Overview of EPSRC / RWM Geowaste Collaboration

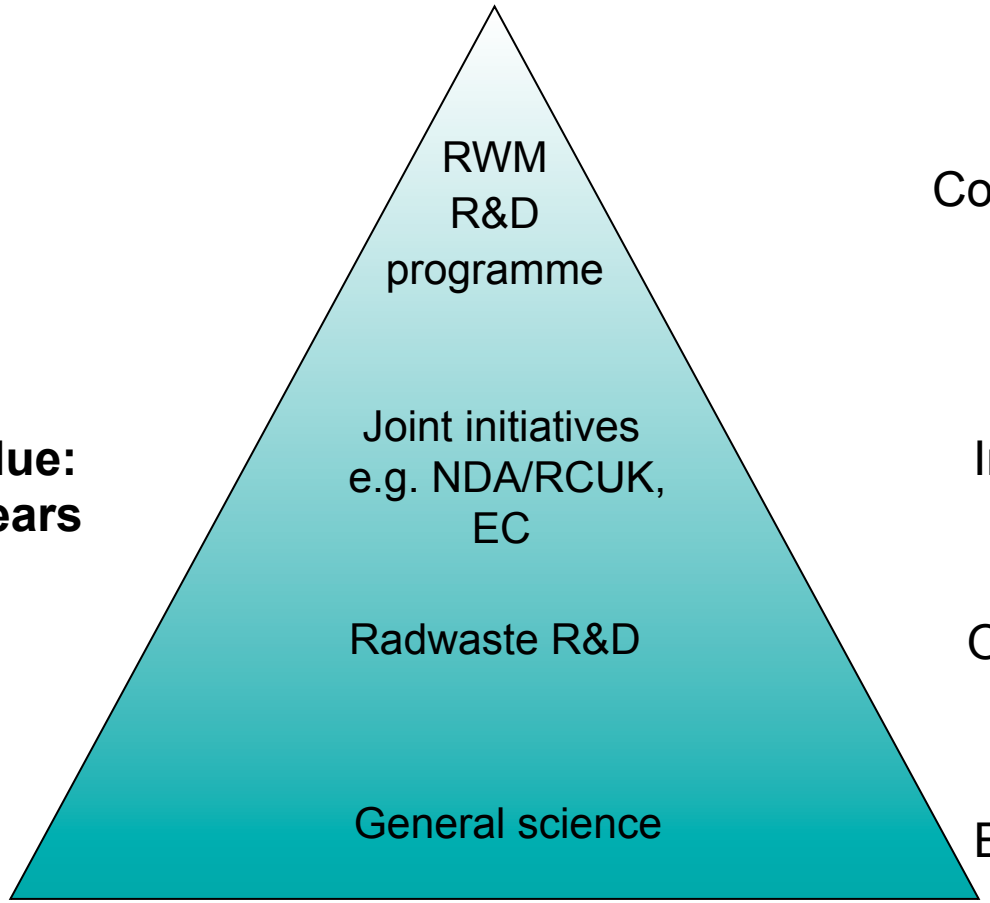
Jon Martin

Head of Research

Radioactive Waste Management Limited

One of our Joint Initiatives - 5 consortia

Geowaste value: £4m over 4 years



C14-BIG

The Post-Disposal Behaviour of ^{14}C and Irradiated Graphite

The Post-Disposal Behaviour of ^{14}C and Irradiated Graphite

- To arrive at a more realistic understanding of post-disposal ^{14}C behaviour
- Allow a more realistic treatment of ^{14}C in performance assessment calculations
- More informed/appropriate disposal of reactor graphite

