

12th May 2006



ENGINE COORDINATION ACTION

Minutes of the 3rd WP3/WP6 Meeting 28/04/2006, Potsdam (Germany)

Contents

1. Formalities (Welcome/Apologies/Attendance)
2. Schedule of work package, as proposed in the e-mail of February 27, 2006
3. Presentation of the status of activities of each partner
4. Organization of Review Papers
5. Organisation of presentations from WP3 activity to Workshop 1
6. Conclusions
7. Table
8. Structure of contributions

1. Formalities (Welcome/Apologies/Attendance)

Participants: Ledrù, Manzella, Kohl, Lokhorst, Karytsas, Genter, Huenges, Bruhn, Forster, Ruggieri, Orzol, Rummel, Spichak, Rath, Schill, Muller, Lenkey

Apologies from Christian Buecker, Reinhard Jung

The previous WP3 meeting was held during the Launching Conference in Orléans, France. It mainly focussed on the presentation of the partners participating to WP3 and WP6, and on a review of activities and tasks. The minutes of the previous meetings can be found on ENGINE webpage.

Some information in these minutes refers to the ENGINE steering committee held on 27/04/2006 in Potsdam.

2. Schedule of work package, as proposed in the e-mail of February 27, 2006

The following persons were defined as representative of institutions participating to WP3/WP6

BRGM - A. Genter

GFZ - D. Bruhn

ISOR - O. Flovenz

TNO - A. Lokhorst

IGG - A. Manzella

ELTE L. Lenkey

CNRS - Y. Géraud

GGA - J. Orzol

GEIE - A. Gerard

IGGL - S. Slaupia

MeSy - F. Rummel

VUA – **JD vanWees (has been proposed in this meeting. To be checked)**

CRES - D. Mendrinós

PGI - M. Wroblewska

GEMRC - V. Spichak

GEOWATT - T. Kohl

Presentation files are still missing from ISOR, TNO, VUA.

ISOR, TNO, IGGL, VUA, PGI did not fill the table with the name of the persons and expertise related to WP3/WP6.

The deadlines defined in the email of February 27 were remembered: they are related to the list of references (May 30), the exchange of personnel for this first phase of activity (September 30), the draft review papers (October 6), the final review papers (December 1).

WP3/WP6 partners are invited to check and update the Table provided at the end of these Minutes. The e-mail addresses are requested, so that coordinators will be able to contact related partners.

An updated table is requested to all partners by May 30.

By May 12 it is planned to define the speakers representing WP3/WP6 activity in Workshop 1 “Defining, exploring, imaging and assessing reservoirs for potential heat exchange” (WS1). A draft of WS1 organization has been proposed by GFZ which is in charge, together with GGA, to organize the workshop. It was proposed to consider deep geothermal reservoirs at temperature higher than 100°C and $Q > 100 \text{ m}^3/\text{h}$. A draft list of speakers was also proposed, both from research institutions and from industry. The proposed structure is as follows.

Aims: Evaluation of status quo: What works? What doesn't? Where is potential and need for RTD?

Defining: Definition: $>100^\circ\text{C}$, $Q > 100 \text{ m}^3/\text{h}$ (suggestion)

Potential areas EU (Overview paper Genter): Different geological environments, current knowledge

Exploration:

New approach: Seismic/MT => results from I-GET project

Shell (tbd)

ISOR (Flóvenz?)

BRGM (Fabriol)

external expertise needed

ENEL (Bertani?)

RWE (Bücker)

Cross hole monitoring: Norsar (Roth?)

Assessment: rock properties from laboratory to reservoir scale

laboratory (GFZ)

borehole measurements, high T (ISOR)

reservoir characterization (GEUS, A/R.Thomas)

reservoir modelling -> in conjunction to WP4

3. Presentation of the status of activities of each partner

Partners gave a brief presentation of the activity of their institutions in geothermics. BRGM, GFZ, IGG, GGA, CRES, TNO, MeSy, GEOWATT, ELTE, GEMRC, IFE, RWTH and IGeM were represented.

The table at the end of these minutes define the activities and expertise of partners, as received so far.

4. Organization of Review Papers

The WP3 activity, as proposed in the e-mail of April 11, and the organization of Review Papers has been discussed.

Two different kinds of review paper are considered the final goals of 2006. The first one regards geographical area specific contributions, the second one regards methodological contributions, including a methodological description of each partner institution.

