real time in situ chemical detection of underwater unexploded ordnance

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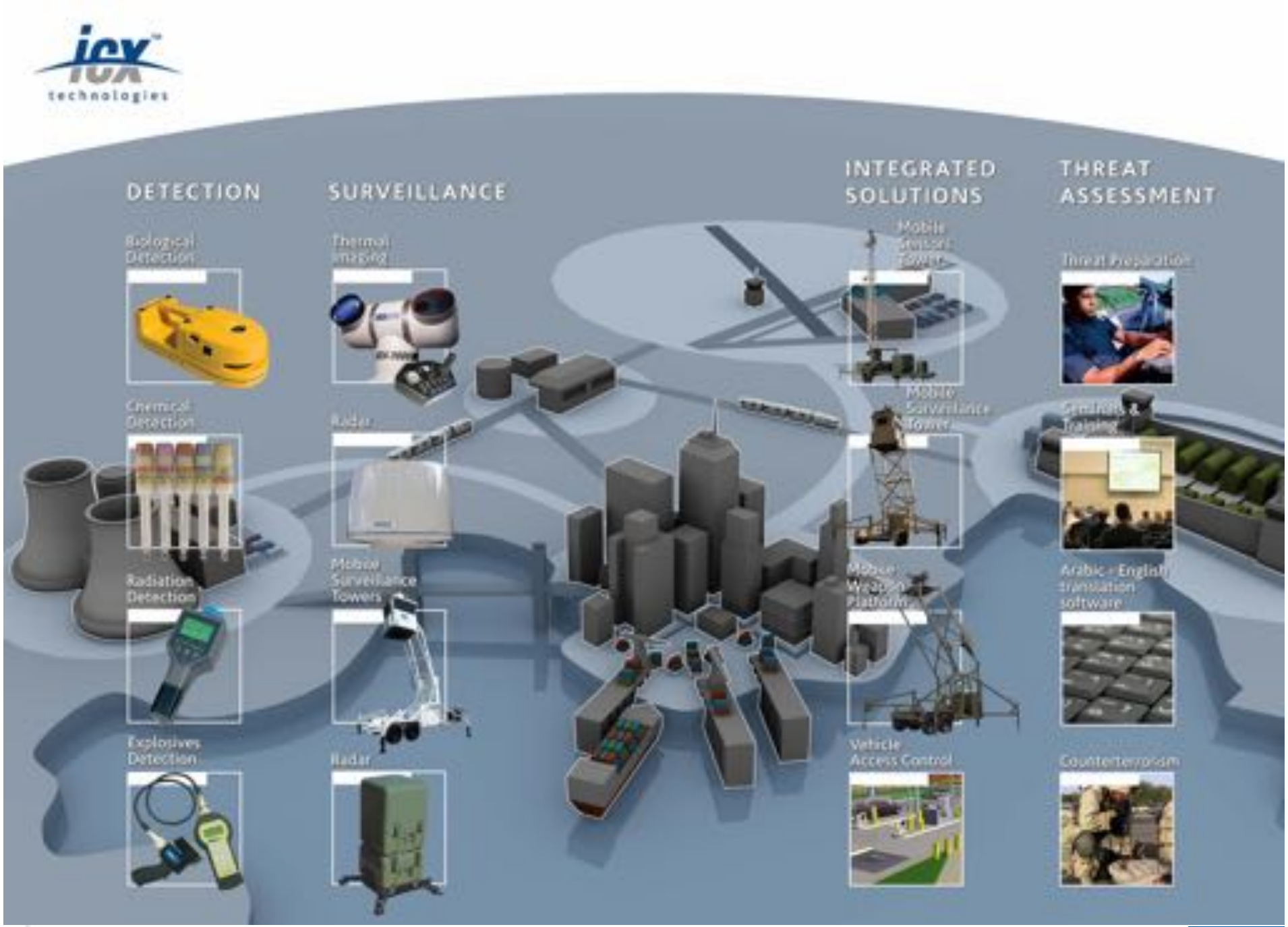
NEW THREATS. NEW THINKING.


icx
technologies
DETECTION
SURVEILLANCE
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Thermal imaging
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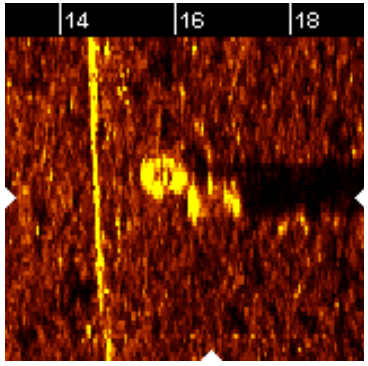
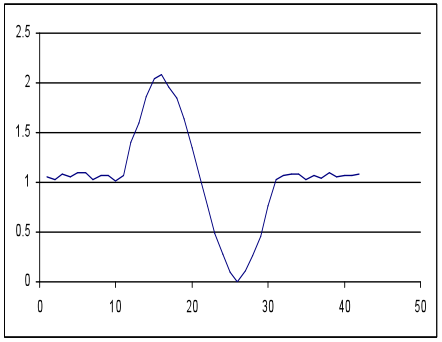
Radar
Mobile Surveillance Tower
Vehicle Access Control
Threat Preparation
Arabic - English translation software
Counterterrorism

