THE CULZEAN FIELD:

FROM DISCOVERY TO FIRST GAS AND BEYOND

DEVEX 2020

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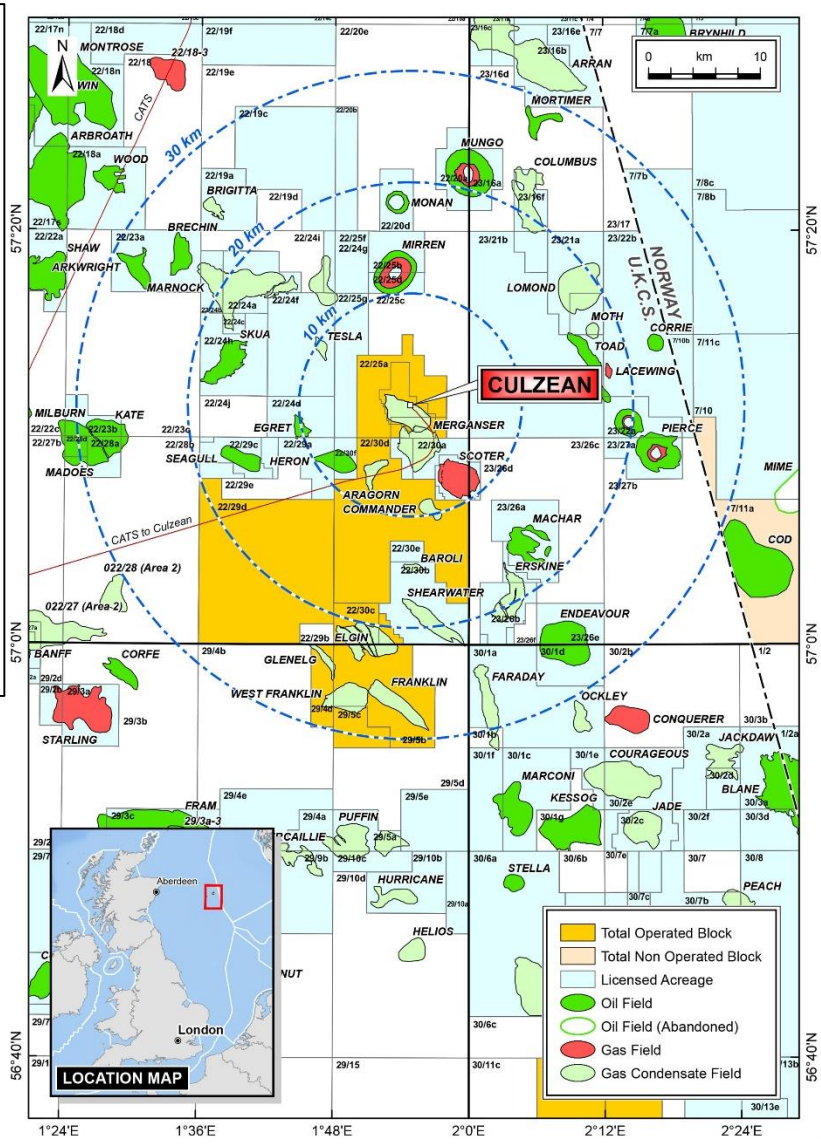
CULZEAN FIELD OVERVIEW & CONTEXT

- uHPHT ~930 bar and ~170ºC 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

