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Oilfield in a box: The Hutton Field Dataset

Geoanalytics and Modelling Programme

Open Report OR/19/034

BRITISH GEOLOGICAL SURVEY

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Foreword

Data from the now decommissioned Hutton field were deposited with the National Hydrocarbon Data Archive which was operated by the British Geological Survey (BGS). This data is being made available for the use in academic research and training,

The report describes the stratigraphic setting of the Hutton field, and brief details of the field's engineering and navigation information for the associated data files. This is not intended to be a definitive report on the geology of Hutton; rather a summary to allow the associated data files to be understood.

Data release is a complex process, and data sets provided to end-users without charge require significant effort to prepare. Such resources are often hard to justify. Therefore, please cite this report and all associated DOI's for the data to allow its value and usage to be tracked.

The dataset can be accessed through the following link:

https://dx.doi.org/10.5285/e7901156-cf98-4a83-af7e-640f05213ad8

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Summary

This report contains a description of the STARR dataset including its origins and a description of the stratigraphy of the Hutton Field. It also gives an overview of the available data and a rationale for the structure of the dataset.

1 NHDA

Petroleum licences issued by the Oil and Gas Authority (OGA) require that all hydrocarbon data from the UK continental shelf (UKCS) data are preserved in perpetuity and in usable condition. Historically, a route to end this obligation was achieved by archiving data in the National Hydrocarbon Data Archive (NHDA), which was active from 2003 to 2016. The NHDA, operated by BGS on behalf of the UK government, was the primary long-term data archive for UK offshore oil and gas exploration and production activity data. During its life the NHDA was used by various operators and organisations to archive a range of UKCS data from one field, 15 licences, 33 seismic surveys and 102 wells. Details on these can be found at the web link:

http://www.bgs.ac.uk/nhda/home.html

After decommissioning the Hutton Field, the then operator Kerr McGee deposited the well and seismic data within the NHDA. The NHDA has taken over management of this data and has now licensed it for academic and non-commercial use.

Data was also deposited with Common Data Access Limited (CDA) who are a not-for-profit subsidiary of Oil and Gas UK and provided a function to report data to the OGA and share data. This CDA data archive will be at the core of future UK National Data Repository (NDR). The CDA system maintain a digital repository of more than 11,500 wells from the UKCS, more information on CDA can be found online at: https://cdal.com/

2 The Hutton Field

The Hutton Field is located in the East Shetland Basin in Quadrant 211 to the west of the North Viking Graben in the UK Northern North Sea (Figure 1). It is approximately 480km NE of Aberdeen and extends across blocks 211/28 and 211/27; it was discovered by Conoco well 211/28-1a in 1973 (Haig, 1991).

