Hydrographic Society
Benelux
Delft University
12th December 2003

Hydrographic Survey in Deep Water and its PROBLEMS for Rockdumping

presentation by

Clive Skelhorn

Team Manager Project Surveyors

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Where to begin ????

What do we do

(as hydrographic surveyors)

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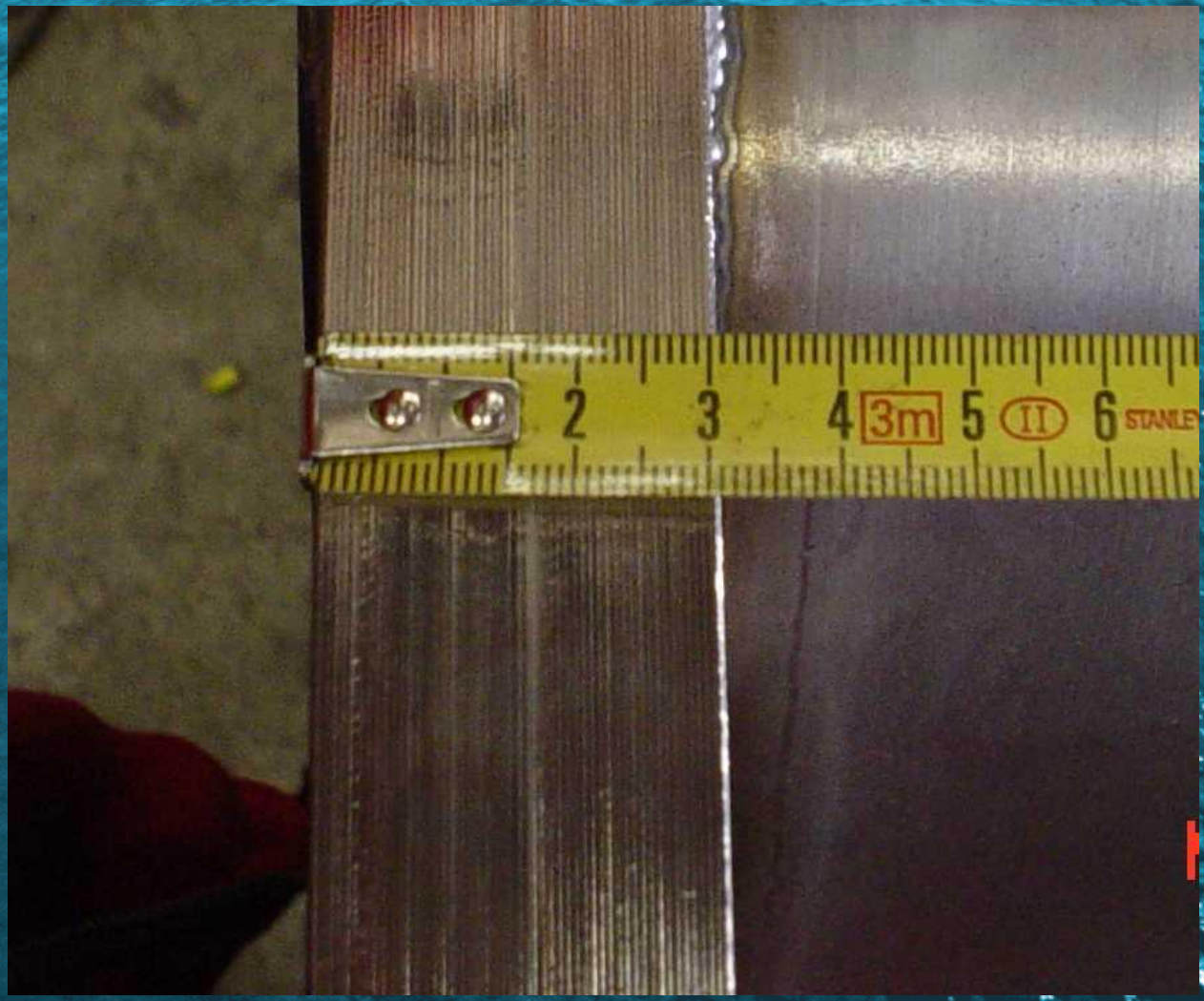
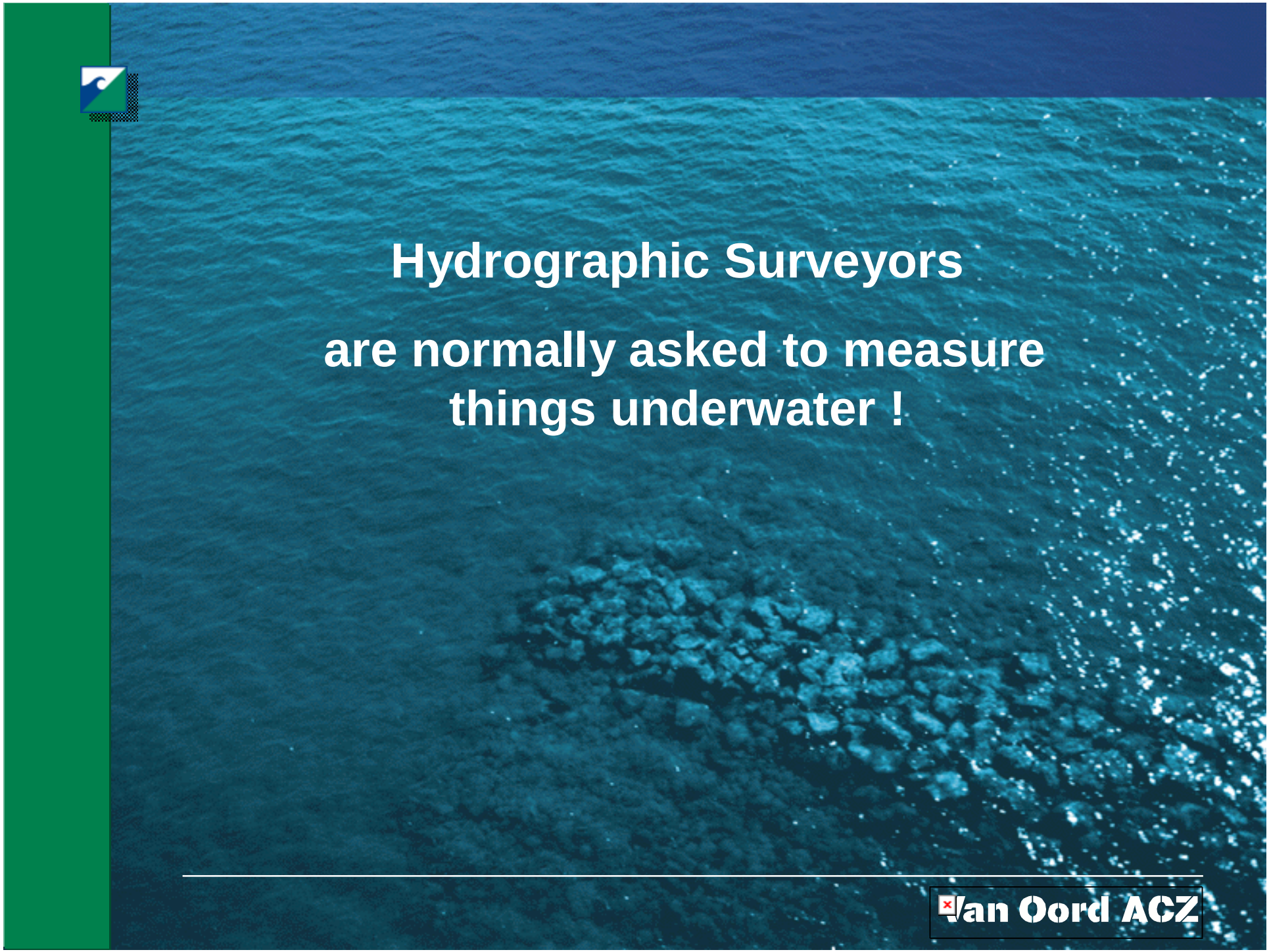
We measure things !!!!