pH 9.5 CDP fed microcosm

Interface Analysis Centre

University of BRISTOL

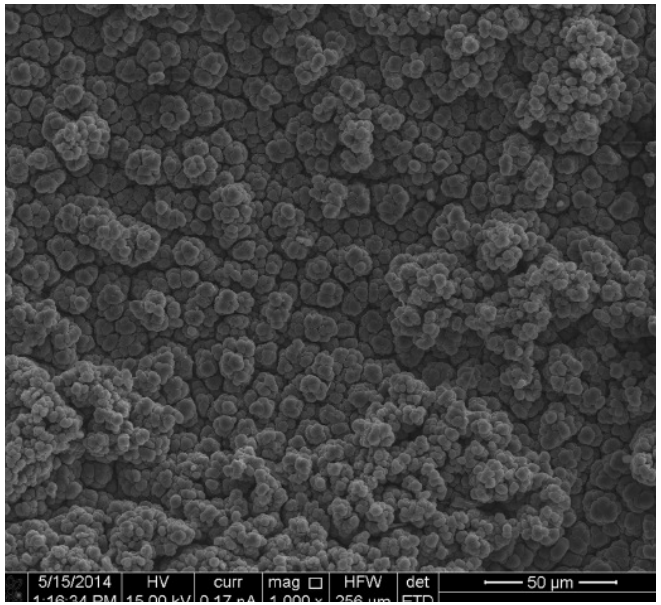
University of HUDDERSFIELD

uclan

Radioactive Waste Management Limited

Improved Understanding of Reactor Graphite

C14 enrichment in deposit on Oldbury graphite, channel wall face



C13 simulants successfully prepared by microwave plasma chemical vapour deposition (MPCVD) - Similar morphologies to C14 deposits on irradiated graphite achieved

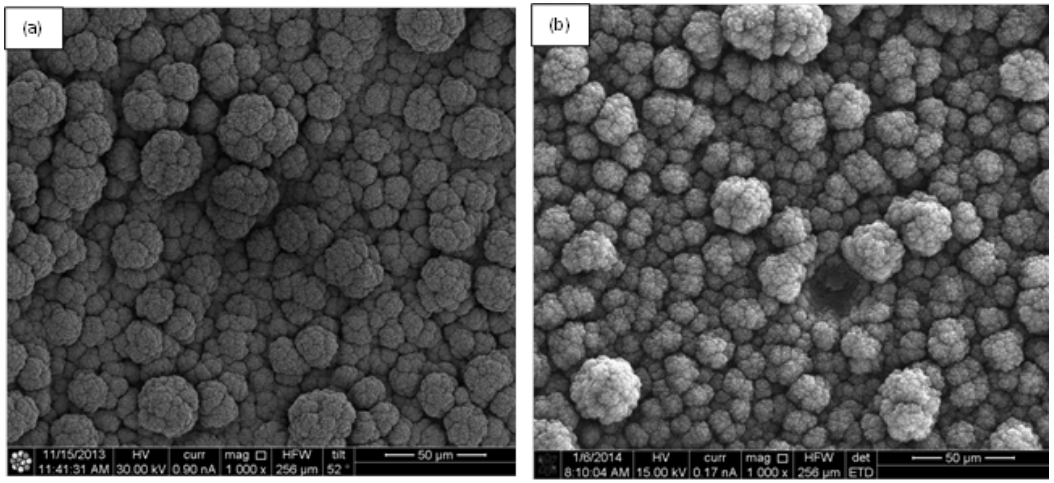


Figure 2, Scanning electron micrographs from ^{12}C (a) and ^{13}C (b) carbonaceous deposits on Pile Grade A graphite, system pressure 10mbar.

