

# Deep-Arvor: a CTD & DO profiling float for Argo

S. LE RESTE, V. DUTREUIL, X. ANDRE, C. TRAUTMANN, T. BESCOND, Ifremer Brest, France.



Ifremer

The first prototype of Deep-Arvor was deployed this summer. Deep-Arvor is designed to achieve more than 150 profiles from 3500 meters depth, with CTD continuously pumping and oxygen measurements. High resolution profiles are transmitted by the Iridium satellite system.

Deep-Arvor maintains the self-ballasting feature of Provor/Arvor and the easy deployment of Arvor thanks to its light weight.

✓ The starting point of the development is Arvor (2000m), whose sub-assemblies have been improved and extended: the 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, reducing costs).

The heart of Deep-Arvor is the I535 controller already used in Arvor.

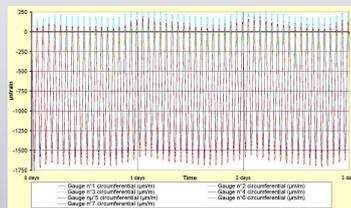


Deep-Arvor deployment (Strasse 2012)

✓ Sub-assemblies have undergone intensive tests: several hydraulic engines passed the equivalent of 150 cycles at operating pressure; the composite housings withstood the cycles of compression and steady state which are representative of their life; the effect of swell has been assessed; real time missions were performed in the pressure tanks or in pool.



Hyperbaric tests of hydraulic engine



Housing: pressure cycling, circumferential gauges.



Pressure tank testing

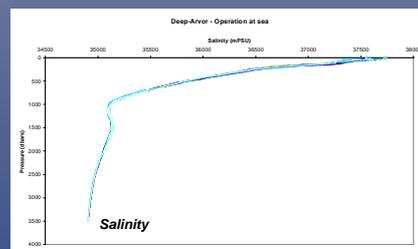
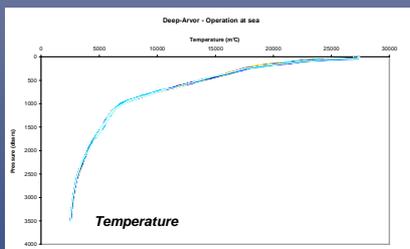
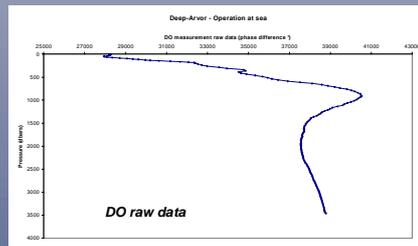
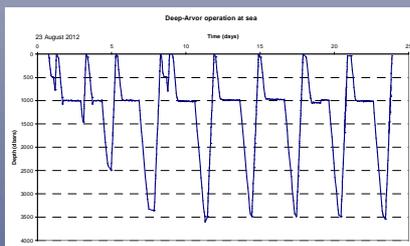


Swell testing in pool

✓ Industrialization phase: first units planned for 2013 (NKE Manufacture)

## First results at the sea:

- The first prototype is cycling every 3 days in mid-Atlantic ocean, 10 cycles has been achieved (23 August - 20 September 2012),
- According to the Argo oxygen meeting conclusions (Brest, may 2011), the float transmits raw data (phases) of the optode. Thus oxygen concentration may be post-calculated with a suitable algorithm.
- The power balance shows that the objective of 150 cycles at 3500 meters is realistic,
- A second prototype is being tested and will be deployed soon.



## Main features of Deep-Arvor:

- Full scale accuracy of CTD: 3500 meters,
- Pressure withstanding: 4000 dbars
- 150 profiles at 3500 meters depth,
- Seabird 41CP CTD + Aanderaa 4330 optode (raw data: phases + T),
- Fully programmable cycle during operation (period, parking & profile pressure, alternate pressure to go deeper every  $n$  cycle...),
- 3 sampling areas (depth, middle, surface) with high resolution capabilities (1 meter),
- Over 1000 points profile with CTD & DO transmitted (programmable),
- Iridium transmission & GPS positioning, mission parameters are remote controlled,
- Weight in air: 26 kg,
- Dimensions: hull diameter 14 cm, total length 216 cm.



This development has been achieved within the NAOS - Novel Argo Ocean observing System - project framework ([www.naos-equipex.fr](http://www.naos-equipex.fr)). It is one of the projects selected in the Equipex call for proposals of the French program "Investissements d'avenir" ([www.naos-equipex.fr](http://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 biogeochemical sensors, deeper measurements and under ice operations in the polar seas. 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.