Behaviour of a piston corer and New insights on quality of the recovery

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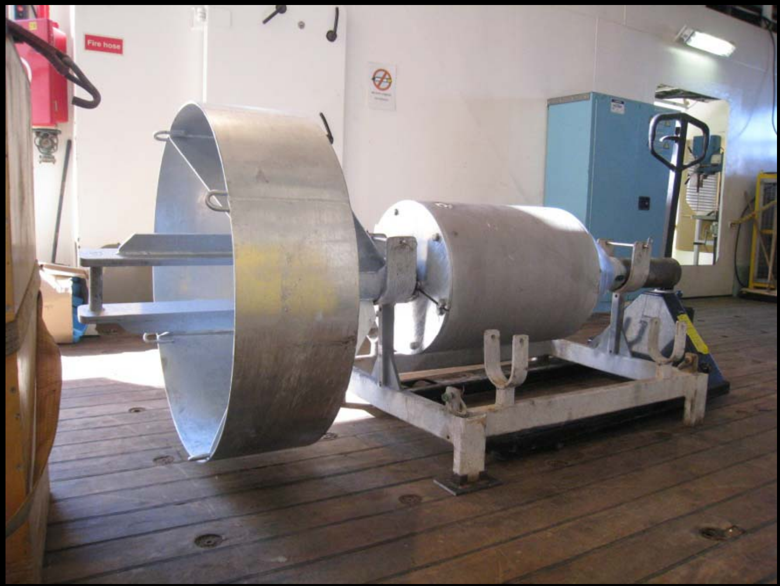
from Ifremer

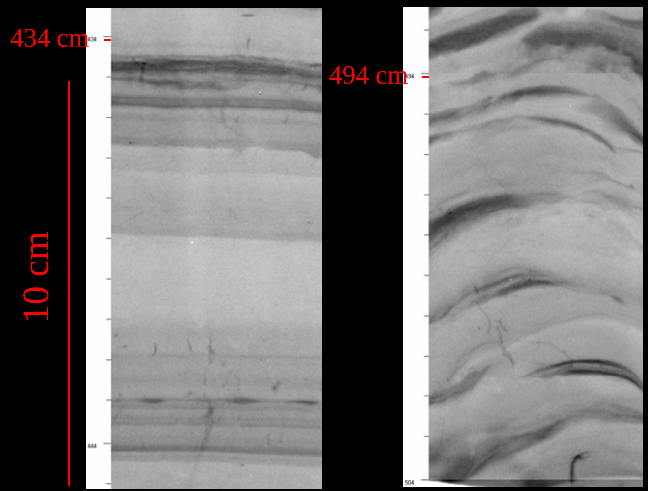
Overview and Objectives

- Review for the coring
- What has been done aboard RRS *James Cook*
- Results and outlook

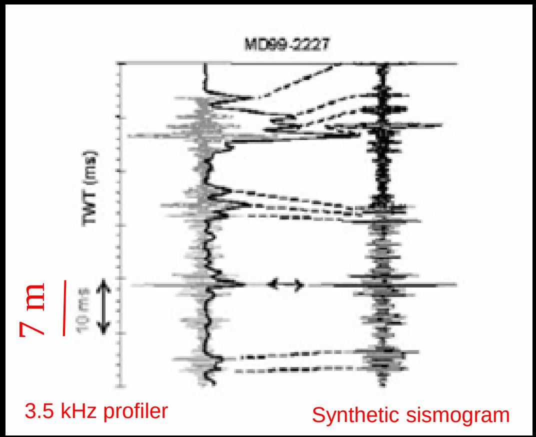


What we know

- Setting in doubt of the quality of cores by a number of scientists
- Variable quality of cores according to the ships and the adjustments
- No information on the real course of the corer

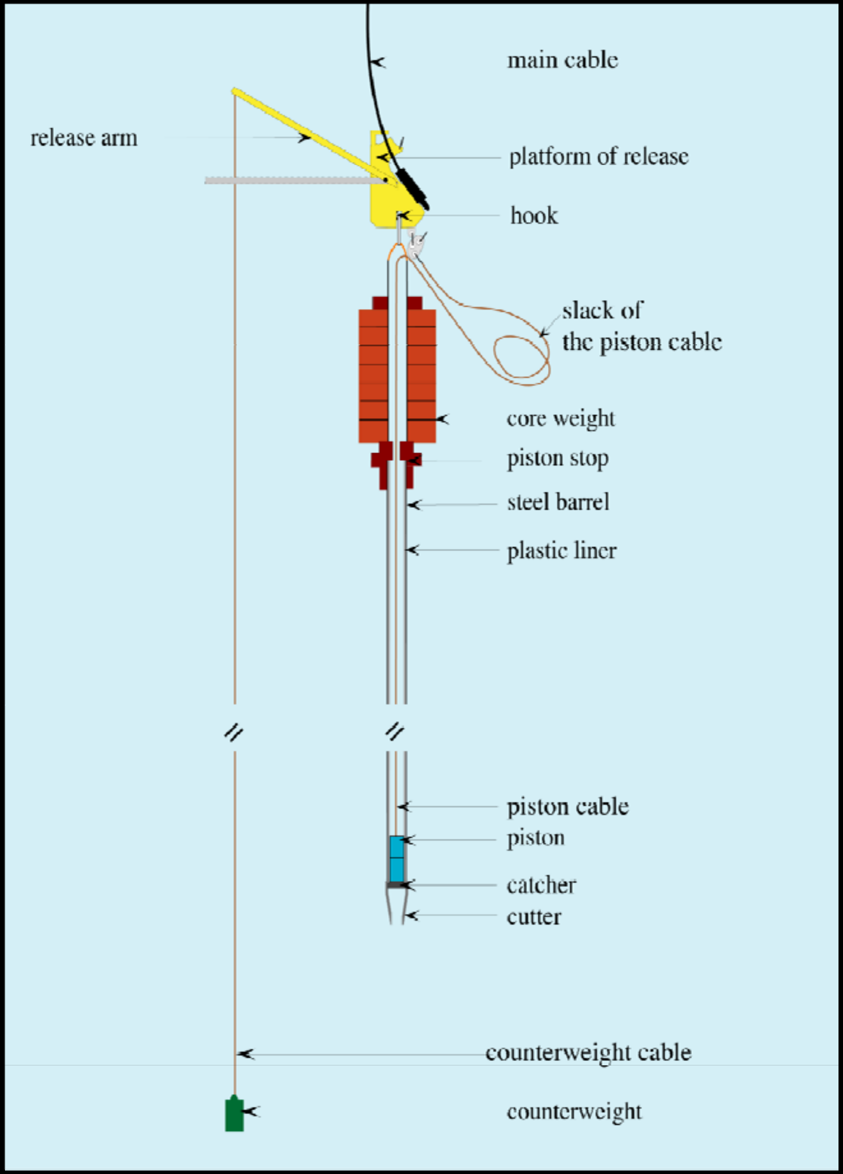


X ray from
KESC3-14 core
(Motillon, 2006)



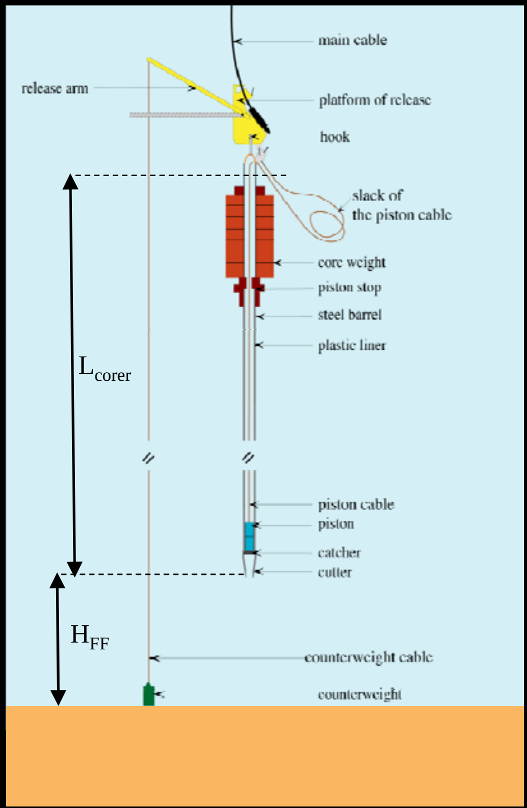
(Szérémáta et al., 2004)

Sketch of a piston corer

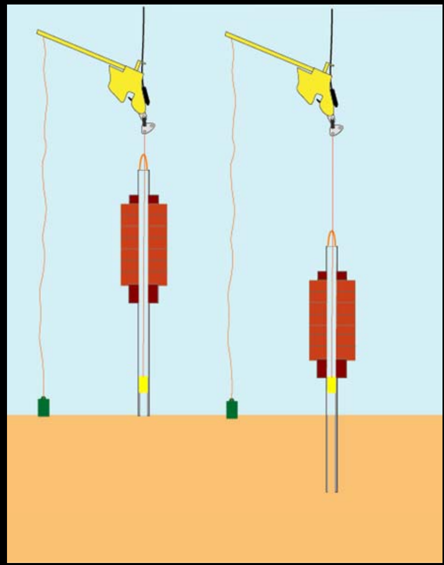


- 7 solid parts
  - trigger
  - counterweight
  - piston
  - corer weight (bomb)
  - steel barrel (pipe)
  - core catcher
  - plastic liner
- 3 cables
  - main cable
  - counterweight cable
  - piston cable

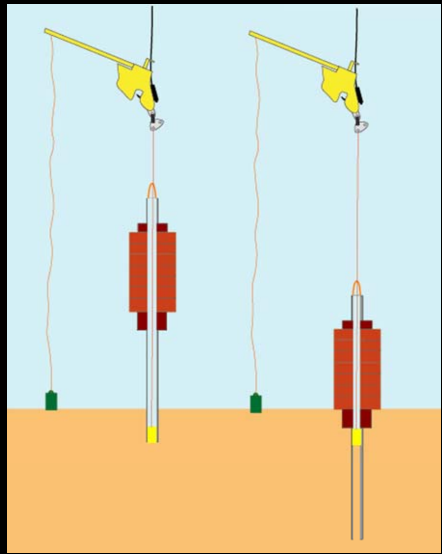
Setting of the piston cable



- Piston cable too short
  - Water at the top
  - Early and deadened stop
  - Shorter core



