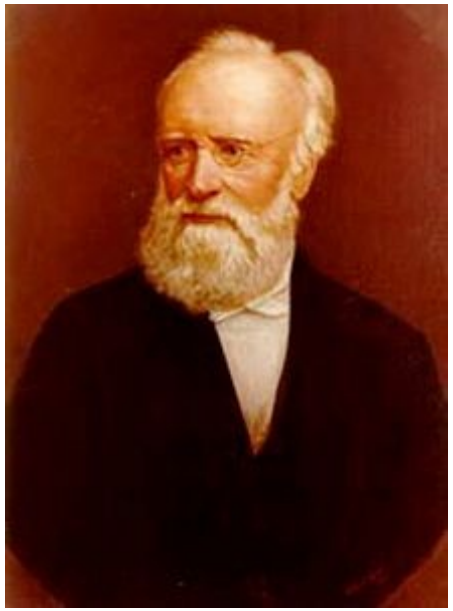
e School of Earth and Environmental Sciences (SEES)

The University of Manchester



- The Department of the University dates from 1851 at the foundation of Owens College, the first Chair of Geology was William Williamson.
- In 2004, the formation of the University of Manchester saw the combination of geoscience, environmental science and atmospheric science.
- In 2016 the addition of ecological sciences to form the current school.
- 75 academic staff makes us one of the largest Earth and Environmental Science Schools in the UK.
- 80 research staff; 25 technical staff; and 20 support staff

MANCHESTER 1824
The University of Manchester

Atmospheric Sciences:

A world leading interdisciplinary research group

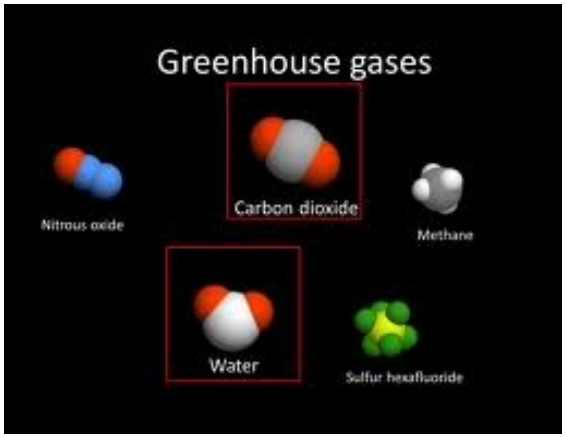
Main Themes:

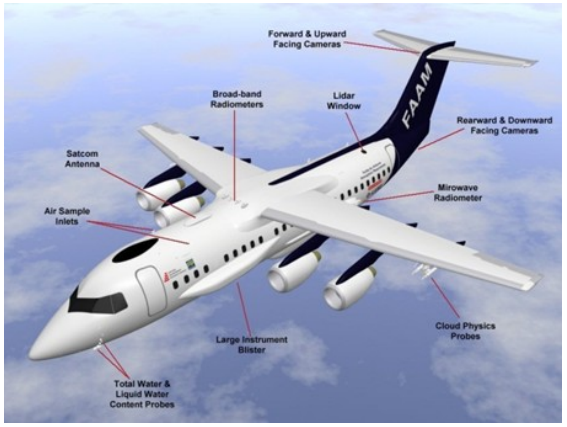
- Aerosols
- Atmospheric Chemistry
- Cloud Physics
- Mesoscale and Dynamical Meteorology
- Radiation
- Remote Sensing
- Surface Exchange
- Urban Pollution

11 Academic Staff, 35 research staff, 2 technical staff, 17 research students

Home to a major hub of the NERC National Centre for Atmospheric Sciences (NCAS)

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL





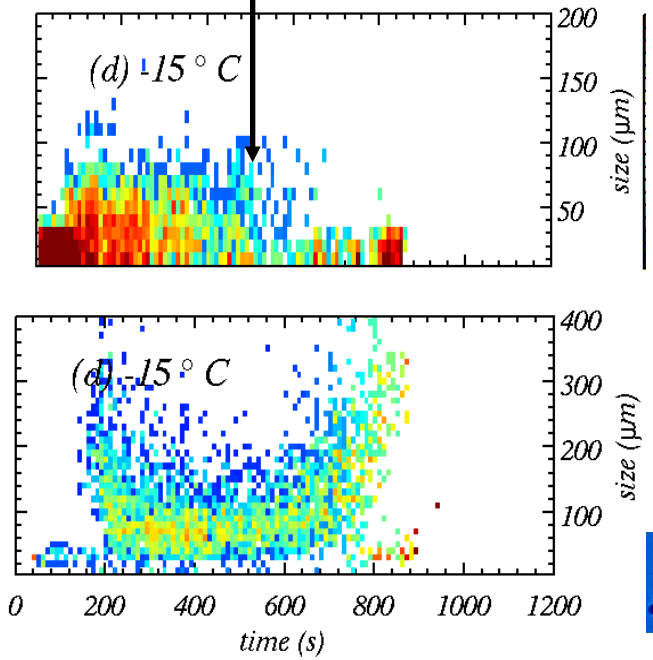
Large laboratory cloud-chamber to study microphysical processes: aerosol activation ice crystal formation, snow, etc

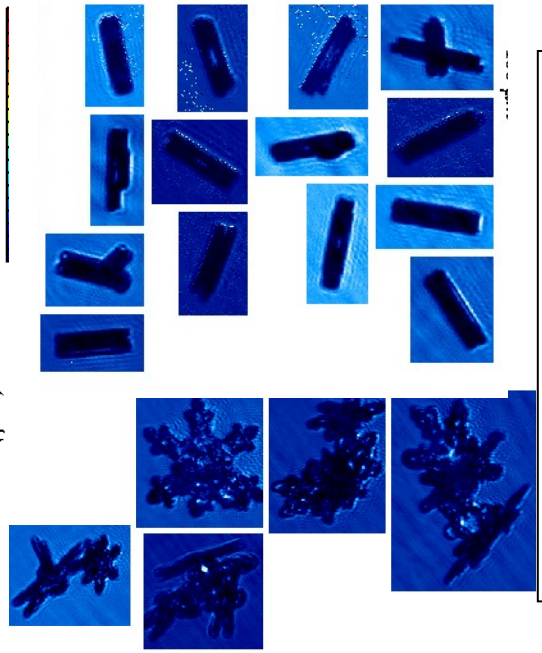
Field work on cloud microphysics at mountain top sites

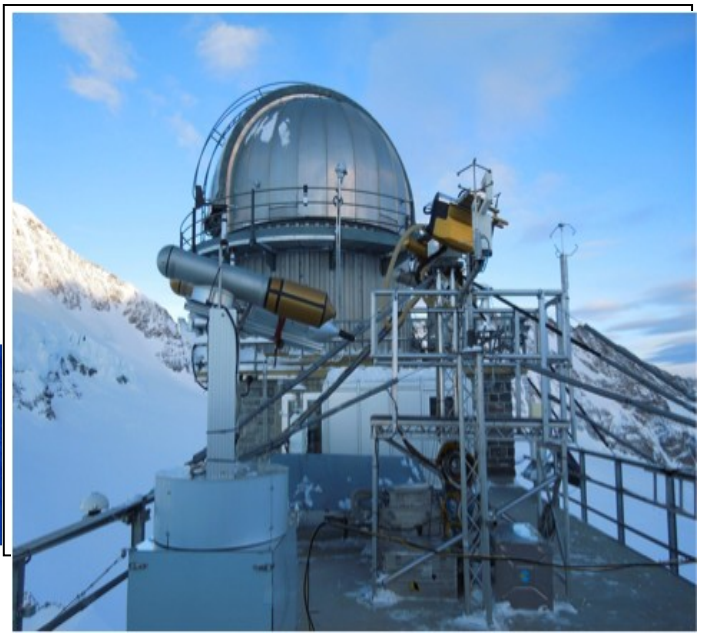
- Walk in cold rooms down to −55 deg C
- 10 m high – spans 3 floors
- Study of cloud processes and research into snow formation.
- Various on-going PhD projects
- Links to weather and aviation industries

Physics of the growth of ice and liquid particles

100 μm sized snow crystals





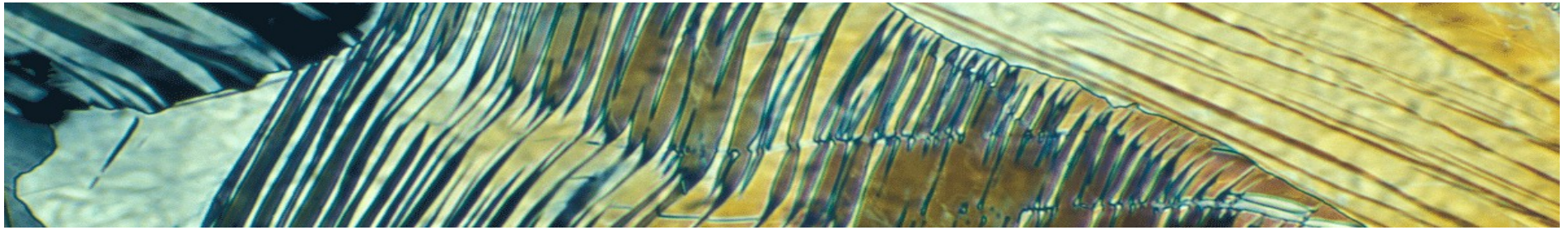


South American Biomass Burning Analysis (SAMBBA)
A Brazil-UK International Collaborative Experiment

Geophysics Research

The University of Manchester

- Crustal structure and dynamics, around mountain belts and sedimentary basins
- Interdisciplinary links into 22 academic staff with research expertise in petrology, volcanology, structural geology, rock mechanics and fluid flow
- Funding mix from UK research councils and the global oil industry



