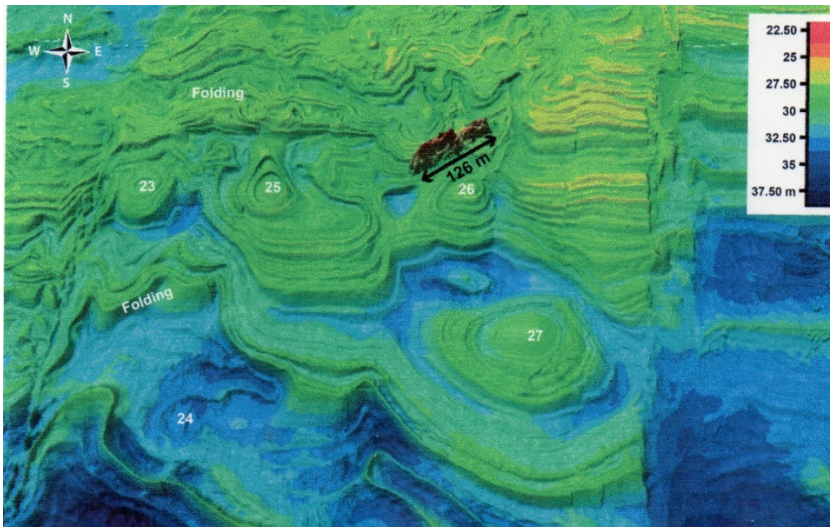
Isle of Purbeck Sub-Aqua Club

Bumps in the Bay



A research project on large, circular seafloor anomalies along the Jurassic Coast

Sponsored by The BSAC Jubilee Trust

2019

Report Authors

Project Manager: Peter Mensikov

Scientific Advisor: Professor Dan Bosence

Isle of Purbeck Club Chairman: Chris Dunkerley

Contents

Introduction	3
Project Background	4
Dry Training	5-7
Identified Sites	8-9
Shallow Trials 1	10-12
Shallow Trial 2	13-14
Results to Date	15-18
Public Presentation	19
Future Plans	20-21

Appendices

Project Diary	Day 3	22-23
Project Diary	Day 4	24-26
Project Diary	Day 5	27-31
Project Diary	Day 6	32-34
Project Diary	Day 7	35-37
Project Diary	Day 8	38-41
Project Diary	Day 9	42-45
Project Diary	Day 10	46-49
Project Diary	Day 11	50-53

Introduction

The Jurassic Coastline, an UNESCO world heritage site, stretches 95 miles from Devon to Dorset. It has been cited as a geologist dream; the exposed folded layers of strata have enabled significant land-based studies to be undertaken without particular difficulty. However, underwater geological studies are limited.

A major breakthrough came with the multibeam survey DORIS (DORset Integrated Seabed study) This was a collaborative project between Dorset Wildlife Trust, Maritime and Coastguard Agency, Channel Coastal Observatory and National Oceanographic Centre, Southampton and was funded through a major award from Viridor Credits.

This underwater survey revealed large circular structures in the Purbeck Limestone which have not been seen in any of the coastal cliffs or quarries from Durlston Bay to Portland despite over a hundred years of geological research.

In 2018 Emeritus Professor of Geology, Dan Bosence, Royal Holloway University of London published a research article about them *"Discriminating between the origins of remotely sensed circular structures: carbonate mounds, diapirs or periclinal folds?" (Journal of Geological Society London, vol 155, 2018)*

This research was presented as a talk entitled "Bumps in the Bay" at the Etches Museum, Kimmeridge, Dorset. In the audience were a couple of members of the Isle of Purbeck Sub-Aqua club who had been diving on and around these structures for years without actually recognising their potential geological significance. After the talk the members and a couple of other divers in the audience introduced themselves to Dan and discussed the possibility of collaborating on a voluntary basis to undertake further the research. In particular, the collection of seafloor geological samples from these structures.

Project Background

Like many other branches of the British Sub-Aqua Club; the Isle of Purbeck Sub-Aqua Club (IPSAC) have been struggling to retain old members and recruit new. One significant area of success for IPSAC has been the increase of interest when “Diving with a Purpose” has featured within the annual program. It was felt that a “Bumps” Project could maintain this momentum. The table below shows those dives cancelled due to “Lack of interest”. (Dives cancelled due to weather are not included)

	Diving with a purpose Dives cancelled	Normal club dives Dives cancelled
2018	1 out of 12	19 out of 51
2019	0 out of 14	11 out of 38

The initial scientific requirement was to obtain rock samples and a photographic record. This meant that the Project would have to be carefully handled as coercing divers to chip rocks off possibly, fairly featureless, bottoms could have a negative rather than positive impact on underwater enthusiasm.

It was decided that as the subject knowledge required was far beyond all but a couple of members the Project should be introduced by Dan Bosence himself but in a way that would immediately engage all those that has expressed an interest – therefore the traditional classroom/lecture theatre approach was discarded in favour of a site visit encompassing practical tasks.

With the depths involved and the unknown element of “sampling” the project would be broken down into three clearly defined stages. Dry training; Shallow water training and then the actual Project dives.

Standard protocols regarding the preparation of Risk Assessments, Dive-Plans and the completion of SOLAS forms would be undertaken before any divers entered the water.

Recognising that the learning curve was going to be steep and that a formal report would have to be submitted on completion of the Project daily diaries would be produced and circulated; these would act both as a debriefing tool and as a medium for prompt feedback. These diaries would feature both informal and formal elements.

Dry Training

The diary from the actual day is reproduced as below:-

Day 1 – 14th April 2019

Location (s)

- Portland Bill – West of the Lighthouse
- Easton Quarry
- Cove House Inn

Participants

- Prof. Dan Bosence – Scientific advisor
- Arnaud Gallois – PHD Geology consultant with the Royal Hollaway University
- Pete Mensikov – Project Manager
- Keith Coombs – Diver
- Chris Dunkerley – Diver
- Nick Martin – Diver
- Martin Oppenshaw – Diver
- Sheilah Oppenshaw – Diver
- Dave Peglar – Diver
- Nick Reed – Diver
- Stephan Spiriak – Diver
- Mike Wilson - Diver

Site 1 - Portland Bill, West of the Lighthouse

Dan thanked all those turning up and introduced the project by pointing out how fortunate we are on the "Jurassic Coast" to be able to clearly see our geological past. He demonstrated this by standing beside a layer of Portland Stone topped by a layer of Purbeck Stone: he dated the stratum and explained how they came to be. Using hand lenses, he had participants examine the formations at a magnification of x10. Dan pointed out various fossilised features and their importance in dating the rocks as Jurassic in age.

Moving away from the rock face Dan discussed formations more specific to the project and drew attention to some "bumps" actually present within Purbeck Limestones near the carpark. These are somewhat smaller than the underwater ones that will be targeted but even so show how such anomalies within rock formations can occur. He précised three possible

method of formation of the underwater “bumps” but the wind chill factor in the open curtailed any significant discussion. A full set of postulations are contained within his initial paper

Site 2 –Stone Firms Quarry (off Pennsylvania Road, Easton)

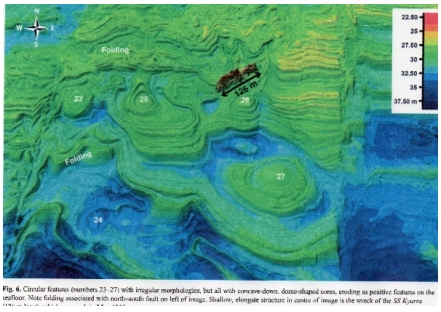
From the early morning session Dan now took the participants to a working quarry to look at sampling techniques and tools. The visit recognised Health and Safety requirements with the issue of Hi-viz jackets and hard-hats.

Firstly, sample size was discussed and demonstrated “fist size” was the preferred option; enough to provide material for scientific examination, a sensible size to handle underwater and easy to put into the string sample bags. Then the method of obtaining the “fist size” sample was demonstrated by Dan using a lump hammer and chisel, he emphasised the use of cracks in the strata or going for the edge of the rock to minimise time; he also emphasised the importance of orienting the sample by marking the upper face, ideally with a chiselled “X”. A heavy 1.5M bar with chisel point was tried in order to eliminate the lump hammer and allow the diver to operated standing up on the bottom. At the end of the session bags and tools were issued in readiness for the first trial dive.

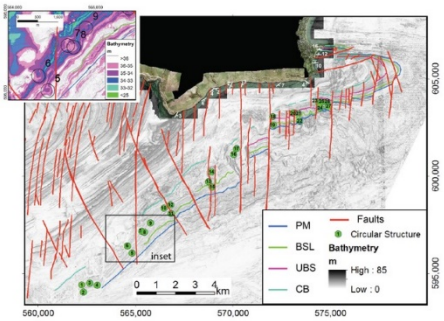
Site 3 –Cove House Inn

After lunch Dan used his A3 project folder to show divers a range of documentation. These documents reinforced the mornings work and also generated important discussion: -

- Multibeam survey printouts – these were used to show the relative position of the “bumps” to known underwater features and also their relationship to the shore.



- SeaSearch photographs – Dan used these to show us what style of seabed we should be expecting and also to reiterate the importance of “chipping off” an *in-situ* sample and not collecting a loose rock from the bottom. He also used them to show fractures and features where a chisel could be applied to best effect.



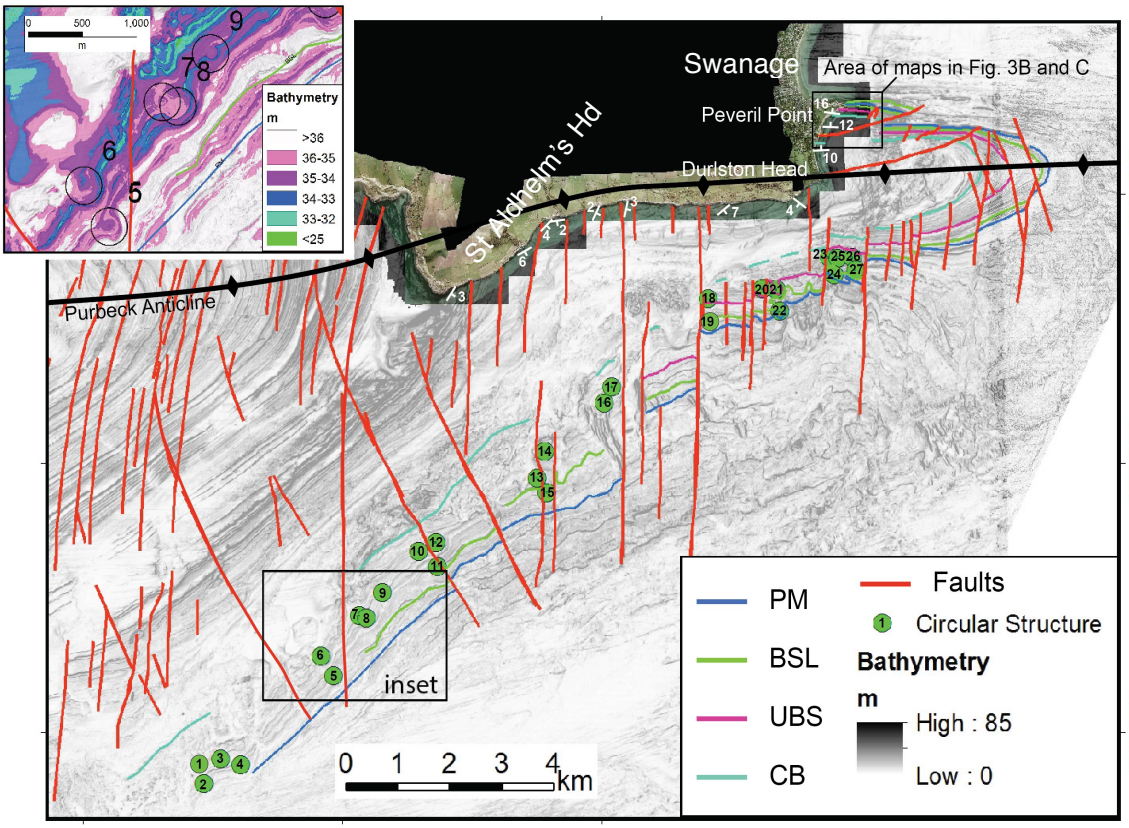
- Discussion was undertaken on the selection of the trial site and diving procedures that could be employed.
- Significant discussion was had on the practicality of the sampling against the time available at depth.

Summary

A useful and interesting day that certainly focused the participants minds on the difficulties of the forthcoming underwater trial. It is apparent that compromises are going to be needed between what the geologists desire and what the divers can achieve both from realistic and safety-oriented aspects. The compromises reached and the rationale behind the decisions are discussed later in this report.

Identified Sites

About 27 major, circular structures (bumps) were identified from the DORIS data and can be seen on the figure below. For reader convenience the landmass jutting South is Saint Aldhelms Head; a significant feature just West of the Dorset sea-side town, Swanage. The bumps can be seen to occur in a band stretching southwest from Durlston Head, just south of Swanage. They appear to be constrained within the upper part of the Purbeck Limestone Group as identified by ledges traced out of the seafloor (coloured lines on map below). The bumps disappear to the SW and also disappear before this band of limestone reaches the cliffs of Durlston Bay (between Durlston Head and Swanage).



The table below locates each of the 27 sites and provides further data. 7 of these sites were selected for collection of seafloor samples and photographs as detailed later in report.

Number	UTM_E	UTM_N	Diameter (m)	Nearest Neighbour (m)	Geometry
1	562290	594437	57	360	Ω
2	562331	594058	95	382	Ω
3	562644	594517	117	360	Ω
4	563042	594386	134	420	Ω
5	564824	596056	118	450	Ω
6	564589	596426	147	450	Ω
7	565317	597169	76	150	Ω
8	565463	597133	120	150	Ω
9	565766	597601	61	560	Ω
10	566471	598371	133	370	Ω
11	566829	598090	81	450	Ω
12	566800	598529	55	370	Ovoid
13	568755	599735	120	350	?
14	568899	600224	63	515	Ω
15	568939	599442	101	350	Ω
16	570042	601132	93	330	Ω
17	570192	601428	95	330	Ω
18	572040	603054	52	1065	Ω
19	572066	602656	95	420	Ω
20	573096	603246	99	264	Concentric
21	573363	603238	110	264	Ovoid
22	573430	602832	86	422	Lobate
23	574377	603818	30	169	Concentric
24	574471	603503	34	327	Concentric
25	574545	603814	33	169	Lobate
26	574819	603819	27	236	Ovoid
27	574894	603600	128	236	Ovoid

Shallow Trial 1

The diary from the first shallow trial along with the minutes of the subsequent Dive Review meeting are reproduced as below: -

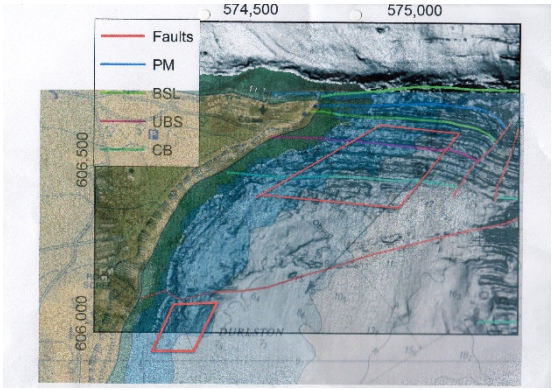
Day 2 – 12th May 2019

Location (s)

- Dive Site 1A 50 36.340; 01 56.455 (WGS 84)
- Dive Site 1B 50 36.038; 01 56.980 (WGS 84)

Participants

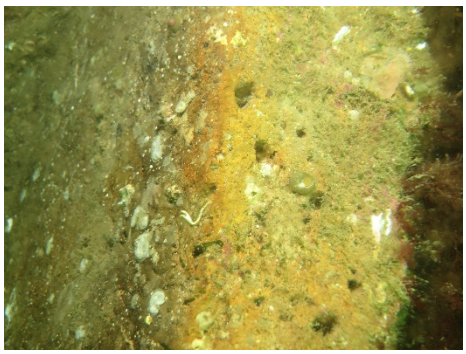
- Pete Mensikov – Project Manager
- Keith Coombs – Diver
- Chris Dunkerley – Diver
- Nick Martin – Diver
- Nick Reed – Diver



Site 1A – Durlston Bay

Divers were briefed prior to departure referencing the Dive Plan sent out the previous evening and the multibeam survey overlaid with the proposed sites.

