

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Commission of the European Communities Natural Analogue Working Group Meeting, post-meeting field trip to the Peña Blanca natural analog site, and field research at the Peña Blanca natural analog site
20-5704-063, 20-5704-064

DATE/PLACE: September 11-22, 1994
Santa Fe, New Mexico
Chihuahua, Chihuahua, Mexico

AUTHORS: English C. Percy, William M. Murphy, David A. Pickett,
and Ronald T. Green

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DATE: September 11-22, 1994

PLACE: Santa Fe, New Mexico
Chihuahua, Chihuahua, Mexico

PARTICIPANTS: English C. Percy, William M. Murphy, David A. Pickett, and Ronald T. Green (CNWRA)
Linda A. Kovach (NRC)
Ignacio Reyes, *Universidad Autonoma de Chihuahua* (UACH)
Other participants in the NAWG meeting (see attached list)

AUTHORS: English C. Percy, William M. Murphy, David A. Pickett, and Ronald T. Green

BACKGROUND AND PURPOSE OF TRIP:

This trip included four parts: (i) participation in the 6th Commission of the European Communities (CEC) Natural Analogue Working Group (NAWG) meeting, (ii) leading of a post-meeting field trip for NAWG participants to the Peña Blanca natural analog site, (iii) conduct of field research at the Peña Blanca natural analog site, and (iv) a presentation to representatives of UACH. E. Percy and W. Murphy participated in the NAWG meeting and helped lead the field trip. E. Percy, R. Green, and D. Pickett conducted field research at Peña Blanca. E. Percy met with UACH.

The 6th CEC NAWG meeting was the most recent in a series of meetings held approximately every two years to facilitate information exchange among researchers active in the area of natural analog studies. This international working group was established in 1985 at the initiative of the CEC to provide a forum for discussion of national and international natural analog projects and to evaluate the application of natural analog studies to performance assessment. A core group of scientists active in natural analog research serves as the guiding body of the NAWG, and a Secretariat provided by the CEC administers activities within the NAWG.

The post-meeting field trip to the Peña Blanca analog site was conceived as a means of familiarizing NAWG participants with research at the site and of encouraging assessment of the utility of work conducted to date and of work planned for the future. The proximity of the NAWG meeting location

(Santa Fe, NM) to the Peña Blanca analog site (Chihuahua, Chihuahua, Mexico) increased the likelihood of substantial participation in the trip.

Field research conducted at the Peña Blanca analog site after completion of the field trip comprised the most recent field research conducted under Task 3 of the Geochemical Natural Analog Research Project. CNWRA natural analog research within the Peña Blanca uranium district is focused on the Nopal I deposit. The purposes of this field research were to conduct additional measurements of mechanical properties of fractures within and around the Nopal I deposit, to collect additional samples of vein filling minerals from the EW fracture at 13.5 m N on Level +10, to collect additional samples of caliche for age dating from the immediate area of the Nopal I deposit, to measure radon concentrations in the air within the Level +00 adit of the Nopal I deposit, to conduct an electromagnetic survey of the entire Nopal cuesta, and to familiarize D. Pickett with research at the site.

A meeting was arranged with representatives of UACH to inform them of progress in the collaborative research at the Peña Blanca analog and to discuss the possibility of a collaborative research agreement.

SUMMARY OF PERTINENT POINTS:

The NAWG meeting produced stimulating discussions on the status of analog research as applied to performance assessment (PA). The program meeting followed the following topical sessions: Presentation of Natural Programs/Projects; Near-Field Processes and PA Implications; Far Field Processes and PA Implications; and Natural Analogs and Performance Assessment. In addition there was a volunteered poster session mainly dealing with studies at specific sites. A complete transcript of the meeting was prepared and is available for viewing (not citation). A proceedings containing invited papers, summaries by session chairs of discussions, and volunteered papers will be available from the CEC.

The field trip to Peña Blanca was well attended and resulted in many useful interactions. Participants from nine countries were able to make first hand observations of the analog and discuss various interpretations. Field research at the Nopal I deposit was productive; each of the goals listed earlier was accomplished. The presentation for representatives from UACH was well received and may result in a closer working relationship among the NRC, CNWRA, and UACH.