underwater explosive signatures

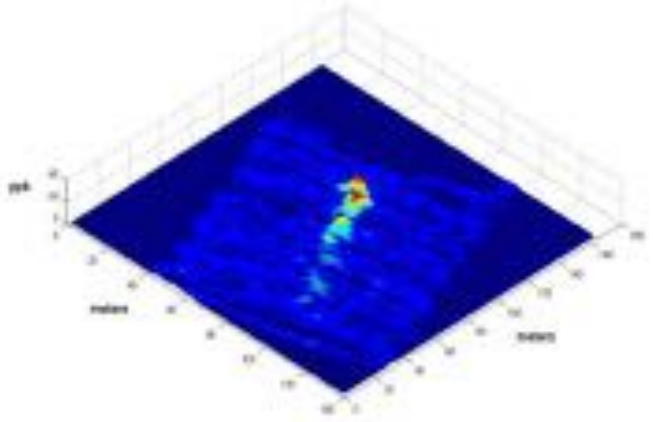
acoustic



electromagnetic



chemical



UK dump sites

beaufort's dyke

beaufort's dyke disposal site

- deepest part of Irish Channel
  - 200-300m deep
- UK MoD dumped chemical and convetional weapons post WWII
  - 14500t of phosgene
  - estimated 1m tonnes total of assorted munitions
  - understood that much of the material missed the deep sections
  - reports of incendiary devices washing ashore in Scotland
- natural gas pipe line,
- proposed tunnel linking Scotland and Ireland

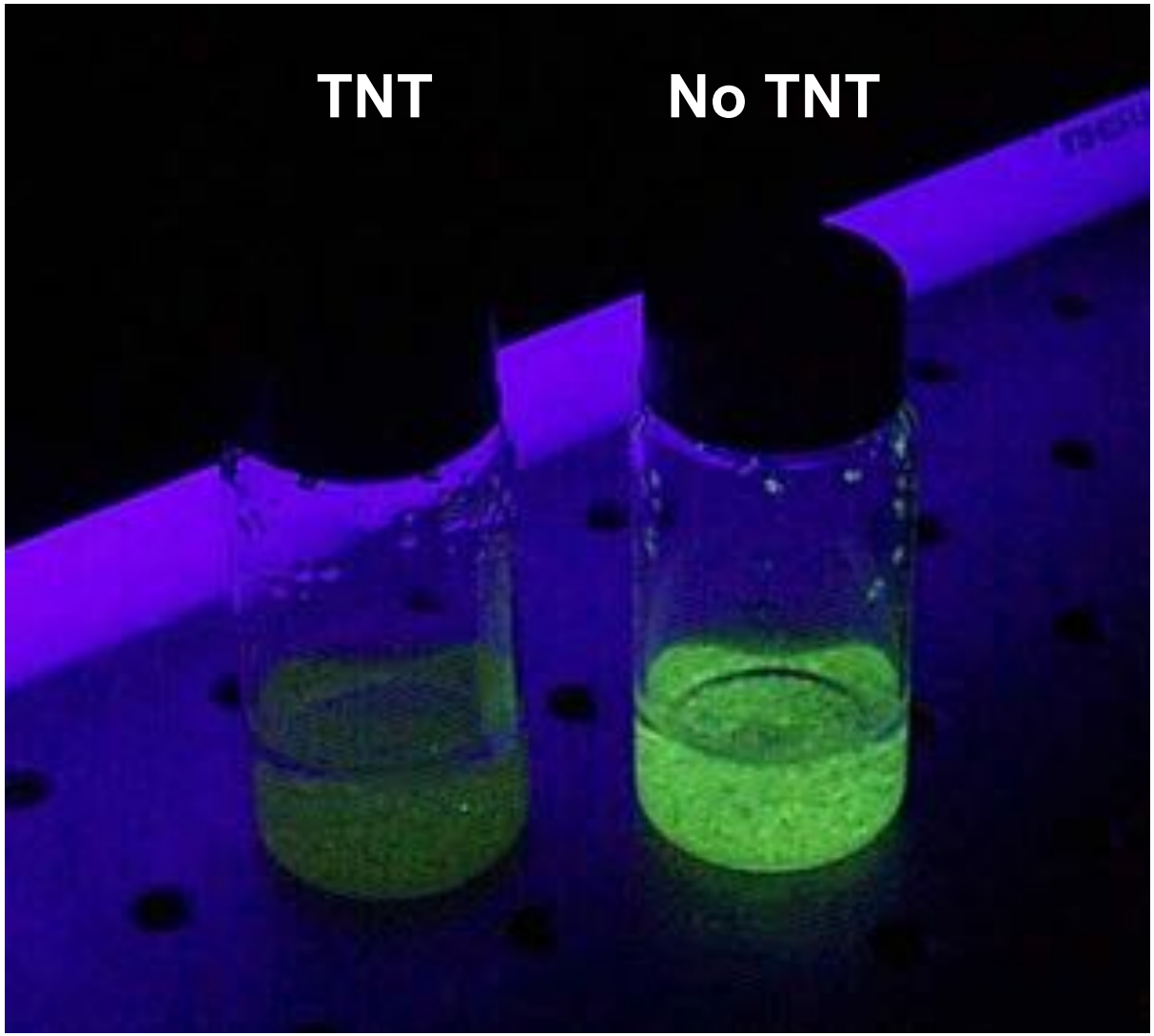
Halifax NS testing by Sandia NL

- UUXO that has been submerged for 53 to 82 years often produces a detectable signature.
- 59 water samples were analyzed.
  - 34 samples (58%) produced detectable explosives signatures.
- 27 sediment samples were analyzed.
  - 26 samples (96%) produced detectable explosives signals.
- concentrations ranged from 0.05 to >100 ppb
- concentrations decreased with increasing distance from the target.

