

PROVOR line

Technical update

Euroargo workshop Trieste june 2008

Patrice Brault

## Company update

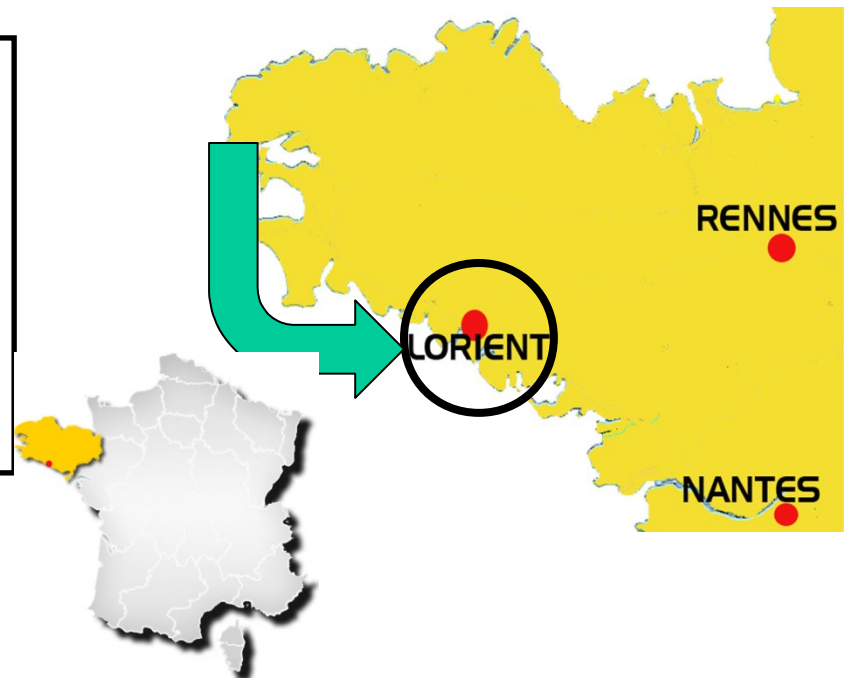
Since 1st January 09 Provor float activity has been sold to nke company ,( 30 km from Kannad

Technical team has move as far as industrial know how.

Partnership with Ifremer (TMSI team) is maintained with all floats products .

### **Staff:**

- 34 people are working in **design and engineering**
- 28 in final assembly and logistics
- 15 in sales and administration.



## 4 FIELDS OF ACTIVITY



Home control



Marine electronics



engineering



### nke instrumentation

- Oceanography, and challenging environments,
- Autonomous Data Loggers (pressure, temperature, salinity...), monitoring of the medium (siltation, heat flow...), behaviour analysis of immersed systems (acceleration, inclination, corrosion...),
- control of fishing parameters (bite time, trawl immersion time...)-
- Automated Systems : monitoring of estuary waters (Marel), Instrumented Buoys (current measurement, temperature chain...)-
- Embedded instrumentation, specific to Offshore, Industrial or Marine applications.
- Floats

## Nke & COLLABORATIVE RESEARCH

- beach water quality control linked with discharges from cleaning stations **GIRAC**
- real time operation system for survey and alarm relative to phytoplantonic proliferations in fresh water reserves **PROLIPHYC**
- local ocean weather forecast **PREVICOT**
- Real time scientific informations for fishing boats **SIAD**
- Optical sensor for sea water density and salinity **NOSS**
- Artic project with float **Damocles**

## A long partnership with Ifremer on floats

- **A family of floats**
  - 1st float MARVOR : multicycle Rafos float in 90-94
  - PROVOR for ARGO program in 99
  - Provor Acoustic, Provcarbon, Provbio
  - Sliding along a cable POPS , MOPS ( under ice operation.. )
  - Now a new generation of smaller profiler .. ARVOR or PROVOR2
- **Reliable technology** based on
  - **flotation engine** technology enabling a capability to be deployed worldwide without ballasting,
  - **development methodology** including all phases until sea trials.
  - availability of high-performance offshore lagrangian floats.
- **Since 90 , constant industrial partnership** between **IFREMER** team

| Tekelek | Martec | Kannad | Nke    |
|---------|--------|--------|--------|
| → 1998  | → 2006 | → 2008 | 2009 → |



# Provor range and pass



**Marvor**  
Multi cycle  
Rafos

1990-1997



**Provor-T et**  
**CTF**



**Optical sensors**  
**Iridium**



**Rafos**  
**Sofar**  
**CTD**



20 Kg to



**Upper sou**  
**Rafos / S**  
**acousti**  
**modem**  
**Iridium**

What is an  
ARGO float ?

PROVOR CTS 3

Antenna

Flexible Argos Antenna

CTD sensors

SBE 41 CP

(continuous pumping)

