

Deep-Arvor: The results of the first industrial prototype deployment

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Ifremer

Deep-Arvor was designed by Ifremer to achieve more than 150 profiles from 4,000 meters depth, with CTD continuously pumping and oxygen measurements. After the validation of two first models at the sea, the industrialization has been entrusted to NKE. The first constructed prototypes of Deep-Arvor have been deployed successfully in May 2014. Thanks to its light weight, Deep-Arvor maintains the self-ballasting feature of Provor/Arvor and the easy deployment of Arvor. High resolution profiles are transmitted by the Iridium satellite system.

✓ The starting point of the development is Arvor (2,000 m), which sub-assemblies have been improved and extended in the following way: SBE41CP CTD includes a reinforced pump, the volume of the hydraulic pump has been decreased in order to address the high pressure constraint, the volume of oil has been increased to fit with the new range of depth (and future additional sensors) and the antenna has been strengthened.

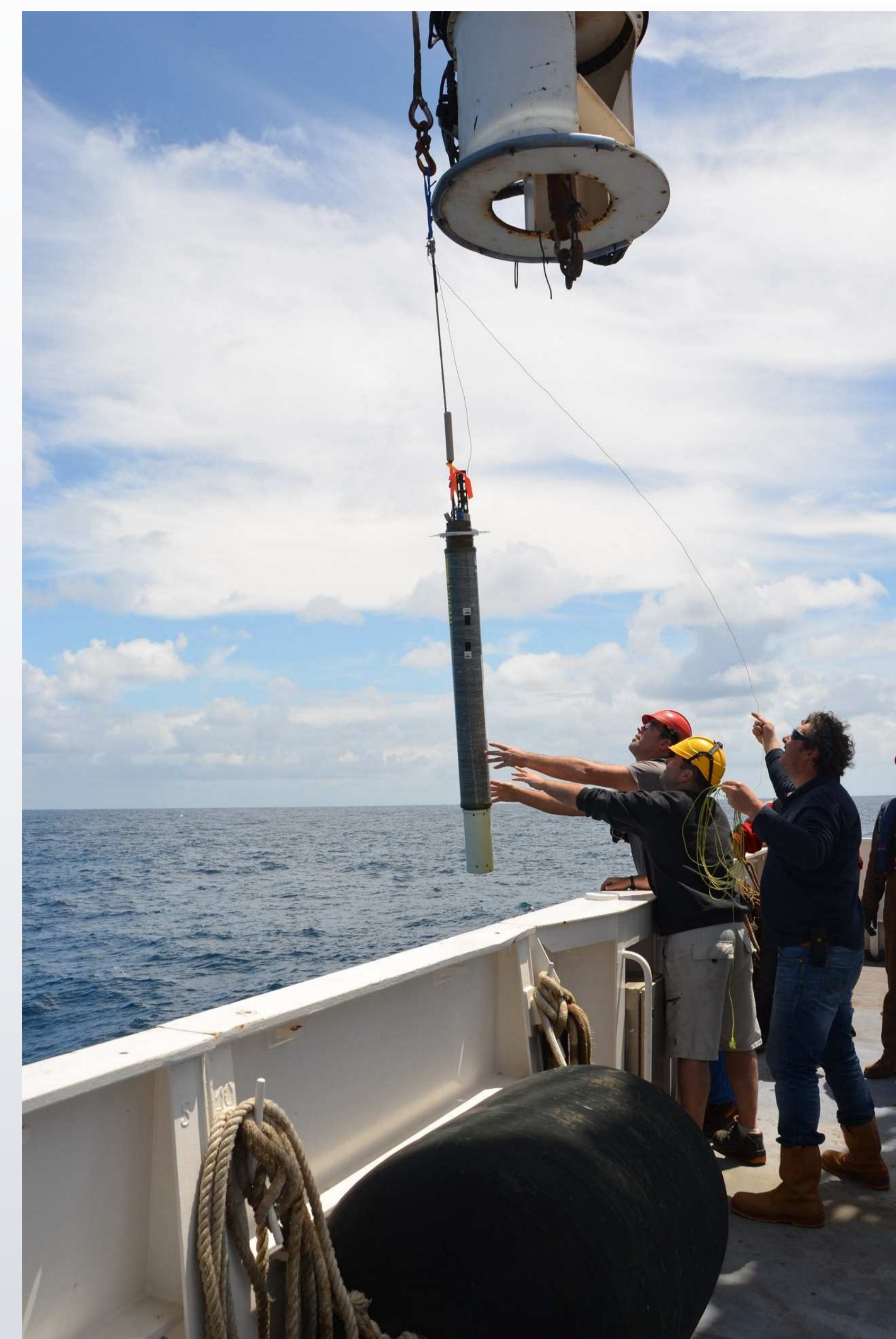
The housing is made by filament winding. This technology gives lightness while maintaining the withstand of the pressure. It also offers manufacturing advantages (ordering by few units, reduction of costs).

