



Oil & Gas
Authority

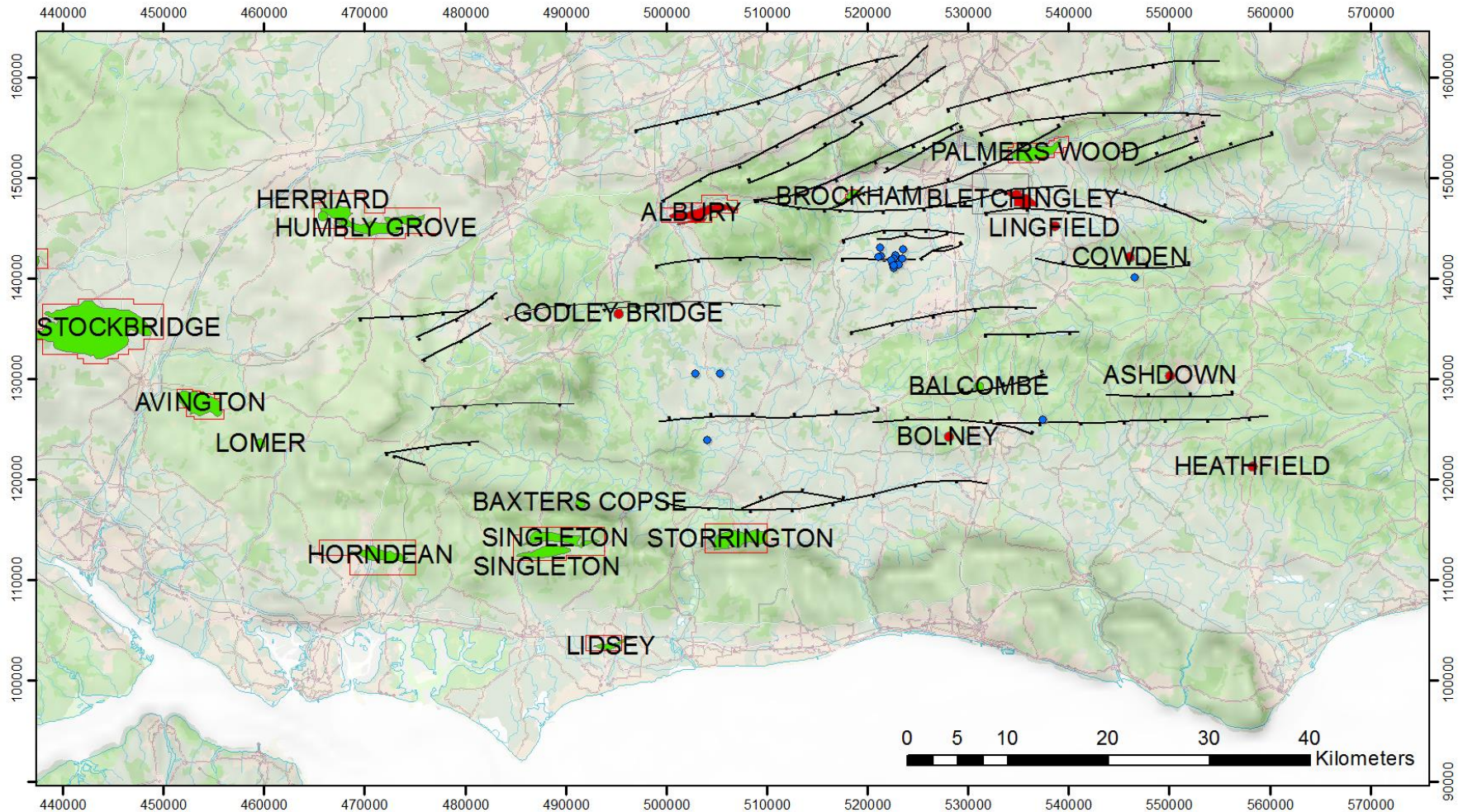
Additional data for

3 Oct 2018 Newdigate Seismicity Workshop

Map of nearby production, published induced seismicity and the Davis and Frohlich 1993 criteria



