

Offshore Special Area of Conservation (SAC): Braemar Pockmarks

SAC Selection Assessment Document



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Version 5.4 (March 2018)

¹ Atlantic wolf fish hiding beneath Methane derived authigenic carbonate (MDAC) overhangs at Braemar Pockmarks SAC © Oceana

Introduction

This document provides detailed information about the Braemar Pockmarks Special Area of Conservation (SAC) and evaluates its interest feature (Submarine structures made by leaking gases) following the EC Habitats Directive² selection criteria and guiding principles. The site was submitted to the European Commission in 2008 for the protection of Annex I habitat Submarine structures made by leaking gases, approved as a Site of Community Importance (SCI) in 2009 and designated as a SAC in 2015. Analysis of additional survey data collected in 2012 (reported in Gafeira & Long 2015) recorded the presence of the interest feature beyond the previous site boundary. This document is a revised version of JNCC's Selection Assessment Document that supported the original site nomination, taking into account the newly available information.

The advice contained within this document is produced to fulfil the requirements of JNCC under the Conservation of Offshore Marine Habitats and Species Regulations 2017, relating to the conservation of natural habitat types and habitats of species through identification of Special Areas of Conservation (SACs) in UK offshore waters. Under these Regulations, JNCC has an obligation to provide certain advice to Marine Scotland and Defra to enable the Secretary of State and Scottish Ministers to fulfil their obligations under the Regulations as well as to Competent Authorities to enable them to fulfil their obligations.

Sites eligible for designation as offshore marine SACs are selected using the criteria set out in Annex III (Stage 1) of the Habitats Directive and relevant scientific information. Sites are considered only if they host a Habitats Directive Annex I habitat or Annex II species. Socio-economic factors are not taken into account in the identification of sites to be proposed to the European Commission³.

In addition to information on the Annex I habitat (Submarine structures made by leaking gases) found within the site, this document contains i) a chart of the site, ii) its name, location and extent, and iii) the data resulting from application of the criteria specified in Annex III (Stage 1) of the Habitats Directive. This complies with the legal requirements outlined under Regulation 7. JNCC has adhered to the format established by the Commission for providing site information. This format is set out in the 'Natura 2000 Standard data form' (CEC 1995) (prepared by the European Topic Centre on Biological Diversity on behalf of the European Commission to collect standardised information on SACs throughout Europe).

NOTE: No recent evidence is available to infer any changes to the non-qualifying features listed in the original Site Assessment Document. The present document only updates our formal advice for the designated feature Submarine structures made by leaking gases.

² See: <http://jncc.defra.gov.uk/page-1445>

³ Following European Court of Justice 'First Corporate Shipping' judgement [C-371/98](#) (7 November 2000)

Document version control

Version	Issue date	Amendments made	Issued to and date
5.4	13.03.18	Cover image updated following Sub Group review	Scottish Government (March 2018)
5.3	22.01.18	MPA Programme Leader sign-off	MPA Sub group (January 2018)
5.1	10.01.17	Addressing comments from public consultation	
5.0	11.07.17	Finalised for public consultation	
4.7	06.07.17	Updated following comments received from programme leader review	Marine Scotland (July 2017)
4.6	30.05.17	Updated following comments received from the MPA Sub-Group	
4.5	26.05.17	Document updated to reflect new data and proposed site boundary change to incorporate revised extent of pockmarks incorporating verified and potential Submarine structures made by leaking gases.	MPA Sub-Group (May 2017)
4.1	09.01.12	Minor changes made, overall document not reviewed, changes include site map amendment with new depth data and corrected coordinates, document dates, contact details and layout updated.	
4.0	01.07.08	Post consultation modifications, including site boundary amendment	Secretary of State (July 2008)
3.1	13.11.07	Draft SAC changed to possible SAC	Public consultation (Dec 2007)
3.0	25.05.07	New introductory text, revised site summary and map layout, heading & text amendments Additional guiding principles for site selection incorporated under Global Assessment Conservation Objectives and Advice on Operations moved to separate document	JNCC Committee (June 2007) and UK Marine Biodiversity Policy Steering Group (Sept 2007)
2.0	26.08.06	Draft Conservation Objectives and (revised) Advice on Operations added. Map layout revised	Defra, Devolved Administrations, and other Govt. departments (Sept 2006)
1.0	09.05	Site boundary defined; site, habitat and data maps created; report edited	JNCC Committee (Sept 2005), Defra (Dec 2005)

Further information

This document is available as a pdf file on JNCC's website for download (jncc.defra.gov.uk).