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Engineering and Physical Sciences Research Council

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NDA

Nuclear Decommissioning Authority

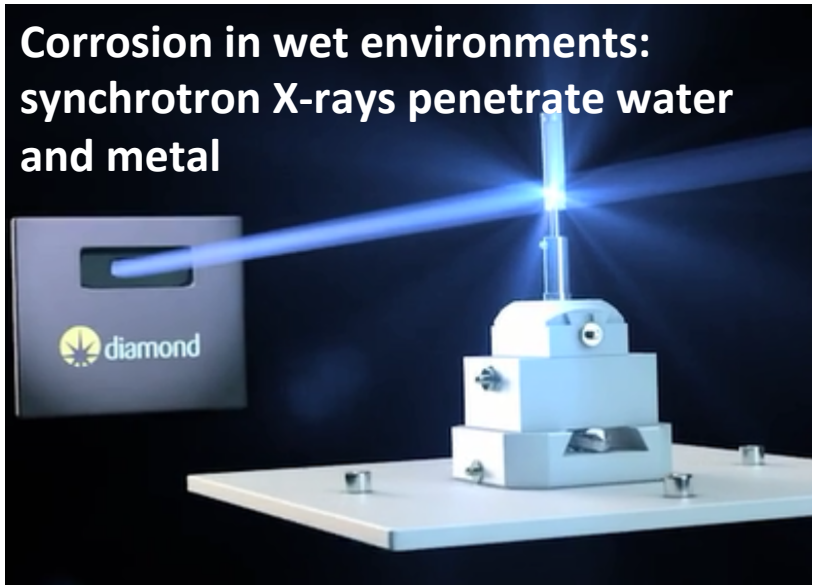
In situ time-dependent characterisation of corrosion processes in nuclear waste storage and GDF environments

Overview of Scope

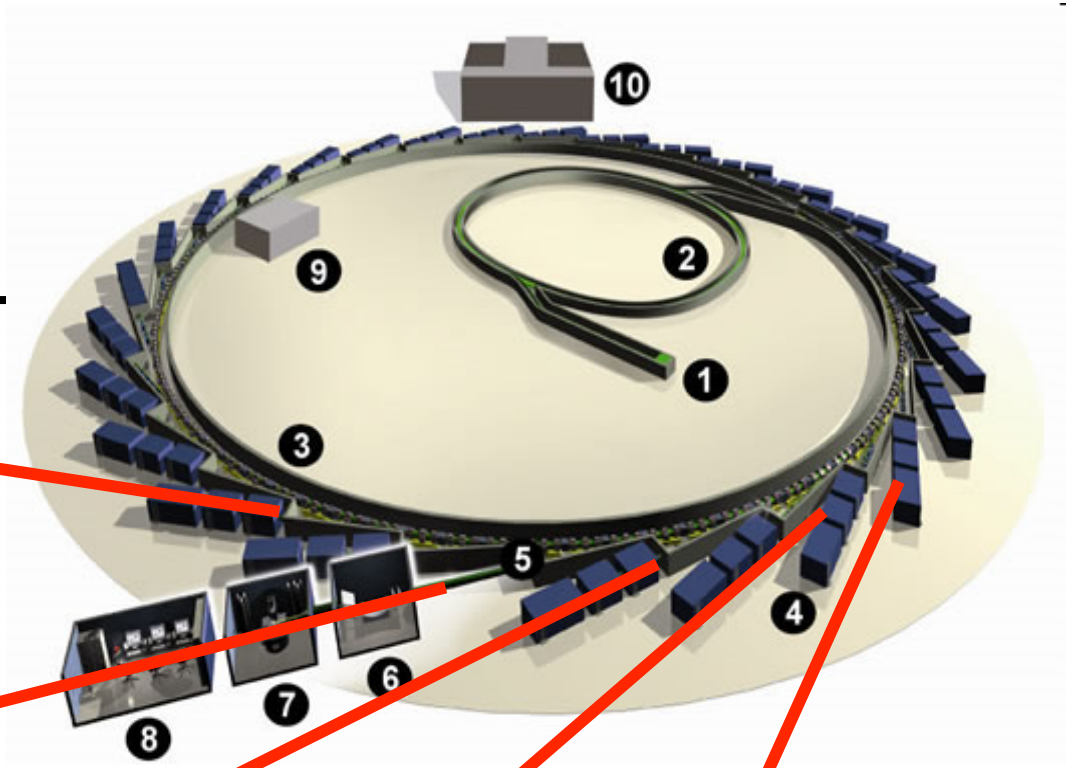
- **Alison Davenport + PhD student (U. Birmingham)**
  - atmospheric corrosion of stainless steel
- **Dirk Engelberg + PhD student (U. Manchester)**
  - Atmospherically induced stress corrosion cracking of stainless steel
  - duplex stainless steels
- **Tom Scott + PhD student (U. Bristol)**
  - U/cement
- **Post-doc (Birmingham) collaborating with Trevor Rayment at Diamond**
  - co-ordinates synchrotron activities
  - atmospheric corrosion and modelling
  - research on steel/bentonite

