MAKERERE UNIVERSITY

COLLEGE OF NATURAL SCIENCES

SCHOOL OF PHYSICAL SCIENCES

DEPARTMENT OF GEOLOGY AND PETROLEUM STUDIES

PROGRAMME FOR THE DEGREE OF MASTER OF SCIENCE IN PETROLEUM GEOSCIENCES

MAY, 2012

1.0 Title of the Programme

Master of Science in Petroleum Geosciences, M.Sc. (Petroleum Geosciences).

2.0 Preamble

Since 1999, the Department of Geology and Petroleum Studies, Makerere University has been offering a Master of Science degree in Geology by coursework and thesis. However, the ongoing Masters programme was started before the discovery of commercial petroleum reserves in the Albertine Graben (Appendices iv and v) and therefore does not adequately cover this discipline. The new undergraduate programme (Bachelor of Science in Petroleum Geosciences and Production) takes four years and its first cohort is in its second year.

The Department of Geology and Petroleum Studies therefore proposes to introduce a Master of Science degree programme in Petroleum Geosciences by course work and thesis whose emphasis will be laid on various aspects of petroleum geology. This programme is intended to train geoscientists in Uganda and from the region to work in the emerging petroleum sector taking into consideration the current global challenges.

The areas of emphasis will include Stratigraphy, Structural geology, Geophysics, Geochemistry, Sedimentology, Environmental Geology and field work.

Justification of the programme

Petroleum has only been discovered in 30% of the Albertine Graben. The Albertine Graben stretches from the border with South Sudan in the north to Lake Edward in the south, a distance of over 500 km and is on average 45 km wide. More skilled manpower is required to explore the rest of the graben to exhaust its full potential estimated between 2-6 billion barrels of crude oil. This would qualify the Albertine Graben as a World Class Oil Province that would sustain a refinery Uganda intends to build in the near future.

In the region South Sudan has discovered about 6 billion barrels of crude oil in the Muglad Rift basin which is a continuation of the Albertine Graben. Tanzania has viable reserves of natural gas in Mnazi bay and Songo Songo Island. Natural gas occurrences have been recorded in the Kivu area of Rwanda. Exploration work is progressing well in DRC, Kenya (Anza and Lamu basins) and Burundi. Further south viable natural gas reserves have been found in Mozambique and Namibia.

The above facts underscore the urgent need to train skilled local human resource in the exploration, development and sustainability of the petroleum industry. Since none of the countries in the region that have either discovered oil resources or are urgently exploring for them have study programmes at university to do this, the Petroleum Geoscientists trained at Makerere University will not only benefit Uganda but also the East and Central African region as a whole.

In future, it is anticipated that Makerere University will be a regional hub for petroleum studies which in future will grow into the centre of excellence. The government of the Republic of Uganda expects Oil Companies to employ suitably qualified Ugandans and therefore the M.Sc programme would fulfill this requirement.

3.0 **Resources**

3.1 **Financial Sources**

Funding for teaching, learning and research costs will accrue from student tuition fees. The Energy and Petroleum (EnPe) scholarships fund supported by the Norwegian Agency for Development Cooperation (NORAD) is expected to provide start-up (seed) funds by sponsoring students (the first cohort of 5 students for 2 years and another cohort of 5 students for 1 year), equipping laboratories and library, and providing expatriate staff. A 30-seater bus to help in transporting students and staff for fieldwork is to be procured. The funds from the EnPe project have partly subsidized the cost of the M.Sc in Petroleum Geosciences.The budget estimates in Appendix 1 show the expected income and expenditure.

3.2 **Physical Facilities**

The Department has acquired a number of facilities through grants from within and outside the country. These include field and laboratory equipments, vehicles, computers as well as reference books and published reports (see Appendix II). The Department has space to handle the proposed programme. The Department is also connected on the computer local area network (LAN) of Makerere University. It is therefore possible to access information through both local intranet and internet supported by the university. The Department of Geology also has a website which depicts its activities. As part of the EnPe project, a seismic laboratory with 15 computers and up to date software has been launched. Also, Schlumberger, the world's biggest oil service company has donated another modern laboratory with software used in interpreting oil well data.

3.3 **Academic Staff**

The programme will be taught by the existing members of staff as indicated in Appendix III. The Department will also tap manpower from other Departments such as Physics, MUIENR as well as external sources e.g. Petroleum Exploration and Production Department (PEPD) and expatriates from

the University of Bergen, Norway. As part of the EnPe project, a number of academic and technical staff will undertake refresher courses
in Norway. These courses will enhance their ability to offer some of the courses on the programme.

4.0 Objectives

4.1 General Objective

The general objective of the programme is to train Petroleum Geoscientists who can contribute effectively to programmes of exploration and development of petroleum resources.

4.2 Specific Objectives

At the end of the training, the participants should be able to:

(i) Identify the key geological features associated with petroleum resources in the context of their discovery and economic viability.

(ii) Execute and interprete information from remote sensing, geological, geophysical and geochemical data during petroleum exploration.

(iii) Apply geological, geophysical and geochemical knowledge in the development of petroleum resources.

(iv) Assess the environmental impact of petroleum resources exploration and development.

(v) Develop the knowledge, skills and confidence to work independently in the exploration and development of petroleum resources and related projects.

5.0 Learning outcomes

On completion of the programme, the Petroleum Geoscientists will have:

- Knowledge and understanding of key areas of petroleum geosciences, and theoretical basis for methods of analysis and modelling, specific examples of petroleum resources assessment and management, and application of worldwide experiences.
- Intellectual skills that include planning; execution and reporting on a significant piece of geosciences research; searching for information and developing ideas; applying appropriate

research principles, designs, methods and techniques; and creating new methodologies or research outputs through synthesis of ideas from a wide range of sources.

- Practical skills including use of relevant field and laboratory equipment; carrying out field and laboratory work and; application of different s techniques.
- Transferable and key skills such as presenting geosciences data; using science-based evidence to solve problems; and effectively communicating research findings.

6.0 **General Regulations**

The studies and examinations for the degree of MSc. in Petroleum Geosciences shall be governed by the general regulations and statutes of Makerere University. The general regulations of the School of Graduate Studies and the College of Natural Sciences shall also apply.

7.0 **Admission Requirements**

Applicants will be required to possess an honours BSc degree in Geosciences (geology, physics and geology, chemistry and geology, math and geology, computer science and geology) from a recognised University.

Applicants with pass degrees may be admitted after demonstrating academic growth and maturity in the field of geosciences. The academic growth and maturity in the field should include additional training such as postgraduate diploma, relevant publication or working in the field of geosciences. In order to participate effectively in the programme, the participants must be able to demonstrate a certain level of proficiency in the English language.

8.0 **Examinations**

During each course, a student's competence in the field of study will be assessed through assignments, tests and examinations in written, oral and practical form. All assessments will be carried out in accordance with the University assessment rules.