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Braemar Pockmarks: SAC Selection Assessment

1. Site name Braemar Pockmarks	2. Site centre location 58°59'11", 1°28'29" (Datum: WGS 1984 UTM Zone 31 North, calculated in ArcGIS)
3. Site surface area 1143 ha/11.43km ² (Datum: WGS 1984 UTM Zone 31 North, calculated in ArcGIS)	4. Biogeographic region Atlantic

5. Interest feature(s) under the EU Habitats Directive

Habitat code: 1180 - Submarine structures made by leaking gases

6. Site summary

The Braemar pockmarks are a series of crater-like depressions on the sea floor, six of which contain verified records of the Annex I habitat Submarine structures made by leaking gases (Gafeira and Long, 2015). In this location, large blocks, pavements slabs and smaller fragments of methane-derived authigenic⁴ carbonate (MDAC) have been deposited through a process of precipitation during the anaerobic oxidation of methane (AOM) by a unique community of microbial organisms. This AOM activity at the sulphate-methane interface (SMI) beneath the seabed results in the presence of hydrogen sulphide in the sediments. The sulphide-rich sediments may host specialist organisms, for example those with chemosynthetic symbionts, whilst the carbonate structures provide a habitat for marine fauna usually associated with rocky reef (Judd 2001). Larger blocks of carbonate can also provide shelter for fish species such as wolf-fish.

The name of the site originates from its proximity to the Braemar oil field in the northern North Sea, approximately 240 km east of the Orkney Islands. The site is situated to the north of the Witch Ground Basin at a water depth of approximately 120 m. The pockmarks within the site are shallow, ovoid, seabed depressions, several metres across, which were created by the expulsion of fluids into the water column (Hovland *et al.*, 2002). It is in the base of these pockmarks where MDAC is formed beneath the seabed. Most of the pockmarks in the Witch Ground Basin occur in very soft muds, however the pockmarks in Braemar Pockmarks SAC occur in firmer, slightly coarser sediments (Gafeira and Long, 2015).

Forty-eight pockmarks have been identified within the Braemar Pockmarks Special Area of Conservation (SAC) boundary; all of which are greater than 20 m in diameter, the largest being 200 m in diameter. Six of the pockmarks have verified examples of the Annex I habitat Submarine structures made by leaking gases, with a further 14 showing strong acoustic reflectance. The high backscatter may be indicative of hard carbonate structures so are considered as potential feature records associated with pockmarks (JNCC, 2016). Both verified and potential occurrences of the habitat are considered to represent the known extent of the feature within the site (JNCC, 2016).

The Braemar Pockmarks SAC occurs in the Northern North Sea Regional Sea (JNCC 2004; Defra 2004). There is one other SAC in the Northern North Sea with Submarine structures made by leaking gases as a qualifying interest feature of the site. Scanner Pockmark SAC is situated to the south-west of Braemar pockmarks SAC. There is also a candidate Special Area of Conservation/Site of Community Importance (cSAC/SCI) for the feature in the Irish Sea – Croker Carbonate Slabs cSAC/SCI. Notable characteristics of these other sites identified for the interest feature are provided in the table below with links provided to further information on these sites.

SAC	Notable characteristics of interest feature
Scanner Pockmark	The faunal communities within the site have previously represented assemblages typically associated with rocky reef, colonising the carbonate structures in the base of the pockmarks. Although pockmark infilling appears to have obscured MDAC structures and

⁴ An authigenic sedimentary rock deposit is one that was generated where it is found or observed. Sedimentary authigenic minerals include calcium carbonate.

	bacterial mats, there are still large numbers of the nematode species <i>Astomonema southwardarum</i> , known to host endosymbiotic, chemoautotrophic bacteria within their body cavity (Rance et al., 2017). However, as a result of the obscured carbonate structures, typical species assemblages appear to be more similar to wider soft sediment ecosystems.
Croker Carbonate Slabs	The seabed surface in this site is composed of extensive areas of exposed MDAC. The seabed habitats created by these MDAC structures are distinctive, supporting a diverse range of marine species that are absent from the surrounding seabed characterised by coarse sediment (Judd, 2005). Areas of 'high relief' MDAC support a diverse range of soft corals, erect filter feeders, sponges, tube worms and anemones whilst the 'low relief' MDAC is colonised with scour-resistant hydroids and bryozoans (Whomersley <i>et al.</i> , 2010).