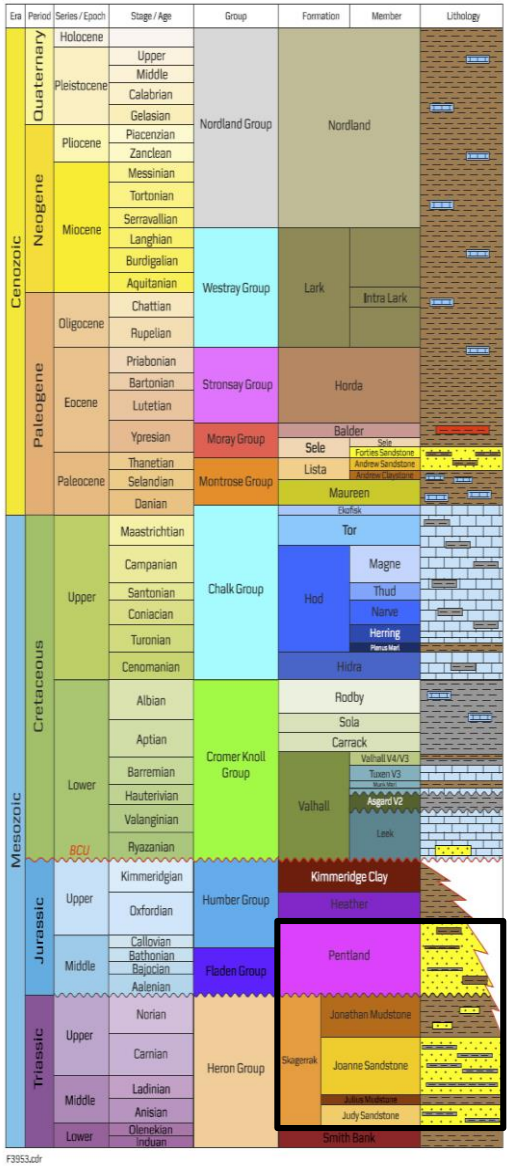


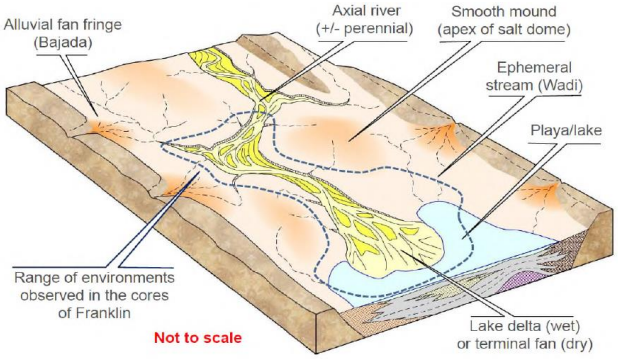
- Culzean represented one of the largest UKCS hydrocarbon discoveries in the last 15 years.
- Culzean estimated to contribute 5% of UK gas supply in 2020
- Currently producing ~100,000 boed
- More than 300Mboe of recoverable HC

