



THE CULZEAN FIELD: FROM DISCOVERY TO FIRST GAS AND BEYOND

DEVEX 2020

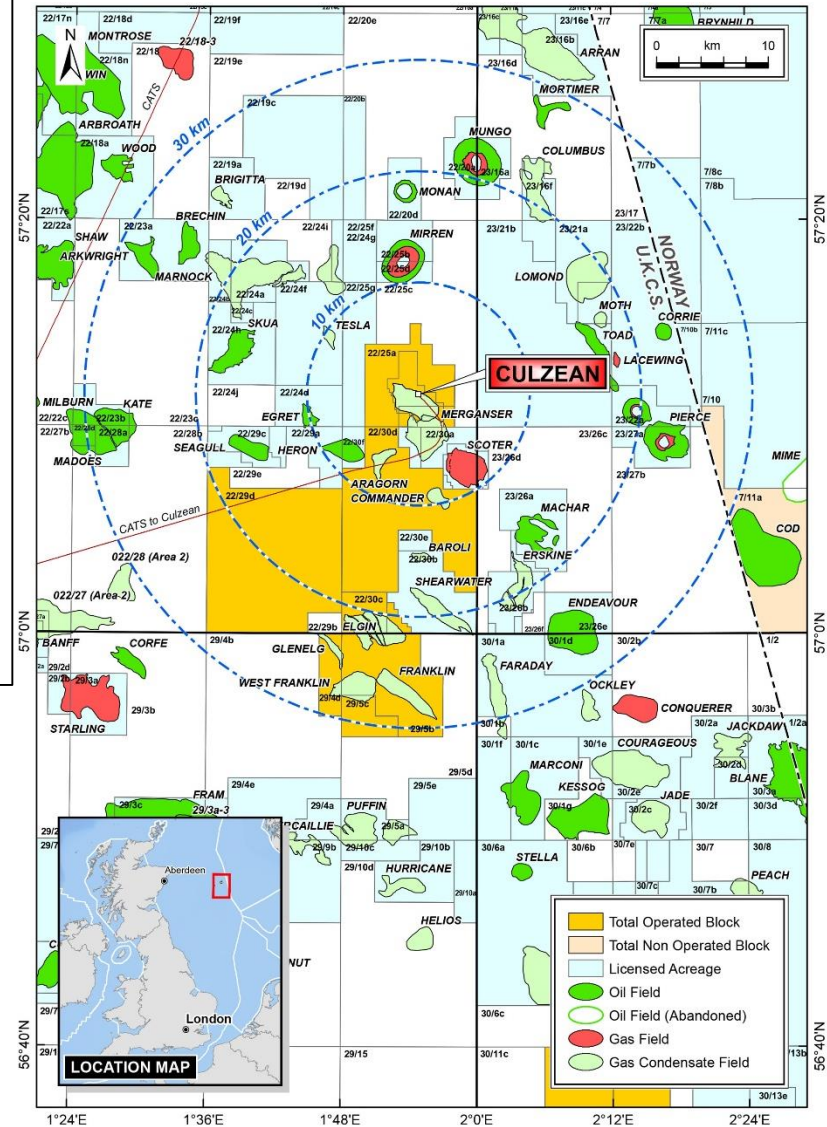
Jesse Clark, Emma Wood



CULZEAN FIELD OVERVIEW & CONTEXT

- uHPHT ~930 bar and ~170°C at 4500m
- Discovered 2008, 240km East of Aberdeen
- Licence P.111, Block 22/25a
 - TOTAL 49.99% (operator)
 - Britoil (BP) 32.00%
 - JX Nippon UK 18.01%
- Development drilling started Aug 2016
- First gas 7th June 2019 from C6
 - First gas export (CATS) on 11th July 2019
- Reservoirs on production:
 - Triassic Joanne – currently producing (C2, C4, C5 and C6)
 - Jurassic Pentland – C3
- Gas properties
 - CGR: 19 Stb/MMscf Pentland, 26 Stb/MMScf Joanne

- Culzean represented one of the largest UKCS hydrocarbon discoveries in the last 15 years.
- Culzean estimated to contribute 5% of UK gas supply in 2020
- Currently producing ~100,000 boed
- More than 300Mboe of recoverable HC



TIMELINE FROM DISCOVERY TO DEVELOPMENT



THE CULZEAN DEVELOPMENT



Utilities and
Living
Quarters

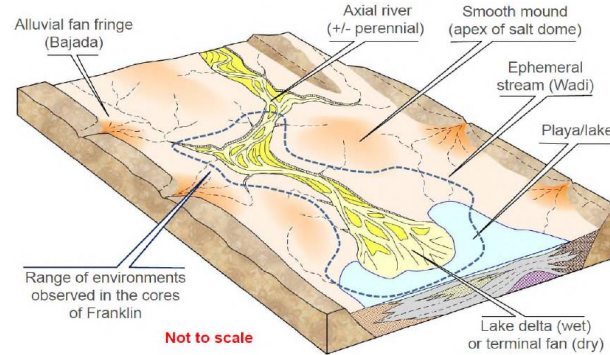
Central Processing
Facility

Well Head Platform
(14 slots)