Hydrographic Surveyors
are normally asked to measure things underwater !
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******** IF ONLY ********

But they can’t hold their breathe long enough

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Installation onboard a vessel of convenience

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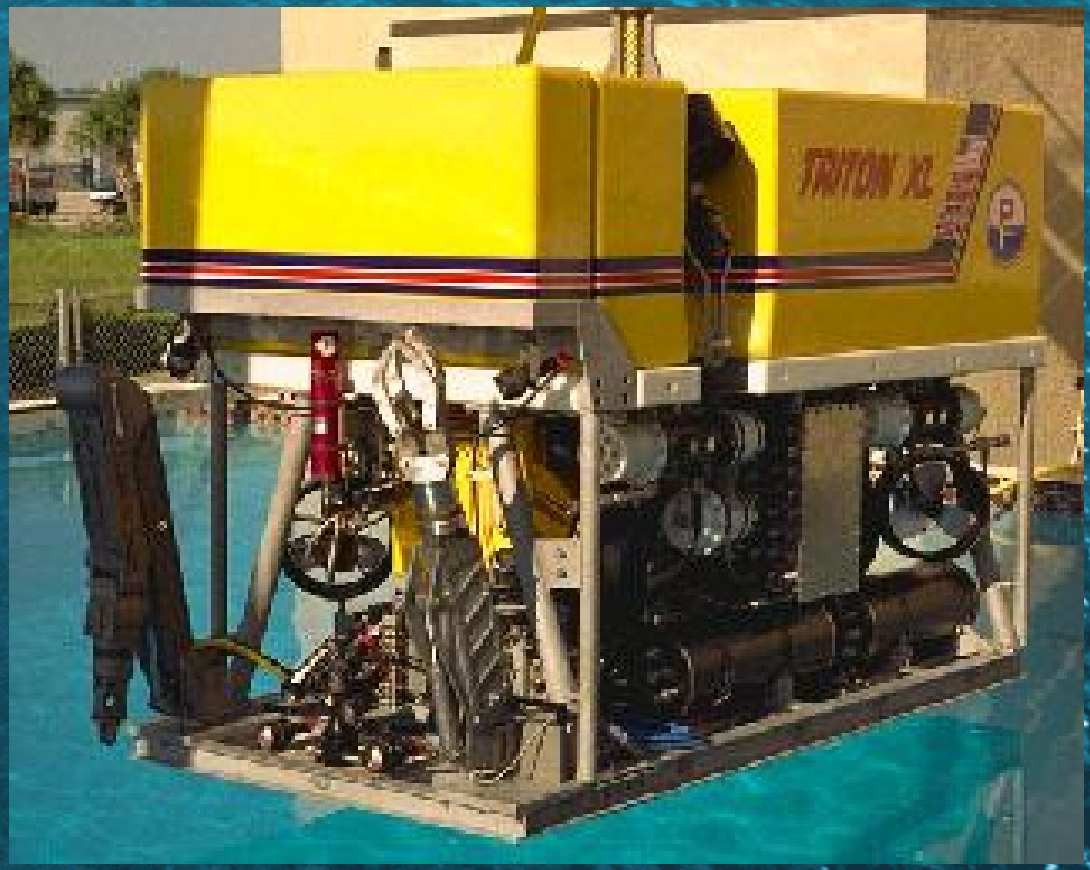
These were used to carry out various types of surveys in the Northsea before ROV's arrived

Then came the ROV
The Scorpio

Followed much later by the improved (some say) Triton XL



Even a dedicated Pipeline survey ROV Here is a Venom ROV with pipeline skid

To go deeper we had the tether management system (TMS) ROV

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But we have

The Flexible Fallpipe ROV

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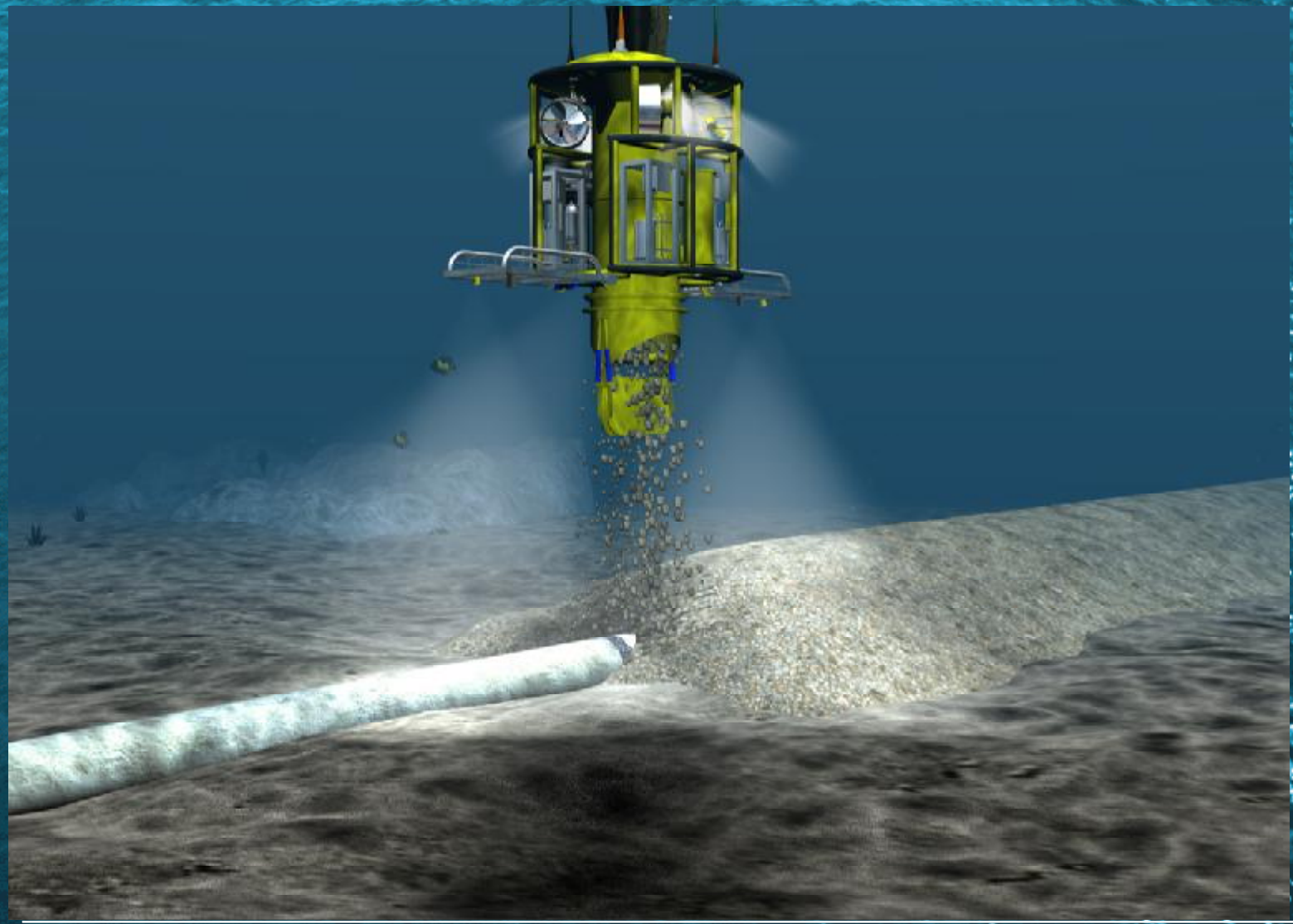
This is the ROV working



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Standard equipment fitted to our vessel and / or ROV

- DGPS (RTK whenever possible)
- Vessel mounted sensors (gyro, heave, pitch & roll etc.)
- Subsurface positioning (HiPap USBL, smartwire, LBL)
- ROV mounted sensors (solid state gyro, heave, pitch & roll etc.)
- Sonar equipment & cameras (Dual-head Seabat 8125, Mesotech)