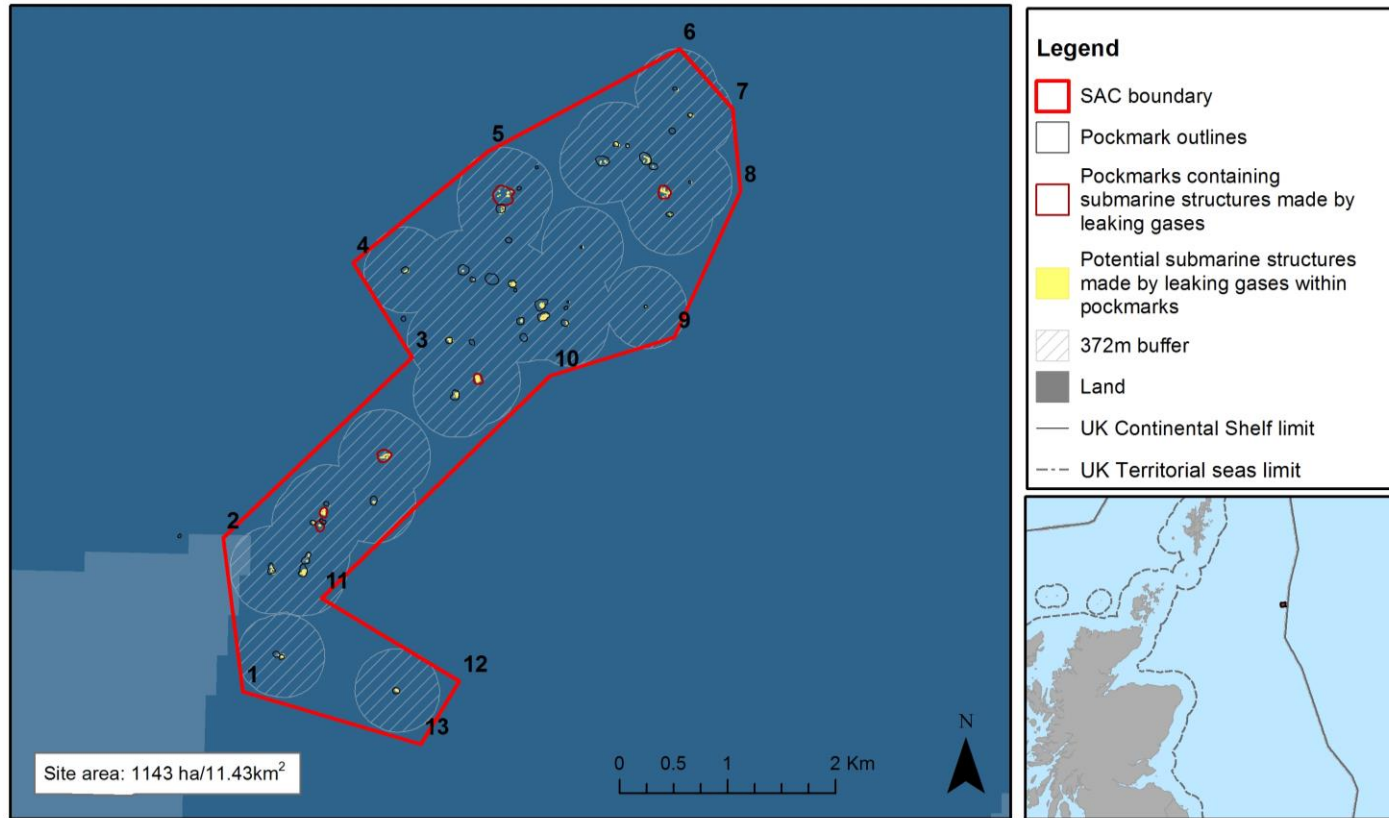
In character, the interest features of the Braemar Pockmarks site are similar to Scanner Pockmark SAC; however, the carbonate structures at Braemar are more abundant and diverse in form than the Scanner Pockmark SAC, and appear to be characterised by slightly different species assemblages.