The heart of Deep-Arvor is the electronic controller I535 already used in Arvor for several years.

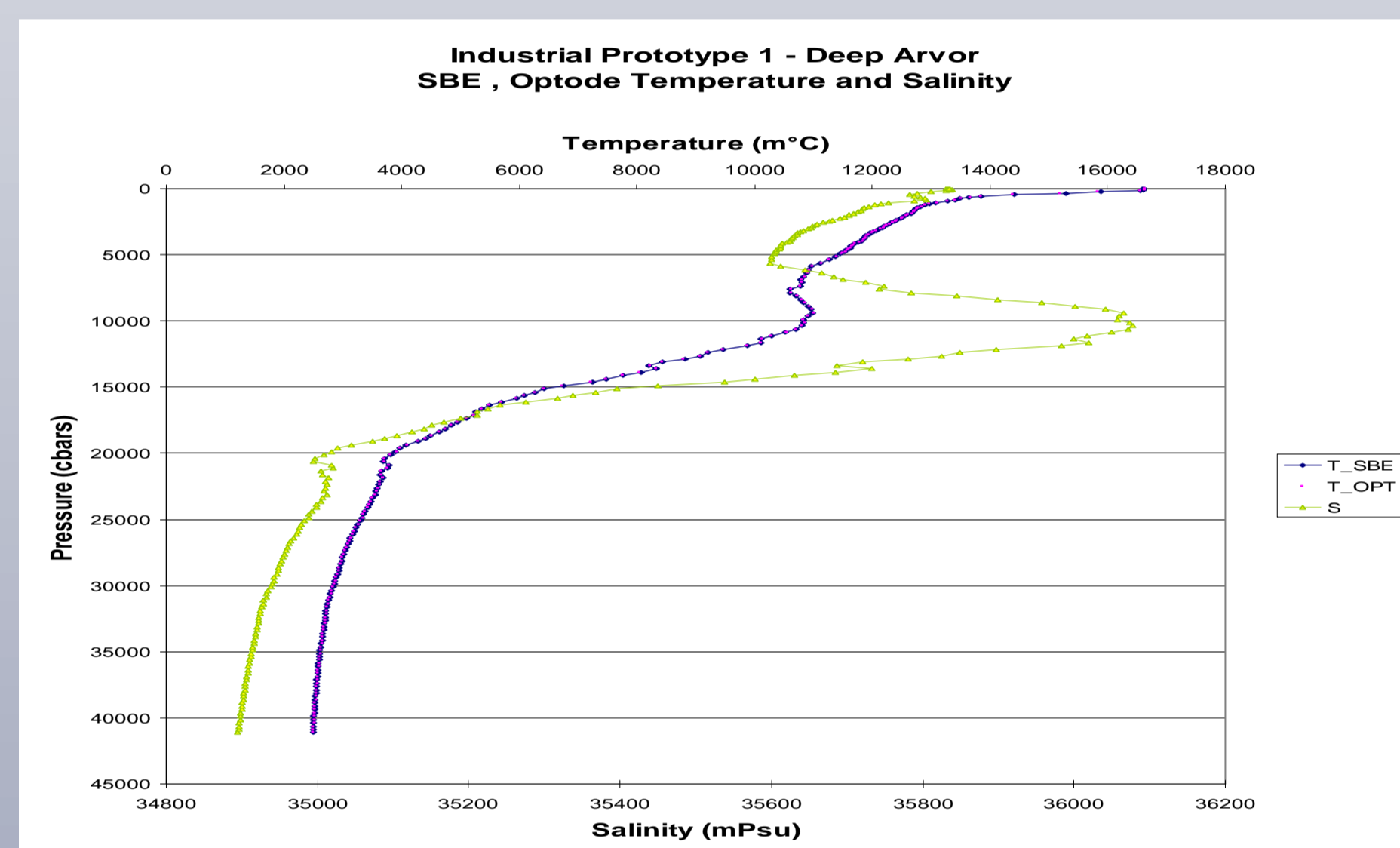
✓ Also the sub-assemblies underwent intensive tests: several hydraulic engines passed the equivalent of 150 cycles at operating pressure. The composite housings resisted compression cycles which are representative of their life. The effect of swell was assessed and real time missions were performed in the pressure tanks or in the pool.