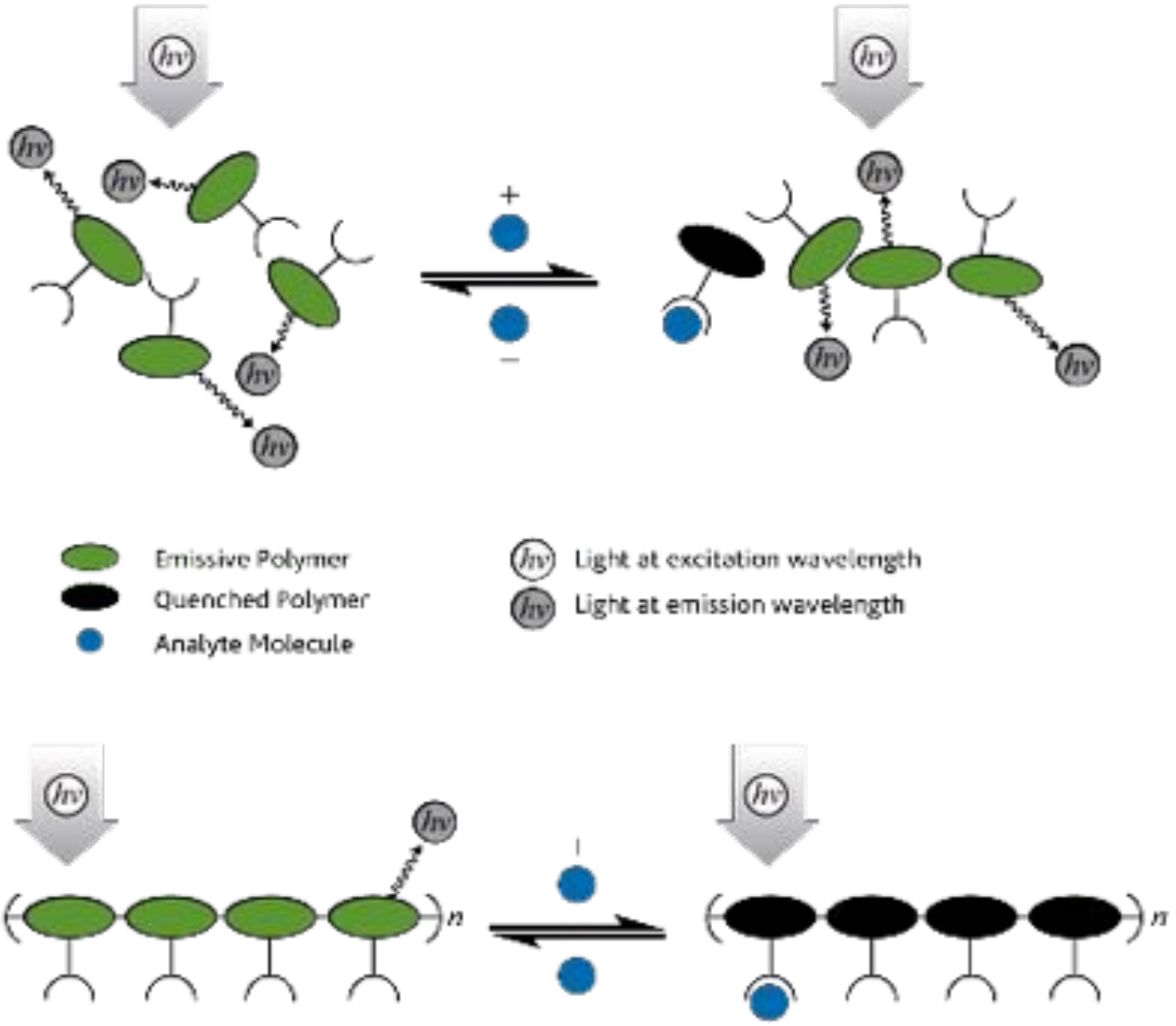
chemical sensing in the marine environment

- initial handheld unit for proof of concept
- integrated to Foster Miller crawler
- developed a Remote Environmental Monitoring UnitS (REMUS) deployed with TNT sensor
  - demonstrated TNT detection in the marine environment
  - mapped a TNT plume
- integrated to SeaBotix LBV
- used the AFP mechanism to develop ultra-sensitive underwater TNT detection system

