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OUTCOMES OF THE 2nd INTERNAL KNOWLEDGE-SHARING WORKSHOP

"Natural Analogues"
Maria Laach, Germany, Monday 17th - Wednesday 19th October 2011

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1. Workshop report

2nd CGS Europe Knowledge Sharing Workshop "Natural Analogues"
Maria Laach, Germany, Monday 17th - Wednesday 19th October 2011

The second CGS Europe Knowledge Sharing Workshop "Natural Analogues" took place in Maria Laach, Germany, 17 - 19 October, 2011. The workshop was organised by Ingo Möller, Heike Rütters and Franz May (BGR) with the help of sessions chairs Salvatore Lombardi (OGS) and Vit Hladik (CGS). At the end of the first workshop day leading edges of research and knowledge gaps in natural analogues were discussed, moderated by Franz May. At the end of the last, third day the workshop conclusions and lessons-learned session was moderated by Alla Shogenova (TTÜ Gi, WP 4.2 leader) and workshop was closed by Roberto Martinez (WP 4 leader).

During the second day workshop participants took part in the field excursion to natural analogues sites along Lake Laach caldera and volcanic complex guided by Franz May and Ingo Möller (BGR).

The detailed agenda of the workshop is given in Annex I and field trip information in Annex II. The workshop was organised into four sessions, all chaired by members of the Workshop Scientific Committee.

- Introductory Session (Chair: Ingo Möller, two presentations)
- Session A. Storage Complex Processes (Chair. Salvatore Lombardi, Franz May and Vit Hladik, 13 presentations).
- Session B & C – Leakage Processes & Impacts of CO_2 Releases (6 presentations)
- Session D – Monitoring (3 presentations)
- Workshops conclusions and lessons-learned (moderation: Alla Shogenova)

In total we had 24 presentations from 18 countries.

Most of the workshop presentations are available on the member's part of the CGS Europe website.
http://www.cgseurope.net

Participants:
39 participants took part in the workshop from 24 CGS Europe countries: Austria – 3, Belgium – 1, Bulgaria – 1, Czech Republic – 2, Croatia –1, Denmark – 1, Estonia – 2, Finland – 2, France – 2, Germany – 4, Greece – 1, Hungary – 1 , Ireland – 1, Italy – 3, Latvia – 1, The Netherlands - 1, Poland – 1, Romania – 1, Serbia – 1, Slovakia – 1, Slovenia –1, Spain – 1, Turkey – 1, UK – 5.

Compilation of natural analogue data from CGS Europe countries:

- In CGS Europe countries we have different levels of research in Natural Analogues.
- Countries with advanced studies and results (mainly CO2GeoNet countries) – UK, Italy, Germany, France, The Netherlands and Norway, but also Greece and Hungary (NASCENT project participants, EC FP5, 2001-2003).
- Countries recently started studies on natural analogues (Turkey, Slovakia, Poland, Czech Republic).

- Countries which have CO2 exposures and ready, or would like to start new studies (Spain, Bulgaria, Austria, Serbia, Slovenia).
- Countries without existed significant CO2 exposures like Baltic Countries, Finland, Sweden, etc.
- Monitoring techniques for Natural Analogues/Natural Laboratories (NA/NL) are developed in Italy, Greece, France, UK, Czech Republic, Germany – example from Maria Laach)
- Several monitoring methods should be applied for Natural Analogues, as every method has its advantages and limitations (however, it is a usual rule for monitoring methods)

The main regions of CO2 exposures in CGS Europe countries:

- Seismically active zones
- Old and recent volcanic activities areas (Germany, Italy, Greece, The Netherlands, Poland, Austria, etc)
- Geothermal areas (Greece, Italy, Bulgaria, Turkey, Hungary, Slovenia, Czech Republic, Austria, etc)
- Oil and Gas accumulation areas (oil, methane, CO2)

Occurrences of natural CO2:

- Natural CO2 deposits
- Mineral waters with natural CO2, spa (Belgium, Hungary, Greece, Italy, Poland, Austria, Germany, etc)
- Submarine sources of CO2 (Italy –Mediterranean Sea, North Sea – Dutch area)

Processes responsible for CO2 production:

- Alteration of carbonate rocks and migration by faults, karstic carbonate rocks, metamorfic and diagenetic processes in carbonate rocks (Greece, Italy, Hungary, The Netherlands, Poland, Slovakia , Slovenia, etc)
- CO2 of biological origin (everywhere is probable, presentation of URS)
- CO2 of mantellic/volcanic origin

Other:

- Depths of gas accumulation could be different, from shallow to about 3 km and more
- Different gases can serve as natural analogues: CO2, methane –microbial , thermogenic, etc), radon, etc…

Lessons-learned for geological storage of CO2:

- During preparation to this workshop and during workshop itself we could understand the importance of Natural Analogues (NA) for understanding of long-term processes during CGS
- It is important to distinguish between natural diagenetic processes and processes caused by CO2

It was suggested that it might be better to use the term “natural labs (NL)” instead of “natural analogues” for the purpose of better public acceptance. In this case, a differentiation could be made between CGS natural analogues, the natural CO2 reservoirs where CO2 does not leak, and natural labs, where we can study leaks, risks, test monitoring tool, etc. However, the utilization of the terms is still under discussion, e. g.

since “lab” is not a positive term in all countries. We can talk about natural analogues and distinguish i) natural accumulations and ii) natural emanations.