The results of the industrial prototypes at the sea:

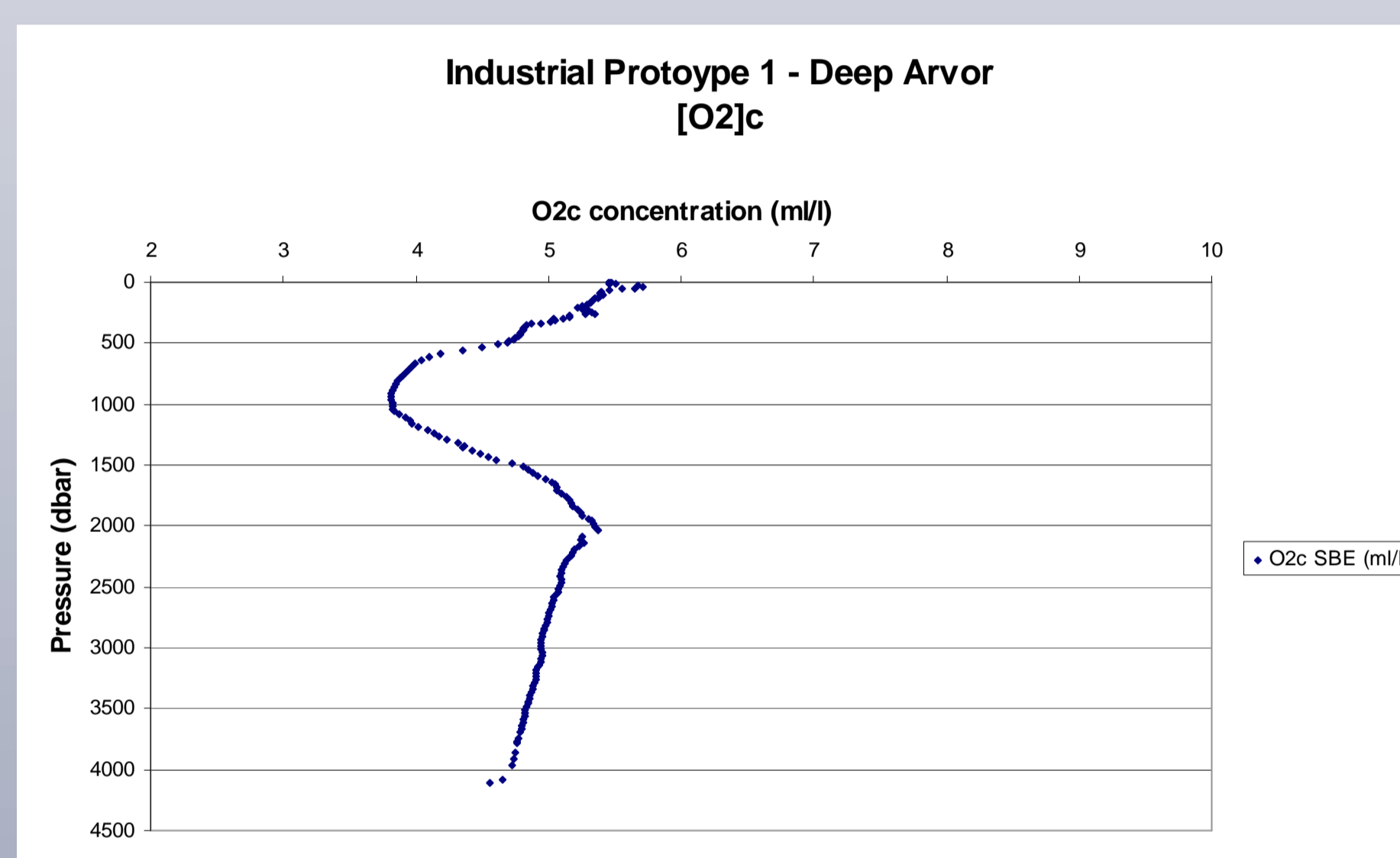
- Two NKE prototypes of Deep-Arvor have been deployed at the sea in May 2014 during the mission Geovide.
- The two prototypes made their first cycle at 4,000 meters depth with CTD and O2 measurement. The next cycles will test the high resolution acquisition mode, the stability of the drift and the sensor data quality.