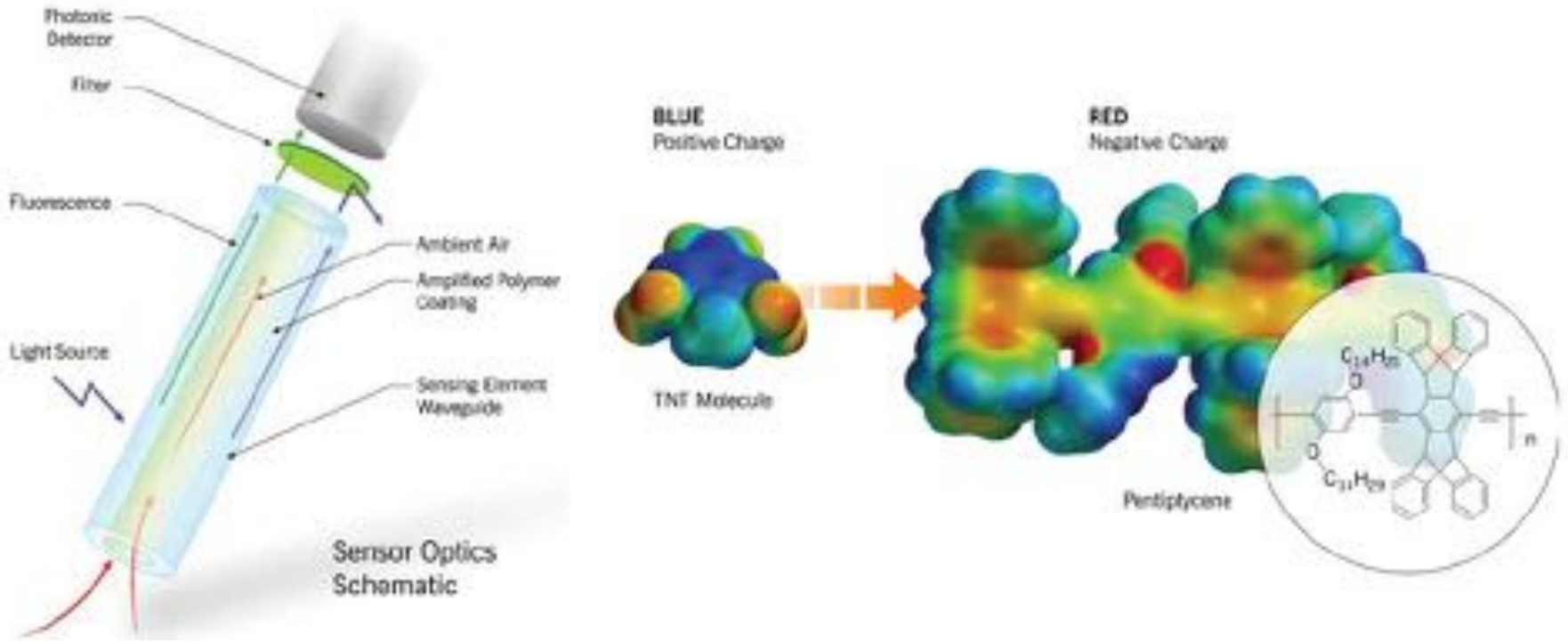
amplifying fluorescent polymers



the AFP technique

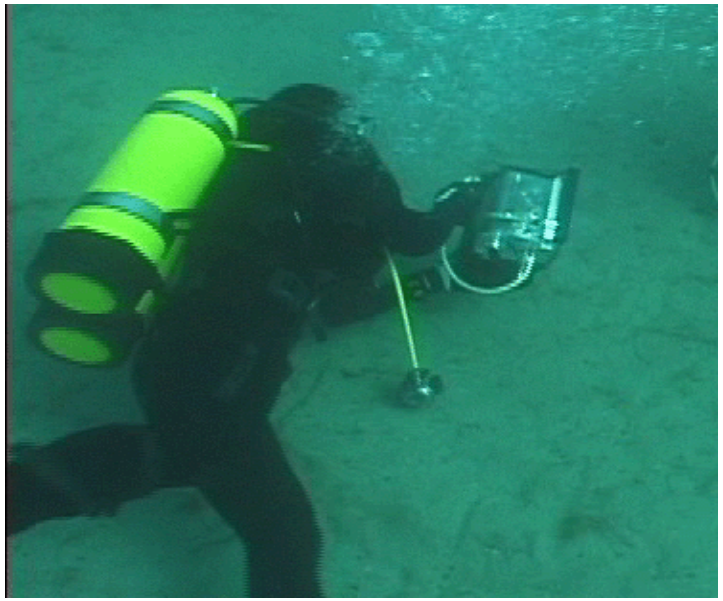


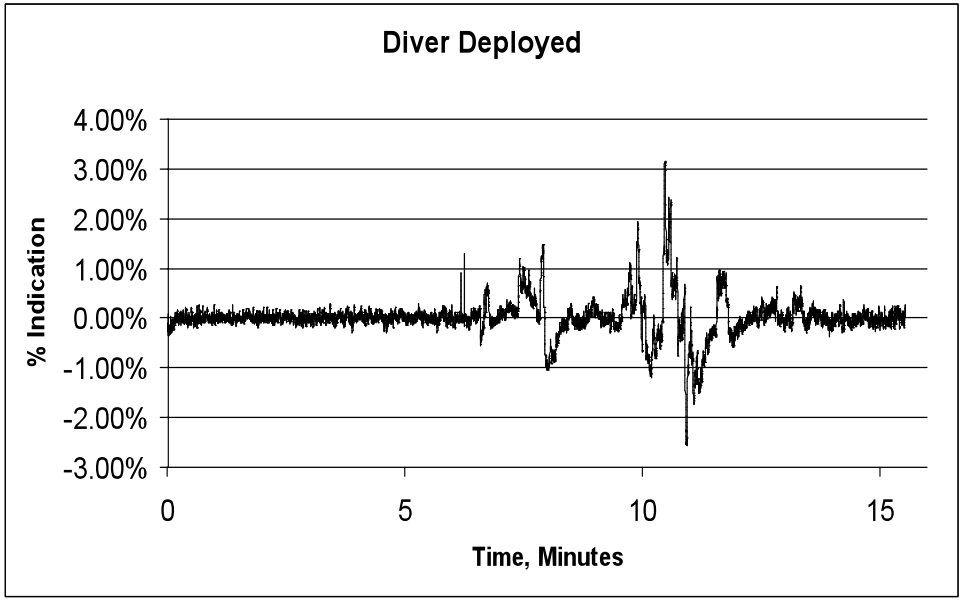
vapor sensor schematic



San Clemente Island tests