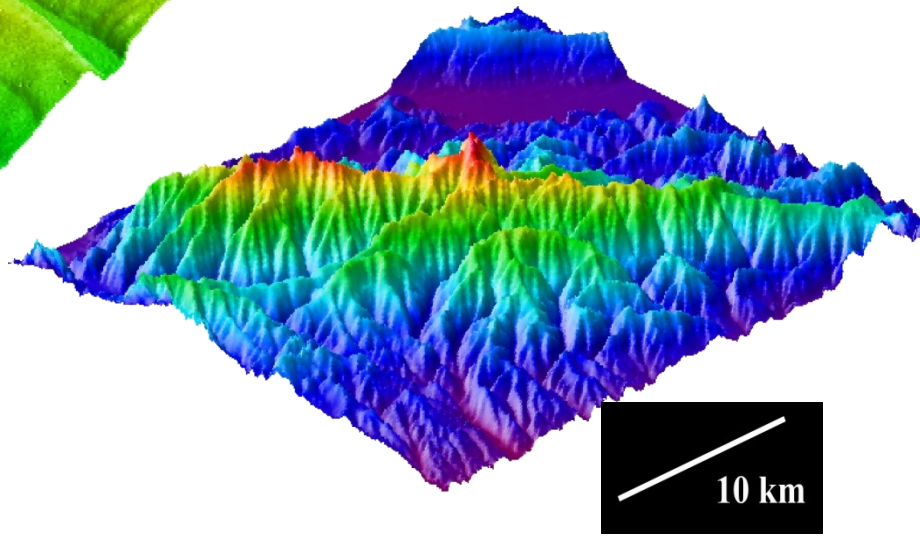
Continental slopes

USA Atlantic coast

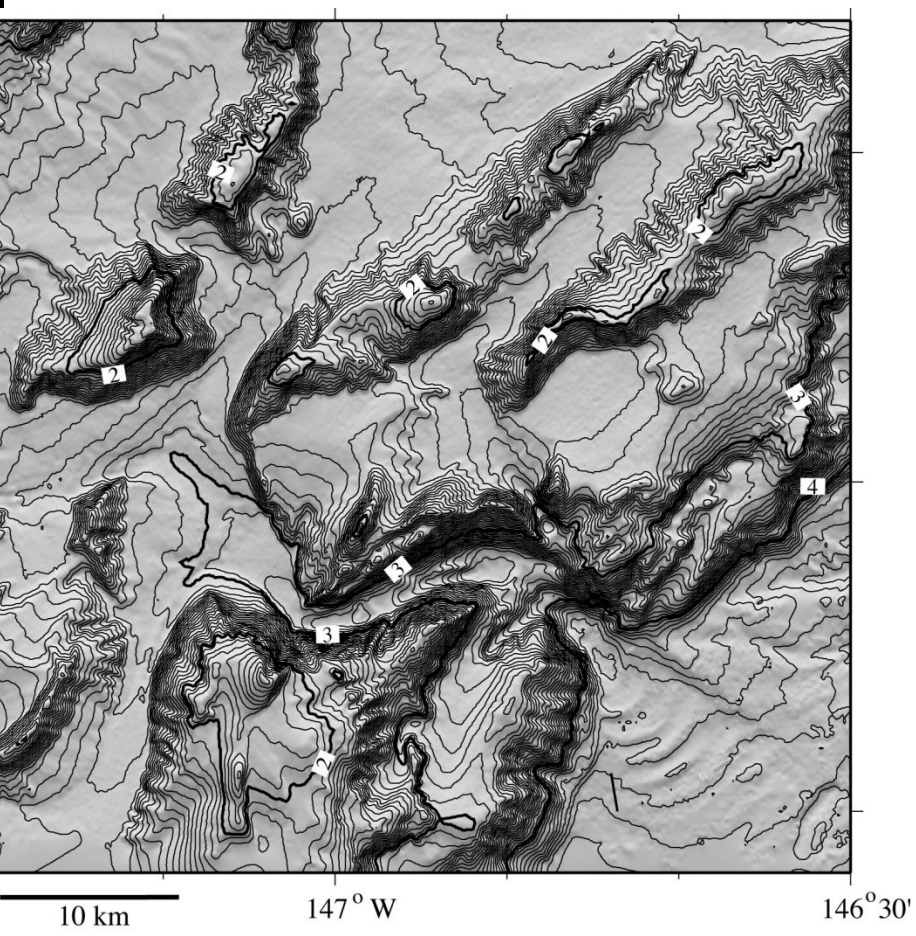
- **Canyon geometrical properties – comparable with river systems**
- **Diffusive topography in some marine sands.**

~100-1700 m depths

Southern Santa Cruz Mountains, CA

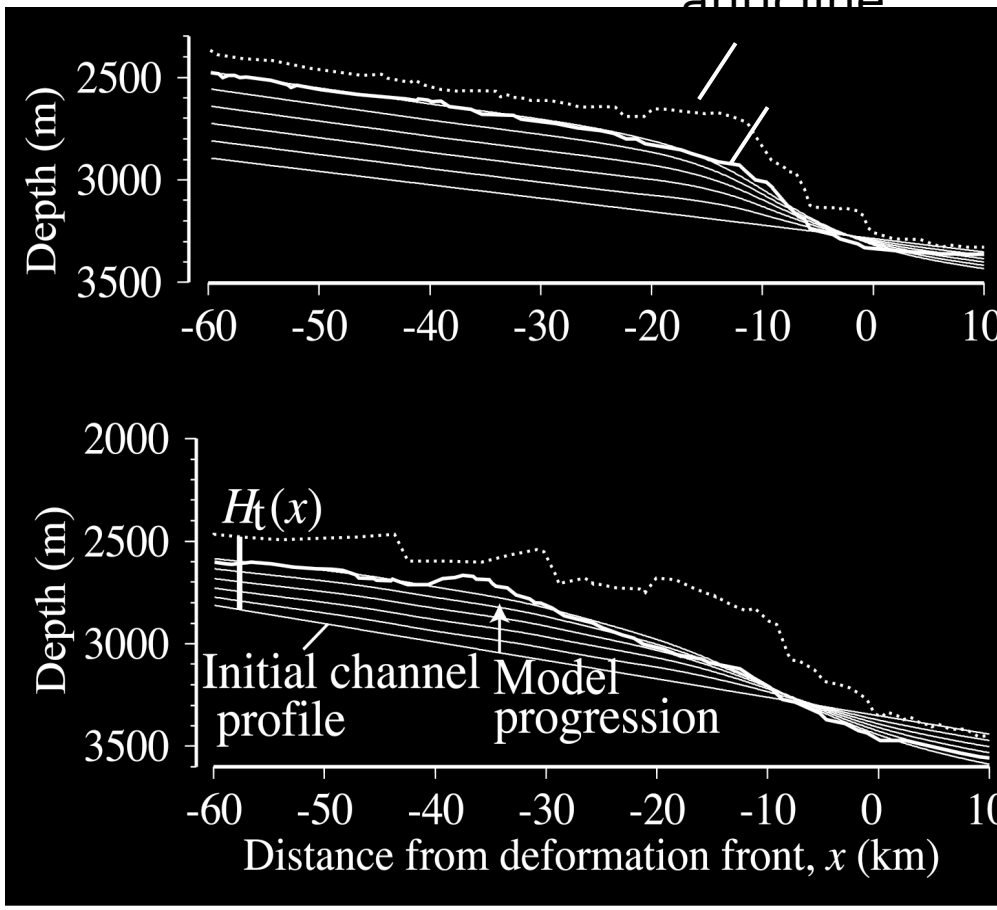


Knickpoints in tectonically active slopes - transient response to tectonics

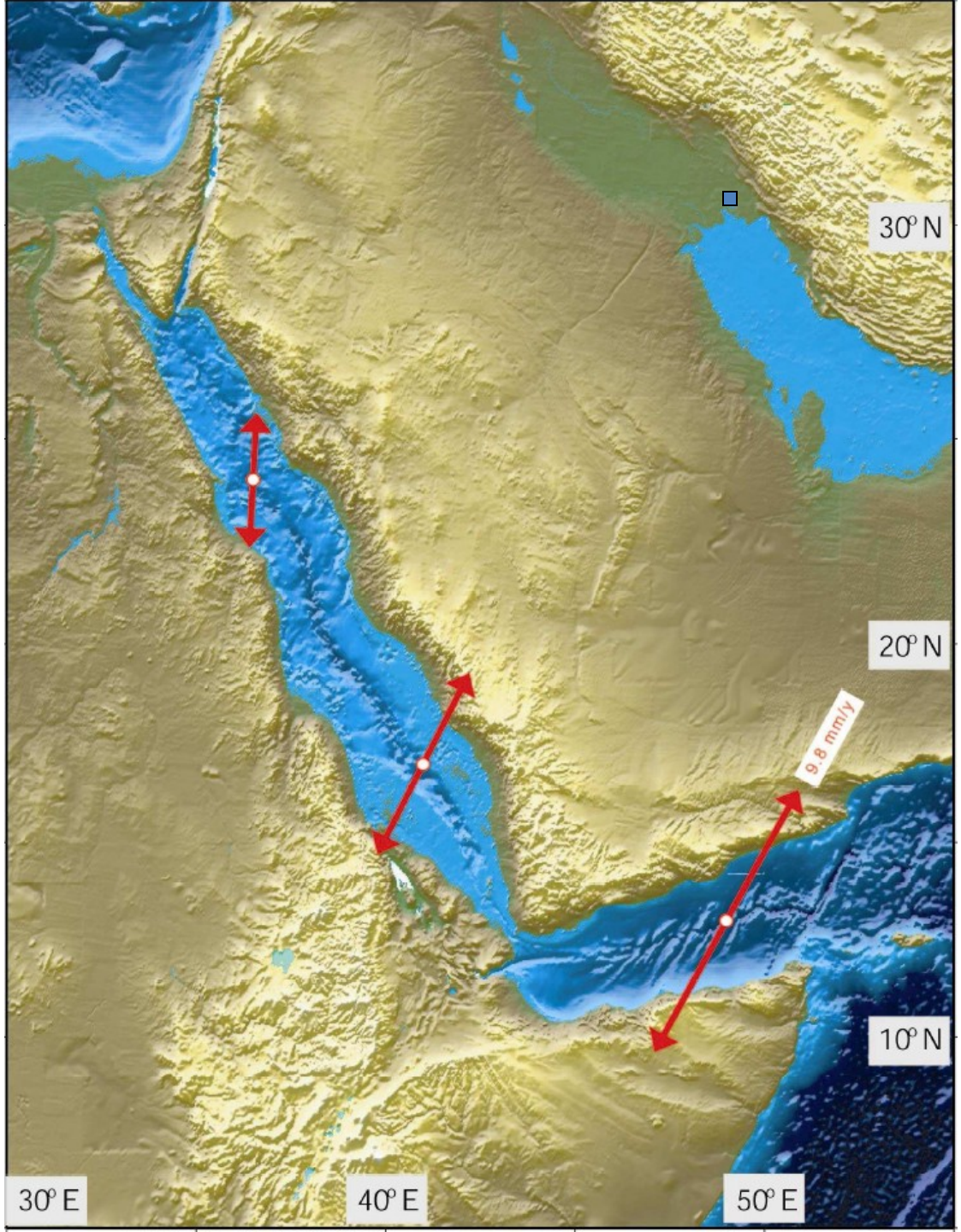


Knickpoint migration (Alaska). Detachment-limited erosion?

Finite difference modelling



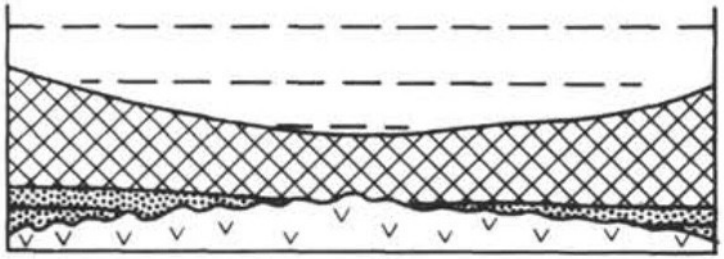
Knickpoint diffusion (S. Barbados prism). Transport-limited erosion?



Central Red Sea - rift in transition to seafloor spreading. An analogue for the early Gulf of Mexico and South Atlantic?

But crustal structure and type are poorly known.