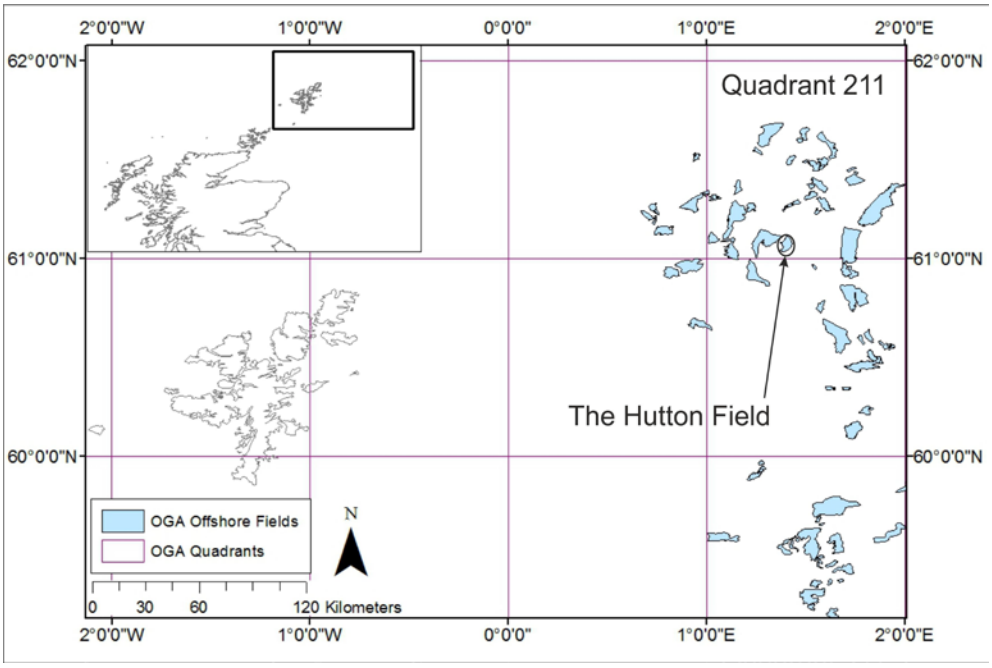

Figure 1: Location map of Hutton oil field. Contains public sector information licensed under the Open Government Licence v3.0.