- Analogues processes are not the same as CGS processes, and we have consider this, but:

✓ Many useful information can be gathered from NA/NL studies
✓ NA complement experimental injection experiments
✓ NL help us to understand gas migration mechanism through faults and fractures, understand risks and test monitoring tools, etc

- Areas less favorable for CGS is able to contribute to CGS processes through NA studies (example of Slovenia)
- One of the negative examples reported (negative PR) is a possibility of boreholes failure, if drilled into natural CO2 reservoir and accumulation of CO2 in cellars (cases from Poland)

Knowledge gaps and possible new research topics:

- Danger of H_2S in natural gas reservoirs
- Using N/A as examples for the communication of risks
- Brine ascent mechanisms and impact on fresh groundwater and environment
- Paleo-fluid systems and hydrothermal ore deposits
- CO_2 bearing geothermal systems
- Trace metal contents in plants around carbonic springs
- Impact of agriculture on element release from soils- regional quantification of C
- Species flux leaking from the deep subsurface
- Alteration of natural cement minerals by CO_2
- Relation between fluid ascent phase transitions and swarm earth quakes
- Soil gas data bank at European level

Lessons learned for future CGS Europe knowledge sharing workshops:

- When a field trip is included in the programme, it should be at the beginning or at the end of the workshop.
- More details on workshop logistic, better for us (some of us had problems to find local taxi on Sunday to come to Maria Laach hotel).
- New colleagues and young researches and students from CGS Europe countries could be attracted (we were glad to see many new faces at the workshop).
- Field excursions or similar (pilot plants, etc) are attractive and good examples for understanding processes and technologies.
- We are ready to start new research areas in our countries and to organise new research projects, initiatives between CGS Europe countries.
- Old EU countries should help to follower countries to start research in the new areas


Lessons-learnt


Promoting CGS

Annex 1 - Workshop programme

2nd CGS Europe Knowledge Sharing Workshop "Natural Analogues"
Maria Laach, Germany, Monday 17th - Wednesday 19th October 2011

October 17, 2011

Monday, 17th October 2011 – Day 1	
Welcome to the 2nd CGS Europe Knowledge Sharing Workshop on Natural Analogues	
8.30 – 9.30	Registration
9.30 – 9.35	Welcome from the host organization. Ingo Möller (BGR)
9.35 – 10.00	Welcome and introduction to the workshop: 1. Status of research related to natural analogues. Roberto Martinez (S-IGME)
10.00 – 10.20	2. Natural analogues in Europe – overviewing the CGS Europe questionnaire survey. Heike Rütters (BGR)
10.20 – 10.50	Coffee Break
Session A – Storage Complex Processes	Chair: Salvatore Lombardi
10.50 – 11.10	3. Natural analogues in Germany. Franz May (BGR)
11.10 – 11.30	4. An overview of the use of analogues in CO_2GeoNet and NASCENT. Nick Riley on behalf of Jonathan Pearce (BGS)
11.30 – 11.50	5. Slovakian natural analogues – A review. Utilization and potential development in the future. Ludovít Kucharič, Dušan Bodiš & Marián Zlocha (SGUDS)
12.00 – 13.30	Lunch
13.30 – 13.50	6. Mineral waters and hydrogeothermal resources in Bulgaria. Konstantin Shterev & Georgi Georgiev (SU)
13.50 – 14.10	7. Natural analogues in Serbia. Snezana Komatina-Petrovic (UB)
14.10 – 14.30	8. Natural Analogues in Spain. Roberto Martínez (S-IGME)
14.30 – 14.50	9. Isotope and Gas Geochemistry of Geothermal Fields: Case studies from Turkey and implications for geological Storage of CO_2. Nilgun Gulec (METU-PAL)
14.50 – 15.20	Coffee Break Chair: Franz May
15.20 – 15.40	10. CO_2 enriched groundwater in Belgium. Kris Welkenhuysen (RBINS-GSB)
15.40 – 16.00	11. Understanding long-term trapping mechanisms and leakage. Nick Riley on behalf of Jonathan Pearce (BGS)
Closing Day 1	
16.00 – 16.20	12. What can we learn from communities living on natural analogue areas? Samuela Vercelli (URS)
16.20 – 16.40	13. The Lake Laach region as monitoring test site. Ingo Möller (BGR)
16.40 – 17.45	Closing Day 1, including a first brain storming on natural analogues, leading edges of research and knowledge gaps
19.00 – …	Workshop Dinner

Tuesday, 18th October 2001 – Day 2		
	Field Excursion	**Guides: Franz May & Ingo Möller (BGR)**
8.30	**"Natural analogues at your fingertips …**	
until		
latest afternoon		**… and under your feet"**
	Some first field trip information are linked to the workshop website on **http://www.cgseurope.net/NewsData.aspx?IdNews=63&ViewType=Actual&IdType=478**	
	The itinerary can be found on the next page.	