Satellite transmitter

ARGOS PTT

Control unit

Low power controller

Housing

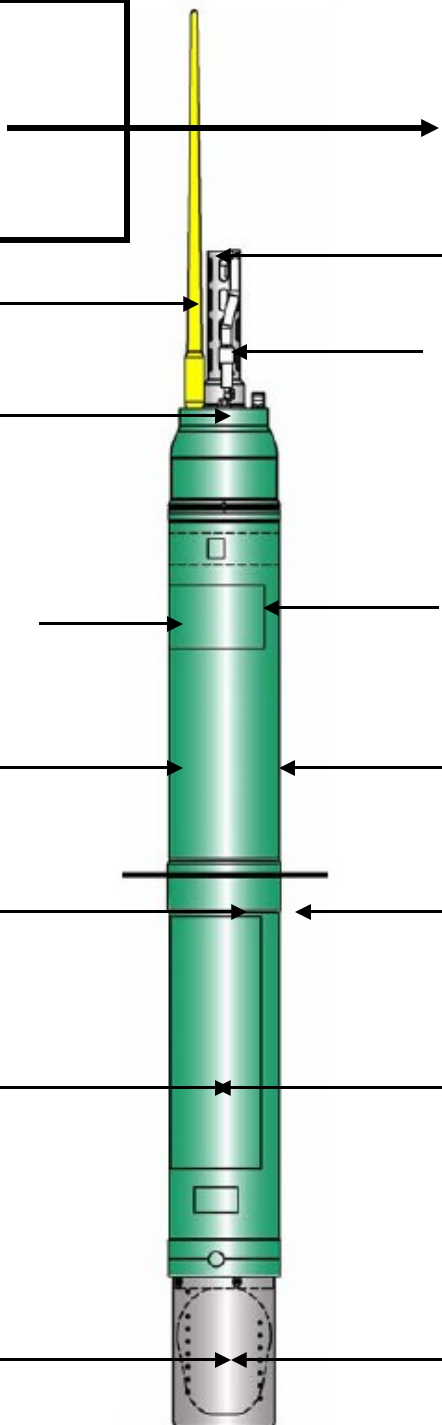
High sturdiness anodized  
Aluminum

Energy

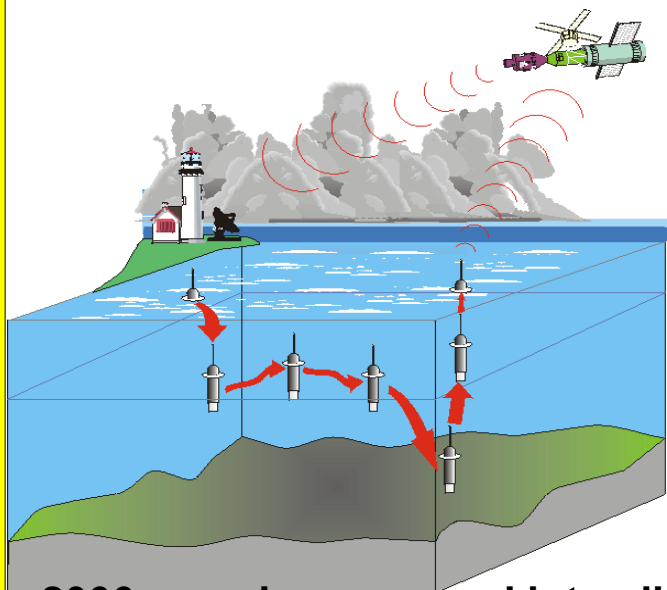
Lithium battery

Buoyancy engine

High pressure pump with  
large capability of buoyancy



# PROVOR CTS3 cycle scheme



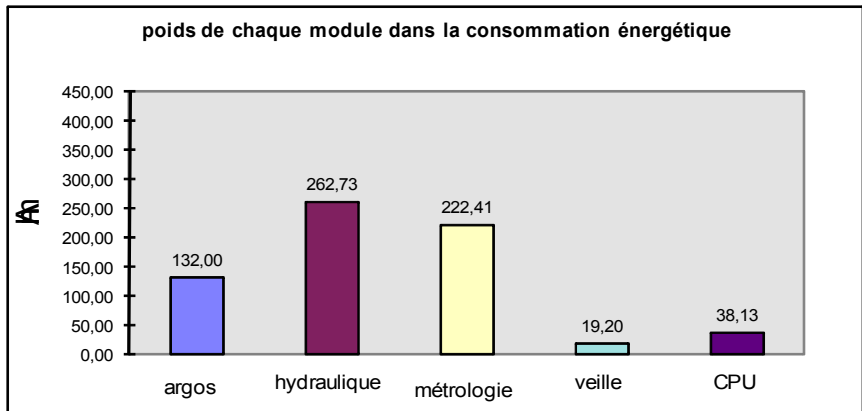
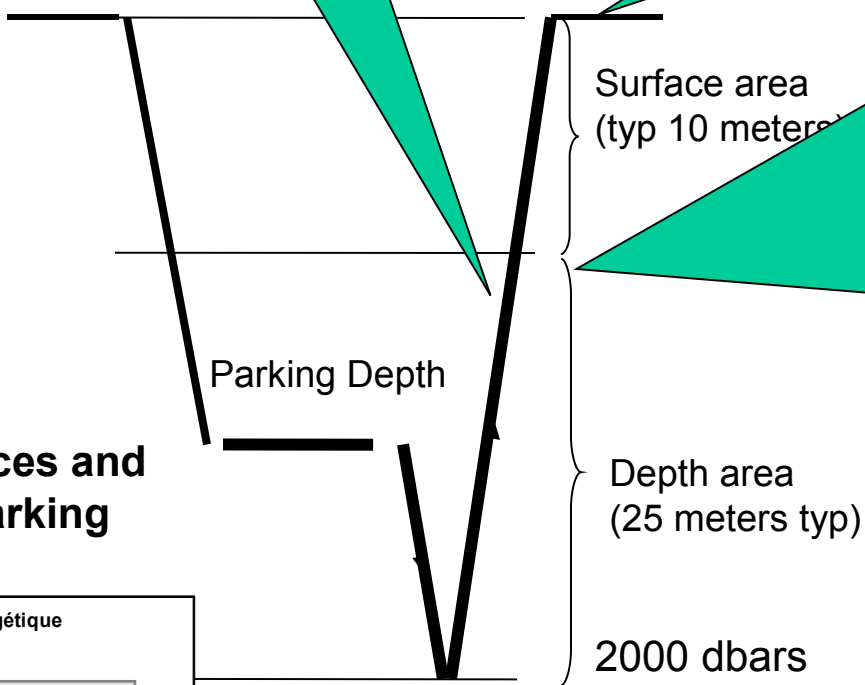
**•2000 samples averaged into slices and 92 CTD profile data + 18 CTD parking depth samples (typ) transmitted**