The shot was prepared with a 13m line. All survey kit apart from the cameras was attached to the two "D" rings 1M and 2M from the base.



The shot was deployed 0.7M from the actual required position. 4 samples were obtained. Visibility was around 2M with a current running of less the 0.5 knots.

Sample 1 – Next to the shot, 6.8M deep
Sample 2 – 5M South of the shot 7.3M deep
Sample 3 – 10M South of the shot 6.9M deep
Sample 4 – 5M North of the shot

A significant number of photos (approx. 60) supported the sampling were taken.
All kit successfully remained on the shot when it was recovered; the little bit of air in the bag by the last diver made the recovery very smooth.

Site 1B –Durlston Bay
The shot was deployed 0.9M from the actual required position. 2 samples were obtained. Visibility was around 2M, the dive was on slack water.

Sample 5 – Next to the shot, 8.8M deep
Sample 6 – 10M South of the shot 8.7M deep

Summary
The divers felt it was a successful and enjoyable day but the "proof of the pudding" is going to be when Dan examines the specimens during the debrief meeting on the 14th May. Many "Lessons were learnt" The second shallow trial will reflect these: -

- Sample 1 took 11 minutes to obtain, chipping was breaking off tiny little bits rather than the fist size.
- Sample 5 took 17 minutes to obtain, large portions of the site were under a dusting of sand about 60mm thick. Wafting the sand away clearly exposed the bed rock but only a small area at a time therefore trying to find a suitable fracture or overhang to get the chisel in was dramatically time consuming.
- Sample 6 was obtained with one hammer blow. **Action** – divers not to be ruled by "shot; 5M North, 10M South etc" but to find a site, get the sample and then note where they are.
- The identity tallies on the bags were useless they continual snagged and were mis-read. **Action** – small slates to be inside with pencil, diver pops sample in and notes position. Divers reel lines to be felt-tip banded at, say, 2, 4, 6, 8, 10M. Compass to be carried.
- Looking for site took time, that the chipper doesn't have. **Action** – if the surveyor finds an ideal sample site whilst measuring and describing he calls the chipper across.
- "X" on top face of sample didn't work; the chipper spent time doing it and then when he hit the target the wrong bit broke off and on a couple of samples the growths on the top surface negated the need. **Action** – wax crayon?
- Dive slate left on board, tape lost? **Action** – better housekeeping at the end of the day
- Tape measure end clip was difficult to use, **Action** - replace with carabiner.
- Chisel put down when reaching for sample, **Action** – Chisel and hammer to be as a pair on one rope with one carabiner.
- Photographs were a bit random, **Action** – Dan to define
- Team of two could work, **Action** – Dan to put in order of priority what he wants firstly sample; secondly sample position? etc

---

Addendum - Review Meeting, Tuesday 12th May 2019

Participants
- Pete Mensikov – Project Manager
- Prof. Dan Bosence – Scientific advisor
- Chris Dunkerley – Diver

The samples were presented to Dan and the difficulties encountered during the trial were discussed in depth. Some of the smaller samples, due to the surprising amount of extensive boring, would not be easy to prepare for microscopic examination. A number of points arising will be incorporated into the next trial: -

- The "be all and end all" of a dive is to obtain a sample, everything else is a bonus

- The pedantry of “sample at shot, sample 5M north of shot” should be refined to “get a sample – record where it came from”
- A two-man team can work
- A photo with a scale attached of the sample in situ and then removed would be ideal
- Sample bags, slates and the dive plan will all be modified accordingly.
- Marking with a wax crayon will be tested

Shallow Trial 2

After the review meeting of Trial 1 it was decided that a second shallow trial was needed to validate the practical matters arising; the diary from that trial is reproduced as below: -

Day 3 – 19th May 2019

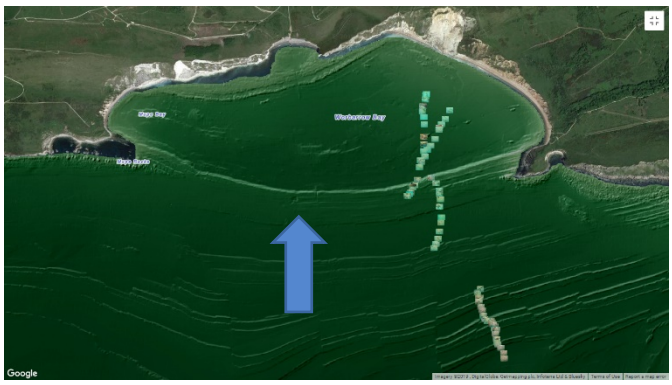
Location (s)

- Dive Site 50 36.821; 02 12.427 (WGS 84)

Participants

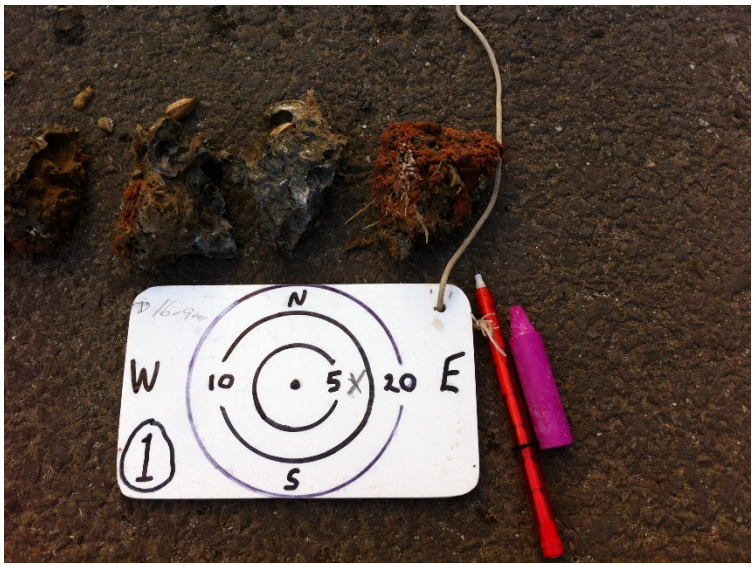
- Pete Mensikov – Project Manager
- Chris Dunkerley – Diver

Site – Worbarrow Bay



The shot was deployed on the wreck of the Black Hawk as it was a scheduled club dive but conveniently this wreck lies, tucked in, on a ledge identified by Dan as a suitable sampling point. The buddy pair doing the sampling attached the hammer and chisel to the shot line but took slates, camera and folded sample bags down with them. The bags contained identity slate, pencil and wax crayon. Visibility was around 4M with a current running of less the 0.5 knots.

2 samples were obtained



Sample 1 – 8M East of the shot, 16.9M deep.

Sample 2 – 3M North of the shot 16.4M

Photographs were taken (with a ruler alongside) prior to the sample being taken and then again when the sample was freed. Unfortunately, the camera was lost when kit was being sorted prior to ascent.

All remaining kit was successfully sent to the surface by lifting bag.

Summary

The divers felt that this 2nd trial was far smoother. A number of observations were made: -

- Sample 1 looked ideal *in situ* and was marked accordingly but a number of blows resulted in it fragmenting and the wax top face marking appears to have been lost.
- Sample 2 looked identical to sample 1 *in situ* but remained intact and was obtained in one blow. The marking of the top face by the red wax crayon can clearly be seen.
- The slates pre-marked with radius rings and compass orientation only needed to be marked with a pencil cross – they were quick to use and worked a treat, however they need to be negatively buoyant.
- Having the sample bags folded and secured with bungy prior to use also worked a treat.
- The wax crayon loose in the bag made it easy to use; they will get lost and should be treated as a consumable
- The team of two worked really well
- Locating the ideal sample site and then collecting from it was far easier than being ruled by pre-dive instructions.
- Chisel and hammer were roped as a pair – saved time.
- The 30m trial will put divers under time-pressure – this will validate, or not, the above.

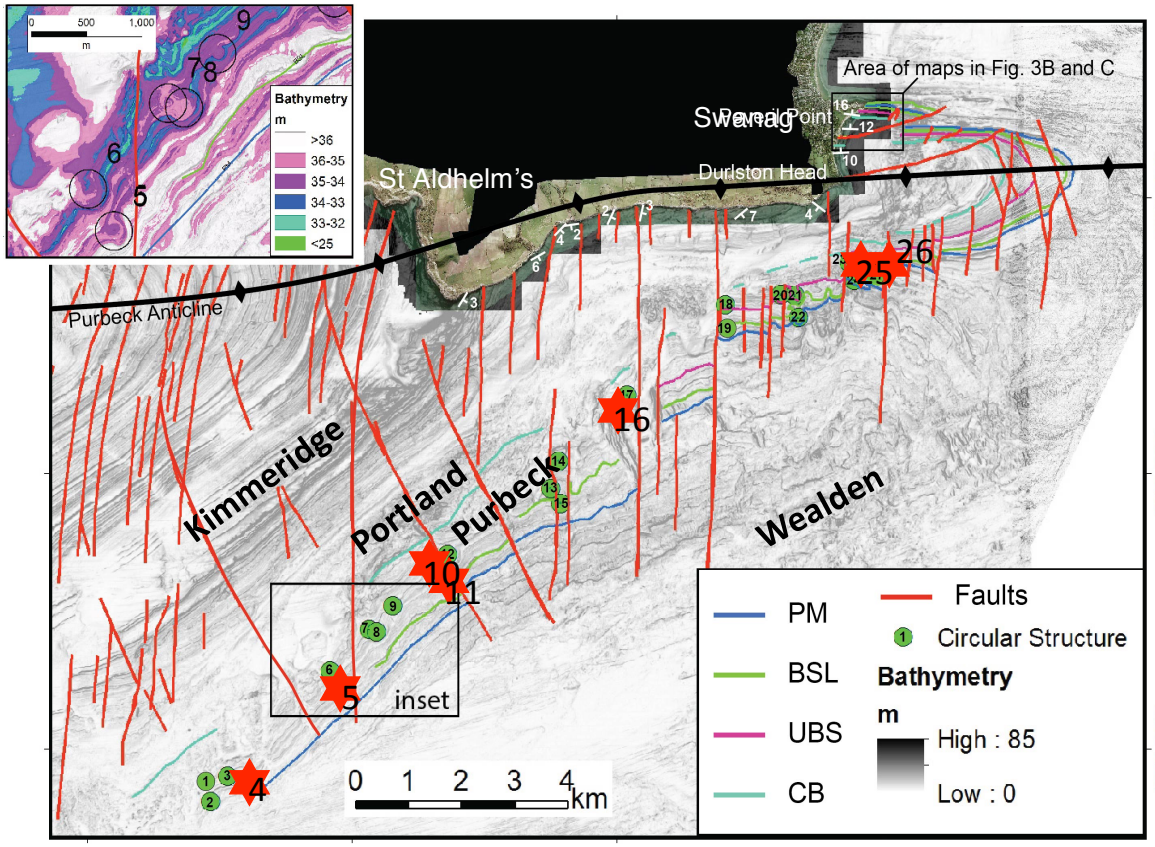
Results to date

Overall it was judged as a most successful year, as, despite poor weather, 7 bumps were sampled covering their geographical spread from northeast to southwest and from shallower to deeper water sites.

The table below summarises the series of 8 successful dives undertaken. These were on 7 sites as shown on the following map with a return visit to sample different areas at site 10. The full details of each dive are available in "Diary format" in **appendix "A".**

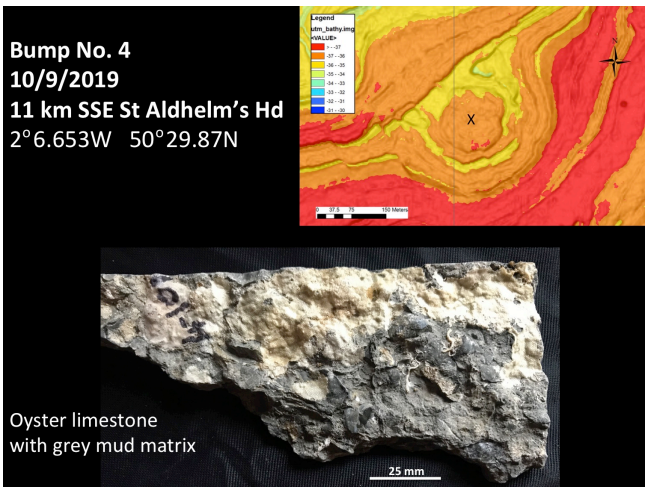
DATE	LOCATION	DIVERS	WEATHER	VIS	DEPTH	SAMPLES
28TH May 2019 Day 4	Site 26 50 24 889 01 56 592	Peter Mensikov-Chip 1 Stephan Spiriak-Photo 1 Keith Coombes -Photo 2 Chris Dunkerley -Chip 2	WNW 3-4	6m	28m	(5 samples)1at 4.6m &1at 13.4m South of shot 1at 3.5m,1at 7.5m,1at 6.5,North of shot
24th June 2019 Day 5	Site 25 50 34 888 01 56 825	Peter Mensikov-Chip 1 Jeremy Goodall-Photo 1 Chris Dunkerley-Chip 2 Keith Coombe-Photo 3 Nick Reed chip-3	SW 3-4	5m	29.2m	(7samples)1at 5M,1at 10M West of shot 1at 5M,1at 10M,1at15M South of shot 1at Shot, 1at 6M North of shot
25th June 2019 Day 6	Site 16 50 33 469 02 0 675	Peter Mensikov -Chip 1 Keith Coombes –Photo1 Chris Dunkerley-Chip 2 Nick Reed-Photo 2	Variable 3-4	5m	31.6m	(4samples)1at Shot,1at9M North of shot, 1At 6M, at 10M South of shot
26th June 2019 27th June 2019 28th June 2019	Site 10 & 11	Blown out	NE 5-7			No Dives
12th July 2019 Day 7	Site 10 50 32 009 02 3 734	Peter Mensikov-Chip 1 Keith Coombes-Photo 1 Chris Dunkerley-Chip 2	W 3-4	5m	34m	(4samples) 1at 5M, 1at10.2M South of shot 1 at Shot, 1at 5M North of shot