8.1 Progressive Assessment

The student will be required to sit at least two course tests during and after completion of every course. Assessment marks from tests are to be combined with marks attained from practicals, assignments and seminar presentations. The progressive assessment mark of the first academic year shall be 40% and 30% for courses with practicals and/or fieldwork and those without respectively.

8.2 Written Examinations

At the end of each semester of the first academic year, candidates will be required to sit a written examination in each course offered. This will contribute 60% or 70 % of the total examination marks in the first and second semester.

8.3. Field course

This course will be conducted during the intersemester break. The progressive assessment will be based on field work (e.g., in discussions, measurements, sampling, base map field notes, presentations) and the field report will be assessed for the final examination.

8.4 Project work and Dissertations

This will have to be accomplished within the second academic year. Each candidate will undertake a piece of original research during the third and fourth semesters, which will form the subject of a Master of Science dissertation. The dissertation will be based upon an individual research project under the guidance of the candidate's supervisors. The supervisors will assist the candidate in designing the aims and scope of the project. The supervisors also have to introduce and accompany the student to the fieldwork area at least during the initial stages of the course.

After having carried out fieldwork each student has to do literature search, sample analysis and data interpretation on a topic approved by the Department.

The student gives a seminar presentation on the research findings and subsequently prepares a scientific report (dissertation) which is presented to an audience comprising of supervisors, and other members of the viva voce panel. The dissertation will be examined according to the University regulations.

8.5 Academic Progress

8.5.1 Normal Progress

Normal progress shall occur when a student has passed the assessments in all the courses he/she had registered for in a particular semester and not when he/she has passed the assessments in the core courses only (i.e. when Grade Point [GP], is at least 3.0).

a) All course units shall be examinable and the general university semester examination rules shall apply.

b) Progressive assessment will consist of assignments/coursework (minimum of 2), practicals and tests (minimum of 2), and will contribute either 30% for course units that do not include laboratory/field/practicals or 40% for course units that have a laboratory/field practical component.

c) Consequently, university examinations held at the end of the semester will contribute 70% (for course units without laboratory/field practical component) and 60% (for course units that have a laboratory/field practical component).

d) Overall assessment will be done using the general university grading system shown in Table 1 below, while the following additional letters are used where appropriate:

W = Withdrawal from course, I = Incomplete course, AC = Audited course

Table 1. Grading system for the intake of 2008/2009 academic year on wards

Marks	Letter Grade	Grade Point (GP)	Interpretation
90 – 100	A+	5	Exceptional
80 – 89	A	5	Excellent
75 – 79	B+	4.5	Very good
70 – 74	B	4	Good
65 – 69	C+	3.5	Fairly good
60 – 64	C	3	Pass
55 – 59	D+	2.5	Marginal Pass
50 – 54	D	2	Clear Fail
45 – 49	E	1.5	Bad fail
40 – 45	E-	1	Qualified fail
Below 40	F	0	Qualified fail

8.5.2 Description of Grading

a) **A+ Exceptional:** Thorough knowledge of concepts and/or techniques and exceptional skill or great originality in the use of concepts/techniques in satisfying the requirements of an assignment or course.

b) **A Excellent:** Thorough knowledge of concepts and/or techniques together with a high degree of skill and/or some elements of originality in satisfying the requirements of an assignment or course.

c) **B+ Very Good:** Thorough knowledge of concepts and/or techniques together with fairly high degree of skill in the use of those concepts/techniques in satisfying the requirements of an assignment or course.

d) **B Good:** Good level of knowledge of concepts and/or techniques together with considerable skill in using them to satisfy the requirements of an assignment or course.

e) **C+ Fairly Good:** Acceptable level of knowledge of concepts and/or techniques together with considerable skill in using them to satisfy the requirements of an assignment or course.

f) **C Pass:** Slightly better than minimum knowledge of required concepts and/or techniques together with some ability to use them in satisfying the requirements of an assignment or course. The student has some basic knowledge and a limited understanding of key aspects of the subject area and can attempt to solve familiar problems albeit inefficiently and with limited success.

g) **D+ Marginal Pass:** Minimum knowledge of requirement concepts and/or techniques together with some ability to use them in satisfying the requirements of an assignment or course. The Student has familiarity with the subject area.

h) **D Clear Fail:** Poor knowledge of concepts and/or techniques needed to satisfy the requirements of an Assignment or Course.

i) **E, E- and F Bad and Qualified Fail:** Lack of understanding of knowledge of concepts and techniques.

8.5.3 Probationary Progress

Postgraduate students are on probationary progress if the GP for any course is less than 3.0 or the CGPA is less than 3.0. This probationary status serves as a warning to students that their performance is below the level required. Such a student shall be allowed to progress to the next semester but shall still retake the course(s) he/she had failed and obtain at least the Pass mark (60%) in the course(s).

8.5.4 Failure of Examinations

8.5.5 Any student who fails to attend a scheduled assessment, not completing an assignment or not presenting the results within an allocated time, will be considered as having failed unless an acceptable reason can be offered.

8.5.6 Discontinuation

(a) When a student accumulates three consecutive probations based on CGPA he/she shall be discontinued.

(b) A student who has failed to obtain at least the Pass Mark (60%) during the third assessment in the same course or courses he/she had retaken shall be discontinued from his/her studies at the University.

(c) A student who has overstayed in an Academic Programme by more than two (2) years without a good reason shall be discontinued from his/her studies at the University.

8.5.6 **Terminal Diploma**

All students who do all the course work and pass but for various reasons fail to complete their studies will be issued with a Terminal Diploma.

8.6 Award

A 'Master of Science' degree in Petroleum Geosciences (M.Sc. (Petroleum Geosciences)) will be awarded to a student who has fulfilled the requirements of the M.Sc. (Petroleum Geosciences) programme of Makerere University.

9.0 Curriculum

9.1 Duration and Structure of the Programme

The programme shall cover a period of two academic years i.e. four semesters, each of 17 weeks. Each course will consist of credit units, as defined by the College of Natural Sciences regulations. One hour of lecture or seminar is one contact hour. Two hours of tutorial, practical and four hours of fieldwork are equivalent to one contact hour.

The students will be required to:

(i) Attend lectures.

(ii) Participate and contribute in a series of seminars.

(iii) Acquire hands-on-experience with laboratory equipment. This will also involve analysis of samples for research purposes.

(iv) Participate in group fieldwork.

(v) Carry out independent mapping and exploration related researches under the guidance of their supervisors.

(vi) Interpret results of the findings using the state of the art software and standard conventional methods and with assistance of their supervisors.

(vii) Prepare progress reports, oral presentations to the department, and finally the dissertation to the Directorate of Research and Graduate Training.