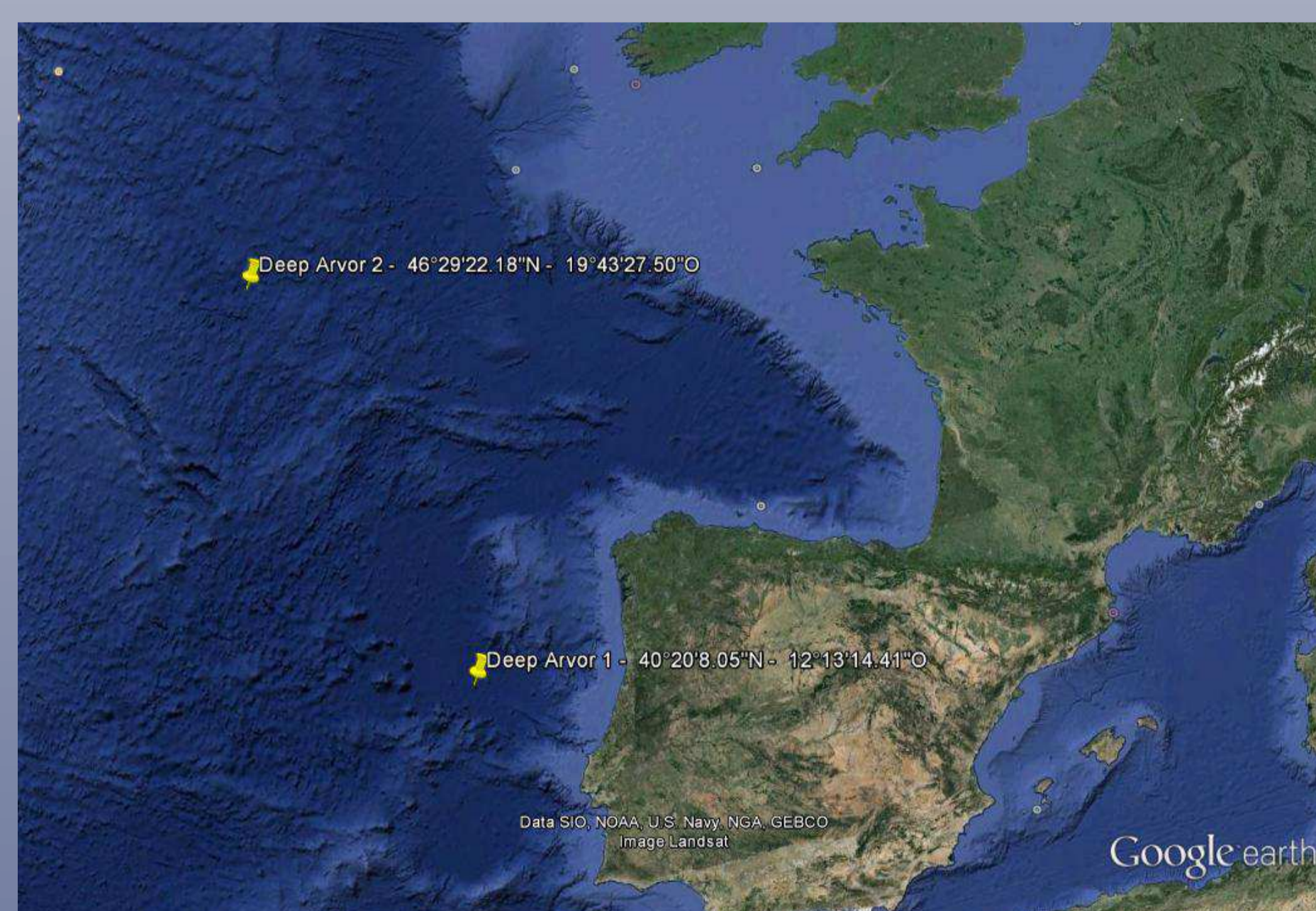
Deployment of the prototype 2 during the campaign Geovide on the ROV/Pourquoi Pas? - May 2014