		Jeremy Goodall-Photo 2				
26th July 2019 Day 8	Site 11 50 31 850 02 3 425	Mike Wilson Chris Dunkerley-Chip Jeremy Goodall Nick Reed	SW 3-4	2m	35m	(3 samples) 1at 5.8M South of shot North of shot
9th August 2019	Site 5	Blown out	SW 6-8			
DATE	**LOCATION**	**DIVERS**	**WEATHER**	**VIS**	**DEPTH**	**SAMPLES**
23rd August 2019 Day 9	Site 5 50 30 766 02 5 136	Pete Mensikov-Chip 1 Keith Coombes-Photo 1 Chris Dunkerley-Chip 2 Jeremy Goodall-Photo 2	SW 3-4	2m	34.6m	(3samples)1at 5.8M, 1at 10M South of shot 1at 2M from shot
10th September 2019 Day 10	Site 4 50 29 870 02 6 653	Chris Dunkerley-Chip 1 Jeremy Goodall-Photo 1 Peter Mensikov-Chip 2 Nick Reed-Photo 2	SW 3	3m	34.1m	(4 samples)1at 5M, 1at 10M South of shot, 1at Shot, 1at 5M North of shot
22nd October 2019 Day 11	Site 10 re-visit 50 32 009 02 3 734	Peter Mensikov-Chip 1 Keith Coombs Photo ½ Stephan Spiriak-chip 2 Chris Dunkerley Chip 3 Jeremy Goodall-Photo3 Mike Wilson-Survey Dan Bosence-Advisor	Variable 3	3m	34.1m	(5 samples) 1at 25M,1at 12M Southwest of shot 1at 25M, 1at 12MSouth of shot 1at 25M Southeast of shot Survey revealed Lips on seabed at 30M South, 41M West,



In total some 32 samples were recovered from the 7 sites located in the map above and these have been cleaned, sliced and samples selected for production of microscope slides. These slides reveal what sort of rocks are in the core of the circular structures. The main results are as follows:

1) Most of the samples indicate rock types that are known to occur in the middle and upper part of the Purbeck limestone. These are limestones laid down in a large lagoon or lake that existed in this area in late Jurassic times. These results confirm the interpretation made from tracing seafloor rock ledges in the DORIS data from the Durlston Bay cliff outcrops. For example, a distinctive oyster rich limestone was recovered from site No. 4 as shown below which is known to occur midway through the onshore outcrops of the Purbeck Limestone.



2) The recovery of Purbeck limestones from the core of the circular structures provides further evidence that it is very unlikely that the bumps are volcanic cones or meteorite impact structures which would have their own, very distinctive rock types. These origins were low on the list of possible modes of formation because of the rarity of volcanic activity in the Wessex basin at this time and the extreme rarity and isolated nature of impact structures globally.
3) Similarly, no beds of salt were sampled. Salt diapirs (conIcal intrusions of light, ductile salt into overlying strata) were one of the three possible preferred origins in the 2018 paper by Bosence but despite the wide coverage of the sampling no halite or gypsum/anhydrite beds were encountered. Isolated cubes of halite were found in one site (10) but these are known to occur throughout much of the Purbeck limestone.
4) One site (No.10) has some fragments of rock types that are not found in the middle and upper Purbeck limestones preserved within some limestone beds. These fragments are from limestones, known as tufas, formed in lake environments through the precipitation of calcium carbonate (lime) normally under the influence of microbial communities. If these occurred *in situ* as thicker beds rather than as reworked fragments then this would support the hypothesis that the bumps are tufa mounds formed on the floor of the Purbeck lake that have been truncated by seafloor erosion to generate the circular structure.

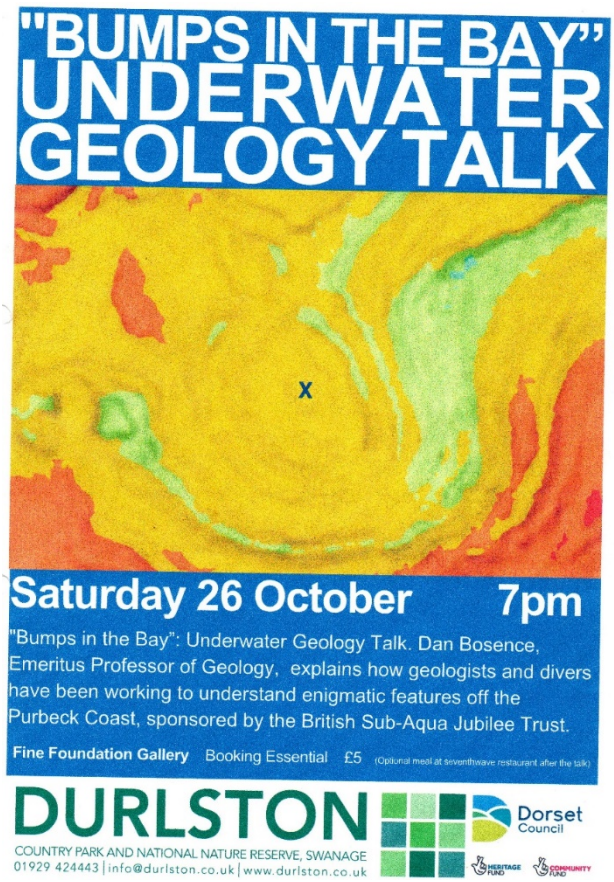
In addition to above it is important to also record the “intangible results and successes”. The season commenced with the majority of the participants having little or no knowledge of the underwater geology. On the first couple of dives the samples were being brought to the surface and merely given a cursory inspection before being thrown in the project bucket; by the mid-point of the season the samples were being examined, compared and discussed and by the end of the season there was a positive enthusiasm to attend the presentation, be told the results and discuss the future. This increasing enthusiasm was reflected in the dive bookings as the season progressed; early in the season club members were being cajoled to take part but by the end members were asking about next year and taking part again.

Public Presentations

On the 26th October 2019 Professor Bosence gave an extremely successful (over-subscribed), public talk to an audience in the Fine Foundation Gallery, at the Castle in Durlston Country Park, Swanage.

The presentation was initially going to be just a supplementary event to the Clubs “End of Season” get-together but then Dorset Council asked if it could be an “open” event and feature in their “What’s on” guide. This proved so popular that extra seating was installed.

The flyer produced by Dorset Council formally acknowledged the support of the Jubilee Trust. The assistance of the trust was also acknowledged during Dan’s talk.



Further presentations, at a higher scientific level were given at the National Oceanography Centre, Southampton on 13th November and at the British Sedimentological Research Groups annual meeting at Royal Holloway University of London, 13-17th December 2019.

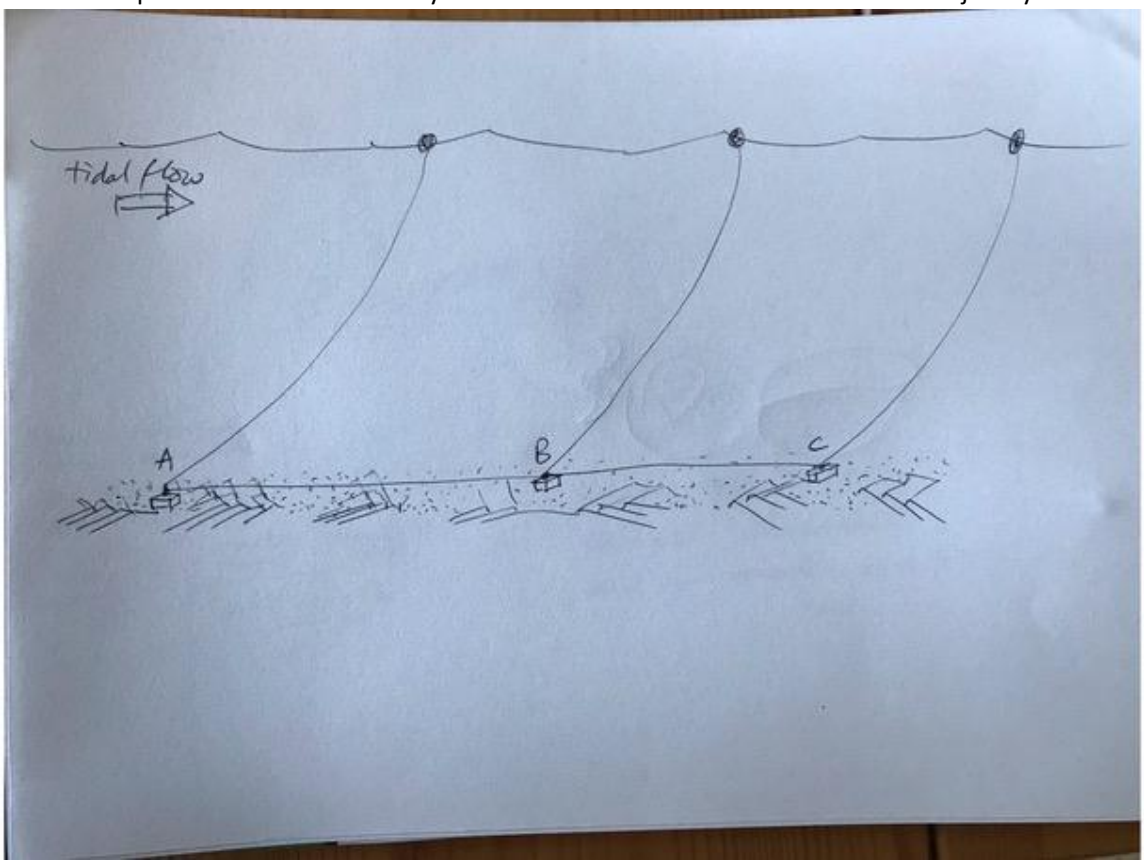
Future Plans

Whilst it can be seen from the results on the previous few pages that progress has been made concerning the origin of the “Bumps” the definitive answer is still outstanding.. Because most of the dives have retrieved lithologies that are well-known within the Purbeck limestones it is thought that the rock types and the structure that actually formed the original bump are at a lower level than is exposed in most sites on the present day sea-floor. What we are seeing are the dome-shaped, or draping, cover, to the structure rather than the rocks forming the actual dome.
It is therefore planned to firstly carry out a more detailed view of the DORIS data using 3D imaging software that is revealing more information on bump morphology on the sea floor. This can be used to target sites that we now expect to reveal the older, lower levels of rocks that should provide the evidence we are seeking.

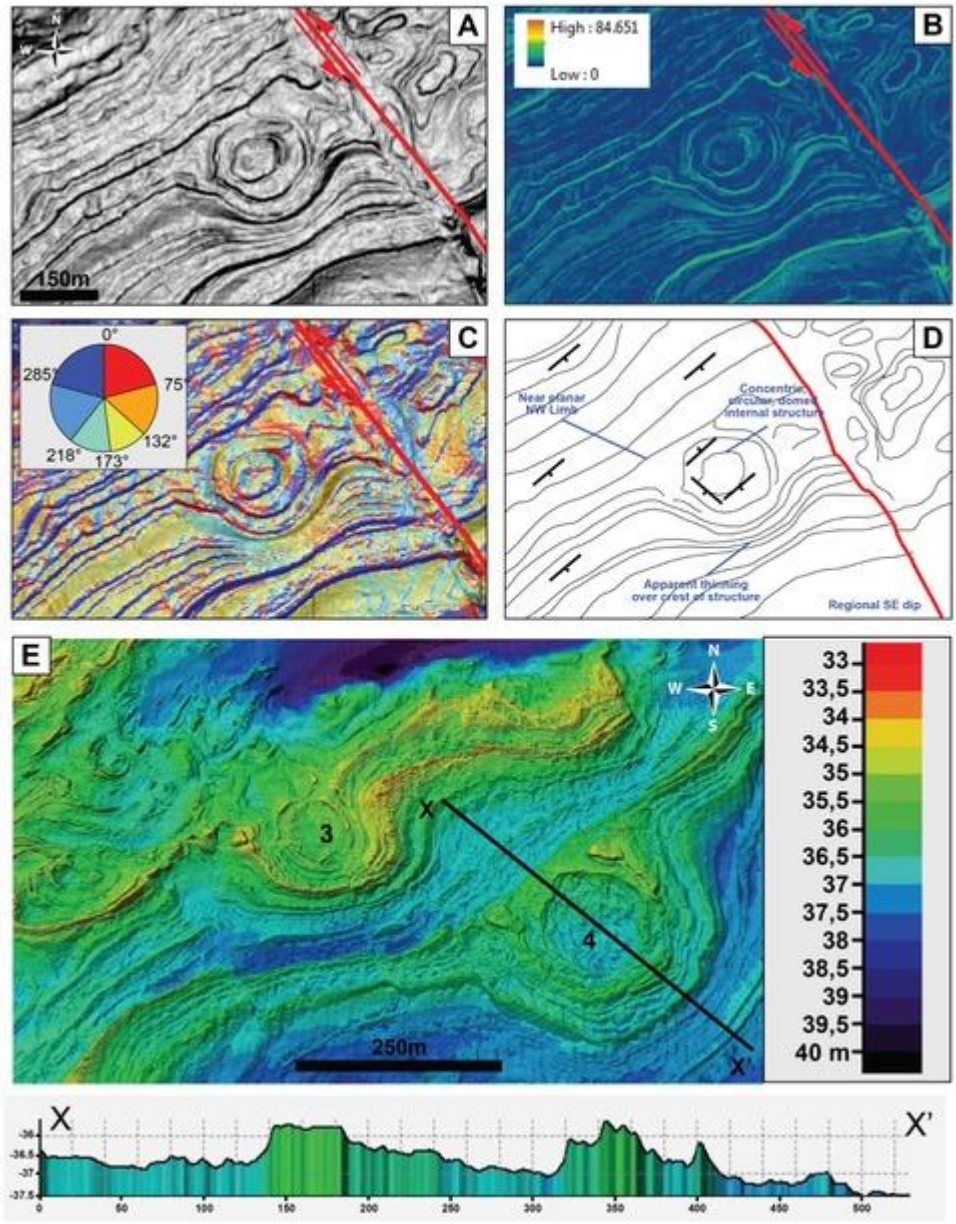
Dive planning for the future is provisional at the moment and is dependent on being able to secure further funding to enable project progress throughout the 2020 season.

Sample collection is still key to resolving the origin of the bumps and now that the divers have proven themselves competent with single point sampling it has been suggested that “dip and strike” sampling along various transects using a preplaced line would enhance the data collection. Possible use of a clinometer has also been discussed.