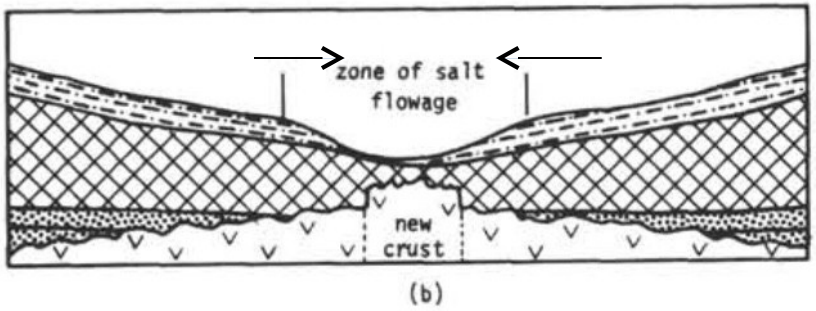
Evaporites (halite, anhydrite, shale…) deposited to several km thickness in the Miocene

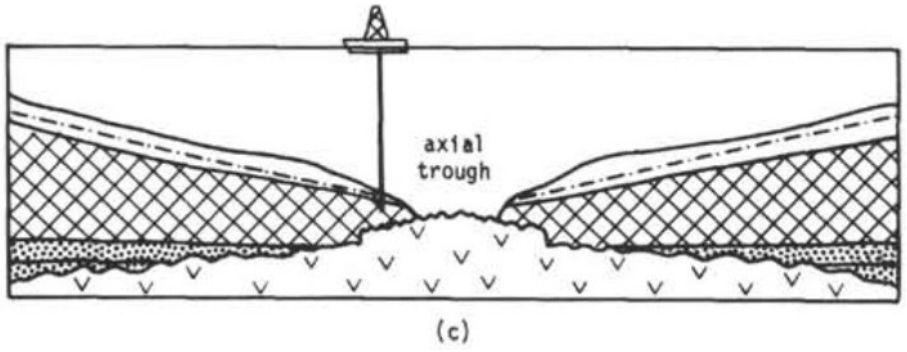


End Miocene

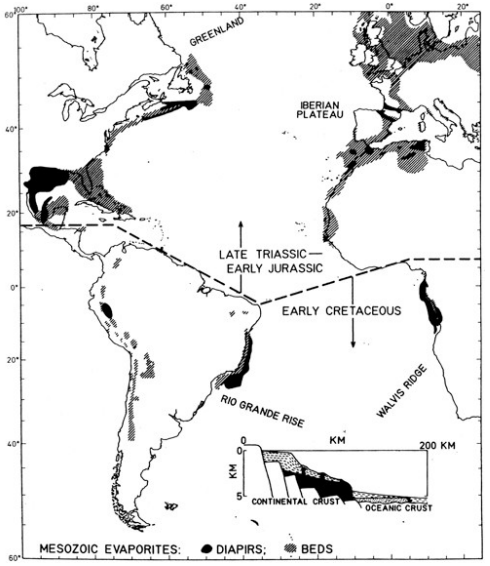
Subsidence and rifting remove lateral constraints on the evaporites, causing widespread flowage.

An analogue for the early South Atlantic and Gulf of Mexico margin salt?



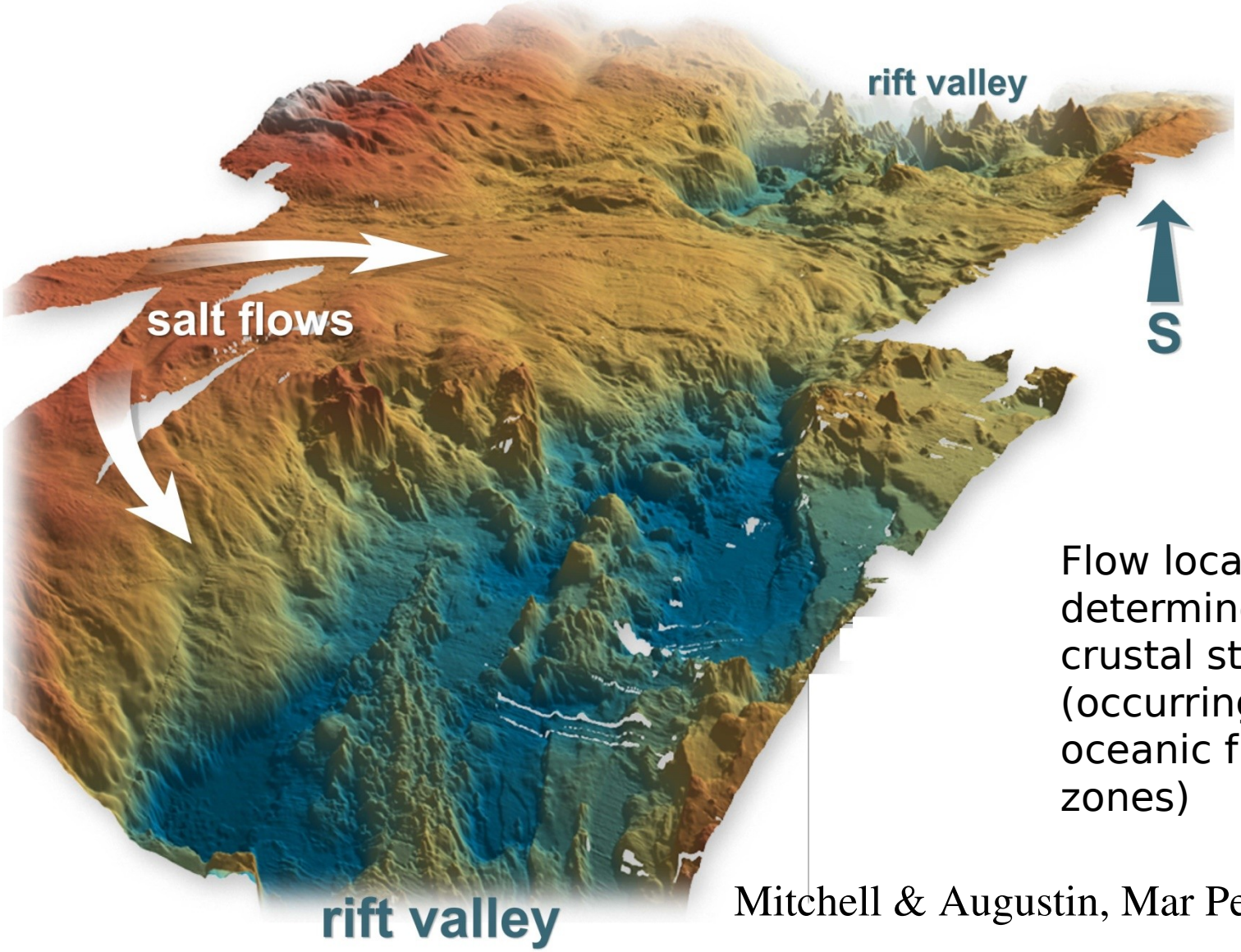


Girdler & Whitmarsh, DSDP vol 23, 1974



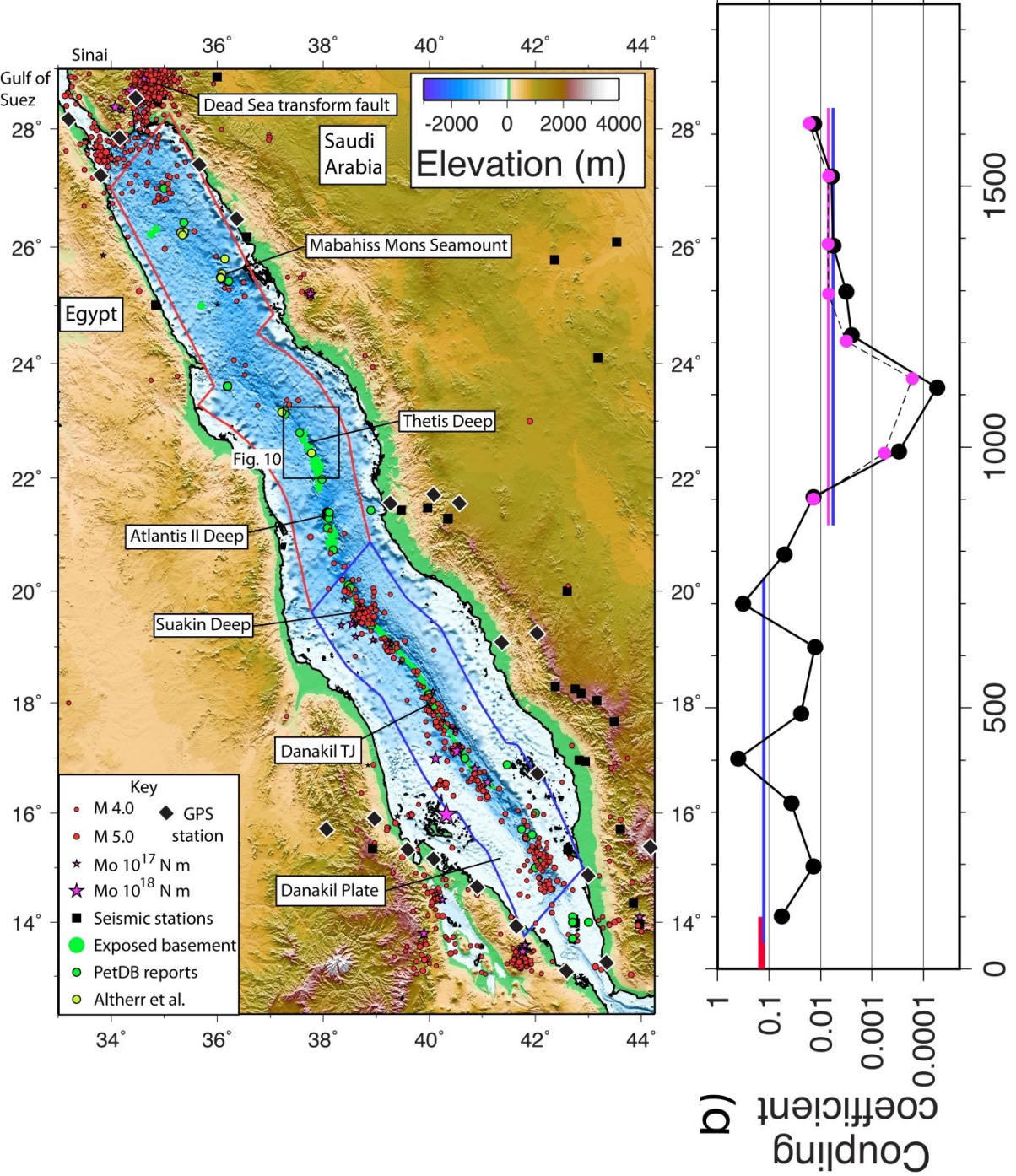
Mesozoic evaporites (Emery, 1977)

Salt flows invading the spreading centre



Flow locations determined by crustal structure (occurring along oceanic fracture zones)

Mitchell & Augustin, Mar Petrol Geol, 2017



Earthquake seismology

Seismic coupling in northern Red Sea is only 10% of that in the south – why?