Here you can see the size of the survey arms

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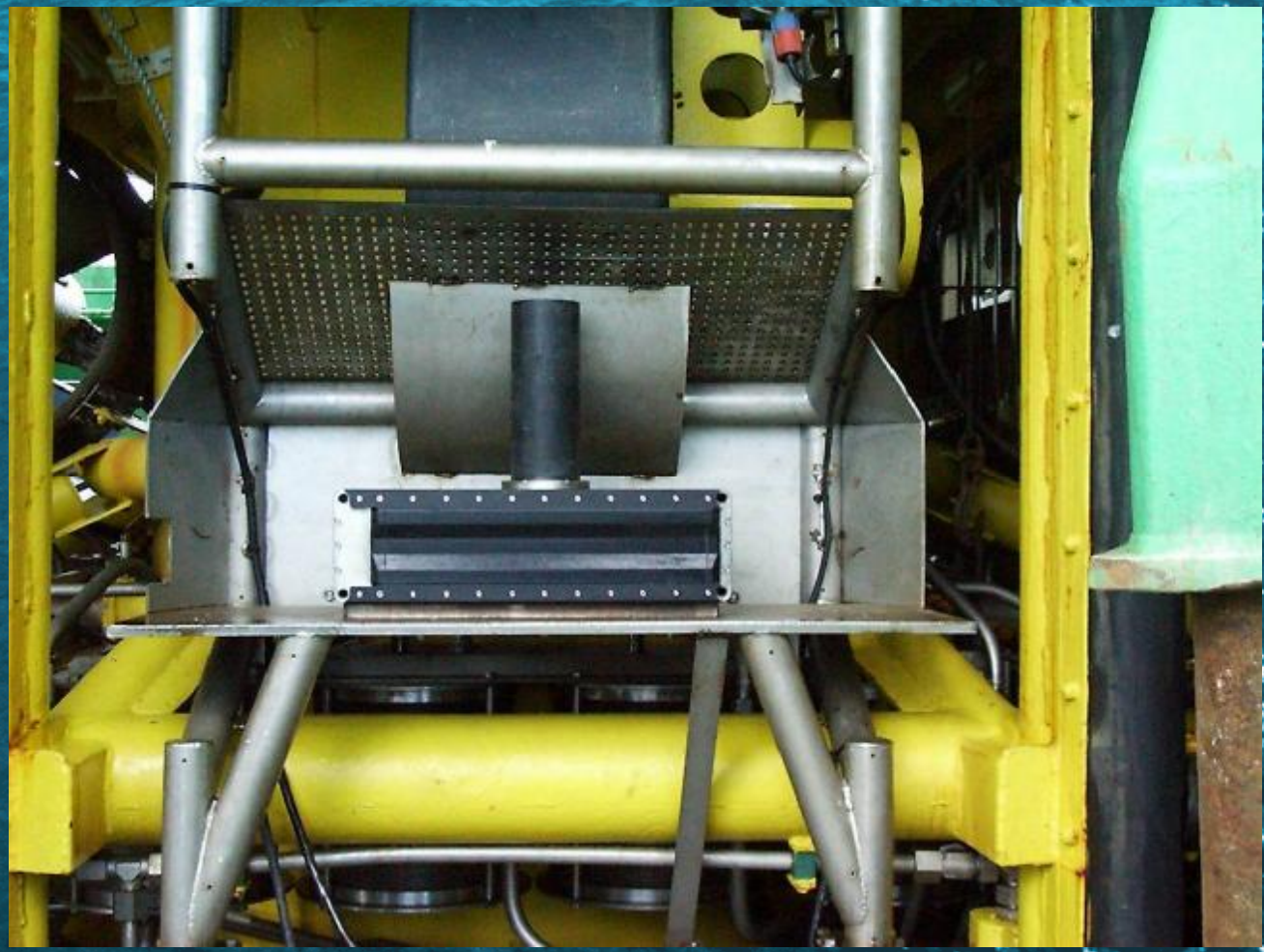
Single Head installation



Dual Head installation

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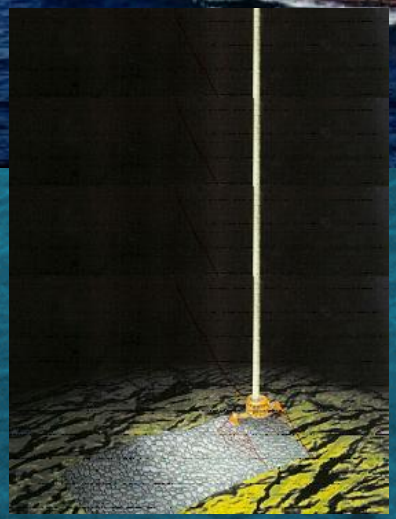
Each time going Deeper



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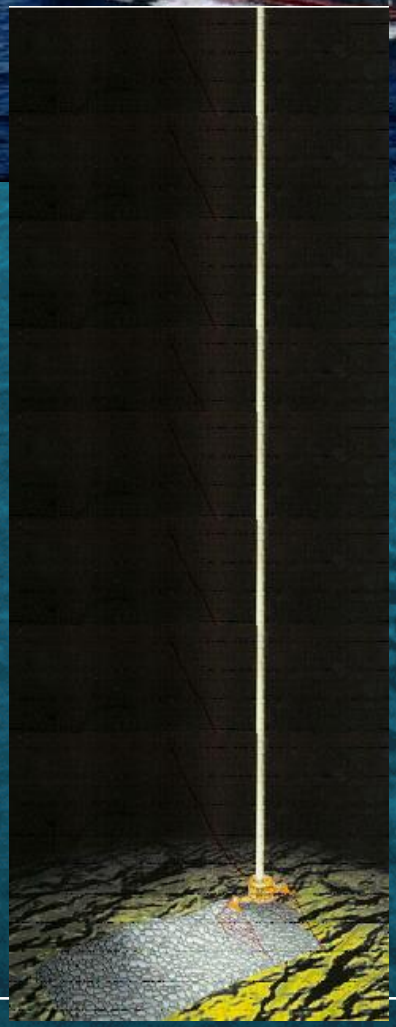
and deeper



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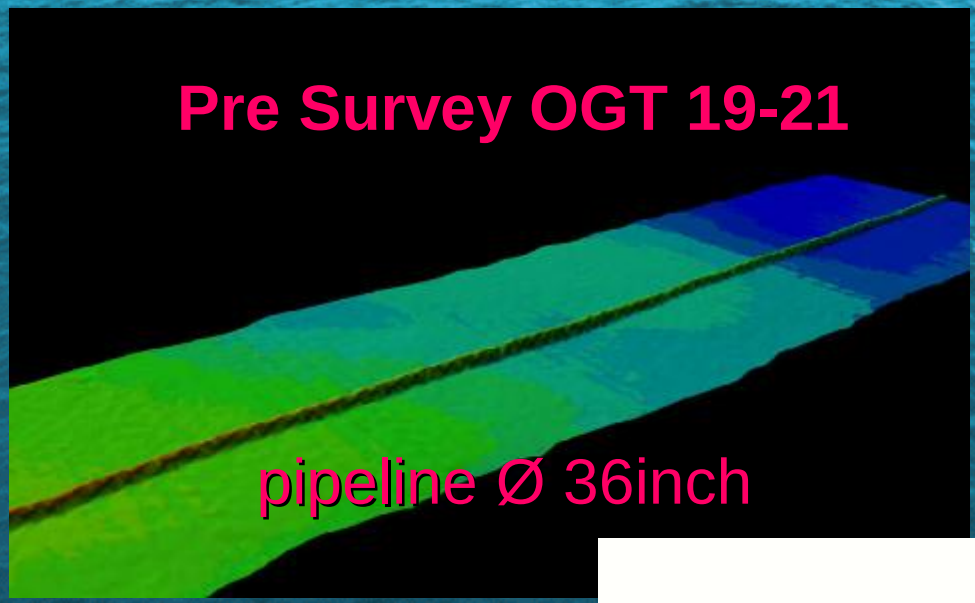
FFPV Tertnes pre and post results



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So what are the problems when we continually go deeper ???

