

NORM in the UK's onshore oil and gas industry

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What is this presentation about?



UK oil and
gas

NORM
formation

Quiz

NORM
Issues

Fracking

R&D

My Background

Chemistry Masters



Radiochemistry Ph.D.



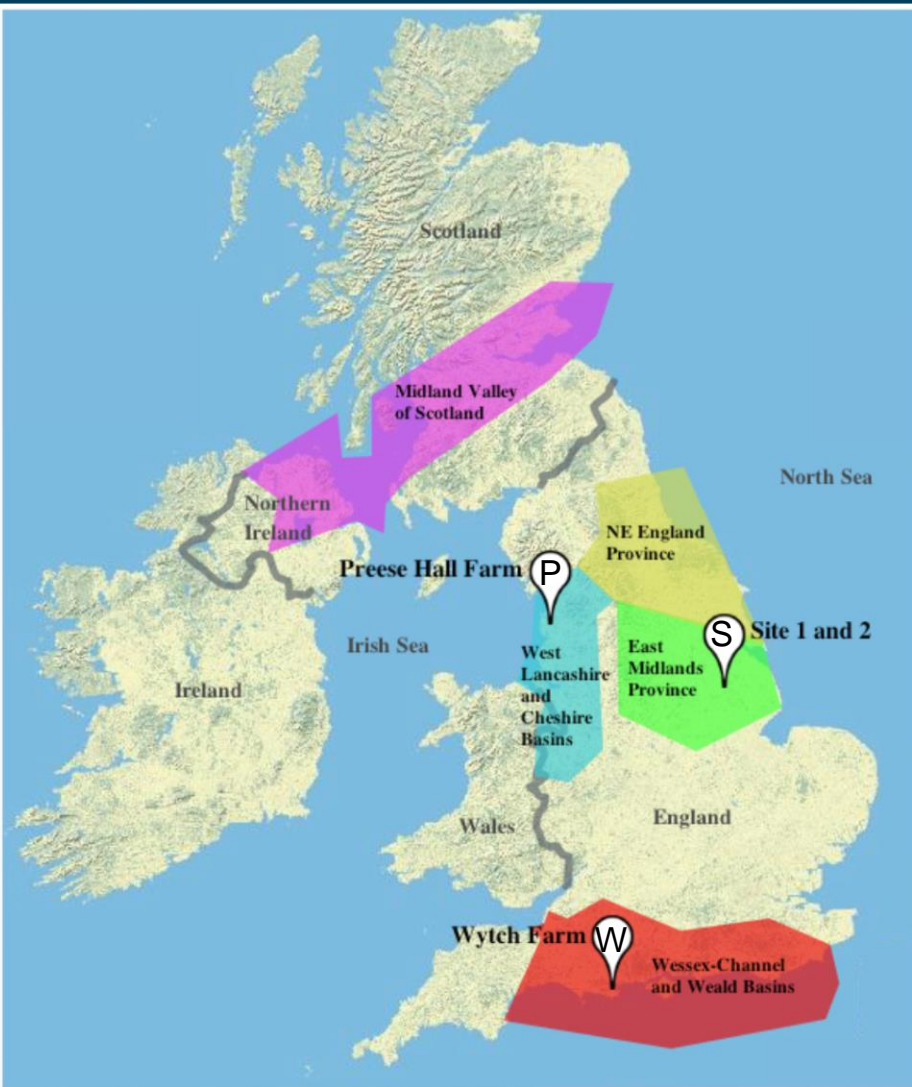
Loughborough
University



Radiation Protection



Onshore oil and gas in the UK



- 5 main regions
- Different geology
- ~40 operational sites
- Shale gas potential
- Only 1 site has been fracked P
- Biggest onshore site in Europe W
- NORM analysis at only 1 site
- 2 new sites (my work) S