TIMELINE FROM DISCOVERY TO DEVELOPMENT

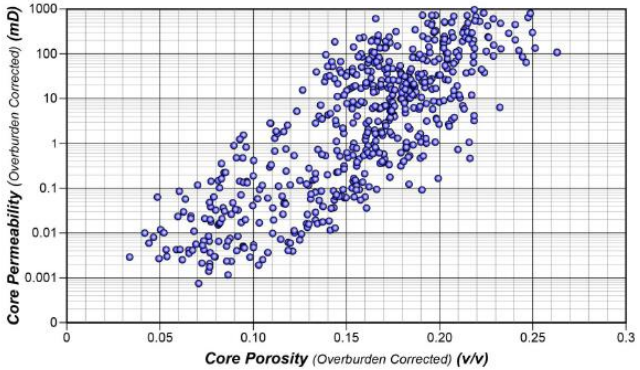
THE CULZEAN DEVELOPMENT

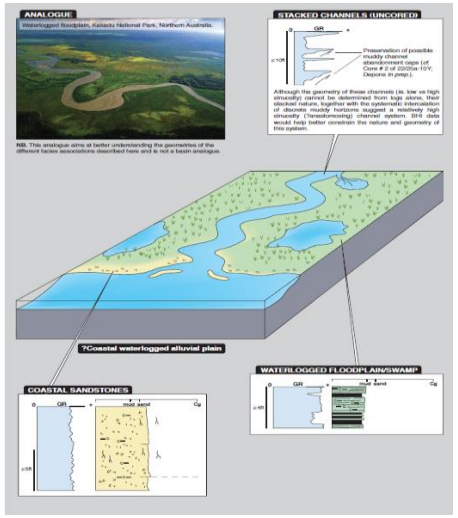
BASIC GEOLOGY OF CULZEAN





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

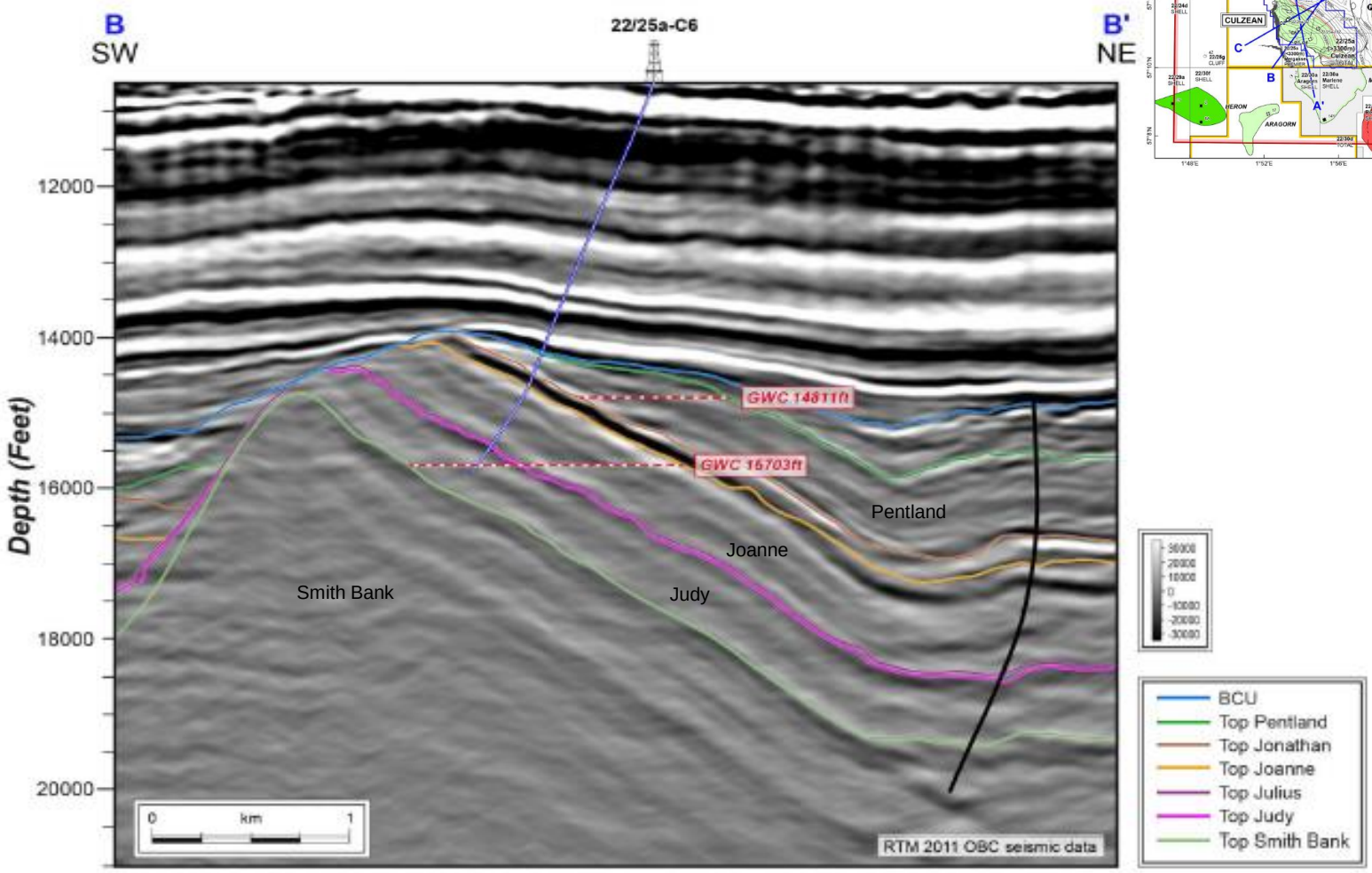


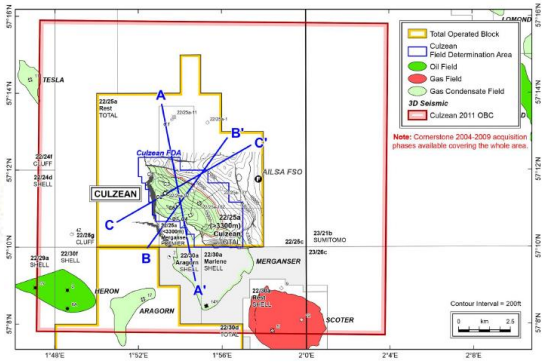


- Culzean reservoirs
  - Jurassic Pentland
    - Coastal plain meandering fluvial system
  - Triassic Skagerrak (Joanne + Judy Members)
    - Semi arid continental fluvial system
  - Exceptional petrophysical quality for these depths
    - Joanne average porosity of 17%
    - Early porosity preservation