1: Equipment capable of going there

ie; deeper rated

2: Possibility of strange currents

3: Poor positioning accuracy

due to; Thermoclines,

Limitation of the USBLsystem

4: Excessive ROV motion

There seems to be some current

If the fallpipe has too big an angle (it is after all flexible) there could be a blockage

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POSITIONING

What can contribute to poor underwater Positioning ?????

1 : Thermoclines making acoustic transmission difficult

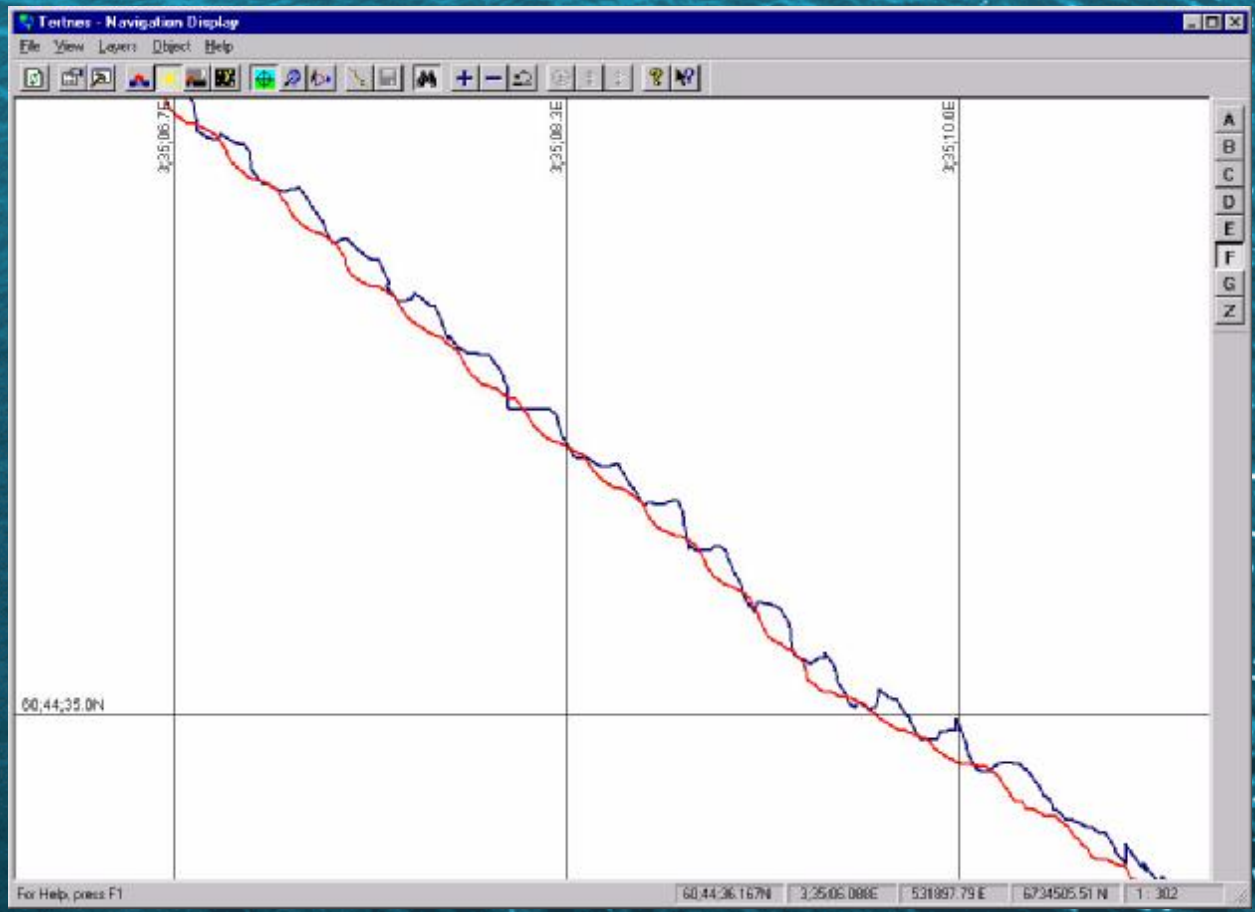
Use an LBL array

2 : USBL system performance or accuracy

Noisy environment

Spiky / jumpy data

In this display the red line is the generated from the Doppler information whilst the blue is generated from the USBL data



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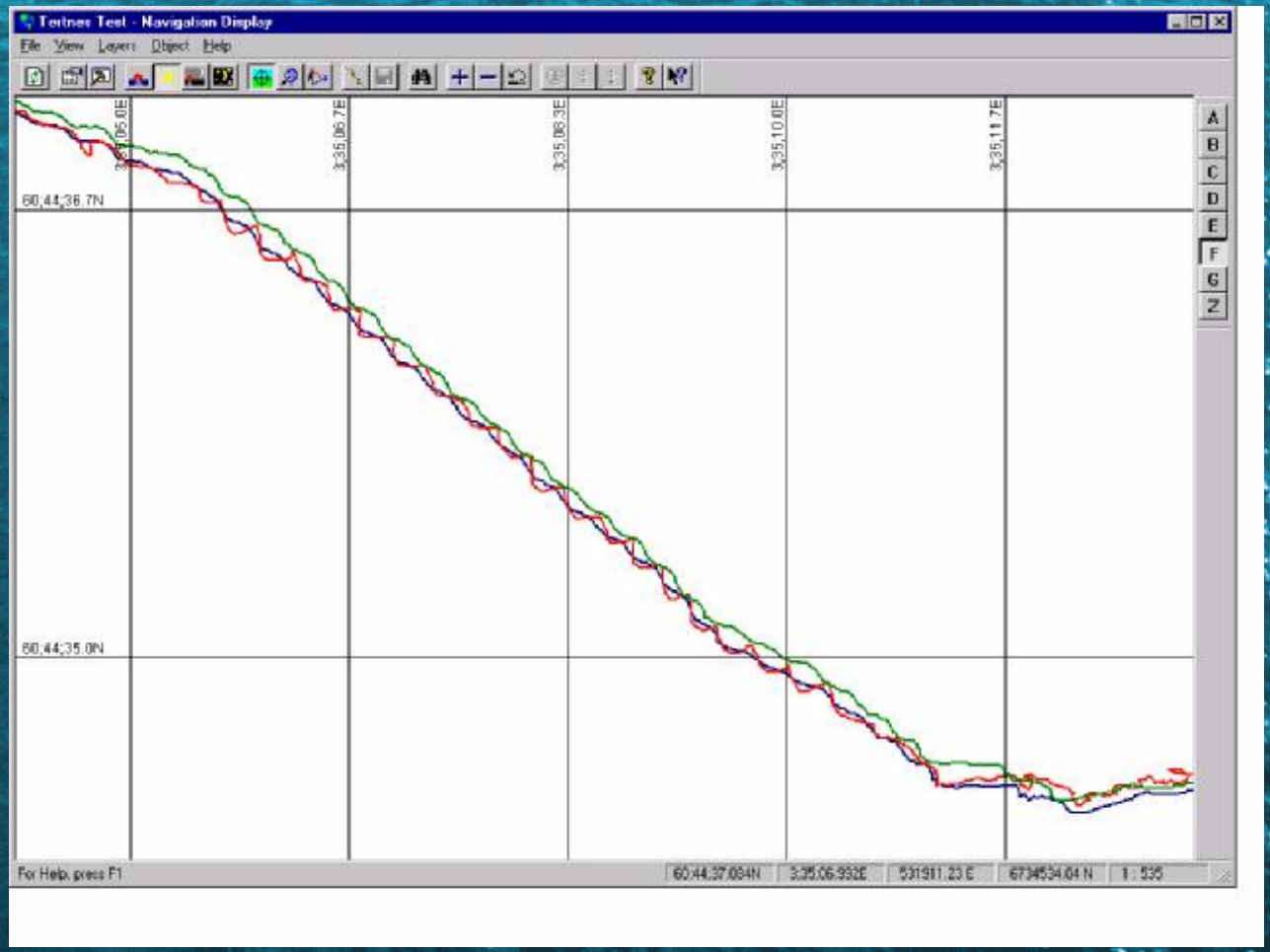
Green is Doppler track, red is USBL track with the blue track being the result of the integration



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What is the effect on the USBL with increasing depth??

