

**NST - Part IB EARTH SCIENCES A – 2017-2018
LECTURE LIST**

Michaelmas Term

LECTURES 1-8 MAPS AND STRUCTURES – Dr Owen Weller

Lecture 1 Introduction and Anatomy of a map

Practical 1 Introduction to maps and construction of cross sections

Lecture 2 Structural geology orientation

Practical 2 Stereographic construction

Lecture 3 Stress, strain and rheology

Practical 3 Regional stratigraphic relations: the Portland 1:250,000 sheet

Lecture 4 Folds

Practical 4 Stereographic analysis of a folded/cleaved area

Lecture 5 Foliations, lineations and deformation history

Practical 5 Geometry of folds in sand/mudstone multilayers

Lecture 6 Brittle faults

Practical 6 Brittle failure diagnosed using Mohr diagrams

Lecture 7 Ductile shear zones

Practical 7 Interpretation of brittle/ductile shear zones

Lecture 8 Regional tectonic regimes

Practical 8 Balanced cross-section construction

LECTURES 9-15: TECTONICS AND GEODYNAMICS - Dr Sanne Cottaar

Lecture 9 Earthquakes

How do we know what happened? Location, strike/dip/rake, first-motion mechanisms, magnitude/intensity.

Practical 9 Making a fault plane solution of a real earthquake, using actual seismograph records.

Lecture 10 Plate Tectonics

Geometry, velocity triangles, Euler Poles, GPS, relative and absolute plate motions. Intro to driving forces.

Practical 10 South Atlantic opening; Gulf of Aden / Red Sea-East African Rift evolution; Azores-Gibraltar Plate boundary.

Lecture 11. Triple Junctions

Geometrical rules, examples and effect on tectonics. Past plate motion models.

Practical 11 Triple junctions and the evolution of a plate system through time.

Lecture 12 Subduction Zones and Mountain Ranges

Earthquake and fault characteristics, large earthquakes, deep earthquakes.

Practical 12 Megathrust earthquakes and deep seismicity.

Lecture 13 Mid-ocean Ridges, Continental Rifts, and Strike-Slip Faults

Normal faulting on ridges and continental rifts, relation to volcanism, making basins and highlands, strike-slip faults (North Anatolian), earthquake triggering.

Practical 13 Active normal faulting in central Greece.

Lecture 14 Earthquake Hazard

Hazard assessment methods, earthquake cycles, geomorphology, trenching, vulnerability.

Practical 14 Identifying and examining active faults using satellite data.

Lecture 15 Global Seismology

Body and surface waves, travel-time curves and ray parameter, radial Earth models, intro to tomography.

Practical 15 Global body waves.

LECTURES 16-21 SEDIMENTARY BASINS - Professor Nicky White

Lecture 16 Background and introduction

What are sedimentary basins? Where are they and why are they interesting?

Practical 16 Revision of Airy isostasy; subsidence plots; decompaction and backstripping example.

Lecture 17 Extensional sedimentary basins & passive margins

Subsidence, crustal thinning and normal faulting.

Practical 17 Evolution of North Sea basin from seismic reflection imaging, crustal thinning, and well logs.

Lecture 18 Other sedimentary basins

Flexural rigidity, foreland basins and "mystery" basins.

Practical 18 Evolution of Po Valley foreland basin: subsidence and thrust faulting. World-wide occurrence of foreland basins.

Lecture 19 Petroleum perspectives

Heat flow and thermal history; down-hole temperature measurement; source rocks and the origin of coal, oil, and gas

Practical 19 hydrocarbon generation and trapping in the southern North Sea.

Lecture 20 Fate of a basin

What ultimately happens to sedimentary basins?

Practical 20 Post-Permian onshore and onshore geology of the British Isles. Deep seismic reflection imagery.

Lecture 21 Building and interpreting sub-surface images

Seismic reflection experiments at sea: logistics, practicalities, innovations; expensive kit on a ship

Practical 21 Three-dimensional seismic interpretation.

LECTURES 22-24 OCEAN CIRCULATION AND CLIMATE - Dr Alex Piotrowski

Lecture 22 Physical Hydrosphere – Atmospheric and surface ocean circulation.

Practical 22 (for ESA and ESB): Lecture on Introduction to GIS Dr Nigel Woodcock

Use of Quantum GIS: Dr Nigel Woodcock and Dr Owen Weller.

Lecture 23 Physical Hydrosphere – Deep water mass formation and circulation.

Practical 23 Ocean stratification and mixing.

Lecture 24 Physical Hydrosphere - Deep ocean mixing.