TOTAL

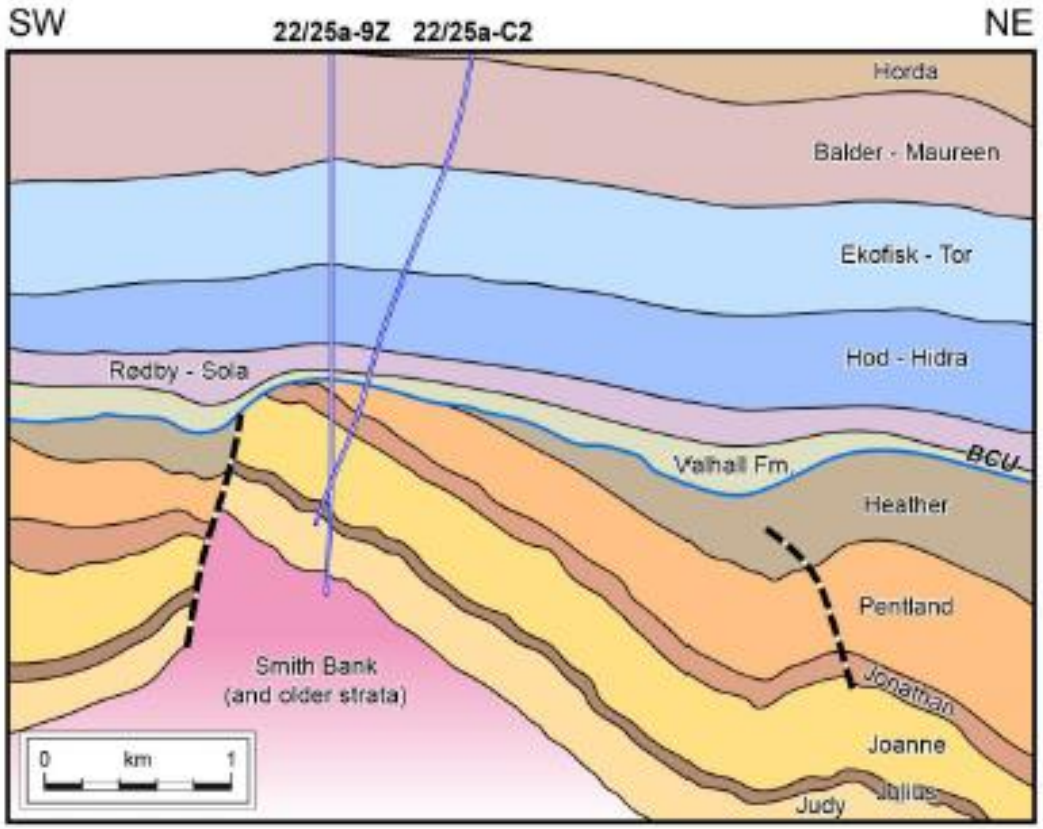
STRUCTURAL CONTEXT



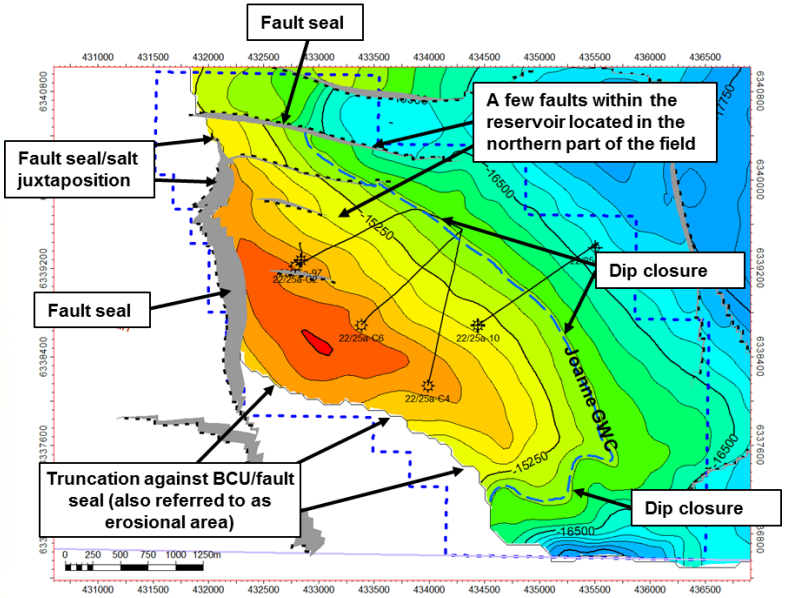


- A number of data sets cover the Culzean area with the key ones being:
  - Cornerstones towed streamer pre-stack depth migration survey (2011)
  - Culzean specific High Density Ocean Bottom Cable (HDOBC) (2011)