SUMMARY OF ACTIVITIES:

CEC NAWG Meeting — Santa Fe, New Mexico, September 11 to 16, 1994

The NAWG meeting was attended by 52 participants from 15 countries. The meeting was organized into sessions entitled: (i) Presentations of national programs/projects, (ii) Near-field processes and PA implications, (iii) Far-field processes and PA implications, and (iv) Natural analogs and performance assessment. More detail is provided on the attached agenda. CNWRA participation included co-chairing of the opening session by E. Percy and presentation of a talk entitled "*In-situ* distribution coefficients derived from Uranium and Thorium decay series isotopes in water-rock systems: promise and practice" by W. Murphy. Additionally, two posters describing research at the Peña Blanca analog site were presented.

After brief welcoming statements by R. Levich, U.S. Department of Energy (U.S. DOE) and D. Curtis, U.S. Los Alamos National Laboratory (U.S. LANL), J. Smellie (Sweden, CONTERRA) who is on the

NAWG core group, gave a cogent summary of the status, accomplishments, and directions of natural analog studies. He clearly regards the subject as a maturing one, with a record of successful applications.

W. Miller (UK, INTERA) noted that among the various national HLW programs differing definitions of "natural analog" persist. He offered this distillation: natural analog studies provide "information" that is "portable."

J. Cramer (Canada, AECL) reported that the Environmental Impact Statement for the Canadian repository was submitted in September 1994 employing a hypothetical reference disposal system. A possible deficiency statement will follow, which will identify known areas for improvement. Although asserting that natural analogs can not be used for absolute validation, they are useful for illustrations such as long term chemical buffering at Cigar Lake and slow copper corrosion of Cronan's canon.

L. Kovach, Nuclear Regulatory Commission (NRC) noted that PA is a regulatory concept and summarized the regulatory framework in the US and NRC sponsored analog projects. Work on halogen migration at the Valles Caldera and CNWRA work at Akrotiri and Peña Blanca were emphasized.

P. Cloke (US, SAIC) emphasized the need for multiple analog sites for support of long-term performance assessments. He recognized that no one site is likely to be appropriate for evaluation of all of the processes required for performance prediction. Rather, different sites can potentially supply information for "different and mutually exclusive parameters and processes."

R. Alexander (Switzerland, NAGRA) reported that the Swiss consider HLW sites in basement rocks or clay and are considering as a high priority a LLW site near Lausanne. A natural analog site of interest is in Maqarin, Jordan, where there is active precipitation of cementitious materials from hyper alkaline solutions.

P. Airey (Australia, ANSTO) referred to the Alligator Rivers Project (ARAP) and suggested that a successor project was possible. One key aspect of the work would be a continuation of NRC LLW funded research on U(VI) sorption. He also touted zirconolite as an analog for synrock.

J. Smellie (Sweden, CONTERRA) summarized features of major projects: Cigar Lake, ARAP, Poços de Caldas, Oklo, Maqarin, and Palmottu.

R. Blomqvist (Finland Geological Survey) described Palmottu, where 1.7 billion year old U occurs in crystalline rocks. Aqueous solutions change progressively from HCO_3^- to SO_4^{2-} to Cl^- dominated with depth. U(IV)/U(VI) measurements of waters compare favorably with Eh measurements.

P. Hernán (Spain, ENRESA) described the El Berrocal project, focusing on a uranium deposit in crystalline rocks.

M. Ivanovich (UK, AEA Tech) discussed Maqarin, where interaction of hyperalkaline fluids with wall rocks could cause sealing and limit matrix diffusion, which is an important retardation mechanism. Work on uranium transport was also described for the El Berrocal site.

D. Louvat (France, CEA) described a number of activities at Oklo. Ru (product of reactor Tc) is well retained. Zircon, apatite, and secondary uraninite formed in the reactor retain final decay products. Silicate glass from the reactor is retained as inclusions in apatite. The evolution of the Oklo basin

involved a dolerite dike intrusion, greenschist facies metamorphism, and deformation. Modern alteration and transport of uranium at Oklo is also under investigation.