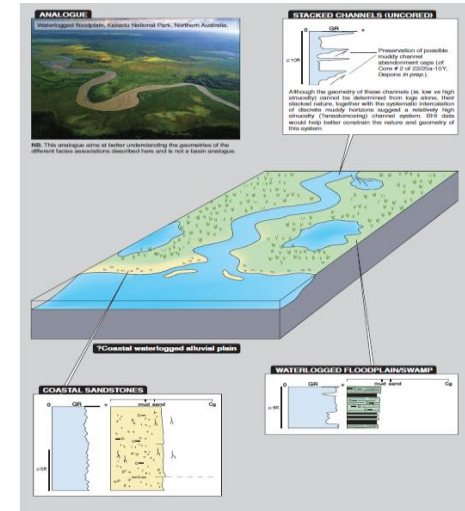
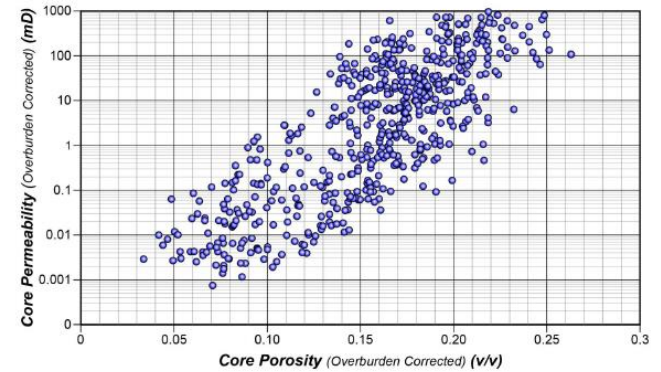
Floating Storage & offloading

BASIC GEOLOGY OF CULZEAN

| Era | Period | Series / Epoch | Stage / Age | Group | Formation | Member | Lithology | |
|----------|------------|----------------|--------------|--------------------|--------------------|-------------------|------------------|------------------|
| Cenozoic | Quaternary | Holocene | Upper | Nordland Group | Nordland | | | |
| | | | Middle | | | | | |
| | | Pleistocene | Calabrian | | | | | |
| | | | Gelasian | | | | | |
| | | | Pliocene | | | Piacenzian | | |
| | | | Zanclean | | | | | |
| | Neogene | Miocene | Messinian | | | | | |
| | | | Tortonian | | | | | |
| | | | Serravallian | | | | | |
| | | Oligocene | Langhian | | | | | |
| | | | Burdigalian | | | | | |
| | | | Aquitanian | | | | | |
| | Paleogene | Eocene | Chattian | Westray Group | Lark | Intra Lark | | |
| | | | Rupelian | | | | | |
| | | Paleocene | Priabonian | | | | | |
| | | | Ypresian | | | | | |
| | | | Thanetian | | | | | |
| | | Cenozoic | Eocene | Selandian | Stronsay Group | Horda | Balder | |
| Danian | | | | Moray Group | Sele | | | |
| | | | | Montrose Group | Lista | Fort St Sandstone | Andrew Sandstone | Archie Sandstone |
| Mesozoic | | Cretaceous | Upper | Maastrichtian | Chalk Group | Hod | Tor | |
| | | | | Campanian | | | Magne | |
| | | | | Santonian | | | Thud | |
| | | | | Coniacian | | | Narve | |
| | Turonian | | | Herring | | | | |
| | Cenomanian | | | Hilda | | | | |
| | Cretaceous | Lower | Albian | Cromer Knoll Group | Vailhall | Rodby | | |
| | | | Aptian | | | Sola | | |
| | | | Barremian | | | Carrack | | |
| | | | Hauterivian | | | Vailhall V4/V3 | | |
| | | | Valanginian | | | Tuvern V2 | | |
| | | | Ryazanian | | | Repsel V2 | | |
| | Jurassic | Upper | Kimmeridgian | Humber Group | Heather | Kimmeridge Clay | | |
| | | | Oxfordian | | | | | |
| | | Middle | Callovian | | | | | |
| | | | Bathonian | | | | | |
| | | | Bajocian | | | | | |
| | | | Aalenian | | | | | |
| Triassic | Upper | Norian | Heron Group | Skagerrak | Jonathian Mudstone | | | |
| | | Carnian | | | | | | |
| | Middle | Ladinian | | | | | | |
| | | Anisian | | | | | | |
| | Lower | Olenekian | | | | | | |
| | | Induan | | | | | | |