7. Site boundary

The boundary for the Braemar pockmarks SAC encompasses all verified and potential records of the Annex I habitat Submarine structures made by leaking gases recorded in the area (based on evidence presented within Gafeira and Long 2015). Using JNCC's guidance (2012) on defining boundaries for marine SACs for Annex I habitat sites fully detached from the coast, a 3:1 ratio of distance from a feature to depth ratio was used to create a buffer on a precautionary basis around examples of the feature. The proposed amendment to the site boundary was drawn from the outermost edges of the buffers. Maximum water depth in the site is 124m therefore a buffer of 372m has been applied around all potential and verified records of the feature.

8. Map of site

Figure 1: Map of current boundary of the SAC showing the proposed amendment, alongside the known distribution of verified and potential records of Annex I habitat Submarine structures made by leaking gases.



Boundary coordinates:

- 1) 58° 57' 31", 1° 26' 15" 2) 58° 58' 17", 1° 26' 2" 3) 58° 59' 12", 1° 27' 49" 4) 58° 59' 40", 1° 27' 13" 5) 59° 0' 14", 1° 28' 30"
 6) 59° 0' 46", 1° 30' 20" 7) 59° 0' 29", 1° 30' 51" 8) 59° 0' 4", 1° 30' 57" 9) 58° 59' 20", 1° 30' 21" 10) 58° 59' 8", 1° 29' 9"
 11) 58° 57' 60", 1° 26' 60" 12) 58° 57' 36", 1° 28' 21" 13) 58° 57' 17", 1° 27' 59"

Site map projected in UTM (Zone 31N, WGS84 datum). Seabed habitat derived from BGS 1:250,000 seabed sediment maps © NERC and SeaZone bathymetry. Bathymetry © British Crown Copyright. All rights reserved. Permission Number Defra012012.002. This product has been derived in part from material obtained from the UK Hydrographic Office with the permission of the Controller of Her Majesty's Stationery Office and UK Hydrographic Office (www.ukho.gov.uk). NOT TO BE USED FOR NAVIGATION. The exact limits of the UK Continental Shelf are set out in orders made under section 1(7) of the Continental Shelf Act 1964 (© Crown Copyright). Map copyright JNCC 2018.

9. Assessment of interest feature(s) against selection criteria

This assessment has been undertaken following UK guidance set out in JNCC (2009).

9.1 Submarine structures made by leaking gases

Annex III selection criteria (Stage 1A):

a) **Representativity**

The Braemar Pockmarks SAC occurs in the Northern North Sea Regional Sea. The faunal communities are representative of those present on Submarine structures made by leaking gases, consisting of anemones and hydroids, as well as chemosynthetic organisms (Dando *et al.*, 1991). However, the site has been subject to some damage from bottom trawling and there is evidence of this throughout the site (Gafeira and Long, 2015; Hartley, 2005). Lineations recognised on both side-scan sonar and multibeam backscatter data have been interpreted as fishing trawl tracks, including through the pockmarks themselves, but it is not possible to determine whether these are cumulative scars from fishing over time or whether these are from recent activity (Gafeira and Long, 2015). There have also been faint channels close to an abandoned wellhead that are likely to emanate from anchor mooring cables (Rance *et al.*, 2017).

The grade for the feature is B: Good representativity

b) **Area of habitat**

Taking into account the distribution of the two known sub-types of Submarine structures made by leaking gases in UK waters (bubbling reefs and submarine structures associated with pockmarks), Braemar Pockmarks SAC represents a relatively small proportion (approximately 0.3%) of the total known resource in UK waters. This is because a significantly greater recorded extent of the feature (55km²) occurs within the Croker Carbonate Slabs cSAC/SCI by comparison to Braemar Pockmarks (0.185km²). However, when considering the specific type included within this SAC, approximately 23% of the total known resource of MDAC associated with pockmarks is represented when considering all verified and potential records.

The grade for this criterion is A (site contains '15-100%' of total resource of Annex I habitat)

c) **Conservation of structure and functions**

Degree of conservation of structure

The biological and physical structure of the interest feature at the Braemar Pockmarks SAC is likely to have been partially impacted by bottom trawling. From Vessel Monitoring System (VMS) data (2009-2015), there is evidence of mobile and static demersal fishing effort within the Braemar Pockmarks SAC by both UK and non-UK registered vessels. Evidence of trawling scars from fishing have been identified throughout the area, with the majority of activity located to the north and outside of the Braemar Pockmarks SAC boundary (Rance *et al.*, 2017). The pockmarks within the site have been found to be irregular in shape, attributed either due to multiple venting points

in the pockmark or due to sidewall slumping (collapse of walls and partial infill of the pockmark bottom), which may have also attributed to changes in structure recorded between surveys (Gafeira and Long 2015). Nearly a quarter of the mapped pockmarks have evidence of slope failure, one event of which occurred in the 6 year period between the 2005 and 2012 surveys. The cause of slope failure is unknown, but may be either anthropogenic or natural (Gafeira and Long 2015). Despite this infilling, there are still multiple verified records of submarine structures associated with pockmarks within the site.

