UNIVERSITÉ DE NEUCHÂTEL

Centre d'hydrogéologie et de géothermie (CHYN)

Continuing education at the University of Neuchâtel

CERTIFICATE OF ADVANCED STUDIES

Exploration & Development of Deep Geothermal Systems – DEEGEOSYS

3rd edition 2015-2016

General programme




v3 – January 2015

Continuing education at the University of Neuchâtel

CAS DEEGEOSYS - Exploration & Development of Deep Geothermal Systems

1. Introduction

NEEDS IN GEOTHERMAL EDUCATION

Since 2009, a new Master's degree of Science in Hydrogeology and Geothermics began at the University of Neuchâtel, organized by the Centre for Hydrogeology and Geothermics. A common-core syllabus covers basic domains in hydrogeology and in geothermics, then the specialization intervenes for the last part.

As specialists are missing for exploration and exploitation of the geothermal reservoirs in Switzerland and Europe, a continuing education programme in deep geothermal systems still corresponds to a real need.

Today, a Certificate of Advanced Studies (CAS DEEGEOSYS) is available at the University of Neuchâtel and presented here. The 1st and 2nd editions took place successfully in 2011-2012, respectively 2013-2014 with more than 20 participants.

OBJECTIVES

This Certificate of Advanced Studies (CAS DEEGEOSYS) is dedicated to train scientists and engineers in several fields of applied geothermics. They will be capable of planning, of setting up and of leading exploration and/or development projects of deep geothermal resources (deep aquifers and Enhanced Geothermal Systems).

2. Organization of the CAS DEEGEOSYS

NAME

Certificate of Advanced Studies (CAS) in Deep Geothermal Systems - DEEGEOSYS.

ORGANIZING INSTITUTION

Centre for Hydrogeology and Geothermics of the University of Neuchâtel, Swiss Laboratory for Geothermics - CREGE.

VENUE

Centre for Hydrogeology and Geothermics, Faculty of Sciences, University of Neuchâtel.

PARTICIPANTS

Earth scientists (geologists, geophysicists, hydrogeologists, geochemists), civil- or energy engineers, having a M.Sc. or an equivalent degree.

TRAINING PROGRAMME

The CAS DEEGEOSYS includes four one-week long modules separated by a two-month break. Each module covers a specific topic.

Module	Topic	ECTS
1	Geothermics and geophysics	2
2	Geochemistry and hydrochemistry	2
3	Drilling and logging	2
4	Reservoir evaluation and production	2
-	Technical report	2

The modules include courses given by international experts, exercises, visits of geothermal installations and exams.

At the end of the course, the participants will be required to write a technical report.

TECHNICAL REPORT

Having followed 4 modules, the participants draft in a personal way a report on one of the themes studied during the CAS, supervised by one of the teachers. This technical report should take approximately 60 working hours and must be validated by the responsible teacher and the management of the CAS.

CREDITS ECTS (EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM)

The CAS DEEGEOSYS totalizes 10 ECTS: 2 ECTS per module (courses, exercises, examinations, technical visits) and 2 ECTS for the technical report.

CERTIFICATE

To be granted the certificate of the CAS, the participants have to achieve successfully the 4 modules, the exams and the technical report.

FEES

The fees include registration, administration, course material, social events and all activities during the modules, as well as the tutorial during the personal work (technical report).

Fee	Amount (CHF)
Application (no refund)	200
Administration	200
Four modules	4’400
Technical report	1’100
Grand total	**5’900**

The fees do not include transportation to and from Neuchâtel, accommodation and meals during the modules.

On inquiry and if there is enough place, participants who do not wish to follow the whole CAS, or to realize the technical report, can register separately for 1, 2 or 3 modules.

Fee to follow a single module (application and administration included): 1'400 CHF.

SCHEDULE

The first edition of the CAS DEEGEOSYS will start in September 2015.

Activity	Dates
Module 1	September 7 - 11, 2015
Module 2	November 9 - 13, 2015
Module 3	January 11 - 15, 2016
Module 4	March 14 - 18, 2016
Technical report deadline	May 30, 2016

FREQUENCY

Annual to biennial: the training programme of the CAS must be completed within a single edition; on inquiry and by exceptional dispensation, it could be followed on two editions.

ATTENDANCE

The maximum number of participants is limited to 20, in order to facilitate the relations between the teachers and the participants, as well as the exercises in the computer room.

LANGUAGE

The language of the CAS is English (lectures, hand-outs, exams, technical report).

The technical report at the end of course must be written in English, but on request, French or German are potentially possible.

LECTURERS

Main teachers: 6 to 7 international experts coming from various research institutes and/or from private companies from France, Iceland, Italy and Switzerland, give most lectures of the modules.