Mitchell & Stewart, Geophys. J. Int. 2018

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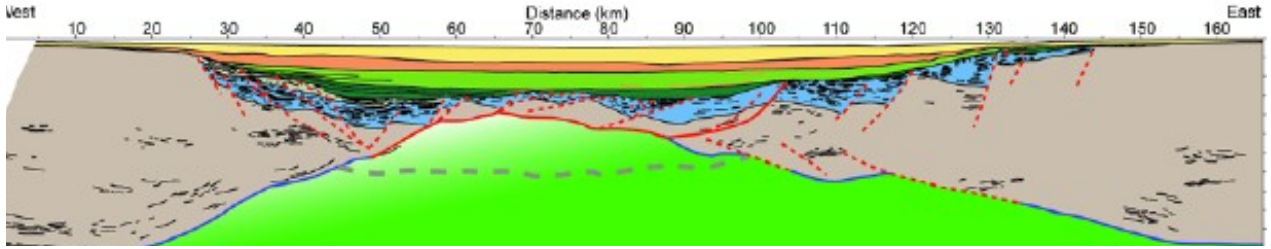
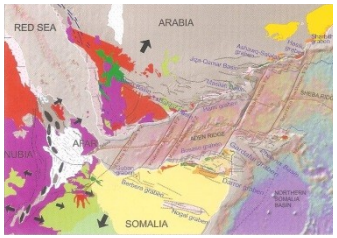
STRATgroup

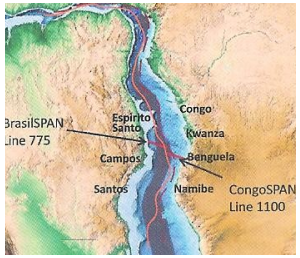
21 YEARS

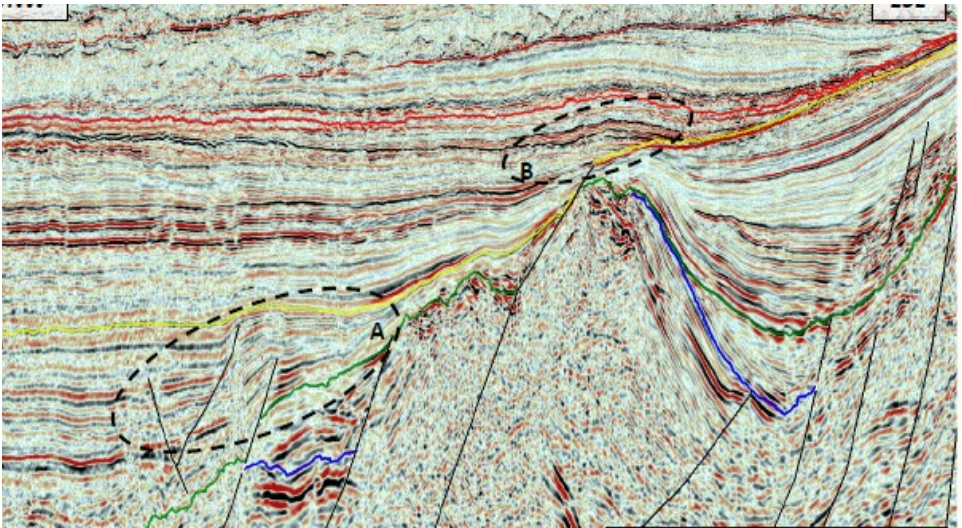
UNIVERSITY OF LEEDS

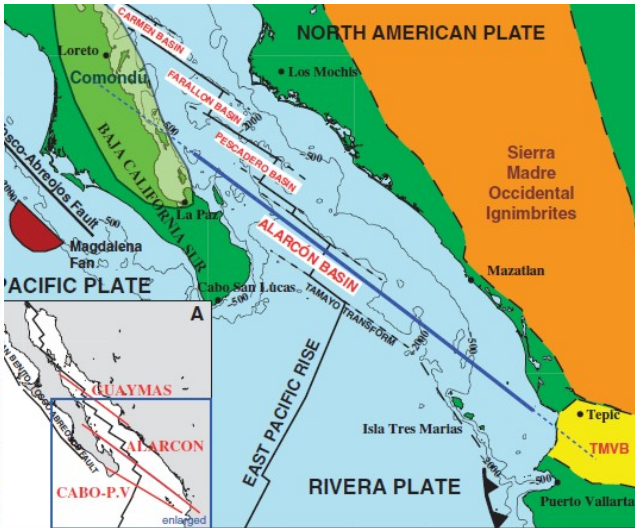
Stratigraphic Evolution of Conjugate Margins: Reservoir Development in Time and Space

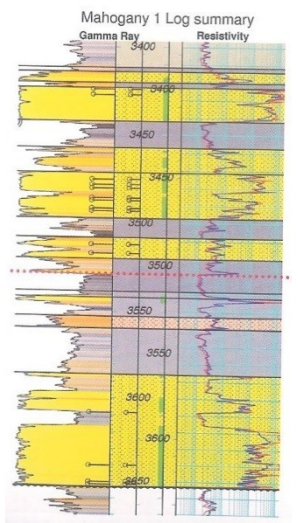


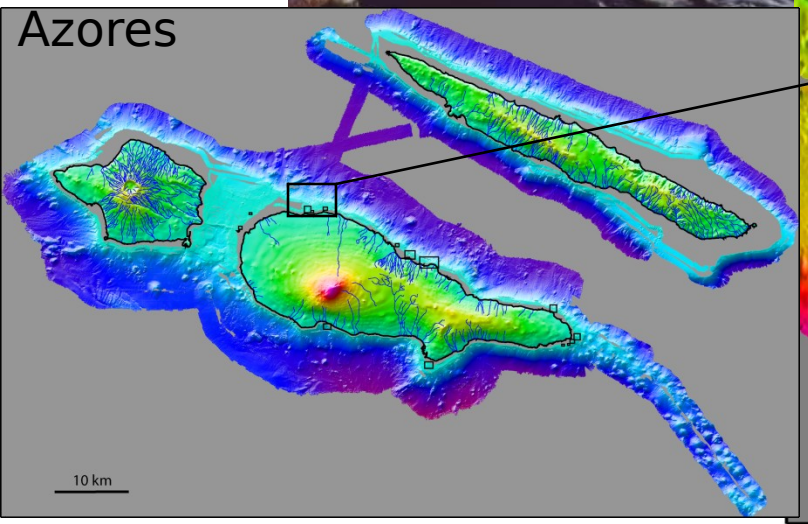


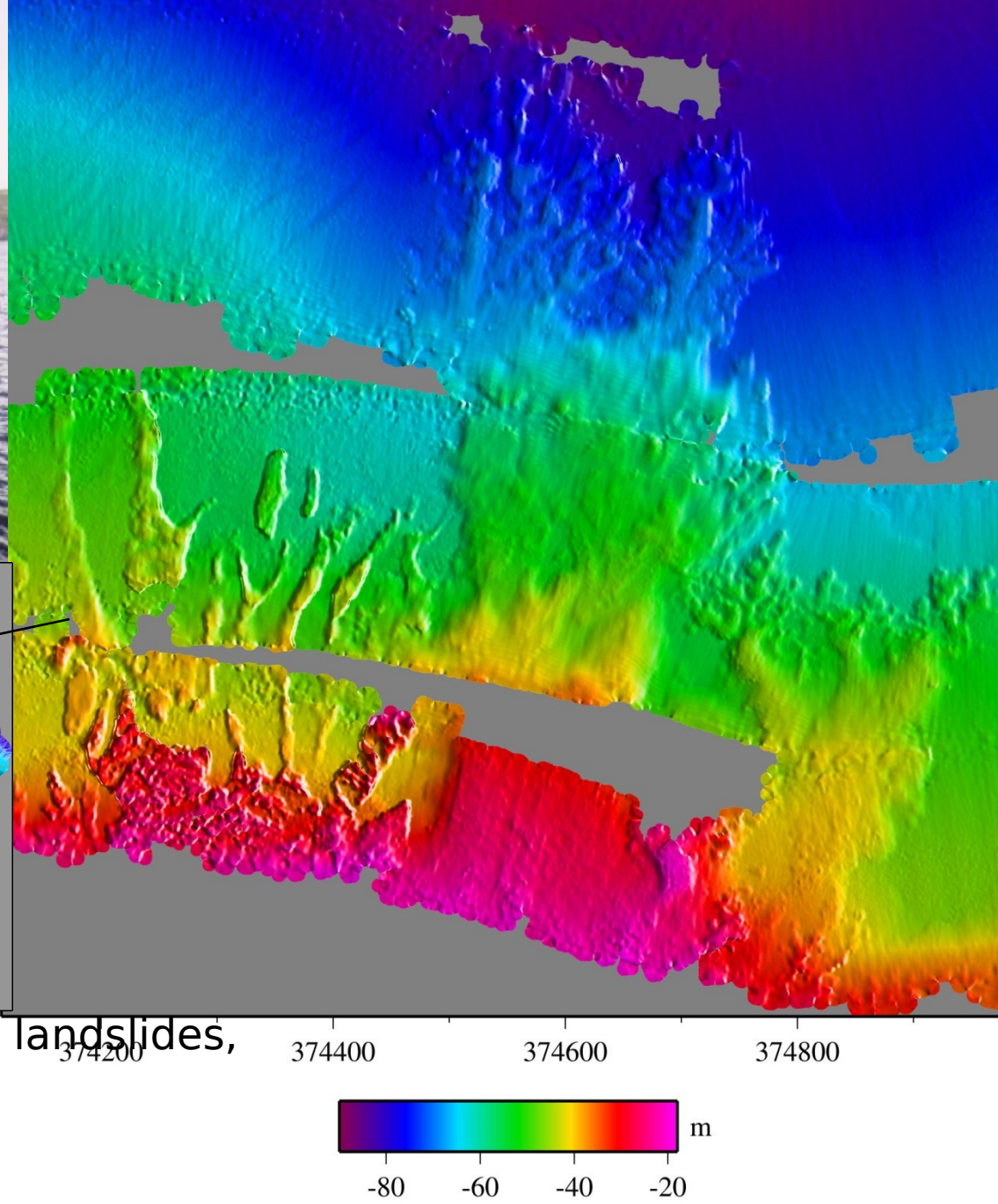












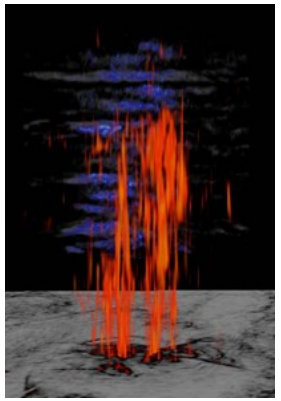
Volcanic island nearshore flows, landslides, coastal sand clinoforms.