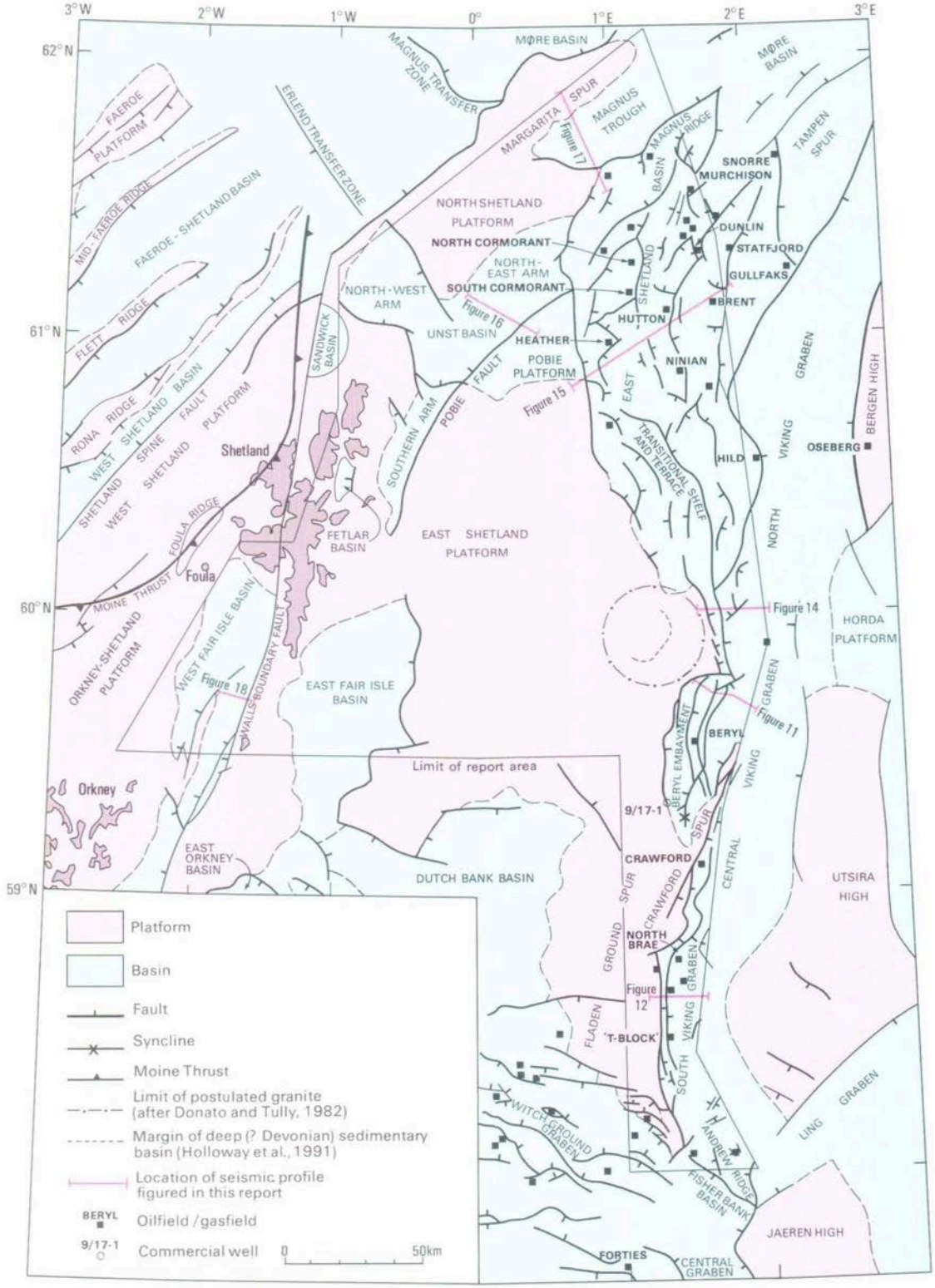

Figure 2: Simplified map of the Northern North Sea showing the main structures. From: Johnson et al. (1993), Figure 10.

The field measures approximately 9km north to south and 3km east to west (Haig, 1991). A series of three tilted fault blocks (A, B, and C), downthrown to the northwest, make up the main structure (Figure 3).