CTD continuous sampling during ascent profile

Transmission to satellite

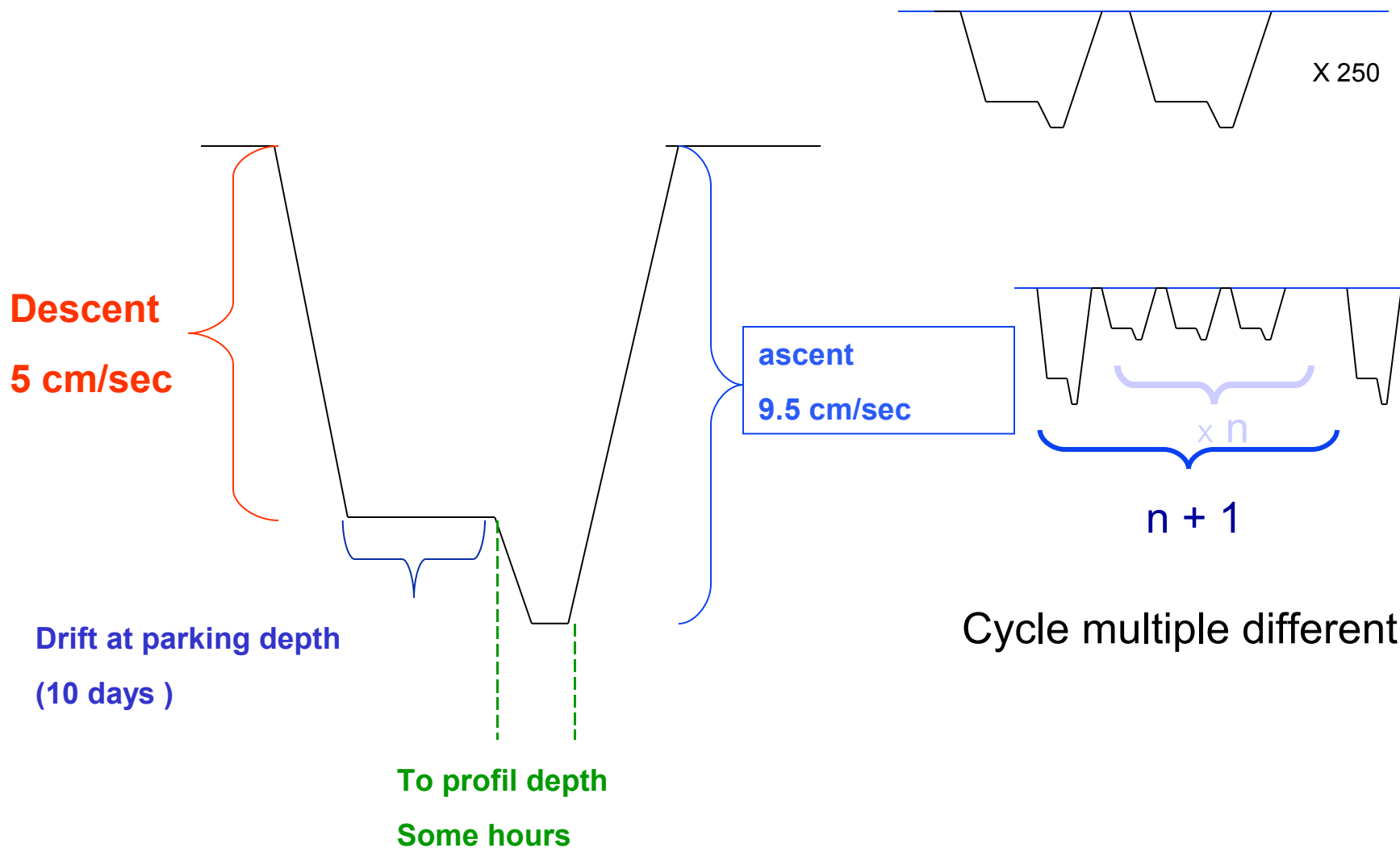
programmable:

- Upper and lower layer depth
- sampling interval in each layer
- Parking depth
- data compression
- all mission timings
- data compression with « slice » method



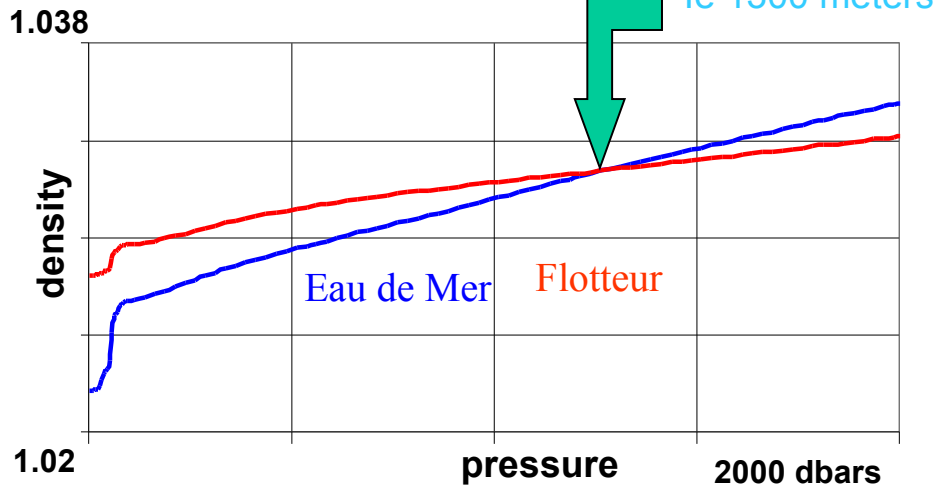


# cycle details et des paramètres missions



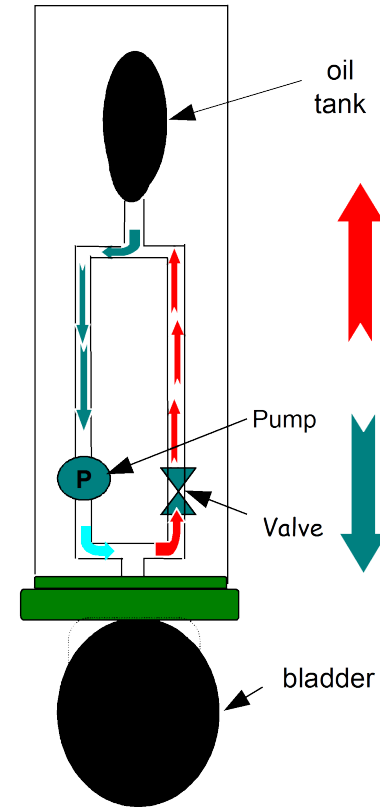
# Buoyancy engine Provor/ Arvor

Comparaison densité flotteur et densité eau de mer (Provor dans le Golfe de Guinée)



Stabilization crossing point water and float density

|                      | Provor  | Arvor  |
|----------------------|---------|--------|
| Oil capacity         | 3000 cc | 850 cc |
| from 0 to 2000 dbars | 250 cc  | 90 cc  |
| Antenna emergence    | 500 cc  | 350 cc |



→ No preballasting required whatever the area of deployment

# CTD acquisition pump activation mode ?

PUMP effect are

- New water to be measured
  - Thermal stability of conductivity cell
  - CTD Consumption
- Resultant accuracy ...

