The use of Slocum gliders to deliver near real-time environmental data for the Oil & Gas and Mining industries

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Blue Ocean Monitoring

Leader in providing innovative operational and environmental ocean data solutions.

- Experienced Metocean data service provider specialising in autonomous systems
- Solution driven sensor networks for Oil & Gas, Mining and Environment
- Offices in Perth, US, UK, Singapore & strategic alliance with group in South Africa
- Largest commercial Slocum glider fleet globally
- Master Services and Supply Agreement with Teledyne Webb Research. Exclusive 3rd party service provider for Australia and SE Asia region
- 24/7 ‘Follow-the-Sun’ operations & piloting capability
Teledyne Webb Research Slocum Glider

Ultra-efficient, buoyancy propelled autonomous underwater vehicle

Slocum gliders use small changes in buoyancy to move through the water column. This is converted to horizontal motion by wings, resulting in a saw-tooth dive profile.

- Communication by RF or Iridium & ARGOS position beacon
- Near real time data access & control

Vessel-Free Operation – Deploy/Recover from vessel then operate independently
Teledyne Webb Research Slocum Glider
Advantages

Effective, highly capable tool for ocean data collection

- Low cost
- Ultra-long duration
- Low HSE risk
- Near real-time information & control
- Low logistical requirement
- Address multiple applications
Flexible sensor platform, key sensor constraints are power consumption & weight
Blue Ocean Data Systems

Cloud based data acquisition, management & visualisation system.

Automated data delivery / feed

Configurable Alert System

Mission logging & pilot communication

Multi platform input, real time acquisition, QAQC, product generation & web based distribution
Blue Ocean Data System

Web based secure client portal

- Platform ‘agnostic’
- Secure access to near real-time data products
- Logging & client-pilot communication
- Alarm notification & acknowledgement
- Overlay custom data (model output, charts etc.)
Operational Challenges

Operational areas hold unique challenges for long duration autonomous systems

- Strong currents
- Large density ranges
- Fishing activity - ghost nets & discarded gear
- Unauthorized retrieval
- Vessel traffic
- Bio-fouling
Operational Challenges

Marine life interaction

Source: UWA
Case Study 1
Environmental Compliance – Produced Formation Water Survey
Oil Detection

North-west Australian ‘Oil-in-water’ EX/EM Spectrums

Figure: Oil in water EEMS Response at 100ppm Concentration (Harrison, 2012)

= Turner C3 EX/EM range (EX 285nm EM 350/55nm)
Oil & Gas

Regulatory changes in Australia

- Recent change to regulations regarding Produced Formation Water (PFW) discharge (NOPSEMA)
- Burden of proof now falls on operator to demonstrate environmental compliance
- Operators are looking to new innovative solutions to achieve compliance
Produced Formation Water (PFW) survey

- PFW survey conducted for Woodside Energy Ltd & BMT Oceanica
- Data used to guide field sampling strategy in near real-time
- Sensor payload included WET Labs FLBBCD, Turner C3 & Seabird CTD
- Fluorescence based hydrocarbon detection
- Lab verification of sensors with PFW sample from facility

**Key benefits**
- Reduce standard survey frequency & implement regular glider based surveys
- Significant cost reduction
- Persistent data collection
- Long term in-situ data to improve circulation & dispersion modelling
Case Study 2
Environmental Compliance – DSTP Monitoring & Alarm System
PTNNT – Batu Hijau

Marine tailings disposal system to minimise environmental impact

• Batu Hijau, Sumbawa, Indonesia
  – Newmont Mining’s Indonesian subsidiary (PTNNT) commenced operations at the Batu Hijau mine in 1999
  – The Government of Indonesia and PTNNT selected the Deep Sea Tailings Placement (DSTP) as the preferred tailings management plan to reduce the environmental impact

• DSTP Operation
  – Tailings flow via gravity as a slurry to the edge of the Senunu Submarine Canyon through a pipeline 3.2km offshore at a depth of 125 meters, below the biologically productive photic zone
  – Due to the greater density of the slurry, the tailings is predicted to migrate into the Senunu Canyon and settle at depths greater than 3,000 meters
As part of tailings permit, Indonesian Government requires PTNNT conduct ongoing Total Suspended Solid (TSS) monitoring

- Compliance Zones A, B & C

- Existing method was to conduct regular vessel based sampling with lowered frame (CTD & FLNTU)

- Glider payload included WET Labs FLNTU, WET Labs BB3SLO & Seabird CTD

- Alarm, notification & acknowledgement system implemented
TSS Turbidity Correlation

Calibration experiment to establish relationship between glider based optical measurements and TSS concentration using representative tailings sample

- Tailings sample from mine
- Measurements of Turbidity, Backscatter & Total Suspended Sediment (TSS) concentration
- Strong linear relationship between TSS concentration & Turbidity ($R^2 \sim 0.98$)
Coverage

Significantly greater coverage of sample sites compared to existing methods
Data Comparison

High resolution, persistent measurements

Station: S16
12-002 Batu Hijau DSTP TSS
Range cutoff = 300 m
39 glider profiles in range

www.blueoceannoting.com
Mining

Deep Sea Tailings Placement (DSTP) Monitoring

- Real-time information – allowing real-time operations management
- Significant cost saving
- Higher spatial & temporal data density
- Method is currently under review by the Indonesian Ministry of Environment
Key Research & Development

- Operational data assimilation project
- Optimisation of track, distribution & number of vehicles
- Data submission into Australian Integrated Marine Observing System (IMOS) public database
- Sensor development & integration - working with partners
- Control automation
Conclusion

• Slocum glider is an effective, highly capable sensor platform

• Safe & low cost – increasingly important in the current commercial climate

• Utility maximised when using as part of a wider sensor ‘network’

• Broad range of applications driven by innovation & development of new sensors

• Has reached a level of maturity, now widely accepted in the commercial space