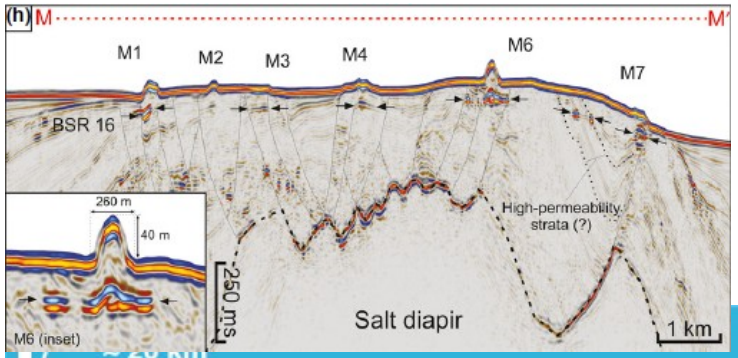
Basin Analysis and Hydrocarbons

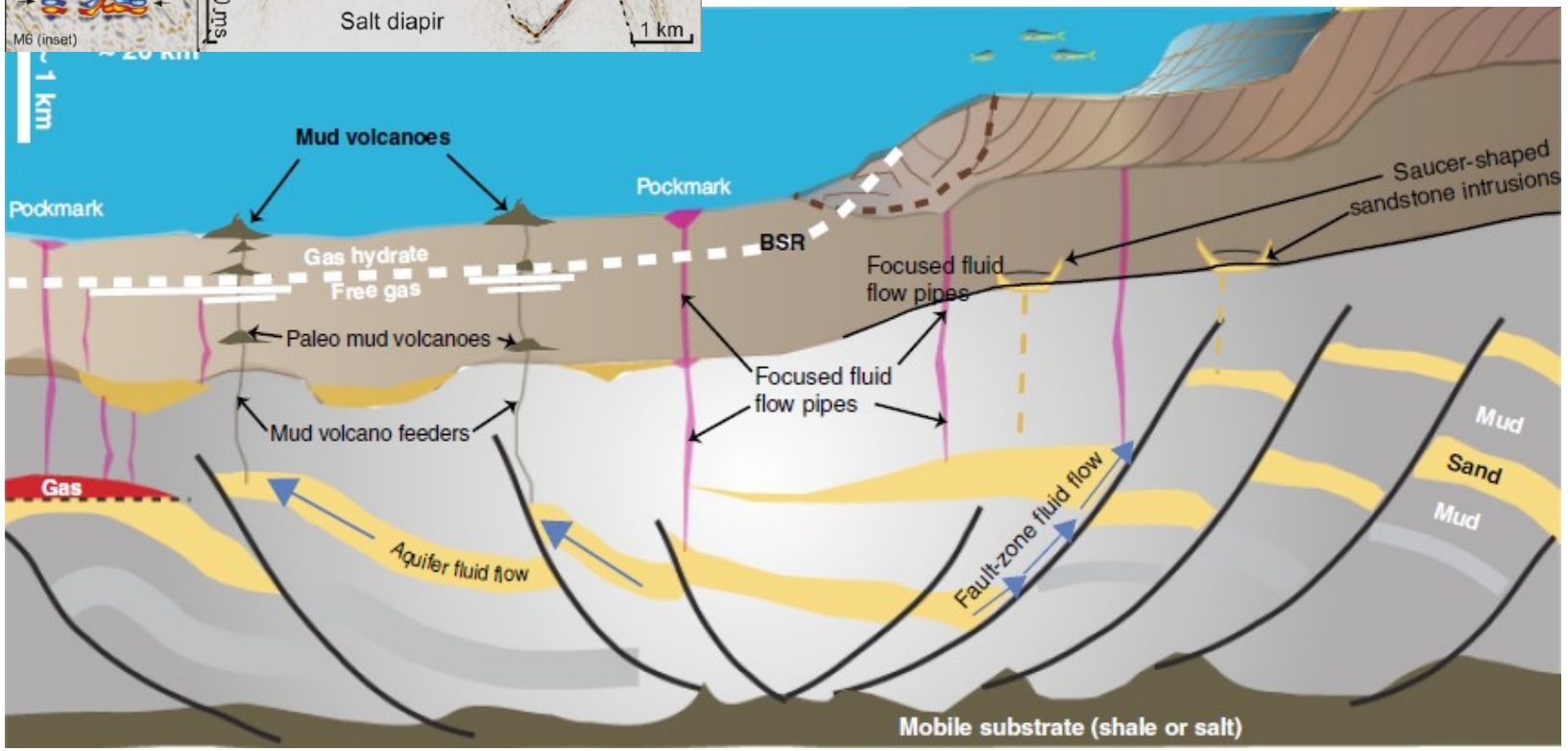
- Analysis of exhumed oil and gas reservoir analogues to drive exploration concepts and to increase recovery from mature fields
- Shale gas/oil
- International oil industry funding consortia
- Industry training courses
- MSc Petroleum Geoscience

Seismic imaging of fluid flow in frontier and mature basins: implications for exploration, development and carbon storage

- **Petroleum system**
- **Prospectivity**
- **Seal integrity**
- **Hazards**

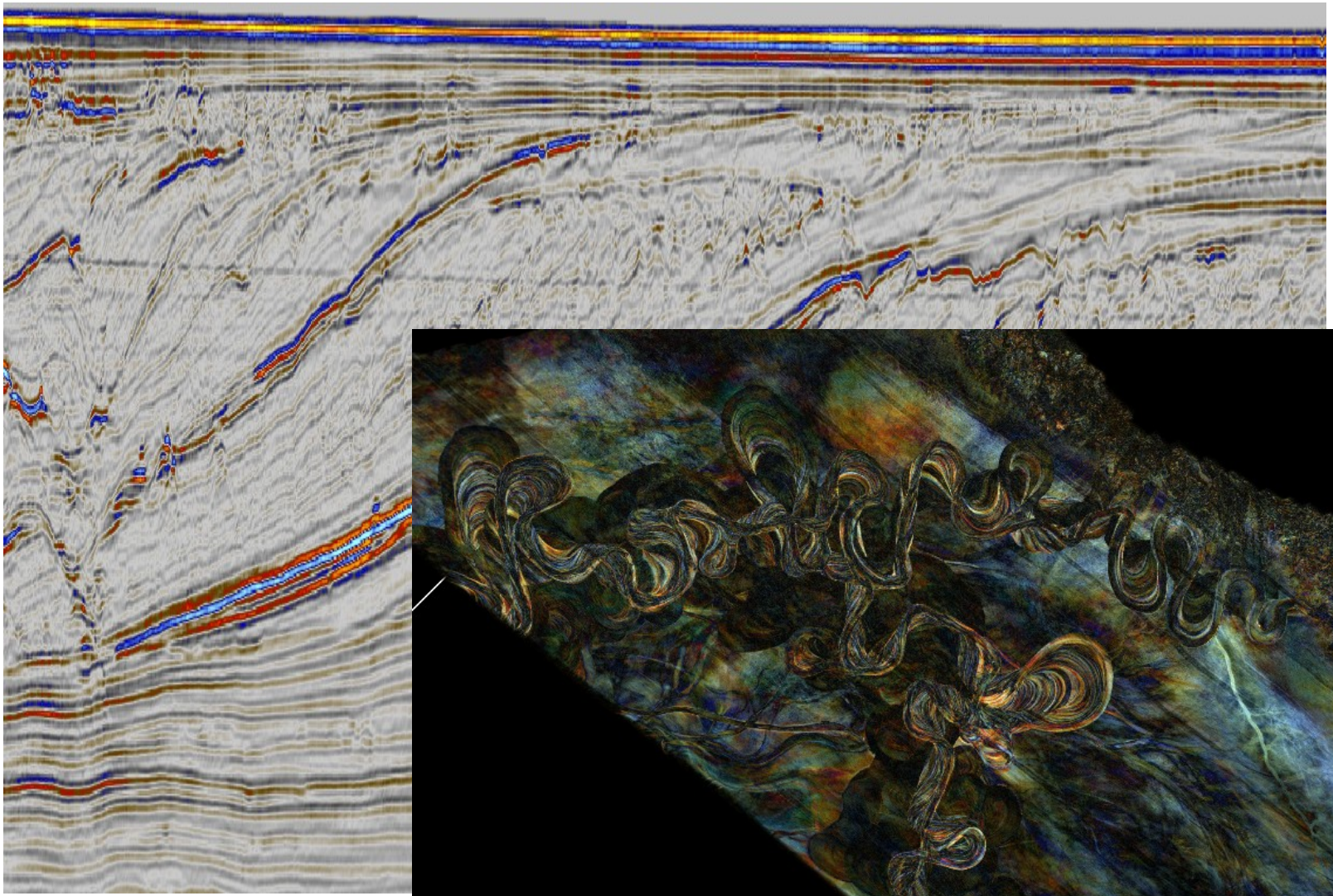






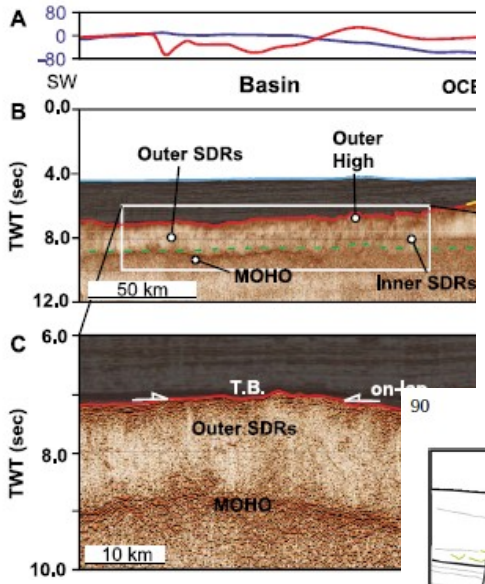
Huuse et al. 2010: Basin Research; Serie et al. 2012: Geology; 2016: Basin Research

Siliciclastic seismic stratigraphy and geomorphology
- Basin evolution, controls on facies and architecture



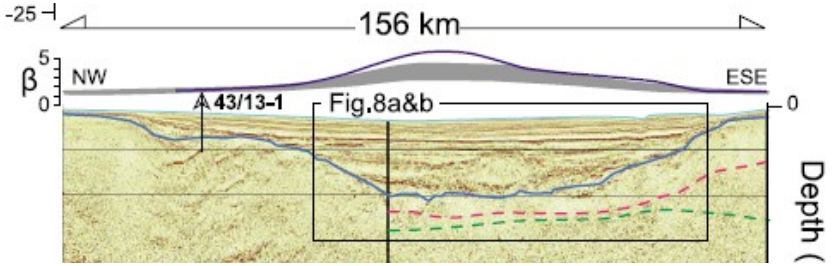
mads.huuse@manchester.ac.uk

Volcanostratigraphy: New insights into frontier basin formation offshore western India*, NW Europe*, S Australia and South China Sea*



Geochemistry Geophysics Geosystems G3
CALVÈS ET AL.: NEW EVIDENCE FOR ORIGIN OF PMVR 10.1029/2011GC003852