S. Lombardi (Italy, Univ. di Roma) showed scenes from the Dunarobba Forest where sequoias were buried in mud (clay) over 2.5 million yr ago. The wood is well preserved because of the reducing conditions and it can be sawn and polished. Isotopic data indicate a closed system.

W. Steininger (Germany, Kernforschungszentrum Karlsruhe) expressed the intent of the Germans to get involved in analog studies. Issues of significance for the Gorleben salt dome site are room closure rate, permeability of dams, and brine pocket size.

D. Curtis (US, LANL) presented a review of corrosion rates for spent fuel derived from laboratory analogs and natural analogs. He noted that there appear to be disparities between laboratory measurements and natural system measurements for corrosion under similar conditions. Nevertheless, he finds "enough consistency of understanding and results to suggest that defensible values for spent fuel corrosion rates could be selected from available information." Discussion in response to this presentation included recognition that "consistency" among abstracted rates may be independent of the accuracy of the values and that it may be difficult to demonstrate the accuracy of such interpretations within acceptable limits. Curtis' approach is to use monitor elements to chart uraninite oxidation rates. At Oklo Tc release is based on ^{99}Ru depletion. $^{99}\text{Tc}/\text{U}$ disequilibrium is a monitor at Cigar Lake. Losses of ^{129}I that are calculated to be less than ^{99}Tc losses at Cigar Lake are inconsistent with their chemistries, suggesting some problems with the models. Rates of ^{129}I losses at Koongarra (Alligator Rivers) are about 100 times faster than at Cigar Lake, consistent with the oxidation state difference.

R. Pusch (Sweden, IDEON) discussed clay mineralogy at length. He noted salt redistribution and precipitation near heaters in tests on unsaturated clay buffers.

J. Vira (Finland, Teollisuuden Voima Oy) gave a review of the few PA references to analog studies. The pitting factor for copper was cited as a direct application. Oxidation rate of Cronan's cannon depends on tenorite inclusions, not on oxidation state in the reducing zone.

B. Hofmann (Switzerland, Nat. History Museum of Bern) described radiolytic effects in nature, which are rare. Generally the group opinion was that they are of little relevance to nuclear waste systems.

J. Bruno (Spain, INTERA) described a multiple group modeling study of trace metal solubility and speciation at analog sites to test models and data bases. At the sites an $\text{FeOOH}-\text{UO}_2(\text{OH})_2$ solid solution was shown to be important.

At the poster session T. Paces (Czech Republic Geological Survey) presented information on the Jáchymov uranium mine in the Czech Republic. This mine contains uraninite that has been exposed to oxidizing, unsaturated conditions due to mining for variable periods of time up to 400 yr. This site may provide a unique opportunity to study uraninite oxidation rates and mechanisms over long, but well constrained, periods of time.

D. Read (UK, WS Atkins) advocated use of analogs for uncertainty reduction in PA model formulation and for hypothesis testing.

J. McCarthy (US, ORNL) gave a summary of colloids indicating that natural colloids are mostly irrelevant to waste systems because of unnatural colloids formed at alkaline and redox fronts. Small amounts of organic matter can change the surface charge of hematite colloids affecting their mobility. All Am and 30 percent of Cu is complexed by organics at ORNL. Sites of anomalous migration were cited (e.g., 9 km Pu migration at LANL).

B. Crowe (US, LANL) gave a talk that is not on the agenda. Because W. Murphy was scheduled to be the following speaker (although the schedule was changed) Crowe's talk is attributed to Murphy in the transcript. The talk focused on probability models for volcanism at Yucca Mountain and concluded with a rough probability distribution function.

K. Nordstrom (USGS) gave a review of mass balance methods to determine dominant reactions in nature and the sequential iteration and other methods for reactive transport modeling. The talk stimulated a lengthy debate on the validity of thermodynamic and kinetic data for nuclear waste and analog systems and the utility of geochemical modeling, with most possible positions advocated and few or no conclusions reached.