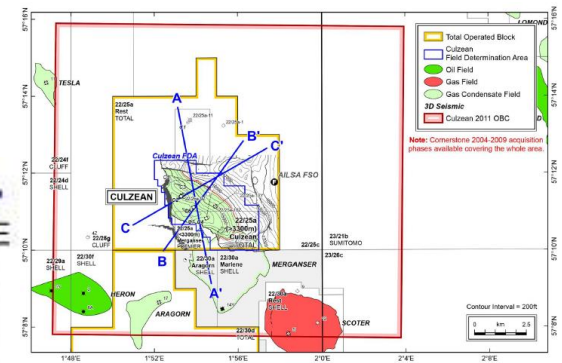
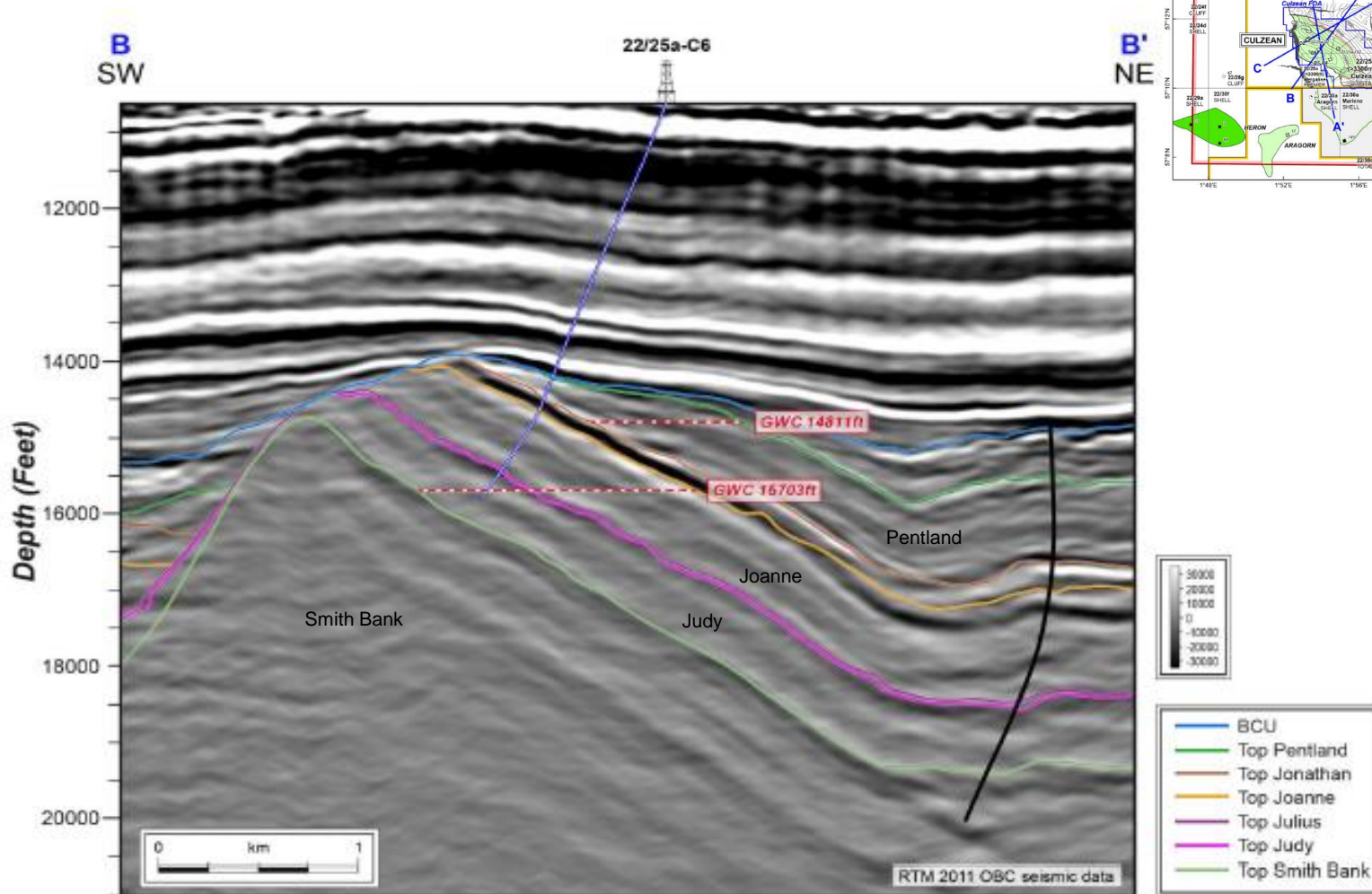
Depositional model for the Triassic of the Central North Sea [3]



● Culzean reservoirs

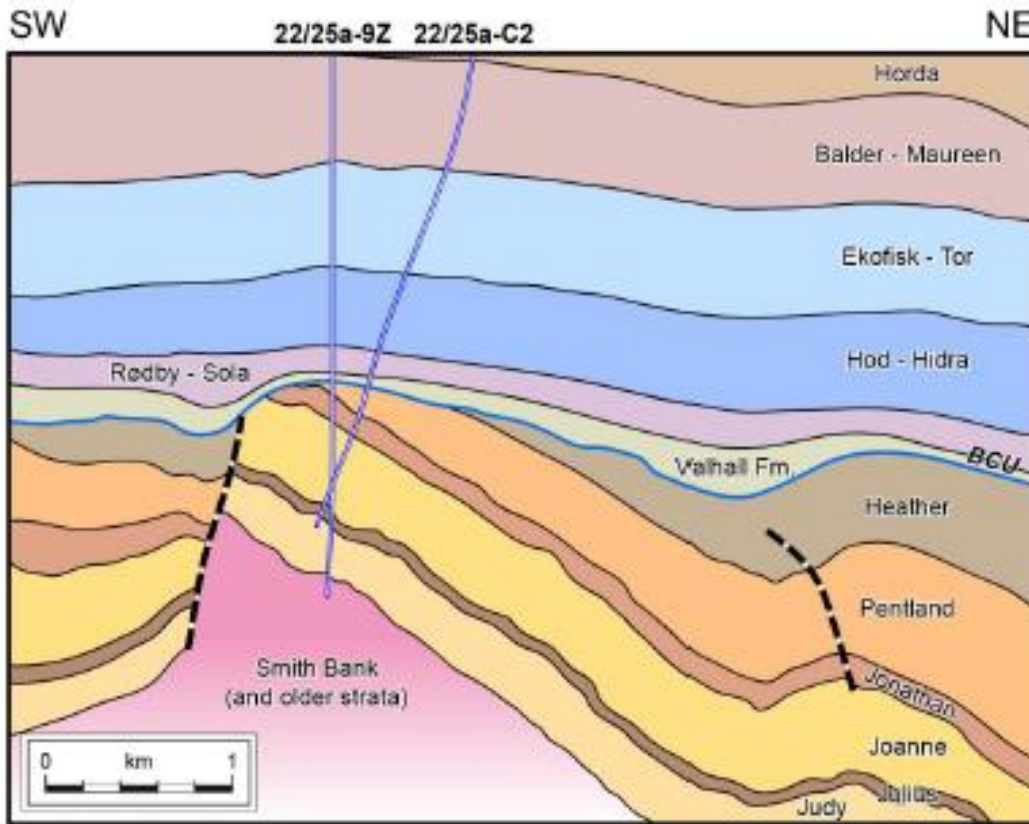
- Jurassic Pentland
 - Coastal plain meandering fluvial system
- Triassic Skagerrak (Joanne + Judy Members)
 - Semi arid continental fluvial system
- Exceptional petrophysical quality for these depths
 - Joanne average porosity of 17%
 - Early porosity preservation