- Piston cable too long
  - No recovery of the seafloor
  - Penetration of the bomb in sediment
  - Pile up effect



- Free fall height
- Lenght of piston cable =
  L_{corer} + slack =
  L_{corer} + H_{FF} + rebound compensation

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Method and different settings

- Instrumentation of the corer in order to study its kinematics
- Study of the parameters of influence for examples :
  - the cables
  - the free fall height
  - the slack of the piston cable
  - the elastic rebound of the cable
  - the weight of the bomb
  - the depth

- Modelling of coring starts from measurements

Instrumentation to study the piston corer

- Measure of displacements with a pressure sensor,
- Determination of the index of release and measurement of the slope of the corer with an accelerometer

Instrumentation to study the piston corer

Specifications of the sensors

- pressure sensor 660 bar
- resolution in depth 0,20 meter
- accuracy of the accelerometers 1%
- sampling rate: 100 Hz
- overload 200 G without damage
- setting and reading wireless parameters
- housing made by titanium

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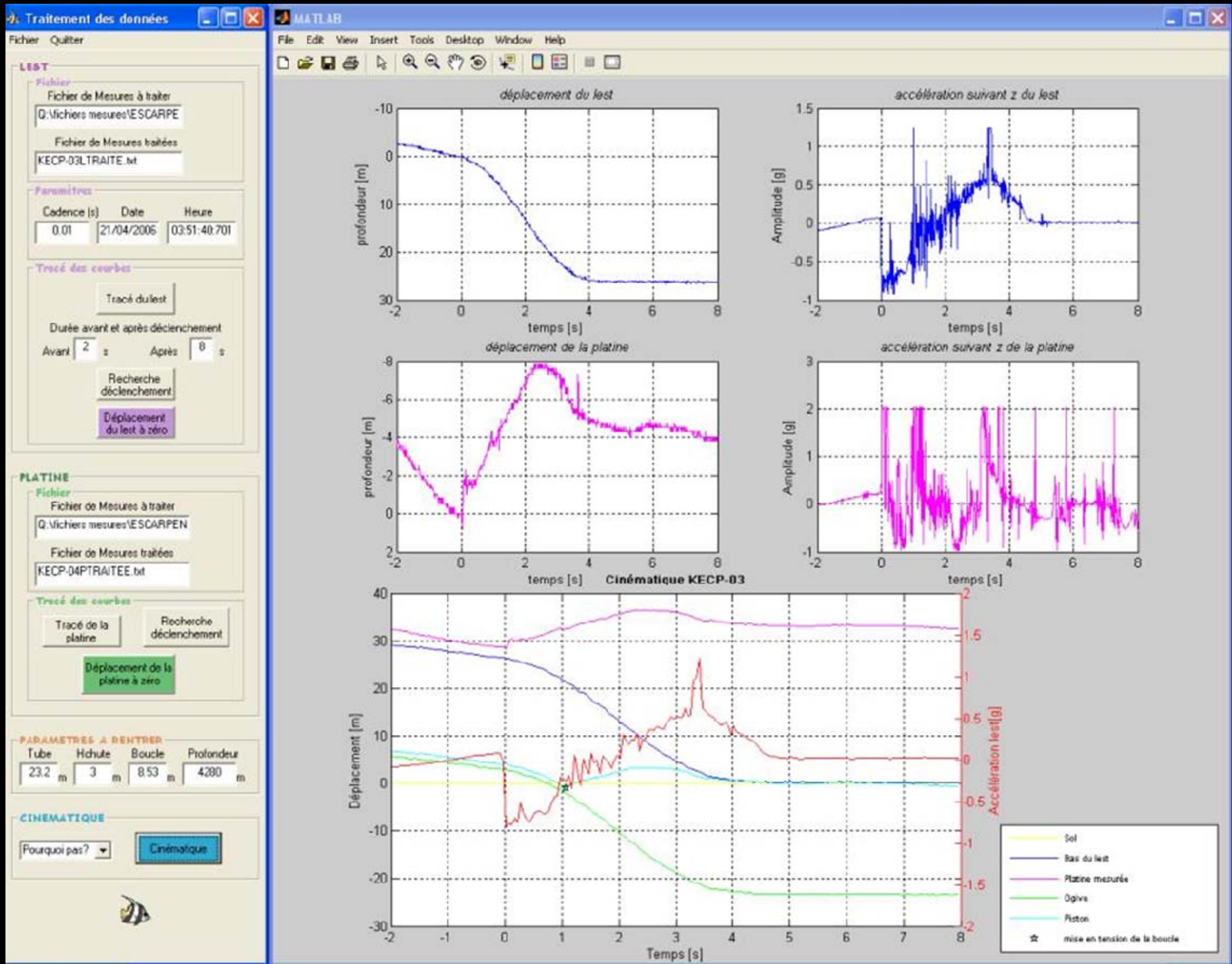
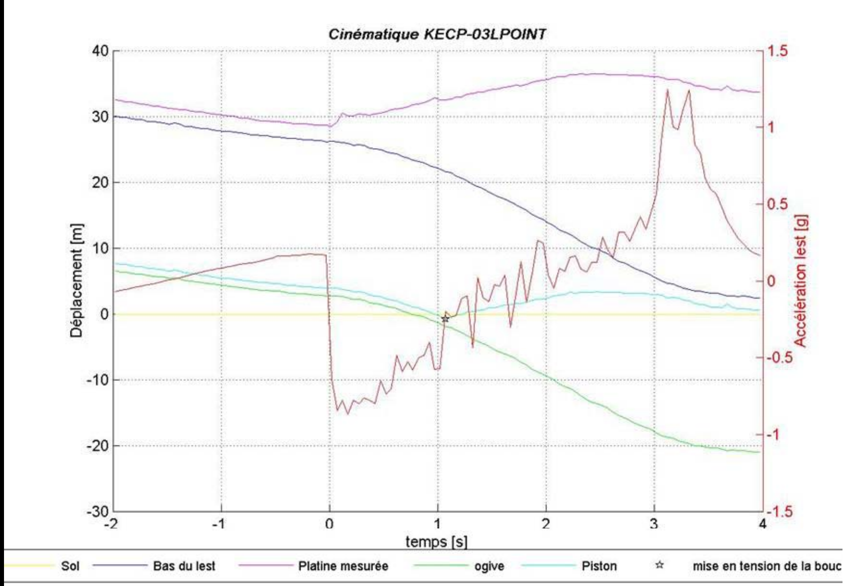
Cinema software

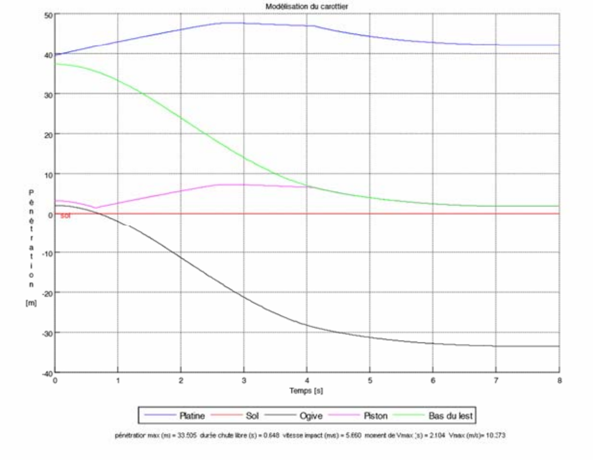


Modelling

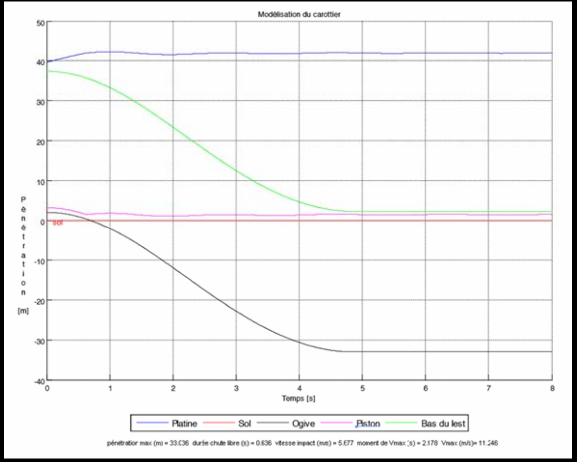
- Reconstitution of the kinematics of the coring
  - from records
  - from modelling
- Modelling
  - improving the settings
  - testing different cables