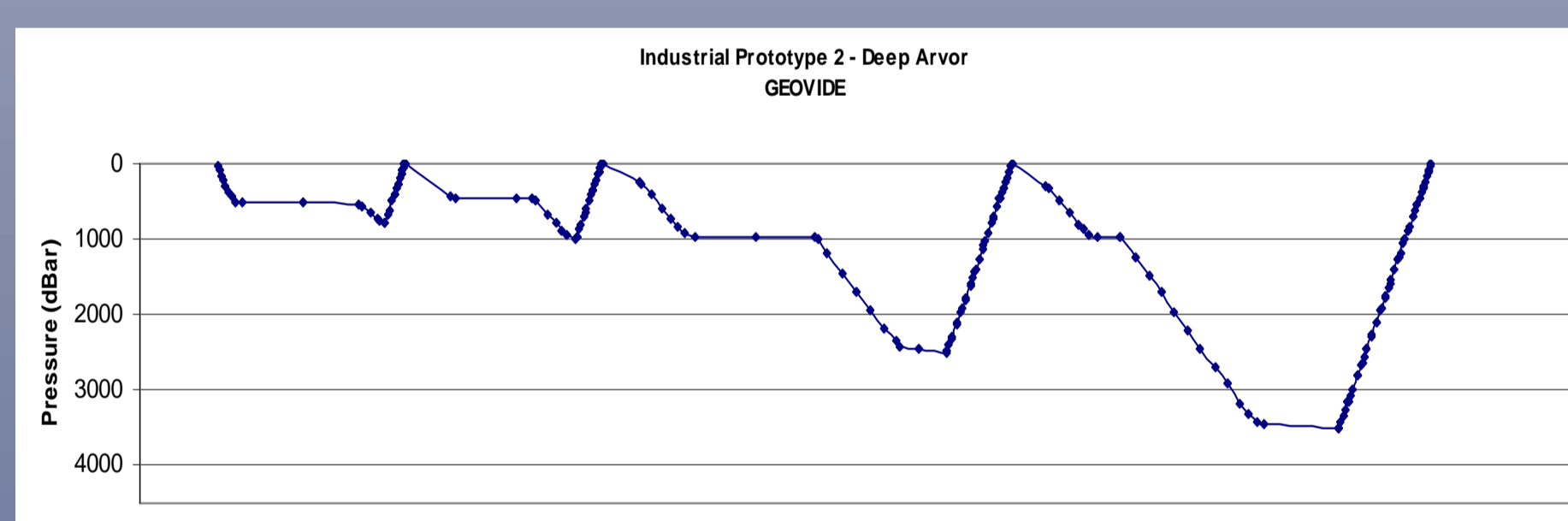
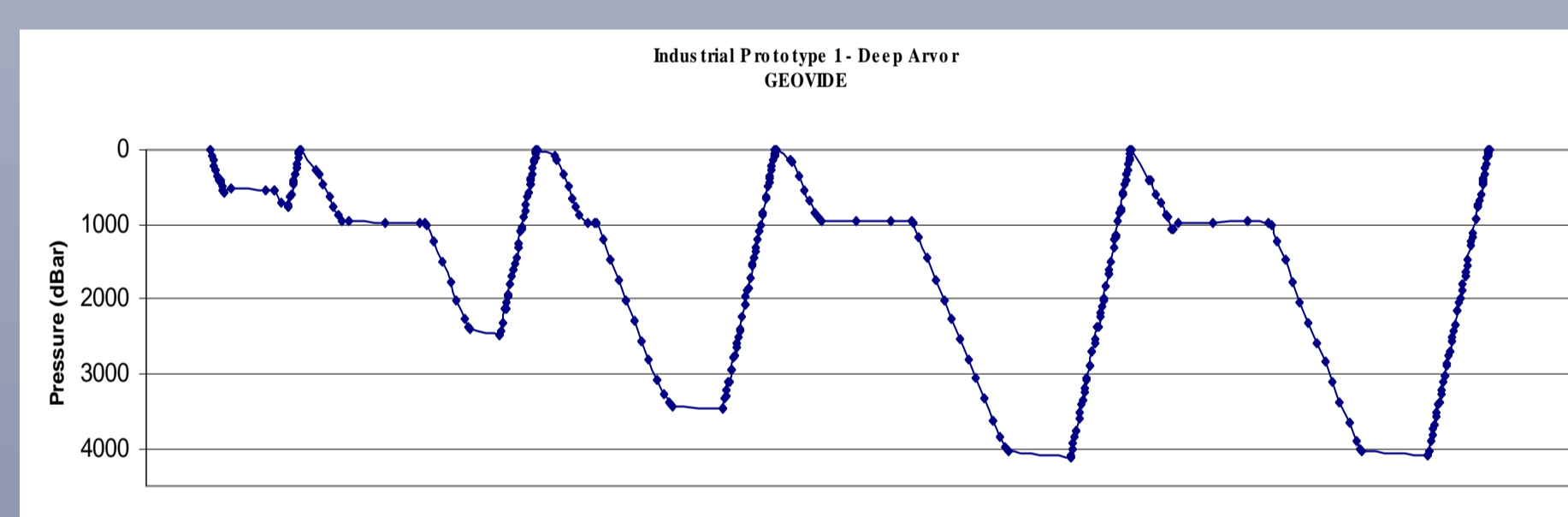
Salinity and temperature acquisition