STRUCTURAL CONTEXT

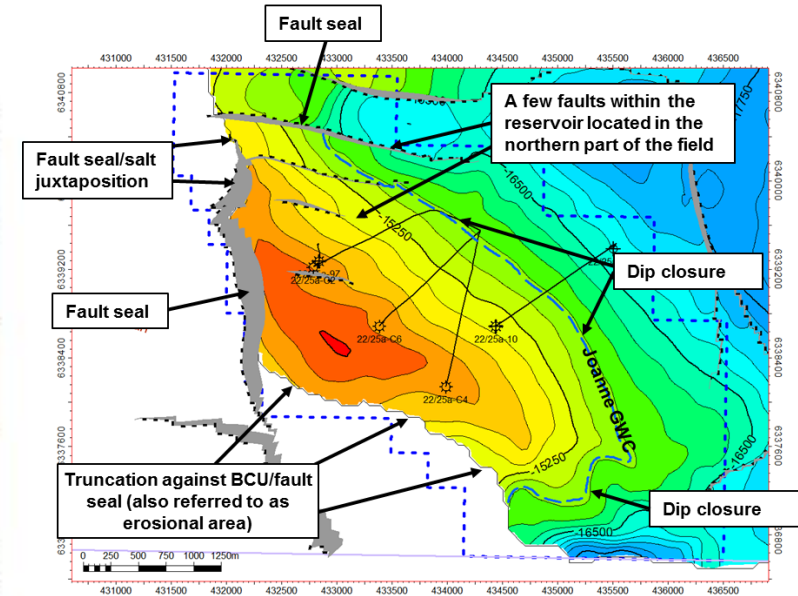


- A number of data sets cover the Culzean area with the key ones being:
 - Cornerstones towed streamer pre-stack depth migration survey (2011)
 - Culzean specific High Density Ocean Bottom Cable (HDOBC) (2011)