Initial thoughts are to use 3 pairs of divers to undertake a succession of dives starting at different stations along the single transect as the sketch below– an ambitious scenario to complete in one slack window plus a bit of drift on entry and exit but it is felt that the results would justify the effort.



The positioning of this transect rope would be guided by Dan reviewing the enhanced data (for information only the current level of data in various formats can be seen below).



A – shows the basic DORIS detail of a proposed site
B – shows the amount of dip
C – gives the direction of dip
D – provides data annotation
E – gives and overview of the specific site in relation to others.

There would be obvious operational difficulties in the positioning of the line but it would be the intention to run some shallow trials prior to tackling the deeper desired sites.

The proposed series of “Bumps” dives for the 2020 season and their integration into the normal Club program can be seen at http://www.ipsacdivers.co.uk/php/diving_current.php

Appendix – Project Diaries

Day 3 – 19th May 2019

Location (s)

- Dive Site 50 36.821; 02 12.427 (WGS 84)

Participants

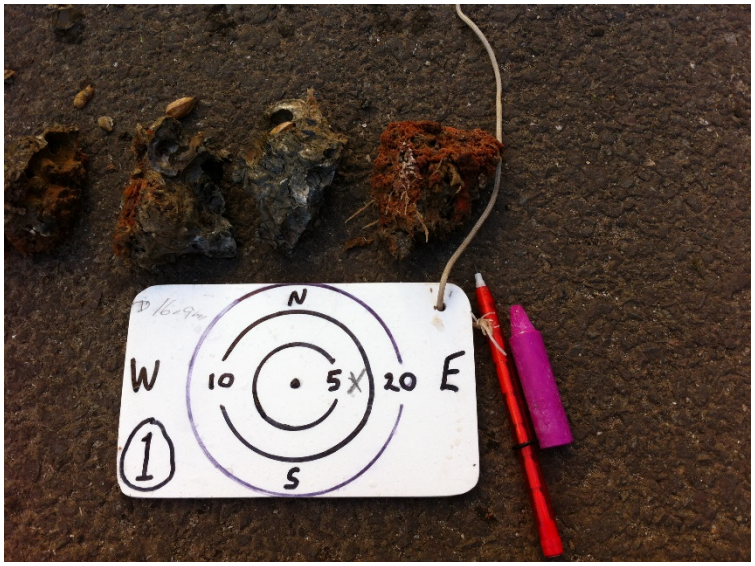
- Pete Mensikov – Project Manager
- Chris Dunkerley – Diver

Site – Worbarrow Bay

The shot was deployed on the wreck of the Black Hawk as it was a scheduled club dive but conveniently this wreck lays, tucked in, on a ledge identified by Dan as a suitable sampling point. The buddy pair doing the sampling attached the hammer and chisel to the shot line but took slates, camera and folded sample bags down with them. The bags contained identity slate, pencil and wax crayon.

Visibility was around 4M with a current running of less the 0.5 knots.

2 samples were obtained



Sample 1 – 8M East of the shot, 16.9M deep.

Sample 2 – 3M North of the shot 16.4M

Photographs were taken (with a ruler alongside) prior to the sample being taken and then again when the sample was freed. Unfortunately, the camera was lost when kit was being sorted prior to ascent.

All remaining kit was successfully sent to the surface by lifting bag.

Summary

The divers felt that this 2nd trial was far smoother. A number of observations were made: -

- Sample 1 looked ideal in situ and was marked accordingly but a number of blows resulted in it fragmenting and the wax top face marking appears to have been lost.
- Sample 2 looked identical to sample 1 in situ but remained intact and was obtained in one blow. The marking of the top face by the red wax crayon can clearly be seen.
- The slates pre-marked with radius rings and compass orientation only needed to be marked with a pencil cross – they were quick to use and worked a treat, however they need to be negatively buoyant.
- Having the sample bags folded and secured with bungy prior to use also worked a treat.
- The wax crayon loose in the bag made it easy to use; they will get lost and should be treated as a consumable
- The team of two worked really well
- Locating the ideal sample site and then working it was far easier than being ruled by pre-dive instructions.
- Chisel and hammer were roped as a pair – saved time.
- The 30m trial will put divers under time-pressure – this will validate, or not, the above.

Day 4 – 28th May 2019

Location (s)

- **Dive Site 26 -** 50 34.889; 01 56.592 (WGS 84)

Participants

- Pete Mensikov – Project Manager
- Chris Dunkerley – Diver
- Keith Coombs – Diver
- Stephan Spiriak – Diver

Site – Approx 1 mile South of Anvil Point

The commercial skipper demonstrated significant care in the deployment of the shot; it was perfectly on the marks! (obviously with a +/- tolerance from the actual satellites)

Charter cost was minimised as the company were able to put divers from another club on the wreck Kyarra, a stones' throw away.

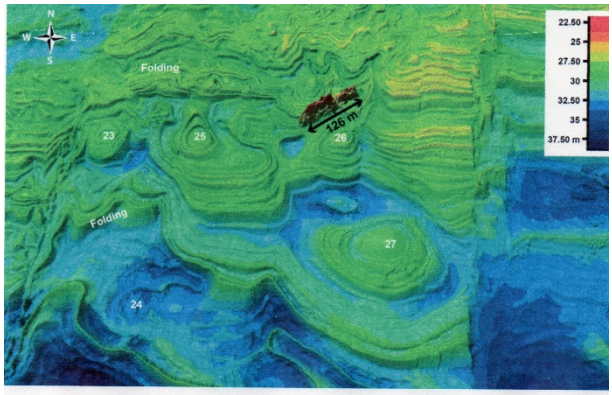


Fig. 6. Circular features (numbers 23–27) with irregular morphologies, but all with concave-down, dome-shaped cores, eroding as positive features on the seafloor. Note folding associated with north–south fault on left of image. Shallow, elongate structure in centre of image is the wreck of the *SS Kyarra*

Two buddy pairs took part using the methodology proven during the previous shallow trial. Again hammer and chisel were deployed and recovered with the shot line; other survey equipment was taken down by the divers.

Visibility was around 6M with a current running of less the 0.5 knots on descent but none noticeable on the bottom. The "No-stop" operational window was 20 minutes and coincidently the "slack" window wasn't much more, the divers experiencing a current on their 6M safety stop.

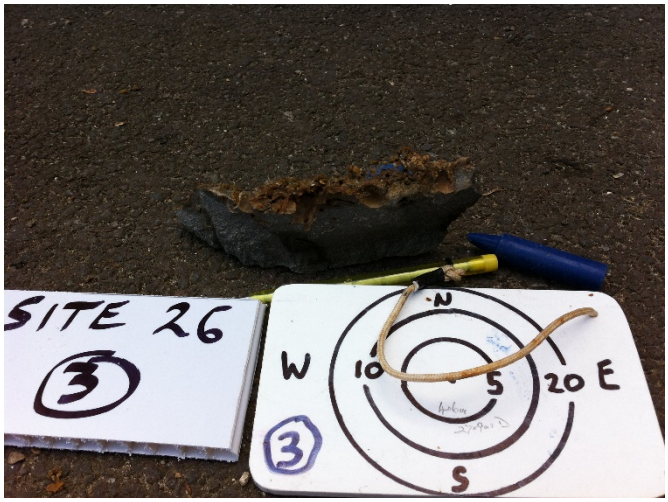
5 samples were obtained. It is thought that Dan will be very happy with 4 of these but what looked like a good spot to hammer 13.6M South of shot turned out to be extremely friable and a frustrating waste of limited time.

NB The sample numbers are not necessarily in numerical order and in fact numbers could be missed out; the reason being is that the slates in the sample bags are pre-marked and the diver on the bottom will just grab the first that comes to hand.

Sample 1 – 13.6M South of the shot, 28.4M deep. The selected site looked good but material was crumbling away and a decent "fist size" lump proved impossible

Sample 2 - 3.5M North of the shot, 28M deep. Easily obtained, single hammer blow from an overhang, the sample was oversize and only just fitted the bag but the diver was loathe to waste time trimming it! Due to size the diver was not happy about bringing it to the surface on his person so went back to the shot and secured it there.

Sample 3 – 4.6M South of the shot, 27.9M deep. Nicely cleaved from an overhang, with the top surface clearly marked



Sample 6 – 7.5M North of the shot, 28M deep. Again well cleaved but perhaps a little on the small side

Sample 7 – Couple more pieces close to previous sample site – 6.5M North of the shot, 28M deep

Summary

The divers were very pleased with themselves – everything went to plan. A number of observations were made: -

- Team of two is confirmed as the ideal for future sampling – maximises safety and is operationally very sensible.
- Two decent samples from each pair is likely to be the best achieved from this sort of depth
- Use of a lifting bag was ruled out during the last-minute on-board briefing. Three reasons; wasting sampling time; the boat was not necessarily going to be directly over site for instant recovery and the big sea could have made spotting a low-lying bag difficult.
- Discussion immediately after the dive centred on the deeper sites and the severe limitations imposed by air. Nitrox is going to be needed for sure and mixes might be required.

Day 5 – 24th June 2019

Location (s)

- **Dive Site 25 -** 50 34.888; 01 56.825 (WGS 84)

Participants

- Pete Mensikov – Project Manager
- Chris Dunkerley – Diver
- Keith Coombs – Diver
- Nick Reed – Diver
- Jeremy Goodall - Diver

Site – Approx 1 mile South of Anvil Point, 200M west of "Kyarra". Low water slack approx. 28M

Again the commercial skipper demonstrated significant care in the deployment of the shot; it was perfectly on the mark. (obviously with a +/- tolerance from the actual satellites)

With a team of 5 divers and the clear priority being sample collection it was decided to have three "chippers" and two photographers. One photographer would service N&W whilst the other would be dedicated South.

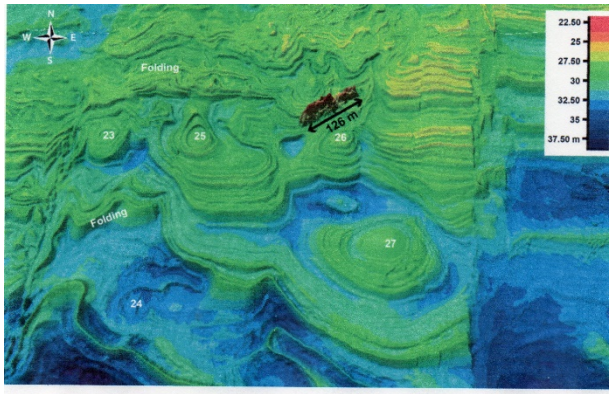
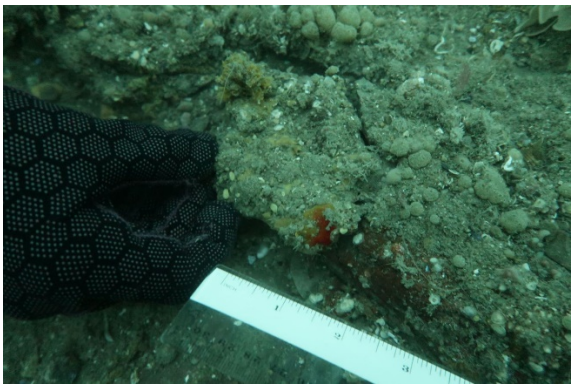
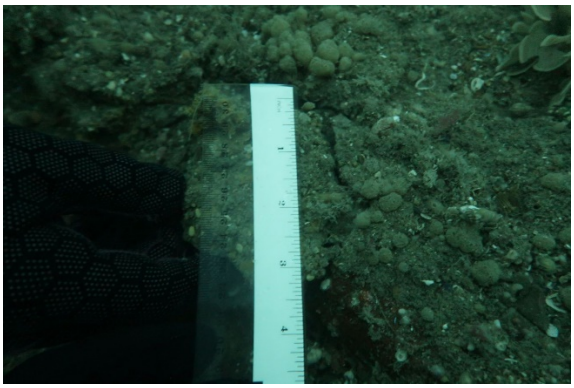


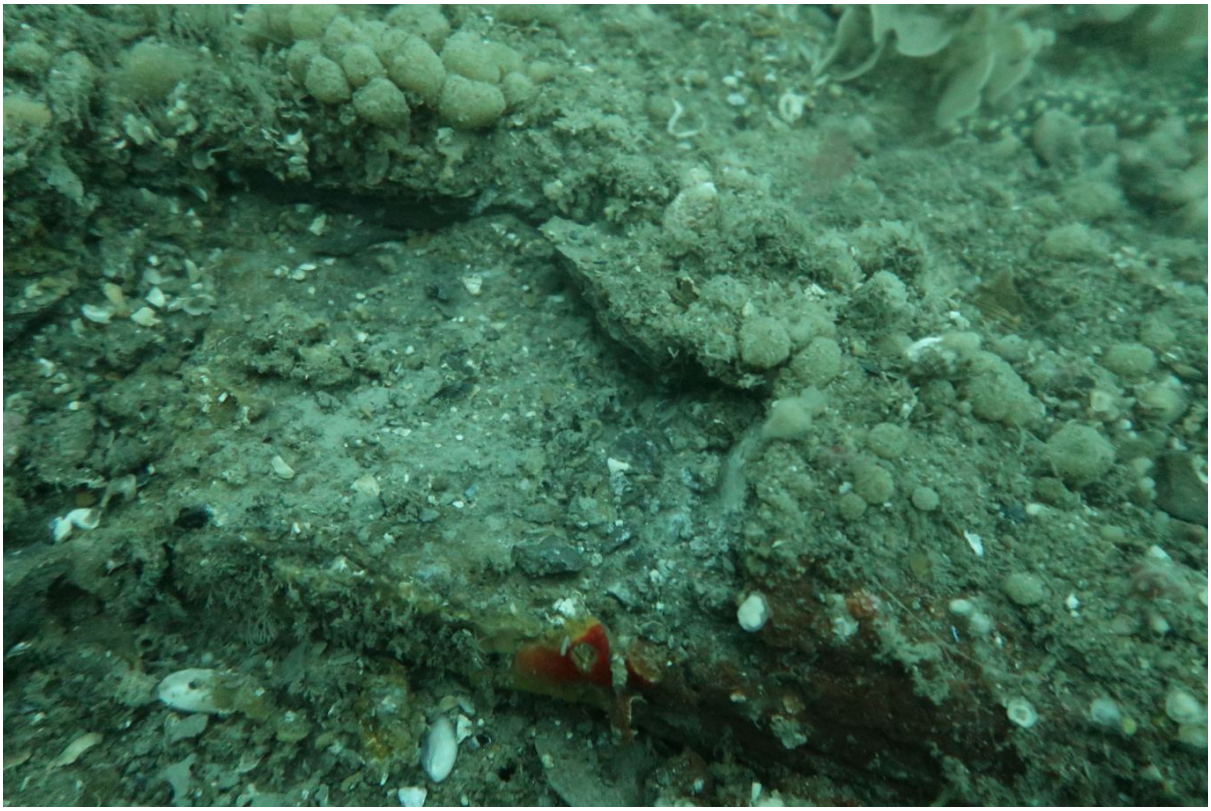
Fig. 6. Circular features (numbers 23–27) with irregular morphologies, but all with concave-down, dome-shaped cores, eroding as positive features on the seafloor. Note folding associated with north–south fault on left of image. Shallow, elongate structure in centre of image is the wreck of the *SS Kyarra*

Visibility was around 5M with a current running of about0.5 knots on descent but zero on reaching the bottom. The "No-stop" operational window was 20 minutes, the current started picking up just before ascent and was quite noticeable on the 6M safety stop. Safety wasn't compromised.

