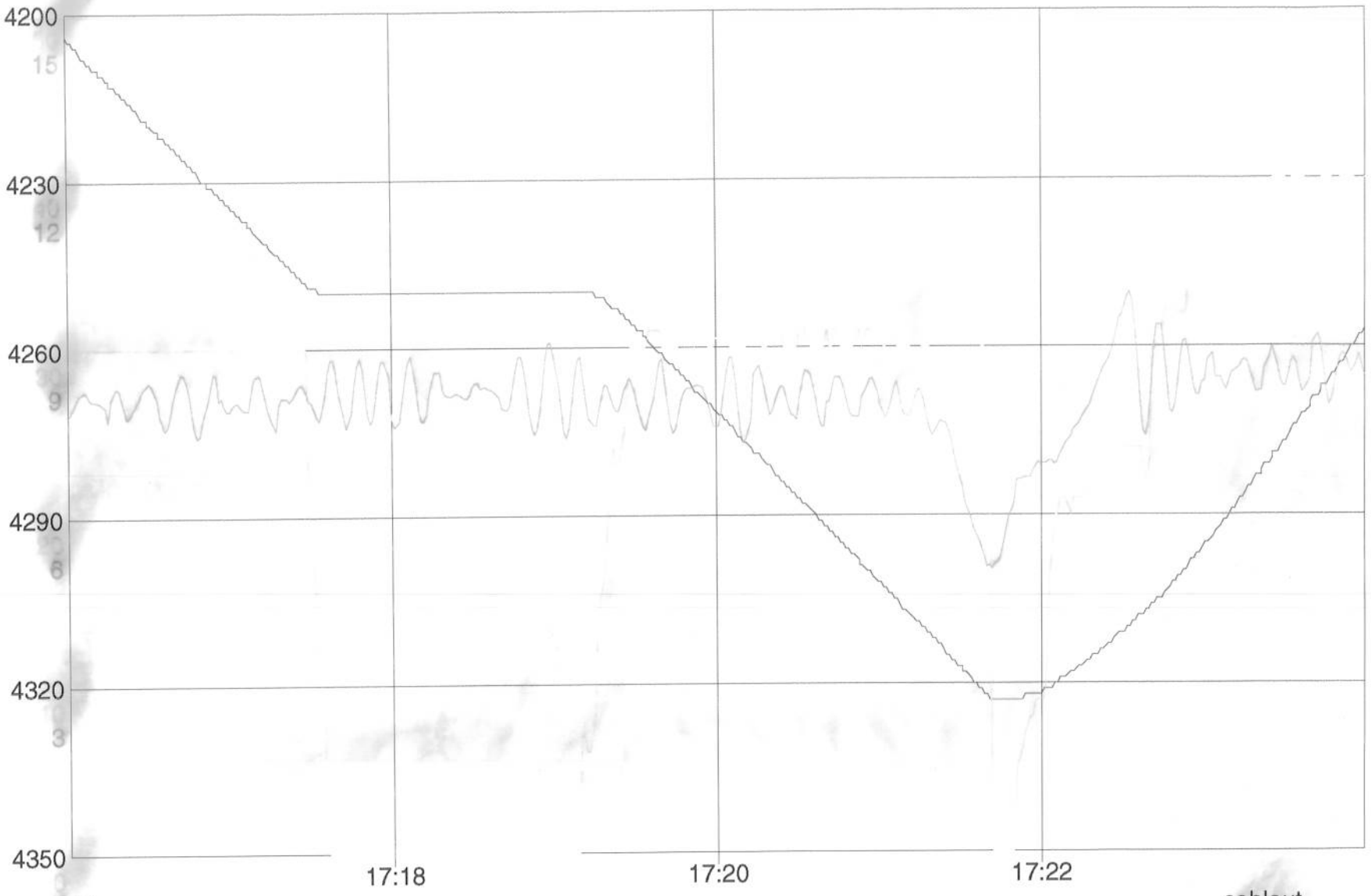
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