The geographical area specific contributions were defined, on the base of participants to WP3/WP6:

1-France, 1-Germany, 1-Iceland, 1-Italy, 1-Benelux, 1-Baltic countries, 1-Hungary, Rumania, Slovakia, Slovenia, 1-Poland, 1-Greece, 1-Russia, 1-Switzerland and Austria.

It was agreed to consider only high temperature (>80°C) geothermal areas in countries having both high and low temperature potentials.

Each partner institution should provide a complete description of their expertise. The following papers are foreseen:

2-BRGM, 2-GFZ, 2-ISOR, 2-TNO, 2-IGG, 2-ELTE, 2-CNRS, 2-GGA, 2-GEIE, 2-IGGL, 2-MeSy, 2-VUA, 2-CRES, 2-PGI, 2-GEMR, 2-GEOWATT.

Also associated volunteer partners like RWTH and IGeM are invited to prepare their papers.

The methodological papers to be prepared are:

2-Geology/ Hydrogeology , 2-Geochemistry, 2-Geophysics, 2-Rock properties (in situ and in the lab), 2-Reservoir modeling.

In order to organize the contributions, every person participating to the WP3 activity is assigned to a methodological review paper. The WP3 leader has made a first assignment based on the information received through the Table circulated in the last months. The persons responsible for each review paper were defined: they will collect all the information from partners and will coordinate the contributions, beside writing the papers.

WP3/WP6 partners are invited to check and update the Table provided at the end of these Minutes. The e-mail addresses are requested, so that coordinators will be able to contact related partners.

An updated table is requested to all partners by May 30.

The following persons were defined as responsible for the review papers:

Genter for 1-France, 2-BRGM and 2-Geology

Bruhn 2-GFZ and 2-Rock properties

Flovenz for 1-Iceland and 2-ISOR

Lokhorst for 1-Benelux and 2-TNO

Manzella for 1-Italy, 2-IGG and 2-Geophysics

Fritz or Dallai for 2-Geochemistry (to be defined)

Lenkey for 1-Hungary, Slovakia, Rumania, Slovenia and 2-ELTE

Géraud for 2-CNRS

Schellschmitt for 1-Germany

Orzol for 2-GGA

Gerard for 2-GEIE

Sliaupa for 1-Baltic Countries and 2-IGGL

Rummel for 2-MeSy

JD vanWees for 2-VUA (to be checked)

Mendrinou for 1-Greece and 2-CRES

Wroblewska for 1-Poland and 2-PGI

Spichack for 1-Russia and 2-GEMRC

Kohl for 1-Switzerland and Austria, 2-GEOWATT and 2-Reservoir modelling

Clauser for 2-RWTH (volunteer)

Schill for 2-IGeM (volunteer)

It was mentioned that we need to contact partners who were not related to WP3/WP6 in the original proposal, but who could give a contribution. In particular, partners involved in reservoir modelling, who are working for WP4/WP7 should be involved. Also partners representing countries who are not covered, such as Spain and Portugal, should be contacted.

WP4/WP7 leaders will invite partners of their WPs to participate to the WP3 activity. WP3/WP6 leaders and CA Coordinator will look for other geographical contributions.

The request of expertise description of each partner institution replaces the previous request of the list of references, since the latter is included in the expertise description. All papers considered relevant to the CA will be requested in pdf format by coordinators. The pdf papers will be made available to the partners, in a form to be defined in conjunction to WP2 (virtual library. The details will be circulated)

The responsible of each partner institution will provide their expertise description by May 30, 2006, following the structure attached to these Minutes.

The deadlines for the foreseen activities are: Partner expertise description - May 30, the request for exchange of personnel for this first phase of activity - September 30, the draft review papers - October 6, presentation to Workshop 1 – 2/3 November, final review papers - December 1.

5. Organisation of presentations from WP3 activity to Workshop 1

A discussion took place of what to expect from WS1. The Coordinator underlined the importance of the workshops as place for debates, and the role of conferences as occasion for presentations and reviews. Moreover, he underlined the fact that workshops are not meant to present advances in the activity of the CA, a role that belongs to conferences.

It was agreed to define a few speakers for WS1, mostly from industries and projects, and to leave space to debates. In particular, debates should focus on themes related to the deliverables foreseen for WP3.