R/V *Pourquoi pas ?,* steel cable, 24 m Calypso corer



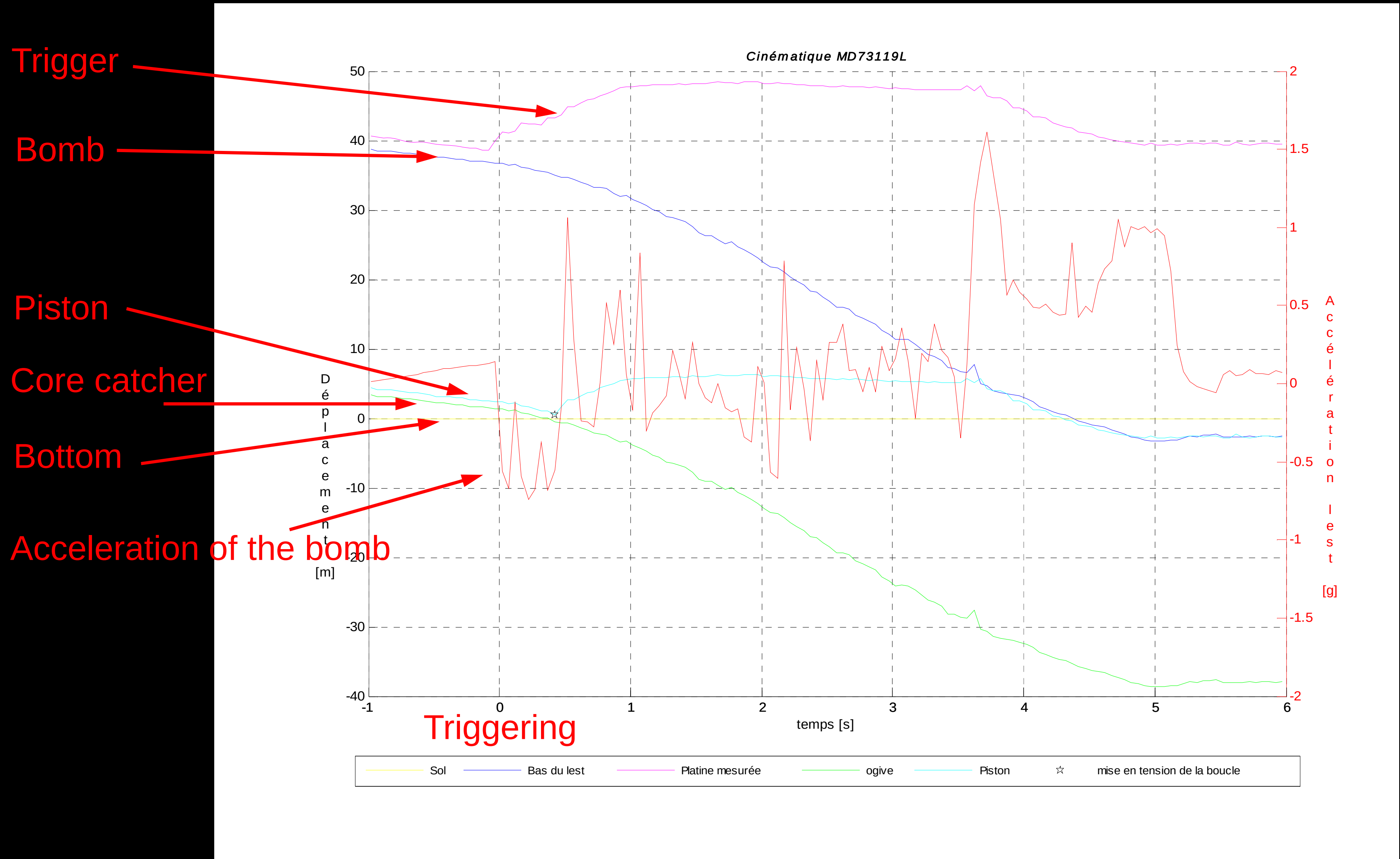
R/V *Pourquoi pas ?,* steel cable, 36 m Calypso corer



R/V *Pourquoi pas ?,* tested cable, 36 m Calypso corer

Kinematics of coring

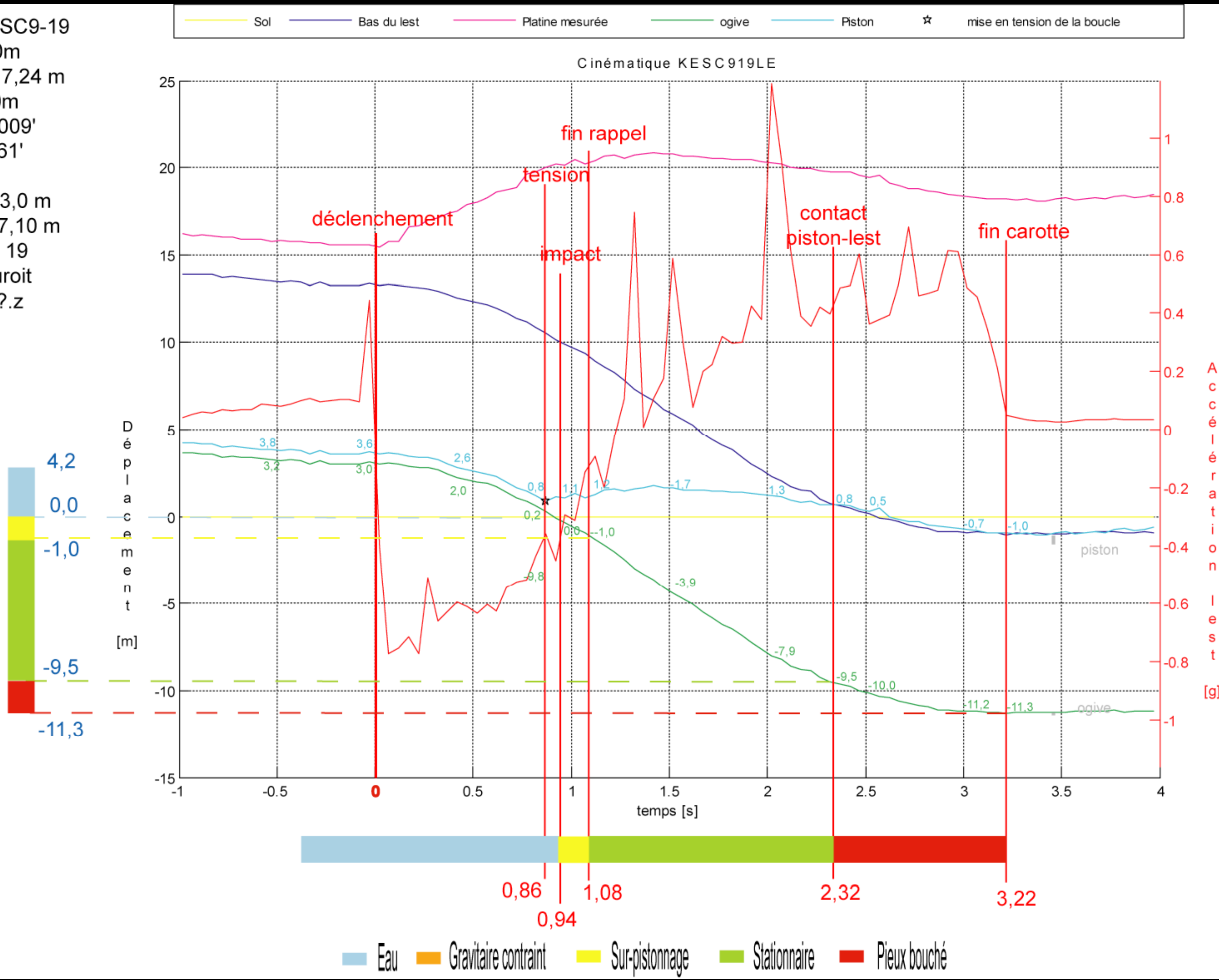
Depth 2523 meters



Quality of recovery during a coring

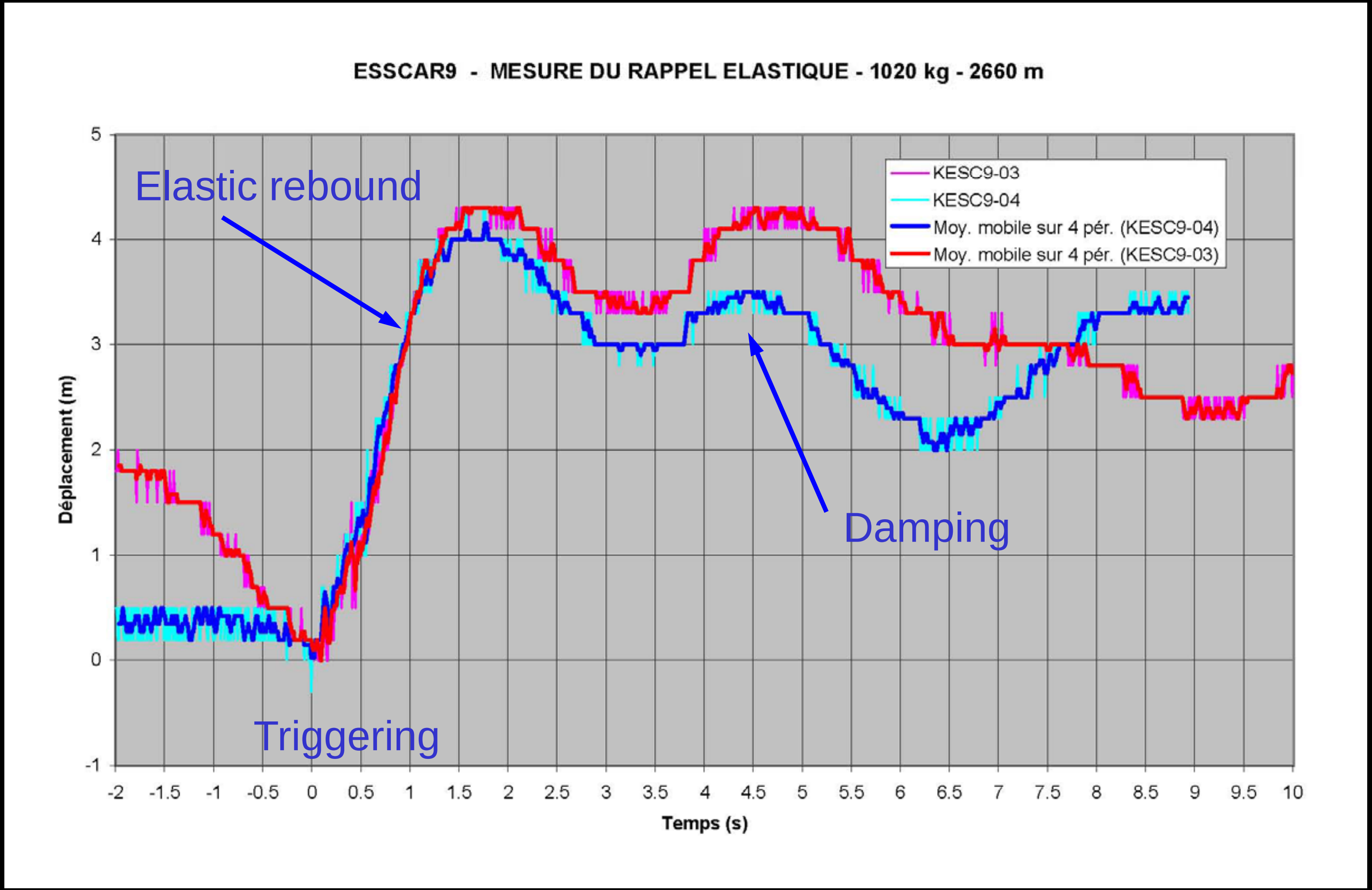
Nom : KESC9-19
Tube : 10m
Carotte : 7,24 m
z : 2160m
N 43° 23,009'
E 7° 44,161'