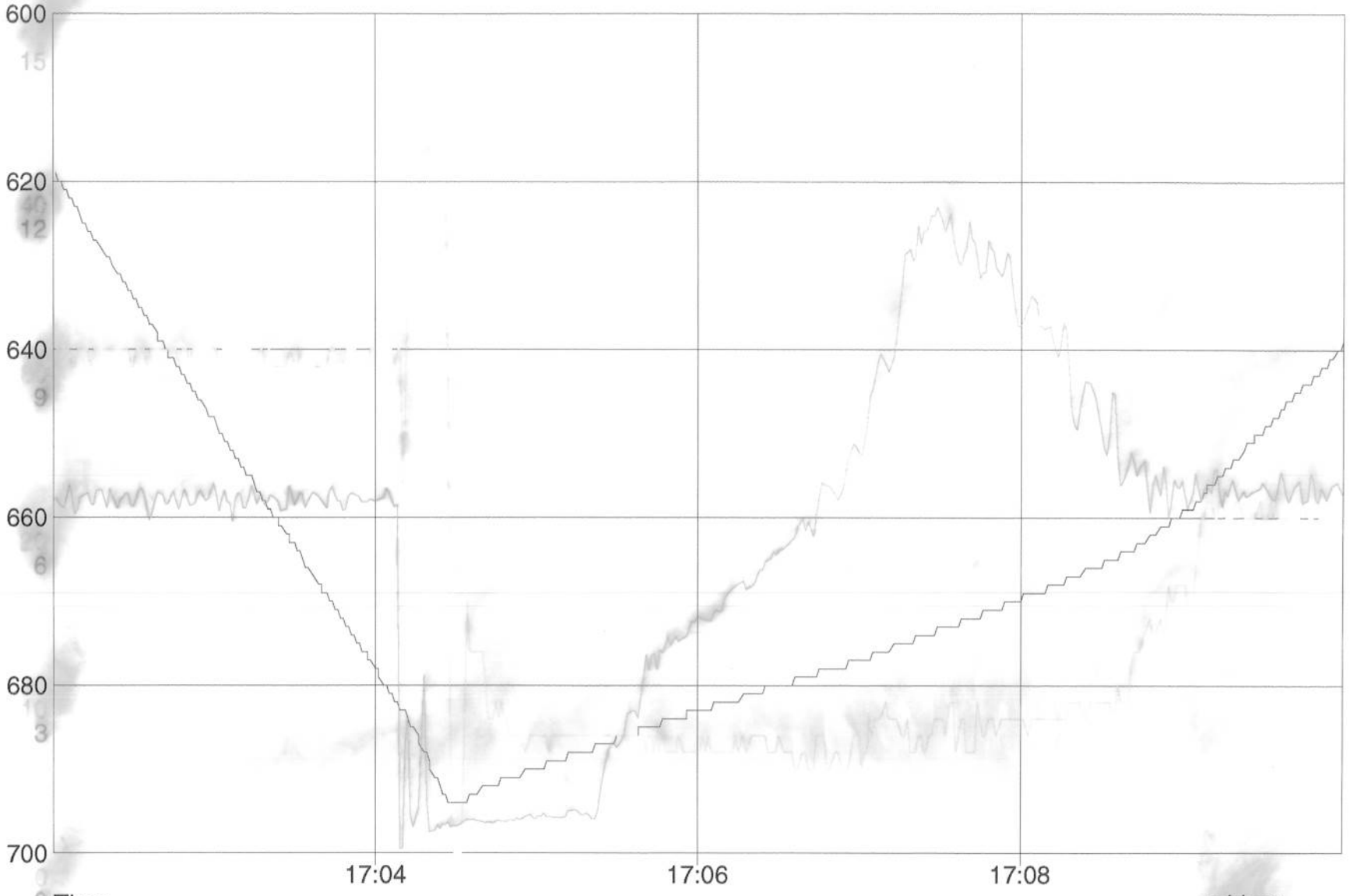
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