Understanding Pitting Corrosion of Stainless Steel Waste Containers

- Develop synchrotron X-ray methods for in situ time-dependent measurement of corrosion processes
- Need to determine safe limits of chloride, humidity and pollutants to limit corrosion damage and maintain integrity of containers
- Mechanism /kinetics of corrosion will inform models for long term corrosion prediction



Highly intense synchrotron X-rays



- radiography
  - 2D imaging
- X-ray microtomography
  - 3D imaging
- X-ray diffraction
  - phase identification
- X-ray absorption spectroscopy
  - oxidation state and co-ordination environment
- X-ray fluorescence
  - mapping elemental concentrations

AMASS Imperial College London

Atomic and Macro-scale Studies of Surface Processes: Towards Mechanistic Understanding of Surface Reactivity and Radionuclide Binding Mechanisms

The **AMASS** Consortium

Loughborough University

MANCHESTER 1824
The University of Manchester

Imperial College London

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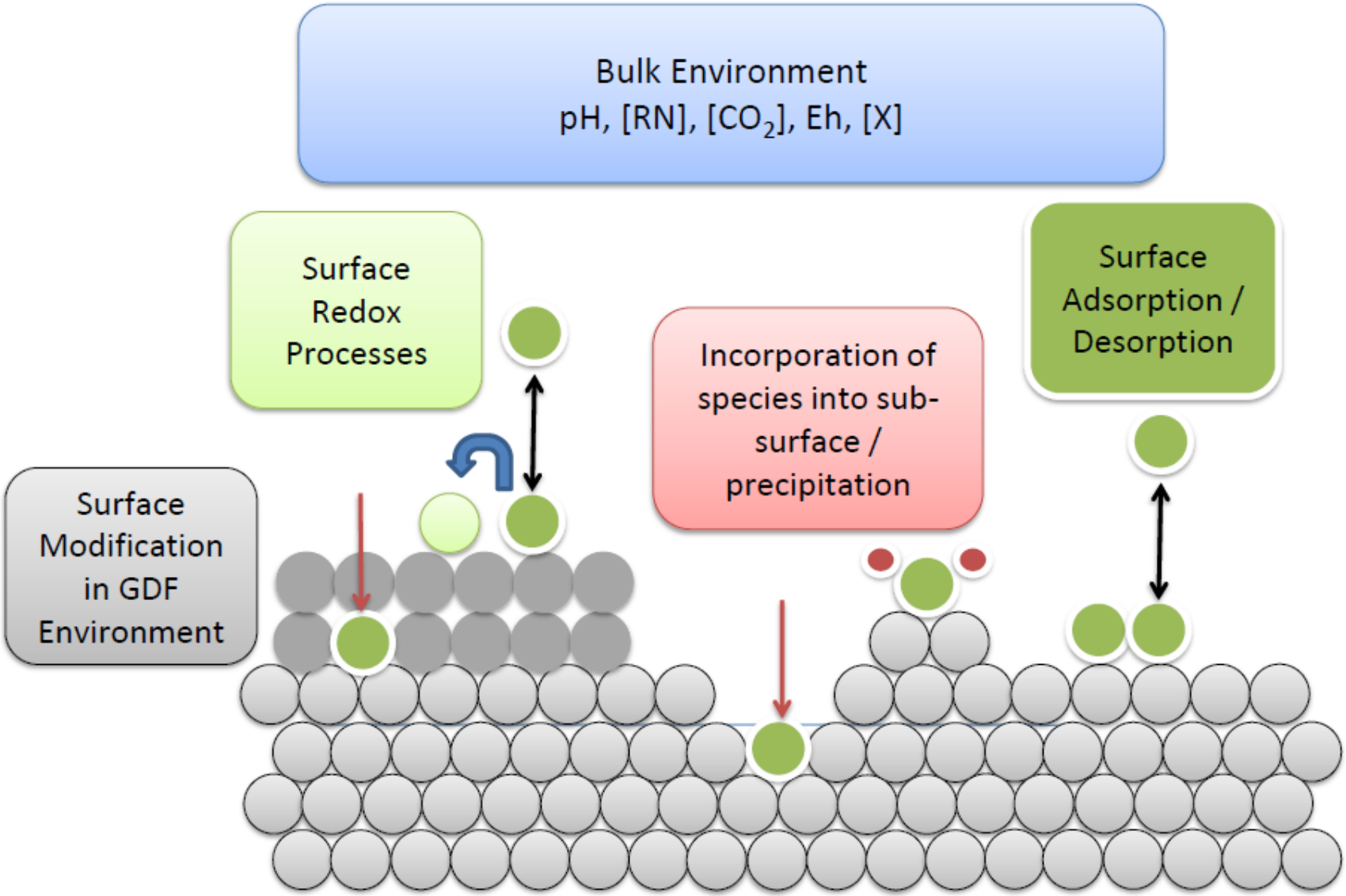
EPSRC
Pioneering research and skills