*on Alace 3-8 sec pumping before measure and*

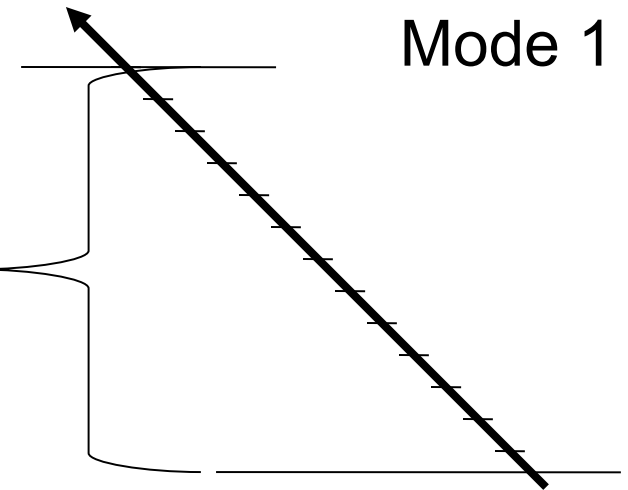
*On Apex: University of Washington 20 seconds before measure by spot sampling, 70 points in a profile*

Provor 2 / ARVOR the 2 modes describes are user selectable (25% saved with mode 2 )

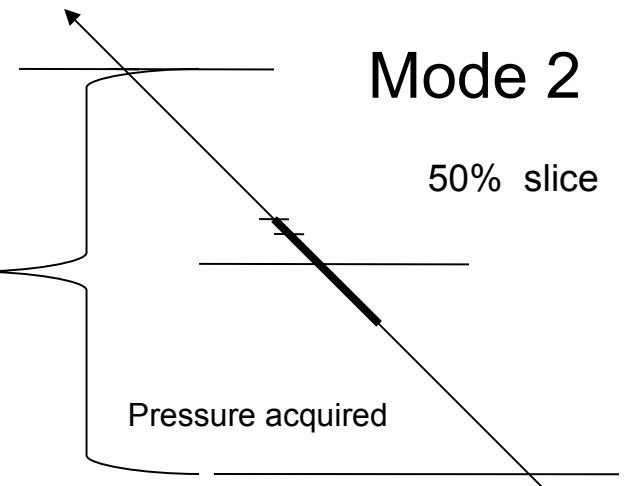
Only mode 2 for for alkaline solution recommended

demand with 0.5 second ? Error

One sclice 50 meters ( 500 secondes) ie acquisition every 2 seconds and averaged before transmission



One sclice 50 meters ( 500 secondes) ie Pressure acquisition until 1 dbar under 50% pumping 20 seconds 10 values acquired and averaged before transmission



# ARGOS messages mode 1

4 types

Type "4" CTD during descent

Type "5" CTD during drift

Type "6" CTD during ascent

Type "0" technical messages

## For a typical cycle

10 days drift (1 measure every 12 hours)

→ 18 triplets data

Ascent with a threshold surface / bottom at 200 meters

bottom zone from 2000 m to 200 m thickness slice 25 m

→ 72 triplets data

Surface zone from 200 m to 5 m thickness slice 10 m

→ 20 triplets data

total is 110 triplets data

or **20 ARGOS** messages of 248 bits 4960 bits

Each message transmit 6- 7 points per messages

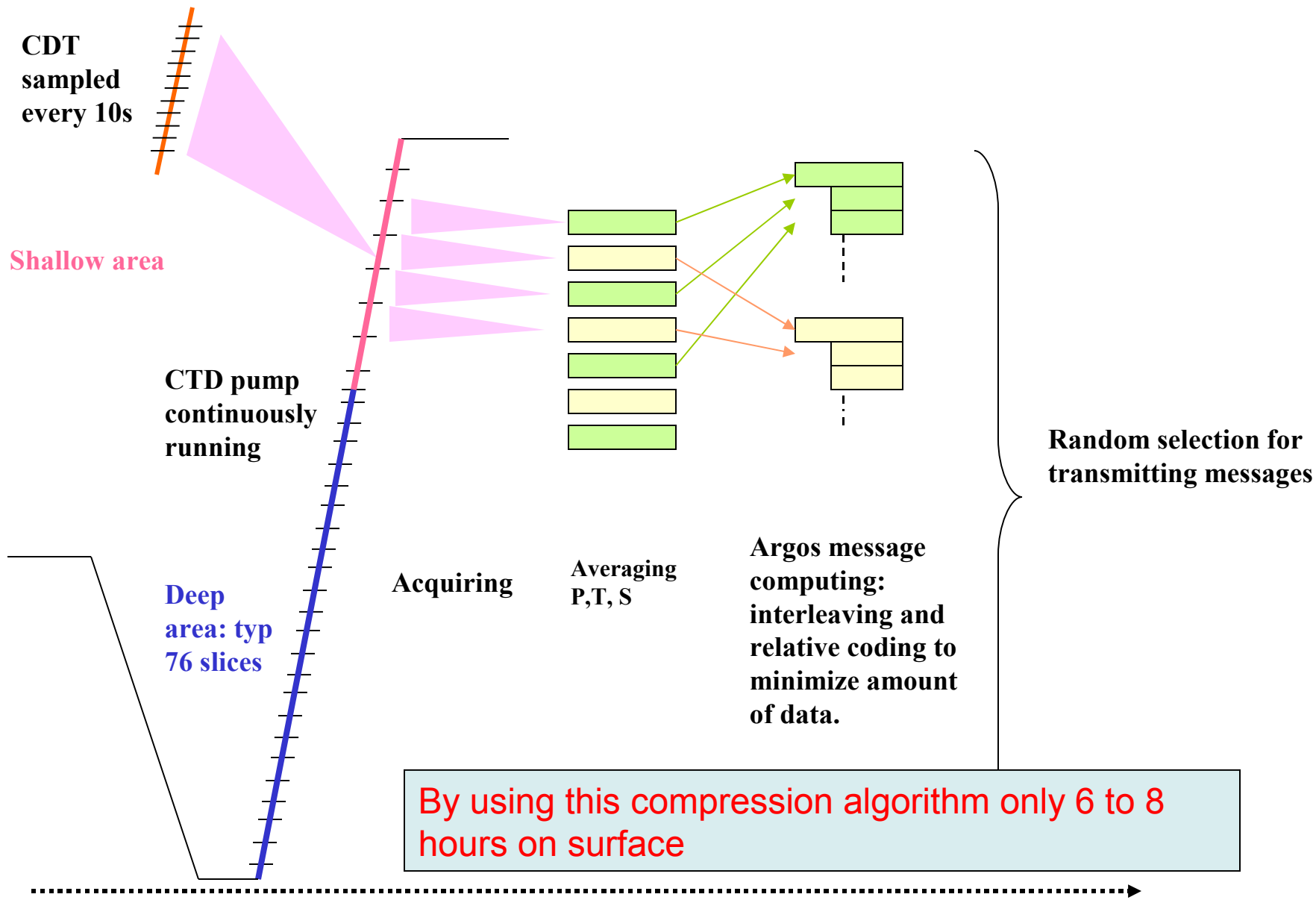
Transmission duration is fixed between 6 hours to 8 hours for low latitude