STRUCTURAL CONTEXT

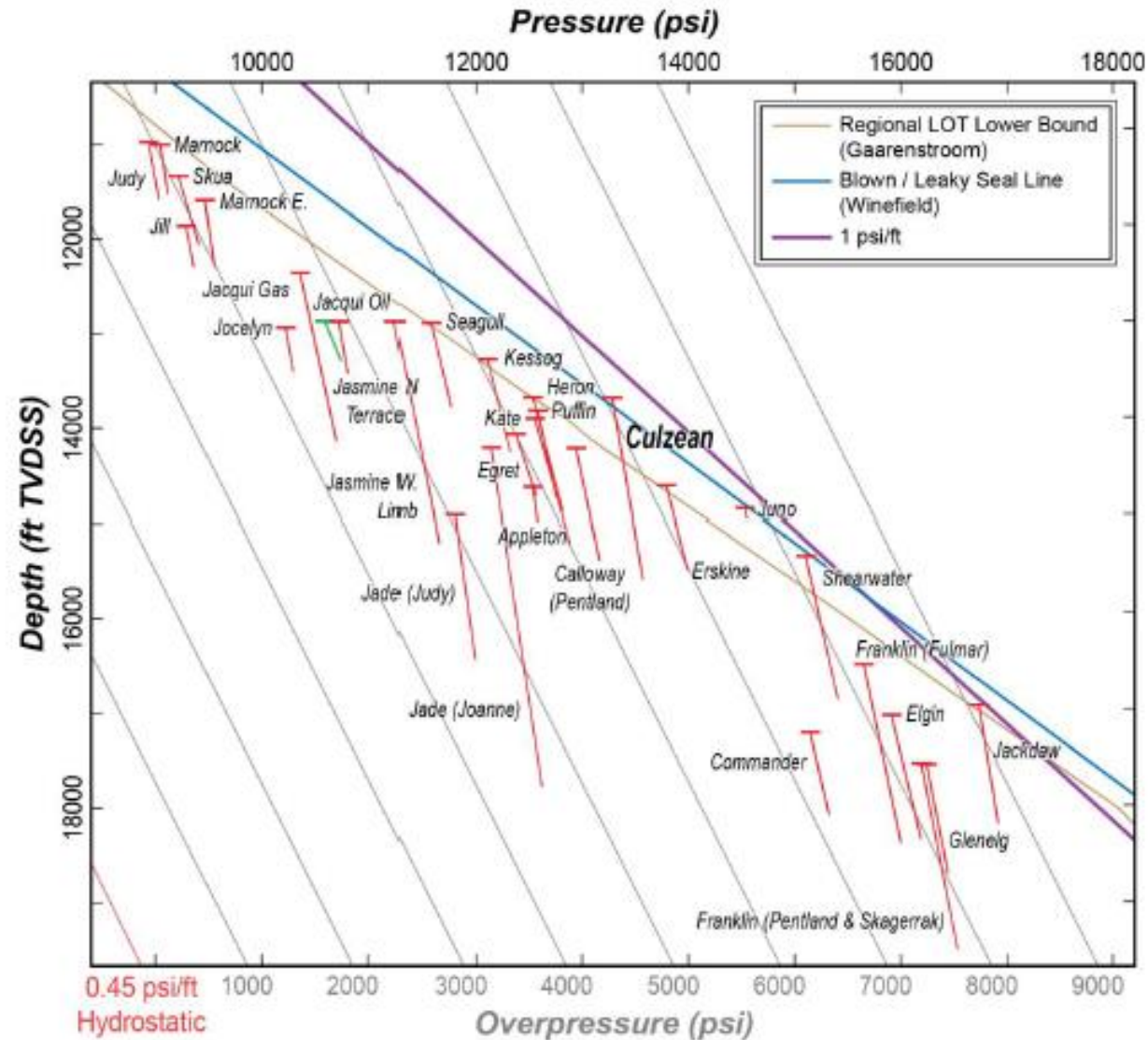


Top Joanne mean depth map with seismically mapped faults displayed



- Salt induced fault block dipping to the east with faults to the north and west
 - Structural closure to the South where BCU cuts into reservoir
- Present day hydrocarbons sourced from coaly Pentland Fm.
 - Sealed by internal mudstones and ultimately sealed by Lower Cretaceous

