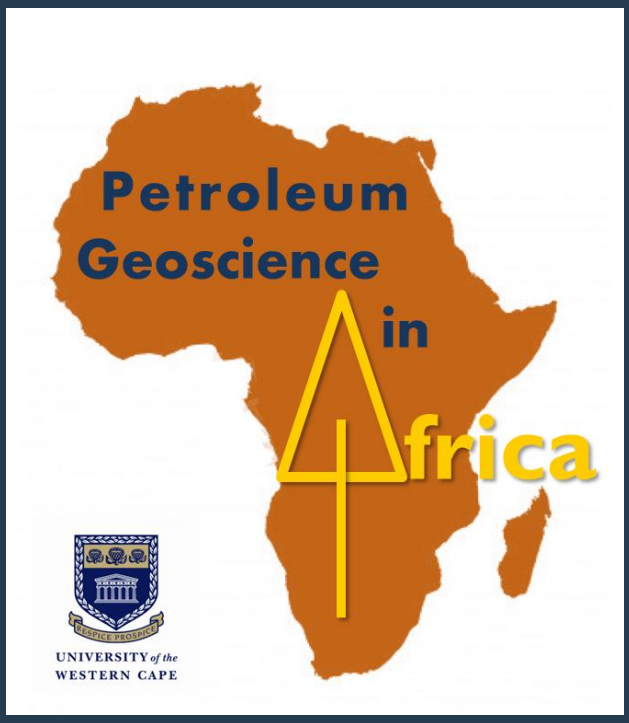
PRELIMINARY VERSION



MSc. In Petroleum GeoScience

In January 2013, UWC - Dept. of Earth Sciences launched an MSc programme in Petroleum Geoscience. This MSc. programme of 1½ year duration is intended for the greater African market where university-hosted education resulting in an MSc degree is not yet available for Petroleum Geosciences. Throughout southern Africa the oil & gas - related industry is seeking to fill geosciences positions. Presently local candidates with sufficient skill and background are difficult to find, meanwhile E & P activities are steadily on the rise.

Course design: The course sequence has a modular set-up following the field "life-cycle" in the oil industry. Such an approach facilitates an easy learning of petroleum geoscience skills and will also raise economic awareness.
The full MSc. programme consists of two semesters, each of 5 months lecturing, practical assignments and assessment, followed by a 6 month research component entailing in an MSc thesis. Individual course modules can be attended as short courses on a day-by-day basis.

Teaching capacity: the course is coordinated by an expat programme manager and instructor with 27 years industry experience, UWC academic staff, some of whom have experience in the oil industry, several local industry specialists and some visiting expat staff. There is support from PetroSA, Tullow and Sasol Petroleum Int. and the South African Oil & Gas Alliance. Academic cooperation exists with the University of Missouri, Rolla.

Fees : Short course attendance fee for industry is 185 US$ per ½ day per attendee. US$ 50 will be charged for cancellation of registration up to 1 week prior the commencement of the course. Bench fees for the year long course are as follows:

Oil company sponsored students	US$ 20 000
Private students	US$ 15 000

UWC endeavours to find sponsorship for all approved students.
All modules will be examined according to UWC's assessment policy and will be subject to external moderation.
Certifications of attendance will be provided and accreditation for short courses towards a degree is in process.

Entry requirements : Honours degree with an average of 70% {upper 2nd} or equivalent. Relevant industry experience will also be considered.

Time table : January - early December courses and practicals, MSc research first ½ of the following year.

Application : UWC application for the next academic year (calendar year) closes end October. Short course application should be made well in advance since classes must remain small.

Contact details-UWC :
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The department employs modelling and interpretation software like Kingdom Suite™, Petrel™, Interactive Petrophysics™, Geovisionary™ and MOVE™.