Weald Basin Field Map

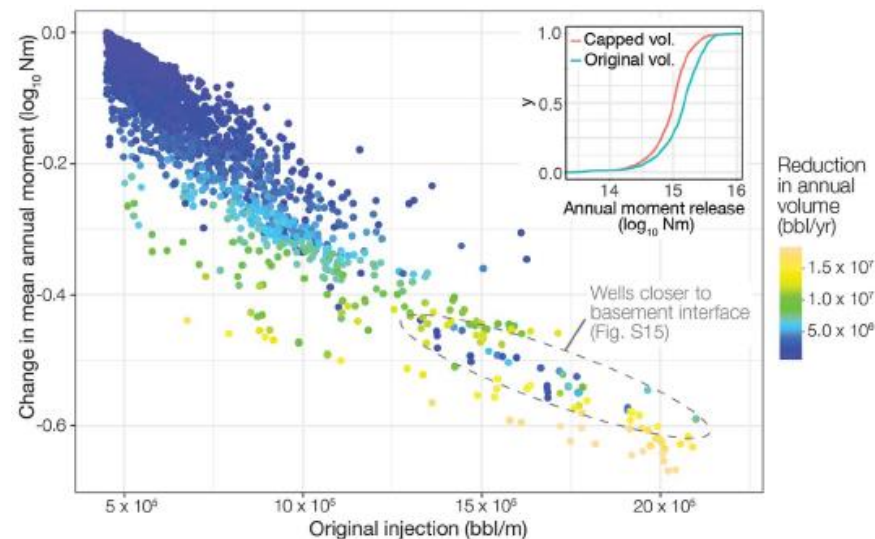


Humbly Grove is a gas storage facility with large volumes injected and produced. Disposal of produced water is injected at Palmers Wood, Storrington, Singleton, and Stockbridge fields at larger rates and volumes than Brockham Field.



Published Induced Seismicity

- Hincks et al., Science 359, 1251–1255 (2018) 16 March 2018 Figure 4B indicate relationship between total injected volumes and monthly injected volumes of wastewater in Oklahoma



- McGarr A (2014) Maximum magnitude earthquakes induced by fluid injection J. Geophys. Res. Solid Earth, 119,1008-1019, Figure 2 summary of total injected volumes against observed magnitudes

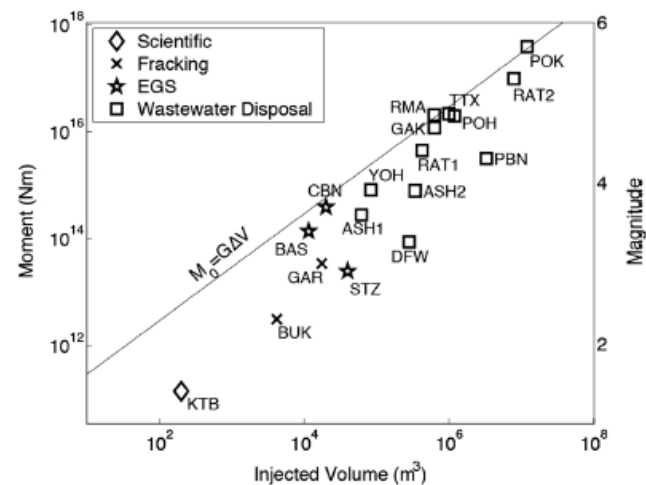


Figure 2. Maximum seismic moment and magnitude as functions of total volume of injected fluid from the start of injection until the time of the largest induced earthquake. The equation along the solid line relates the upper bound seismic moment to the product of the modulus of rigidity and the total volume of injected fluid. These data are listed in Table 1.



Davis and Frohlich 1993 criteria

Temporal Correlation

1. Are these events the first known earthquakes of this character in the region?
2. Is there a clear correlation between injection and seismicity?

Spatial Correlation

- 3a. Are epicentres near wells (< 5 km)?
- 3b. Do some earthquakes occur at or near injection depths?
- 3c. If not, are there known geologic structures that may channel flow to the sites of earthquakes?

Injection Practices

- 4a. Are changes in fluid pressure at well bottoms sufficient to encourage seismicity?
- 4b. Are changes in fluid pressure at hypocentral locations sufficient to encourage seismicity?