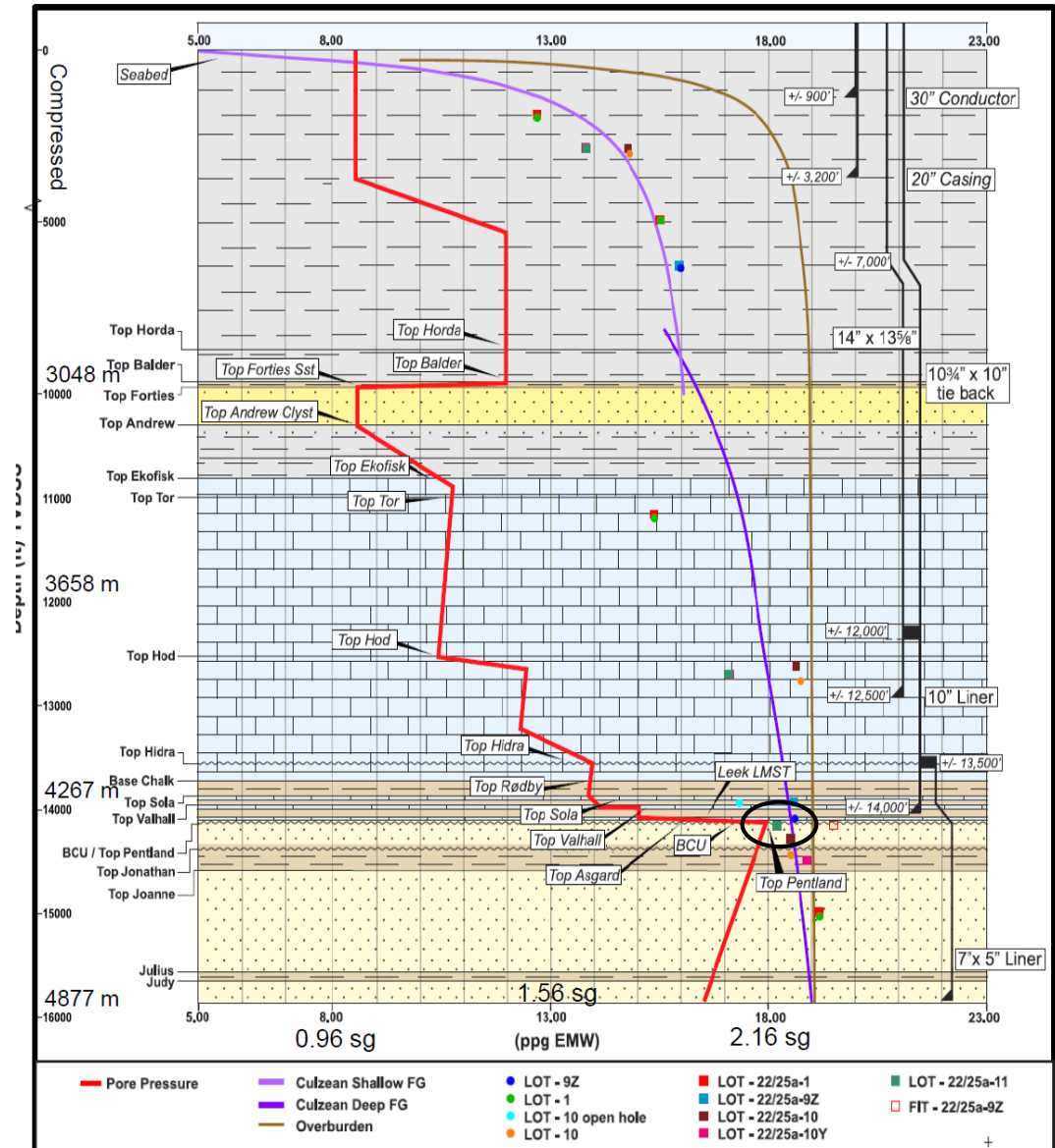
REGIONAL CONTEXT OF CULZEAN



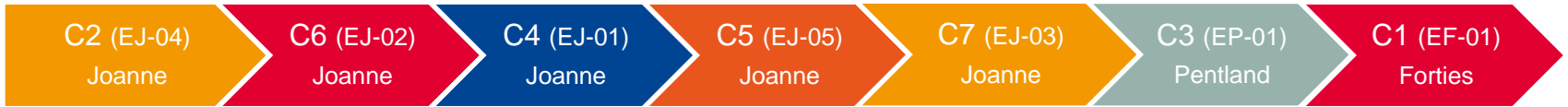
- NE of central graben HPHT domain (Winefield et al)
- Very high pore pressure relative to the depth of the field
- 936 Bar (13575 psi)
- Challenging drilling conditions – tight drilling margins at crest
- Precise placement of the casing shoe immediately above top reservoir is needed to overcome these challenges.

WELL ARCHITECTURE

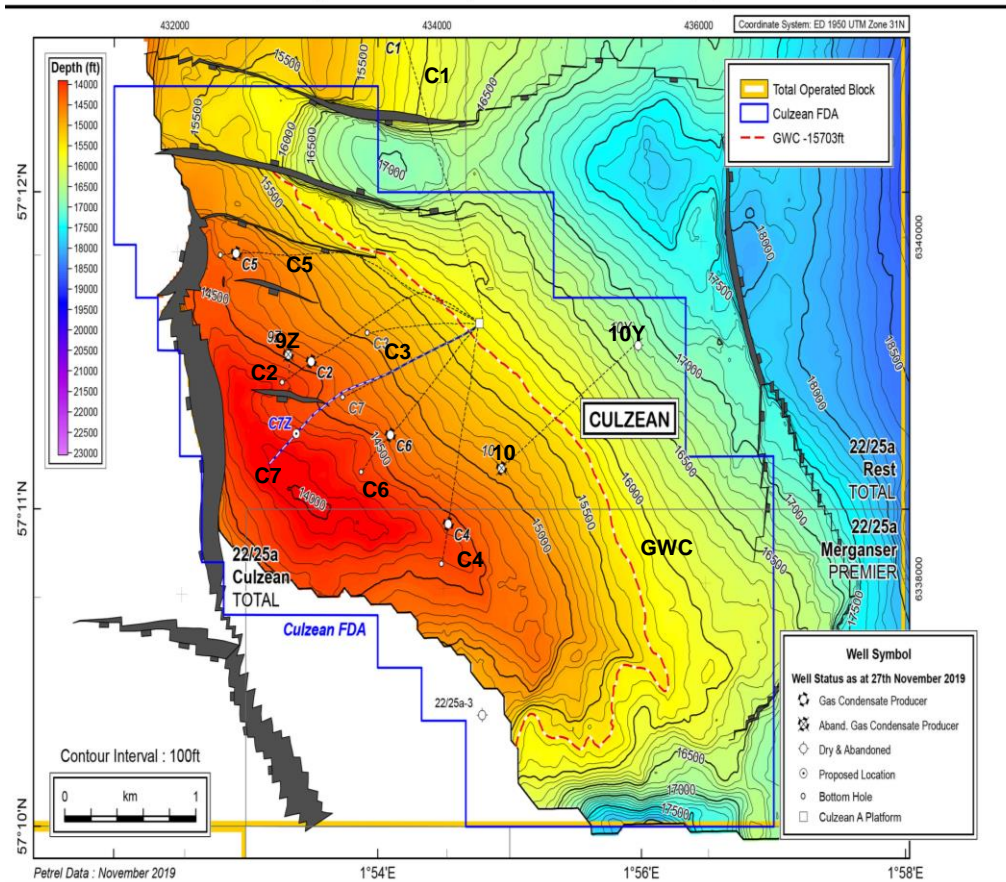
- Key challenge to Culzean delivery has been narrow drilling window at the top of the structure
- Deep set casing strategy used to navigate complexity of narrow drilling window
- Section TD very close to top reservoir
- Lookahead VSP used in order to reduce uncertainty
- Get within 100ft of top reservoir