Programme (Total lecture run-time 2 semesters, thesis ½ year)

WeeK		APG	
1	1	816	Exploration & Production Intro
2		816	E & P cont'd / Reservoir Sedimentology
3	2	816	Res. Sedimentology cont'd
4		816	Res sedimentology / Sequence Stratigraphy
5		816	Basin delineation : Tectonic & Stratigraphic framework
6	3	816	Sequence Stratigraphy / Seismostratigraphy
7		816	Organic Geochemistry + Modelling of Petro Systems
8		816	Model of Petro Systems / Basin Analysis
9	4	816	Seismic physical principles & seismic interpretation
10		816	Seismic interpretation practical
11	5	816	Petrophysics & OHL
12		816	Petrophysics & OHL
13	6	816	Petrophysics & OHL + practical (IP)
14		816	Integrated exercise
15	7	816	Exploration Petroleum Economics
16	8	816	Generate prospect and propose a well : practical
17		818a	Exploration Group Project
18		818a	Exploration Group Project
19		818a	Exploration Group Project
20			Study Week
21 - 23			Assesment
		Break	
28		804	1st week field Plettenburg reservoir Sedimentology
29		804	2nd week Tanqua Karoo Fieldwork
30	9a	817	Production / Development Geology & Reserves calculation
31	9b	817	Development Geol and Res Modelling
32	9c	817	Building a static reservoir model; practical
33	10	817	Intro Reservoir Engineering
34	11	817	Production technology & well completion
35	12a	817	Faults & Fractures; impact on development
	12b	817	Development Petroleum Economics & Risk assessment
36	13	817	Production seismology & Seismic techniques
37	14	817	Unconventional Resources
38		818b	Production Group Project
39		818b	Production Group Project
40		818b	Production Group Project
41			Study Week
42 - 44			Asessment

(starting dates are subject to change when resources so dictate)

1 INTRODUCTION TO UPSTREAM E & P BUSINESS

General Objectives : ***Introduce Petroleum Geoscience in the multidisciplinary scene of Exploration and Petroleum Engineering. Become aware about whom and what is involved.***

- **Geo-scientists; disciplines involved. Exploration vs. Production**
- **Finding & lifting costs, onshore versus offshore, oil versus gas.**
- **What is a lot and what is less? Oil-field units and conversions.**
- **Natural gas & gas markets, cost elements**
- **Unconventional hydrocarbon resources, deep water off-shore.**
- **Regional prospectivity assessment; pre-seismic terrain surveys.**
- **Environmental impact assessment (EIA).**
- **Where does Africa stand in terms of hydrocarbon resources?**

- **Discovering and producing hydrocarbons; the field life-cycle: Seismic data acquisition & interpretation, drilling a well, logging a well, coring & core-analysis, reservoir parameters, reservoir quality and shape, testing a well, economical impact.**

Team assignment with regard to Southern Africa licencing

2 RESERVOIR SEDIMENTOLOGY & STRATIGRAPHY

Sedimentary architecture:

- **Interpret primary sedimentary structures; sets, bed-sets and co-sets. Hydrodynamic response of sediments: recognize the mode of transport and deposition.**
- **Litho-type vs. litho-facies associations. Define and quantify the depositional environment. Correlate sedimentary profiles and delineate (reservoir) architecture. Determine lateral trends and apply trend maps.**

Data sources:

- **Coring, coring equipment, coring methods and core handling.**
- **Responsibilities of the well-site geologist.**
- **The mudlog: cuttings, side wall samples & HC shows**
- **Core description & lithofacies, guidelines.**
- **Field analogues of subsurface reservoirs**

Practical work: sediment description in field and from cores.

Objectives : learn to apply sedimentological characteristics of rocks in order to delineate reservoir type and geometry.