Additional teachers: 4 to 5 lecturers from Swiss laboratories and universities, teach some specific topics.

RULES

A separate document details all the aspects of the teaching and the rules of the continuing education at the University of Neuchâtel.

ORGANIZATION

Laboratory for Geothermics – CREGE
Centre of Hydrogeology and Geothermics – CHYN, University of Neuchâtel, Switzerland
Coordinator: Dr. François-D. Vuataz

DIRECTION OF THE COURSE

- Prof. Steve Miller (director of the CAS), CHYN, Univ. of Neuchâtel
- Prof. Benoît Valley, CHYN, Univ. of Neuchâtel
- Dr. François-D. Vuataz (coordinator of the CAS), CHYN, Univ. of Neuchâtel

SCIENTIFIC COMMITTEE

A scientific committee will validate the structure and the contents of the modules and the programme of the CAS:

- Prof. Pierre Perrochet, CHYN, Univ. of Neuchâtel
- Dr Laurent Tacher, Terreplus Sàrl (Bevaix) et EPF-Lausanne

INFORMATION AND REGISTRATION

University of Neuchâtel
Laboratory for Geothermics - CREGE
Secretary: Mrs. Sabine Erb
e-mail: sabine.erb@unine.ch
T +41 32 718 26 00
More information and registration form on : <www2.unine.ch/foco/CAS-DEEGEOSYS>

ADDRESS

Laboratory for Geothermics - CREGE
CHYN - University of Neuchâtel
Rue Emile-Argand 11
CH-2000 Neuchâtel, Switzerland

LIST OF THE LECTURERS

Dr. Miklos Antics GPC Instrumentation Process Paris Nord II, Immeuble Business Park, Bât. 4A 165, rue de la Belle Etoile - B.P. 55030 F-95946 Roissy CDG Cedex, France m.antics@geoproduction.fr <www.gpc-france.com>	**Dr. Albert Genter** ES Géothermie 3A chemin du Gaz F-67500 Haguenau, France albert.genter@es-groupe.fr <www.es-geothermie.fr>
Dr. Luigi Marini Consultant in Applied Geochemistry via Antonio Fratti, 253 I-55049 Viareggio (LU), Italy luigimarini@rocketmail.com <www.appliedgeochemistry.it>	**Prof. Steve Miller** Laboratoire de Géothermie - CREGE c/o CHYN, Univ. de Neuchâtel Rue E.-Argand 11 CH-2000 Neuchâtel, Suisse Steve.miller@unine.ch <www.unine.ch/chyn>
Sverrir Thorhallson Iceland GeoSurvey Department Geothermal Engineering Grensásvegur 9 - 108 Reykjavík, Iceland s@isor.is <www.geothermal.is>	**Pierre Ungemach** GPC Instrumentation Process Paris Nord II, Immeuble Business Park, Bât. 4A 165, rue de la Belle Etoile - B.P. 55030 F-95946 Roissy CDG Cedex, France pierre.ungemach@geoproduction.fr <www.gpc-france.com>
Prof. Benoît Valley Laboratoire de Géothermie - CREGE c/o CHYN, Univ. de Neuchâtel Rue E.-Argand 11 CH-2000 Neuchâtel, Suisse Benoit.valley@unine.ch <www.unine.ch/chyn>	**Hansruedi Fisch** Axpo Power AG | Neue Energien Flughofstrasse 54 CH-8152 Glattbrugg hansruedi.fisch@axpo.com <www.axpo.com>
Dr. François-D. Vuataz Laboratoire de Géothermie - CREGE c/o CHYN, Univ. de Neuchâtel Rue E.-Argand 11 CH-2000 Neuchâtel, Suisse francois.vuataz@unine.ch <www.unine.ch/chyn>	**Dr. Christoph Wanner** University of Bern Institute of Geological Sciences Baltzerstrasse 3 CH-3012 Bern, Suisse christoph.wanner@geo.unibe.ch <www.geo.unibe.ch/rwi>

3. Preliminary courses plan

The preliminary course plan and the list of the lecturers are still submitted to possible changes.

