National Oceanography Centre, Southampton
UNIVERSITY OF SOUTHAMPTON AND NATURAL ENVIRONMENT RESEARCH COUNCIL

Environment

PELAGRA – Neutrally Buoyant Sediment Traps

Measuring sinking carbon in the oceans

Particulate matter that sinks out of the upper mixed layer of the oceans profoundly affects the balance of chemistry of the upper ocean and ultimately contributes to the support of deep ocean biological communities. Importantly, these sinking particles make a significant contribution to the global carbon cycle as, when they sink beyond the winter mixing depth, the carbon they carry with them is sequestered for centuries. However, much of the particulate matter is recycled in the upper layers and never reaches the deep ocean. It is of great importance that we understand this particle export process in order to quantify, for example, the real contribution to the global carbon cycle.

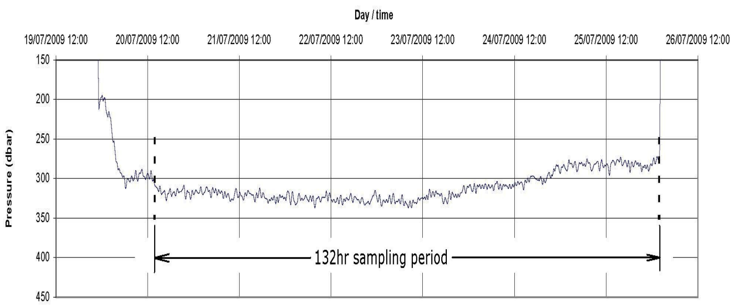
Various indirect methods such as ^{234}Thorium budget deficit have been used to estimate particle flux but the only way to obtain direct measurements is with sediment traps. Traditionally these have been either bottom moored or surface tethered. Due to the effects of currents, internal waves, etc., the movement of water across the mouth of a trap is great when compared to the very low sinking rates of particles. The resulting 'turbulence' can lead to unintentional particle sorting and also serves to attract swimming plankton that can severely contaminate the trapped samples.

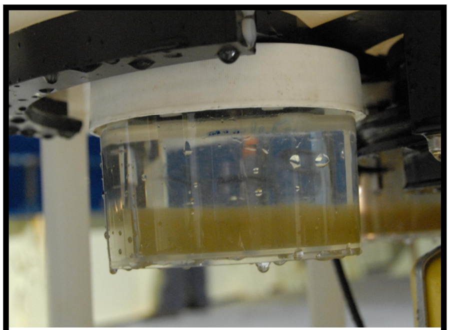
To overcome these problems, engineers at NOCS' Underwater Systems Laboratory developed PELAGRA (Particle Export measurement using LAGRAngian sediment traps). Being neutrally buoyant, a PELAGRA trap is able to passively drift with ocean currents thus maintaining minimal differential water movement across the trap mouth thus alleviating the problems described above.

The traps are built around commercially available and well-proven APEX profiling floats that have an integral 'buoyancy engine' that assists a trap to maintain the required depth or density horizon. Around the central float are four collecting funnels offering a total collection area of 0.46m². Under each funnel is a 500ml collection cup that is closed when deployed. Once the trap has stabilized at the required depth a motorized cam assembly opens the collection cups for a sampling period of up to several days. The cups are similarly closed just prior to ascent.

Prior to deployment each trap is carefully ballasted to match the *in situ* water density at the target depth. A depressor weight assists to sink the trap initially and is released at c. 200m. Each trap is also fitted with an emergency abort weight that is released should it unintentionally descend beyond its 1000m limit. A third 2kg weight is released by a timer at the end of the mission. To aid recovery, the APEX float has an ARGOS satellite positioning system and each trap has a high-visibility marker flag and a flashing light.

The figure below illustrates a typical deployment profile:

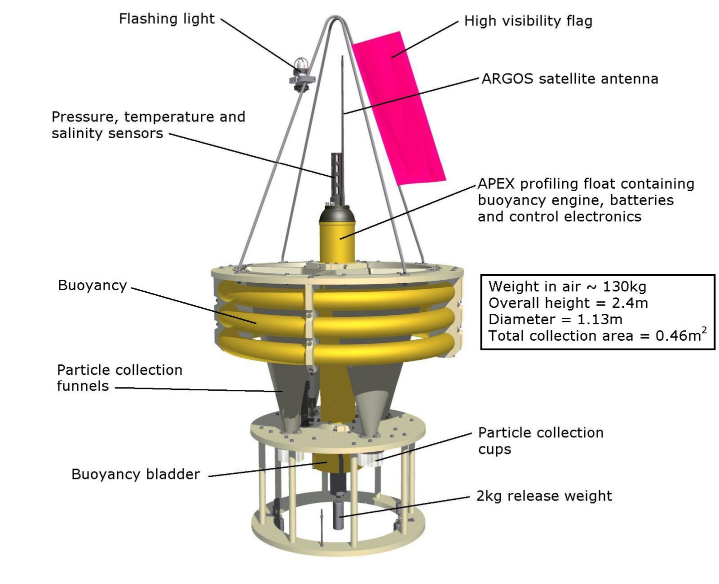




PELAGRA sediment sample collected over a 24hr period at 300m depth, North Atlantic, 2008

Science missions to date:

July 2003	Porcupine Abyssal Plain (NOCS)
June 2004	Porcupine Abyssal Plain (NOCS)
Dec 2004	Crozet Plateau (CROZEX, NOCS)
July 2005	Porcupine Abyssal Plain (NOCS)
July 2006	Porcupine Abyssal Plain (NOCS)
July 2007	Porcupine Abyssal Plain (NOCS)
May 2008	North Atlantic Bloom Experiment (Uni. Washington)
Jan – Mar 2009	South Atlantic (LOHAFEX, Alfred Wegener Institute, Germany / National Institute of Oceanography, India)
July – Aug 2009	Porcupine Abyssal Plain (NOCS)



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