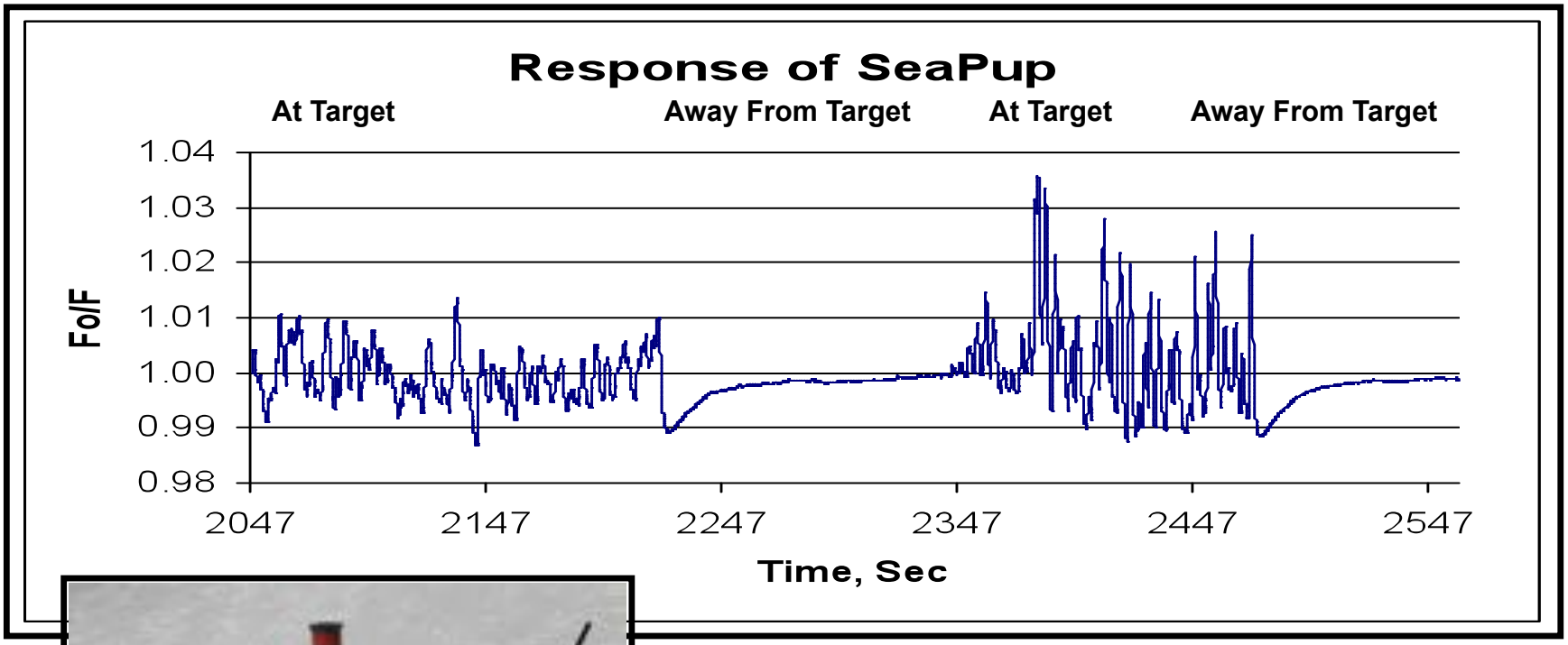
- Divers successfully found TNT up to 30 meters from the source
- Diver operated up-current from the source for approximately seven minutes. This gives an excellent baseline with no TNT indications