2.2 Radial position errors

Position errors were considered for depths of 300, 600 and 900 meters. The results are given below.

Depth	Transducer, radial	ROV, radial
300 m	0.19 m	2.32 m
600 m	0.19 m	4.66 m
900 m	0.19 m	7.00 m

The main contribution to the error is due to the USBL uncertainties. For example, assuming the transducer position error is zero (GPS, attitude and local offsets are perfectly known), the resulting radial positioning error of the ROV for the three depths are

Depth	Transducer, radial	ROV, radial
300 m	0.0 m	2.22 m
600 m	0.0 m	4.44 m
900 m	0.0 m	6.66 m

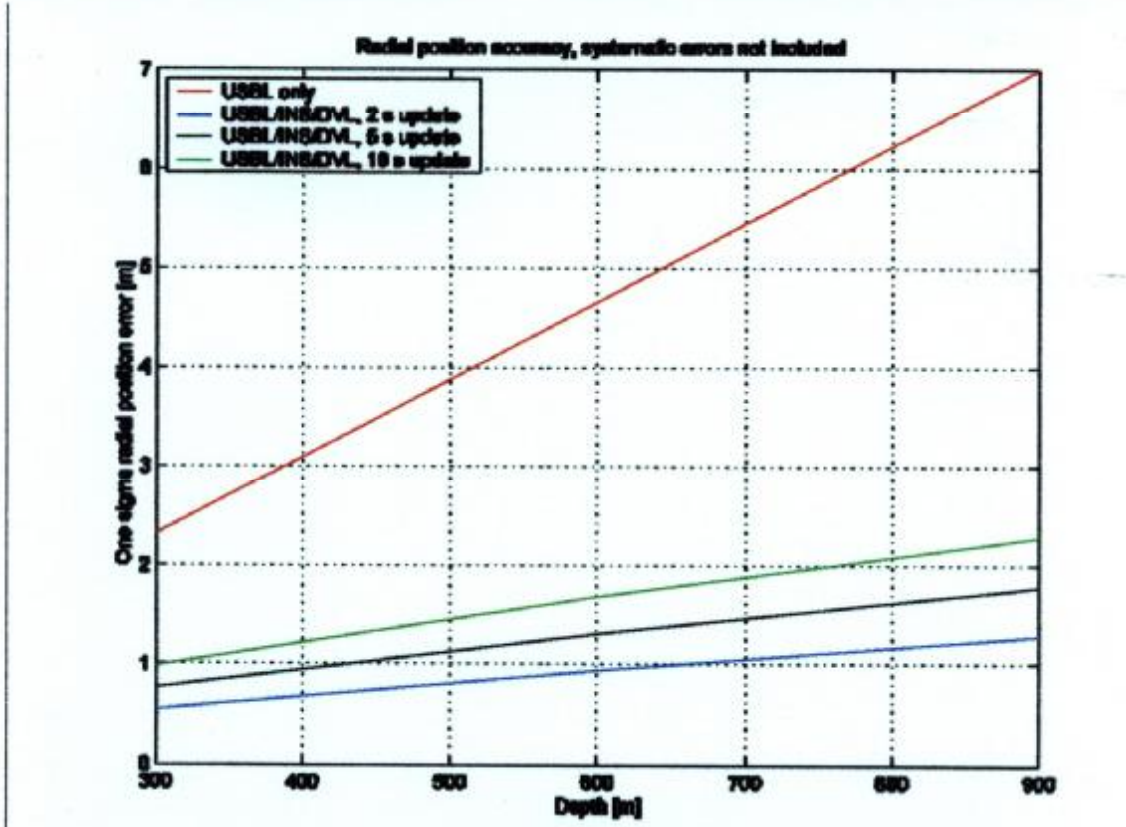
If the standard deviation of the USBL angle measurements would improve to 0.1 deg for σ_{θ_x} and σ_{θ_y}, the radial position errors would improve to

Depth	Transducer, radial	ROV, radial
300 m	0.19 m	1.00 m
600 m	0.19 m	2.04 m
900 m	0.19 m	3.09 m

INS / DVL aiding

3 INS/DVL aiding

If an INS/DVL system is available, the radial position errors can be improved considerably. Although the improvement depends on the geometry of the ROV trajectory with respect to the USBL transducer (e.g., depending on whether the ROV is moving along a straight line or in circles) and the USBL position update frequency, the general improvemt for the depths considered above could be up to a factor five. In the figure below a typical example is given for such an integrated USBL/INS/DVL system



