



RSO Discipline Update: Gas Generation, Migration & Reactivity

Dr Simon Norris (RWM), Dr Andy Cooke (RWM), Prof Kath Morris
(University of Manchester)

Introduction



Dr Simon Norris:

- Principal Research Manager at RWM with over 25 years' research and safety case experience
- RWM lead on gas, near-field processes, GDF-driven coupled processes
- RSO SME (Gas/Geoscience)
- Background:
 - Geology & Geophysics (PhD University of Liverpool)
 - CGeol & CPhys



Dr Andy Cooke:

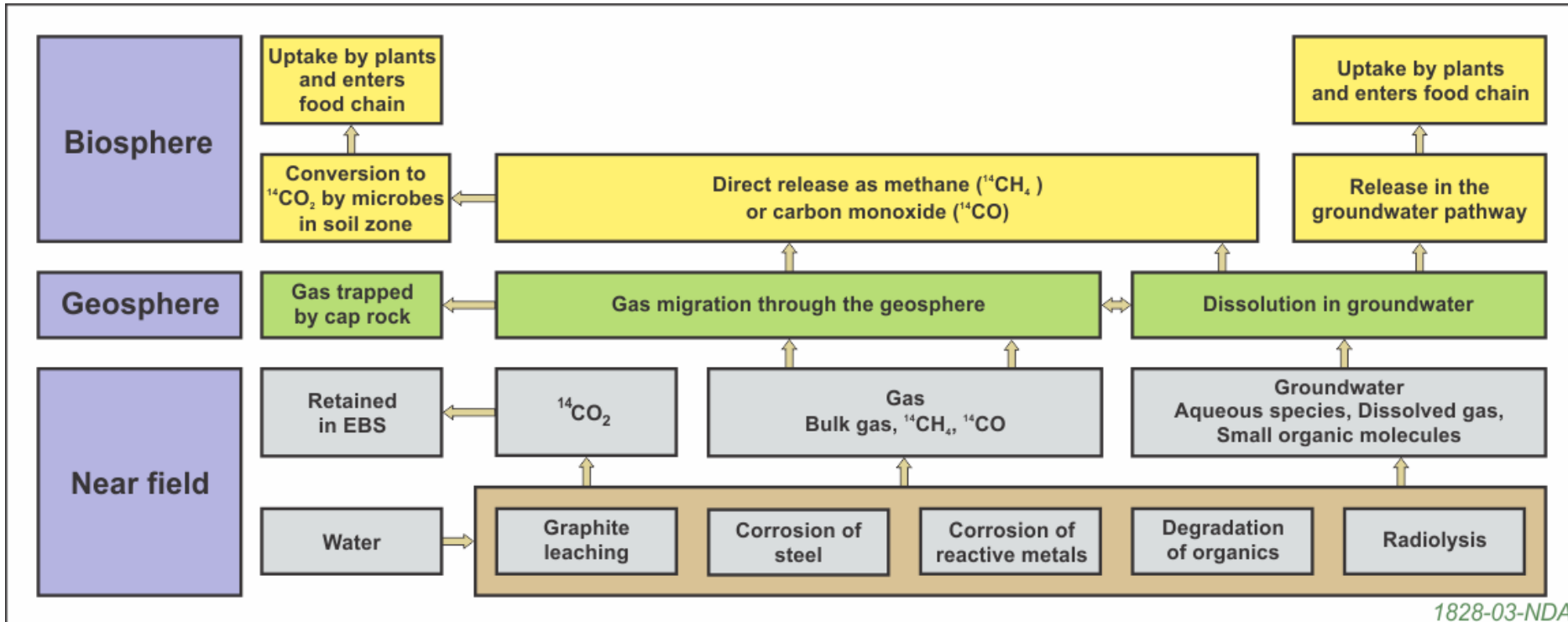
- Research Manager (gas) at RWM since November 2020
- RSO SME (Gas/Geoscience)
- Background:
 - MSci Geophysics (UCL)
 - PhD (University of Leeds) investigating the role of fault zones on fluid flow in carbonate rocks