Wednesday, 19th October 2011 – Day 3	
Opening Day 3	**Chair: Vít Hladík**
9.00 – 9.20	**14. Long-term storage and leakage: Natural Analogues in Hungary. Gyorgy Falus, Agnes Szamosfalvi & Csilla Kiraly (ELGI)**
9.20 – 9.40	**15. Werkendam gas field (NL) as natural analogue: A microscopic view. Marielle Koenen (TNO)**
Session B & C – Leakage Processes & Impacts of CO_2 Releases	
9.40 – 10.00	**16. Modelling gas migration through faults: Latera and S. Vittorino natural labs. Sabina Bigi (URS)**
10.00 – 10.20	**17. Recent lessons learned by "natural labs". Salvatore Lombardi (URS)**
10.20 – 10.40	**18. Natural analogues of CO_2 leakage in Florina area, N. Greece. G. Hatziyannis & A. Arvanitis (G-IGME)**
10.40 – 11.10	**Coffee Break** **Chair: Ingo Möller**
11.10 – 11.30	**19. Natural analogues of CO_2 leakages from storage reservoirs in SE Poland. W. Wolkowicz & A. Wójcicki (PGI-NRI)**
11.30 – 11.50	**20. Occurence of CO_2 in natural environment and its economic use – Case study for Slovenia. Marjeta Car (Geo-INZ)**
11.50 – 12.10	**21. Geochemical and biological approach for the study of natural CO_2 emissions in the French carbonaceous province. Marie-Christine Dictor (BRGM)**
12.10 – 13.40	**Lunch**
Session D – Monitoring	
13.40 – 14.00	**22. CO_2 natural analogues generated by methane oxidation in the Upper Silesian Basin, Czech Republic: Experience from CO_2 monitoring. Juraj Francu, František Buzek, Petr Hemza & Vít Hladík (CzGS)**
14.00 – 14.20	**23. General overview on natural CO_2 sinks in Austria based on existing literature data – A first step towards the evaluation of possible monitoring sites. Gregor Goetzl, Magdalena Bottig & Anna-Katharina Brüstle (GBA)**
14.20 – 14.40	**24. Discontinuous and continuous seepage monitoring at Panarea: Recent results (Riscs; Eurofleet). Sabina Bigi on behalf of Salvatore Lombardi (URS)**
14.40 – 15.10	**Coffee Break**
15.10 – 15.45	**Workshop conclusion:** **Moderation: Alla Shogenova** **- Compilation of natural analogue data from CGS Europe countries** **- Lessons-learned for the geological storage of CO2** **- Knowledge gaps and research problems** **- Lessons-learned for future CGS Europe (knowledge sharing) workshops**
15.45 – 16.00	**Closing Day 3 and closing the workshop** **Roberto Martinez**