The grade for this sub-criterion is II: structure well conserved.

Degree of conservation of functions

The prospects of this feature in terms of maintaining its structure in the future (taking into account unfavourable influences and reasonable conservation effort) are good. Existing Regulations manage oil and gas activity in and around SACs on the UK continental shelf, and a mechanism is available through the European Commission's Common Fisheries Policy to manage fishing activity in the area if deemed to be necessary. The feature is distant from terrestrial sources of pollution, however debris has been recorded on the seabed from human activities such as oil and gas extraction and fishing activities (Gafeira & Long 2015).

The grade for this sub-criterion is I: excellent prospects.

Restoration possibilities

Restoration methods in the offshore area focus on the removal of impacts to allow recovery where the habitat has not been removed. Restoration of the biological communities at the Braemar Pockmarks site may be possible where the submarine structures have not been destroyed. However, where damage has occurred, the restoration potential is unknown. The MDAC is accreted naturally (and over long time periods) and further accretion is dependent on sufficient gas seepage as well as the presence of specific chemosynthetic micro-organisms. There is anecdotal evidence to suggest that the submarine structures are sustained by shallow biogenic gas seepage (John Hartley *in lit* 2005); however, if deeper petrogenic gas supports the structures, there is potential for a reduction in seepage if the underlying reservoir is depleted through commercial activities (Oil and Gas UK 2008). The periodic expulsion of large volumes of methane (Hong *et al.*, 2016) may also expel sediments from within pockmarks, which in turn may result in the uncovering of MDAC below the surface.

The grade for this sub-criterion is III: restoration difficult or impossible.

Overall grade

As set out in JNCC (2009) (Section 4.3 – Synthesis) aggregation rules dictate that due to the fact that structure is considered to be well conserved and that there are excellent prospects for conservation function, the overall grade equates to **A: Excellent conservation** irrespective of the grading for the third sub-criterion.

d) *Global assessment*

There are currently two other SACs with this habitat as a qualifying feature in UK waters. This site makes an important contribution to protecting an estimated 23% of the total known UK resource of the MDAC associated with

pockmarks type of the Annex I habitat Submarine structures made by leaking gases when considering all potential records of the feature. In addition, the interest feature of this SAC is considered to have good structure and function. As such, the global assessment is classed as **A: Site holds an excellent example of the Annex I habitat in a European context.**

Summary of scores for Stage 1a criteria

Area of habitat	Representativity (a)	Area of habitat (b)	Structure and function (c)	Global assessment (d)
Braemar Pockmarks	B	A	A	A

10. Sites to which this site is related

[Scanner Pockmark SAC](#); [Croker Carbonate Slabs cSAC/SCI](#)

11. Supporting scientific documentation

Overview of available evidence

An overview of example data collected from the Braemar Pockmarks SAC is provided in Figure 2.

The Braemar pockmarks were discovered initially during rig site surveys for Marathon Oil Ltd as part of the Braemar field development – hence its name. Further investigation was undertaken in 2001 during pipeline route surveys for the Braemar development. Still photographic images, grab samples of sediments and side scan sonar data provided data during these surveys. Subsequently, in 2003, a Technip Ltd ROV survey acquired video footage, further still images and grab samples of the fauna associated with the carbonate formations. This work has been summarised in a report produced by Hartley Anderson Ltd (Hartley, 2005).

JNCC and Cefas completed a dedicated scientific survey in 2012 to further investigate the Braemar pockmarks (Rance *et al.*, 2017). Ground truthing data were collected using a drop camera for still and video images, and a 0.1m² Day grab collected sediment samples that were sub-sampled for Particle Size Analysis (PSA) and benthic fauna data. Gafeira and Long (2015) used available survey data to undertake semi-automated mapping that helped to characterise the morphology of the pockmarks based on multibeam bathymetry. Backscatter and side scan sonar data were used to characterise the seafloor and associated MDAC. A total of 11 sediment samples recovered MDAC from six individual pockmarks. In addition, analysis of backscatter and side scan sonar data suggested high reflectivity signals from 14 pockmarks. These records could indicate further records of MDAC.