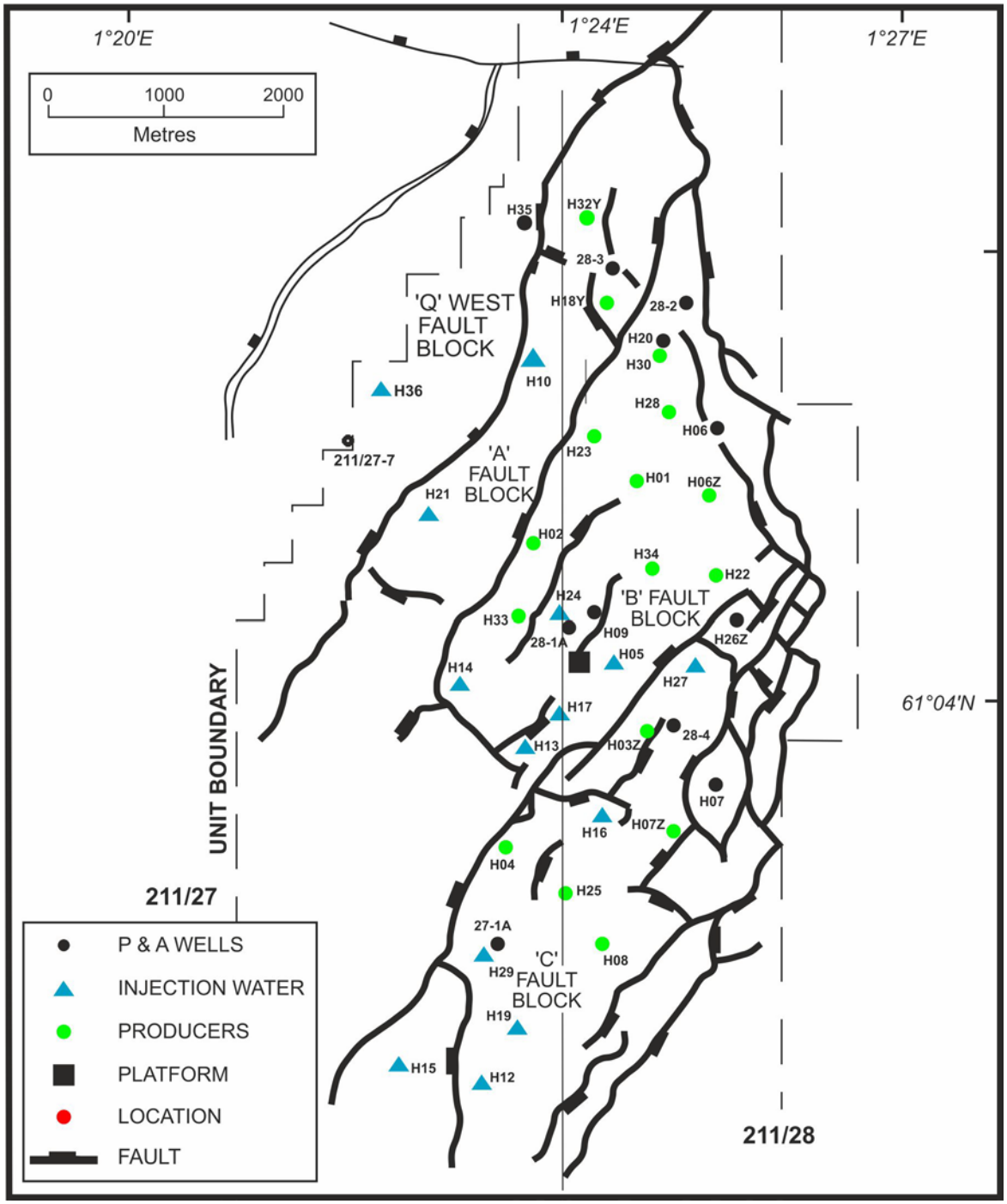

Figure 3: Map showing the main fault blocks of the Hutton Field. From Haig (1991) Figure 11 copyright Geol. Soc.

2.1 FIELD STRUCTURE AND STRATIGRAPHY

The East Shetland Basin formed as a result of Mesozoic rifting, although the precise structural evolution is still debated (Johnson et al., 1993). The most likely model consists of two phases of rifting; initially in the late Permian/early Triassic, followed by another phase of rifting in the late Jurassic (Johnson et al., 1993). However, sedimentation in the basin continued through the Mesozoic and Cenozoic with up to 11 km of syn and post-rift sediments present (Haig, 1991; Johnson et al., 1993).

The East Shetland Basin comprises of a series of north north east to north-east trending tilted fault blocks that downthrow towards the Viking Graben in the east (Figure 2) (Johnson et al., 1993; Zanella & Coward, 2003). The Hutton field lies in the western of the two main north-trending

blocks (Figure 2) (Johnson et al., 1993). The faults with the largest offsets in the East Shetland basin have a northerly tend and are downthrown to the east (Johnson et al., 1993). However, as shown in Figure 3, the faults in the Hutton field have a NE trend, which is a result of more variable fault block tilt direction (Johnson 1993). The majority of the Hutton field sits in quad block 211/28 and a summarised stratigraphy from the Triassic to the present is shown in Figure 4.

The Jurassic age Brent Group is the main reservoir unit in the Hutton field and the Kimmeridge Clay Formation is the source rock (Haig 1991). The Brent Group conformably overlies the Toarcian to Aalenian age Drake Formation of the Dunlin Group in the East Shetland Basin, however, local unconformities have been observed (Johnson et al., 1993; Richards et al., 1993). The Bathonian to Oxfordian Heather Formation of the Humber Group conformably overlies the Brent Group, however local unconformities have been observed (Richards, 1992; 1993).

The Brent Group is comprised of five Formations. These are, in order of oldest to youngest: the Broom Formation; Rannoch Formation, Etive Formation, Ness Formation and Tarbert Formation (Richards et al., 1993). The group consists of both coastal and marine sediments and was deposited in a regressive-transgressive deltaic system (Richards et al., 1993). As a result, the Brent Group can be laterally heterogeneous with Formation characteristics varying, particularly on wireline logs. The main stratigraphic units in the Quad Block 211/28 are referred to using a scheme after Bowen (1975). The relationship between Bowen (1975) and the Brent Group Formations are shown in Table 1.