W. Murphy (US, CNWRA) presented a literature review of the use of U and Th series radionuclides to determine in situ distribution coefficients. This is presently a highly contentious subject, particularly involving two workshop attendees on opposite sides, I McKinley and M. Ivanovich. The following discussion featured these two, the former saying that the methods are worthless, and the latter suggesting that the former misrepresents the state of the art.

I. Neretnieks (Sweden, Royal Inst. Tech.) discussed matrix diffusion as a retardation mechanism and described some experimental studies suggesting anomalous surface diffusion.

At the conference banquet J.R. Phillips (US, LANL) gave an insider's description of Iraqi nuclear weapons technology in his talk "Nonproliferation Inspection Activities in Iraq." The Iraqis had an extensive nuclear weapons program at the time of the Gulf War. Their domestic nuclear energy program was a sham; all efforts were in weaponry.

I. McKinley (Switzerland, NAGRA) advocated use of analogs in repository systems design and cited Cigar Lake as a good design analog for the Canadian system. He also advocated analogs use for input data for PA citing matrix diffusion from Poços de Caldas as a good example.

H. Dockery (US, SNL) gave an off-agenda talk on the US DOE PA program with an emphasis on integration of data. She suggested that natural analog programs should focus on subsystem issues to support subsystem PA models.

R. Codell (US, NRC) also gave an off-agenda talk, summarizing the recent NRC-CNWRA natural analog-PA workshop emphasizing its value in fostering communication between the groups.

J. Lindqvist (Sweden, SKB) is a public relations (PR) person for the Swedish program. He suggested that analogs are of more value as a PR tool than as a scientific or PA tool. Indeed PR was a common theme in many of the technical talks, particularly those describing national programs. Following his talk the shorter version of the NAGRA-produced natural analogs video was shown.

H. von Maravic (Belgium, CEC) gave a programmatic summary of the meeting and suggested formation of subgroups to address particular PA question. The next NAWG meeting is proposed to be in France in 1996, perhaps with an emphasis on geomechanical stresses, paleohydrology, and mixed waste. A field trip to Oklo following the meeting has also been proposed.

Field Trip to the Peña Blanca Analog Site — Chihuahua, Mexico, September 17, 1994

At the end of the NAWG meeting, 18 people traveled to Chihuahua, Mexico, to participate in a field trip to the Peña Blanca analog site. In addition to CNWRA and NRC scientists, representatives on the field trip included the US (LANL, INTERA, Woodward-Clyde), Australia (ANSTO), Austria (IAEA), Spain (CIEMAT), Finland (FCRNS), UK (INTERA), Sweden (CONTERRA), Japan (PNC), and Mexico (UACH).

Prior to departure for the field, Professor Ignacio Reyes (UACH) gave a talk on the geology of the region and the exploration and development of the Peña Blanca Uranium District. In the field, the stratigraphy of the district was briefly examined, with emphasis on the older, uranium deposit-bearing units. A short visit was made to the Margaritas deposit as an example of the typical stratiform uranium mineralization of the district and to provide a contrast to the stratigraphically cross-cutting Nopal I deposit. After lunch at the Nopal I mine camp, the remainder of the day was spent at the Nopal I deposit.

The NRC/CNWRA approach to analog study was presented, followed by a walking tour of the deposit during which observations and interpretations related to source term and transport issues were discussed. Field trip participants eagerly entered into discussions and provided stimulating feedback. There was substantial recognition of the numerous similarities between the Nopal I analog and the proposed US high-level waste repository at Yucca Mountain, Nevada. The strong parallels between natural uraninite alteration at Nopal I and laboratory corrosion tests on UO_2 were well received by participants as an example of natural system confirmation of the long-term utility of short-term laboratory tests. Future work at the site, especially development of additional fracture network data, additional age dating, and hydrologic percolation tests, was strongly encouraged.

Field Research at the Peña Blanca Analog Site — Chihuahua, Mexico, September 18-20, 1994

Location reference markers (aluminum tags, survey flagging, and nylon strings) on the cleared surfaces of Levels +10 and +00 of the Nopal I deposit were found to have been partially disrupted by clandestine bovine mastication. Repairs were made to the markers; future disruption should be reduced by recently constructed fences across the N and S ends of both levels.

