Environment Waikato Technical Report 2006/09

Wilson Bay Sediment Profile Imaging: 1. Instrument Test

Prepared by:
Kay C. Vopel, Greig Funnell
(National Institute of Water & Atmospheric Research Ltd)

For:
Environment Waikato
PO Box 4010
HAMILTON EAST

ISSN: 1172-4005

January 2006

Document #: 1060532

Wilson Bay Sediment Profile Imaging: 1. Instrument test

Kay C. Vopel
Greig Funnell

Prepared for

Environment Waikato

Wilson Bay Group A and B Consortium

NIWA Client Report: HAM2006-004
January 2006

NIWA Project: EVW06209

National Institute of Water & Atmospheric Research Ltd
Gate 10 Silverdale Road, Hillcrest, Hamilton
P O Box 11115, Hamilton, New Zealand
Phone +64-7-856 7026, Fax +64-7-856 0151
www.niwa.co.nz

Contents

Reviewed by: *Approved for release by*

Niall Broekhuizen Bob Wilcock

Formatting checked

Wilson Bay Sediment Profile Imaging: 1. Instrument test

A) Introduction

Sediment Profile Imaging (hereafter SPI) was developed more than two decades ago as a rapid reconnaissance tool for characterising physical, chemical, and biological sediment properties. SPI is a scientifically defensible method and can provide a means of statistical comparison relevant to management decisions[1–6]. Because the sediment column is a good time-integrator of short- and long-term perturbations in the water column and/or the seafloor, this technology allows researchers to deduce dynamics from sediment images using the same inverse methods approach that paleoecologists and sedimentologists use to reconstruct past environmental conditions.

There are two systems available that are capable of producing images of the upper sediment column, the novel SPITwo system (Benthic Science Ltd.) and the commercially available REMOTS™ system (Remote Environmental Monitor Of The Seafloor). Imaging of the sediment is by a specialized scanner (SPITwo) or camera (REMOTS™) that physically penetrates into the sediment and produces a vertical image of the top 10 to 20 cm of the sediment. The REMOTS™ system has been used in numerous sediment quality surveys throughout the Unites States, Pacific Rim, and in Europe.

The prototype SPITwo system is a portable device deployed to the seabed in waters up to 30 m depth (Figure 1). Upon reaching the seafloor, water jets help the imaging cylinder to penetrate the sediment. A modified desktop scanner then scans the 'core' wall while a second camera captures an image of the adjacent seafloor surface. These images are communicated to a computer on the vessel via an underwater cable. The acquisition software displays vertical scans and video of the sediment surface and accepts GPS input, automatically geo-referencing images for importing to Geographic Information Systems.

NIWA proposed to test the applicability of SPI for future resource consent monitoring of the seafloor around mussel farms in Wilson Bay, Firth of Thames, using the SPITwo system. In response to this proposal Environment Waikato and Wilson Bay Group A and B Consortia assigned NIWA to conduct an initial instrument test.

B) Methods

To assess its performance, NIWA deployed the prototype SPITwo system to the seafloor in Wilson Bay, Firth of Thames, at 5 sites near Area A mussel farms on 15 December 2005 (Table 1). Brian Paavo (Benthic Science Ltd.) provided the instrument and assisted in the field.

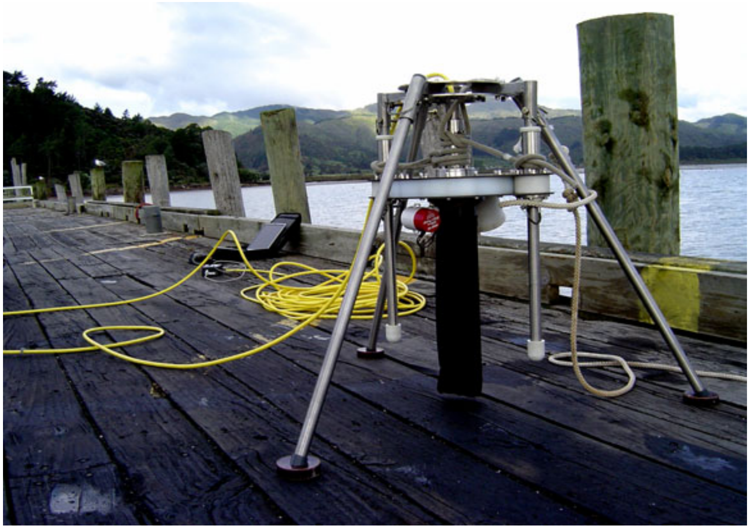

Fig. 1. The photograph shows the frame, the imaging cylinder (covered with black neoprene), and the yellow tether of the SPITwo. The imaging cylinder was covered for the purpose of test scans.

The SPITwo system was deployed from a small inflatable alloy-hull boat (Naiad 5.8) with 4 persons on board using a lightweight davit. The onboard handling of the instrument and its lowering was assessed with respect to safety and feasibility under conditions of rough sea and wind.