Oil and gas NORM formation

Fe

Rapid
n-
capture

^{238}U & ^{232}Th

Decay

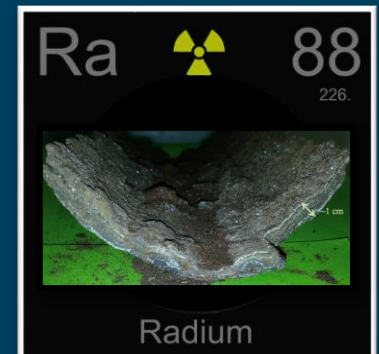
$^{226/8}\text{Ra}$ & ^{210}Pb



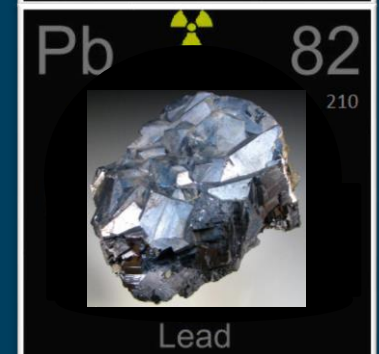
Uranium



Thorium

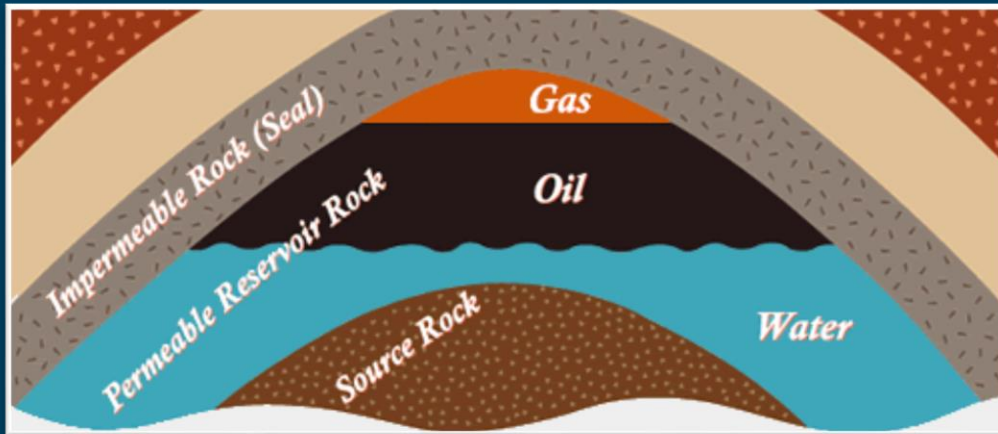


Radium



Lead

Oil and gas NORM formation



$^{226/8}\text{Ra}$ & ^{210}Pb
in rocks

Dissolve

$^{226/8}\text{Ra}$ & ^{210}Pb
in formation
water

Reducing
conditions

$^{226/8}\text{Ra}$ favored
in solution

Oxidising
conditions

^{210}Pb favored