O2 acquisition



Deployment spot of Deep Arvor profiling float



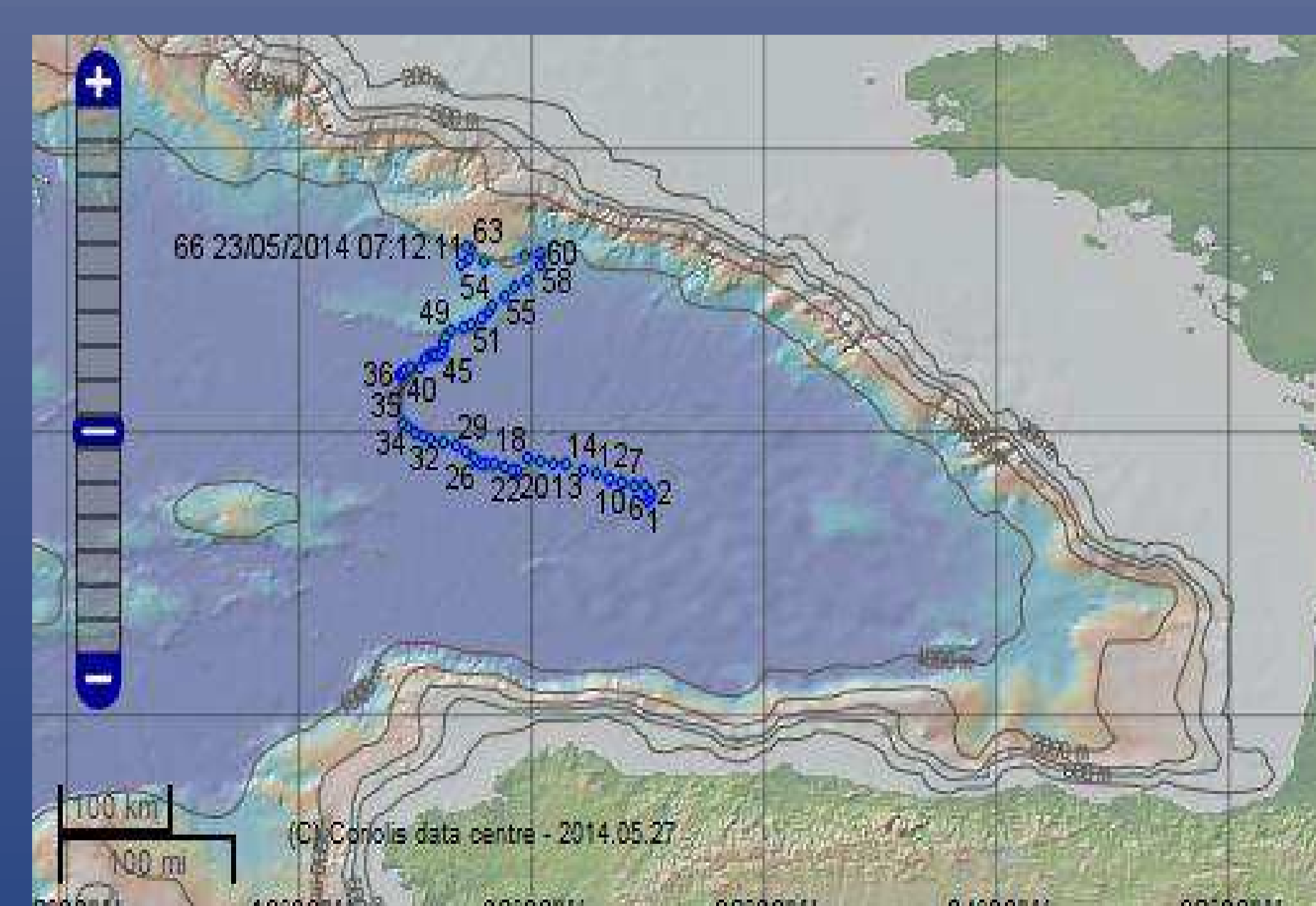