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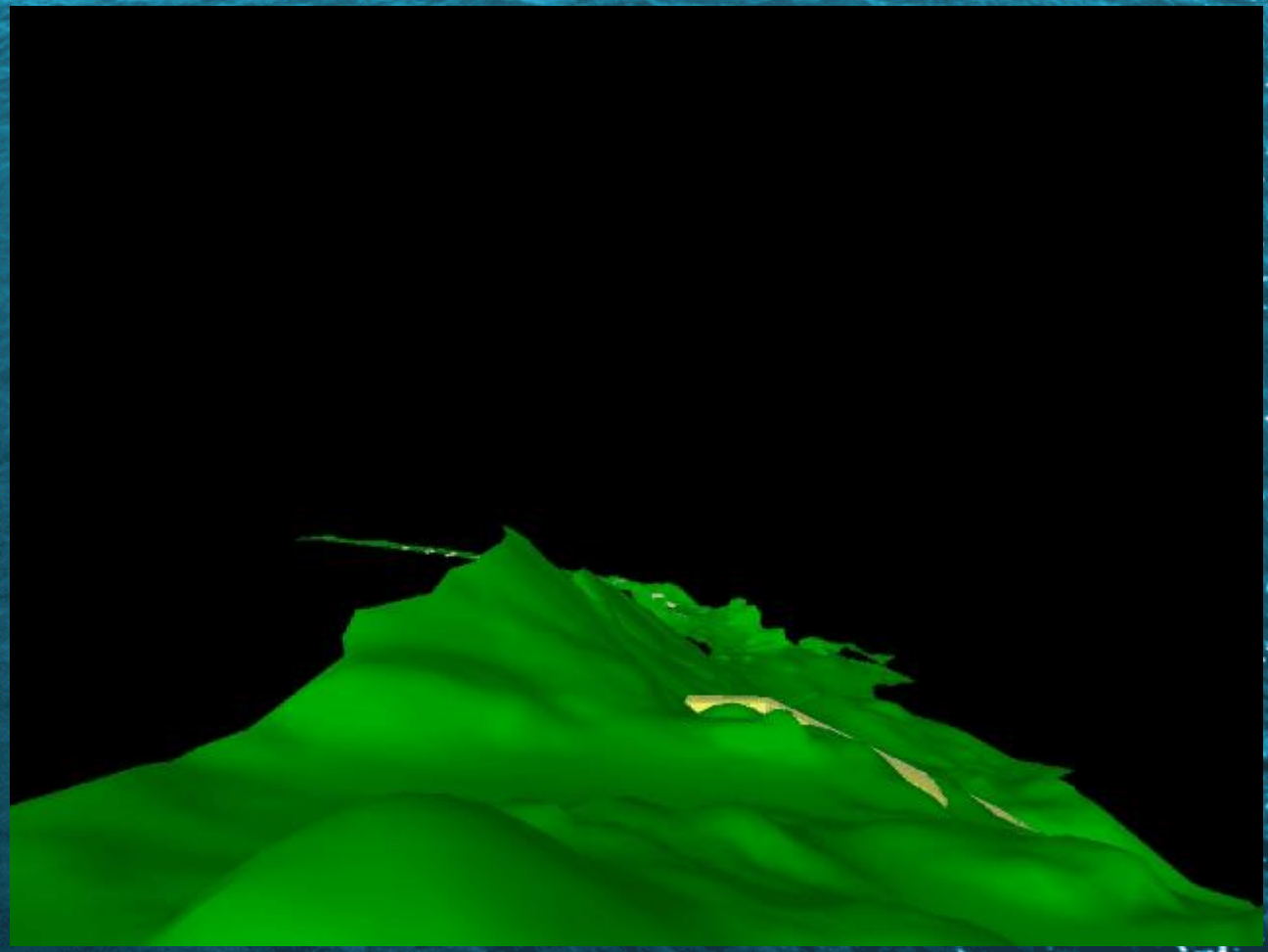
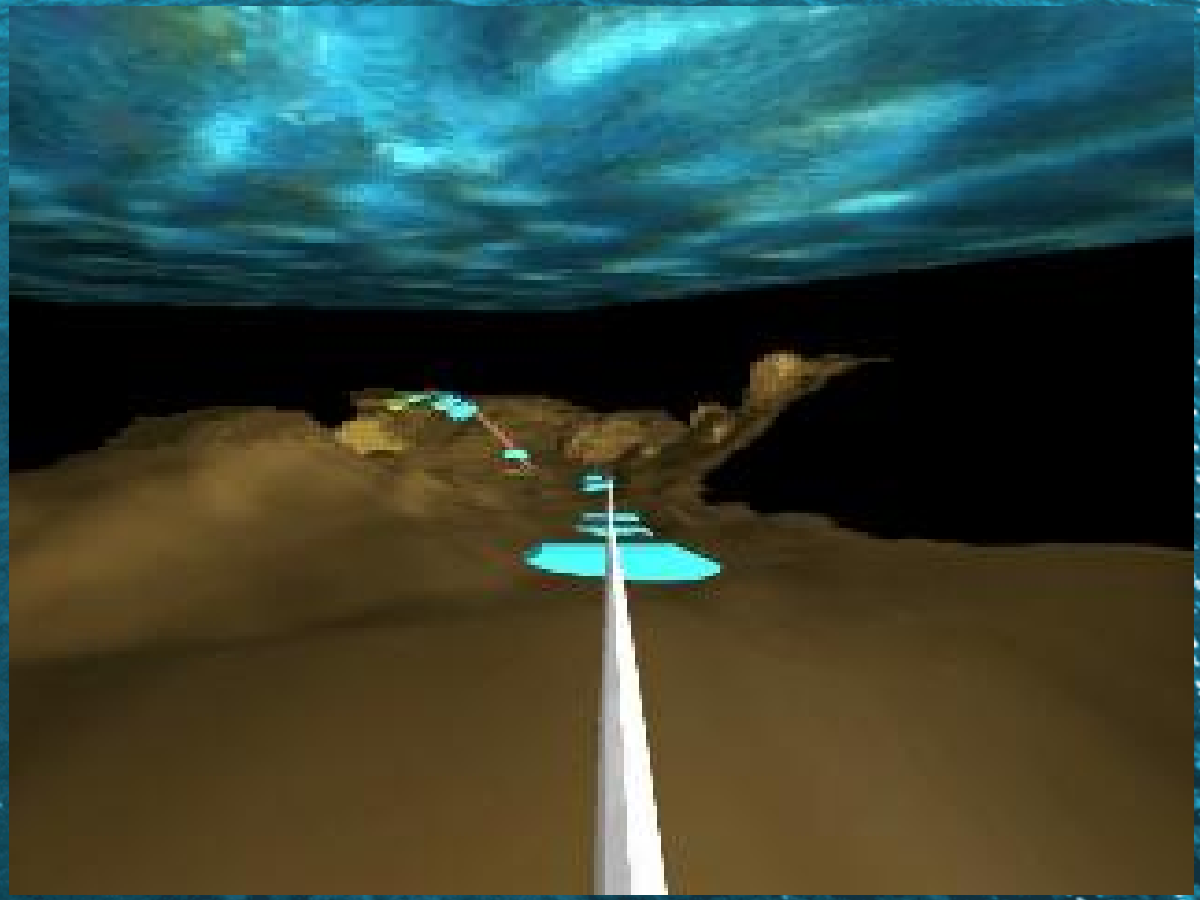
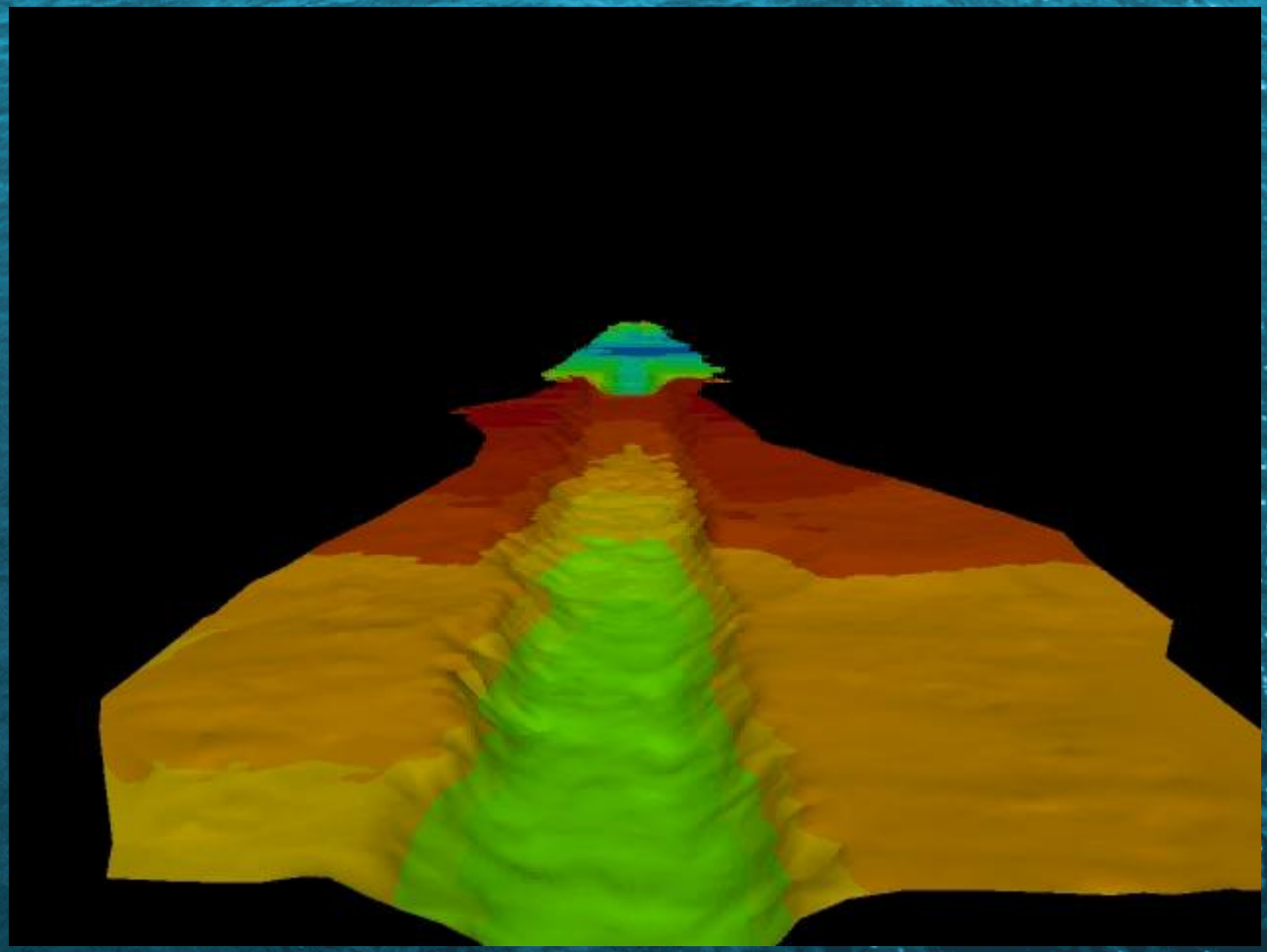
We can also help the pilots by giving them a DTM on the screen while they are flying