Ireland



F. Zhao et al. / Earth and Planetary Science Letters 445 (2016) 79–91

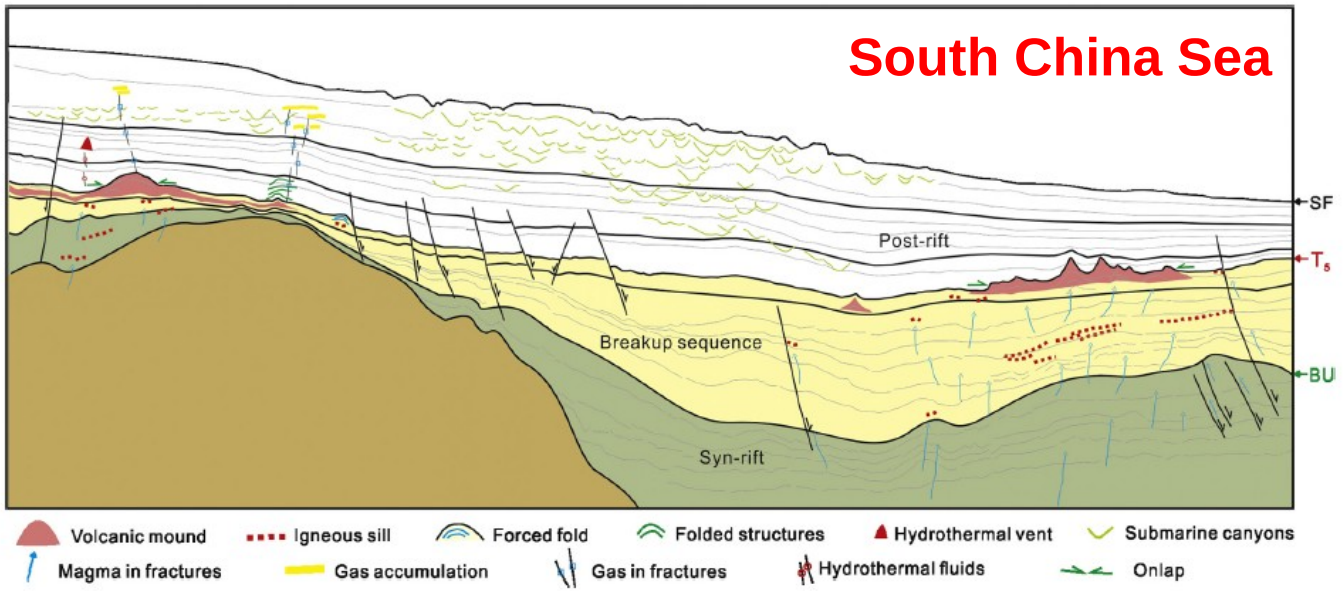
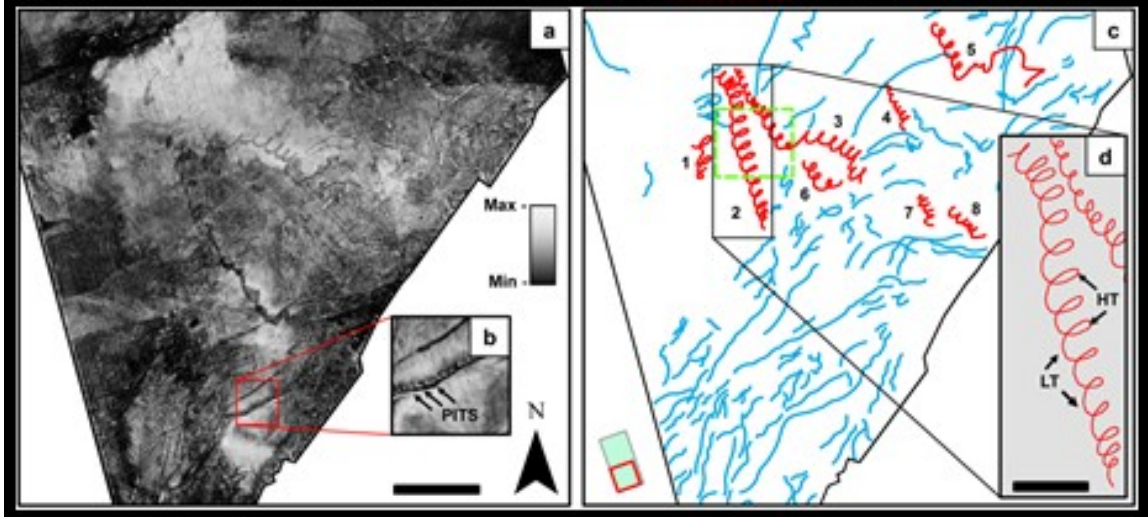


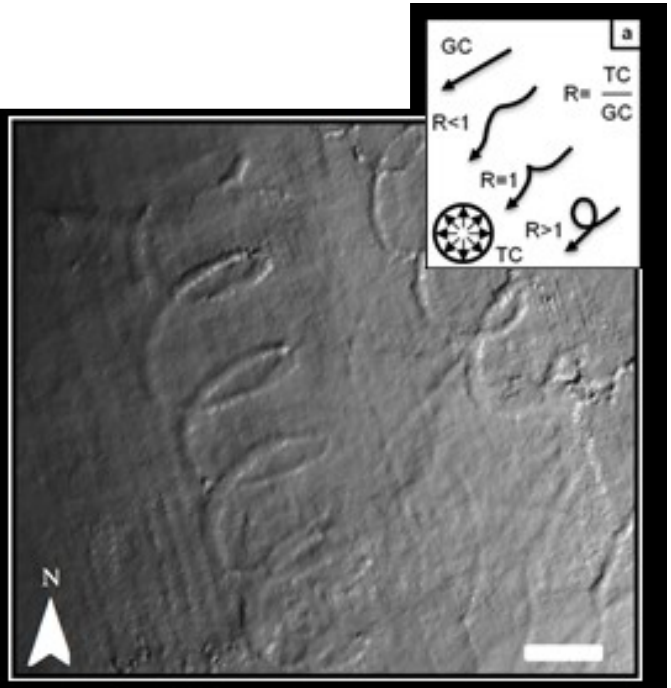
Fig. 10. Schematic illustration showing the formation of igneous complexes in relation to the Early Oligocene–Early Miocene breakup sequence of the Baiyun Sag. SF – Seafloor; BU – Breakup unconformity.

Calves et al. 2011: JGR. 2013: G-cubed; Zhao et al. 2016: EPSL

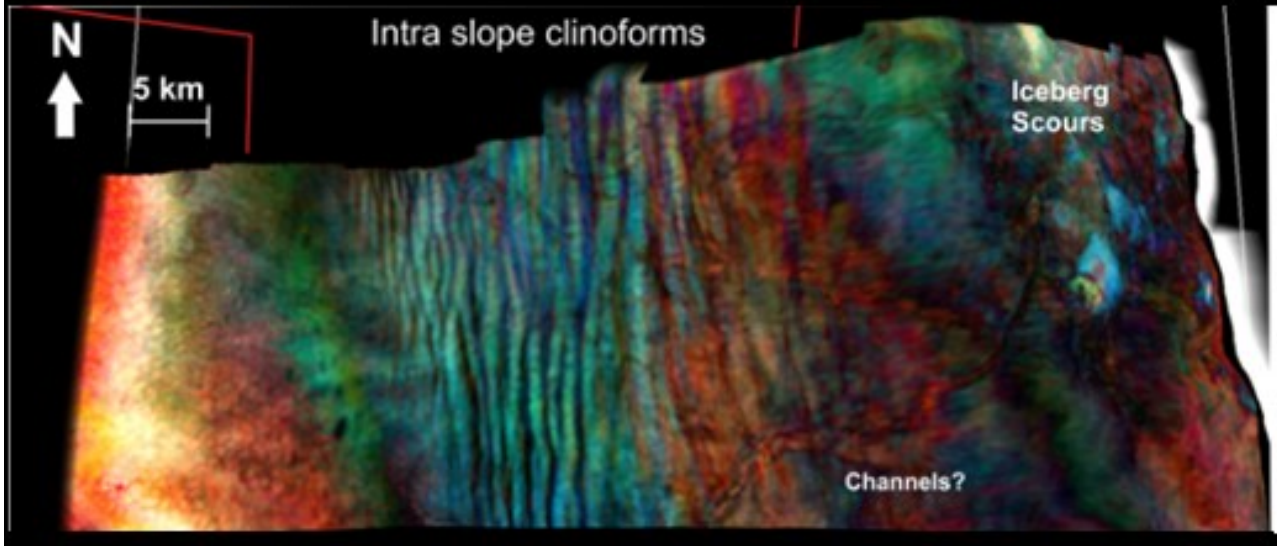
Seismic geomorphology

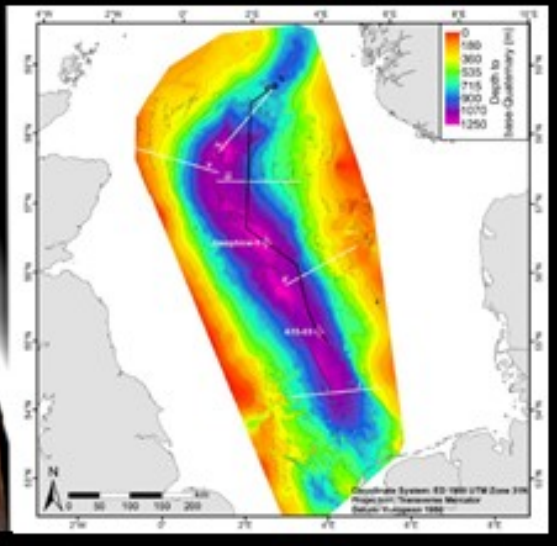
A Newton: glacial geomorphology: palaeo-ocean currents