Geo-physical evidence

A total of 48 pockmarks have been identified within the Braemar pockmarks SAC boundary which correspond to accepted definitions of pockmarks (after Judd and Hovland, 2007). Most pockmarks are small to medium sized, with lengths varying from 22 m to 200 m and widths from 20 m to 189 m. Pockmark depths range from 0.32 m to 5.77 m. Of the pockmarks occurring within the site boundary, six have verified examples of Submarine structures made by leaking gases and 14 show acoustic signatures that indicate that the interest feature may be present. The pockmarks of the Braemar Pockmarks SAC occur in firmer, coarser sediments in contrast to most of those found in the Witch Ground Basin which may influence the

differences in pockmark size and make slope failure more likely (Gafeira and Long, 2015).

The pockmarks have been found to be irregular in shape, attributed either due to multiple venting points in the pockmark or due to sidewall slumping (collapse of walls and partial infill of the pockmark bottom). Ten of the mapped pockmarks appear to have multiple venting points resulting in a 'W'-shaped profile. The presence of several venting points, less than 50 m apart, could be related to complex multiple flow paths for the gas to reach the seabed from the underlying strata that may reflect intermittent seepage and blockage of flow paths (Gafeira and Long, 2015). Direct evidence for active gas seepage was provided by backscatter acoustic anomalies on side-scan and backscatter datasets. Several acoustic anomalies were interpreted to be due to streams of bubbles (gas flares) in the water column (Gafeira and Long, 2015).

Drop camera images and video footage have shown well developed carbonate cemented rocks (MDAC) in various forms: as large rocks, pavements, slabs and smaller fragments (Hartley, 2005).

Biological evidence

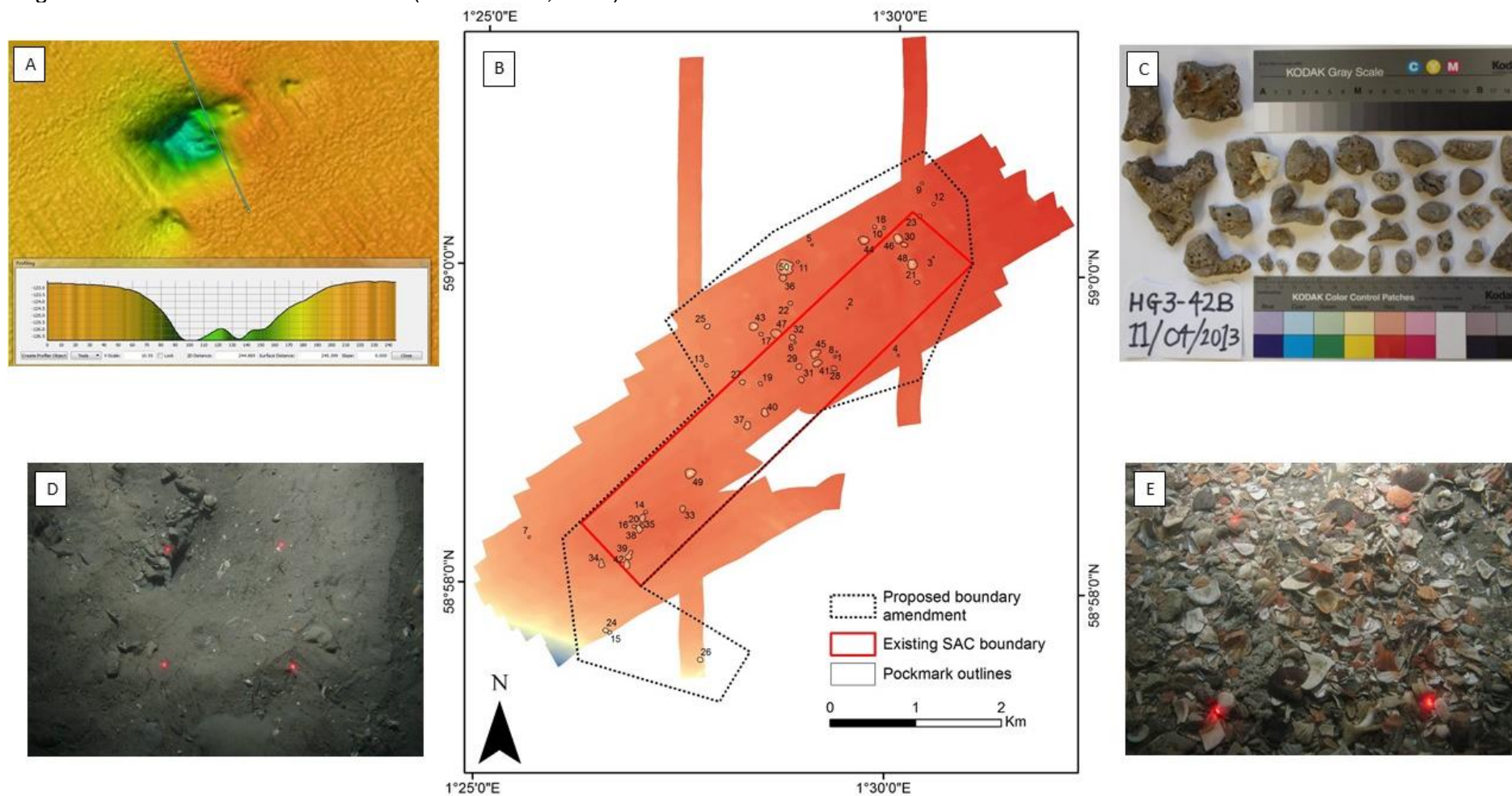
Braemar Pockmarks SAC habitat consists of Subtidal mud interspersed with Subtidal mixed sediment. The latter is primarily associated with the pockmarks and includes shell hash as observed in video and, in some cases, possible MDAC fragments as found in Hamon grab samples (Rance *et al.*, 2017). Based on multivariate clustering analysis of macrofaunal samples, some distinct assemblages coincided only with pockmark features (Rance *et al.*, 2017). The macrofaunal assemblages present were found to be different based on 2012 survey data within and outwith pockmarks. However, this difference could have been due to differing sampling methods. Remotely Operated Vehicle (ROV) observations support that the site's carbonate-cemented structures show evidence of chemosynthesis - indicated by the presence of bacterial mats on the seabed (Hartley, 2005; Gafeira and Long, 2015).