in solution

Oil and gas NORM formation

$^{226/8}\text{Ra}$ &/or
 ^{210}Pb in
formation water

Pumping

Hydrocarbon &
formation water
brought to the
surface

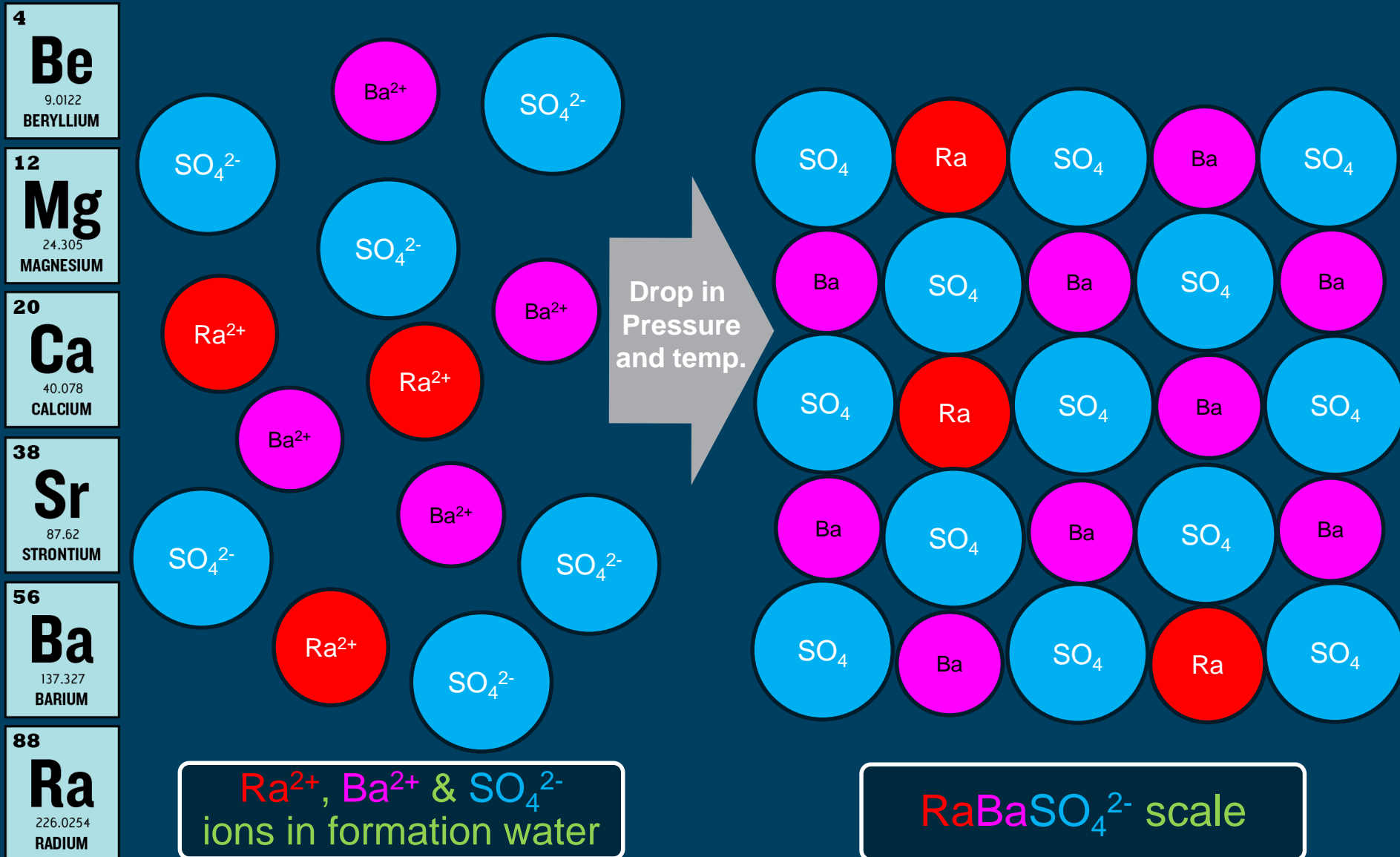
Drop in
Pressure
and temp.

$^{226/8}\text{Ra}$
coprecipitation
with barite

^{210}Pb
precipitation
with galena



Chemistry of NORM formation



Half Time Quiz

1. Go to **Kahoot.it** on your browser
2. Type in the game PIN
3. Give yourself a nickname
4. Quicker (correct) answers = more points