10.0 Structure of the Programme

The syllabus of the programme is divided into two parts. Part 1 consists of two semesters each with four core courses and two electives. The core courses must be taken and one elective chosen in each of the two semesters. Part 2 consists of proposal writing and a research project to be carried out during the third and fourth semesters.

In total, a student is supposed to cover a minimum of 9 credit units and a maximum of 16 credit units per semester. In the 1st and 2nd semesters the core and elective courses are clearly outlined in the detailed description of the programme.

The contact hours per week per course unit including practicals and the recess term are also indicated in the detailed description.

The programme consists of the following course arrangement on a semester system, where L = Lecture; P = Practical; CH = Contact Hours; FW = Fieldwork; CU = Credit Units. The student shall take all the core courses and at least one elective.

In summary the structure of the programme is as outlined below:

Year 1 Semester I

Core Courses

Course Code	**Course Name**	**L**	**P**	**CH**	**CU**
MPG 7101	Petroleum Geology	45	0	45	3
MPG 7102	Petroleum Geophysics	30	30	45	3
MPG 7103	Principles and practices of petroleum	15	30	30	2

	geochemistry				
MPG 7104	Sequence Stratigraphy	30	30	45	3
MPG 7105	Environment, Health and Safety aspects of Petroleum Exploration and Production	30	0	30	2

Electives

Course Code	Course Name	L	P	CH	CU
MPG 7106	Depositional Systems	30	30	45	3
MPG 7107	Petrophysics and Formation Evaluation	30	30	45	3

Intersemester break

Course Code	Course Name	L	FW	CH	CU
MPG 7108	Field Course	0	120	30	3

Year 1 Semester II

Core Courses

Course Code	Course Name	L	P	CH	CU
MPG 7201	Applied Biostratigraphy and Chronostratigraphy	30	30	45	3
MPG 7202	Basin Analysis	15	30	30	2
MPG 7203	Petroleum Structural Geology	30	30	45	3
MPG 7204	Production and Reservoir Monitoring	30	30	45	3
MPG 7205	Research Methods	15	30	30	2

Electives

MPG 7206	Seisimic Reservoir Characterization	30	30	45	3
MPG 7207	Geological Development of the East African Rift System	45	0	45	3

Semester III Project Work/Dissertation

The first part of this semester will be spent in the field gathering data following the research methodology approved in the proposal. This will be followed by laboratory work where the researcher will do sample preparation and later analysis. The candidate may be required to return to the field for more sampling to fill in the gaps envisaged.

Semester IV

The first part of this semester is devoted to data interpretation and presentation of the findings in seminars, workshops or colloquia. The last half of the semester will be spent on writing the dissertation till it is submitted for marking.

11.0 Detailed Course Description

Course Name: Petroleum Geology 3(3-0)

Course Code: MPG 7101

Course Credit: 3 CU

Course Description

This course covers the different properties of petroleum and exploration methods, petroleum systems and the various elements of a petroleum system. Sedimentary basins, petroleum economics and risks are also discussed.

Course Objectives

At the end of the course the students should be able to:

- Apply the appropriate techniques in petroleum exploration.
- Identify the different elements in any petroleum system.
- Assess the economic viability and possible risks involved in a petroleum venture.

Course Content

Content	Contact Hours
Introduction History of Petroleum Geology. Definition of Petroleum Geology. Physical and chemical properties of Petroleum.	5
Methods of Petroleum exploration Surface geology – Direct indications and Surface data Subsurface geology – Well cuttings, Cores, Electric logs, Drill stem tests. Geophysical surveys – Gravity surveys, Magnetic surveys, Electromagnetic surveys and Seismic surveys.	10
Elements of a Petroleum System Source rocks. Reservoir rocks. Seal/cap rock. Trap. Timing. Maturation. Migration.	10
Sedimentary basins and Petroleum sytems **Sedimentary basins** – Definition. Evolution. Types. Importance. **Petroleum sytems** – Definition. Identification. Naming. Classification. Types: Initial rift, Continental platform, Orogenic-Deltaic.	10

Economics of petroleum –Petroleum exploration. Petroleum production. Government policies. Petroleum reserves. **Risks –** Hazard analysis. Environmental problems.	10

Mode of delivery
The course will be lecture-oriented with assignments and class presentations.

Assessment

Assignments, class presentations and tests	30%
Final examination	70%

Available staff	**Status**
Dr. Betty Nagudi	Full time

Reading List

- LINK, P.K., 1982. Basic Petroleum Geology. OGCI Publications, Tulsa.
- MAGOON, L.B., DOW, W.G., 1994. Petroleum System-From Source to Trap. American Association of Petroleum Geologists Memoir, v.60.
- NORTH, F.K., 1985. Petroleum Geology. Allen and Unwin, London.
- EVENICK, J., 2008. Introduction to Well logs and Subsurface maps.
- MCELROY, D.P., 1987. Fundamentals of Petroleum Maps.
- MIALL, A.D., 1996. The geology of fluvial processes, Basin analyses and petroleum geology, Springer, New York, 582pp.
- BJORLYKKE, K., 2010. Petroleum Geoscience: From sedimentary environments to Rock Physics, Springer-Verlag, Heidelberg.
- HUNTT, J.M., 1996. Petroleum geochemistry and Geology. Freeman and Co. New York, 741pp.
- BARNES, J., LISLE, R.T., 2004.. Basic Geological Mapping, 184pp.
- GLUYAS, J., SWARBICK, R. E. 2003. Petroleum Geosciences, Blackwell publishing, 376pp.

Course Name: Petroleum Geophysics 3(2-1)

Course Code: MPG 7102

Course Credit: 3 CU

Course Description
This course deals with the widely used geophysical techniques in petroleum exploration and the principles behind them. Examples of similar studies are used for illustrations.

Course Objectives
At the end of the course the students should be able to:

- Choose and use appropriate geophysical techniques during petroleum exploration.
- Analyze and interpret geophysical data.

Course Content	Contact Hours
Types of geophysical techniques: Gravity, magnetic, electrical and seismic. Geological meaning of geophysical anomalies (anomaly-lithology relationship and relevant rock properties). Forms of rock bodies encountered in petroleum exploration.	15
Gravity Surveys: Principles. Data processing and survey design. Data display and anomaly enhancement.	15
Magnetic surveys: Principles. Data processing and survey design. Data display and anomaly enhancement.	15
Sesimic surveys: Seismic reflection. Seismic refraction. Data acquisition and survey design. Data processing and imaging. Deconvolution and velocity modeling. Seismic signal and seismic noise. Signal extraction and interpretation. Seismic amplitude variation as a function of offset.	15

Mode of delivery

The course will be lecture-oriented with assignments, field classes and practicals.