Table 1: List of the main stratigraphic units in Quad Block 211/28 and how they correspond to the Formations of the Brent Group

	Formation	**Unit Name (Bowen 1975)**
Brent Group	The Tarbert Formation	Upper sand unit
	The Ness Formation	The Delta plain sediments of the Middle Shaly Unit
	The Etive Formation	The Massive Sand Unit
	The Etive / Rannoch Formation	The Massive/Mica Sand Unit
	The Rannoch Formation	The Mica Sand Unit
	The Broom Formation	The Basal Sand Unit

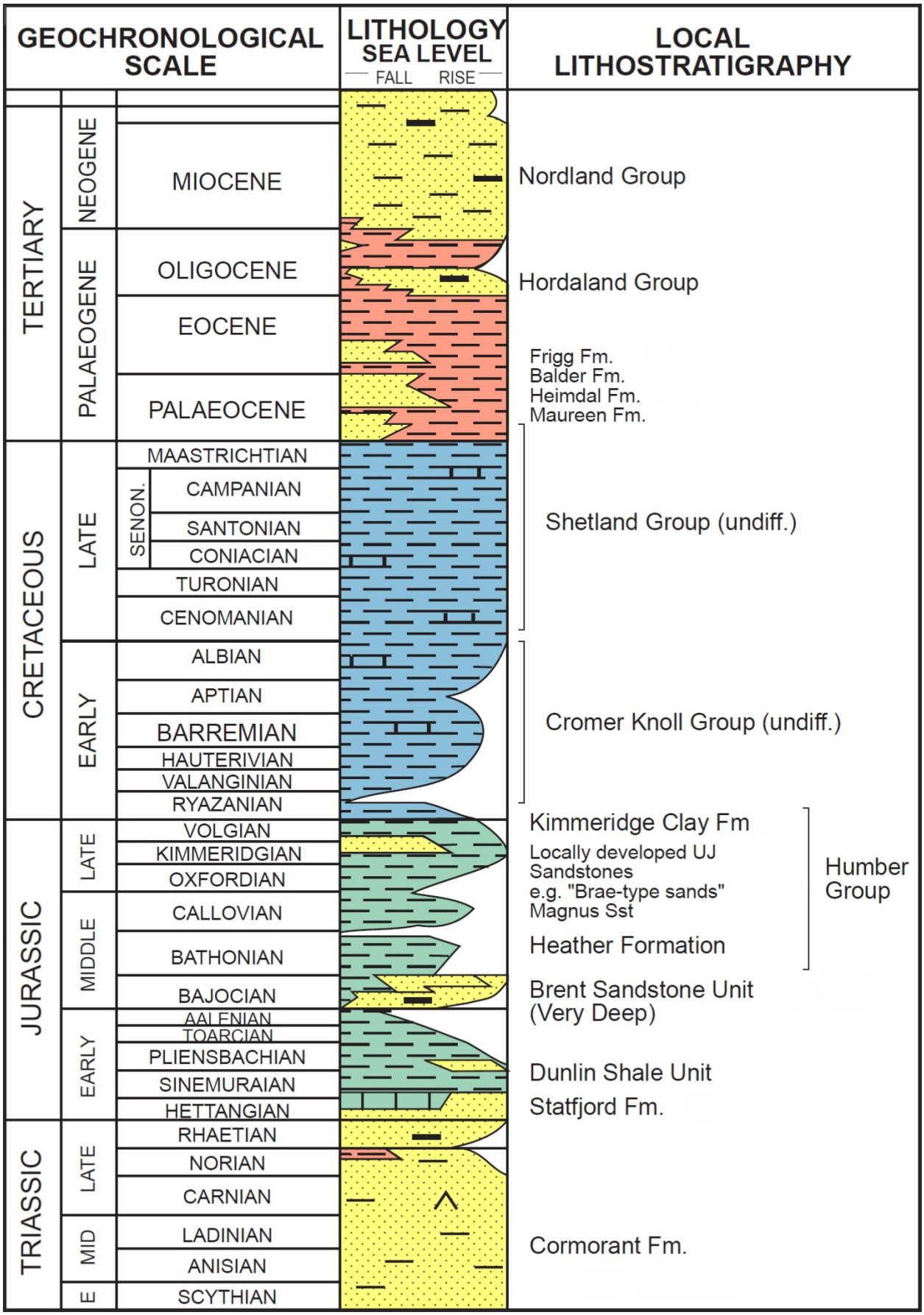

Figure 4: Summarised Stratigraphy of quad block 211/28 Adapted from material provided to BGS by Oryx.