**300 triplets or 40 messages** could be treated at maximum by using relative coding

**It is a user choice !**

40 messages de 248 bits or 9.92 kbits 1240 octets

# Ascending profile acquisition and processing





# CTD SBE 41 ?

| Parameter              | Pressure          | Temperature      | Salinity             |
|------------------------|-------------------|------------------|----------------------|
| Range                  | 0, 2000 dBars     | -2, 35 ° Celsius | 2, 42 PSU            |
| Initial accuracy *     | 2 dBars           | 0.002 C          | 0.005 PSU            |
| Resolution             | 0.01 dBar         | 0.0001 C         | 0.0001 PSU           |
| Drift                  | <5 dbar/5year     | <0.005 C/5ans    | <0.010 PSU / 5 years |
| Transmitted resolution | 1 dBar → 0,1 dBar | 0.001° C         | 0.001 PSU            |

**On PROVOR Pressure offset is compensated at each surfacing**

-For PROVOR an ARVOR except for PROVBIO correction was transmitted wit 1dbar resolution default did not appear clearly

-For Provbio ( Iridium transmission offset correction transmitted with 0.1 dbar resolution : drift appeared

## Situation the 15<sup>th</sup> june 09

-Deployment and production in standby as required by SBE

-It seems that solutions have been fixed by SBE , nke wait for instructions for retrofit

-Offset correction resolution on PROVOR line was increased to 0.1 dbar

# Transmission mode

Two ways / more data / less time in surface

## Iridium & Argos 3

- IRIDIUM

- Two type of modem 9522 and 9601 and two size of SBD 1960/196
- SBD 1960 octets and 200 according model
- Iridium with GPS positioning ( Iridium position 30 km )
- Use of small SBD of 196 bytes , messages



- ARGOS 3

- Several operating possibility but
  - one profile data transmitted in a pass
  - Downlink , with high data rate
  - One profile on one pass
  - Localization by Doppler (2 pass ) or GPS
  - Need of “rendez vous”

Status or nke → Dual frequency Antenna in development  
→ Integration will start soon



# Battery technology Lithium or alkaline ? features

| Technology      | Lithium                            | Alkaline  |
|-----------------|------------------------------------|---|
| Chemical        | Li SOCl <sub>2</sub>               | Alkaline – manganese-Dioxide                      |
| - Capacity      | 12 Ah @ 3.5 volts / -20°C to +55°C | 12.8 Ah @ 1.3 volts / 0°C to 60°C                 |
| Energy / weight |                                    |   |
| Energy / volume | 42 Wh/ 90 gr                       | 15,6 pour 140                                     |
| Longevity       | Self life 10 y                     | Proven succes on float                            |
| Manufacturer    | Saft Battery                       | professional mode l<br>Duracell, Panasonic , Sony |




# Battery technology lithium or alkaline ?

transportation and disposal constraints MSDS

Euroargo workshop Trieste 18 June 09

**Lithium  
class 9**



Formalities to be done ( 90 € )  
but not so difficult

**Alkaline**  
no carriage transport restriction

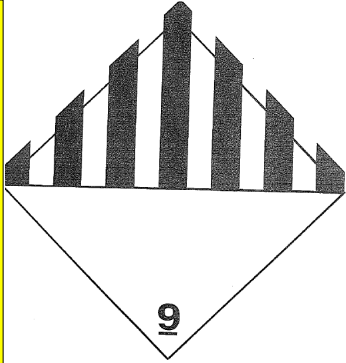
| <u>Material/Product Safety Data Sheet</u><br>(MSDS-PSDS) |   |
|--|---|
| LS/LSG/LSH/LST/LSX<br>products                           | Lithium/Thionyl chloride<br>single cells and multi-cell battery packs |
| Revision 8 Date 10/2008                                  |   |









**DURACELL**

**MATERIAL SAFETY DATA SHEET** (according to 93/112/EEC)  
Product: DURACELL ALKALINE BATTERIES and ULTRA ALKALINE BATTERIES  
Date / revised: 06/11/01

# Alcaline lithium fomalties



| 3. Composition & Information on Ingredients      |         |           |   |
|--|---------|-----------|---|
| Ingredient                                       | Content | CAS No.   | CHIP Classification   |
| Lithium (Li)                                     | 3,5-5%  | 7439-93-2 |  <br>F, R14<br>C, R:<br>R14/15, R21,<br>R41, F<br>S2, S8, |
| Thionyl chloride (SOCl <sub>2</sub> )            | 40-46%  | 7719-09-7 |  <br>C; R14, R21,<br>R37, R41,<br>S2, S8, S24,<br>S37, S  |
| Aluminum chloride anhydrous (AlCl <sub>3</sub> ) | 1-5%    | 7446-70-0 |  <br>R14, R22, R37, F<br>S2, S8, S22, S:<br>S36, S4:      |
| Carbon (C <sub>n</sub> )                         | 3-4%    | 1333-86-4 | NONE KNC  |