Assessment

Assignments, field classes, practicals and tests	40%
Final examination	60%

Available staff	Status
Dr. J.M. Kiberu	Full time

Reading List

- AVSETH, P., MUKERJI, T., MAVKO, G. 2005. Quantitative Seismic Interpretation. Camridge Press.
- Nettleton, L.L. 1976. Gravity and Magnetics in Oil Prospecting, McGraw-Hill, New York, 464pp.
- MUSSET, A.E., KHAN, M.A., 2000. Looking into the Earth: An Introduction to Geological Geophysics, Cambridge University Press, Cambridge, 470pp.
- CLAERBOUT, J.F., 1995. Imaging the Earth's Interior. Blackwell Scientific Publications Verlag.
- KEAREY, P., BROOKS, M., HILL, I.2002. An Introduction to Geophysical Exploration, 3rd ed., Blackwell Science, Oxford, 262.

BURGER, H. R. (1992). Exploration Geophysics of the Shallow Subsurface, Prentice Hall P T R.
- ROBINSON, E. S., and CORUH, C. (1988). Basic Exploration Geophysics, John Wiley.
- TELFORD, W. M., GELDART, L. P. & SHERIFF, R. E., (1990). Applied Geophysics, 2nd edn Cambridge University Press.

Course Name: Principles and practices of petroleum geochemistry 2(1-1)

Course Code: MPG 7103

Course Credit: 2 CU

Course Description

This course emphasizes applications of geochemistry in petroleum exploration and production. Modeling of geochemical data and case studies are also covered.

Course Objectives

At the end of the course the students should be able to:

- Use geochemical methods in petroleum exploration and production
- Identify source rocks, reservoir rocks, structures based on geochemical anomalies.
- Model geochemical data and correlate them with other geosciences data.

Course Content

Content	Contact Hours
Introduction – Definition and applications of petroleum geochemistry	4
Geochemical methods – Hydrogeochemical. Soil hydrocarbon gas. Microbe. Soil salts. Radioactivity. Fluorescence. TOC	10
Hydrocarbon generation and accumulation - Geological constraints. Geochemical constraints.	10
Geochemical correlation, inversion and modeling	8
Reservoir geochemistry – Its role in petroleum exploitation and development.	8
Case studies	5

Mode of delivery

The course will be lecture-oriented with assignments, field classes and practicals.

Assessment

Assignments, field classes, practicals and tests	40%
Final examination	60%

Available staff	Status
Dr. A. Muwanga	Full time

Reading List

- CLUFF, R. M., & BARROWS, M. H., (1982). Hydrocarbon Generation and Source Rock Evaluation (Origin of Petroleum Petroleum III). American Association of Petroleum Geologists, reprint series no. 24, 215p.
- CUBITT, J. M., & ENGLAND, W. A., (1995). The geochemistry of Reservoirs. The Geological Society Special Publication no. 86, 312p.
- HUNT, J. M., (1996). Petroleum Geochemistry and Geology (2nd Ed). W.H. Freeman and Company, 743p.
- JENNIFFER , A. M., (1989). Illustrated glossary of Petroleum Geochemistry. Oxford Science Publications.
- MAGOON, L. B., & DOW, W. G., (1994). The Petroleum System- From Source to Trap. A.A.P.G. Memoir 60, p3-24, Tulsa, OK.
- PETERS, K. E., WALTERS, C. C., & MOLDOWAN, J. M., (2005). The Biomarker Guide (2nd Ed.). Cambridge University Press (Volume 1 and 2). Source to Trap. AAPG Memoir 60.

- SCHUMACHER, D., & ABRAMSB, M. A., (1996). Hydrocarbon Migration and its Near-Surface Expression. AAPG memoir 66.
- TISSOT, B. P., & WELTE, D. H., (1984). Petroleum Formation and Occurrence (2^{nd} Ed). Springler-Verlag, 699p.
- TYSON, R. V., (1995). Sedimentary Organic Matter, Organic and Palynofacies. Chapman and Hall.

Course Name: Sequence Stratigraphy 3(2-1)

Course Code: MPG 7104

Course Credit: 3 CU

Course Description
This course covers the use of seismic reflection data to study and identify lithology and depositional history of sedimentary bodies. It also deals with factors affecting resolution and velocity of seismic waves.

Course Objectives
At the end of the course the students should be able to:
- Apply the basic concepts in sequence stratigraphy during petroleum exploration in different environments.
- Integrate surface (outcrops) and subsurface (cores, well logs and seismic) data.
- Identify depositional sequences, source rocks and reservoir rocks in a sedimentary basin.

Course Content	Contact Hours
Terminology. Basic concepts.	5
Stratigraphic building blocks of depositional sequences	15
Criteria for the identification of depositional sequences. Importance of outcrops, cores, well logs and seismics.	20
Applications - In non-marine, shallow marine and marine settings	20

Mode of delivery
The course will be lecture-oriented with assignments, field classes and practicals.

Assessment

Assignments, field classes, practicals and tests	40%
Final examination	60%

Available staff	Status
Prof. G. Mangerud	Part time

Reading List

- BEST, J. L. & ASHWORTH, P. J., (1997). Scour in large braided rivers and the recognition of sequence stratigraphic boundaries. Nature, 387, p275-277.
- ABDUL, A., BOHME, M., ROCHOLL, A., ZWING, A. PRIETO, J., WIJBRANS, J. R., HEISSIG, K. & BACHTADSE, V., Integrated Stratigraphy and 40Ar/39Ar chronology of the

Early to Middle Miocene Upper Fresh water molasse in Eastern Bavaria, Germany, Springer. Inter. Jour. Earth Sci., Geol Rundsch 2008, 97, p115-134.

- KING, R., (1992). Stratigraphic oil and gas fields: classification, exploration methods and case histries.
- WEIMER, P., POSAMENTER, H. W., (1993). Siliciclastic sequence stratigraphy.

Course Name: Environment, Health and Safety aspects of Petroleum Exploration and Production 2(2-0)

Course Code: MPG 7105

Credit: 3 CU

Course Description

This course covers the best practices regarding environment, health and safety which when adequately implemented can reduce negative impacts of petroleum exploration and production. It includes EHS guidelines of petroleum exploration and production onshore and offshore, international environmental standards in the oil industry, the Environmental Legislation of Uganda, EHS programmes in the Albertine graben.

Course objectives

At the end of the course the students should be able to:

- Follow the set EHS guidelines during petroleum exploration and production in specific areas.
- Safely carry out petroleum exploration and production activities with minimum impact to the environment and/or communities.
- Apply the EHS best practices during petroleum exploration and production as recommended by a particular country.