Table 1: Geographical position and water depth of sites at which the SPITwo system was deployed.

Site	Latitude	Longitude	Water depth (m)
1	-36.933834	175.438258	13.9
2	-36.943309	175.448539	11.5
3	-36.94661	175.450637	11.2
4	-36.919889	175.440181	14.6
5	-36.918619	175.441956	12.3

SCUBA divers observed the landing of the instrument at the seafloor and the subsequent penetration of the measuring cylinder. The underwater performance of the SPITwo was documented using underwater video.

In addition, SCUBA divers collected sediment cores using clear hand-held plastic tubes that could be closed at both ends. These cores were compared with the profile images produced by the SPITwo system with respect to preservation of sediment surface topography, animal burrow structures, and vertical changes (stratification) in colour and texture of the sediment.

The deployment of the SPITwo system was repeated 3–4 times at sites 4 and 5 (Table 1) to assess the practicalities and time required for multiple deployment.

C) Results and discussion

Our *in situ* test revealed that the SPITwo system was easily deployable from a 5.8 m inflatable pontoon boat. Onboard handling and lowering of the SPITwo system required two persons. The instrument could be lowered either by hand, with the lifting rope running through a block on a davit, or by using a winch. Replicate scans at a given location could be produced rapidly by simply lifting and lowering the instrument. The boat was manoeuvred at slow speed while the instrument was held at a safe distance above the seafloor, allowing for fast sampling of multiple stations. Given the speed at which scans were produced, we estimated that hundreds of scans per day are possible under conditions of calm weather.

During the test, the surface video capabilities were not available. The first deployment was delayed due to a faulty cable-instrument connection. The cause of failure was identified and a provisional solution allowed faultless deployments during the following day.

Visual underwater observation of the SPITwo revealed tilting of the imaging cylinder while vertically penetrating the sediment. The horizontal movement, which impaired the preservation of the sediment surface topography in the sediment profile image, was due to the three legs of the SPITwo system continuing to sink into the soft sediment after the scanning cylinder started to penetrate the sediment. Undisturbed vertical penetration of the imaging cylinder requires a stable position of the instrument frame. This problem can easily be solved by simple alterations to the frame design.

The SPITwo system was originally designed for imaging sandy sediments. To help the imaging cylinder penetrate sandy sediment, water jets at the lower end of the imaging cylinder displace sediment. Our test deployment revealed that the imaging cylinder could easily penetrate the soft sediment at Wilson Bay without the need for water jets. The penetration depths could simply be controlled by adjusting the weight of the instrument frame.

Inspection of the sediment scans revealed superb image quality. We compared the sediment profile images with hand-collected sediment cores and found similar stratifications in sediment colour, densities and structures of animal burrow, and small scale heterogeneities in sediment texture and coloration.

D) Summary

Our test showed great potential of the SPITwo systems for the assessment of Wilson Bay seafloor. The instrument can be cost-effectively deployed from a small boat to rapidly produce high-quality profile images of soft sediment. We recommend minor changes to the designs of the instrument frame and the cable-instrument link.

E) References cited

1) Germano, J. D. 1995. Sediment profile imaging: a rapid seafloor impact assessment tool for oil spills. Proceedings of the Eighteenth Arctic and Marine Oilspill Program (AMOP) Technical Seminar, June 14–16, Edmonton, Alberta, pp 1271–1279

2.) Germano, J. D., D. C. Rhoads, L. F. Boyer, C. A. Menzie, and J. A. Ryther, Jr. 1989. REMOTS® imaging and side-scan sonar: Efficient tools for mapping seafloor topography, sediment type, bedforms, and biology, pp. 39–48. *In*: D. W. Hood, A. Schoener, and P. K. Park [eds.] *Oceanic Processes in Marine Pollution*, R. E. Krieger Publishing Co, Malabar, Fl, Volume 4: Scientific Monitoring Strategies for Ocean Waste Disposal.

3.) Germano, J. D., D. C. Rhoads, and J. D. Lunz. 1994. An integrated, tiered approach to monitoring and management of dredged material disposal sites in the New England region. *Disposal Area Monitoring System DAMOS*, US Army Corps of Engineers, New England Division, Contribution No. 87.

4.) Rhoads, D. C., and J. D. Germano. 1982. Characterization of benthic processes using sediment profile imaging: an efficient method of Remote Ecological Monitoring Of The Seafloor (REMOTS™ System). Marine Ecology Progress Series 8:115–128.

5.) Rhoads, D. C., and J. D. Germano. 1986. Interpreting long-term changes in benthic community structure: a new protocol. Hydrobiologia 142:291–308.

6.) Rhoads, D.C., and J. D. Germano. 1990. The use of REMOTS imaging technology for disposal site selection and monitoring, pp. 50–64. *In*: *Geotechnical Engineering of Ocean Waste Disposal*, K. Demars, and R. Chaney [eds.] ASTM Symposium Orlando, Florida.