NDA
Nuclear Decommissioning Authority

About AMASS: The Project



About AMASS: The Team

- A multidisciplinary team across 4 institutions

Mary Ryan (Imperial): Surface Science / Electrochemistry
Roy Wogelius (Manchester): Mineral Reaction Kinetics / Spectroscopy
Kath Morris (Manchester): Radiochemistry/Spectroscopy
Gareth Law (Manchester): Radiochemistry
Nick Evans (Loughborough): Radiochemistry
Neil Burton (Manchester): Computational Chemistry
Fred Mosselmans (Diamond): X-ray Spectroscopy

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Behaviour of UK Specific Spent Fuel Under Conditions Relevant to Geological Disposal

Coordinator: Ian Farnan

CNEC: Department of Earth Sciences

Suitability of UK Spent Nuclear Fuel for Disposal

Summary

Produced batch of DU SIMFuels - chemically representative of AGR SNF
topological/spatial representation needs improving

Producing atomistic models that predict solution/ex-solution FPs in UO_2

Producing interatomic potentials that describe UO_2 and MAs at fuel operating temperatures.

Creation of chemical/rad damage SIMFuel scheduled for October.

Observing the effects of peroxide attack on SIMFuel surface

Electrochemical corrosion of clad underway

U minerals grown in Lab - incorporation of transuranics 'demonstrated'

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Primary differences between AGR and LWR fuels

Organisation of research

WP2 – Imperial – AGR SimFuel preparation
Zoltan Heizl (Bill Lee/David Hambley)

WP3 – Imperial – Modelling of fission product distribution in AGR fuel
Mike Cooper (Robin Grimes/Ian Farnan)

WP4 – Cambridge – Heavy ion bombardment of AGR SIMFUEL
Aleksej Popel (Ian Farnan/Bill Lee)

WP5 – Lancaster – Corrosion of AGR fuel – secondary mineral phase evolution
Nadya Rauff-Nishtar (Colin Boxall/Ian Farnan)

WP6 – Lancaster – Corrosion of UO_2 in presence of steel corrosion products
Chris Anwyl (Colin Boxall/David Hambley)

WP7 – Cambridge – Stability and properties of secondary mineral phases
Fred Lord (Ian Farnan/Colin Boxall)