STRUCTURAL CONTEXT

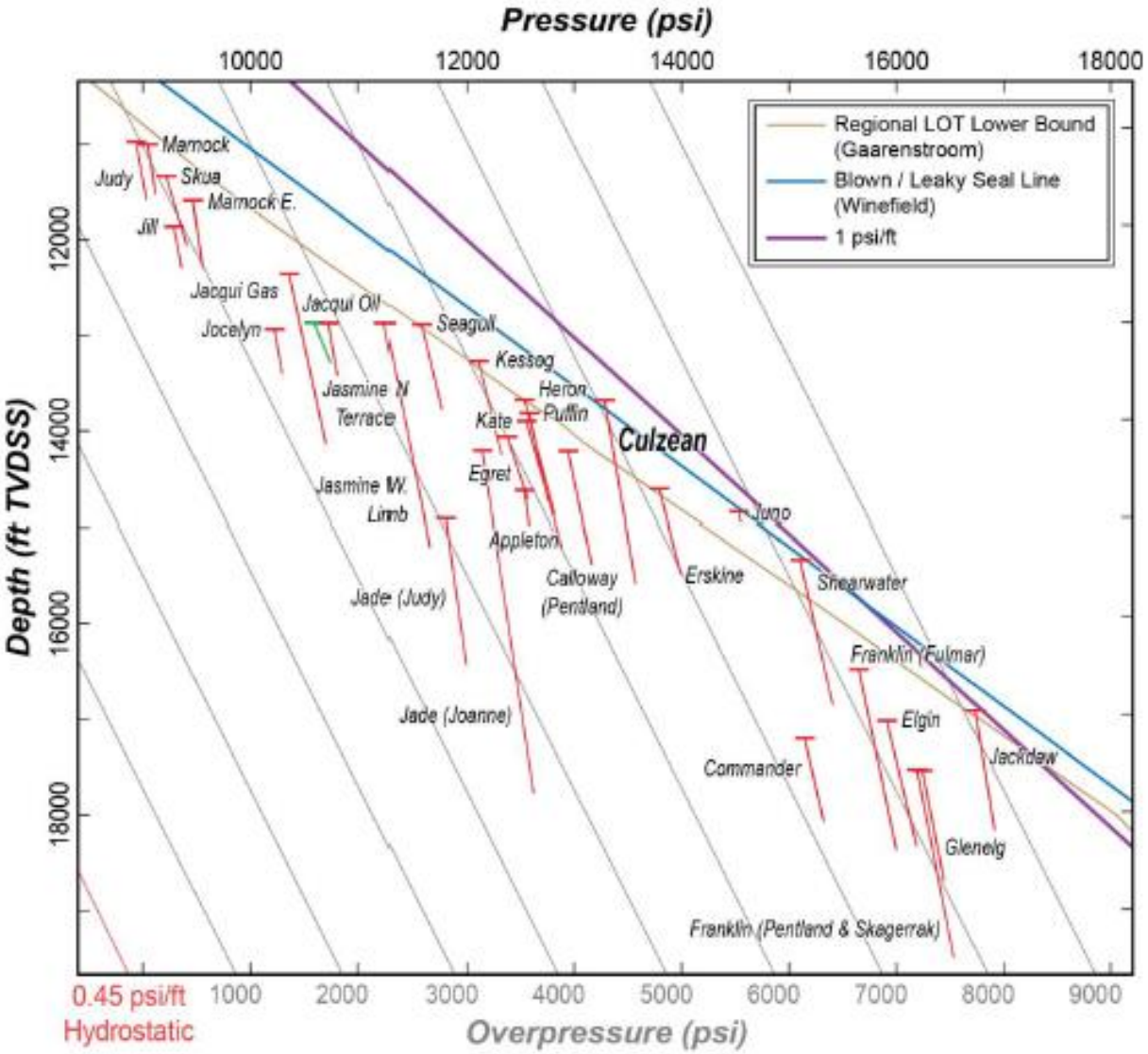


Top Joanne mean depth map with seismically mapped faults displayed



- 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

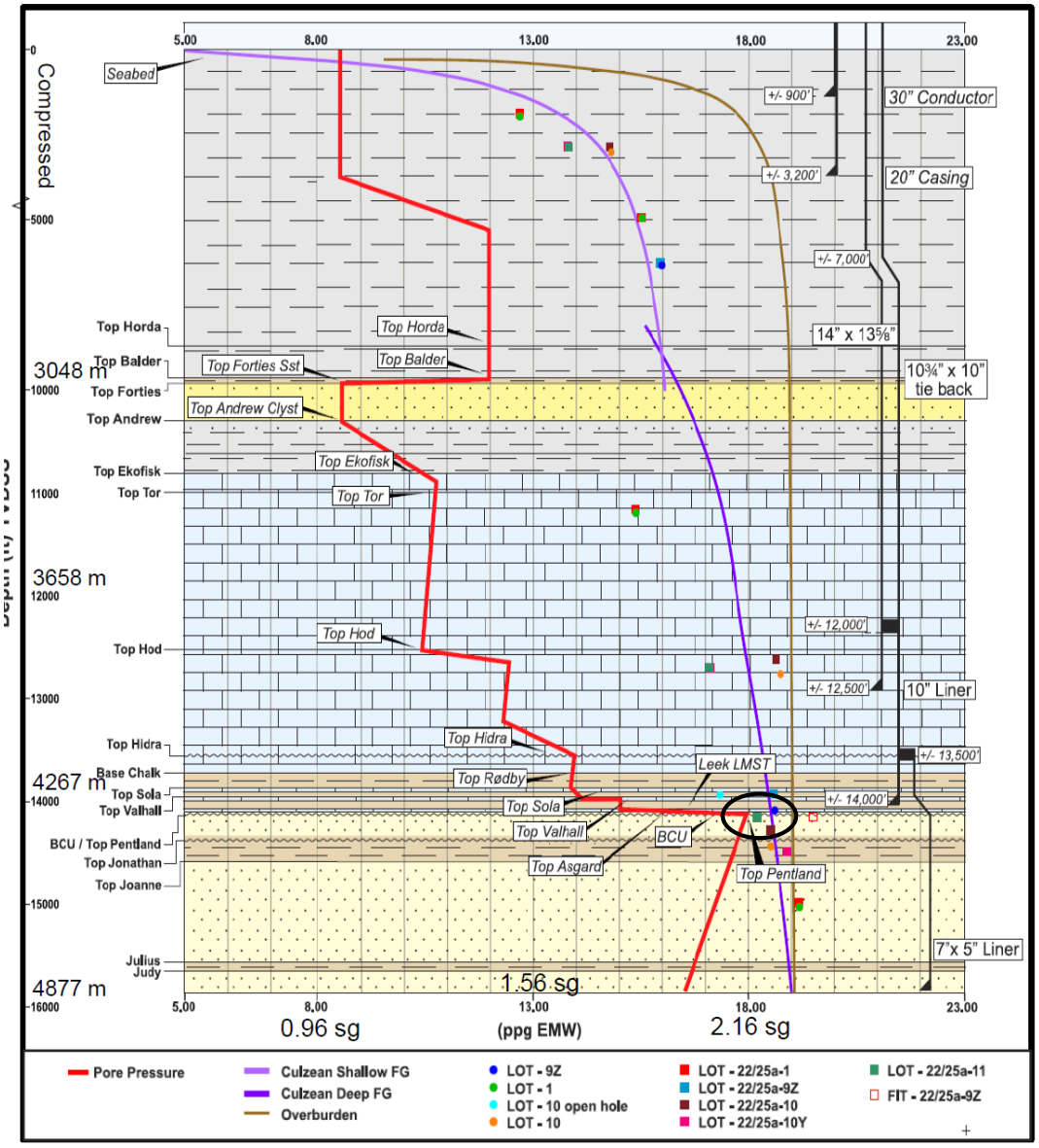
REGIONAL CONTEXT OF CULZEAN



- 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.