2.2 211/28 MAIN RESERVOIR UNITS

This section contains a brief description of the main reservoir units in Quad Block 211/28 based on Haig (1991), Johnson et al. (1993; 2005) and Richards et al. (1993).

2.2.1 Broom Formation

The Broom Formation typically consists of well sorted medium to coarse-grained sandstone with large scale planar cross-beds and shallow marine burrows in the East Shetland Basin (Richards, 1992; Johnson et al., 1993). The Aalenian age Broom Formation has been interpreted to have deposited in a range of depositional settings ranging from a transgressive tidal-flat to fan-delta setting (Richards et al., 1993; Johnson et al., 1993). In the Hutton field, the formation is described as a laterally continuous series of medium-to coarse-grained sandstones with common mud clasts (Haig, 1991). The average thickness is 12.2 m (40 feet) (Haig, 1991).

2.2.2 Rannoch Formation

The late Aalenian to early Bajocian Rannoch Formation typically consists of an upwards coarsening section of mudstones to fine grained sandstones (Johnson et al., 1993; Richards et al., 1993). The Rannoch Formation is interpreted to have been deposited in a storm-influenced shoreface setting (Johnson et al., 1993) and in progressively shallow water on the middle to lower shoreface of a delta front (Haig, 1991). In the Hutton field, the average thickness of the Rannoch Formation is 13.7 m (45 feet), comprised of fine grained micaceous siltstones and sandstones (Haig, 1991).

2.2.3 Etive Formation

The late Aalenian to early Bajocian Etive Formation typically consists either of massive upward coarsening sandstones, or an upward fining sandstone unit (or units) with a sharp base (Johnson et al., 1993; Richards et al., 1993). Deposition of the upward coarsening Etive succession has been interpreted as barrier-bar or beach deposits as a result of progradation (Haig, 1991; Johnson et al., 1993). The upward fining succession has been interpreted to have been deposited in distributary channels (Haig, 1991; Johnson et al., 1993). Sea level changes during deposition affected the thickness and distribution of this unit (Haig 1991). The average thickness of the Etive Formation in the Hutton field is 18.3 m (60 feet) and consists of medium to coarse grained sandstone in the south and east, with medium grained sandstone in the central and western parts of the field (Haig, 1991). Towards the north, the sands thin and become increasing micaceous (Haig, 1991).

2.2.4 Ness Formation

The Bajocian age Ness Formation is comprised of a heterolithic series of interbedded sandstones, mudstones and coals deposited in a delta top setting (Johnson et al., 1993; Richards et al., 1993; Johnson et al., 2005). The Ness Formation represents deposition during progradation and regression of the Brent delta (Johnson et al., 1993) and fluvial channels are interpreted to cut through the deltaic sequence (Haig, 1991). The Formation is informally divided into three units: a lower interbedded unit; a middle mudstone unit; and an upper sandstone unit (Johnson et al., 1993; Richards et al., 1993). The middle mudstone unit represents the temporary abandonment of the delta and flooding of the

delta plain (Haig, 1991). The average thickness of the Ness Formation in the Hutton field is 50.3 m (165 feet) (Haig, 1991).

2.2.5 Tarbert Formation

The late Bajocian to Bathonian age Tarbert Formation was deposited as the Brent delta retreated and consists mainly of shallow marine transgressive sandstones; it marks the final abandonment of the Brent delta (Haig, 1991; Johnson et al., 1993; Richards et al., 1993). The succession is dominated by fine grained sandstones with coarse to very coarse grained sandstones at the base, which may represent a ravinement surface (Johnson et al., 1993; Richards et al., 1993). The average thickness of the Tarbert Formation in the Hutton field is 3 m (10 feet) and consists of poorly sorted medium to coarse grained sandstones (Haig, 1991).