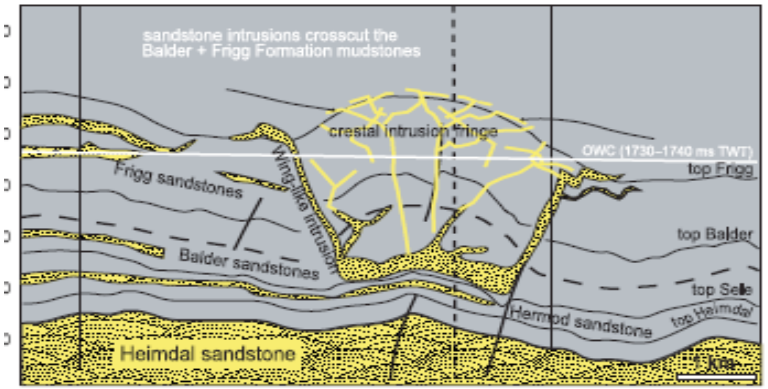


R Harding & R Lamb: seismic geomorphology: North Sea palaeo-environments

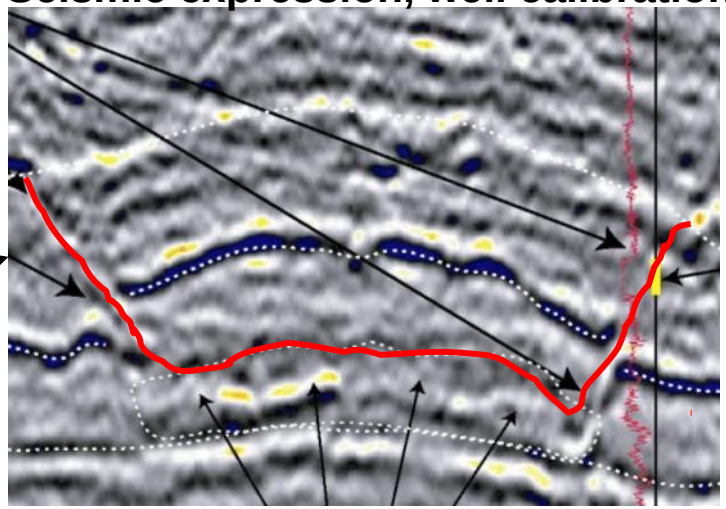


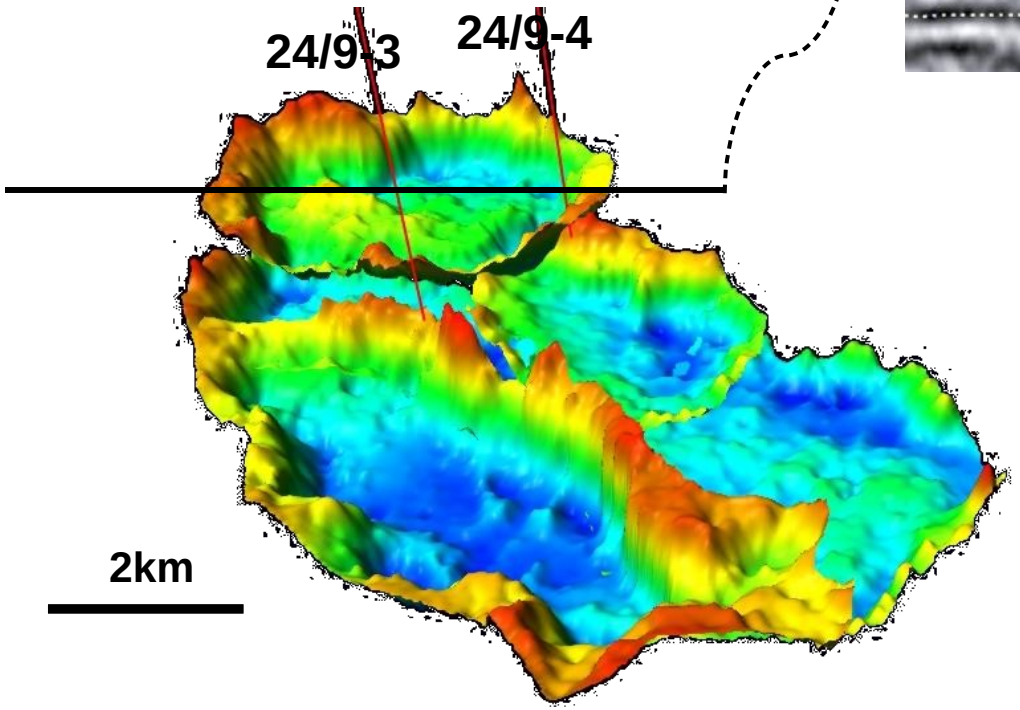


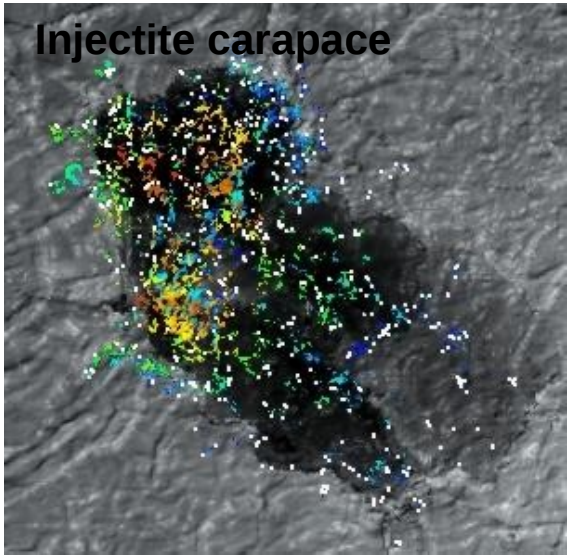
Giant sandstone blocks flanked by wing-like dykes and capped by >200m high injectite complexes = remobilized MTD blocks



Seismic expression, well calibration







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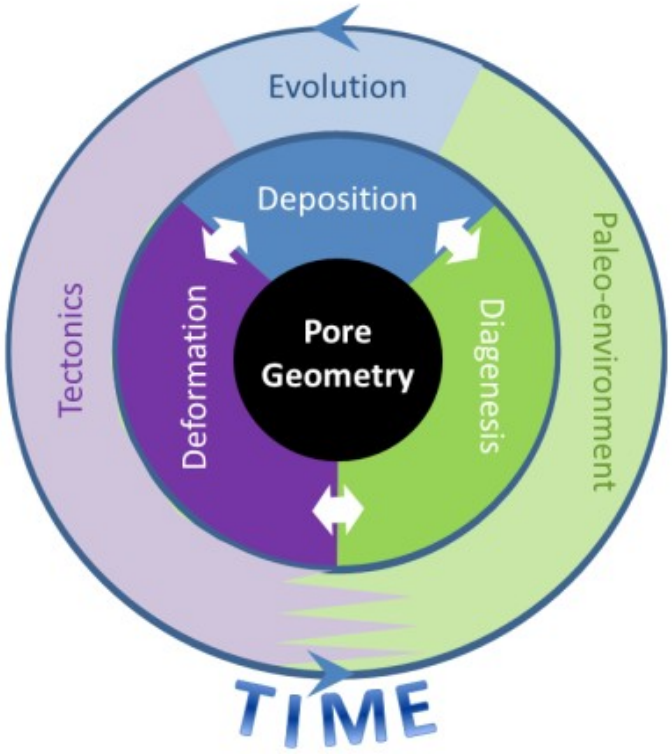
Centre for Integrated, Multiscale Carbonate Petroleum Geoscience (PD^3)

- Research collaboration between leading European centres of carbonate excellence, led by UoM
- Multi-scale, interdisciplinary research into carbonate systems
- Constraint and prediction of the <u>processes</u> controlling reservoir architecture
- Assessment of the geological controls on pore geometry and flow efficiency
- Delivery of consolidated databases, rules sets and predictive tools for E&P



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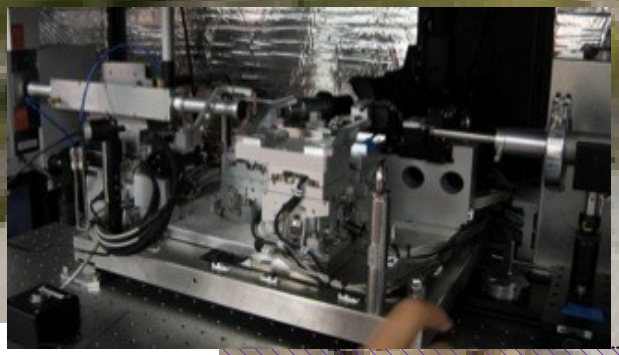
UNIVERSITAS BERGENSIS

ROYAL HOLLOWAY UNIVERSITY OF LONDON

University of BRISTOL

Shale Imaging solutions at Manchester



Scale

km

m

cm

micron

nano

atomic

Unit

hand specimen, rock mechanics, mCT

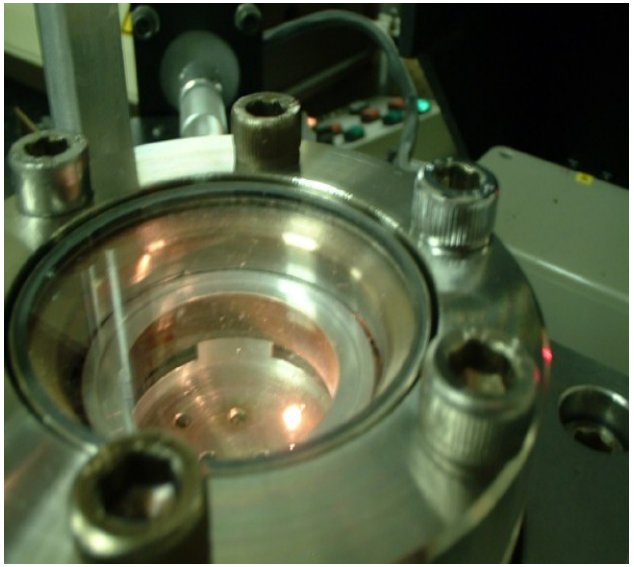
Thin section, SEM, mCT, nCT, 3View

Tomography & Atom Probe

30 mm

We can image the

Isotope Geochemistry and Cosmochemistry



- Developing Novel Techniques.

- Applying them across a wide range of topics, including…
  - Crustal fluids (geothermal, the carbon cycle)
  - Chronology.
  - Noble gas and halogen cycles.
  - Prehistory and history of the solar system.

- 7 Academic Staff (2 Senior Research Fellows), 6 Postdoctoral Research Staff, 3 Technical Staff, 9 Research Students

- Interdisciplinary team
- 2 out of 4 Nodes of UK Cosmochemistry Analytical Network (UKCAN: Noble Gases, TOF-SIMS).

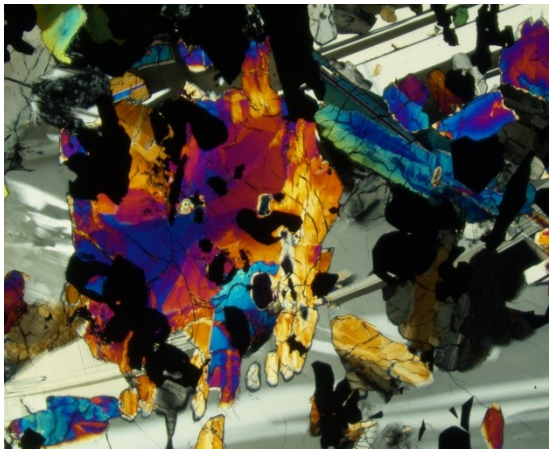
Planetary Science Theme

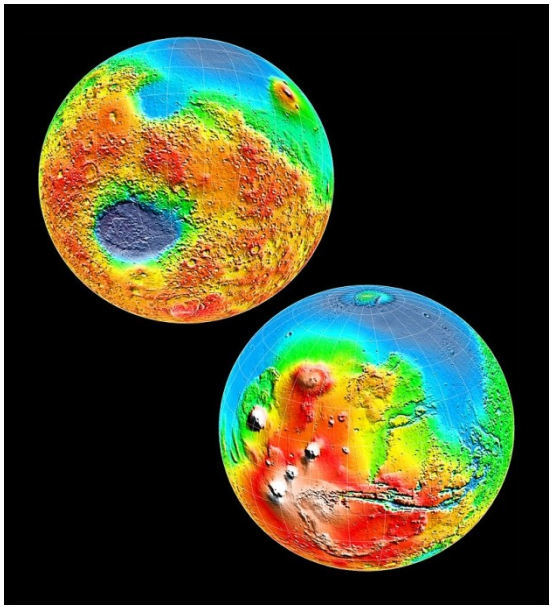
- Prehistory, formation and evolution of our solar system, and the bodies within it.

Research Areas: Focused in Cosmochemistry

- Formation of the elements.
- Solar system formation.
- How did planets get their volatiles?
- Evolution of the Moon and asteroids.
- Analysed ALL samples returned to date (NASA, ROSCOSMOS, JAXA).