The review papers will be presented mostly during the mid-term conference. The geographical contributions will be presented as posters, whereas the methodological contribution will be presented as oral presentation.

6. Conclusions

Since the review papers will be almost completed by the time of WS1, the partners will already have a common background and integration among them should be already working. An overview of different types of geothermal reservoir and geologic scenario will be defined by geographical area contributions, while techniques for imaging permeable systems will be derived from methodological review papers. Contributions regarding these two main themes will be presented and discussed, and speakers will be chosen among the coordinators of review papers.

The WS1 organization committee and WP3/WP6 leaders will define invited presentation from WP3 by May 12.

7. Table

Name and E-mail	Review Paper	Organisation (Organisation #)	Expertise (max 3 most important)	Geographical expertise (max 3 most important)
Dezayes Chrystel c.dezayes@brgm.fr	2 - Geology	BRGM (1)	Structural geology; core and borehole logging, Fracture network analysis,, geophysical well log and borehole image log interpretation in granite	Soultz; Alsace
Genter Albert a.genter@brgm.fr	1 - France 2 - BRGM 2 - Geology	BRGM (1)	Structural geology; core and borehole logging, geophysical well log and borehole image log interpretation in granite, Hydrothermal alteration, conceptual model	Soultz, Alsace, Martinique, Guadeloupe (Bouillante), La Réunion, Limagne
Sanjuan Bernard b.sanjuan@brgm.fr	2 - Geochemistry	BRGM (1)	Water geochemistry; analytical water chemistry, on site measurements (field and wells), tracer test, geochemical fluid monitoring, geochemical modelling	Soultz, Bouillante (Guadeloupe), Martinique, La Réunion, Djibouti, El Salvador, Chile
Bourgeois Bernard b.bourgeois@brgm.fr	2 - Geophysics	BRGM (1)	Electrical - Electromagnetic methods : DC arrays (gradient, dipole-dipole), Spontaneous potential, Magnetotellurics, Borehole electromagnetism, Airborne electromagnetism	Martinique, Guadeloupe (Bouillante), Dominica
Baltassat Jean-Michel	2 - Geophysics	BRGM (1)	General geophysics, Electrical methods, Magnetotellurics, Magnetic Resonance Sounding	Martinique, Guadeloupe (Bouillante)
Bruhn	1 - Germany 2 - GFZ 2 - Rock properties	GFZ (3)	Laboratory petrophysics Structural geology Project management	

Holl	2 - Geology	GFZ (3)	Geological analysis Well log analysis Reservoir characterization	Gross-Schönebeck
Bloecher	2 – Reservoir modeling	GFZ (3)	Numerical petrophysics Hydrodynamic modelling	
Förster	2 – Geology	GFZ (3)	Crustal heat flow, temperature logging and evaluation, rock mineralogy	
Zimmermann	2 – Reservoir modeling	GFZ (3)	Reservoir stimulation Reservoir assessment Hydrodynamic modelling	Gross-Schönebeck
Milch	2 – Laboratory tests	GFZ (3)	Laboratory petrophysics	
Spangenberg	2 – Laboratory tests	GFZ (3)	Petrophysics and well-log analysis	
Moeck	2 - Geology	GFZ (3)	3-D Structural and geological model building; Hydrotectonics	
Henninges	2 - Geophysics	GFZ (3)	Temperature sensing technology for borehole measurements	
Brandt	2 – Reservoir modeling	GFZ (3)	Reservoir engineering	
Flovenz	1 – Iceland 2 - ISOR 2 - Geophysics	ISOR (4)		
Lokhorst	1 – Benelux 2 - TNO 2 - Geology	TNO (6)		
Manzella manzella@igg.cnr.it	1 – Italy 2 - IGG 2 - Geophysics	IGG (8)	MT geophysical method, relation of resistivity and fluids	ITALY: Tuscany, ICELAND; CHINA: Tibet
Bellani bellani@igg.cnr.it	2 - Geophysics	IGG (8)	Shallow thermal prospection	Italy (Larderello, Mt Amiata, Naples).