DEVELOPMENT STRATEGY

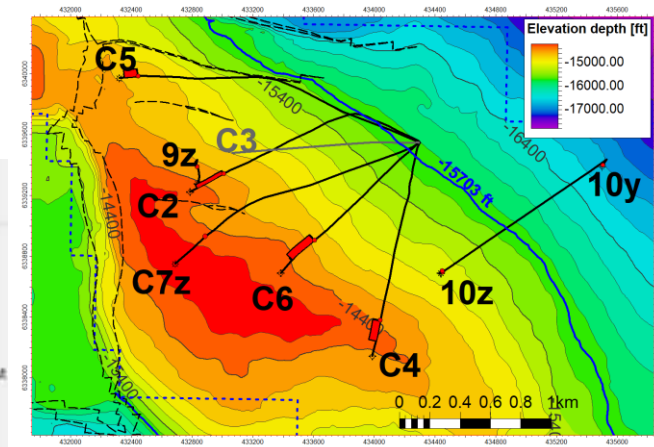
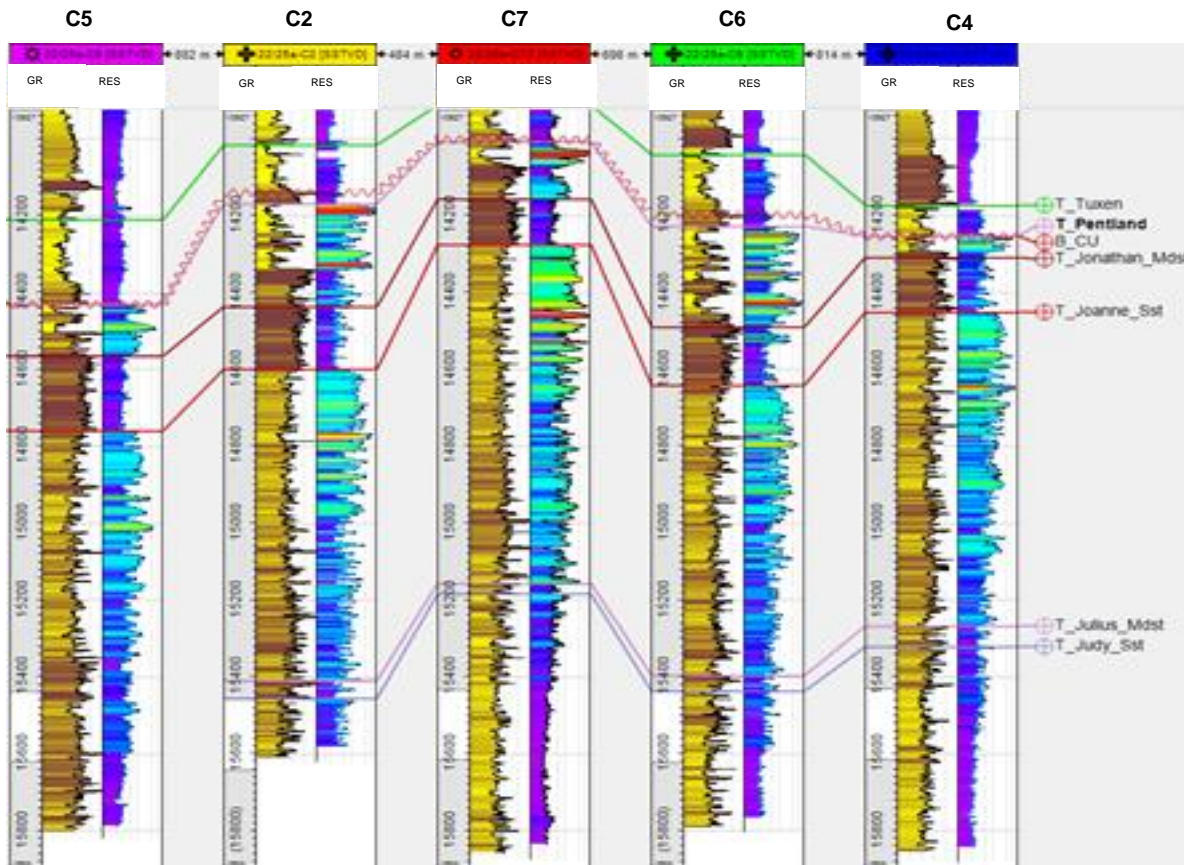


U.K.C.S. - Central North Sea - Block 22/25a - Culzean Field
Top Joanne Depth Structure Map (ft)



- Development comprises 6 production wells and 1 Forties PWRI
- 5 Joanne production wells and 1 Pentland production well
- Development wells spread geometrically across the field to mitigate against compartmentalisation risk
- ULQ and well platform offset from the field to mitigate subsidence/overburden issues