Course Content	**Contact Hours**
EHS guidelines for petroleum explorationand production onshore and offshore: Introduction. Environmental issues (Air emissions, waste water, solid and liquid waste management, noise generation, terrestrial impacts and project footprint, spills). Occupational Health and Safety. Community health and safety. Performance indicators.	8
Environmental Best Practices: Environmental and Social impact Assessment. Environmental Management System. Environmental Performance Evaluation. Environmental monitoring and Auditing Environmental and Social Reporting.	7
Safety Requirements during petroleum exploration and production: Safety management plan. Certificate of competence. Availability of information. Emergency Response Procedures. Protective gear. Notices. precautions against fire. Reporting (deaths and serious injury/damage, potentially hazardous and dangerous substances and/or events, emergencies, progress of activity). Notification to drill (eg.blowout prevention control, location, penetration rate).	4
Environmental Legislation of Uganda: The National Environmental Act, The Petroleum Act 2000. The Petroleum Regulations 1993. The National oil and gas policy for Uganda 2008. The mining act 2003.	8

Mining Regulations 2004.	
EHS programmes in the Albertine graben: UWA protected areas, communities, lake areas.	3

Mode of delivery
The course will be lecture-oriented with assignments and class presentations.

Assessment

Assignments, seminars, class presentations and tests	30%
Final examination	70%

Available staff	**Status**
Dr. A. Muwanga	Full time

Reading List

- Colley W. C. (1998). Environmental and Quality systems integration.
- Tullow Oil plc, 2009. Corporate responsibility report.
- National Oil and Gas Policy for Uganda, 2008. Ministry of Energy and Mineral Development.
- Wawryk, A. S. International environmental Standards in the Oil Industry: Improving the Operations of Transnational Oil Companies in Emerging Economies.
- World Bank Group, 2007. Environmental, Health and Safety Guidelines for Onshore Oil and Gas Development.
- World Bank Group, 2007. Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development.
- Rwakafuzi, L. K., 2006. Environmental Legislation of Uganda, vol.1, NEMA, Kampala, Uganda.

Course Name: Depositional Systems 3(2-1)

Course Code: MPG 7106

Course Credit: 3 CU

Course Description
This course deals mainly with carbonate and siliciclastic deposits in common sedimentary environments. Other deposits such as evaporates are also covered.

Course Objectives
At the end of the course the students should be able to:

- Identify the different depositional environments in any sedimentary body.
- Describe the different types of deposits as well as their geometries, characteristics and sedimentary structures.
- Recognize different depositional settings in a given area.

Course Content	**Contact Hours**
Definitions. Types of depositional systems.	5
Origin and classification of sediments. Sedimentary structures. Fluvial deposits and Alluvial fan. Eolian, playa and arroyo	15

deposits. Lacustrine depositional systems.	
Delta systems, cheniers, siliciclstic tidal flats, barriers, strandplains and associated facies. Estuaries and tidal flats.	15
Siliciclastic shelves, submarine fans and deep marine deposits	10
Carbonate formation and carbonate constituents. Diagenesis of carbonates. Modern and ancient carbonate depositional systems.	15

Mode of delivery
The course will be lecture-oriented with assignments, field classes and practicals.

Assessment

Assignments, field classes, practicals and tests	40%
Final examination	60%

Available staff	Status
Dr. I. Ssemmanda	Full time

Reading List

- GALLOWAY, W. E., HOBDAY, D.K., 1996. Terriginous Clastic depositional systems: Applications to fossil fuel and groundwater resources, Springer, New York, 484pp.
- DAVIS, R.A., 1992. Depositional Systems: An introduction to Sedimentology and Stratigraphy, 2nd ed., Prentice Hall, 591pp.
- TUCKER, M.E., WRIGHT, V.P., DICKSON, J.A.D., 1990. Carbonate Sedimentology, Blackwell Science, Oxford, UK, 482pp.

Course Name: Petrophysics and Formation Evaluation 3(2-1)

Course Code: MPG 7107

Course Credit: 3 CU

Course Description
This course covers core and open-hole well log analysis, well logging suites as well as new logging developments with special focus on certain well logging methods.

Course Objectives
At the end of the course the students should be able to:

- Use basic petrophysical logging methods in petroleum exploration.
- Conduct basic log interpretations to determine petrophysical parameters such as lithology, porosity and fluid saturation.
- Evaluate reservoir formations and determine pay intervals/thicknesses based on the integrated interpretations of different well logs.

Course Content	Contact Hours
Introduction to petrophysics. Petrophysical objectives, measurement value, data hierarchy and calibration logic. Basic petrophysical logging methods (nuclear, electrical, acoustic, imaging). Basic log analysis, basic core-log integration.	12
Standard well logging suites. Special logs and interpretation techniques. New logging developments.	8
Porosity- total or effective, gas zones and complex lithologies calibrating porosity. Applications and use of basic SP, gamma ray, porosity and resistivity logs. Lithology and pay thickness identification.	10
Sw-definition, improving inputs (Rt/Ro, Rw, m,n). OBM/WBM core, capillary pressure, magnetic resonance, facies wettability. Calibrating Sw. Shaly sanda- definition, integrating resistivity with non resistivity data, NMI/NMR/Pc.	10
Fluid contacts and capillary pressure. The reservoir master equation. Permeability- rock types, NMR, conventional logs, bound fluid volume, coates permeability, well tests, producibility, the Sw decision tree, useful simulations.	10
Netpay (definition and evaluation). Seismic-petrophysical work flow, fluid substitutions. Recommendations for drilling, coring and logging, evaluation templates. Systematic errors.	10

Mode of delivery

The course will be lecture-oriented with assignments, field classes and practicals.

Assessment

Assignments, field classes, practicals and tests	40%
Final examination	60%

Available staff	Status
Dr. J.M. Kiberu	Full time

Reading List

- MORAN, J. H., & GIANZERO, S. "Effects of Formation Anisotropy on Resistivity
- Logging Measurements." *Geophysics* 44 (1978): 1266–1286.
- THOMAS, E. C., & STEIBER, S. J. "The Distribution of Shales in Sandstones and its Effect Upon Porosity." *Transactions of the 16th Annual SPWLA Logging Symposium*, 1975, paper T.
- CLAVIER, C., COATES, G., & DUMANOIR, J. L. "The Theoretical and Experimental basis for the 'Dual Water' Model for the Interpretation of Shaly Sands." *Society of Petroleum Engineers Journal*, April 1984: 153–167.

- JUHASZ, I. The Central Role of Qv and Formation Water Salinity in the Evaluation of Shaly Formations. Paper presented at the Society of Professional WellLog Analysts 19th Annual Symposium, June 1979.

Course Name: Field Course 3(0-3)

Course Code: MPG 7108

Course Credit: 3 CU

Course description
This course introduces students to various aspects in the field including discussions at outcrops, taking measurements, sampling, making field notes and sketches/photographs, presentations and writing of field reports.

Course Objectives
At the end of the course the students should be able to:
- Hold meaningful discussions and make good field notes and measurements in the field.
- Carry out field work with minimum supervision.
- Carry out laboratory analysis and data interpretation.
- Write good field reports.