Practical 24 Ocean stratification and mixing.

Lent Term

LECTURES 25-32 STRATIGRAPHY AND SILICICLASTIC SEDIMENTS - Dr Neil Davies and Dr Alex Liu

Lecture 25 **Introduction to Sedimentology, and Volcanogenic Sediments, *Dr Alex Liu***

Practical 25 *Volcanogenic sediments and deposits*

Lecture 26 **Principles of Stratigraphy, *Dr Neil Davies***
Introduction; Lithostratigraphy; Accommodation Space

Practical 26 *Stratigraphy.*

Lecture 27 **Interpreting Siliciclastic Sedimentary Signatures, *Dr Neil Davies***
Facies Analysis; Fluid Flow; The Boundary Layer; Sedimentary Structures

Practical 27 *Bedforms and sedimentary structures.*

Lecture 28 **Alluvial Sedimentary Facies, *Dr Neil Davies***
River processes, deposits and architecture; Alluvial Stratigraphy

Practical 28 *“Virtual fieldtrip”*

Lecture 29 **Continental Sedimentary Facies, *Dr Neil Davies***
Aeolian, lacustrine, glacial and deltaic environments.

Practical 29 *Sedimentary architecture.*

Lecture 30 **Marine Sedimentary Facies, *Dr Neil Davies***
Wave storm and tide processes; Marine ichnology; Sea-level controls on
Sedimentation

Practical 30 *Facies analysis.*

Lecture 31 **Sequence Stratigraphy, *Dr Neil Davies***
Sequences and parasequences; System tracts; Transgressions-regressions;
Relation to global sea level analysis

Practical 31 *Sequence stratigraphy.*

Lecture 32 **Secular Variation in Sedimentary Environments, Dr Neil Davies**
Sequences and parasequences; System tracts; Transgressions-regressions;
Relation to global sea level

Practical 32 *Isle of White map.*

LECTURES 33-36 **OCEAN CHEMISTRY - Dr Sasha Turchyn**

Lecture 33 **The major ion balance of the ocean.**
Introduction to box models, residence time.

Practical 33 *Seawater properties and Marine Ecosystems.*

Lecture 34 **The biological pump and a two-box model of the ocean.**

Practical 34 *Residence time a physical and numerical approach – Cool Box Practical.*

Lecture 35 **Marine Sediments, preservation of carbonate and silicate sediments.**

Practical 35 *Carbonate Bomb, carbonate distribution in sediments.*

Lecture 36 **Chemical sediments and the link to the rock record.**

Practical 36 *Sediment Practical.*

LECTURES 37-42 **CHEMICAL AND BIOGENIC SEDIMENTS – Dr Alex Liu**

Lecture 37 **Carbonate Sediments.**
Carbonate factories; platform carbonates; modern and ancient reef systems.

Practical 37 *Review common components of carbonate sediments; petrographic description of limestones and their classification. Fabrics of ancient reefs; analysis of fore-reef lithofacies and biofacies.*

Lecture 38 **Carbonate Depositional Environments: Warm vs cool water carbonates.**
Warm vs cool water carbonates; modern and Cenozoic systems.

Practical 38 *Cool water carbonate bryozoal limestones; facies analysis.*

Lecture 39 **Carbonate Diagenesis.**

Practical 39 *Osmington Oolite paragenesis. Cowthick hardground. $d_{13}C$ and $d_{18}O$;*

interpretation of carbonate cements.

Lecture 40 Dolomite and evaporates.

Practical 40 Dolomites and evaporites in hand specimen and thin section.

Lecture 41 Ironstones, Phosphorites and Siliceous sediments.

Practical 41 Chemical sediments in the rock record.

Lecture 42 Microbe-sediment interactions.

Practical 42 Microbialites and microbially induced sedimentary structures.

LECTURES 43-48 EVOLUTIONARY PALAEOBIOLOGY – Dr Liz Harper

Lecture 43 What use is the fossil record?

Taphonomy: biominerals; life vs. death assemblages; time averaging; modes of fossil preservation; exceptional preservation.

Practical 43 Taphonomy and styles of preservation.

Lecture 44 Understanding morphospace.

The coiled accretionary skeleton; allometry; heterochrony; ontogeny vs. phylogeny; brachiopod palaeobiology.

Practical 44 Brachiopod systematics and heterochrony.

Lecture 45 Palaeoecology and the adaptive radiation of bivalves: interpreting fossils of a well-known group.

Practical 45 Bivalve systematics and palaeoecology.