Hchute : 3,0 m
Boucle : 7,10 m
Galettes : 19
cable : Suroit
Cu = ? + ?.z



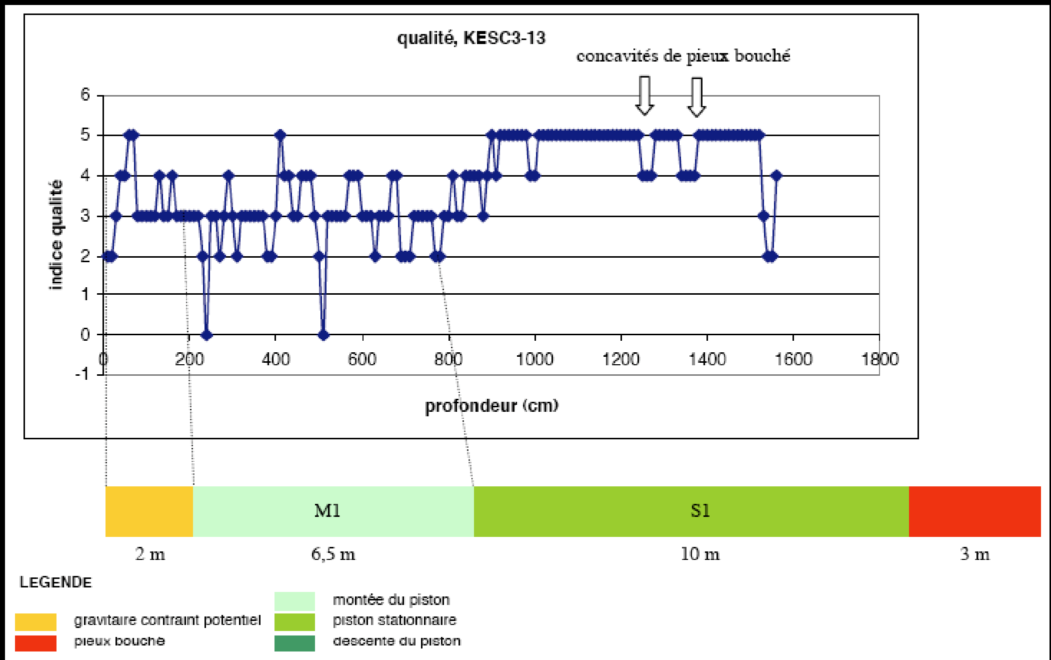
Elastic rebound of the main cable

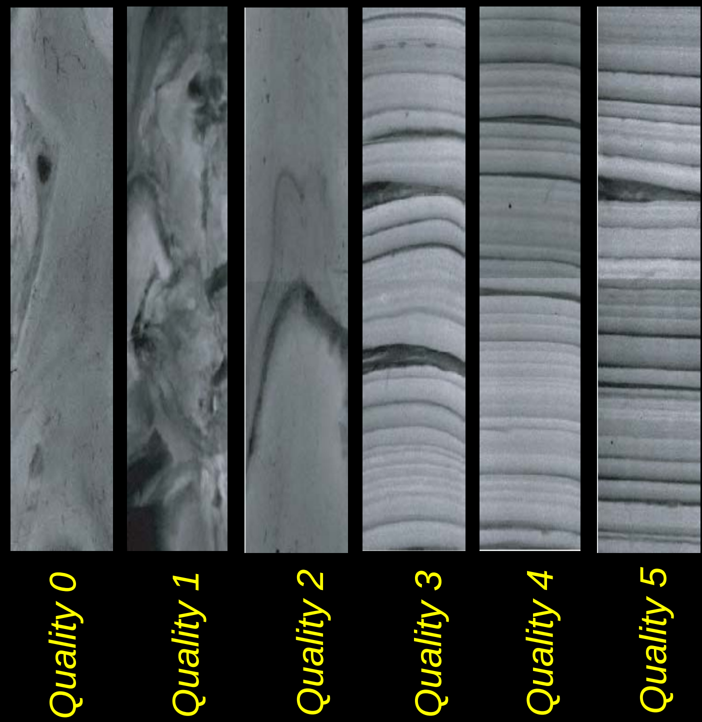
Specific trial to generate and record rebound of the cable



Work of the piston

Estimation of the quality of the cores according to the work of the piston.

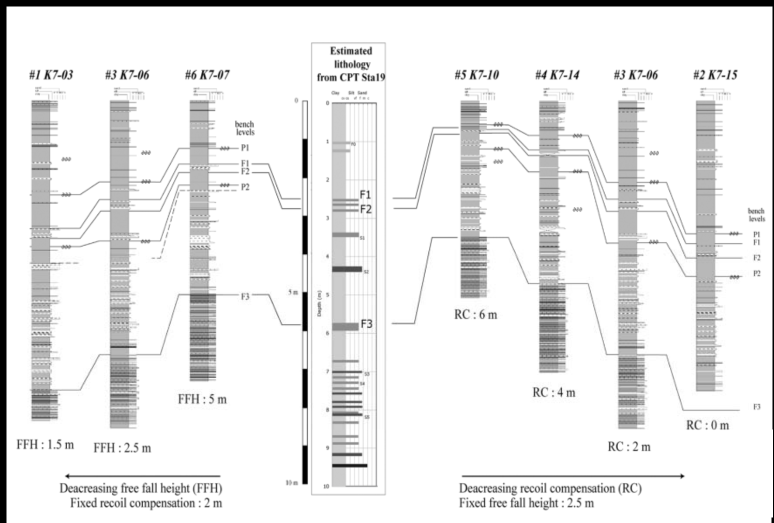


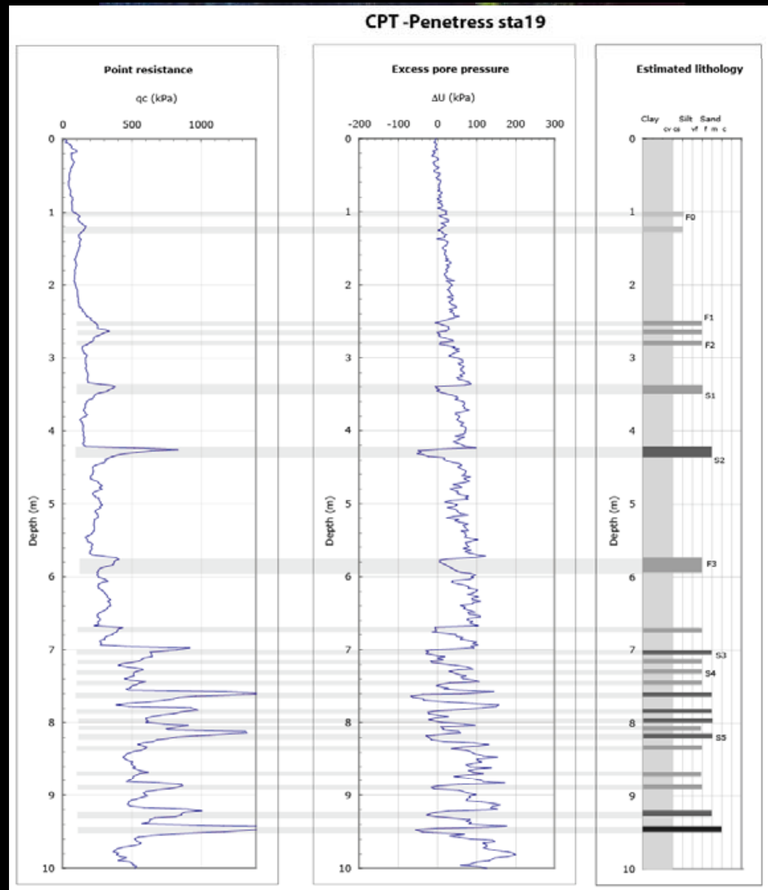


Water sampling, over sampling, stationary, under sampling or pill up effect)

Method and different settings

- Study of the agreement between the kinematics and the real quality of the cores :
  - photography of the cores
  - description of the cores
  - CPT profile
  - multiparameter analysis





The coring aboard RSS *James Cook*

- Mission : JC34T – Vigo to Vigo
- Date : from 28/05/09 to 05/06/09
- In collaboration with the SOC and the NIOZ

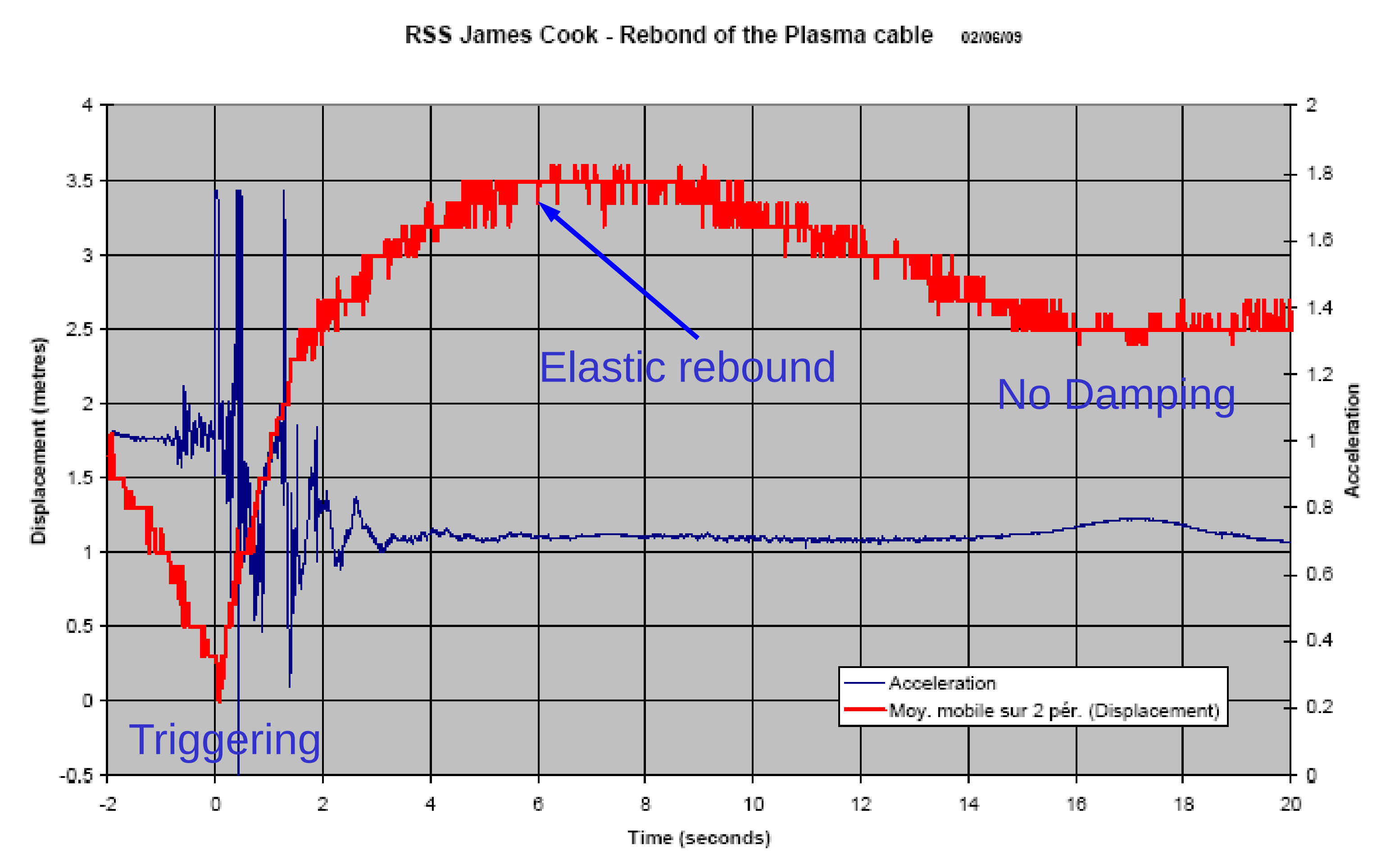
What has been done ?