Course Content

Content	**Contact Hours**
Outcrops: Discussions, measurements, logging, sketches/photographs, field notes.	40
Presentations: Lithology, structures (minor and major), stratigraphy, elements of the petroleum system, sedimentology, facies scheme, depositional environments, palaeogeography, correlations, depositional and sequence stratigraphic history.	40
Field report.	40

Mode of delivery
The course will involve various academic staff having a lot of discussions in different aspects with students carrying out measurements and sampling of outcrops.

Assessment

Fieldwork	40%
Field Report	60%

Available staff	**Status**
Prof. W. Helland-Hansen	Part time

Reading list

- Tucker, M. 2003. Sedimentary Rocks in the field, 2nd ed.,288 pp.

- Fry, N., The Field description of Metamorphic rocks, 128 pp.
- Thorpe, R. Brown, G., The Field description of Igneous rocks, 160 pp.

Course Name: Applied biostratigraphy and chronostratigraphy 3(2-1)

Course Code: MPG 7201

Course Credit: 3 CU

Course description

This course introduces applied biostratigraphic and isotope methods. It covers age determination, stratigraphic correlation, interpretation of depositional environments and presentation of palaeontological data. Requirements of sample selection and strengths and weaknesses of the methods.

Course Objectives

At the end of the course the students should be able to:

- Select appropriate biostratigraphic and isotope methods in petroleum exploration.
- Determine both relative and absolute ages of geologic samples.
- Correlate different geologic formations using biostratigraphic data.

Course Content

Content	Contact Hours
Introduction to the application of biostratigraphy. Paleobathymetry and paleoenvironments.	20
Biostratigraphic methods and programme planning. Data integration and sequence stratigraphy. Quantitative methods of biostratigraphic correlation	20
Basics of age determination and theory of radioactivity. Isochron methods e.g., The U-Pb system. Fission-track dating. $^{40}Ar/^{39}Ar$ dating.	20

Mode of delivery

The course will be lecture-oriented with assignments, field classes and practicals.

Assessment

Assignments, field classes, practicals and tests	40%
Final examination	60%

Available staff	Status
Prof. G. Mangerud	Part time

Reading List

- BROOKFIELD, M. E., 2004. Priciples of stratigraphy, Blackwell Publishing Ltd, Oxford UK, 340p.

- MATTHEWS, R. K., 1984. Dynamic Stratigraphy, Prentice Hall, Englewood Cliffs, New Jersey, 489p.

Course Name: Basin Analysis 2(1-1)

Course Code: MPG 7202

Course Credit: 3 CU

Course description

This course looks at various properties of the rocks/sediments and how the evolution of sedimentary basins can be quantitatively modeled using predictive tools on the timing, depth and location of potential traps, seals and hydrocarbon occurrence.

Course Objectives

At the end of the course the students should be able to:

- Describe the properties of sediments and/or rocks in sedimentary basins.
- Quatitatively model the evolution of sedimentary basins.
- Locate potential traps for hydrocarbons in sedimentary basins.

Course Content

Course Content	**Contact Hours**
Definition of basin analysis and sedimentary basin. Fourier Series/Transforms. Rheological properties of the lithosphere. Lithospheric flexure.	15
Potential field theory (gravity/geoid). Isostasy. Temperature structure of the lithosphere.	15
Lithospheric extension and compression. Isolating the tectonic subsidence of basins.	15

Mode of delivery

The course will be lecture-oriented with assignments and seminar presentions.

Assessment

Assignments, seminars and tests	30%
Final examination	70%

Available staff	**Status**
Prof. Bjorlykke	Part time

Reading List

- SPENSER, A. M.,(ed) (1991). Generation, accumulation and production of Europe's hydrocarbons. Special publication of the European Association of Petroleum Geoscientists, Publication 1, Oxford University Press, Oxford, UK.
- NAETH, J., DI PRIMIO, R., HORSFIELD, B., SCHAEFER, R. G., SHANNON, P. M., BAILEY, W. R., & HENRIET, J. P., (2005). Hydrocarbon seepage and carbonate mound

formation: A basin modeling study from the porcupine basin (offshore Ireland). J. Pet. Geol. 28 (2): 43-62.

- CROKER, P. F., SHANNON, P. M. (1987). The evolution and Hydrocarbon prospectivity of the Porcupine Basin, offshore Ireland. In:Brooks J., Glennie, K., Petroleum Geology of NW Europe. Grahm and Trotman, London, pp 633-642.
- SCHMITZ, T. & JOKAT, W. (2007) Amplitude versus offset analyses of the deep sedimentary structures at the northern flank of the Porcupine Basin SW of Ireland. Springer, Int. Jour. Earth Sci (Geol Rundsch) 96, p171-184.
- HALBOUTY, M. T. (ed). Giant oil and gas fields of the decade 1978-1988. AAPG memoir, vol. 54. Springer, Tulsa.
- PHILIP A. ALLEN AND JOHN R. ALLEN., 1990. Basin analysis; *Principles and applications.* Blaackwell science Ltd. 309-417.
- MYRA, K, MCCLAY, K.R., 1996: Analogue modelling of multiphase rift systems, *Tectonophysics* 273 (1997), p. 239-270
- SCHLISCHE, R.W., 1991: Half-graben basin filling models: New constraints on continental extensional basin evolution. *Basin Research*, vol. 3, p.123-141.
- SCHLISCHE, R, W AND OLSEN, P.E, 1990: Quantitative filling models for continental extensional basins with applications to early Mesozoic rifts of eastern North America: *Journal of Geology*, v. 98, p.135-155.
- RUSSELL, L.R AND SNELSON, S., 1994: Structure and tectonics of the Albuquerque Basin segment of the Rio Grande rift: Insights from reflection seismic data. In Basins of the Rio Grand Rift: Structure, Stratigraphy, and Tectonic Setting, eds G. R. Keller and S. M.Cathere, p. 83-112. Boulder Colorado, 291.

Course Name: Petroleum Structural geology 3(2-1)
Course Code: MPG 7203

Course Credit: 3 CU

Course description

This course covers fundamentals of structural geology in general and in the context of petroleum exploration and production. It will include geologic map interpretation; faults and folds systems; properties of fractures and fracture networks, fractured reservoir analysis, rift history analysis and cross-section construction.

Course Objectives

At the end of the course the students should be able to:

- Determine the type of structures and the tectonic setting of a given petroleum field.
- Develop a 3D picture of a reservoir in any area of interest.
- Assess the impact of subsurface fractures on the flow of petroleum in a reservoir.