7 samples were obtained. All the divers are now getting used to the tasks and the imposed time limits. Surprisingly obtaining samples here was significantly easier than from site 26, a mere 200M away. The strata on the bottom this time was like a stack of dinner plates or roofing slates maybe around 15 to 20mm thick. This meant that a couple of chisel blows would easily release a sample. This following series of 3 photos 6M North of shot is typical of the structure. (The white scale is in inches). The first two shots show the sample in situ being measured with the third shot showing the sample removed and very clearly the "stack" of plates making up the bottom.







The selection of a chipping site was easily made as any growth on the bottom was limited, sporadic and easily removed where necessary.

NB The sample numbers have been dispensed with to avoid any confusion. The ID numbers that appear on the "target" slates can be ignored. The identity plaques will now each carry the position and site number. Depth is no longer highlighted on individual samples. Site depth prevails

After chiselling this sample out the diver lost an empty sample bag he was holding when the shot, a 56LB weight "leapt" back a metre or so pulling him with it (he was attached to the shot by his tape that had less than a meter wound out). It was later determined that the 2nd pair of divers grabbing the topside bouy coupled with the tide running had probably caused the movement.

This sample at 15M South was actually described by the divers as being on the "ridge". The photographer swimming around could clearly see a "bowl" structure.

Although cutting the bedrock for samples was easy, at times it could be frustrating with a single chisel blow providing half a dozen pieces of rock hardly larger than a 50p coin.

This was another example of a single blow causing fragmentation.

Summary

This dive concludes the deep trial phase – everything went to plan and the team now feel confident in their ability to descend below the 30M mark and obtain usable samples in the extremely short time window available to them. Dans "first choice" nominated sites are all beyond the 30M mark

A number of observations were made: -

- The team of two was previously confirmed as the ideal for future sampling, maximising safety and being operationally very sensible. However with an additional volunteer coming along making an odd number it was decided not to reject a volunteer but to "share a photographer" - it worked well and gave the dive an additional chipper. The buddy system was slightly compromised but the photographer knew where his divers were from the tapes and he himself was equipped as a solo diver with an additional air source. Maximum separation would never be more that 6m along the bottom
- The deployment of hammers and chisels attached by carabiner to the shot is ideally suited to the divers giving very quick release on the bottom; however, it was noted that with 3 sets the recovery was awkward. If 3 sets are needed in the future the method of attachment will be reviewed. Other survey equipment was taken down and brought back by the divers – this is working well and will be continued.
- The video and photos supporting these dives are too numerous to include in the daily diary but are held in the applicable folder and will be made available to Dan on his next visit

Day 6 – 25th June 2019

Location (s)

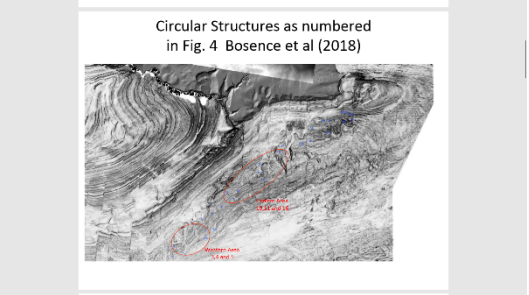
- **Dive Site 16 -** 50 33.469; 02 0.675 (WGS 84)

Participants

- Pete Mensikov – Project Manager
- Chris Dunkerley – Diver
- Keith Coombs – Diver
- Nick Reed – Diver

Site – Approx 3 miles South of Dancing Ledge. Low water slack approx. 32M

This was the first of the 6 prime sites chosen by Dan as being potentially the most likely to provide the geological information needed.



The boat arrived on site a little early as the tidal behaviour in this area isn't as well-known as it is a few miles remote from the local dive sites. Yet again the commercial skipper demonstrated significant care in the deployment of the shot; it was perfectly on the mark. (obviously with a +/- tolerance from the actual satellites)

NB The combination of the dual helm, instrumentation and the skipper's proven ability have now given the team the confidence to ask for any position within a circular structure on future dives.

The team of 4 divers on board today were all involved in yesterdays, last, deep trial and were therefore very clear and confident about the task in hand. The team split into 2 pair "North" and "South" of the shot.

Visibility was around 5M with a "No-stop" operational window of 13 minutes. There was a current running of about 0.5 knots on descent but zero on reaching the bottom, throughout the dive and on the ascent; this can clearly be seen by the slackness in the shot line whilst the divers are on their 6m stop.

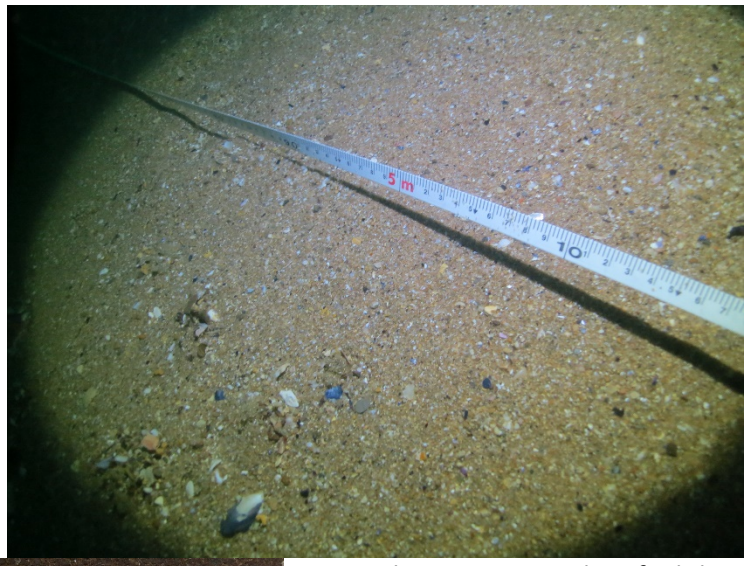
Although the divers descended confidently this ill-founded confidence was shattered once they hit the bottom; it appeared to be a very bleak terrain without features or ledges from which samples could be obtained. On close inspection the uniformity of the bottom wasn't the strata but a 40mm thick soft growth.

This growth had to be pushed aside before a sample site could be selected. Difficult, but each pair did obtain 2 samples in accordance with the dive plan.

The majority of soft growth on this sample (6M South of shot) survived the bagged journey to the surface and can be clearly on the right-hand side as the sample itself tapers off.

The divers were surprised by this growth as the currents in this area are significant; the Admiralty state "Overfalls on East-going stream".

The chipper tasked with 5M North found nothing and had to progress 4 more meters before a site worth trying was found.



Even when a site was identified the samples tended to crumble rather than shear cleanly. However as discussed above just finding a site was difficult and time was against the divers being fussy in the actual selection.

Summary

This results of this, the first dive on a “preferred”, deep site undoubtedly validated the practice undertaken over the last few weeks.

A number of observations were made: -

- Expect the unexpected.
- A series of short videos, including audio, were taken during this dive and gave a very useful insight to those in the dry. These were forwarded to Dan.
- Again, the videos and photos supporting this dive are too numerous to include in the daily diary but are held in the applicable folder and will be made available to Dan on his next visit

Day 7 – 12th July 2019

Location (s)

- **Dive Site 10 -** 50 32.009; 02 3.734 (WGS 84)

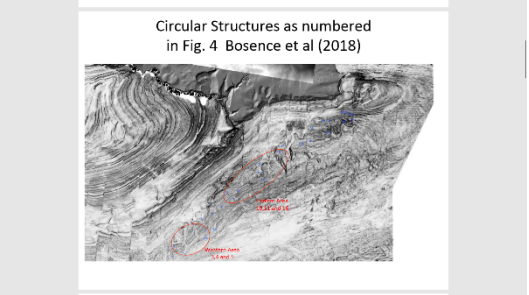
Participants

- Pete Mensikov – Project Manager
- Chris Dunkerley – Diver
- Keith Coombs – Diver
- Jeremy Goodall – Diver

Site – Approx 3 miles South and a little West of St Aldhelms Point. Low water slack approx. 34M

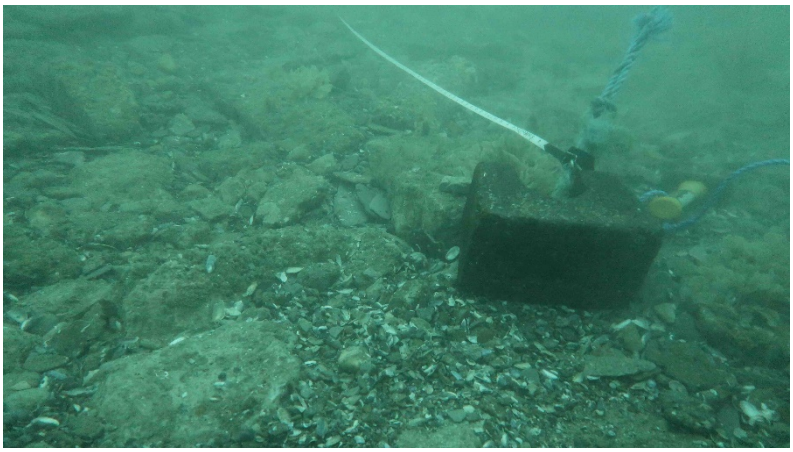
This was the second, in the Eastern block, of the 6 prime sites chosen by Dan as being potentially the most likely to provide the geological information needed.

A very straightforward, nicely timed arrival on site with the tidal information previously gained from site 16 being put to good use.



The team of 4 divers on board today were all involved in previous "Bumps" dives and were well prepared. The team split into 2 pairs, one North, and one South of the shot.

Visibility was around 3M with a "No-stop" operational window of 11 minutes. There was a current running of about 0.5 knots on descent but zero on reaching the bottom, throughout the dive and on the ascent.

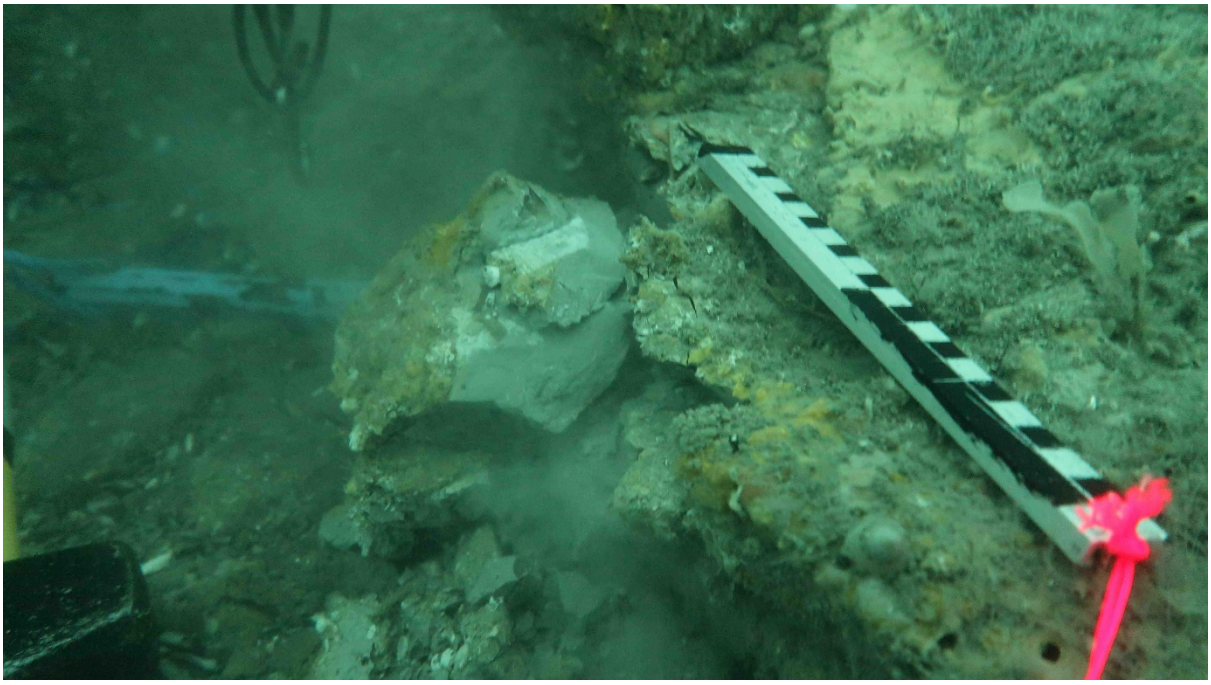


All four divers had expected this site to be very similar to the last site dived in this sector (site 16) which was difficult to sample; however they were extremely surprised and pleased, once they got to the shot to be faced with a bottom that could be described as "text-book"; very little surface growth and significant ledges that cleaved easily and cleanly.