We even have the ROV in it so they can see exactly where it is and where the rock should be exiting



This video was actually made from project data to enable our client to see the seabed for himself



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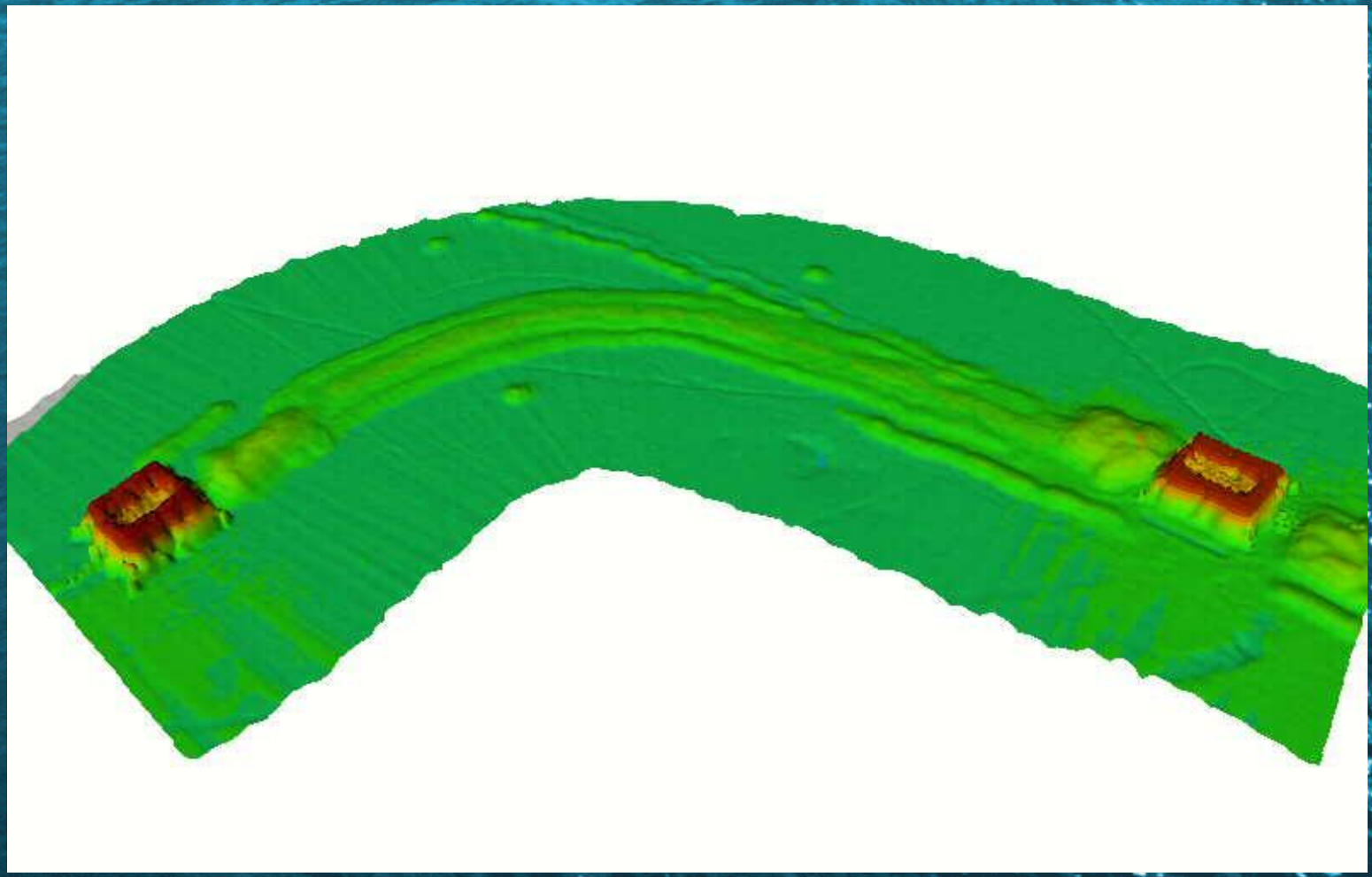
Two templates and various pipelines/umbilicals



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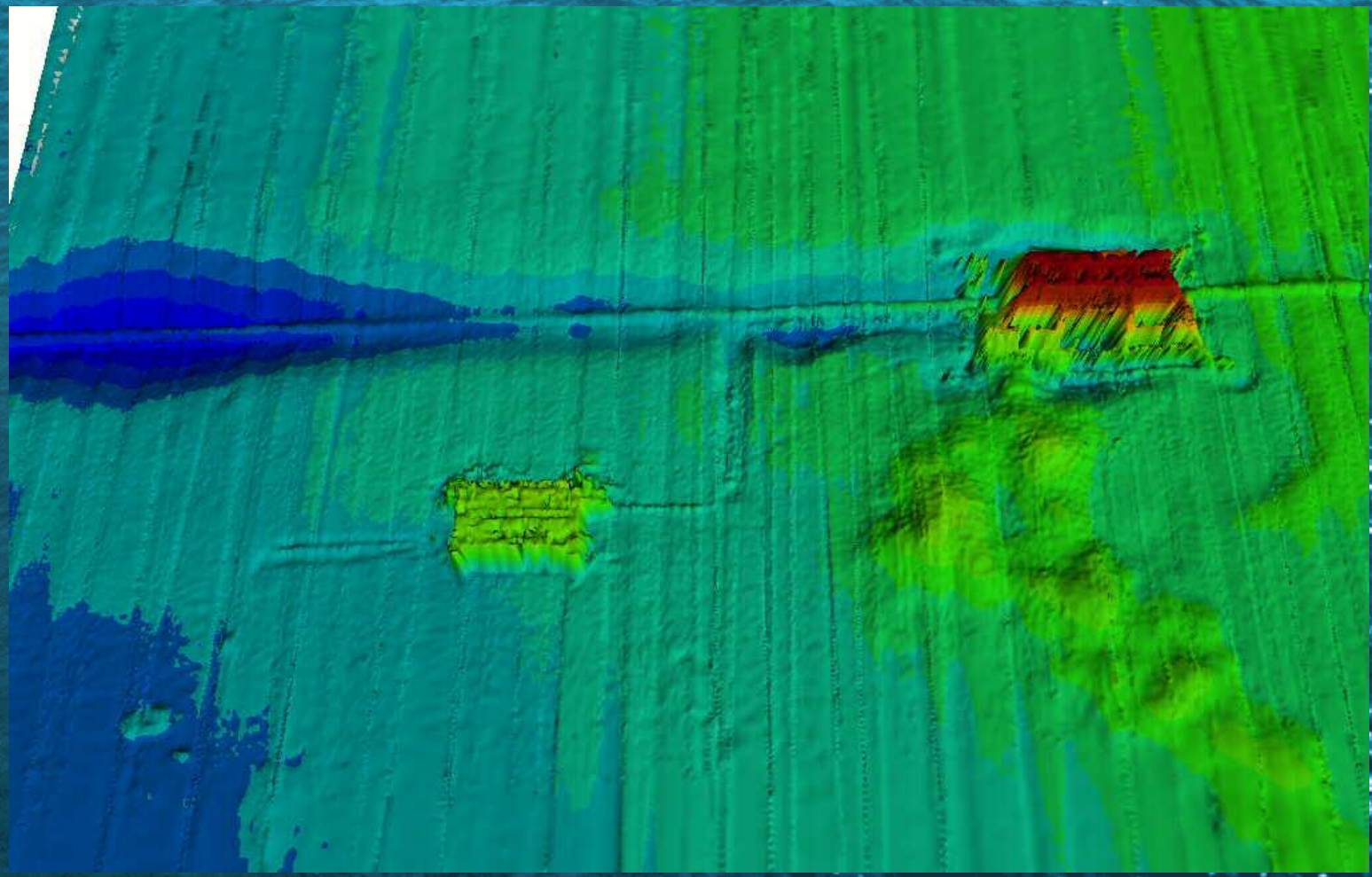
Manifold with “T” piece