Course Content

Content	Contact Hours
Geologic map interpretation: lithology, structures. Cross-Section construction	10
Stress, brittle failure, fluid-induced failure. Fault and fold system classification based on tectonic setting, geometric analysis of faults and folds, fault system evolution, fault seal.	20
Rift History analysis: Tectonic events in the Albertine Graben and the EARS.	10
Fractured reservoir analysis: prediction of subsurface fractures in reservoirs, impact of fractures on flow, modeling of fracture networks in reservoirs.	20

Mode of delivery
The course will be lecture-oriented with assignments, field classes and practicals.

Assessment

Assignments, field classes, practicals and tests	40%
Final examination	60%

Available staff	Status
Dr. J.V. Tiberindwa	Full time

Reading List

- COLLINSON & THOMSON, D. B., (1987). Sedimentary Structures.
- DAVIS, G. H., (1984). Structural Geology of Rocks and Regions. John Wiley & Sons, New York.
- PARK, R. G. (2001). Foundations of Structural Geology. 3rd ed. Nelson Thornes, Cheltenham, UK, 202p.
- PHILLIPS, F. C. (1971). The use of Stratigraphic Projection in Structural Geology. 3rd Ed. Edward Arnold Ltd. 87p.
- RAMSAY (1967). Folding and fracturing of rocks. MacGraw Hill.
- GROSHONG, R.H. 1999. 3D Structural Geology. A Practical Guide to Surface and Subsurface interpretation, Springer, New York, 324pp.
- MCCLAY, K.R., 2004. The Mapping of Geological Structures, John Wiley and Sons, 224pp.

Course Name: Production and Reservoir Monitoring 3(2-1)

Course Code: MPG 7204

Course Credit: 3 CU

Course description

This course introduces the different methods that can be used to monitor the reservoir and production of petroleum using special tools in order to minimize risks and maximize production.

Course Objectives

At the end of the course the students should be able to:

- Use appropriate tools for the production and reservoir monitoring.
- Interpret production and reservoir monitoring logs.

Course Content	**Contact Hours**
Type of data, setup and maintenance. Fluid migration through casing-formation annulus. Causes of casing damage and leaks. Production logging tools and principles.	10
Flowmeters. Apparent flow and type of perforation gun. Recognition of vertical flow. Bubble counter techniques. Temperature tools and identification of flow behind the casing. Gradiomanometer, fluid density tools and their application. Water Hold-up meters.	10
Calipers. Gamma-ray and spectral-ray identification of NORM. effect of deviation on production logging tools. Mono and Multiphase flow analysis. Porosity and water saturation.	10
Relations between reservoir parameters and seismic parameters. Requirements for acquisition of time lapse seismic data. Processing of time lapse seismic data. Repeatability and matching. What can change in addition to reservoir changes? Relation between repeated well logs and repeated seismic data. Coupling to fluid flow simulation. Differencing techniques. Use of seabed seismic data for reservoir monitoring. Techniques for time shift estimation and determination of changes in pay thickness. Monitoring of fluid movements. Methods for discrimination between pressure and fluid saturation effects. How to estimate compaction changes in a reservoir. Field examples.	20
Time lapse monitoring of gas-oil and oil-water contacts and water saturation. Identification of oil and gas by-pass and presence and speed of water flow behind the casing. Problems with horizontal wells. Selecting the right tools.	10

Mode of delivery

The course will be lecture-oriented with assignments, field classes and practicals.

Assessment

Assignments, field classes, practicals and tests	40%
Final examination	60%

Available staff	**Status**
Prof. Tor Arne Johansen	Part time

Reading List

- ECONOMIDES, M. J., HILL, D. A. & EHLIG-ECONOMIDES, C., 1993. Petroleum Production Systems, Prentice Hall Petroleum Engineering Series.
- DAKE, L. P. (2004). The Practice of Reservoir Engineering, Elsevier.
- THOMAS, G. W., 1981. Principles of Hydrocarbon Reservoir Simulation, Prentice Hall, 207p.

Course Name: Research Methods 2(1-1)

Course Code: MPG 7205

Course Credit: 2

Course Description

This course outlines the different methods employed in geosciences research including GIS and elementary statistics. The student learns to write a research proposal, to collect data at various stages (during desk study, field work, laboratory analysis) and presentation of data. The course also covers preparation for fieldwork, time management during research/project and selection of appropriate methods and area of study.

Course Objectives

At the end of the course the students will be able to:

- Write a research proposal.
- Assess previous work from literature and identify research needs.
- Plan their work taking into account the risks, costs and the required time.
- Choose researchable topics and identify appropriate methods for geosciences research.
- Collect, analyze, interpret and process geoscientific data.
- Effectively communicate the research findings.

Course Content

Content	**Contact Hours**
Introduction Research facilities in the department. Safety protocols at Makerere University. Basic safety. Planning, costing and safety assessment during geosciences research.	3

Areas of Geosciences research Structural geology, stratigraphy and mapping, sedimentology, hydrogeology, engineering geology, geochemistry, petrology, environmental geology, geophysics, palaeontology, petroleum etc.	2
Proposal writing Desk Study/Literature search. Choosing a researchable topic. field work preparation and time management.	5
Field work Depends on the research area and involves both reconnaissance and detailed field work e.g. **Geophysics:** Target identification (minerals, water, hydrocarbons etc). Survey plan (profile/grid). Gravity, magnetic, resistivity, electromagnetic and seisimic methods. **Structural geology and geologic mapping:** rock sampling, structural measurements. **Geochemistry:** Sample type (eg.,Water, rock, soil, sediment, HC etc). Sampling methods. Sample storage and preservation.	10
Laboratory work ***Type of Analysis:*** Depending on the research area and objectives of the research the samples may be subjected to microscopic studies, geochemical analysis (qualitative and/or quantitative, semi-quatitative, isotope), physical and chemical properties determination. ***Laboratory methods and techniques:*** Petrographich, Geochemical, Geophysical.	10
Data Analysis and Presentation ***Data analysis*:** Specialized packages/programmes for Geosciences data analysis. Presentation: in form of Seminars, publications, reports, posters, dissertation.	10
GIS methods of research Identification of fields and objects. Data collection and entry, data analysis and presentation	5

Mode of delivery

The course is lecture-oriented with assignments, oral presentations and practicals.