*Amount varies depending on cell size.*

| SHIPPER'S DECLARATION FOR DANGEROUS GOODS<br>DECLARATION DE L'EXPEDITEUR POUR MARCHANDISES DANGEREUSES   |   |   |  |
|--|---|---|--|
| Shipper<br><i>Expéditeur</i>   | Air Waybill No<br><i>N° de la LTA</i><br>Page <i>of/de</i> Pages<br>Shipper's Reference Number (optional)<br><i>Références de l'expéditeur (optionnel)</i>              |   |  |
| Consignee<br><i>Destinataire</i>   |   |   |  |
| Two completed and signed copies of this Declaration must be handed to the operator.<br><i>Deux exemplaires remplis et signés doivent être remis à la Compagnie.</i>          | <b>WARNING</b><br>Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. |   |  |
| TRANSPORT DETAILS<br>DETAILS DU TRANSPORT  |   |   |  |
| This shipment is within the limitations prescribed for : (delete non-applicable)<br><i>Cette expédition est dans les limites autorisées sur : (rayer la mention inutile)</i> | Airport of Departure :<br><i>Aéroport de départ :</i>   |   |  |
| <table border="1"> <tr> <td>PASSENGER AND CARGO AIRCRAFT<br/>AVIONS<br/>PASSAGER ET CARGO</td> <td>CARGO AIRCRAFT ONLY<br/>AVIONS<br/>CARGO UNIQUEMENT</td> </tr> </table>   | PASSENGER AND CARGO AIRCRAFT<br>AVIONS<br>PASSAGER ET CARGO   | CARGO AIRCRAFT ONLY<br>AVIONS<br>CARGO UNIQUEMENT | Shipment type : (delete non-applicable)<br><i>Type d'expédition : (rayer la mention inutile)</i> |
| PASSENGER AND CARGO AIRCRAFT<br>AVIONS<br>PASSAGER ET CARGO  | CARGO AIRCRAFT ONLY<br>AVIONS<br>CARGO UNIQUEMENT   |   |  |
| Airport of Destination :<br><i>Aéroport de destination :</i>   | <input type="checkbox"/> NON-RADIOACTIVE <input type="checkbox"/> RADIOACTIVE   |   |  |
| NATURE AND QUANTITY OF DANGEROUS GOODS (see sub-Section 8.1 of IATA Dangerous Goods Regulations)   |   |   |  |

## 2. Hazards Identification

Do not short circuit, recharge puncture, incinerate, crush, immerse, force discharge or expose to temperatures above the declared operating temperature range of product. Risk of fire or explosion.

## 13. Disposal considerations

**Product:** Dispose in accordance with appropriate regulations. If in doubt, contact your national Gillette office for information. Do not incinerate, since batteries may explode at excessive temperatures.



# Battery technology lithium or alkaline

## Provor case cost

|                  | Lithium        | Alcaline         | Li → Al |
|------------------|----------------|------------------|---------|
| Cost             | 900 €          | 200 €            | + 700 € |
| → on float price | Base           | - 5 %            |         |
| → Longevity      | 270 cycles (1) | 160 cycles (2)   |         |
| → Cost per cycle | 50 €           | 77 €             | - 27 €  |
|                  |                | + 50% per profil |         |

•Cycle 1 is 2000 m/ 10 days / **92 points** during ascent / **continuous pumping**  
**18 pts from frift 6 hours on surface**

•Cyle 2 is 2000 m/ 10 days / **70 points** during ascent / **pump switched** / 6 hours in surface

|                   | Cycle 2 Lithium | Cycle 2 Alcaline |
|-------------------|-----------------|------------------|
| PROVOR CT3        | Up to 300       | Up to 170        |
| PROVOR 2 or ARVOR | Up to 270       | Up to 160        |