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Caprai caprai@igg.cnr.it	2 - Geochemistry	IGG (8)	Gaschemistry)	Toscana, Vesuvius, Pozzuoli, Phlegrean area, Grecia, El Salvador, Giappone
Cioni cioni@igg.cnr.it	2 - Geochemistry	IGG (8)	Gas and water geochemistry	Italy, Kenya, Thailand, Indonesia, Colombia, Ecuador, Tibet
Dallai dallai@igg.cnr.it	2 – Geochemistry?	IGG (8)	Geochemistry of fluid and gaseous inclusions, alteration minerals, gases; evolution of g.s.	Larderello, Carpathians, Antartica
Gherardi gherardi@igg.cnr.it	2 – Reservoir modeling	IGG (8)	Geochemical modelling Gas geochemistry	Larderello, Abano e comprensorio euganeo Costa Rica, Ecuador
Gianelli gianelli@igg.cnr.it	2 - Geochemistry	IGG (8)	Integrated models, Hydrothermal metamorphism	Larderello, Amiata, Iceland, Guadelupe, The Geysers, Ethiopia, El Salvador
Guidi guidi@igg.cnr.it	2 - Geochemistry	IGG (8)	Fluid geochemistry	Aeolian Islands, Fhlegrean area, Azores, Turkey, Kenya, Guatemala, China, Ethiopia, Honduras, El Salvador
Laurenzi laurenzi@igg.cnr.it	2 - Geochemistry	IGG (8)	⁴⁰ Ar- ³⁹ Ar geochronology	Toscana, Campania, Lazio, Sicilia
Magro magro@igg.cnr.it	2 - Geochemistry	IGG (8)	Noble gases geochemistry	Larderello, Amiata, Vulsini, Sabatini, Euganei, aree termali varie; Romania, Bulgaria, Ungheria, Mexico, Costa Rica, Ecuador, India, Philippines,
Minissale-Vaselli minissa@unifi.dst.it	2 - Geochemistry	IGG (8)	a) Geothermal prospecting by fluid geochemistry. b) Conceptual modeling	Italia, India, Romania, Marocco, Cina, Tunisia, Grecia, Bulgaria, Salvador. Costarica, Messico, Nicaragua, Colombia, Cile
Pennisi pennisi@igg.cnr.it	2 - Geochemistry	IGG (8)	Geochemical and isotopic features of geothermal areas (Boron)	Toscana
Principe	2 - Geology	IGG (8)	Geological mapping, volcanology,	Campi Flegrei, Vesuvio , Vulture,

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principe@igg.cnr.it				archeomagnetism	Vulcano, Lipari, Ischia, Nisyros e Milos (Grecia)
Rossi rossi@igg.cnr.it	2 - Geophysics	IGG (8)		Topographic and micro-gravity monitoring networks; subsidence	Larderello-Travale
Ruggieri ruggieri@igg.cnr.it	2 - Geochemistry	IGG (8)		Fluid inclusions, hydrothermal alteration and isotopic studies; evolution of G.S.	Larderello, Amiata, El Salvador
Alessandro Sbrana	2 - Geology	IGG (8)/UNIPI		Fluid geochemistry	
Paolo Fulignati	2 - Geochemistry	IGG (8)/UNIPI		Fluid geochemistry, fluid inclusions	
Lenkey	1 - Hungary, Slovakia, Rumania, Slovenia 2 - ELTE 2 - Geology	ELTE (11)		Modeling groundwater flow and thermal field, geothermal database handling	Hungary
Yves Gérard (geraud@illite.u-strasbg.fr)	2 - CNRS 2 - Geology	Cnrs(12)		Petrophysique, porosity, permeability, thermal conductivity, fault zone	Soultz, Spain, Turkey, Greece
Guy Marquis (guy.marquis@eost.u-strasbg.fr)	2 - Geophysics	Cnrs(12)		self-potential monitoring and modelling, MT	Soultz, El Salvador
Louis Dorbath	2 - Geophysics	Cnrs(12)		geophysics	
Michel Rabinowicz	2 - Geophysics	Cnrs(12)/EHDRA		geophysics, modelling of convective cells	
Pierre Genthon	2 - Reservoir modeling	Cnrs(12)/EHDRA		modelling of reservoirs	
Jean-Jacques Royer	2 - Geology	Cnrs(12)/EHDRA		geology, modelling of heat and fluid transfer in reservoirs	
Jean Schmittbuhl	2 - Reservoir modeling	Cnrs(12)/EHDRA		modelling of porous and fractured media	
Jean-Pierre Hulin	2 - Reservoir modeling	Cnrs(12)/EHDRA		modelling of porous and fractured media	
Bertrand Fritz	2 - Geochemistry?	Cnrs(12)/EHDRA		geochemical modelling	