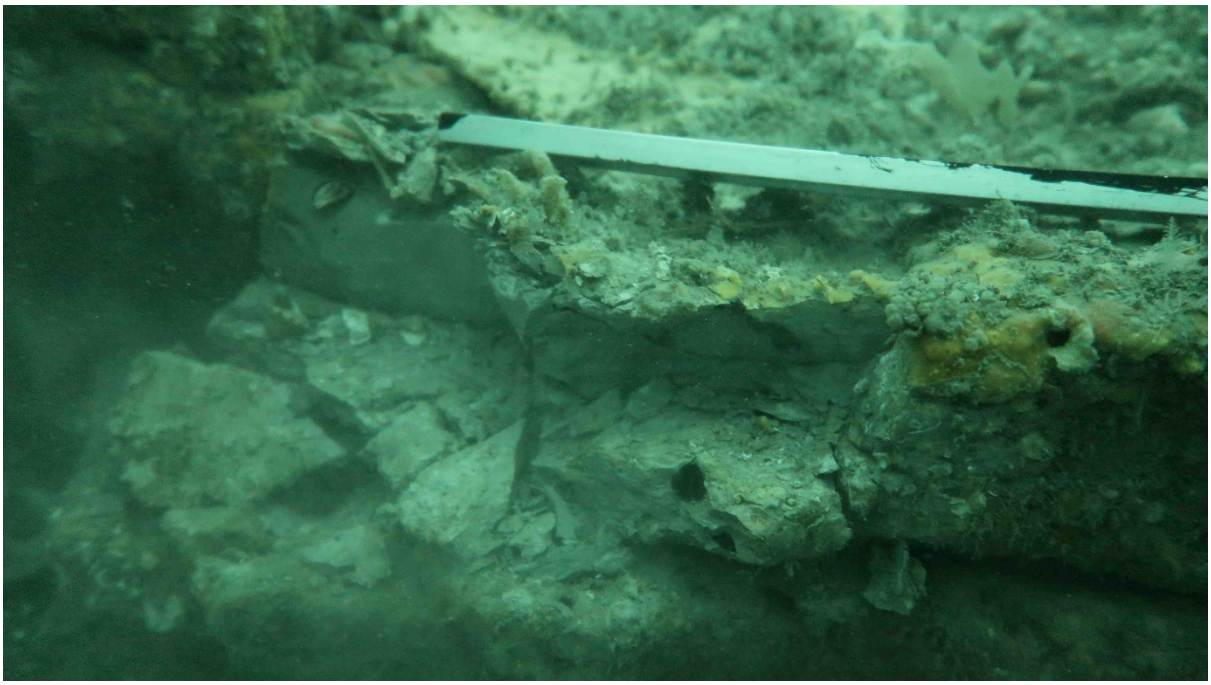
This series of photos could easily be taken for the previously mentioned "text-book":-

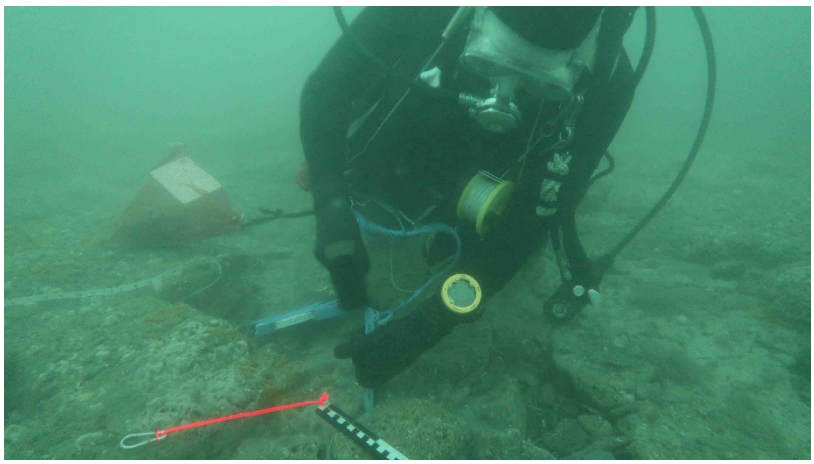
The chosen sample near the shot prior to cleaving.

The sample cleaved, referenced against the 1cm chequered rule and ready for bagging



The sample site after the sample has been bagged.





However not everything was text-book! The diver working 5M North soon had his complacency shaken when his selected site cleaved easily leaving him with a sample so big that only just fitted the sample bag – ideal for Dan to work on but when the diver moved the bag he realised that his buoyancy would be badly affected and thereby safety on the ascent might well be compromised; time was too short to reduce the sample so it was attached to the shot. This is not ideal as the shot is recovered by a powered winch over the bow of the boat. Fortunately, the sample bag and contents arrived topside intact.

The divers had been briefed that one sample at this depth was the target and two was a bonus. Both pairs achieved the bonus with no deco penalties.

Summary
An ideal site for divers, an ideal set of samples for Dan.

A number of observations were made: -

- Don't assume the strata; each site needs to be judged on arrival at the bottom.
- The photos supporting this dive are too numerous to include in this diary but are held in the applicable folder and will be made available to Dan on his next visit

Day 8 – 26th July 2019

Location (s)

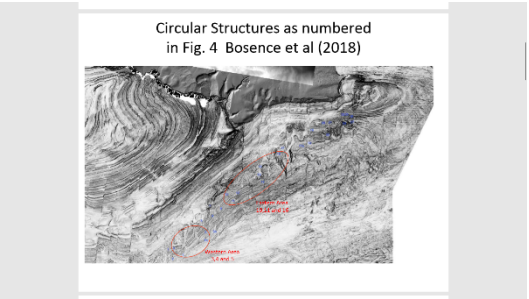
- **Dive Site 11 -** 50 31.850; 02 3.425 (WGS 84)

Participants

- Mike Wilson - Diver
- Chris Dunkerley – Diver
- Jeremy Goodall – Diver
- Nick Reed – Diver

Site – Approx 3 miles directly South of St Aldhelms point. Low water slack approx. 35M

This was the third dive on the Eastern prime sites chosen by Dan as being potentially the most likely to provide the geological information needed.

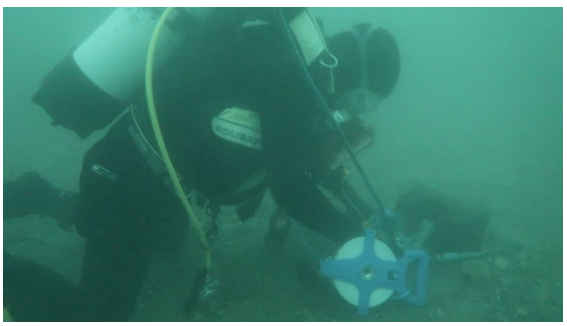


Despite being only ½ a day after the Met Office had declared "The highest temperature ever recorded in the British Isles" conditions were not ideal. The seastate was "moderate", a RIB would have aborted after coming around Anvil Point.

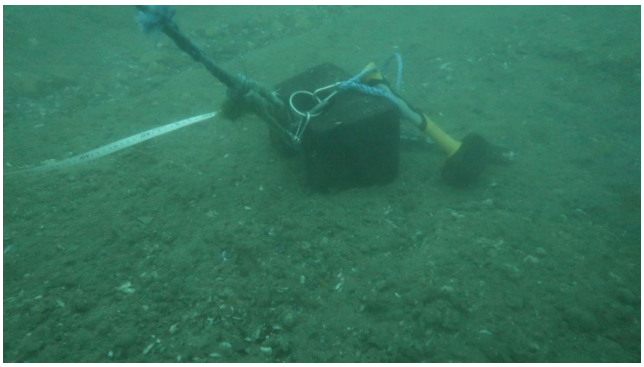
On site the 56 lb shot was deployed but the significant swell was causing it to jump along the bottom, it was recovered and an additional length of rope was added to minimise the swell effect. The 2nd deployment was successful and clearly validated during the dive with the skipper taking this photo of his instrument showing a split screen view of GPS position against sonar in which the shot line and the two descending divers can clearly be seen, a mere 1.5M form the designated position.

The team of 4 divers easily split into 2 pairs as two had selected Nitrox and two were on air. The dive plan called for the "Air pair" to enter first; the thinking behind this was that they would then be clear of the 6m safety stop when the "Nitrox pair" arrived.

Visibility was around 2M with a current running of about 0.5 knots on descent, zero on reaching the bottom and zero on ascent. The topside swell was clearly noticeable at bottom with the shot line continual "snatching", the shot did remain positioned but was clearly on the border



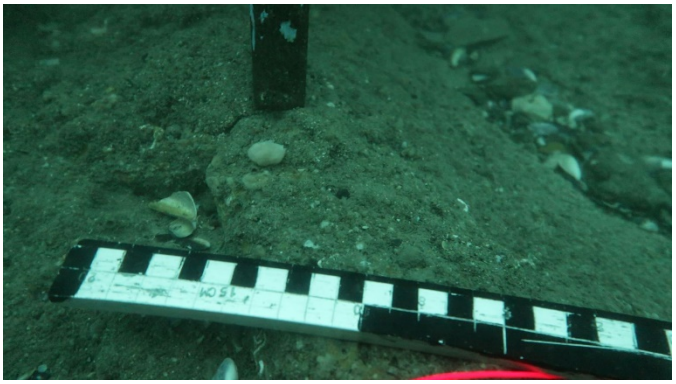
line of stability. The “No-stop” air operational window was 11 minutes. The hammer/chisel sets were badly tangled after the double descent and cost the first pair a vital minute or so.



3 samples were obtained; however, this was a difficult site. The bottom was flat and featureless as far as “sampling” was concerned. The chipper tasked to work at the shot had to move 5.8 metres from the shot before he could find anything suitable.

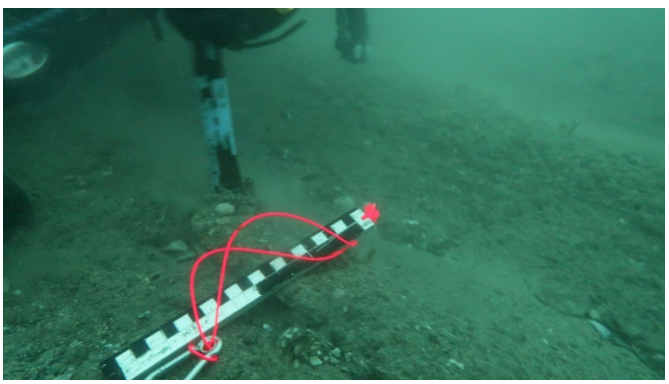
Even when a suitable site was found getting a decently sized sample was difficult, the single plate that was exposed was only about 20mm thick, fortunately the site was almost completely clear of marine growth, sand or gravel. Time was a huge issue; the divers were briefed that obtaining one sample was the target and getting two was a bonus, however the air pair with their one sample bagged still incurred a 1-minute deco penalty as their ascent started. The Nitrox pair obtained two samples but had a glitch with a bag clip and incurred an 11-minute deco penalty.

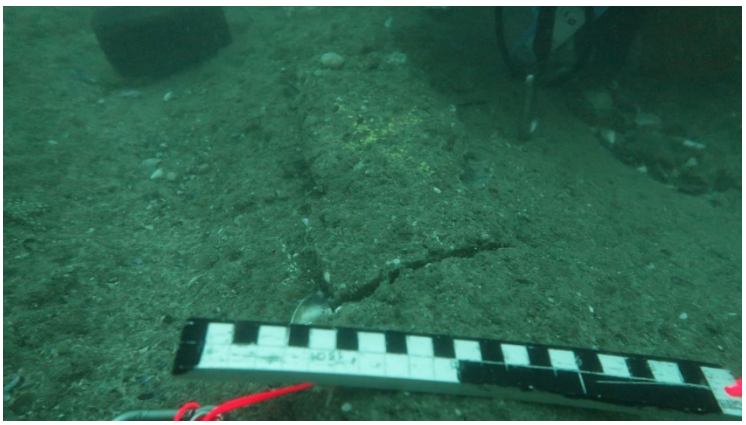
Both the chippers and photographers are now very clear what is required with the chipper pausing whilst the photographer frames the picture. This sequence in obtaining the 5.8M South sample nicely demonstrates the partnership.



Selection of site with chisel poised; chequer square reference markers are 1cm

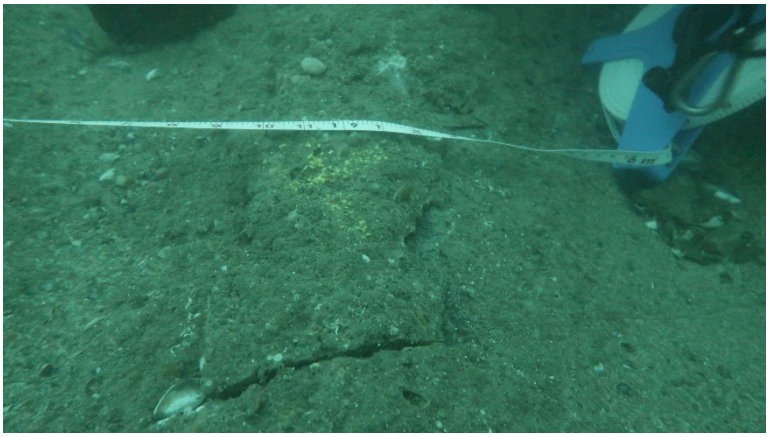
During the chiselling operations

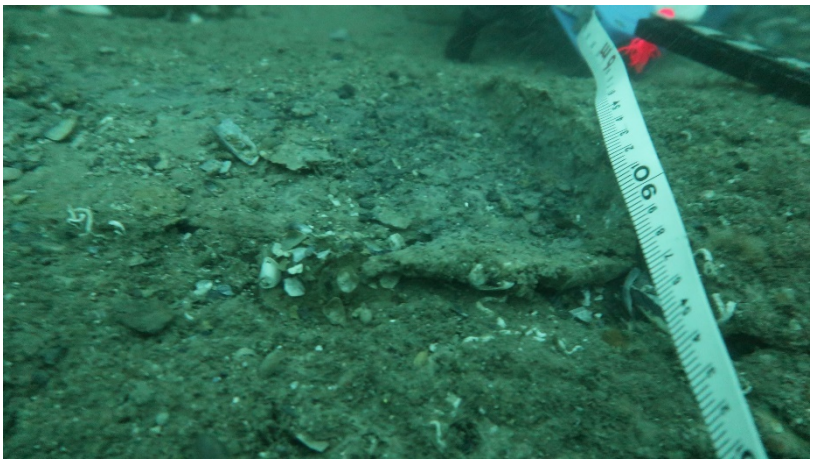




The sample is now loose but still in situ with its top face identified by the yellow wax marker.

Still in situ but now distance referenced from the shot datum by the tape





The site from which the sample was removed

Summary

This dive concludes sampling the three designated positions on the Eastern Site.

A number of observations were made: -

- The diver tasked with taking the sample at the shot “panicked” when a suitable site for chiselling couldn’t be found and went scuttling around with no regard to direction. Once a suitable site had been located and the sample taken the diver realised that he was 5m south

– a specific site given to the second pair – fortunately the second pair didn't bother with their compass as they had already agreed that during pre-dive brief that they would head off 180 degrees to the first pair's tape. The confusion on the "target" slates was corrected prior to the samples being tagged for Dan.

- Both the air divers felt seasick on their return to the boat. They both blamed the uncomfortable safety stop at 6M. The gas divers had 11 minutes on the stop but are both a lot more resistant to seasickness. During the post-dive discussion it was suggested that on future dives the photographer will be nominated dive leader; after their final picture they have time to deploy a DSMB if they deem it necessary whilst the chipper bags his sample, winds up/unhooks the tape and attaches the hammer/chisel set to the shot.
- Again, the photos supporting this dive are too numerous to include in the daily diary but are held in the applicable folder and will be made available to Dan on his next visit

Day 9 – 23rd August2019

Location (s)

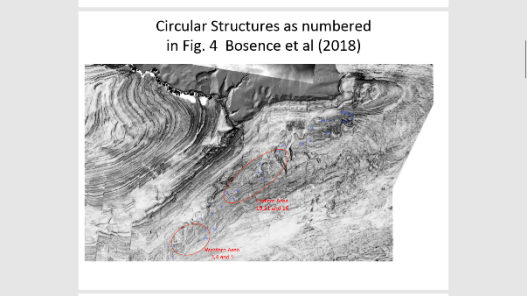
- **Dive Site 5 -** 50 30.766; 02 5.136 (WGS 84)

Participants

- Keith Coombs - Diver
- Chris Dunkerley – Diver
- Jeremy Goodall – Diver
- Pete Mensikov – Project Manager

Site – Approx 5¾ miles directly South of Ropelake Head. Low water slack approx. 35M

This was the first dive on the Western prime sites chosen by Dan as being potentially the most likely to provide the geological information needed.