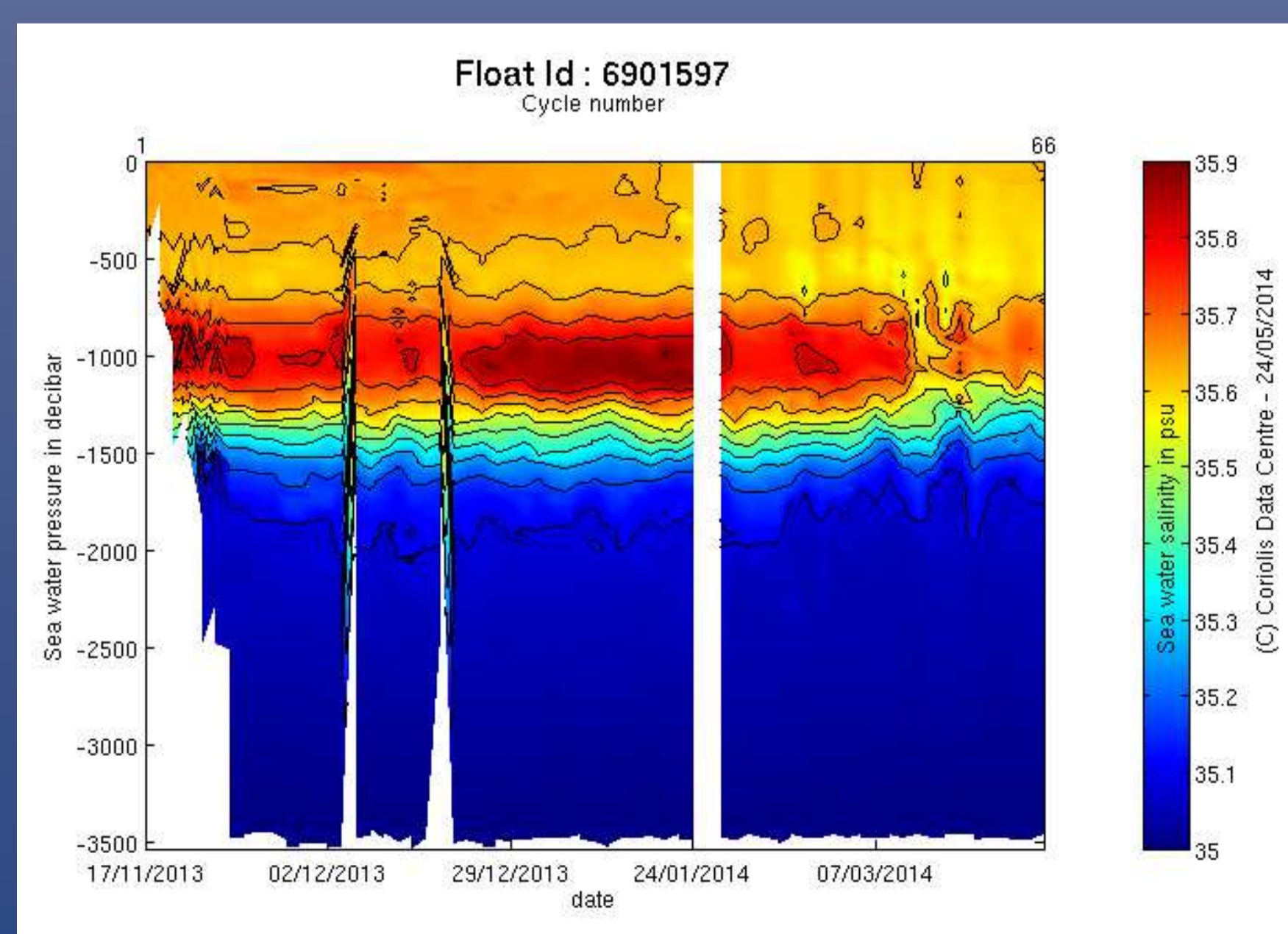
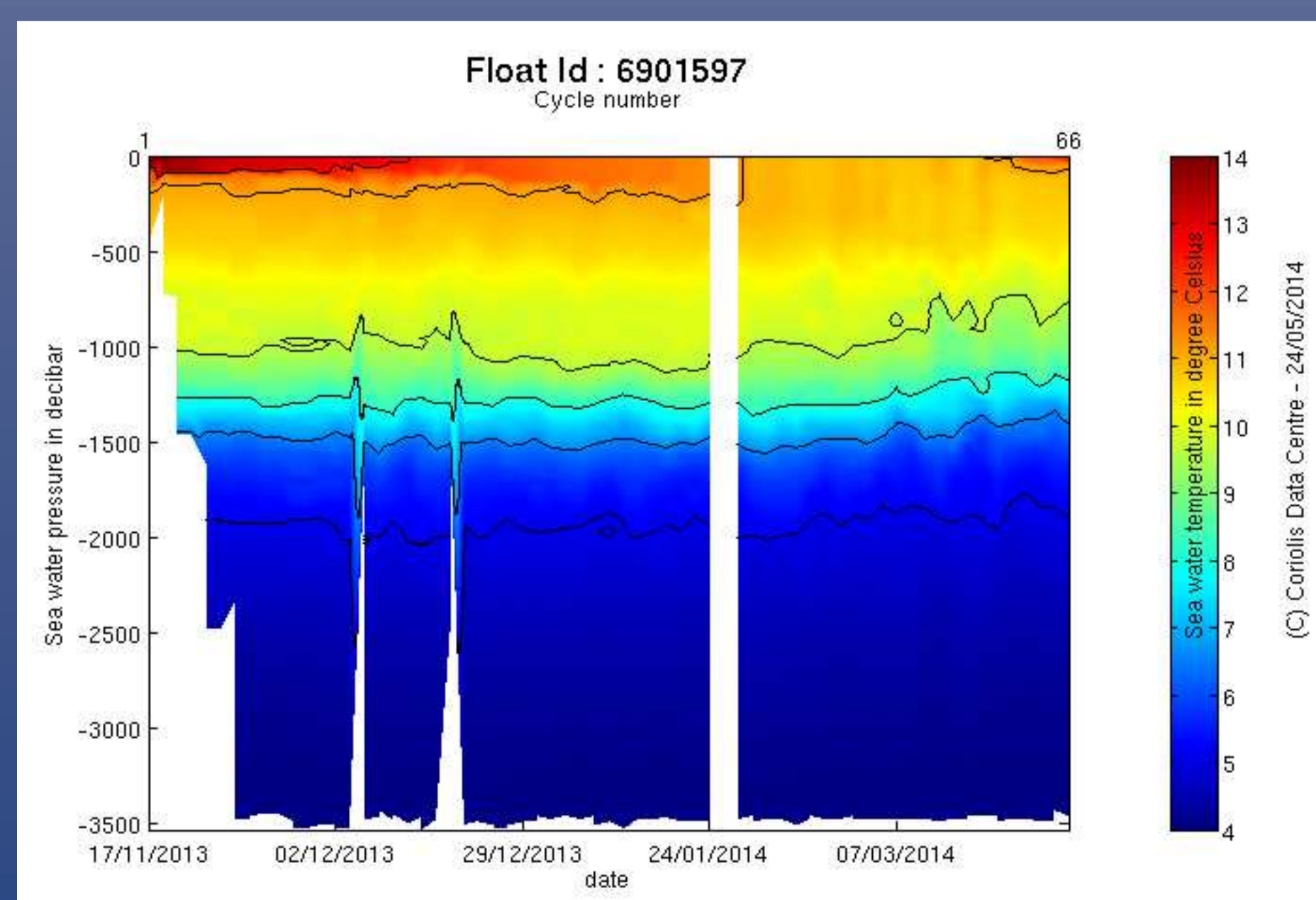
Deep Arvor cycling 1 & 2

