Deep NINJA: a new float for deep ocean observation developed in Japan

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We are very happy to introduce a new profiling float for the deep ocean, Deep NINJA. It has been developed since 2007 by Tsurumi Seiki Co. Ltd. (TSK) and JAMSTEC and recently a prototype was built (Figure 1). Specifications of the system are the following:

- Height: 198 cm (with antenna)
- Weight: 76 kg in air (including floating collar)
- Diameter: 18 cm for hull and 37 cm for floating collar
- Maximum observing depth: 3000 dbar
- Sensor: CTD sensor for deep floats developed by Sea-Bird Electronics. Additional sensors can be added on board.
- Communication: Iridium (float locations are fixed with GPS system)
- Battery: Lithium
- Lifetime (est.): 120 cycles (2000-dbar dives except for a 3000-dbar dive every four cycles)

Now we are considering the possibility of enhancing the maximum depth of the prototype to 4000 dbar.

One of the most important features is its buoyancy engine (Figure 2), which was newly developed for Deep NINJA. It has a new mechanism, which is a hybrid of the two existing systems, the single-stroke piston and the hydraulic pump. The engine was tested at up to 3500 dbar without incident in the laboratory and it can generate significant float buoyancy when adequate oil is provided in the interior reservoir. These two features are essential to buoyancy engines for deep floats. Another advantage of the engine is reliable control of buoyancy even at that depth. The shorter engine piston results in a smaller float, which translates into a longer lifespan of the float, too.

The new engine brings many benefits to the Deep NINJA, most importantly that the float is able to make observations below 2000 dbar. The Deep NINJA is expected to have a large payload capacity, which is a result of the new engine design.

Deep NINJA operating software is now being developed and will be finished by the end of August. In the fall of 2010, the first field test is planned to be carried out in coastal waters. After multiple field and laboratory tests, the first dive to a depth of 3000 dbar was planned for May 2011. We expect to present the test results in the next year.

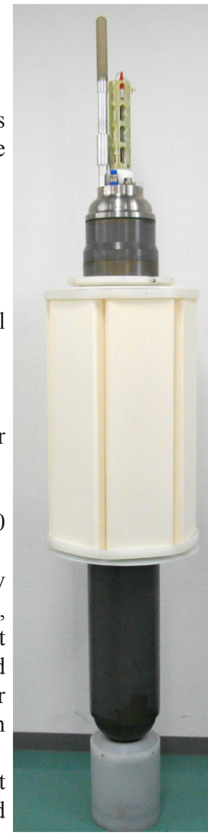

Figure 1: A prototype of Deep NINJA

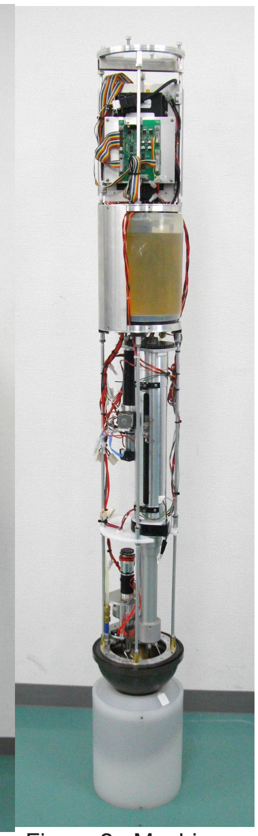

Figure 2: Machinery of Deep NINJA

ARVOR communication improvements for marginal seas applications

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New requirements have appeared in the last few years for profiling floats and the ARVOR float is being made to meet these new requests. The two main requirements are less surface time and the ability to modify mission parameters after deployment to monitor specific events. For deployment in marginal seas, less surface time is needed in order:

- to lower the risk of thefts, trawling or impact in these highly trafficked seas
- to delay the time of beaching on the shores
- to have better estimates of subsurface currents

For coastal applications, the reduction of surface time:

- facilitates the realization of successive profiles at the same location to delay beaching
- delays the development of bio-fouling

As a solution to reduce surface time and allow for mission modification, ARVOR floats have been fit with both Iridium and ARGOS-3 communications. An Arvor float has been fitted with an Iridium modem coupled with a GPS receiver and a high pressure antenna, for Argo marginal seas requirements. Using Iridium allows extra information about the behavior of the float to be sent. Additionally, a last CTD raw data is acquired before stopping the CTD pump at the end of the rising profile (useful for knowledge of surface properties). There is improved vertical resolution (2 dbars) and power balance, as well as remote control available during operation (modification of cycling period, parking depth, profile depth…). The capability to manage seabed stationing is proven at sea.

Assessment, integration and testing at sea of the ARGOS-3 communications has been done.

The system works with the interactive mode capability (low data rate) of the MetopA satellite. It uses its prediction pass tables to make a rendez-vous at the surface. Argos2 standard communication is maintained in case of interactive mode failure.

Two floats have been deployed in the Mediterranean Sea in February 2011. The floats have done more than 30 cycles and the synchronization of the float with the Argos3 satellite pass is accurate. A few data sets have been sent in one Argos3 satellite pass, showing the interest of the system, however, the time spent at the surface is variable and has to be improved. More analysis is planned as well as improvements and high data rate implementation for 2012.