Petrography and diagenesis using cores and SWS:

- **Thin sections, micrographs, acid solubility, XRD / fluorescence, SEM**
- **Establishing a Diagenetic (para) sequence, predicting diagenetic trends.**

3 BASIN DELINEATION: TECTONIC & STRATIGRAPHIC FRAMEWORK.

Stratigraphic/sedimentary basin style:

- **Availability of (bio-, litho, chrono and chemo) stratigraphy data.**
- **Basin evolution: characterise basin shape, sediment influx, large-scale sedimentation episodes and identify mega sequences.**

Tectonic basin style:

- **Characterising various extensional / compressional stages through time.**
- **Overview of tectonic settings and (sedimentary) basin styles.**

Practical including un-folding using MOVE™ software

The concept of Sequence Stratigraphy:

- **Para-sequences and para-sequence sets.**
- **Sequence boundaries and lateral predictability of sequences.**

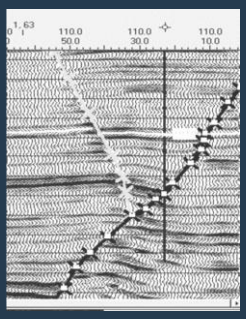
Sequence Stratigraphy *versus* Seismo Stratigraphy: guidelines for geological guided seismic interpretation.

Practical work: pick reflectors, identify faults, make a seismostratigraphic interpretation, generate basic seismic attributes (employing Kingdom Suite™).

4 HYDROCARBON MATURATION and OCCURRENCE.

- **Source Rock (deposition, definition and classification), Kerogen type.**
- **Principles of organic geochemistry;biomarkers, burial and maturation, TOC, FID, chromatography, Rock Eval. Oil versus source rock correlation.**
- **Formation, migration fairways and accumulation of hydrocarbons.**

- **Principles of a Petroleum Systems Model; temperature history, timing, trapping configurations and seal integrity.**
- **What then is 'Basin Analysis' ?**



5 GEOPHYSICAL METHODS for PETROLEUM EXPLORATION & PRODUCTION

- **Marine and Seismic acquisition, 2D & 3D acquisition geometry, costs.**
- **Basic physics; reflection coefficient, amplitudes, acoustic impedance.**
- **Seismic processing; stacking, deconvolution, migration, Pre & Post SDM, inverted seismic data, digital filtering, imaging.**
- **Calibration and well tie; well synthetics, VSP surveys.**

Seismic interpretation:

- **Seismo-stratigraphic Interpretation. Detection of hydrocarbons (DHI).**

Practical work: handling seismic data on a work station, tie-in a well.

6 PETROPHYSICAL METHODS and LOG EVALUATION

Introduction to petrophysics and open hole logging (OHL) tools:

- **Overview of logging methods; vertical resolution, invasion profiles, mudcake, depth of investigation, log quality control.**
- **Conventional Logging tools and their physical principles.**
- **Logging While Drilling (LWD), CT-logging, Special logging tools and imaging logs.**

Laboratory analysis of cores.

- **Concepts of capillary pressure, wettability, relative permeability.**
- **Plugging & sampling conditions. RCA and SCAL and integration of such analyses.**

Identification of reservoir, fluids and fluid type:

- **Basic porosity calculation and evaluation of hydrocarbon saturation, Calibration of logging data with core-measured data.**
- **What about permeability?**
- **Log interpretation and formation evaluation on the screen (IP)™**
- **Logging suites to propose for a range of wells.**

Objectives : detect the reservoir, identify hydrocarbons and calculate pay. Learn how to correlate logs

7 INTRODUCTION TO PETROLEUM ECONOMICS & RISK ASSESSMENT.

- **Make decisions : explore then drill ?**
- **Licence costs & licence obligations.**
- **Expected hydrocarbon volumes. Expectation graphs.**
- **Possibility of success (POS), Estimated Monetary Value (EMV)**
- **Cash flow profile, Economic indicators.**
- **Risk assessment and risk mitigation.**
- **Risked versus unrisked resources/reserves**

8 GENERATE a PROSPECT and PROPOSE A WELL.

Practical work and resulting essay: identify lead, generate prospect, propose a well, costs of that well, EMV.

Objectives : Understand formation, migration and accumulation of hydrocarbons and quantify favourable accumulation conditions. Use seismic interpretation results as an input for decision making. Make risked probabilistic estimates of resources.

If feasible a short field trip to study analogue reservoir outcrops will be organised.