3 Description of Data

The dataset consists of 64 wells from blocks 211/27 and 211/28 and includes two exploration wells, five appraisal wells, and 57 development wells. Twelve of the development wells are marked as sidetracks. A full listing of all of the available data can be found in the spreadsheet: Filespace_Listing.xlsx

The well data is split into two categories, with information that relates to a specific well placed in the **Well_data** folder and data that relates to multiple wells placed in the **Field_Data** folder.

In addition to the well data, there is a 3D seismic survey which has had the header geometry edited to allow it to be read easily into Petrel.

The metadata for all of the wells including slot numbers and previous names can be found in the **Well_Meta_Data** folder.

3.1 WELL META DATA AND NAMING CONVENTIONS

Many of the wells in the Hutton Field are referred to by two separate identifiers, a WELLREGNO and a slot number. The WELLREGNO should be treated as the primary identifier, however, many of the platform wells (i.e. production wells)are also referred to by a slot number which appears in multiple documents such as: Hutton_production_data.xls and Hutton_water_injection_data.xls. For clarity, the slot number has been added to the file CDA_NHDA_HUTTON_WELLS_20_APR_2018.xlsx to allow for comparison across the dataset.

There was also a discrepancy between the WELLREGNO listed in 2014 and the current WELLREGNO from CDA for 30 wells in the field. All of the registration numbers have been updated to make them consistent with the current outputs from CDA (treated as the definitive reference). However, for clarity an index of old and new filenames is available in CDA_Renamed_wells.xlsx. For more information on naming conventions for UKCS wells see Hatwin (2016).

3.2 FIELD DATA

The data that relates to multiple wells has been split into five categories:

- **Multi_Well_Reports** - A list of well reports which make reference to multiple wells;
- **Strat_Data** - Contains stratigraphic and chronostratigraphic information for a subset of the wells in this dataset;

- **Velocity_data** - Digitised check shots from a subset of the wells in this dataset;
- **Hutton_production_data.xls** - Production data from the Hutton Field (wells are referred to by their slot names);
- **Hutton_water_injection_data.xls** - Water injection data from the Hutton Field (eells are referred to by their slot names).

3.3 WELL_DATA

Well data has been sorted by well and split into five categories:

- **Comp_Log_Scan** – A composite or final well log, or where this log is not available, a summary log such as lithology log or mud log. Where this is not provided, presume no such log was available.
- **Deviation** – PDFs and Digitised deviation surveys provided to BGS with the initial data deposit, which are not available for all wells. For a subset of wells there is a .las file containing the calculated well path using minimum curvature which has been resampled to 15 cm increments in the **Wellpath** folder. If deviation information is not contained in this folder it may be available in one of the well reports.
- **Digital_Data** – Digital wireline and checkshot information in digital formats including: .dlis, .lis, .las and .segy. For a subset of wells, a joined well log has been created for the high value curves and is available in the **Joined_Well_Log** folder.
- **Log_Scans** – Scanned copies of the original logs from the well which can include: wireline, mud, velocity and lithology, etc. logs. This information is compiled from CDA and the data deposited with BGS.
- **Reports** – A series of reports from the well which can include: drilling end of well reports, geological end of well reports, end of well reports, stratigraphic/geological/palaeontological reports etc.

There is likely to be significant duplication of files in the well data folder as data has been deposited with BGS multiple times with different file names. These have been left in the dataset to provide a maximal dataset containing all of the possible files. In addition to this, some reports that cover well construction information for multiple wells, usually motherbores and their sidetracks, are included in the **Well_data** folder. One example is the file KM038185.pdf which can be found in wells 211/28a-H18, 211/28a-H18Y and 211/28a-H18Z. A summary of the information available for each well is presented in Table 2.