Module 1 Geothermics & Geophysics - September 7 - 11, 2015

Date **Location**	**Themes**	**Lecturer**
Monday	Welcome and introduction of the CAS DEEGEOSYS Generalities, theoretical bases of geothermics	CAS direction Steve Miller
	World geothermal use, situation in Europe and Switzerland Exploration concept of deep reservoirs	Steve Miller
Tuesday	Heat production, district heating systems Energy conversion, electricity production, power plants Economic aspects of geothermal installations; environmental and societal aspects of geothermal installations	Steve Miller
	Practical exercises on computer	
Wednesday	Exploration : Geophysical methods (thermal, seismic)	Steve Miller
	Exploration : Geophysical methods (seismic, gravity)	
Thursday	Exploration : Geological and geophysical methods for the development of conceptual models; 3D modelling: data, methods and softwares	Albert Genter
	Exploration : Fracture network and 3D models at Soultz	
Friday	Trip to Soultz-sous-Forêts/Rittershoffen, Alsace, France Presentation of the Soultz/Rittershoffen EGS project	Albert Genter
	Visit of the Soultz/Rittershoffen EGS power plant	

Module 2 – Geochemistry & Hydrochemistry - November 9 - 13, 2015

Date **Location**	**Themes**	**Lecturer**
Monday	Welcome and introduction of the Module 2 Fluid and mineral geochemistry, basics of thermodynamics, geochemistry of rocks and secondary minerals	CAS direction Luigi Marini
	Exploration : Fluid geochemistry, origin of solutes, and water types Exploration : Fluid data interpretation, gas geochemistry	Luigi Marini
Tuesday	Exploration : Isotope geochemistry Exploration : Field surveys, sampling and measurements	Luigi Marini
	Reactive transport modelling of fluid-rock interactions	Christoph Wanner
Wednesday Computer room	Exploration : Soil gas survey Exploration : Analyses, data quality and presentation Exploration : Chemical geothermometers	Luigi Marini
	Exercises on various geochemical problems (on PC)	Luigi Marini
Thursday	Exploration : Chemical and isotopic geothermometers Geochemical modelling of fluid-rock interactions	Luigi Marini
	Case histories in high and low temperature systems Scaling and corrosion in geothermal installations	Luigi Marini F.-D. Vuataz
Friday Computer room	Exercises on geochemical modelling (on PC)	Luigi Marini
	Written examination of the Modules 1 & 2	CAS direction

Module 3 – Drilling & Logging - January 11 - 15, 2016

Date **Location**	**Themes**	**Lecturer**
Monday	Welcome and introduction of the Module 3 Generalities, basics of drilling technology Concept of exploration drilling	CAS direction Sverrir Thorhallsson
	Drilling platform, rig types, waste handling, cementing Wells targeting, directional drilling	Sverrir Thorhallsson
Tuesday	Drilling for high temperature reservoirs Design and completion for exploration and exploitation wells	Sverrir Thorhallsson
	Drilling cost and cost control, progress of the technology Use of drilling reports to assess the reservoir formation	Sverrir Thorhallsson
Wednesday	Measurements while drilling (MWD), geo-monitoring parameters during drilling Safety questions, drilling incidents	Sverrir Thorhallsson
	Borehole logging	Benoît Valley
Thursday Travel Lectures at the hotel	Departure for XXX drilling site (Paris basin or Munich basin)	By bus
	Arrival at the hotel YYY Drilling of geothermal doublets in sedimentary reservoirs Drilling in dense urban environments Environmental impact and assessment of deep boreholes Night at the hotel YYY	 Pierre Ungemach
Friday Travel	Presentation of the geothermal project XXX Visit of the XXX drilling site Return to Neuchâtel	Pierre Ungemach

Module 4 – Reservoir evaluation & Production - March 14 - 18, 2016

Date Location	**Themes**	**Lecturer**
Monday	Welcome and introduction of the Module 4 Introduction to reservoir engineering Pumping technology	CAS direction Miklos Antics
	Equipment performance Monitoring programme, maintenance and life-time	Miklos Antics
Tuesday	Injection and production tests Effects of continuous fluid injection	Miklos Antics
	Simulation of reservoir exploitation	Miklos Antics
Wednesday	Reservoir stimulation I : Chemical methods Stimulation in carbonate reservoirs Economy and sustainable exploitation of deep reservoirs	Miklos Antics
	Case history of the Dogger reservoir of the Paris Basin Case history of Larderello geothermal field Methods in geothermal well testing (pumping, equipment) Design of hydraulic testing, examples	Miklos Antics Hansruedi Fisch
Thursday	Reservoir stimulation II : Hydraulic methods and induced seismicity Rock mechanics and tectonics Introduction to hydraulic stimulation Oil & gas industry best practice experience	Steve Miller
	Introduction to induced seismicity Earthquakes and tectonics Induced seismicity and Enhanced Geothermal Systems Lessons learned and future directions	Steve Miller
Friday	Written evaluation of Modules 3 + 4	CAS direction
	Closing ceremony	

Technical report – Delivery date: May 30, 2016

Writing of the technical report by the participants	Supervision by the lecturers and the CAS direction

DEADLINE FOR REGISTRATION

>>> June 15, 2015.

This document and the registration form can be downloaded at :

http://www2.unine.ch/foco/CAS-DEEGEOSYS