Assessment

Assignments, tests, oral presentations and practicals	40%
Examination	60%

Available staff	**Status**
Dr. M. Owor	Full time

Reading List

The reading list will include but not limited to the following:

- GILL, R., 1997. Electron beam methods. In: Modern analytical geochemistry:An introduction to quantitative chemical analysis techniques for earth, environmental and material sciences, Gill, R. ed. Pp215-234. Addison Wesley Longman, Harlow, England.
- ROLLINSON, H.R., 1993. Using geochemical data: evaluation, presentation, interpretation. 352p. Addison Wesley Longman, Harlow.
- COMPTON R.R. 1962: Manual of field geology. John Wiley and Sons, inc.
- HATCHER R.D. JR. 1995: Structural Geology: principles, concepts, and problems.
- RITCHIE W., WOOD M., WRIGHT R. AND TAIT D. 1988; Surveying and mapping for field scientists. Longman group UK. Ltd.
- DOBRIN, M.B. AND SAVIT, C.H. 1988. Introduction to Geophysical Prospecting, McGraw Hill, 4th Edition.
- GRIFFITHS, D.H AND KING, R.F. 1981. Applied Geophysics for Geologists and Engineers, , Pergamon, Second Edition.
- GELDART, SHERRIF AND KEYS. 1976. Applied Geophysics, Telford, Cambridge University Press.
- KEAREY AND BROOKS. 1984. Introduction to Geophysical Exploration, , Blackwell
- WORTHINGTON, P. F. “The Evolution of Shaly Sand Concepts in Reservoir Evaluation.” *The Log Analyst*, January–February 1985: 23.

Course Name: Seismic Reservoir Characterization 3(2-1)

Course Code: MPG 7206

Course Credit: 3 CU

Course description

This course deals with integration of seismic data obtained from a broad range of case studies. These data can be modelled and used to predict reservoir properties including lithology and pore pressure.

Course Objectives

At the end of the course the students should be able to:

- Explain the theory behind rock physics and seismic reservoir characterization.
- Apply fundamental techniques and construct data used in seismic reservoir characterization (SRC).
- Carry out SRC studies whenever necessary.
- Explain the role of rock physics in reservoir characterization.

Course Content

Content	Contact Hours
Introduction: Methods used and scale issues. Integration of data.	5
Theory of rock physics: Basic rock physics. Main parameters influencing rock elasticity. Saturation effect modelization. Rock physics model. Difference between Gassmann and petroleum modelization.	5
Physics and AVO Principles: why AVO. Waves propagation. Data prerequisites, seismic attributes.	5
Well to seismics calibration: objectives, methods. Recommended wavelet extraction techniques. Real case example (multi-well calibration). Wavelet deconvolution.	10
Interprtation of AVO attributes: Crossplot principles. AVO seismofacies. AVO Class. AVO facies volume.	5
Inversion of seismic data: Inversion methodology (fundametals). Post-stack and prestack inversion. Validating and interpreting inversion results.	10
P- and S-waves in isotropic and anisotropic rocks. Principles for the measurement of acoustic properties in the laboratory. Simple rock physics models, mainly based on the Biot-Gassmann poro-elastic theory and critical porosity. Observed and modelled relations between seismic velocities and porosity, lithology, fluid saturation and mechanical stress/pore pressure. Seismic amplitude as a function of offset (AVO) and angle (AVA). Inversion of seismic data. Reservoir monitoring using repeated seismic measurements. Ocean bottom seismics.	10
Reservoir property prediction: Attribute classification. Techniques of prediction. Validation of characterization results	10

Mode of delivery

The course will be lecture-oriented with assignments, field classes and practicals.

Assessment

Assignments, field classes, practicals and tests	40%
Final examination	60%

Available staff	Status
Prof. Tor Arne Johansen	Part time

Reading list

- VOGELAAR, B. SMEULDERS, D. AND HARRIS, J. (2010). Exact expression for the effective acoustics of patchy-saturated rocks.
- GOLOSHUBIN, G., AND VAN SCHUYVER, C., (2006). Reservoir imaging using low frequencies of seismic reflections. Society of exploration Geophysicists.
- SAENGER,E.H, SCHMALHOLZ,S.M., LAMBERT,M.A., NGUYEN, T. T., A. TORRES, A., METZGER, S., HABIGER, R.M., MULLER,T., S. RENTSCH, S., AND E. MENDEZ-HERNANDEZ, E., (2009). A passive seismic survey over a gas field: Analysis of low-frequency anomalies.
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  PER AUSETH, MUKERJI, T. AND GARY MAVKO, G., (2005). Quantitative seismic interpretation. Cambrige university press.
- ROWAN,M.G, Royklgfield (1989). Cross section restoration and balancing as aid to seismic interpretation in extensional terranes.
- ADLER, F., 1999, Robust estimation of dense 3D stacking velocities from automated picking. 61st Mtg Eur. Assoc. Geosci. Eng. (EAGE) Abstract
- AKI, K., AND RICHARDS, P. G., 1980, *Quantitative Seismology: Theory and Methods*. San Francisco: W. H. Freeman and Co
- AL-CHALABI, M., AND ROSENKRANZ, P. L., 2002, Velocity–depth and time–depth relationships for a decompacted uplifted unit. Geophys. Prospecting, 50, 661–664
- ALLEN, J. L., AND PEDDY, C. P., 1993, *Amplitude Variation with Offset: Gulf Coast Case Studies*. Geophysical Development Series, Vol. 4, Soc. Expl. Geophys
- ANSELMETTI, F. S., AND EBERLI, G. P., 1997, Sonic velocity in carbonate sediments and rocks. In *Carbonate Seismology* (ed. Palaz, I. and Marfurt, K. J.), 53–75, Soc. Expl. Geophys
- AVSETH, P., 2000, Combining rock physics and sedimentology for seismic reservoir characterization of North Sea turbidite systems. Unpublished Ph.D. thesis, Stanford University
- AVSETH, P., AND MUKERJI, T., 2002, Seismic lithofacies classification from well logs using statistical rock physics. Petrophysics, 43, 70–81

Course Name: Geological Development of the East African Rift System 3(3-0)

Course Code: MPG 7207

Course Credit: 3 CU

Course description

This course covers plate tectonics in general and in relation to specific examples in the world, Africa and East Africa. It will cover the East African Rift System in detail.

Course Objectives

At the end of the course the students should be able to:

- Describe the tectonic activity in East Africa.
- Determine the sedimentary basins in the region.
- Identify areas with the petroleum potential within the EARS.

Course Content

Content	Contact Hours
Principles of Plate tectonics	5
Types of rifting and continental margin evolution, plate rotations, plumes and plate-boundary types	10
Regional stratigraphic, plate framework and tectonic regime. Regional structural elements and complexities	10
Regional examples of sedimentary basin origin and evolution. Petroleum potential in East Africa.	10
Tectonics of the East African Rift System	10

Mode of delivery

The course will be lecture-oriented with assignments.

Assessment

Assignments and tests	30%
Final examination	70%

Available staff	Status
Dr. E. Barifaijo	Full time

Reading List

- OXBURGH, E.R., TURCOTTE, 1974. Membrane tectonics and the East African Rift, Earth and Planatery Science letters, Vol.22p 133-140.

- ABEINOMUGISHA, D., KASANDE, R. 2009. Tectonic control on Hydrocarbon accumulation in the intra-continental Albertine Graben of the East African Rift System System, presented at AAPG, International Conference and Exhibition, Cape Town, South Africa, 2008.