- Number of coring : 11 (of which 1 for rebound of the rope and 1 bend)
- Depth : 5250 to 5300 m
- Free fall : 3 m
- Rebound compensation : 2 m
- Weight of the bomb : 1500 kg
- Length of corers : 10,8 m except last coring (16,2 m)
- Colleagues of the NIOZ tested different noses and core catchers

Elastic rebound of the Plasma* rope

Plasma* 12 strand is one of the best synthetic rope

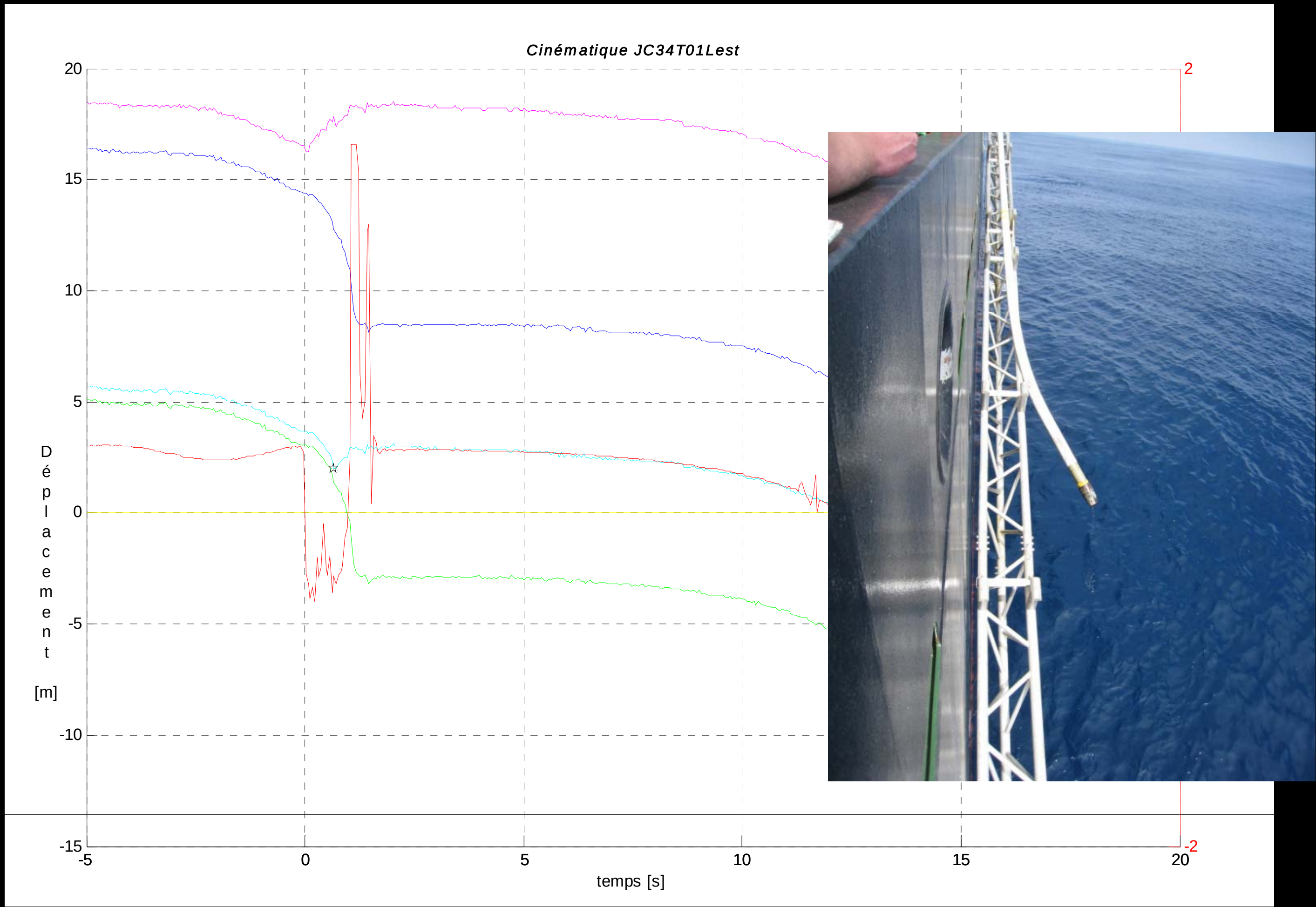
(highest strength, lowest stretch, low creep, torque free, easy to splice,…)



Second coring

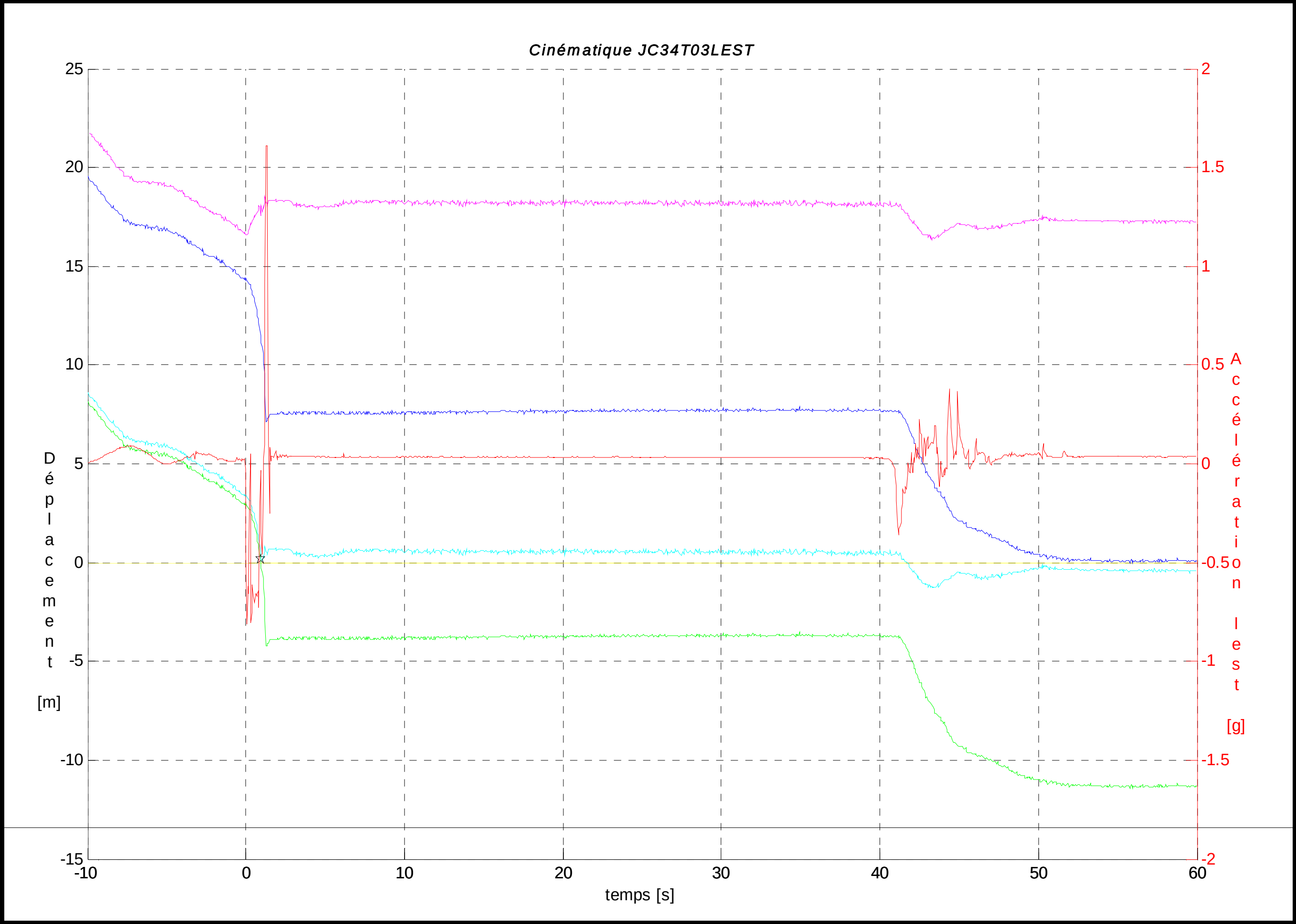
The corer is standing upright and laying flat 10 seconds later

(no elastic compensation ⇒ water sampling in the corer,…)