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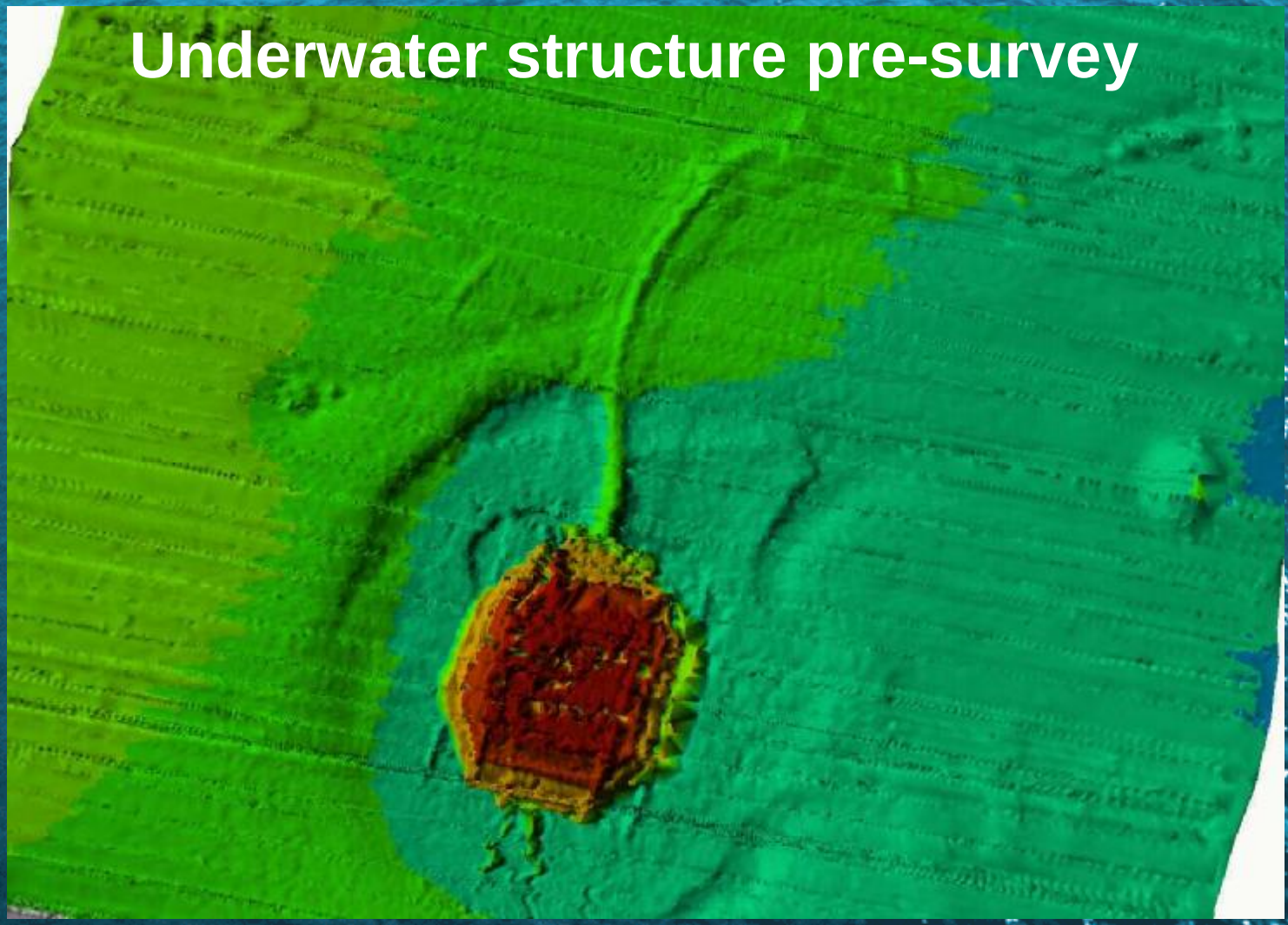
Underwater structure pre-survey



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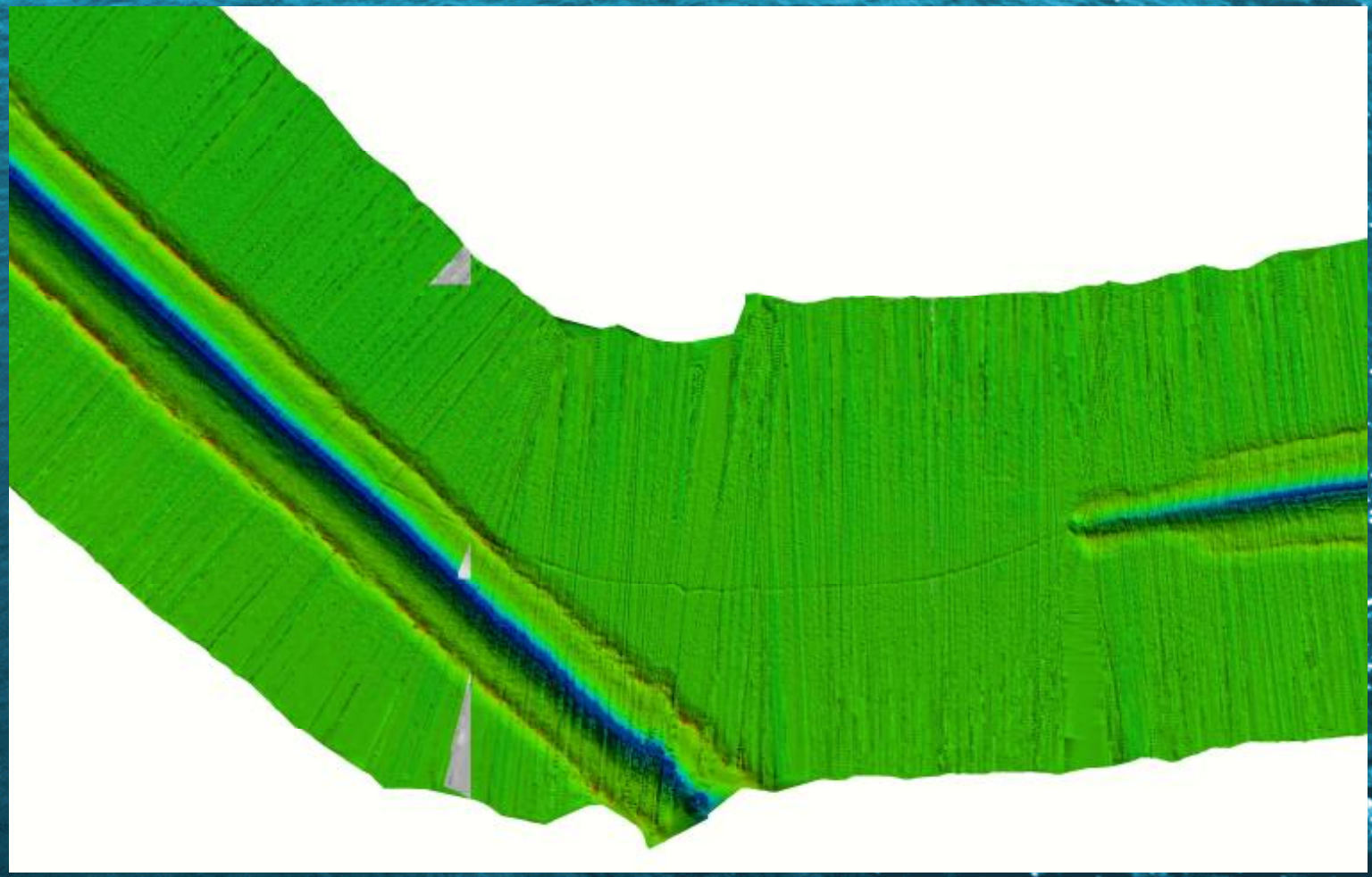
4” umbilical from trench to trench



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THANK YOU

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