Lecture 46 Assessing similarity and reconstructing phylogeny; cladistic methodology.

Practical 46 Cladistic analysis using molluscs.

Lecture 47 Organism interactions.

Recognition and quantification in the fossil record; importance in evolution. Trace fossils as evidence of behaviour and interactions.

Practical 47 *Fossil evidence of competition and predation – including visit to Sedgwick Museum.*

Lecture 48 **Large scale trends and events in the fossil record.**
Radiation and extinction, evolutionary faunas, tiering, A tale of two clades.

Practical 48 *Trace fossils.*

Easter Term

LECTURES 49-50

MICROPALAEONTOLOGY – Dr Liz Harper

Lecture 49 Introduction to microfossils.

Siliceous microfossils and silica deposition through time; diatoms, radiolaria and sponges.

Practical 49 Siliceous microfossils and sponges.

Lecture 50 Calcareous and organic walled microfossils; coccolithophores, foraminifera and dinoflagellates

Practical 50 Coccolithophores, forams and dinoflagellates.

LECTURES 51-55

VERTEBRATE EVOLUTION – Dr Jason Head

Lecture 51 Building vertebrates from scratch.

Basic organ systems and control mechanisms - Cambrian origins and general similarity to modern acraniates (*Amphioxus*) - Ordovician hard parts and fish - "ostracoderms" - fins and jaws in the Siluro-Devonian - Fish in general, but very brief - lobe-finned fish and their ecology - tetrapod design (constraints of life on land) - why onto land? (SW=Land in physiological terms) - Devonian palaeoenvironments - *Acanthostega* - revision of tetrapod origins.

Practical 51

Section 1 *Chordate characteristics - dem. and guided tour of Zoology Museum*

Section 2 *Early fish dem (ostracoderms + gnathostomes).*

Section 3 *ORS - the orcadian lake.*

Lecture 52 Early tetrapods.

What are amphibians? - exploiting land - Carboniferous environments - biases in fossil record of tetrapods - what are reptiles? - reptile origins - size as a factor in evolution of land habits. Early reptiles - first radiations - some obscure but interesting groups (pareiasaurs, marine radiations - plesiosaurs and ichthyosaurs, placodonts).

Practical 52

Section 1 *Upper Devonian - Greenland seds fossils and environment.*

Section 2 *Amphibians and reptiles demonstration (modern and fossil - possible short museum visit). Eggs and egg shells (structure and function - re.*

life on land).

Section 3 *Marine reptiles and faunas of the Wessex Basin.*

Lecture 53 **Synapsids and their evolution.**

Mammal-like reptile origins in Late Carboniferous Pelycosaurs (classic reptiles) with sails - size and physiological control - Therapsids of the Permo-Trias - increasingly mammal-like - body redesign, elementary mechanics body and limb posture - cranial mechanisms for feeding and breathing - why?

Practical 53

Section 1 *Mammal-like reptiles dem. (short museum visit).*

Section 2 *The Great Karoo Basin - sedimentary environments from Early Permian -Lower Jurassic.*

Lecture 54 **Permo-Triassic palaeoenvironments**

Karoo sequence (Early Perm - Early Jur) - environmental change - continental climates -mammals vs reptiles and survival strategies - origins of dinosaurs, decline of early mammals - outline analyses of faunal transition (competitive vs opportunist models). Dinosaur organisation - structural design.

Practical 54

Section 1 *Dinosaurs demonstration materials (Sedgwick tour).*

Section 2 *Analysis of Tr/Jr transition using published data (patterns in the fossil record?). Discussion.*

Section 3 *Summary of Karoo biozonation using vertebrates.*

Lecture 55 **Dinosaurs and birds**

Dinosaur classification - pelvic structure - life styles - plant-animal co-evolution - vicariance biogeography (worked example) - nesting and parental behaviour of dinosaurs - dinosaurs and bird origins - brief extinction scenarios for the K-TEC.

Practical 55

Section 1 *Dinosaur-crocodile-bird demonstration.*

Section 2 *Review of course - mini discussion in lab.*

LECTURES 56-57

CASE STUDIES - Dr Alex Copley & Dr Alex Piotrowski

Lecture 56 **Basins in the Past and Present - Tectonics of the Wessex Basin and Gulf of Corinth, Dr Alex Copley.**

Practical 56 *The active and ancient tectonics of extensional basins.*

Lecture 57 Basins in the Past and Present - Sediment, Climate, and Paleontology of Mesozoic and Modern Marine Basins – *Dr Alex Piotrowski*

Practical 57 Paleoenvironment of the Wessex Basin