Fourth coring

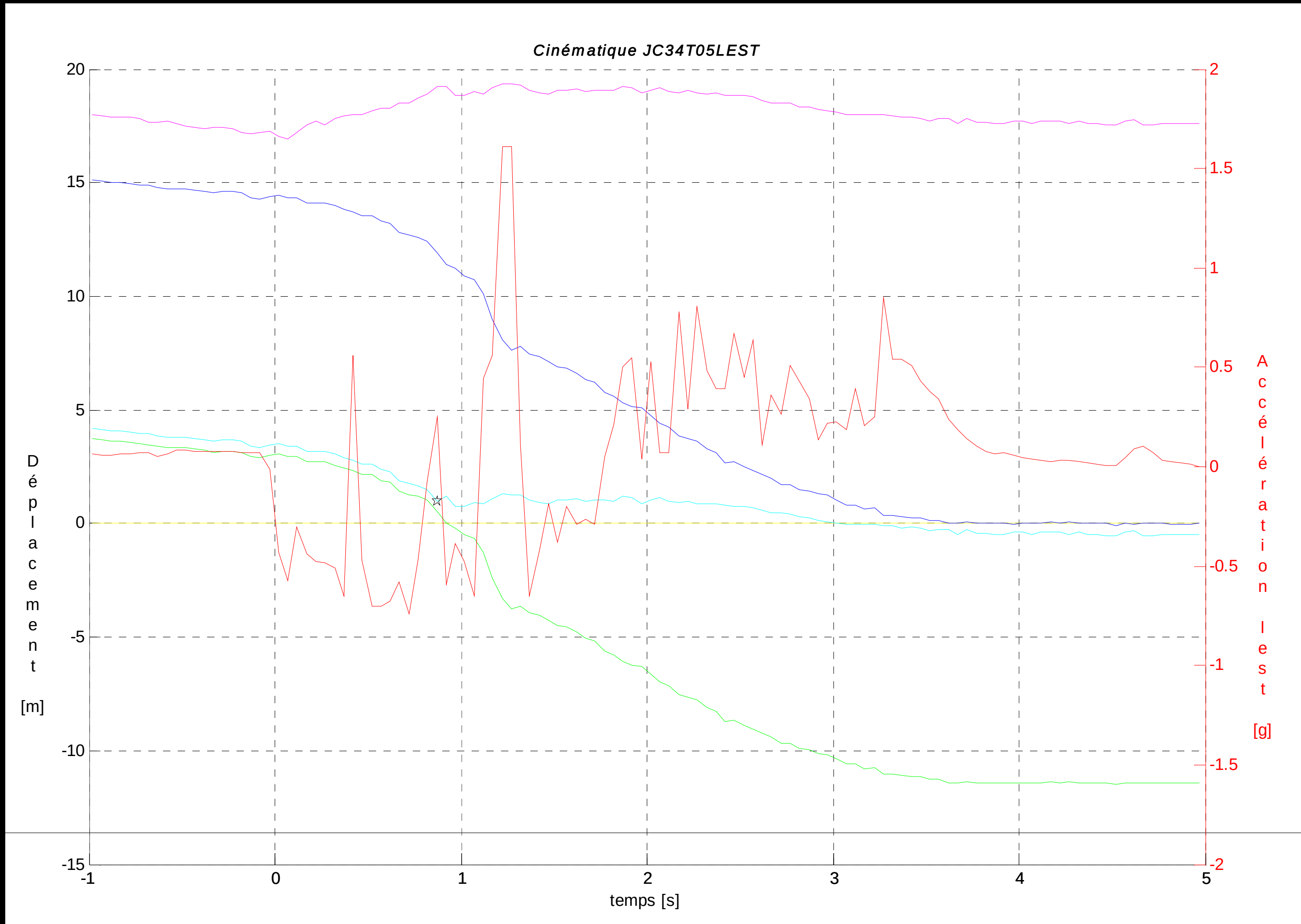
The corer is standing upright during 40 s then continues its course (good elastic compensation ⇒ no water sampling in the corer,…)



Fifth coring

The corer dropped off, then has been hardly slowed down

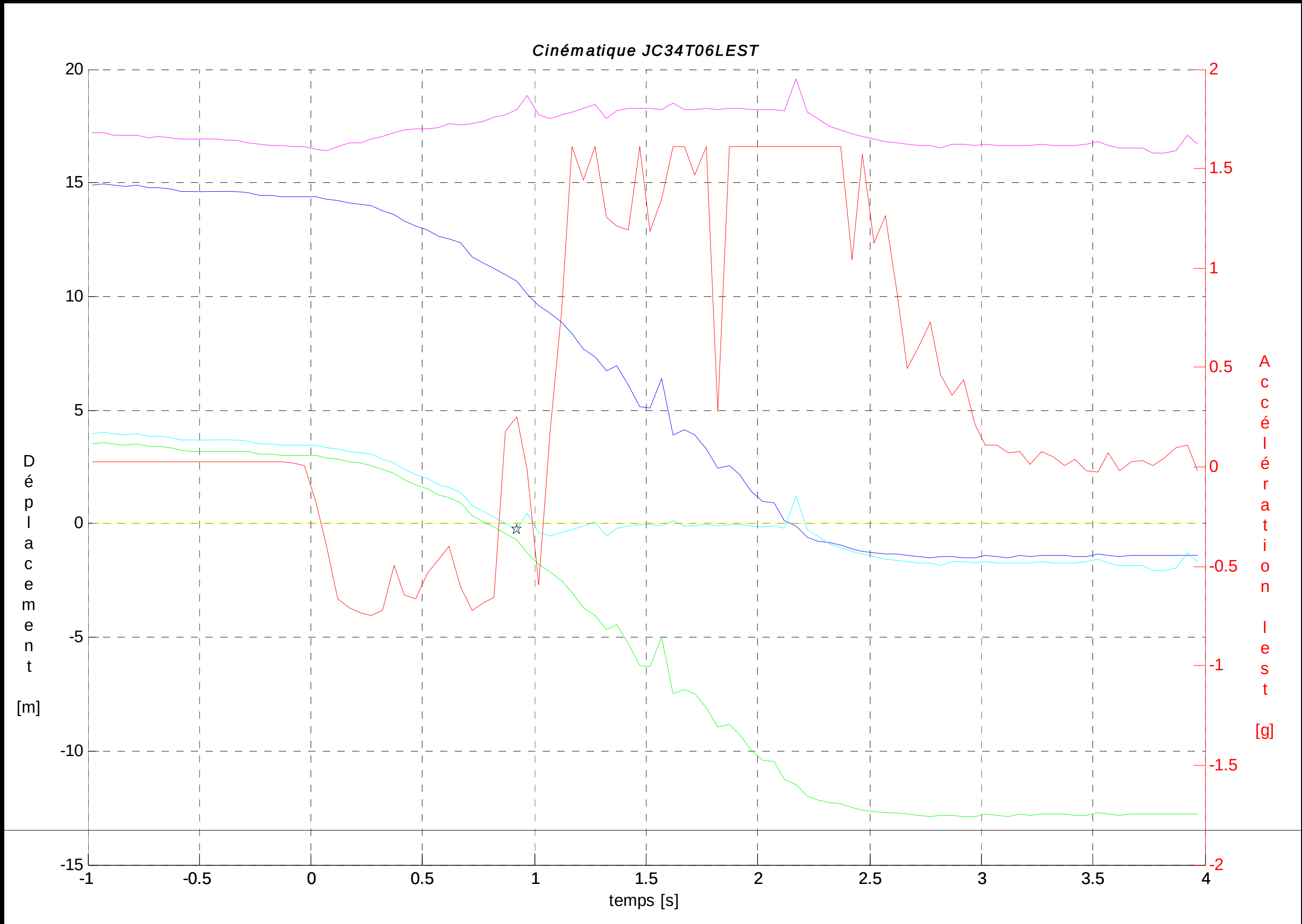
(quite good elastic compensation ⇒ 1 meter of water sampling in the corer,…)



Sixth coring

Important penetration, the bomb ended its work against the piston

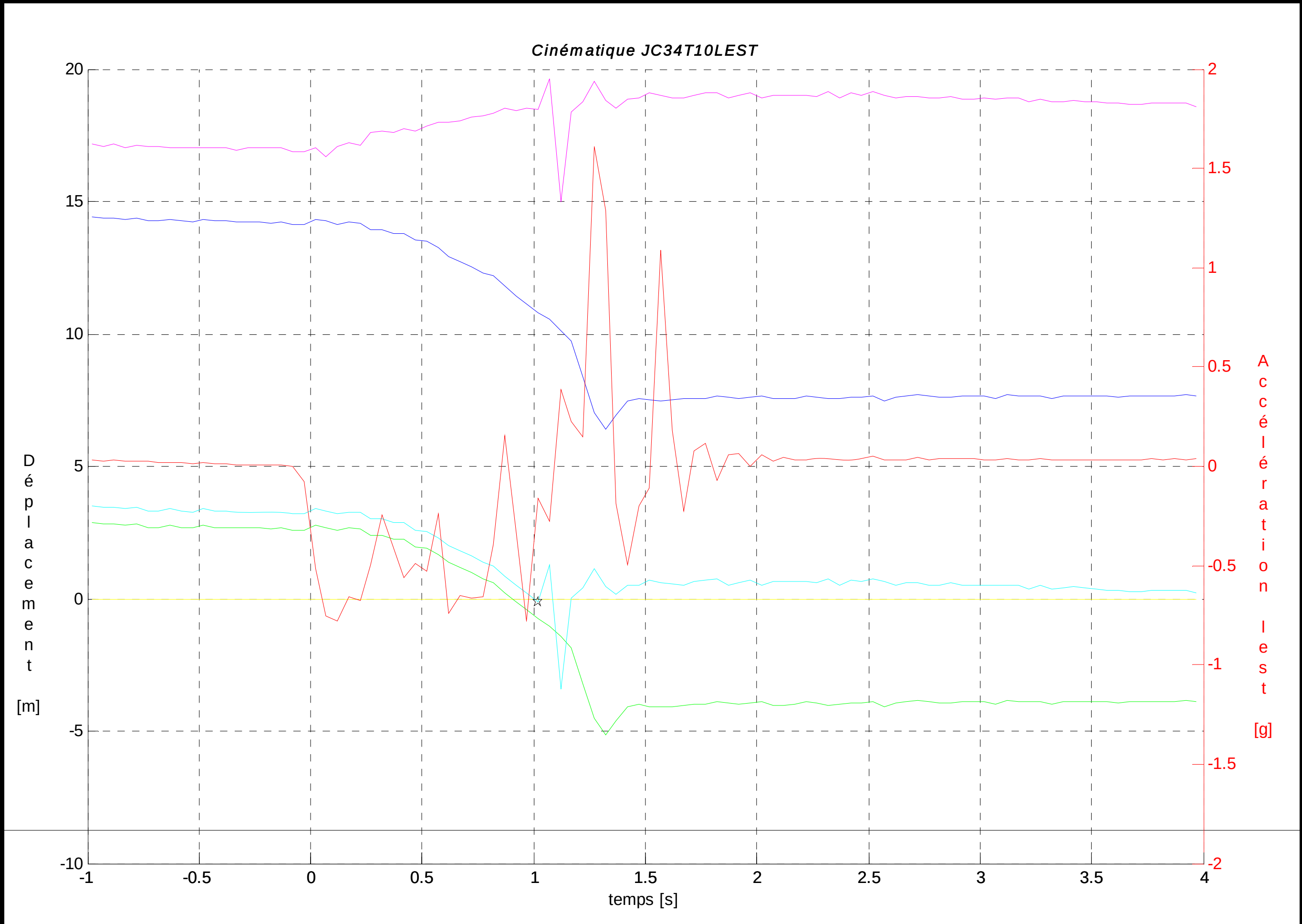
(good elastic compensation ⇒ stationary piston, then pile up effect…)



Second last coring

Incomplete penetration, the liner collapse and the bomb goes up !

