Geophysical Research Abstracts, Vol. 8, 09213, 2006
SRef-ID: 1607-7962/gra/EGU06-A-09213

Hippocampe : a new versatile ocean bottom seismometer

Y. Hello, B.A., Yates, A. Anglade, A. Gailler, Ph. Charvis

Géosciences Azur (IRD, CNRS, UNSA, UPMC) Observatoire Océanologique, BP 48, Villefranche-sur-mer, France — yann.hello@geoazur.obs-vlfr.fr

Since 2004, Geosciences Azur OBS team based in the south of France has conducted the development of a new concept of instrument, called “Hippocampe”. This last design, is capable to accomplish the four fundamental actions required for an OBS being used in passive mode (to record earthquakes) as well as in active mode (to record an active source) : 1- it goes down to the seafloor and insures a proper coupling of the sensor; 2- it is capable to record a 24 bits good quality signal over a one-year period, down to a 7000 m maximum depth; 3- it keeps track of the time with a very good accuracy; 4- it comes back to the surface rapidly, with reliability. In addition to these main basic rules, we can add a rapid turn over, which is necessary to conduct modern active experiments.

Descent and coupling — This new instrument is easy to program and to manipulate on board a ship. The total weight before deployment is nearly a hundred kilograms, including the anchor attached under the instrument and necessary to descent the OBS down to the seafloor. It goes down to the bottom at speed of ∼1 m/s. Only the anchor is touching the bottom. The OBS is floating at ∼1m above the seafloor. The main structure is composed of a two 17 “ glass spheres assembled together by a (demountable) chassis. The electronic takes place in the main sphere. The second sphere is used for extra floating and receives the extra batteries necessary to long-term deployments. A “single-sphere” version is proposed for very short active experiments. The sensor is encapsulated in a 6“ external sphere. It is suspended to a short arm fixed on the main structure for the descent, and later liberated when the OBS has reached the seafloor. To ensure a good coupling, the sensor is deported and deployed on the seafloor ∼1.5m away from the anchor. Two kinds of sensors are available: a tri-axial 4.5 Hz short period sensor, or 30 s Broad Band sensor. Both are self-leveled. The sensor is attached to the main sphere by a 3 meters length Kevlar reinforced electrical cable.

Signal quality and electronics design — The signal from the sensor is input in a 4 channels 24 bits design board. The extra channel is used for an hydrophone. An extra 4 channels board can be stacked on the other in order to monitor the mass position of the Broad Band sensor. Sampling rates can be adjusted separately for this purpose. The data logger is developed from a CF1/2 CPU Persistor Instruments, which is based on the Motorola 68338 microprocessor, with 512Kb of ram and a 128 Mb compact flash card. Data are buffered in a flash memory card before being written on a Hard disk drive. For short deployments, a larger memory flash card can replace the hard disk. Considering long-term deployment parameters (100s/s, 4 channels), the total consumption of the instrument is less than 500 mW.

Clock accuracy — The clock is a Seascan SISMTB, with 5.10^{-8} s stability and low power consumption. The main sphere is covered by hardhat in order to prevent the internal temperature not to exceed the limit range of the clock (35˚C).

Reliable recovery — Two acoustic boards are used to communicate with the OBS from the surface. The main one is a two-way channels acoustic board using a transducer as input. One channel can be used to free the sensor from its arm at the beginning of the experiment and the other (or both) to release the OBS from bottom at the end. Acoustic distance ranging can be done to measure distance from the OBS to the boat and to monitor the ascend of the OBS on his way back to the surface. The second is only received by the hydrophone and used as a spare. An acoustic encoded signal sent from the surface is detected by the hydrophone, and issues in the release of the instrument. The release command is transmitted to a dual release system composed of an electric motor activated release unit coupled with a burning wire. Assembled in parallel, they make an " or" function to insure the release of the anchor weight on bottom. The OBS then comes on surface with an ascend speed of 0.8 m/s. On surface, it can be easily located with a VHF radio finder completed at knight by two xenon strobe light flashes. The OBS can be tracked in good weather condition from a distance of 5 nautical miles.

Rapid turn over — Before deployment, the air is vacuumed from the spheres and replaced with nitrogen in order to prevent condensation due to the difference in temperature between the surface and the seafloor. Each sphere is equipped with pressure gauge probe to control the vacuum. The first operation, as soon as the OBS is recovered, is to measure the internal clock drift against a referenced GPS clock receiver. Errors control and check list of other parameters are done before the data down load through an USB port. The OBS can be reprogrammed using the same connector for an immediate redeployment. Wake up, released function and verbose mode can be controlled from the outside using magnet switches. When activated, the verbose mode disables the control port and will not keep active signal on the output. To minimize the corrosion, no leak current would be observed.

First experiment at sea (March-June 2005) — During the Esmeraldas experiment, offshore Ecuador, a network of 20 Hippocampe OBSs was deployed, together with 7 OBSs from the previous generation and 30 land-seismometers, to study the 3-D structure and seismic activity of Ecuador subduction zone, during more than 3 months. This network recorded successfully shot of the 128-liter airgun source towed by R/V Atalante and numerous earthquakes. For this first deployment the new Hippocampe OBS provide excellent results, with 100% recovery, and an excellent coupling with the sea bottom especially for horizontal components.