Table 2: Summary of available data for each Well in the Hutton Field

WELLREGNO	Comp_Log_ Scan	Deviation	Digital _Data	Joined_Well_ Log	Log_ Scan	Well_ Report	Wellpath	Files_ Per_ Well
211_27-_1	1	0	0	0	4	5	0	10
211_27-_1A	1	0	4	0	73	44	0	122
211_27-_2	1	0	3	0	45	44	0	93
211_28-H1	1	3	1	1	134	47	1	188
211_28-H10	1	2	5	1	126	29	1	165
211_28-H15	1	3	5	1	129	31	1	171
211_28-H2	1	2	10	1	240	56	1	311
211_28-H24	1	2	7	1	44	29	1	85
211_28-H25	1	2	10	1	49	29	1	93
211_28-H26	1	2	4	1	110	49	1	168
211_28-H26Z	1	2	7	1	116	38	1	166
211_28-H27	1	2	8	1	106	61	1	180
211_28-H3	1	3	1	1	160	38	1	205

211_28-H36	1	2	3	1	26	30	1	64
211_28-H37	0	2	3	1	19	46	1	72
211_28-H38	0	2	5	1	8	13	1	30
211_28-H4	1	2	7	1	239	72	1	323
211_28-H41	0	2	0	0	2	18	1	23
211_28-H41Z	1	2	2	1	19	17	1	43
211_28-H5	1	2	8	1	82	23	1	118
211_28-H6	1	2	5	1	83	27	0	119
211_28-H6Z	1	2	7	1	87	20	1	119
211_28-H7	1	2	6	1	112	43	1	166
211_28-H7Z	1	2	15	1	138	22	1	180
211_28-H8	1	2	6	1	75	17	1	103
211_28-H9	1	2	2	1	94	19	1	120
211_28-_1A	1	3	2	1	200	85	1	293
211_28-_2	1	2	3	1	104	19	1	131
211_28-_3	1	2	6	1	81	24	1	116
211_28-_4	1	2	3	1	97	18	1	123
211_28a-H11	1	2	6	1	130	61	1	202
211_28a-H12	1	2	6	1	99	40	1	150
211_28a-H13	1	2	3	1	134	16	1	158
211_28a-H14	1	2	9	1	160	44	1	218
211_28a-H16	1	2	1	1	170	49	1	225
211_28a-H17	1	2	9	1	169	66	1	249
211_28a-H18	1	0	1	1	63	29	0	95
211_28a-H18Y	1	2	7	1	186	66	1	264
211_28a-H18Z	1	2	3	1	19	6	1	33
211_28a-H19	1	2	5	1	118	53	1	181
211_28a-H20	1	2	0	0	69	27	1	100
211_28a-H20Z	1	2	5	1	122	60	1	192
211_28a-H21	1	2	10	1	125	40	1	180
211_28a-H22	1	2	8	1	136	77	1	226
211_28a-H23	1	2	11	1	140	71	1	227
211_28a-H28	1	0	3	1	85	47	0	137
211_28a-H29	1	2	4	1	61	30	1	100
211_28a-H30	1	2	9	1	66	15	1	95
211_28a-H31	1	2	3	1	15	23	1	46
211_28a-H31Z	1	2	4	1	21	11	1	41
211_28a-H32	0	2	0	0	1	13	1	17
211_28a-H32Y	1	0	3	1	23	32	0	60
211_28a-H32Z	1	2	0	0	2	22	0	27
211_28a-H33	1	2	0	0	17	14	1	35
211_28a-H33Z	1	0	3	1	29	9	0	43
211_28a-H34	1	2	1	1	23	30	1	59
211_28a-H35	1	2	4	1	32	15	1	56
211_28a-H39	0	2	3	1	11	7	1	25
211_28a-H40	0	2	5	1	10	9	1	28
211_28a-H42	1	2	5	1	10	18	1	38
211_28a-H43	1	2	0	0	1	17	1	22
211_28a-H43Z	1	2	2	0	17	14	1	37

211_28a-H44	0	2	2	0	38	44	1	87
211_28a-H45	1	2	1	0	15	33	1	53
Totals	57	118	284	52	5119	2121	55	7806

Glossary

Unit / Abbreviation	Full Name
BGS	British Geological Survey
CDA	Common Data Access Limited
NHDA	National Hydrocarbon Data Archive
OGA	Oil and Gas Authority
UKCS	UK Continental Shelf
WELLREGNO	OGA Wellbore registration number

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