(very poor and bad recovery …)



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Main results

- Piston coring unfolds in 5 phases
  - No sampling or water sampling
  - Extra suction phase
  - Stationary phase
  - Under sampling phase
  - Optional pile up effect phase
- The setting of the cables determines the duration of the phases and then plays a key role on the thickness and on the quality of the recovered layers
- The elastic rebound of the main cable must be compensated by setting of the piston cable

Main results

- Measure and modelling of the elastic recall of the cable
- Measure and modelling of the operations of coring
- Interpretation of the work of the piston during the various phases of the coring

100%

- Study of the safeguarding of the sedimentary layers according to the different settings
- Study of the quality of the cores according to the different settings

20%

- Correction of the position of the levels
- Suggestion of settings and improvement of the cores quality

0%

Ongoing work and next steps

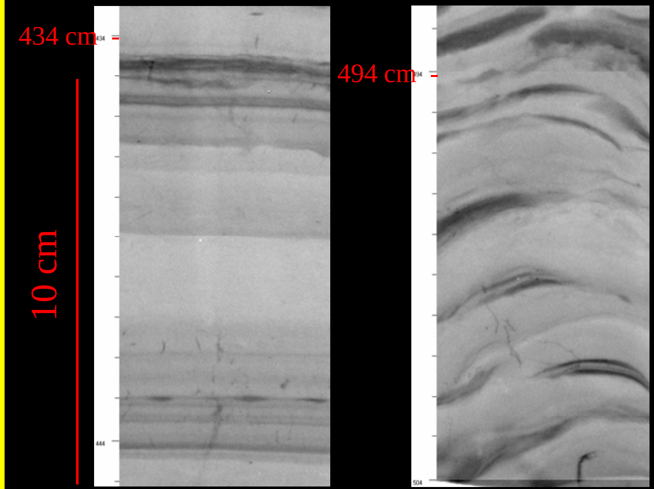
- Possibility to improve other coring equipment
- Possibility to study fundamental changes in coring operations
- ‘Bartering’ between access to sea and the skills on coring in order to improve the quality of the sampling and to advance in the knowledge
- Possibility to Other ??

Thank for your kind attention

- Question ?

Disturbances in cores

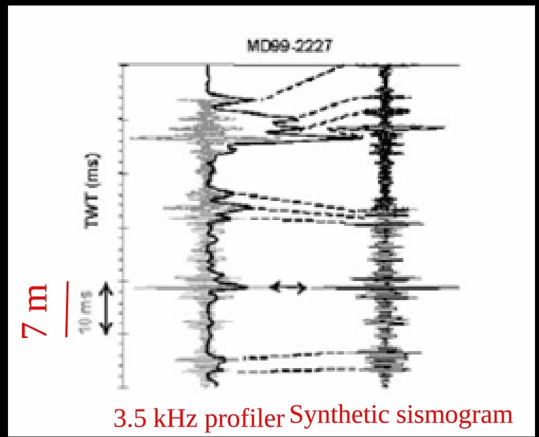
- Friction on the liner



X ray from KESC3-14 core

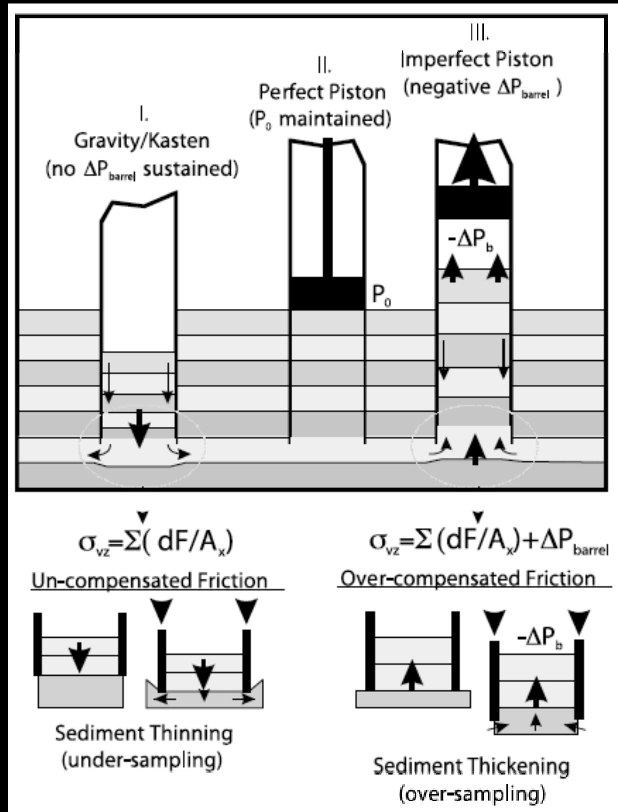
(Motillon, 2006)

- Vertical distorsion



(Széréméta et al., 2004)

- Under/over sampling

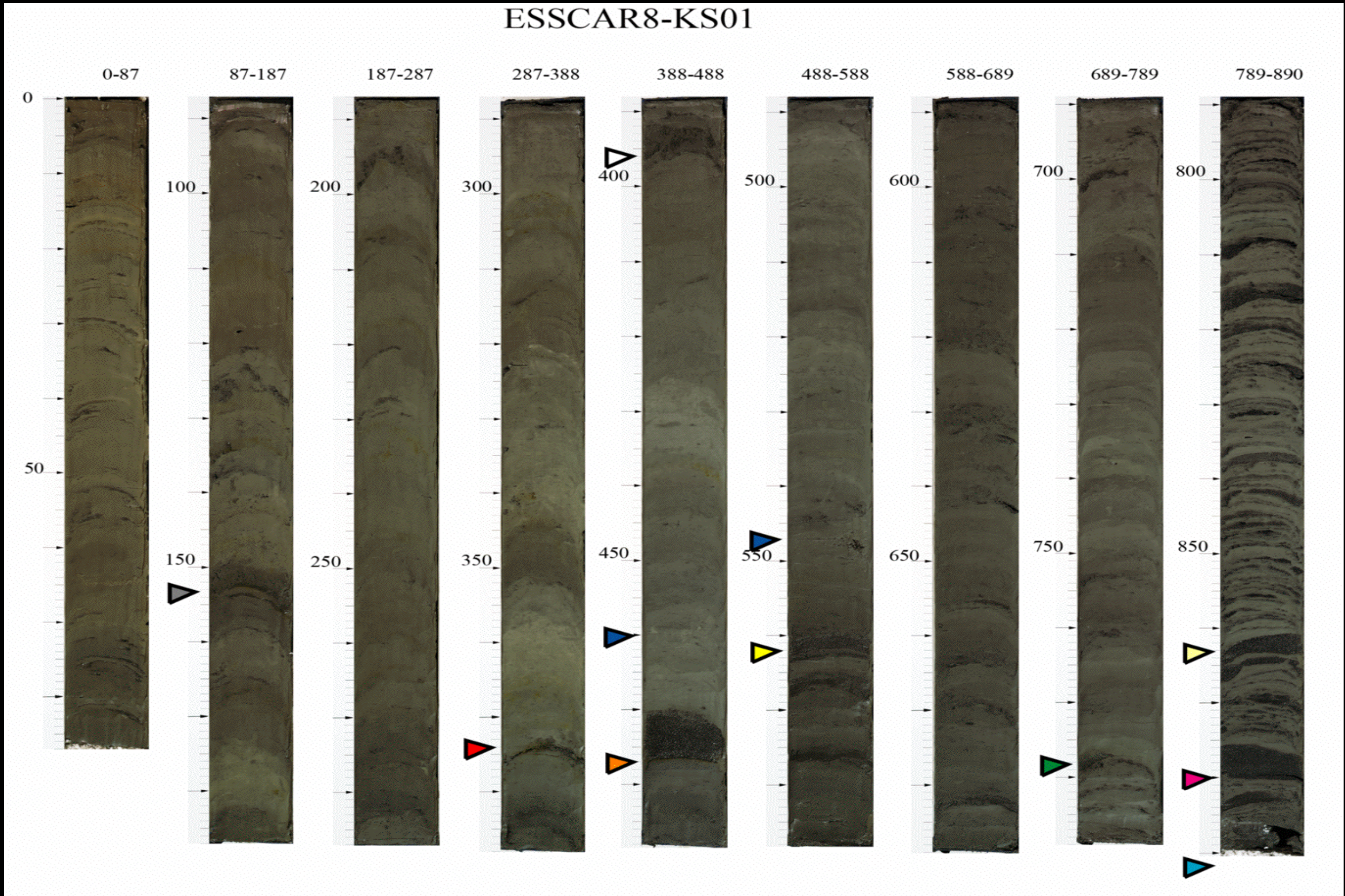


(Skinner et McCave, 2003)