# PROVOR range for ARGO

## Provor CTS3

Nke ARGO basis offer until 2009

Self ballasting

Available in Lithium and Alkaline battery

**dedicated for multi-sensors embedded with good payload capacity**



## PROVOR2 or ARVOR

CTD optimized float for Argo applications



Self ballasting

Available in Lithium and Alkaline battery



# PROVOR line ARGO model



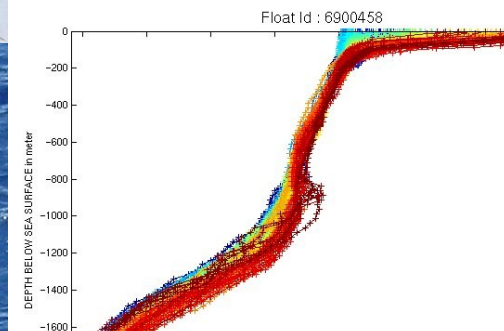
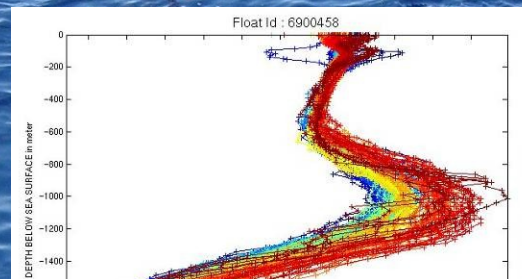
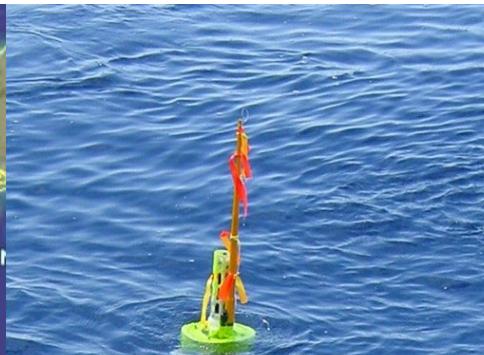
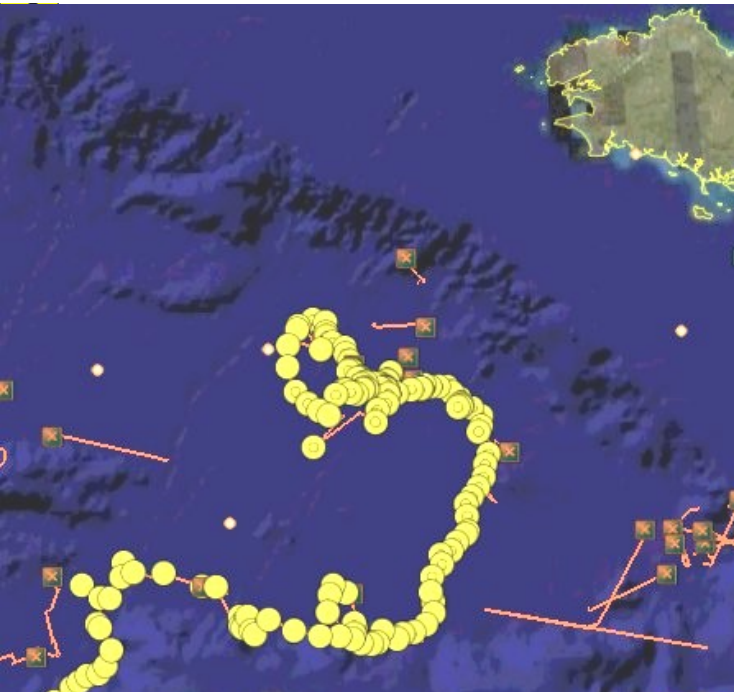
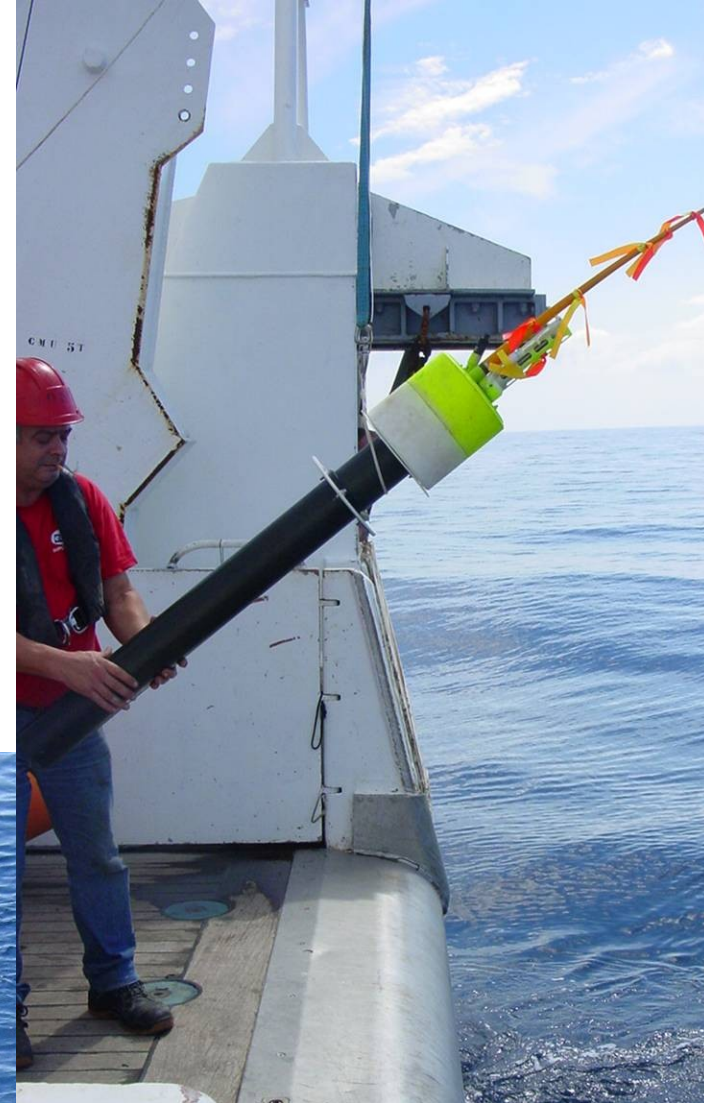
| Provor CTS 3  | PROVOR2 / Arvor  |
|---|--|
| SBE 41 CTD with pump  |  |
| Identical high hydraulic pressure pump  |  |
|   | Improved hydraulic efficiency due to mechanical design                         |
| $\Phi$ 17 cm L 170 cm<br>34 Kg  | $\Phi$ 11 cm L 120 cm<br>20 Kg Deployable by one person                        |
| Wide Sea experiences<br>feed back  | subassemblies reliability<br>Ifremer design know ledge<br>qualification method |
| Efficiency<br>Performances       | Technical frame for improvements ,<br>pump, electronics                        |
| Wide payload capability   | Additional payload capability reduced  |

Both model pro posed with Alkaline or lithium battery



# Provor 2/ Arvor

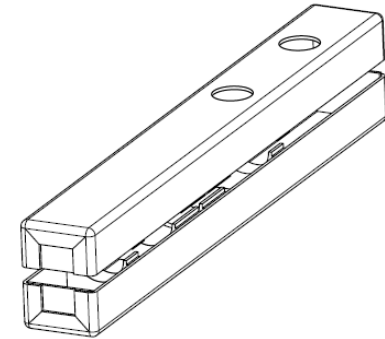
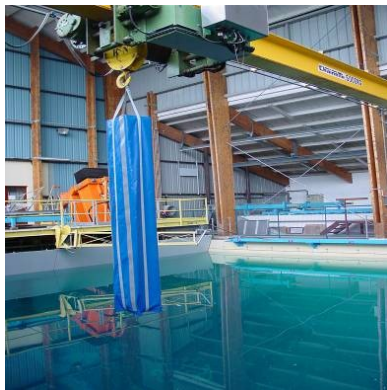
- **Qualification at sea** (end dec 07)
  - 186 cycles performed @ 2000 m / 2 days cycle
- **Other units deployed , Indian ocean , atlantic**
- but others in stand by due to pressure sensor issue



# Deployment from opportunity ship

## To facilitate deployment from opportunity ship

- PROVOR is shipped in a cardboard box itself in a wooden box
- A reusable release kit including sliding bag , padlock