The main features of Deep-Arvor:

- Operational depth: **4,000 meters**
- Pressure test: 4,580 dbars
- **150 profiles** at 4,000 meters depth
- Sensors:
 - Seabird 41CP CTD (continuous pumping)
 - Aanderaa 4330 optode (raw data: phases + T)
 - Optional Sensor Available
- Data acquisition:
 - 3 sampling areas (depth, middle, surface) with high resolution capabilities (1 meter)
 - Over 1,000 points profile with CTD & DO transmitted (programmable)
 - Remote control available (period, parking & profile pressure, alternate profiles ...)
- Transmission: Iridium (& GPS)
- Programming link: Bluetooth, serial protocol
- Housing: Filament winding
- Weight in the air: **26 kg**
- Dimensions: housing diameter 14 cm, total length **216 cm**

The results of Ifremer models at the sea:

- Two Ifremer models of Deep-Arvor were deployed at the sea in August 2012 and October 2013, for a total of **130 cycles**.
- The first model achieved 60 profiles at 3,500 dbars between August 2012 and January 2013, cycling every 3 days in mid-Atlantic ocean. The second model was deployed in October 2013 in the bay of Biscay, achieved **70 profiles at 3,500 dbars** and it is still cycling.



This development has been achieved within the project framework NAOS - Novel Argo Ocean observing System (www.naos-equipex.fr). It is also one of the projects selected in the Equipex call for proposals of the French program "Investissements d'avenir" (www.naos-equipex.fr). Its two main objectives are:

- To consolidate the French contribution to the Argo core mission (global temperature and salinity measurements) by deploying 10 to 15 additional floats per year from 2012 to 2019 (in total 110 floats).
- To develop and validate the next generation of Argo profiling floats. New float capabilities will include: improved performances, integration of the biogeochemical sensors, deeper measurements and under ice operations in the polar sea. NAOS is a strong partnership between IFREMER (coordinator), UPMC (co-coordinator), CNRS, UBO/IUEM, SHOM and two private companies: CLS for satellite telecommunication aspects and the NKE SME which is in charge of the industrialization and commercialization of French Argo floats.

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