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Jean Dubessy	2 - Geochemistry	Cnrs(12)/EHDRA	geochemistry, fluid-rock interactions	
Judith Sausse	2 - Geochemistry	Cnrs(12)/EHDRA	geochemistry, fluid-rock interactions	
Jean-Luc Potdevin	2 – Reservoir modeling	Cnrs(12)/EHDRA	geochemical modelling	
Bruno Goffé	2 - Geology	Cnrs(12)/EHDRA	field and experimental mineralogy	
Olivier Vidal	2 - Geology	Cnrs(12)/EHDRA	experimental mineralogy	
Roland Hellmann	2 - Geochemistry	Cnrs(12)/EHDRA	experimental geochemistry	
Eric Oelkers	2 - Geochemistry	Cnrs(12)/EHDRA	geochemistry	
Jung r.jung@gga- hannover.de	2 – Reservoir modeling	GGA (13)	Stimulation, hydraulics, geothermal resources	Not geographically confined
Schellschmitt	1 – Germany 2 - Geophysics	GGA (13)	Thermal field, thermal properties, geothermal resources	Europe
Orzol j.orzol@gga- hannover.de	2 – GGA 2 – Reservoir modeling	GGA (13)	Hydraulics, stimulation	Not geographically confined
Tischner t.tischner@bgr.de	2 – Reservoir modeling	GGA (13) / BGR	Hydraulics, stimulation	Not geographically confined
Thomas r.thomas@gga- hannover.de	2 - Geophysics	GGA (13)	Seismic exploration	Germany
Buness h.buness@gga- hannover.de	2 - Geophysics	GGA (13)	Seismic exploration, microseismics	Germany
Schellschmitt	2 - Geophysics	GGA (13)	Thermal field, thermal properties, geothermal resources	Europe
Gérard -	2 - Geophysics	GEIE (14)	Geophysical exploration methods(MT,Gravity,Magnetics,seis mics.), Data synthesis, Hydrothermal reservoirs	Various targets in France including Rhine graben, Parisian basin, Central massif, Réunion,.....Djibouti, Azores.....
Sliampa	1 – Baltic countries 2 - Geology	IGGL (15)		

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Rummel (mesy-bochum2004 @t-online.de)	2 – Geology	MeSy (16)	hydrofrac stress testing, reservoir stimulation, laboratory rock mechanics and fracture mechanics	world-wide; special projects: KTB, Urach, Soultz, Cornwall, NAGRA, SKG-Sweden, ANDRA
Cloetingh	2 – Geology	VUA (17)		
JD vanWees??	2- VUA 2 – Geology	VUA (17)		
Dr. C.Karytsas	2 - Geology	CRES (18)	Geothermal Production Technology Geothermal Exploration Technology	European Union, Romania, Bulgaria, United States
Mr. D.Mendrinou	1 – Greece 2 - Geophysics	CRES (18)	Geothermal Production Technology Geothermal Exploration Technology Geothermal Reservoir Engineering	European Union, Romania, Bulgaria, New Zealand
Wroblewska	1 – Poland 2 - Geology	PGI (22)		
Spichak	1 – Russia 2 – Geophysics	GEMRC (25)	3D MT modeling and imaging deep structures, 3D temperature models, indirect monitoring macro-parameters	JAPAN (Hokkaido, Kyushu), RUSSIA (Kamchatka, northern Caucasus), ITALY (Larderello), KYRGYZSTAN (northern Tien Shan), USA (Kilauea volcano, Hawaii).
Thomas Kohl kohl@geowatt.ch	1 – Switzerland, Austria 2 – Reservoir modeling	Geowatt (29)	Modeling of deep structures, visualisation, hydrothermal field	GERMANY: KTB area; FRANCE: Upper Rhine valley, SWITZERLAND
Sarah Signorelli signorelli@geowatt.ch	2 – Reservoir modeling	Geowatt (29)	Modeling of geological structures	SWITZERLAND: Swiss Plateau
Clément Baujard baujard@geowatt.ch	2 – Reservoir modeling	Geowatt (29)	Rock mechanics, stress field analysis, flow in fractured/porous media	FRANCE: Upper Rhine, Paris
Clauser	2 – Reservoir	RWTH Aachen	(1) Geothermal energy; (2) petro-	GERMANY: Upper Rhine graben,