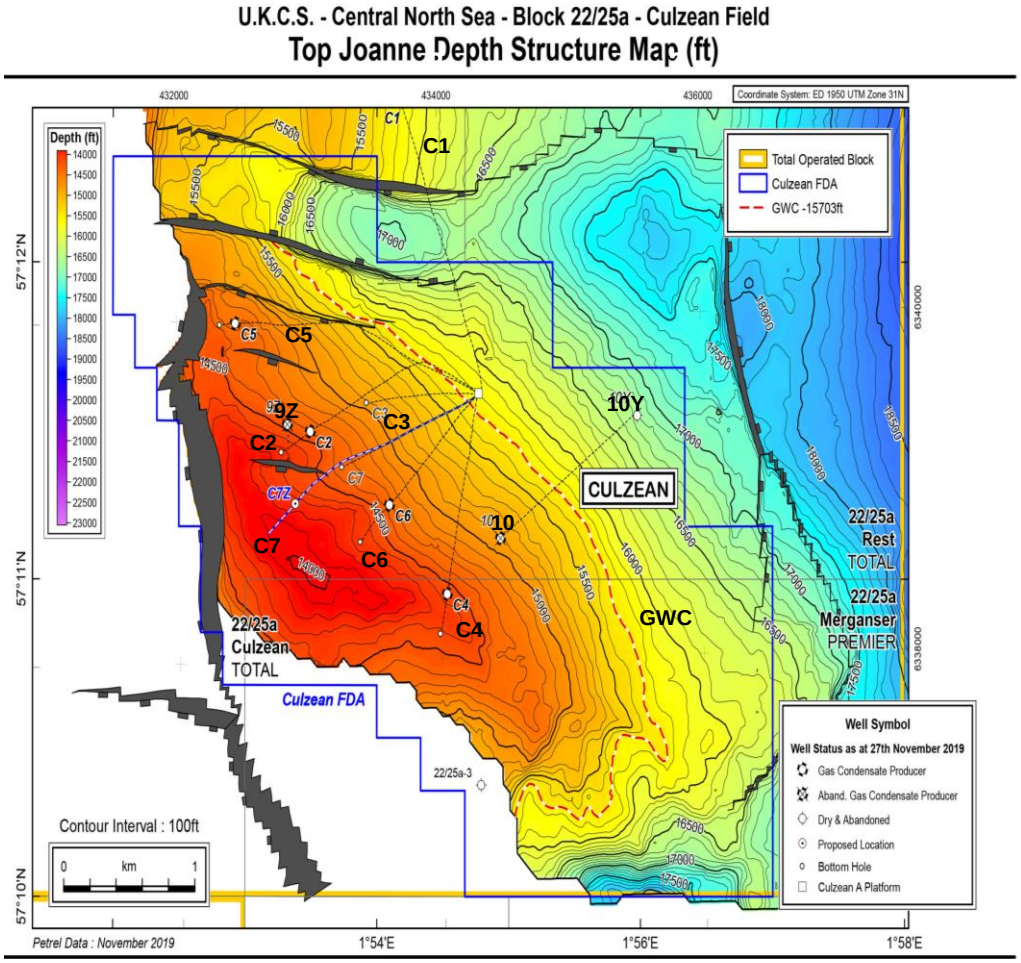
WELL ARCHITECTURE

- 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



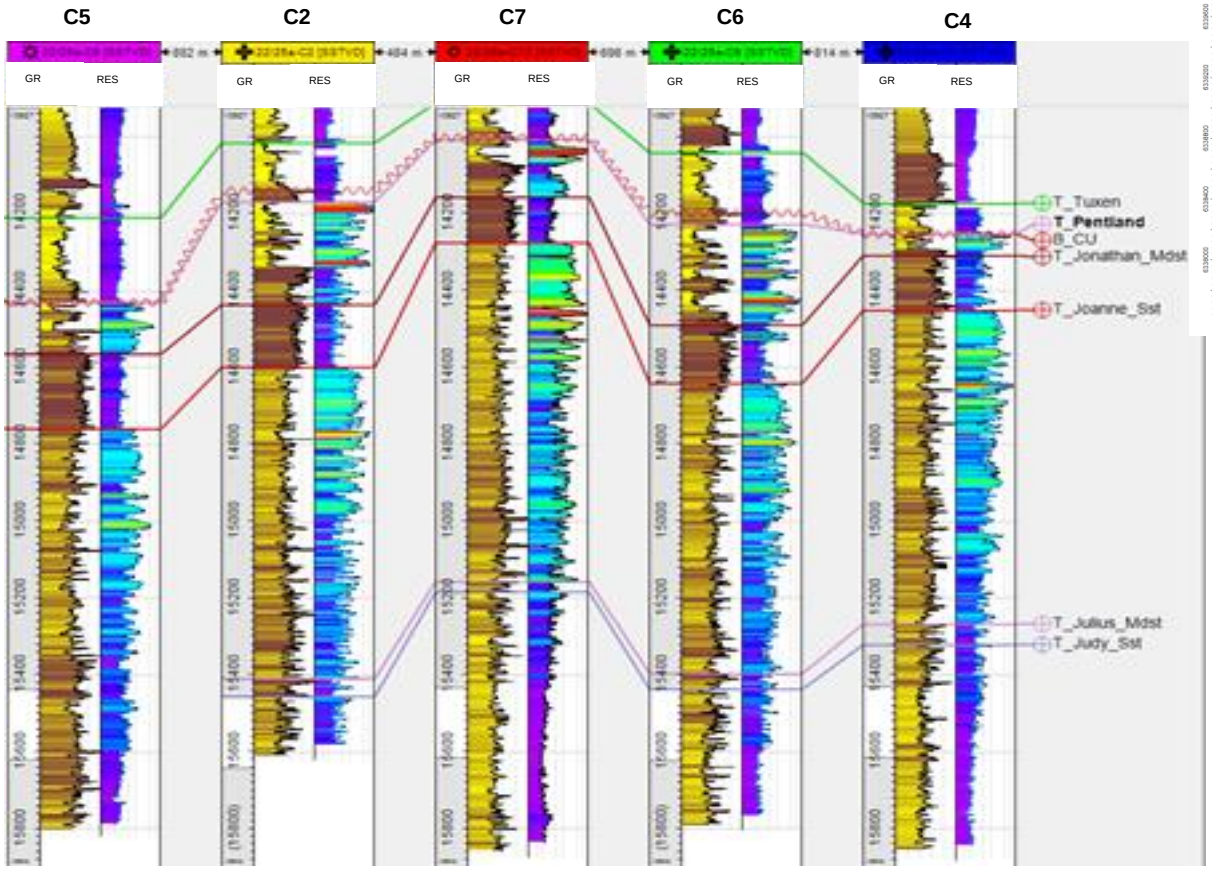
DEVELOPMENT STRATEGY