Prof Kath Morris:

- RWM RSO Director
- BNFL Chair of Environmental Radioactivity at The University of Manchester and has over 20 years' experience in academic research

Background (waste-derived gas)



Key ongoing RWM projects

- Gas Studies Integrated Project
 - Improved gas generation and migration modelling over a range of scales and throughout all phases of the GDF (Transport, Ops, P-C)
 - Development of RWM's safety case through:
 - Better understanding of the hazards associated with waste-derived gas
 - Better understanding of gas source terms and sinks
 - Developing Claims, Arguments, and Evidence (CAE) for the 'gas pathway'
 - Commercial contract with support from University of Huddersfield (subcontractor to Jacobs) on microbial experimentation tasks
- EURAD GAS: *Mechanistic understanding of gas transport in clay materials*
 - International collaborative project
 - BGS providing RWM's in-kind project contribution
- Gas Processes in Halite (PhD):
 - Sam Clarke, University of Cambridge
 - Andy Woods (PI) with BGS project support

Gas theme updates

RSO Launch Event: Gas workshop (September 2020):

- RWM commitment to funding a gas research theme via the RSO
- 4 themes, each discussed by two workshop groups. Workshop outputs, in conjunction with other research drivers, have fed in to RWM's RSO programme (highlighted red).
- Key outputs:

Gas Generation: Inorganic Processes

- Removing uncertainty in understanding of corrosion of stable metals (impact of groundwater)
- Corrosion of U metal
- Gas generation from graphite
- Treatment and encapsulation options for Magnox fuel
- Sorbents for gas in waste container ullage

Gas Generation: Organic/Bio

- Microbial gas generation and consumption processes (e.g. hydrogen consumption)
- Role of microbes on gas migration (biofilms, pore blocking etc.)
- Assumptions about microbial consumption in the safety case

Gas theme updates

Gas Migration and Reactivity: EBS System

- THMC-G couplings
- Interfaces between different GDF materials
- Novel EBS materials, including consideration of supply chain security
- Smart engineering approaches – e.g. controllable properties

Gas Migration and Reactivity: Geosphere/Biosphere

- Quantifying gas migration from subsurface to surface
- Controlling factors on gas migration at depth
- Controls on reactivity?
- Integration of understanding to the safety case

Gas theme updates

2020 RSO bursary projects

- Microbial gas consumption processes in the GDF safety case for Low Heat Generating Waste (LHGW) – *Bethan Payne*
- LHGW GDFs in the Circular Economy: Utilising waste rocks as EBS material - *Elise Mouat*
 - Both awarded to the University of Edinburgh (Dr Ian Molnar), with support from Quintessa and the University of Stirling
 - Starting October 2021

Forward vision

Priorities for future research:

- Gas generation rates under site-specific groundwater conditions
- Data-driven techniques for site characterisation
- Upscaling gas migration properties (pore scale to GDF/geosphere scale)
- Gas migration in evaporites and interbedded clay/halite rocks
- Site-specific understanding of the controls on gas migration
- Interactions and reactivity of gases in the GDF near-field

Seeking UKRI matched funding

RSO coordination of gas area (e.g. topic meetings, conference sessions etc.)

Upcoming opportunities

2021 RSO bursary call projects

- Gas migration through GDF interfaces
- Lithological control on the gas transport properties of UK-specific Lower Strength Sedimentary Rocks
- Machine learning methodologies for optimised gas transport characterisation

2022 RSO bursary call

- A minimum of two gas-related PhDs – watch this space!

Commercial opportunities

- Literature review to assess feasibility of novel hydrogen getter materials as a mitigation to waste-derived gas hazards during the operational and post-closure phases of the GDF, informing future research.
- To be issued on OJEU – open to academia, either as sole contractors or part of a consortium