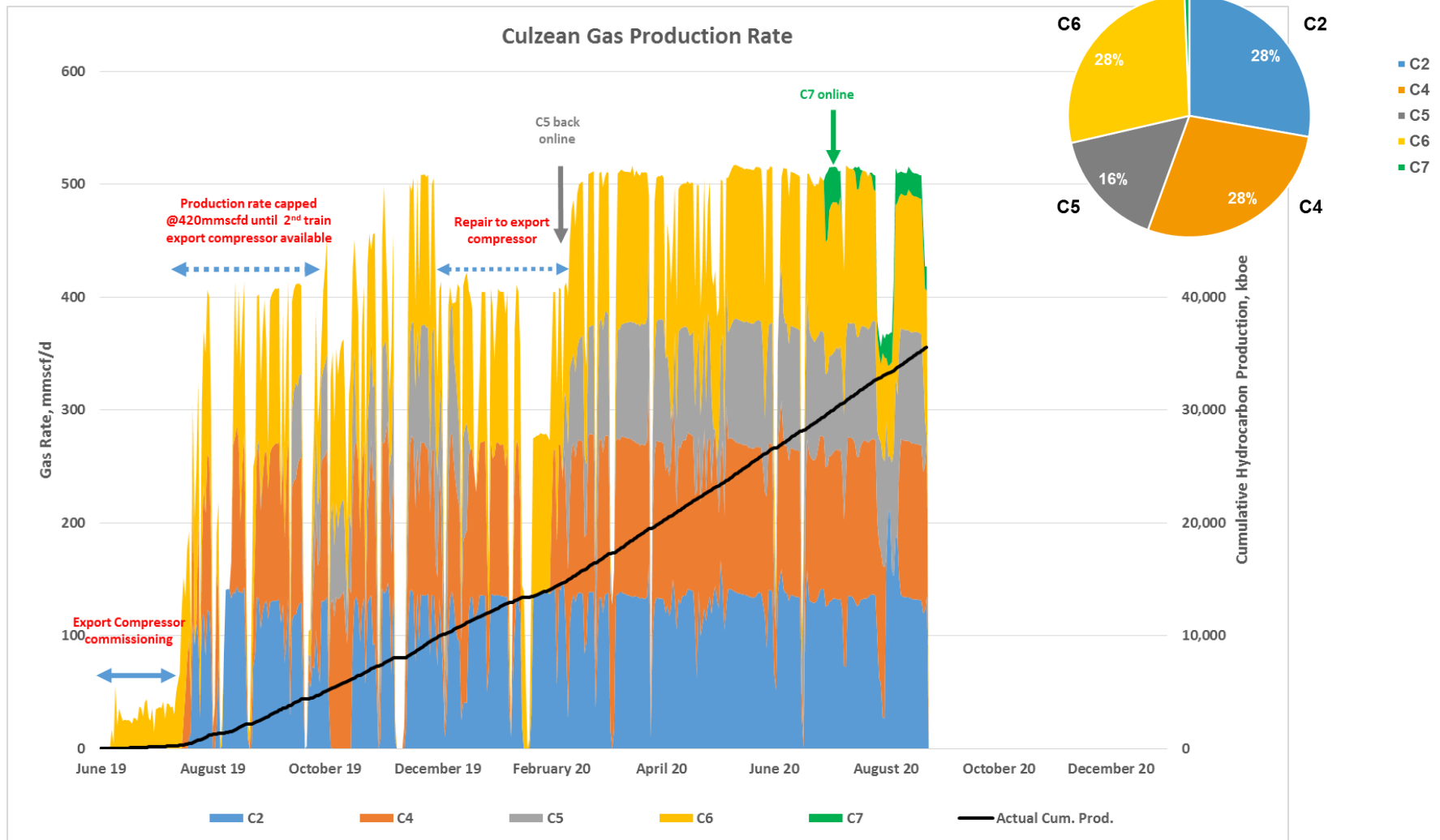
DEVELOPMENT WELLS



- Development wells have come in slightly better than expected in terms of HCPV in both the Joanne and Pentland
 - The Judy was drilled in the C7 well with poorer updip reservoir quality than expected
 - Flow trial was carried out

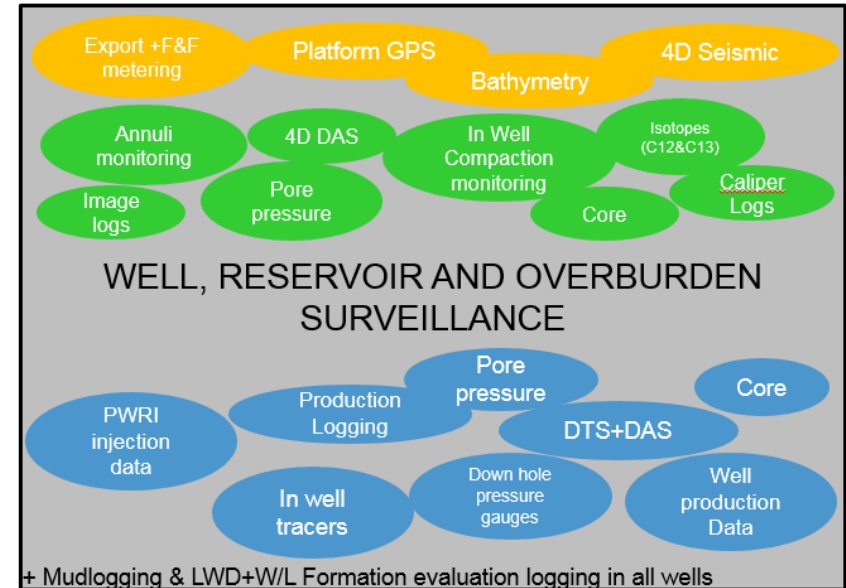
PRODUCTION HISTORY

Production split between the wells

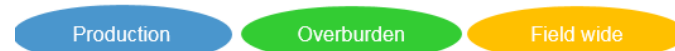


- Early “teething issues” following commissioning but now at full plant potential

MONITORING STRATEGY



- All wells equipped with fibre optical cables
 - Down hole pressure gauges
 - Active DAS / DTS monitoring (including 4D DAS surveys)
- Hoping to use inwell tracer technology to reduce overall well interventions
- Overburden monitoring is a key aspect
 - Well integrity
 - Subsidence
 - Geomechanical changes
- Capitalising on the Elgin-Franklin HPHT experience



THANK YOU!!

- Many Thanks to our partners BP Exploration Operating Company Ltd, JX Nippon Exploration & Production (U.K.) Ltd
- I would also like to acknowledge input from TOTAL colleagues – namely the Culzean team (old and new!)