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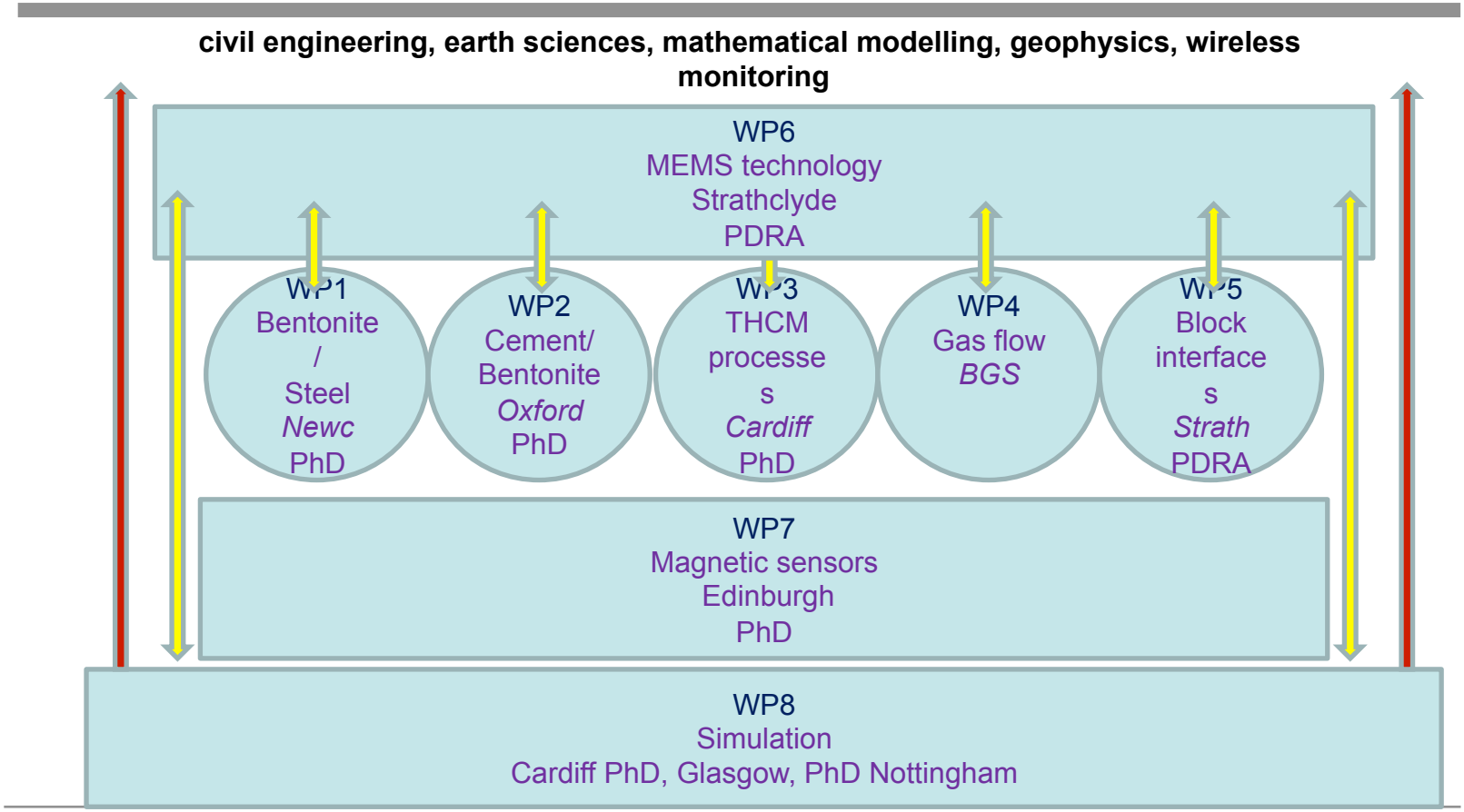
SAFE Barriers:

A systems approach for engineered barriers



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Consortium Approach

- **Multi-disciplinary research into the thermo-hydro-mechanical-chemical evolution of the EBS under the full range of environmental conditions**
- **Taking a *whole systems approach* to analysis of EBS**
  - predictive understanding of the THMC evolution
  - effects of interfaces
  - up to the upper-bound of environmental conditions

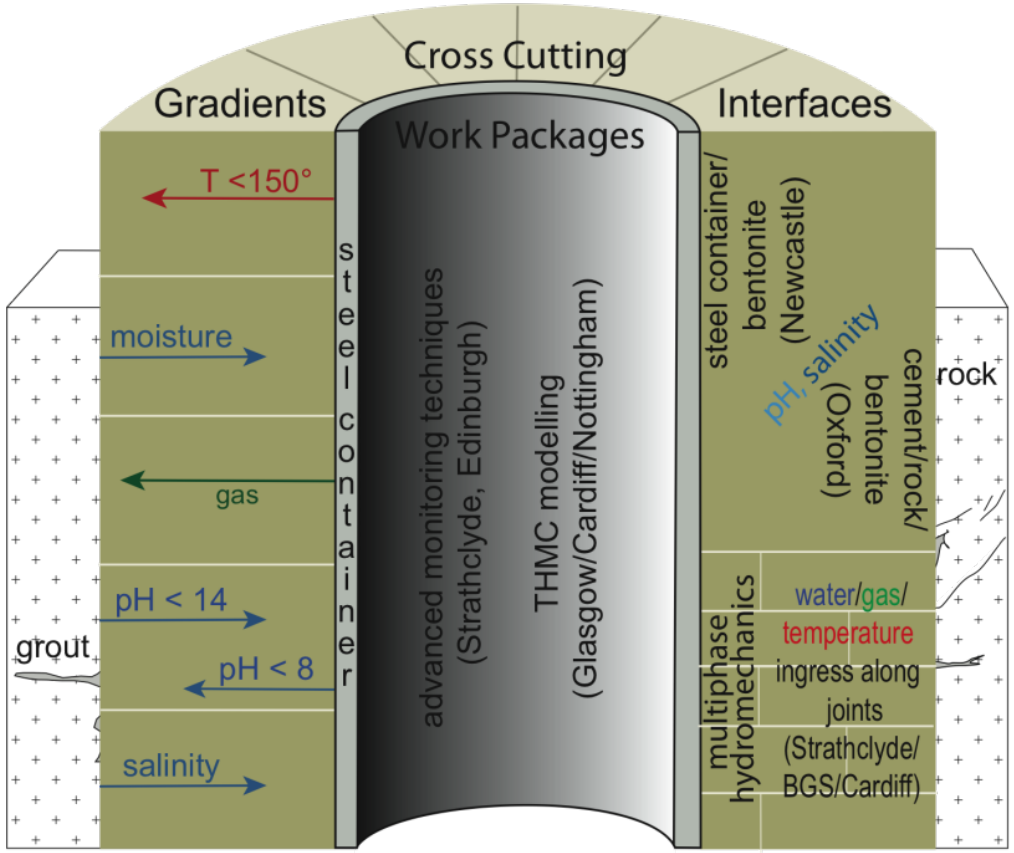

Figure 1 Consortium Structure**:** Advanced experimental monitoring techniques underpin a *whole-systems* engineering analysis of EBS evolution in extreme environments.

The Consortium

- **Strathclyde University – Prof R Lunn – PI**
  - Newcastle University – C Davie
  - Oxford University – N Hankins
  - Cardiff University – H Thomas
  - British Geological Survey – J Harrington
  - Edinburgh University – S Harley
  - Nottingham University – A Cliffe
  - Glasgow University – P Grassl
- **Started Sept 2012**

Summary

- Addressing balance between ‘needs driven’ and ‘curiosity driven’ research.
- Valuable collaboration with RCUK
- Together with NERC RATE programme and ad hoc studies contributes to pool of 50 PhDs and 25 PDRAs currently funded by RWM.