Annex 2 - Field Trip, Tuesday 18th October

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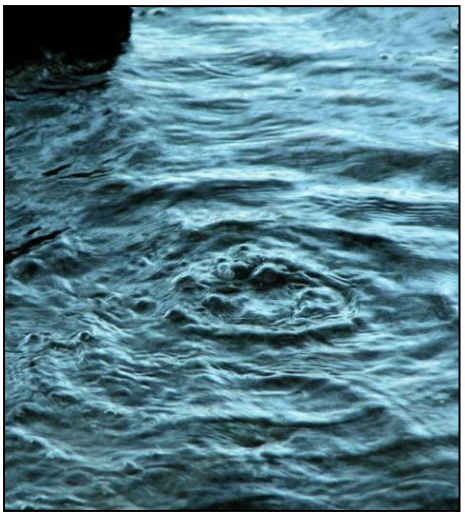
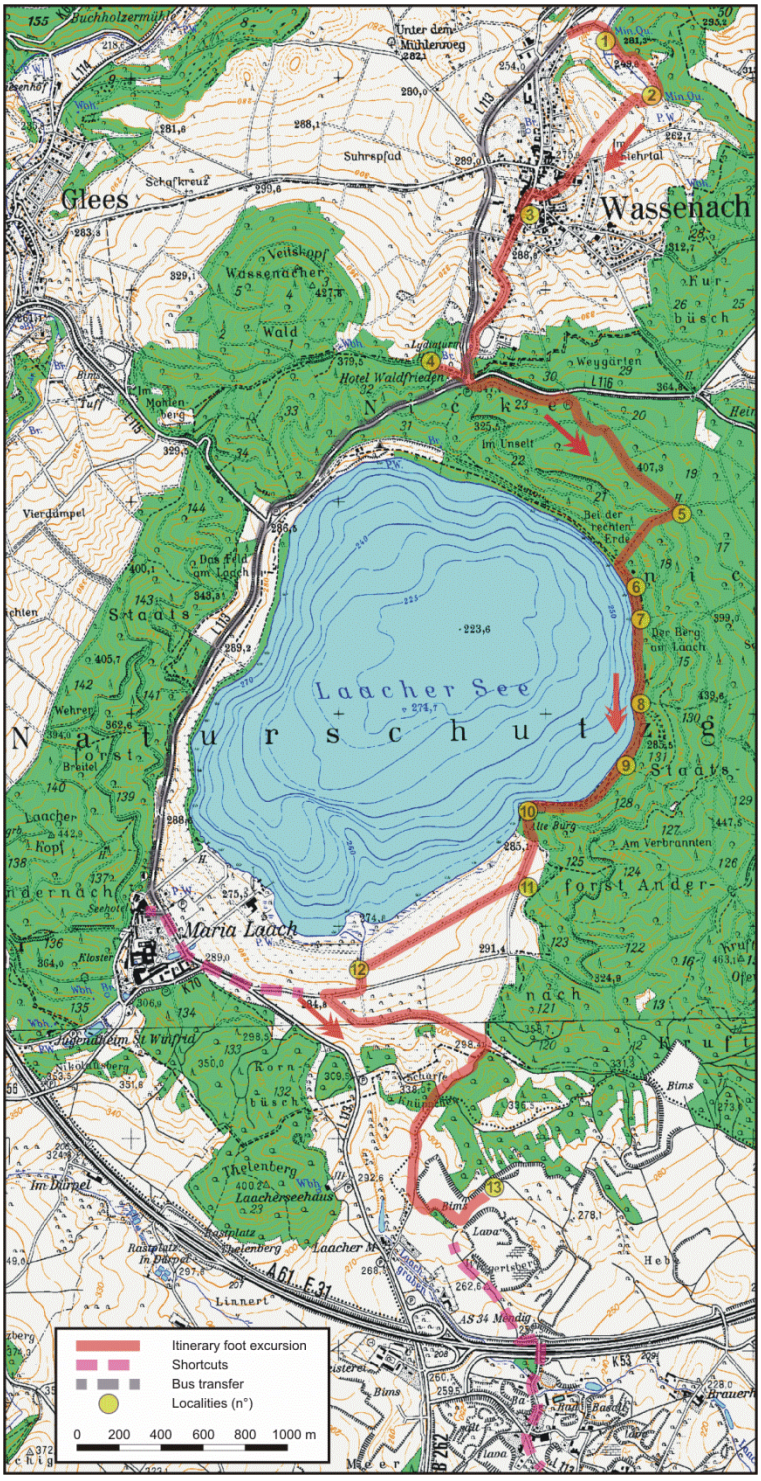
The field trip was conducted as a foot excursion. Guided by Franz May and Ingo Möller (BGR), the group of 37 persons from 21 different countries was taken along the Lake Laach caldera and volcanic complex. Highlights of the excursion were the demonstration of

- natural CO_2 emanations out of Lake Laach,
- dry mofettes,
- bubbling mineral springs and other
- geological aspects of the quaternary volcanic field.

The excursion started early in the morning and was ended just before sunset at about 6 pm. The group spent most of the time on farm or forest roads/paths which are generally, but not always easy to walk.
Starting point was a small valley near "Wassenach" village where we could observe the first natural analogues of this trip: Two carbonic springs and other indications for CO_2 emanations.

After a short stop in "Wassenach", the visit of "Lydiaturm" watch-tower provided an overview of the Lake Laach caldera as well as the wider





surrounding. More than 400 mio years of mid-european geological history could be explained from there.

The itinerary continued along the eastern shore of Lake Laach where geological outcrops and features of CO_2 gas releases were shown and explained in the CCS context.

A visit of the artificial outlet of the lake, the so-called “Fulbert-Tunnel”, led over to the final location of the excursion: The world-famous “Wingertsbergwand” outcrop which is an impressive, 30m high wall showing the complete stratigraphy of the volcanic deposits related to the volcanic Lake Laach eruption about 12’900 years ago.

The excursion brought deep insights into the geological setting of the volcanic area, but moreover, the demonstration of the natural analogues to CO_2 storage and leakage processes underlined once more the importance of such studies which are true to scale for future geological CO2 storage operations.