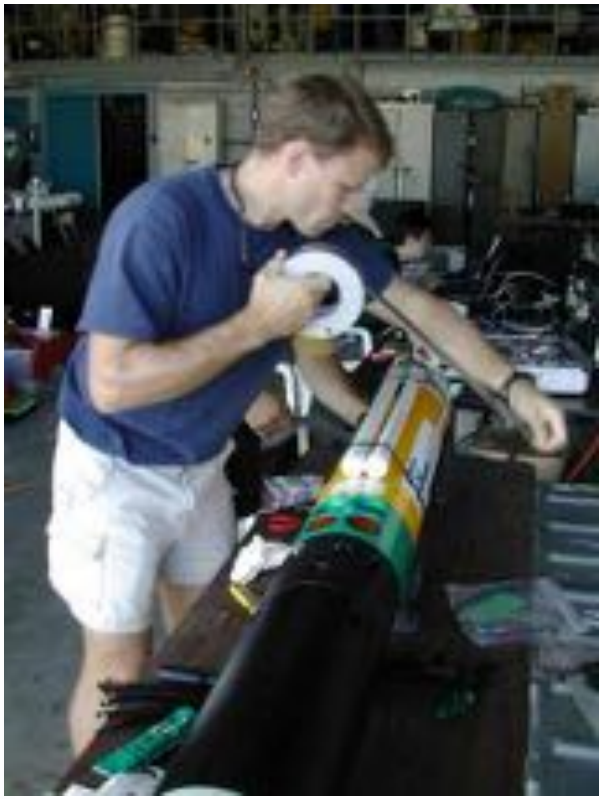
January 2004 tests in Panama City, FL

SeaPup on crawler robot



SeaDog on the REMUS

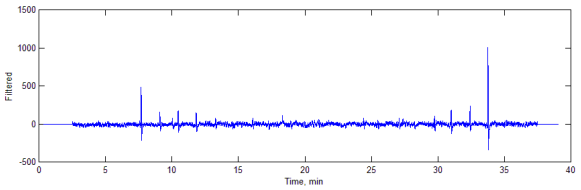
MINIOP #3 April 2003 Duck, NC

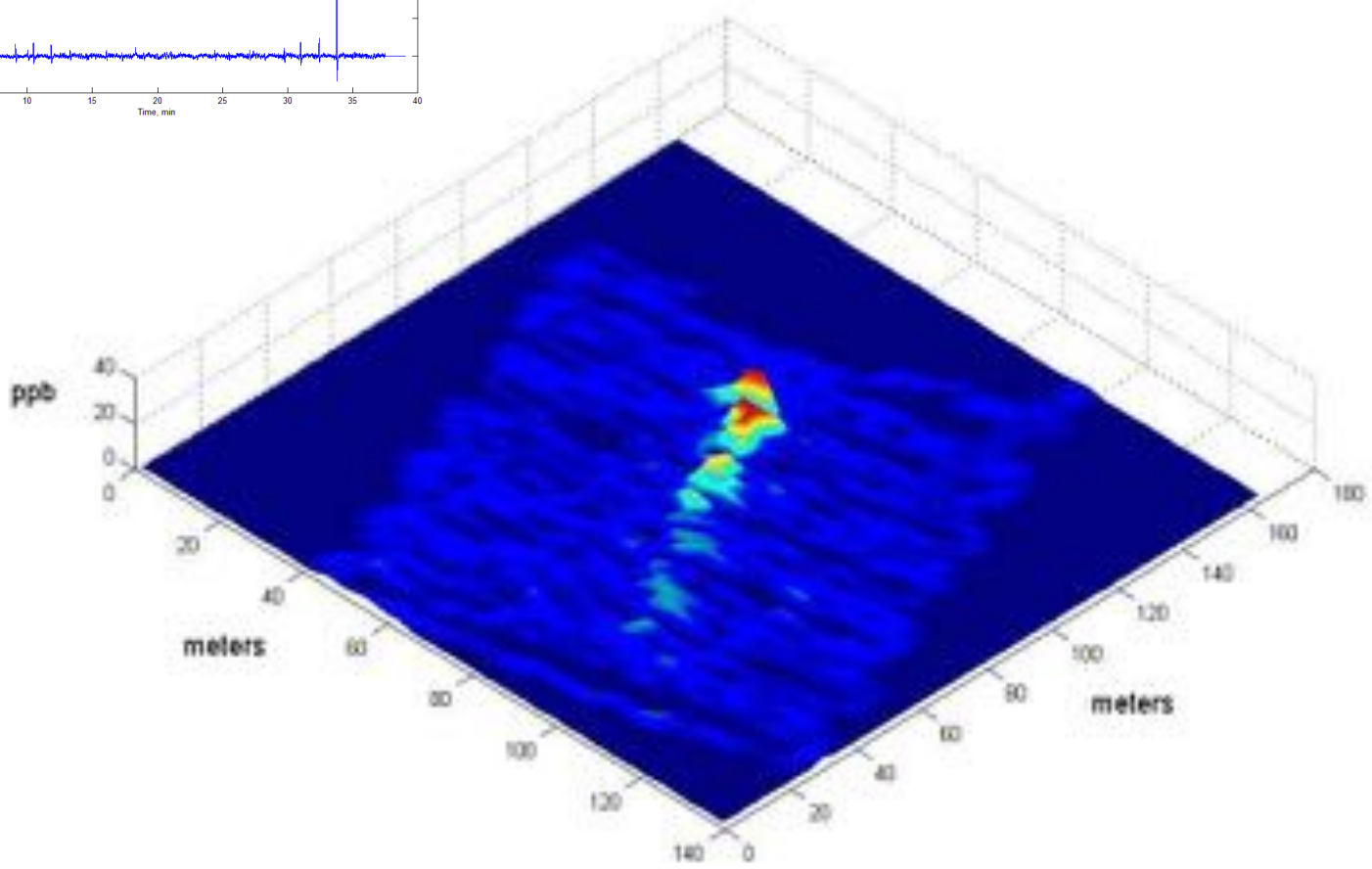


REMUS and SeaDog undergoing buoyancy modification

SeaPup waiting for its next mission

real time plume mapping

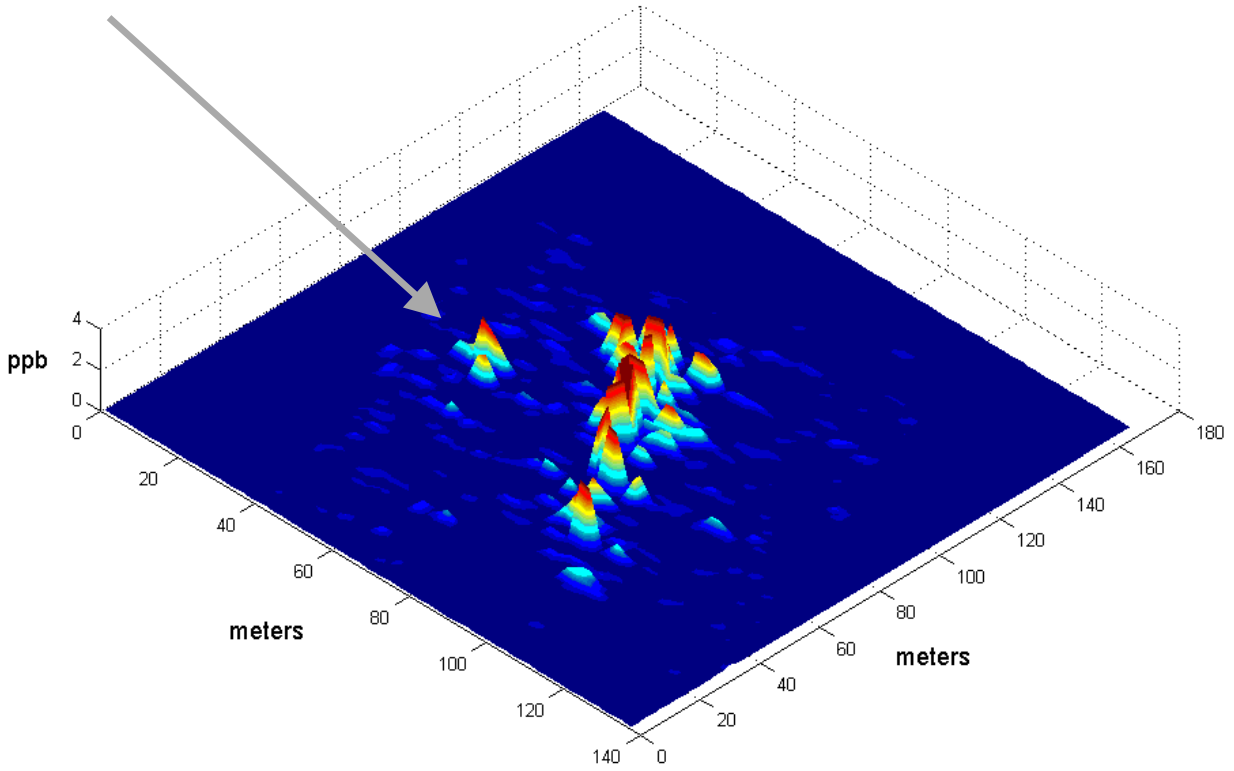




this is the first ever Real-Time map of an underwater TNT plume. it shows a valid