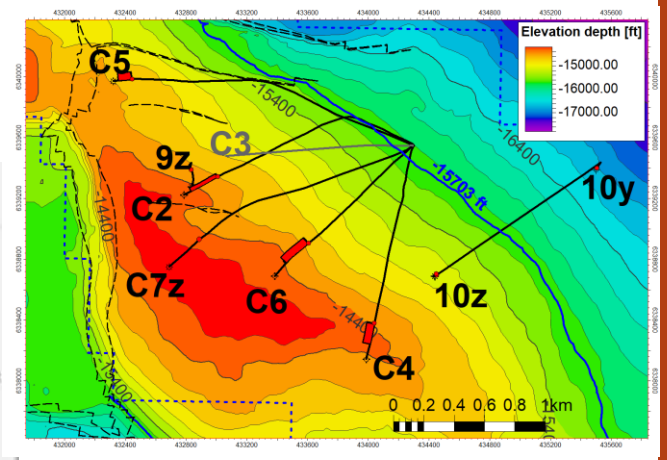
C2 (EJ-04) Joanne → C6 (EJ-02) Joanne → C4 (EJ-01) Joanne → C5 (EJ-05) Joanne → C7 (EJ-03) Joanne → C3 (EP-01) Pentland → C1 (EF-01) Forties