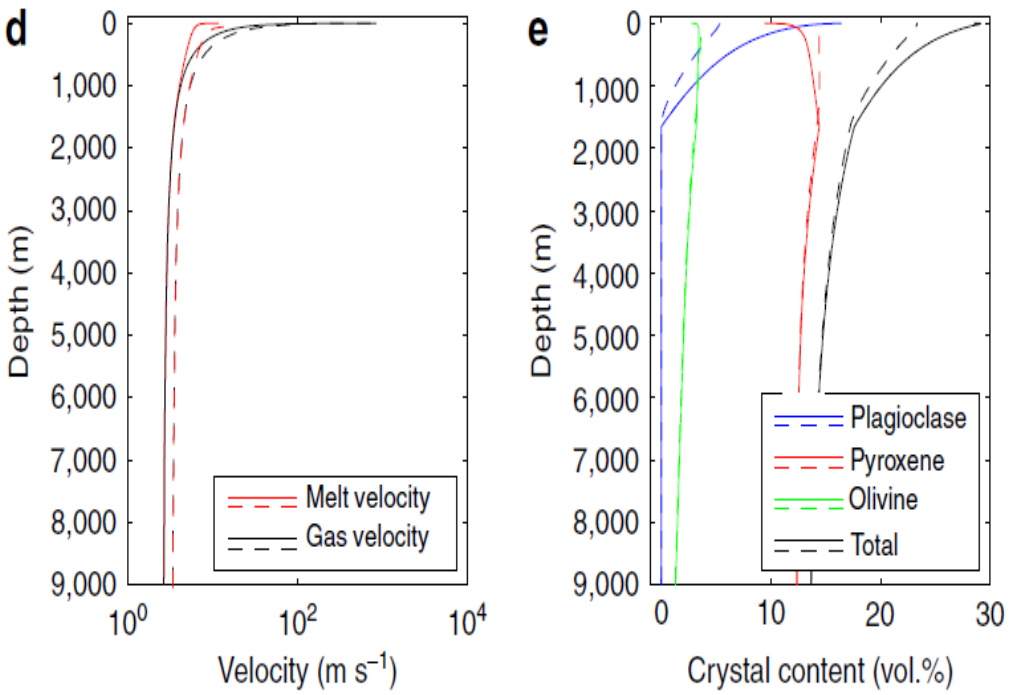
- Links across wide school, faculty and university.
  - Planetary atmospheres (CAS)
  - Planetary imaging (Medicine, Geoscience)
  - Modelling of landscapes, ice layers (Maths)
  - Presolar grain composition/extreme materials (Materials)
  - Astrobiology (MES)



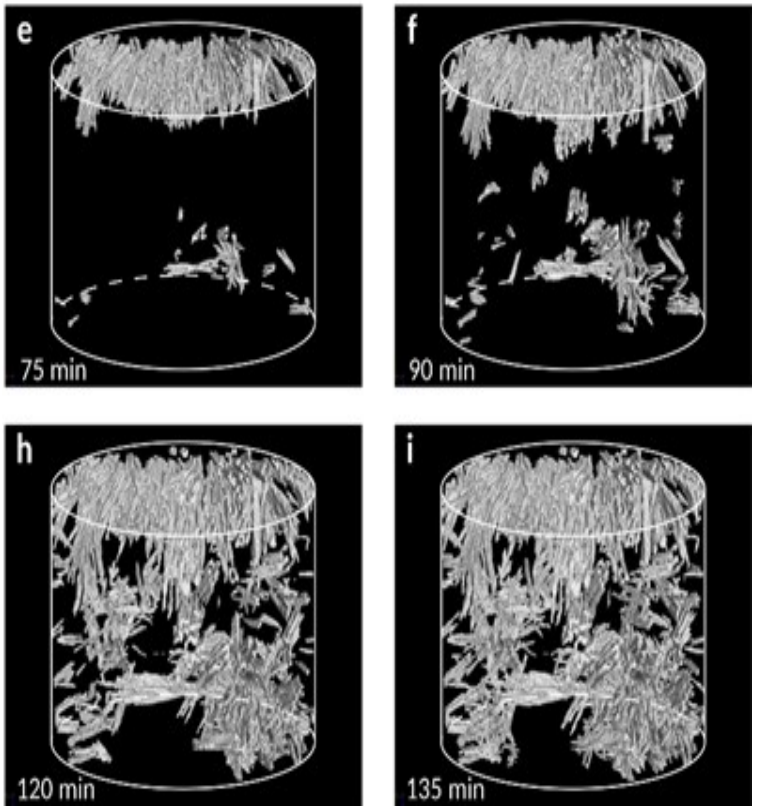


NASA / MOLA

Volcanology Research in Manchester



Modelling of magma ascent on Etna volcano
La Spina et al., 2016, Nat. Comms.
La Spina et al., 2017, EPSL



Tomographic imaging of crystal growth in magma, in revision, Nature Sci. Rep (vertical field of view is 2 mm)

Our Undergraduate Degree Courses

- Geology (BSc)
- Geochemistry (BSc)
- Environmental and Resource Geology (BSc)
- Earth Sciences (MEarthSci)
- Geology with Planetary Science (BSc)
- Geology with Planetary Science (MEarthSci)

- Geography and Geology (BSc)
- Geography and Geology with a year abroad (BSc)

- Environmental Science (BSc)
- Environmental Science with a year in industry (BSc)
- Environmental Science with a year abroad (BSc)
- Ecology (BSc)

- Petroleum Engineering (MSc)

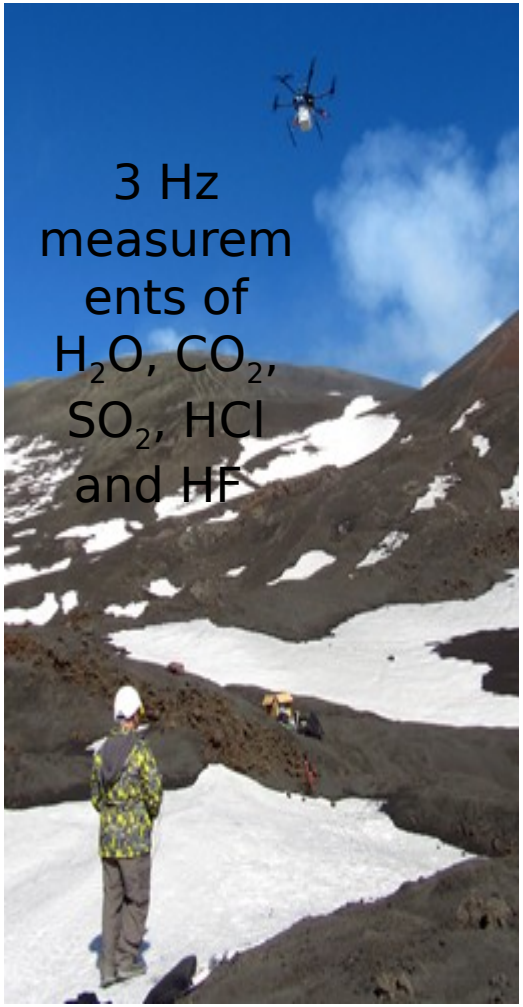
Our Taught Masters Degree Courses

- Petroleum Geoscience MSc
  - Exploration
  - Reservoir Development and Production

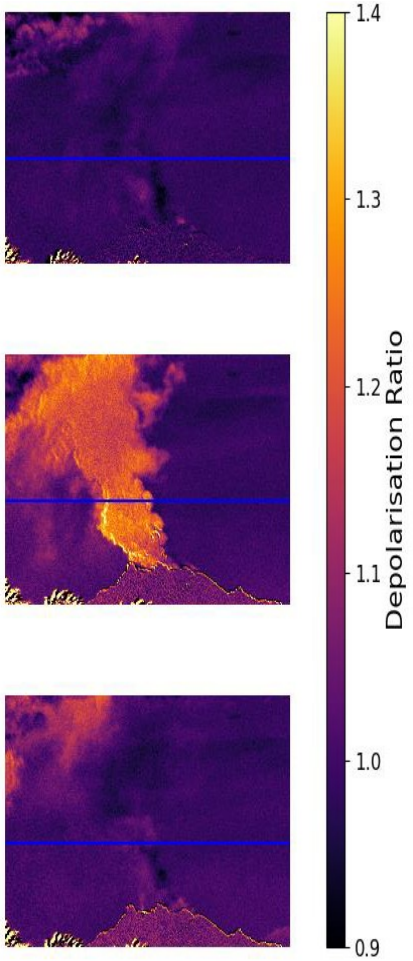
  A leading Petroleum Geoscience MSc programme in the UK is a flagship course and is seen as an industry leader.

- Pollution and Environmental Control MSc
- Applied Environmental Science MSc
- Masters in Environmental Science and Pollution (European Collaboration)

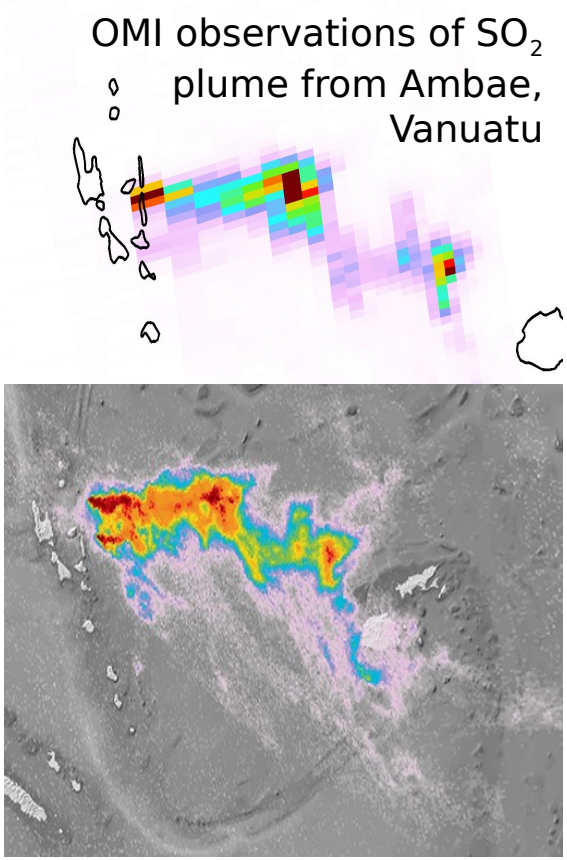
Volcanology Research in Manchester



Drone-based measurements of volcanic gases
D'Amato et al., AMT, 2018



SO_2 and ash imaging of volcanic plumes
Esse et al., in prep.



Current satellite data allow us to assess eruptive SO_2 emissions. New data from TROPOMI has 12 times higher spatial resolution

Molecular Environmental Science

State of the art physical, chemical and biological sciences and modelling techniques combined to understand molecular-scale processes that have global implications

- Water including (bio)geochemistry of toxic trace elements
- Applied and fundamental mineral science
- Organic (bio)geochemistry
- Geomicrobiology
- Molecular palaeontology
- Nuclear environmental research