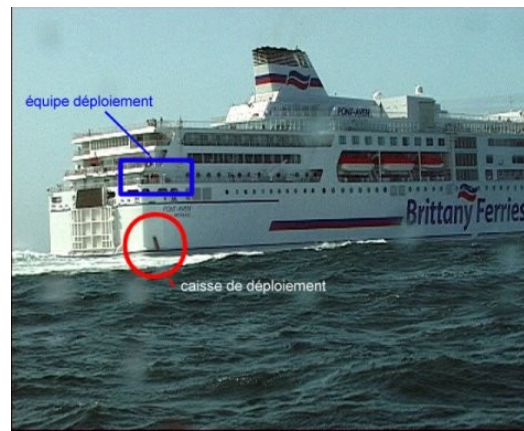


**Brest basin test**

**Opening using a “salt pastille” padlock**

**Trials on board  
‘Pont Aven’  
(Brittany ferries)**

**20 knots, 15 meters high**



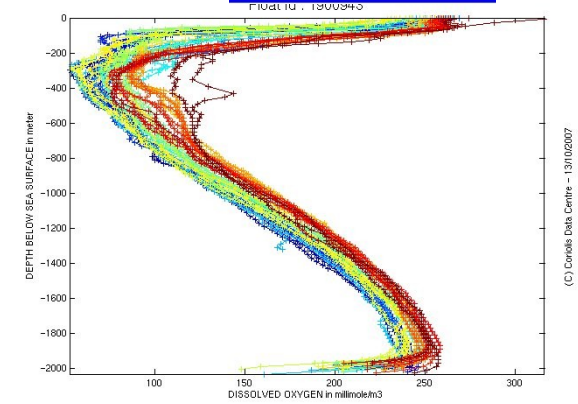


# Provor DO

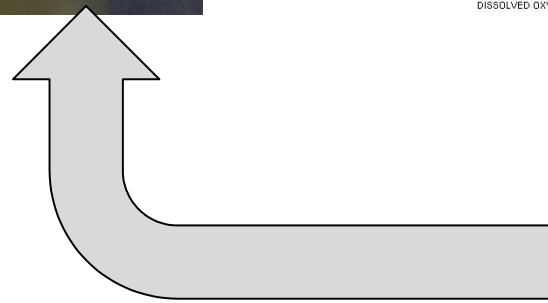
## Contribution for marine carbon sources and sinks assessment

E L

### CTD and dissolved oxygen sensor (Aanderaa optode)



Now mounted on the top  
Better temperature answer  
Ai calibration?



# PROV-BIO "biogeochemical "

## **CTD + optical sensors :**

**Version A :Wetlabs + Transmissometer  
-Satlantics Irradiance sensor**

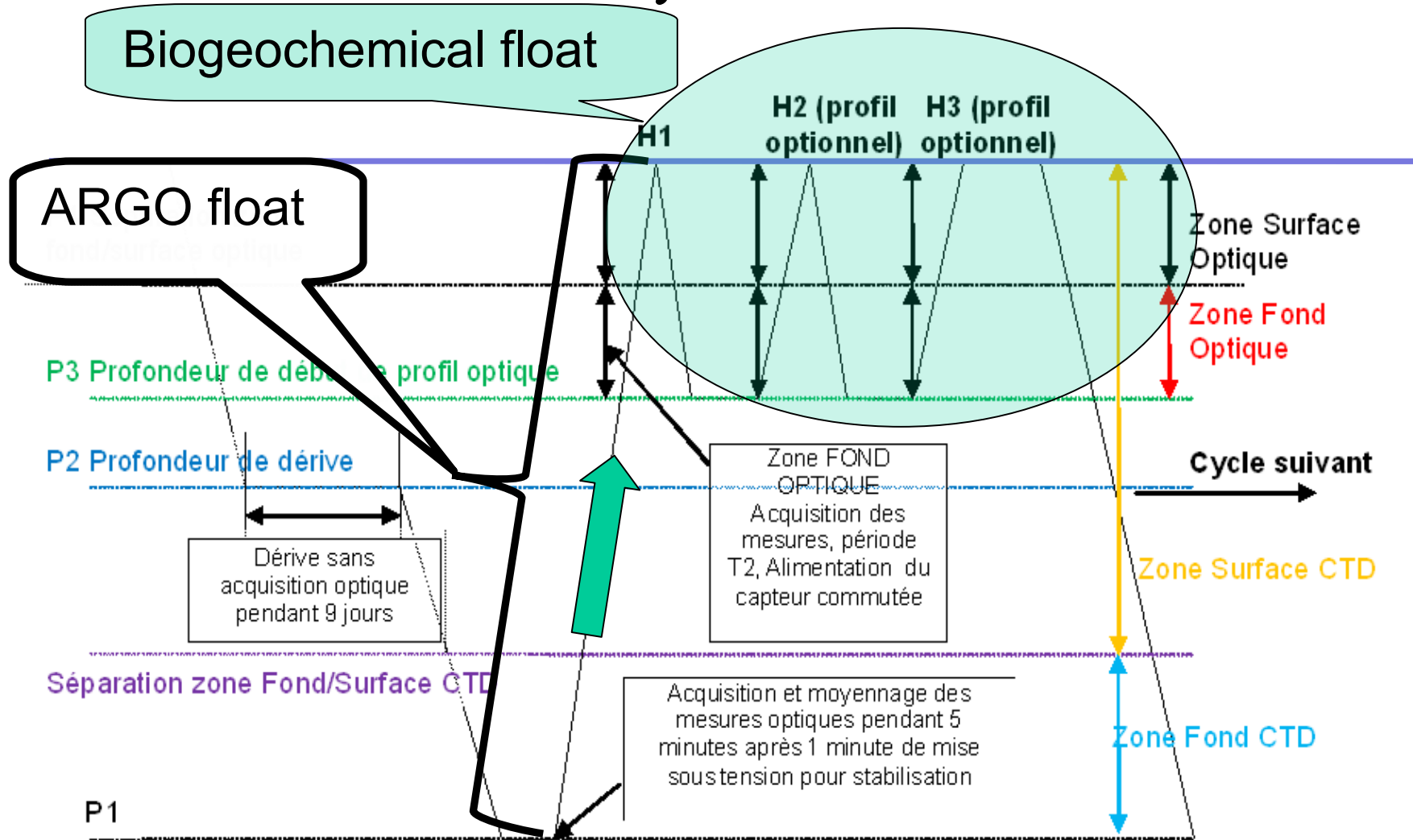
**Version B : versA + Chla & CDOM+  
radiometer**

**Iridium Transmission**

- **Oldest one has performed 91 cycles  
Manufactured and developed by nke for  
LOV in collaboration with Ifremer**
- **4+ 8 profilers deployed**
- **4 in production and pending deployment**



# Provbio B cycle features





# Provbio . . . .

- For result see LOV web site and Laurent Coppola presentation
- Several types and distinct of messages
  - ARGO and ,
  - scientific messages,
  - Technical messages different ( pressure issues )
- All parameters could be modified through by remote control
- Caution and instructions are strictly necessary
- For nke Such developments are source of improvement for the whole community



# Users wishes welcome !

**Longer autonomy 6 years ? or more often profiles**

**Deeper 3000 dbar , 3500 dbars ? Preliminary study in progress**

## **For marginal seas**

Two ways , less time in surface to reduce traffic exposure

Remote control , for mission update ,

For recovery operation at opportunity date

**Others sensors ?**



## As conclusion

- PROVOR 2 / ARVOR nke model for offer now
- Nke offer is growing .
- Thanks to the old industrial partnership between IFREMER and nke
- nke : Developments still in progress on antennae , materials, sensors, functionalities to be able to cheaper for better proposals, cheaper for user



Merci



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