Second Semester : Production & Development

9a PRODUCTION / DEVELOPMENT GEOLOGY and RESERVES CALCULATION

- **Common maps and cross-sections, thematic maps, facies maps, isopachs and isochores.**
- **Sedimentary guided log-correlation and assimilation with seismic data; delineation of the sedimentary reservoir model.**
- **Integrate core-geology, petrophysics & core-measured data, define internal reservoir architecture and distribute reservoir properties.**

- **Volumetric calculations and uncertainty definitions; probabilistic and deterministic reserves.**
- **Development well-patterns, injectors/producers, water flooding. Scope for further development; where are the remaining hydrocarbons? In-field opportunities. Enhanced oil recovery**
- **4D reservoir monitoring : changing hydrocarbon contacts and saturations over time.**
- **Study a comprehensive development geology plan.**

9b BUILDING A (computer assisted) STATIC RESERVOIR MODEL.

- **Deterministic and Stochastic reservoir models, applications of such models, geostatistical methods.**

- **Quantify geology : assign static reservoir properties, visualize by mapping.**

9c Practical work; elaborate a static reservoir model (Petrel™).

Objectives : quantify geology and integrate this with well-data. Build a static geological model, make a reserves calculation. Learn about common production geological practises.

10 INTRODUCTION TO RESERVOIR ENGINEERING PRINCIPLES

- **Drive mechanisms, Material Balance principles, Phase diagrams**
- **Compositional ranges of crudes, condensate, wet and dry gas.**
- **Producibility, pressure testing, recovery, recovery methods.**
- **Capillarity, wettability and relative permeability effects in the reservoir**
- **PVT measurements at reservoir conditions and STP.**
- **Dynamic reservoir simulation: history matching & production forecasting**
- **Production forecast scenarios and field development plan (FDP).**

Objectives: Understand concepts of reservoir engineering sufficiently to communicate with reservoir engineers.

11 INTRODUCTION to SUBSURFACE PRODUCTION TECHNOLOGY and WELL COMPLETION

- **Well completion, Well IPR, perforating techniques.**
- **Well stimulation methods: acidising & hydraulic fraccing.**
- **Surface evacuation facilities**
- **Safety aspects onshore and offshore**

12 FAULTS and FRACTURES; THEIR IMPACT ON DEVELOPMENT.

(2 days!)

- **Fault transmissivity: sealing faults / open faults**
- **Fractures: definition and descriptive elements.**
- **Fracture storage and fracture related permeability**
- **Modelling of faults and fractures, sensitivity analysis.**

Example study of fractured fields

13 DEVELOPMENT PETROLEUM ECONOMICS & RISK ASSESSMENT. (3 days!)

- **The field Development Plan (FDP); development scenarios and options**
- **Profitability indicators & project value: IRR, PV and NPV.**

- **Sensitivity parameters and risk perception, Tornado diagrams.**
- **Risk assessment and risk mitigation.**

- **Investment decisions**
- **Some remarks on portfolio management.**

14 PRODUCTION SEISMOLOGY

- **Amplitude versus offset (AVO), angle dependent reflectivity, seismic inversion, Seismic modelling; fluid substitution.**
- **Borehole seismology.**

17 UNCONVENTIONAL RESOURCES

- **Coalbed methane (CBM) and ECBM, mine gas.**
- **Production techniques and well-economics of unconventional projects**
- **Absorption / desorption parameters. Laboratory methods.**
- **Shale gas, hydraulic fraccing, production rates. Potential resources.**
- **Tight gas reservoirs and oil reservoirs.**
- **Distribution of unconventional reservoirs in Africa.**
- **Areas of potential development. Shale gas in Karroo.**

Miscellaneous :

- **Some presentations by industry staff regarding innovative techniques and new technological trends.**
- **How to effectively report relevant information that has "decision" value?**

MSc. PROGRAMME: last ½ year of practical work and Thesis

- ***Thesis {preferably as an intern in a E & P company}***