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c.clauser@geophysik.rwth-aachen.de	modeling	University	physics and geophysical logging; (3) analysis and simulation of heat and fluid flow in porous and fractured rocks	Molasse Basin, KTB area, Northern German Basin, Eifel & Lower Rhine embayment; FRANCE: Upper Rhine graben; AUSTRIA/NORTHERN ITALY: Eastern Alps; RUSSIA: Kola peninsula
Kühn m.kuehn@geophysik.rwth-aachen.de	2 – Reservoir modeling	RWTH Aachen University	(1) Geochemical fluid-rock interaction; (2) Analysis of driving forces for hydrogeologic fluid flow; (3) numerical simulation of reactive transport	GERMANY: Northern German Basin; AUSTRALIA: Mount Isa Inlier; NEW ZEALAND: Waiwera;
Rath v.rath@geophysik.rwth-aachen.de	2 – Geophysics	RWTH Aachen University	(1) Inverse methods; (2) Numerical techniques of modelling and optimization; (3) electrical and electromagnetic prospecting methods for fluid content and permeability	GERMANY: Molasse Basin; KTB area; FRANCE: Upper Rhine graben; ITALY: Tuscany; CHILE/BOLIVIA/ARGENTINA: Andes; RUSSIA: Kola Peninsula
Schill schille@uni-mainz.de	2 – Geophysics	IGeM Mainz	Geological and geophysical reservoir analysis	Germany: Upper Rhine valley; China: Tibetan plateau
Regenauer-Lieb	2 – Geology	IGeM Mainz	Geodynamic modeling	Germany: Upper Rhine valley; China: Tibetan plateau

8. Structure of contributions

1 - Area specific contributions

Geological setting of geothermal relevant structures

- geological scenario (sedimentary, volcanic, cristalline)
- tectonic setting
- typical temperature range and thermal conditions
- fluid features (salinity, status)
- fluid circulation characteristics and transmissivity range

Assessment of reservoir

Methodology used

- geophysics, geochemistry, geology, ...
- planned activity
- experience

Current utilization of resource

- thermal and power output (if any)
- # power plants
- planned / potential extension
- experience

Law regulations

- review, and if possible the law itself.

Reference list

For each paper, please provide:

- complete author list
- abstract
- keywords
- pdf files of the main papers, to be inserted in the “virtual library”. The coordinator responsible for the contribution will decide what are the main papers. However, he/she should be ready to provide the pdf file of other papers, in case it is requested by other partners.

2.1 – Methodological expertise in Institution

List of methodologies used for geothermal investigation and exploration

List of equipments and laboratories

List of activities and projects related to geothermal investigation and exploration and related web pages (when applicable)

Reference list

For each paper, please provide:

- complete author list
- abstract
- keywords
- pdf files of the main papers, to be inserted in the “virtual library”. The coordinator responsible for the contribution will decide what are the main papers. However, he/she should be ready to provide the pdf file of other papers, in case it is requested by other partners.

2.2 - Methodological specific contributions

The following papers and related topics have been defined

I. Geophysics

- ✓ heat flow
- ✓ seismic
- ✓ electric and electromagnetic
- ✓ gravity

II. Geochemistry

- ✓ gas geochemistry
- ✓ fluid geochemistry
- ✓ Rock chemistry

III. Rock properties (in situ and in the lab)

- ✓ petrophysics
- ✓ rock mechanics
- ✓ hydraulic properties

IV. Geology / Hydrogeology

- ✓ alteration mineralogy
- ✓ lithologies (i.e. preferred settings)
- ✓ tracer tests
- ✓ hydrotests
- ✓ stress field

V. Reservoir modeling

- ✓ hydro-mechanical
- ✓ geochemical
- ✓ 3D structural modeling

The topic lists should not be considered comprehensive, or the topics listed in order of importance. The coordinators will choose what topics should be discussed and in what order.

General structure of the paper

Review of the main advantages and limits of the various methodologies

Overview of utilization of the various methodologies for geothermal investigation and exploration, in particular in Europe (but not only); Case studies

Future directions

List of equipment or software available in Europe, and in particular among ENGINE partners (specify)

List of equipment or software necessary for methodological advances