- 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

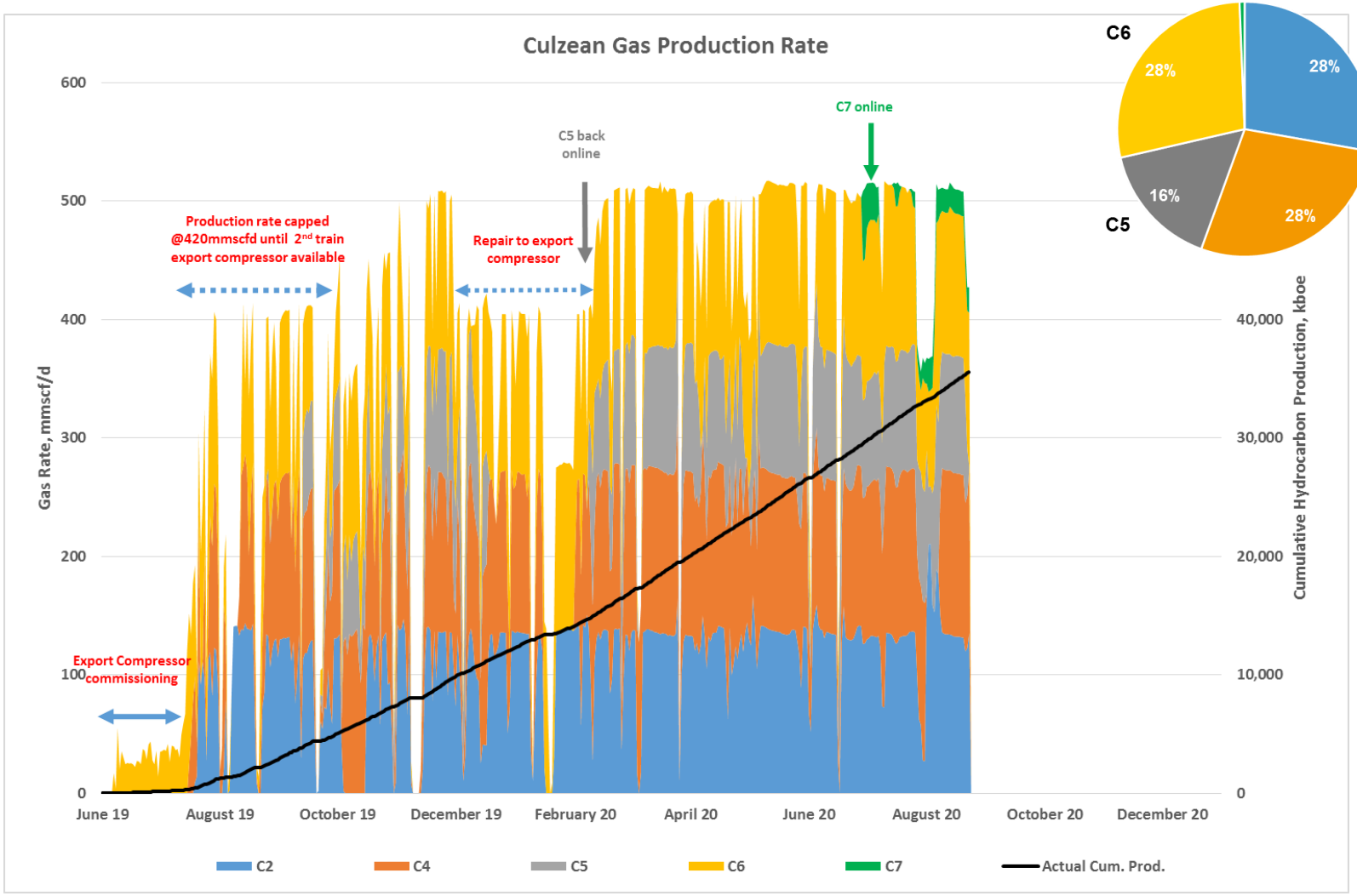
DEVELOPMENT WELLS





- 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

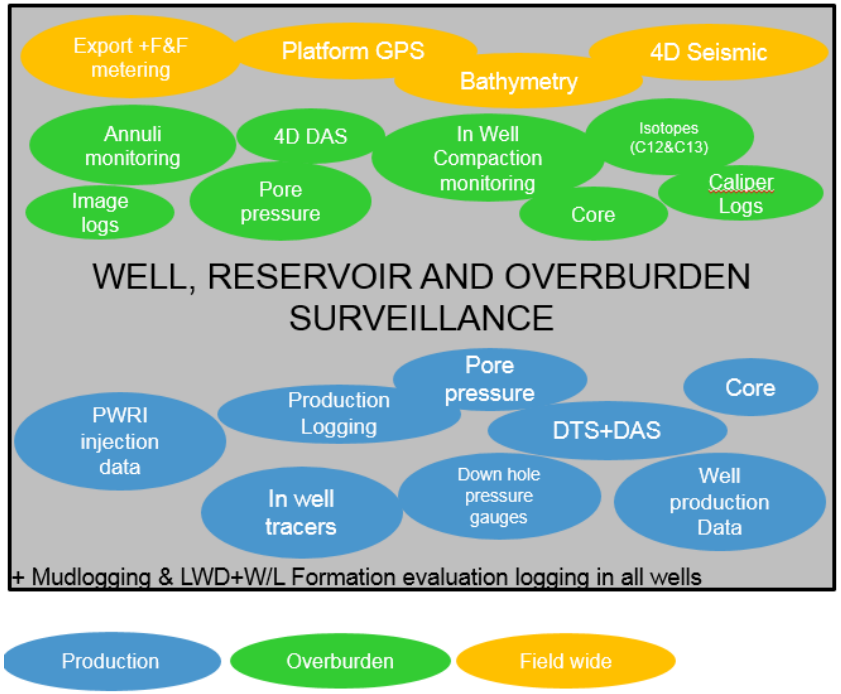
PRODUCTION HISTORY



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!)