indication, position, and plume structure of an known source. minimum speed is approx 1 m/s, plume approx 1 meter wide.

anomalous source detection

3 of the 5 SeaPup missions show a second indication of TNT

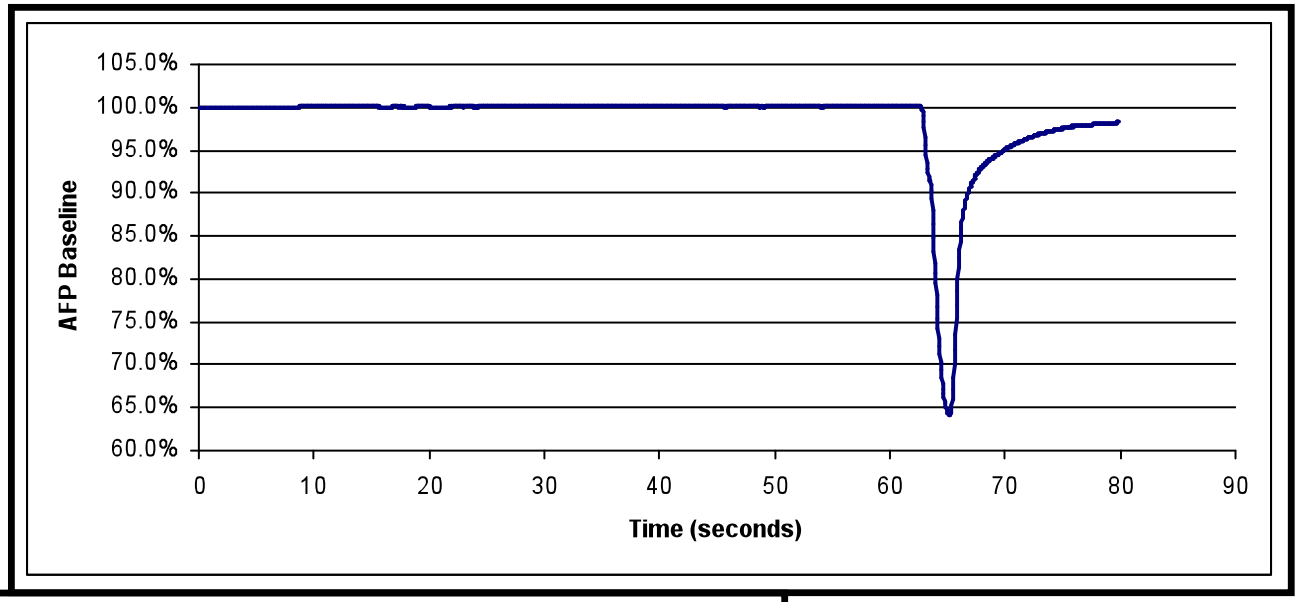


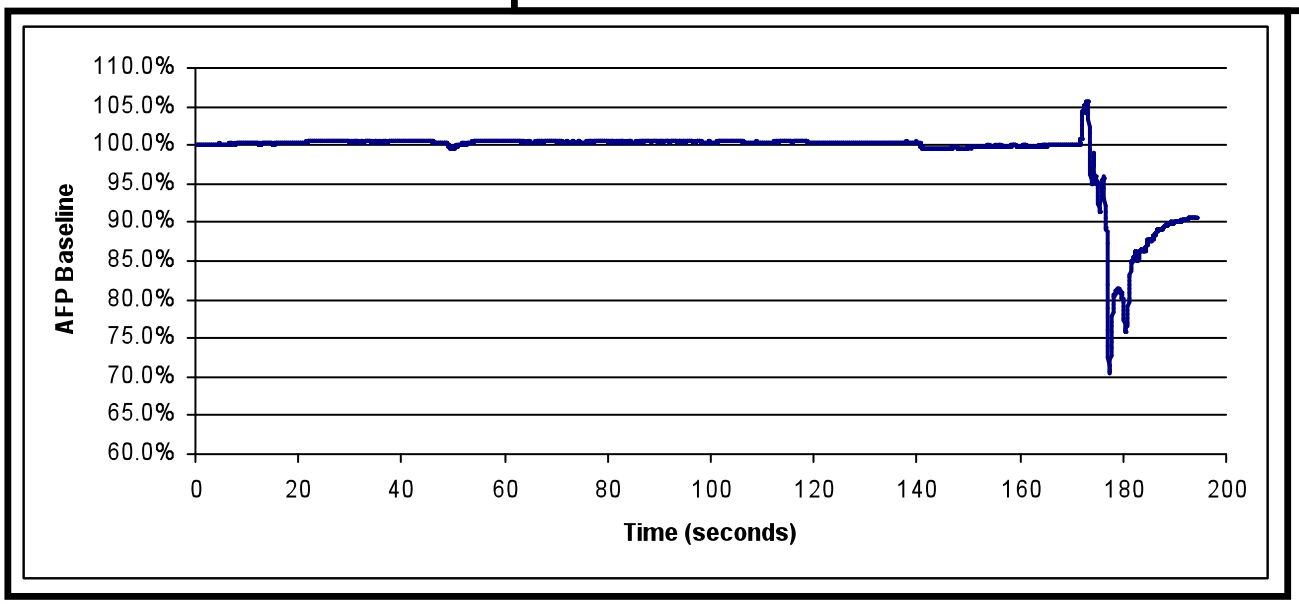
ongoing test bed

- SeaBotix ROV
  - upgraded for high thrust, station keeping, 2 video cameras
- SeaPup underwater explosives detector
  - could include radiological detector for added IED detection