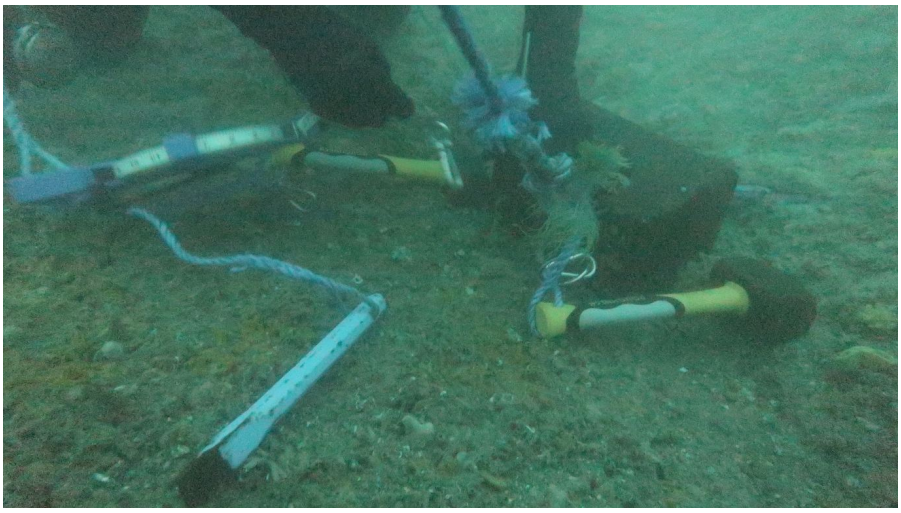
This particular dive had been blown out a fortnight ago due to some unseasonal storms with the unsettled weather continuing up until a couple of days before today. Once the charter boat was underway it was evident that the day, topside, was going to be perfect with hot sun and the sea like a mirror!

On site the 56 lb shot was deployed with 38M of line attached to avoid the "swell effect" that was experienced on the last dive. Interesting tidal condition was noted prior to entry; although only two days off a decent Neap the tide abated in accordance with the prediction but instead of the indicator bouy closing up to the main bouy (as is normally seen when slack is imminent) it started to veer, very gently but very clearly. It is suspected that this site being very close to the end of St Albans Ledge was being subjected to peculiar and localised tidal behaviour.

The dive plan had been amended slightly and the team were reminded of this change prior to descent – the photographer is to determine whether or not to deploy the delayed buoy based not just on bottom conditions but also anticipated state of the shot once the 6M mark is reached. The reason for this emphasis is that on the previous dive two divers were complaining of seasickness caused by hanging on the shot that was replicating unpleasant surface conditions.

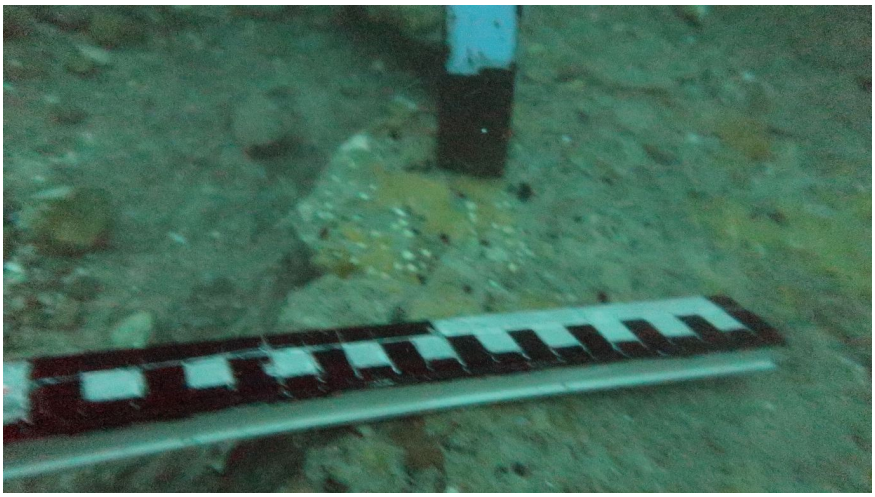
The team of 4 divers split into 2 pairs with a planned few minutes delay on entry for the second pair to ensure that on ascent the 6M point on the shot only served one pair at a time.

Visibility was poor, probably the result of the last two weeks. For the first 10M of descent everything looked good but by 20M it was getting very dark and at the bottom it was down to not much over a 1M, the auto-shutter on the camera struggling to cope. The current was gently running throughout the descent, dive and ascent but at less than 0.5 knots; neither impeding safety or the task. The "No-stop" air operational window was 11 minutes.

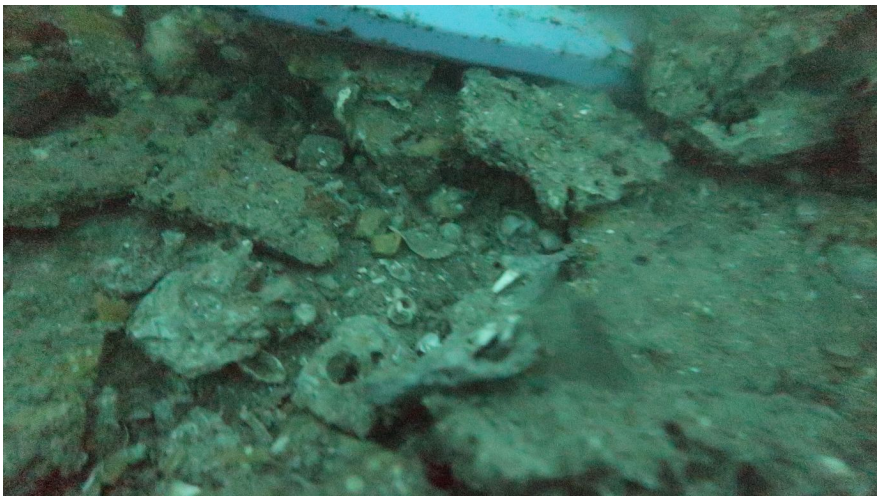


3 samples were obtained; however, again this was a difficult site. The bottom was reasonably clean of loose debris or marine growth. It was flat with limited sites for sampling. The chipper tasked to work at the shot had to move 2 metres from the shot before he could find anything that looked suitable.

The three ledges that were worked on were all deceptive with small, almost unnoticeable holes on the surface but once the chisel blade entered the sample piece would crumble away rather than cleaving cleanly. It appears from inspection that honey-combing of the bed has been achieved by marine life boring into the bed and then enlarging their habitat as they grew.



These two photographs are before the chisel blow and after the blow. A frustrating experience when time is very much against the diver.



Chequer square reference markers are 1cm

Again, here at 5M south initial inspection of the bed gives the impression that a useful size "lump" can be achieved…….

……. but in fact, the sample that comes away only just has enough substance to permit machining and polishing prior to microscopic examination.

Summary

This dive is the first of the series of three on the Western Site.

A number of observations were made: -

- The low visibility severely limited the selection of site but with both pairs obtaining similar samples perhaps this isn't an issue.
- The first pair only obtained one sample; post dive consideration was that the chipper was probably being too fussy with the size?

- The lack of a true “slack” needs to be considered when planning the next two dives in this Western area.
- Again, the photos supporting this dive are too numerous to include in the daily diary but are held in the applicable folder and will be made available to Dan on his next visit

Day 10 – 10th September 2019

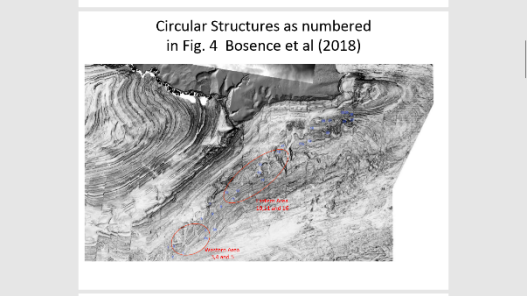
Location (s)

- **Dive Site 4 -** 50 29.870; 02 6.653 (WGS 84)

Participants

- Nick Reed - Diver
- Chris Dunkerley – Diver
- Jeremy Goodall – Diver
- Pete Mensikov – Project Manager

Site – Approx 6½ miles directly South of Grey Ledge. Low water slack 37.3M



This was the second dive on the Western prime sites chosen by Dan as being potentially the most likely to provide the geological information needed.

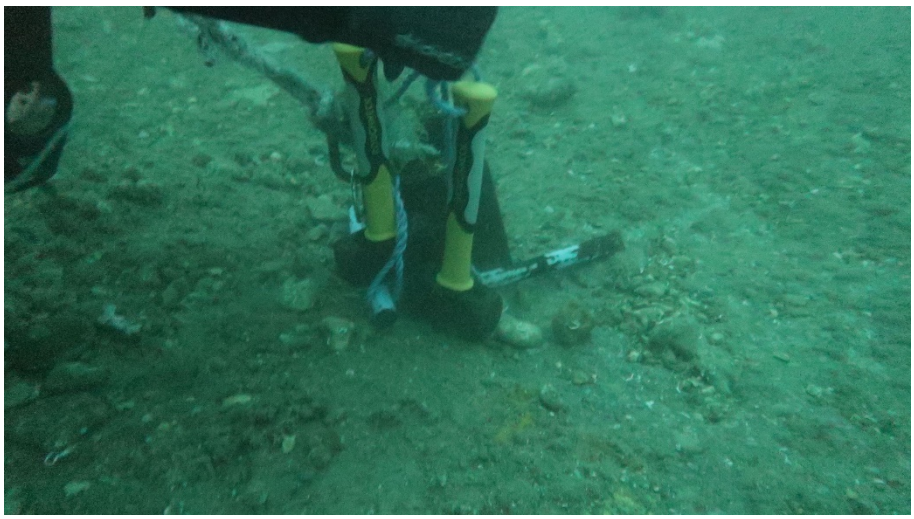
Good conditions with sea-state "smooth" and SW F3.

On site the 56 lb shot had to be deployed twice as the first deployment started dragging even though there wasn't a lot of tide left; it looked as though the buoy was being dragged down - there was probably an inadvertent bight in the line, shortening it and causing the problem; the second deployment was on target and stable.

The dive plan had been amended, last minute, to plan B reflecting one diver cancelling due to illness; however the remaining team of 4 were all experienced and no problems were envisaged.

The team of 4 divers split into 2 pairs with a planned few minutes delay on entry for the second pair to ensure that on ascent the 6M point on the shot only served one pair at a time.

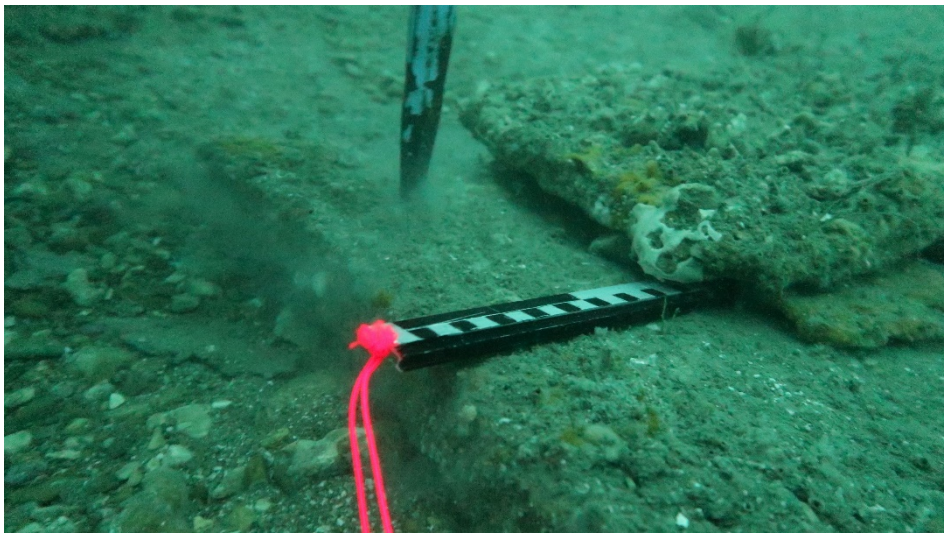
There was a slight current running on the descent but for the dive and final ascent nothing at all was felt. Visibility was around 3M. The "No-stop" air operational window was 13 minutes.



4 samples were obtained. This was an interesting site (as far as the diver working on the shot could see) in as much it was a flat surface with two beds clearly visible. The top bed around 25mm thick with the lower bed around 10mm thick.

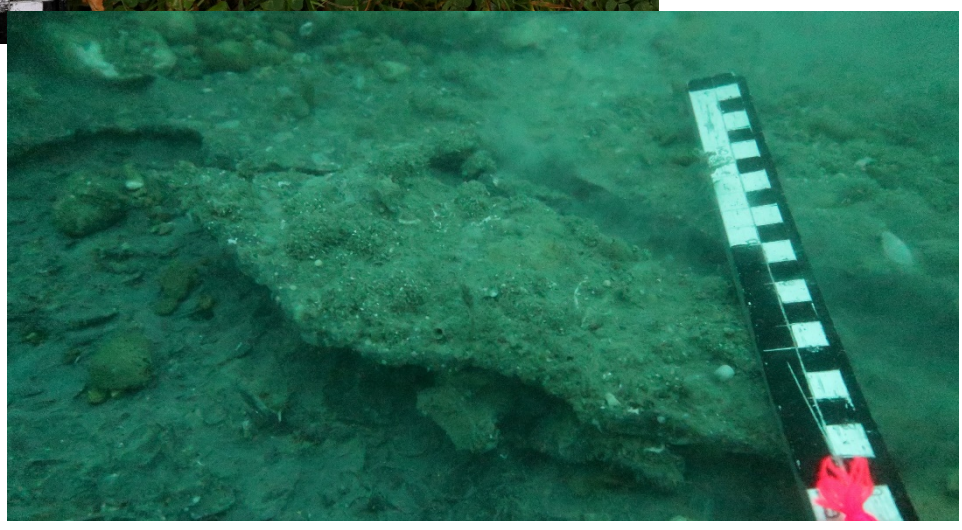
The bottom was reasonably clean of loose debris with a few areas of soft marine growth 20mm thick. What was noted however were numerous, loose pieces, 200 to 300mm across of what looked like the lower bed. These were quickly examined but left in situ following Dans instruction that only bedrock was to be recovered.

The chipper on the shot selected the thicker bed for the sample; it cleaved well and a decent sized sample was achieved. The scale rule has been wedged under one of the large loose pieces of 10mm bed discussed earlier.