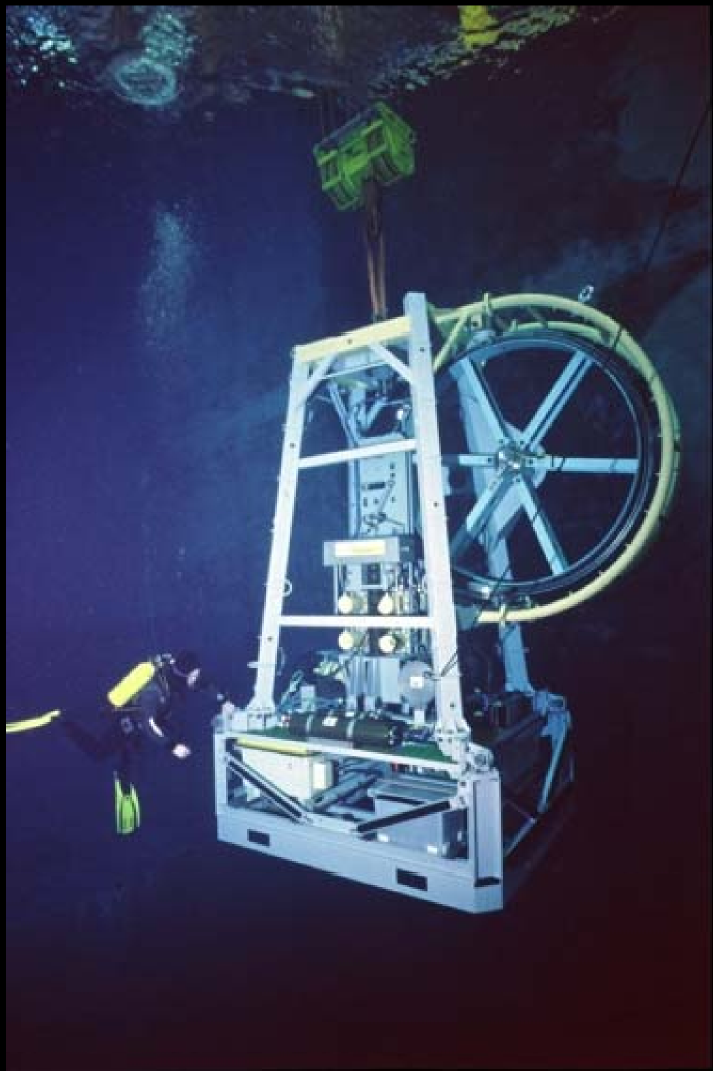
- Stationary piston relative to seabed (STACOR device)

Results - Sedimentology

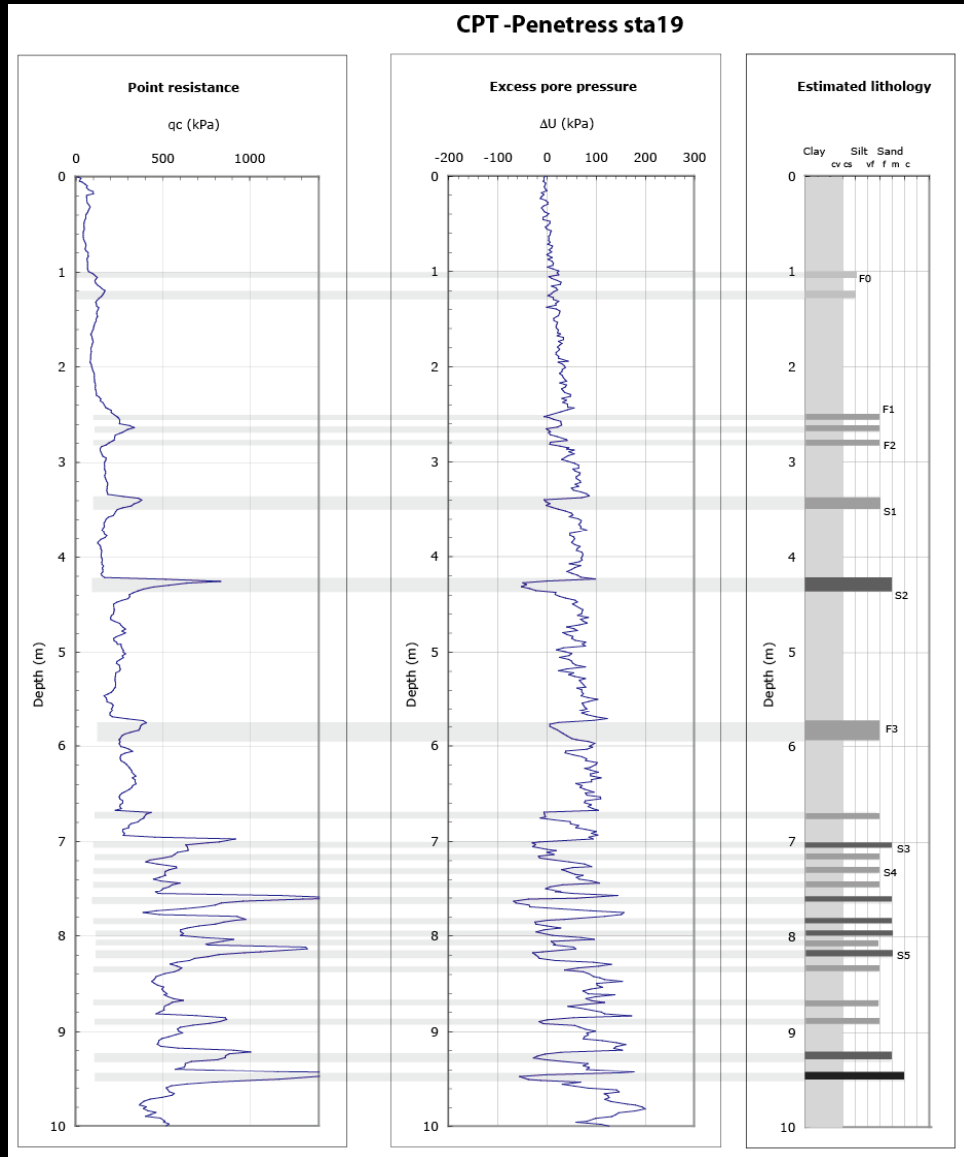
Photo of a core. Checking where the sedimentary levels are and estimation of the quality of the cores each 10 cm.



Results - CPT trial



Penfeld penetrometer device



(Douglas et Olsen, 1981 ; Robertson, 1990)

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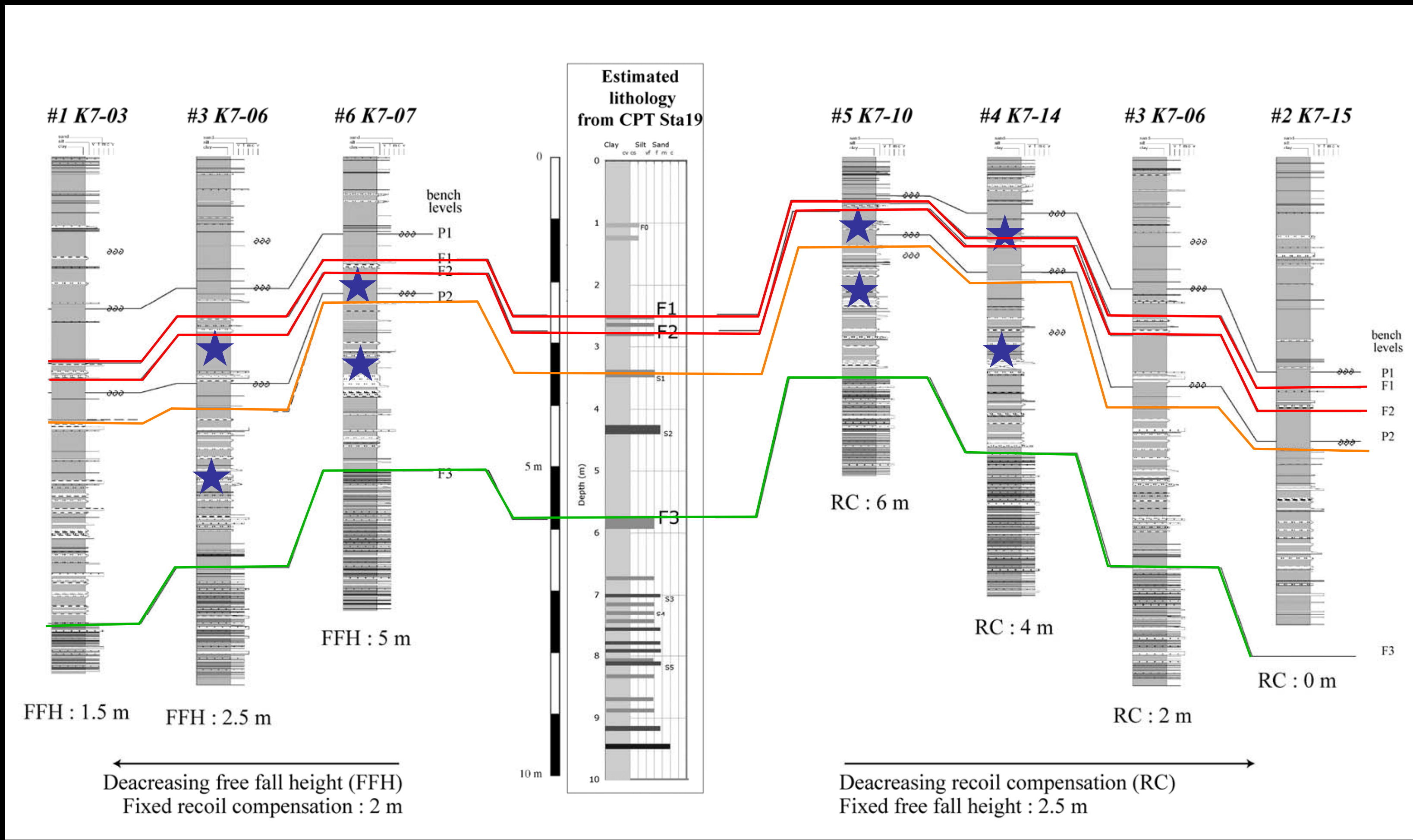
Results - Sedimentology



Synthesis of the sedimentary logs and comparison with the CPT lithology.

The sedimentary levels change according to the settings.

Settings for a good geometry can be different than settings for good quality of sediment

Main results

For cores made at the same spot, we can have very different results

	KS01	KESC9-28
Penetration	full	full
Lengths of core	9 m	8,60 m
quality	Bad (notation 2,3/5)	Very good (notation 4,8/5)
Safeguarding of levels	Bad, soughing	good
Max depth of sampling	7,50 m	8,40 m

We improve quality of cores by optimising the adjustment of all the parameters