SeaPup / SeaBotix LBV

freshwater lake testing

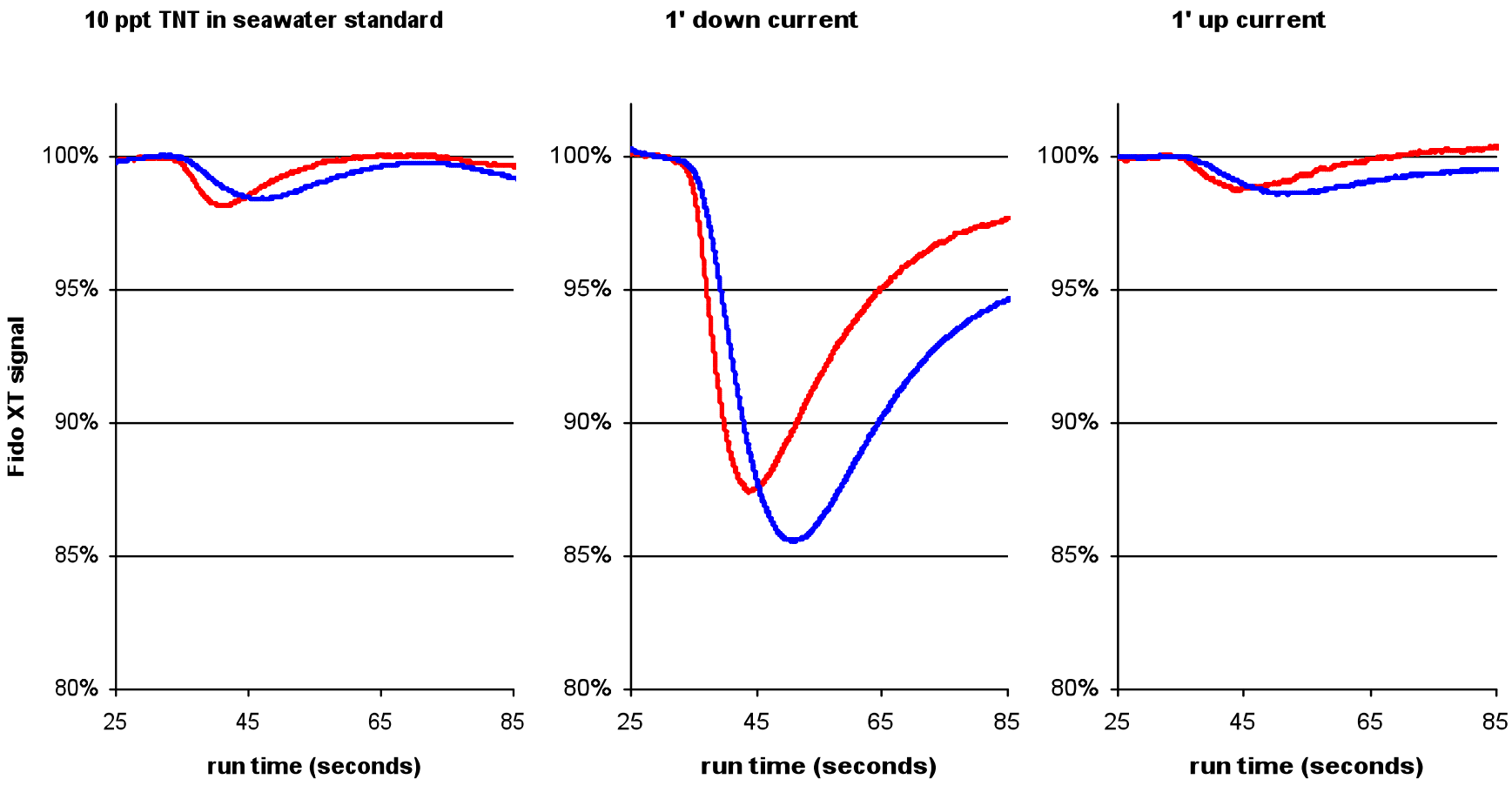




ordnance reef

ordnance reef

preconcentration adds sensitivity



speed v sensitivity

- real time – 1 ppb
  - plume mapping
  - active searching
- preconcentration – 1ppt
  - anomaly interrogation
  - environmental monitoring

conclusions

- SeaPup sensor is capable of finding targets in the marine environment
- additional improvements that have already been demonstrated in the laboratory will make significant advances in the range of detectability
  - enhanced analyte sensitivity
  - better understanding of the nature of trace chemical signatures in the marine environment.

acknowledgements

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- University of Hawaii School of Ocean and Environment Science and Technology (UH SOEST)
  - Roy Wilkens
- UH Hawaii Undersea Research Laboratory (UH HURL)
  - Terry Kerby
- SPAWAR
  - Vladmir Djapic & Rich Arrieta

questions?

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NEW THREATS. NEW THINKING.