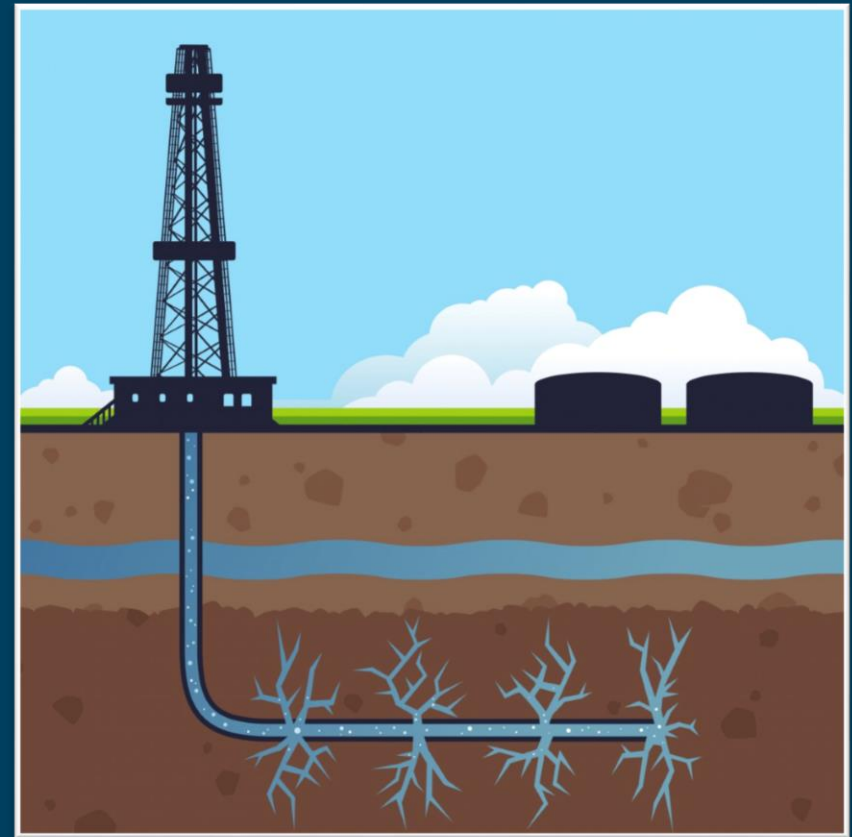
NORM issues in the UK



- ~90% of offshore NORM is disposed of at source – not available onshore
- Only 1 site in open literature – Wytch Farm (^{210}Pb)
- Extent or even existence of NORM at other onshore wells is unknown
- Fracking may become prevalent – large volumes of flowback fluid

Fracking

- Large volume of fluid pumped down wellbore at high pressure
- Fractures in shale open and enlarge
- 'Flowback fluid' returns to the surface
- It is typically highly saline and can contains radionuclides



West Lancashire's Bowland Shale



- High shale gas prospectivity – Bowland Shale
- Preese Hall Farm – flowback up to 90 Bq/L ^{226}Ra

Ph.D. - Characterisation – East Midlands



- Numerous oil producing sites
- NORM samples from 2 sites characterised

- High shale gas prospectivity
- Fracking in the future?

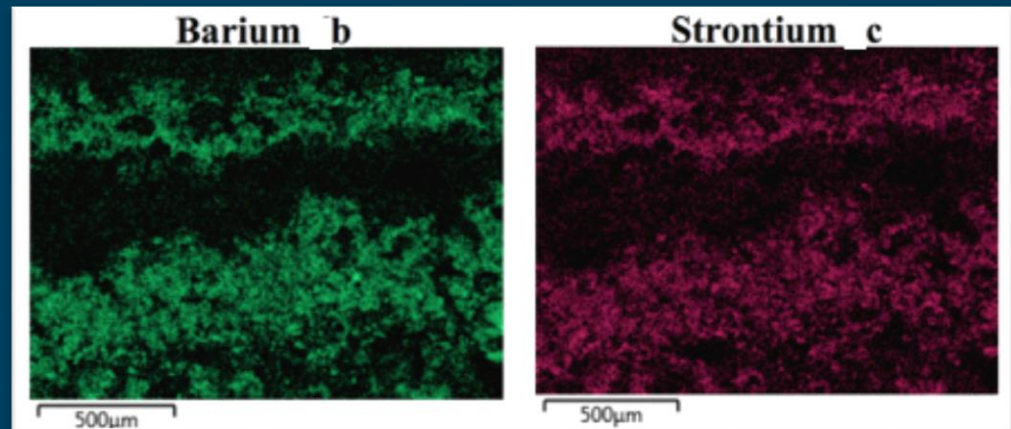


Ph.D. - Characterisation – East Midlands

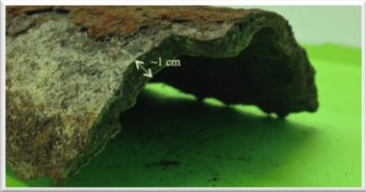


- Radium
- More ^{226}Ra than ^{228}Ra
- Ra coprecipitated with barium & strontium sulfate

- Scale more active than sludge
- Scale $^{226}\text{Ra} = 86 \text{ Bq/g}$
- Sludge $^{226}\text{Ra} = 4 \text{ Bq/g}$
- Scale dating: 2.2 years



Ph.D. - Characterisation – East Midlands

NORM Sample	^{226}Ra activity (Bq/g)	Waste category	Health Physics “technical” term
East Midlands sludge 	4	Exempt (< 10 Bq/g)	Tickle
East Midlands scale 	86	Permit (> 10 Bq/g)	Pokey
US EPA 1993 scale 	15,000	Equivalent to ILW	Honking

Summary: Future NORM issues from Fracking



- West Lancashire and East Midlands have good shale gas potential
- ^{226}Ra found in flowback from West Lancashire
- ^{226}Ra and ^{228}Ra found enhanced in NORM from the East Midlands
- Likelihood that fracking in both regions will lead to Ra-containing flowback fluid

Thanks



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL



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National Physical Laboratory