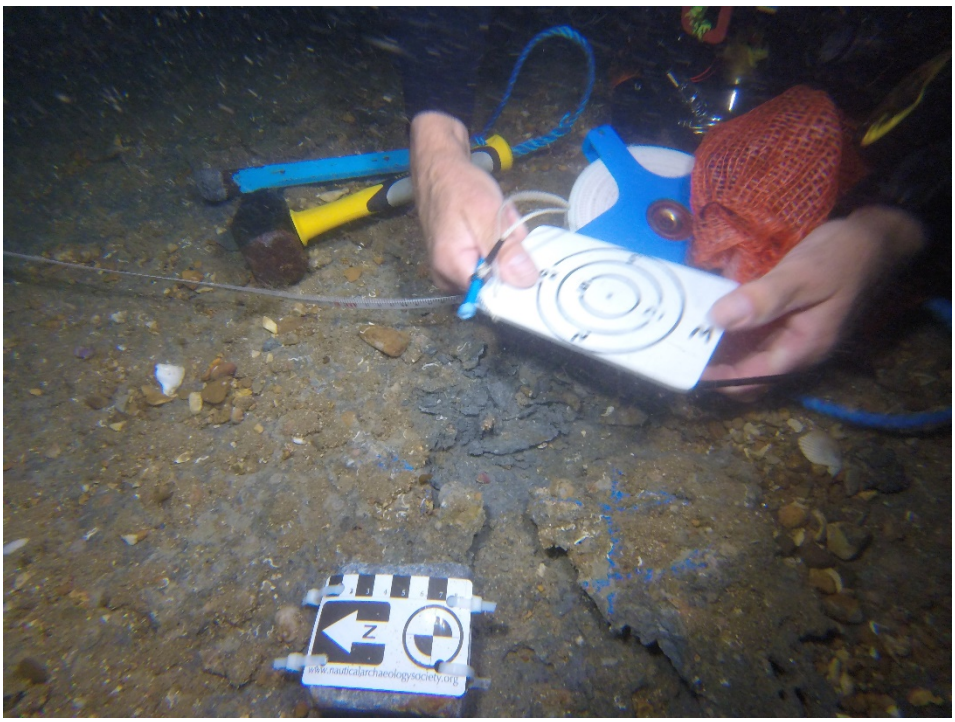
What was particularly interesting in this sample wasn't discovered until it was examined in the dry. It is actually two beds in one sample as can be seen from the side-on view of the cleaved surface.

The hunt for a suitable "5M North" sample

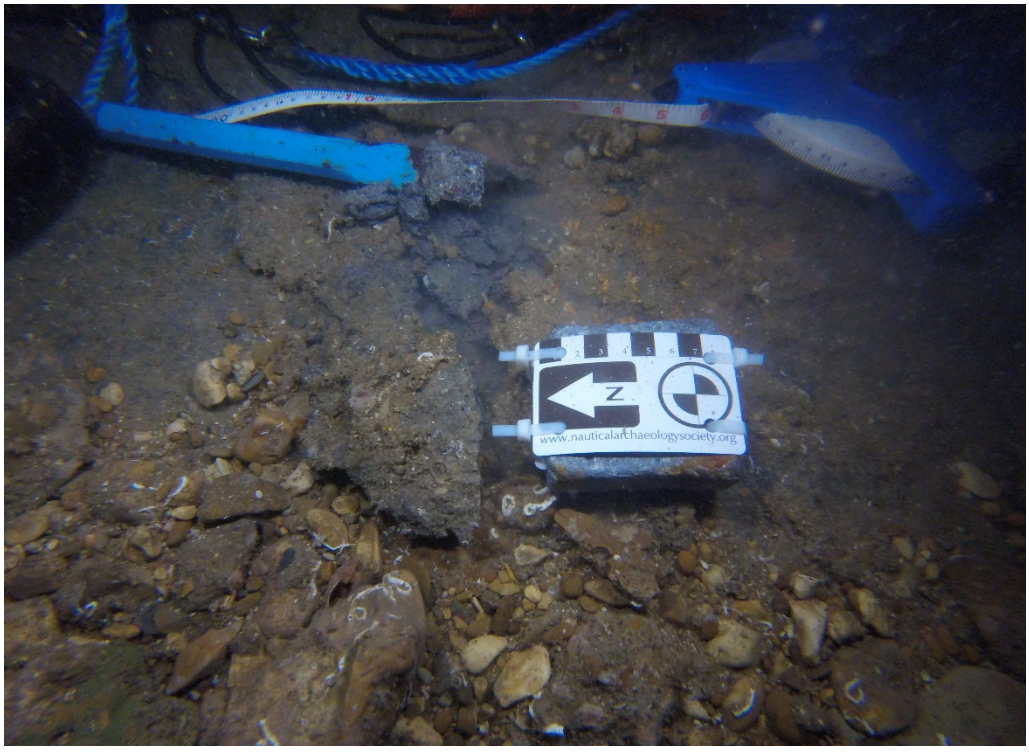


site was frustrated by the abundance of the loose pieces of bed, initially appearing to be fixed but as soon as they were touched it was apparent that they had either broken away or had been swept in by the current. A decent sample site wasn't found until the tape showed 15M. The sample cleaved well and remained intact, although boring was present it was minimal.

An operational glitch occurred at this time; the chipper recorded 15M North on the target slate but after the dive the photographer said it was more likely 10M as the tape had "looped". The photographer thought the shot had moved. Movement of the shot would also affect the accuracy of measurement of the pair working South on their second sample.



At the 5M South site a new tool was successfully introduced to the project. It is a credit card sized piece of plastic and provides on one side a "North" pointer and cm scale and on the other side a 2mm scale and colour chart – it is a product produced by the Nautical Archaeology Society. The photo shows it in use strapped to a piece of lead for stability.



The 10M sample was taken from "inside" the bed rather than on the edge of it, although this picture shows it a short video makes it much clearer. This will be

available to Dan on his next visit.

Summary

This dive is the penultimate one of the project.

A number of observations were made: -

- As well as numerous photos, additional to those used in this diary, a video is available showing a different sampling technique.
- Now that the divers are becoming consistent and proficient in obtaining the all-important samples it is perhaps worth considering having a “surplus” diver swimming around both teams in order to gain an overall impression of the site. It is clear that with the limits of time both the photographer and the chipper are far too focused to consider sightseeing themselves.

Day 11 – 22nd October 2019

Location (s)

- **Dive Site 10 -** 50 32.009; 02 3.734 (WGS 84)

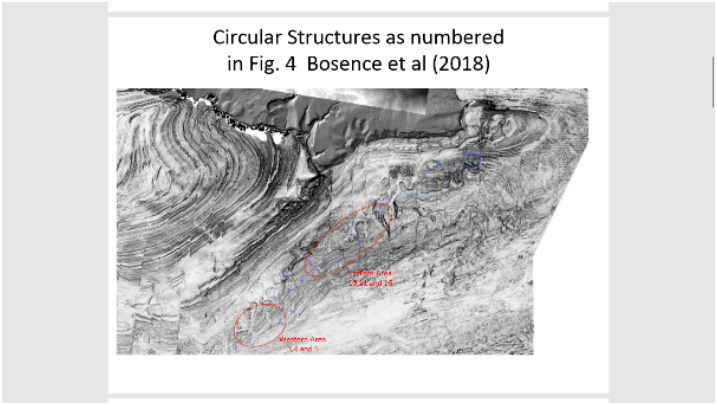
Participants

- Pete Mensikov – Project Manager
- Chris Dunkerley – Diver
- Keith Coombs – Diver
- Jeremy Goodall – Diver
- Mike Wilson – Diver
- Stephan Spiriak – Diver
- Dan Bosence – Scientific Advisor

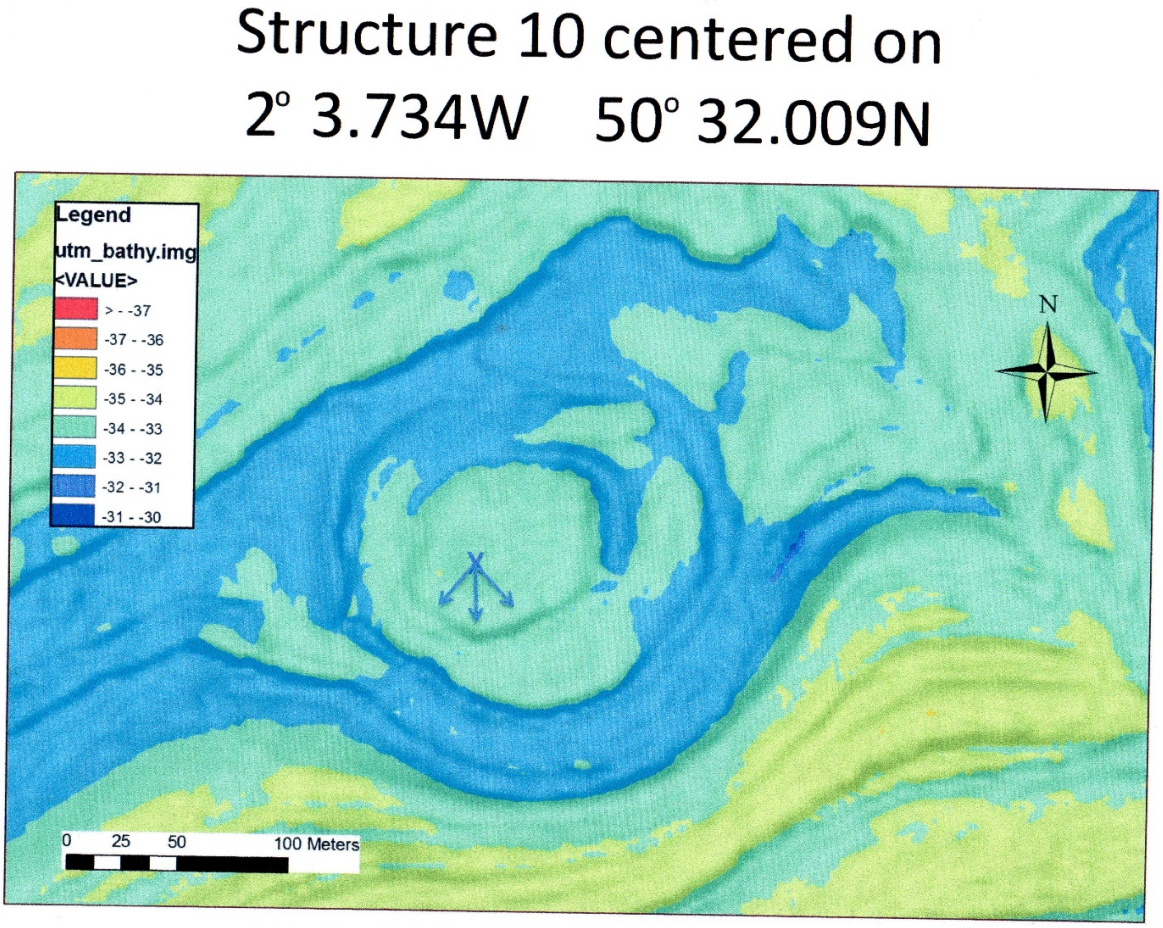
Site – Approx 3 miles South and a little West of St Aldhelms Point. Low water slack approx. 34M

This was the second visit to this site and was required by Dan to investigate further an interesting anomaly arising from the microscopic examination of the Sample "10M South of the shot" obtained in July.

As well as the normal sampling and photography it was decided to undertake a visual survey of the area of interest.



The printout below, provided to both the divers and skipper, defines the sector of interest as an arc of 90^0 from the shot position (The convergence of the 3 vector arrows in blue) bounded by the SW vector, the southern lip (legend turquoise 33-34) and the SE vector.



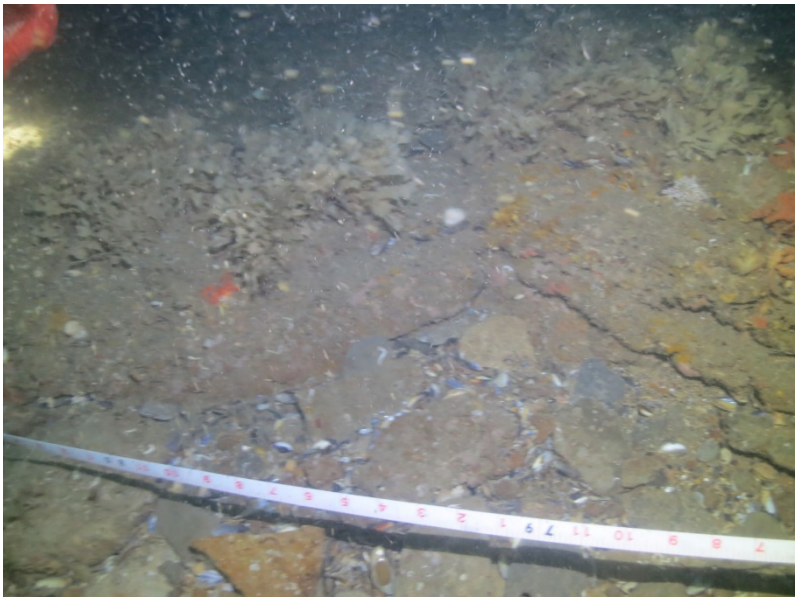
The shot was deployed, position checked and on this occasion the dive commenced early; this was a deliberate ploy to optimise the last remnants of the ebb to minimise the effort required by the "sightseeing" diver. The dive plan for the "sightseeing" diver was to pull down to the shot against the tide and then once on the bottom clip-on a "distance flagged" reel line and drift with the tide (approx. 270^0 ,the white rope is the surface buoy line and nicely demonstrates the angle of ebb) noting features up until the 35m flag then commence an arc covering the sector of interest using the "lip" as a boundary. The intention was that this diver's line would have swept through the dive site and be clear of chippers 3 vector tapes by the time they were ready to start.

The rest of the team of 5 divers on board were all involved in previous “Bumps” dives and were well prepared. The team split into a pair and a three for ascent/decent. With the emphasis on sampling it was decided that the SW and SE vector divers would share a photographer. The diver going south would have his own dedicated photographer.

Visibility was around 4M with a “No-stop” operational window of 14 minutes. There was a current running of about 0.5 knots on descent but zero on reaching the bottom, throughout the dive and on the ascent. The “Sightseer” had a planned, extended dive and ascended on a DSMB as the Flood commenced.

The pair heading South swam out on their tape and validated both the positioning of the shot and the site print-out by locating the “lip” at around 30M. Whilst the chipper was setting up the photographer took this shot of the “lip”. NB The sightseer also recorded the lip at 41M West.

It was interesting just how different the “lip” at 30M South was from the bed rock seen here at 25M South West (the tape was inverted here showing the imperial measurement of 79 feet)



The divers had been briefed that one sample at this depth was the target and two was a bonus. 5 samples were obtained in total from the 3 target areas.

Summary

A good set of samples and a fine validation of shot position coupled with DORIS data against site measurement.

A number of observations were made: -

- The “Sightseer” provided a full report but due to light levels and an initially erroneous compass reading the survey produced minimal useful geological data; however, lessons learnt from the exercise will be significant in how this task is approached in the future.
- The 25M swim with equipment to the first sample site consumed valuable bottom time; but due to the requirement of a circular/arc search also being required it was accepted as “a necessary evil”
- The photos supporting this dive are too numerous to include in this diary but are held in the applicable folder and will be made available to Dan on his next visit
- A video was produced of the SW and SE vectors; this will be made available to Dan on his next visit
- Difficulties with shared photographer (however the conscious decision was taken that samples take precedent)
- The NAS “directional/scale credit cards” need to be used, if and, when they become available