Meiofaunal analyses recorded a high proportion of nematode taxa that did not conform to descriptions of marine species recorded in British waters (Rance *et al.*, 2017). The nematode species *Astomonema southwardarum* known to host endosymbiotic, chemoautotrophic bacteria and a characteristic species of methane seep habitats (Austen *et al.* 1993) were not identified within the Braemar Pockmarks samples, although are present in Scanner Pockmark SAC. *Leptonemella* sp. were recorded which hosted ectosymbiotic bacteria that adhered to and colonised the cuticle of the adults (Rance *et al.*, 2017). Other fauna such as the bivalve species *Lucinoma borealis*, *Axinulus croulinensis* and *Thyasira equali*, and high densities of *Siboglinum fiordicum* have been recorded in Braemar pockmarks (Hartley, 2005). It should however be noted that these shallow-water seep, symbiont containing species are not restricted to seep sites but can all be found in other reducing environments (Dando, 2010).

The hard carbonate substratum seems to provide a habitat and distributional stepping stones for a variety of species (based on ROV observations). A range of fish species (cod, haddock, wolf-fish and conger eel) appear to use the pockmark depressions and the carbonate structures for shelter. In addition, the frequent occurrence of egg masses of Buccinid gastropods on the carbonate-cemented rocks has been noted (Hartley, 2005). As well as providing a potentially favourable, sheltered habitat for a variety of marine organisms, pockmarks with active gas seeps and associated structures may have ecological significance because i) of the utilisation of methane and its by-product, hydrogen sulphide, by chemosynthesisers;

(Judd, 2001) and ii) MDAC provides a hard substrate suitable for colonisation by certain benthic organisms (Dando *et al.*, 1991).

Figure 2: Example outputs from analysis of data for the Braemar Pockmarks SAC. A) Illustration of depth profile from Pockmark 50 containing MDAC within the proposed site boundary amendment B) Semi-automated mapping of pockmarks undertaken by Gafeira and Long (2015), with current and proposed site boundary amendment included C) Photograph showing carbonate cemented sandstone and siltstone from grab samples acquired within Pockmark 50 (Milodowski and Sloane, 2013), D & E) Seabed imagery from JNCC/Cefas 2012 survey showing shell fragments and MDAC in Pockmark 50 (Rance *et al.*, 2017).



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