Introduction

• What is Hydraulic Fracturing Fluid?
• Chemical additives in Shale Gas:
  • Injected Water, Produced Water, Recycle Water
  • Friction-reducing additives
  • Other additives and Proppants
  • Produced water prediction
Aim:
• To understand the geochemical processes during hydraulic fracturing so that we can predict the composition and impact of flow back fluids

Objectives:
• Statistical analysis of produced and flowback fluids from US
• Use UK Geothermal catalogue to identify deep groundwater compositions
• Simulation of reactions in fracking with synthetic fracking fluids and groundwater compositions; shale samples and at high pressure and temperatures
The Potential Water Quality Impacts of Shale Gas Exploitation

Background

**Bowland Basin:**
- Contains sufficient organic matter to generate considerable amounts of hydrocarbons, typically in the range 1-3%
- Mature for gas generation at depths between 1524-2895 m

Shale gas resources of the Bowland Basin, NW England
Clarke et al., 2018
Background

**Samples:**
- Samples come from the Upper, & Lowland Bolwand shales, and Pendel Grits
- Samples locations shown in Figure
- Samples from outcrops and boreholes
- Characterised by: XRD, XRF and TGA
Results

• Case Study: **Marcellus shale Gas, Pennsylvania, USA**
  • Waste fluids contain high levels of salinity, toxic metals, and radioactivity
  • Groundwater and surface water concentrations of salinity are exceeding aquatic ecotoxicological water standards by a factor 10–100
Results

- The statistical study of UK geothermal data results helps to understand the formation of water composition in associated research area.

Loveless et al., 2018
Results

• Predicting non-conservative behaviour - Metal addition
• Relative to the slickwater what was added by the shale?
  • Fe and Mn
  • Si and Al
• Sequential extraction
Results

- Controls of flowback composition
  - Included compositions for: tap water, Preese Hall flowback fluid & geothermal fluid

![Graphs showing flowback composition](image)
Future

The Potential Water Quality Impacts of Shale Gas Exploitation

• Shale Gas:
  • Understanding of the reservoir characteristics, including stratigraphy and petrophysical characteristics

• Characterization of potential contamination pathways
  • Geodatabase: Data collection and Database Development
  • Statistic analysis of Produce water and Recycle water
  • Aquatic toxicology and improved waste water treatment
  • Strontium isotope analysis to trace the source of mixing fluid