Measurements were made to further define the mechanical properties of the fracture network that may have affected elemental transport at the site. Fracture aperture, orientation, roughness, location, and surface coatings were determined for 220 surfaces. These mechanical measurements will provide a means to generalize a relatively small number of laboratory measurements of fracture hydraulic conductivity and roughness to the fracture network within and surrounding the deposit.

Additional samples were collected along the EW fracture at approximately 13.5 m N on Level +10. Samples include both the fracture wallrock and variable portions of the fracture-filling minerals. These samples will be used to further investigate the partitioning of uranium and rare earth elements among

secondary minerals along the transport path and to constrain uranium decay series disequilibria along the fracture.

Levels of ^{222}Rn in air were measured in the adit on Level +00 to provide baseline information on potential radiological hazards associated with proposed percolation studies in the adit. E-PERM radon detectors were deployed at four locations in the adit, and a fifth detector was lowered 80 m into the vertical shaft on Level -20. Preliminary values for radon activities in the adit range from around 100 to 800 pCi/L, whereas air at the bottom of the shaft contained 2,000 pCi/L. The adit concentrations appear to be low enough to allow activity in the adit while staying well below MSHA exposure limits for miners. Uncertainties in background corrections, temporal variations, and dose estimations remain to be resolved.

In order to better constrain chronology of past surface exposure and hydrochemical events, samples of fracture-filling caliche were collected from the vicinity of the Nopal I deposit. If suitable, these carbonate materials will be dated using uranium-series disequilibrium methods, yielding information on timing of deposition and aqueous transport of radionuclides.

A set of electromagnetic measurements was completed covering the entire Nopal cuesta. These measurements were conducted at the same measurement sites used during a survey conducted during February 1994. An EM-47 time domain electromagnetic system with a 160 m perimeter transmitter loop was used; upon reduction of the data, perched water zones (or other conductors) may be detected at depths of up to 150 to 200 m. The survey conducted during February 1994 provided baseline measurements at the end of the nominal dry period; measurements conducted during this trip correspond to the end of the nominal wet period of the year. Data from these two surveys may provide evidence of temporal and spatial variations in perched water tables that may interact with the Nopal I uranium deposit.

Presentation — Chihuahua, Mexico, September 21, 1994

E. Percy gave a talk describing the US high-level waste program, the CNWRA, and research at the Peña Blanca analog to representatives from the *Universidad Autonoma de Chihuahua*, including administrators from the *Dirreccion de Investigacion y Posgrado*. After the talk, the possibility was discussed of establishing a more formal relationship between the CNWRA and UACH as a framework for continuing research at Peña Blanca. This potential agreement would simply provide a document recognizing the mutual benefits of collaborative investigations at the site and the intent to continue such research.

CONCLUSIONS:

Participation in NAWG is critically important.

PROBLEMS ENCOUNTERED:

Results from the electromagnetic survey may be inconclusive. These measurements were timed to coincide with the end of the nominal wet period of the year. This year, however, there has been much less rain than usual in the area. The nearest measuring station recorded only about 5 cm of precipitation during the previous 6 mo. The absence of a strong contrast between the measurements during February 1994 and September 1994 may preclude a definitive interpretation of the postulated perched water zone at the site. The next opportunity for such measurements would be Fall of 1995.


PENDING ACTIONS:

Final reduction and interpretation of radon measurements and the results of the electromagnetic survey.

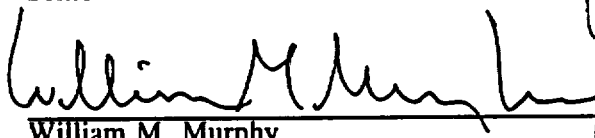
RECOMMENDATIONS:

Follow up the possibility of a collaborative research agreement with UACH. Follow up on possibility of study of uraninite oxidation rate at the Jáchymov mine.

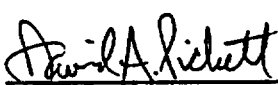
SIGNATURES:


English C. Pearcy
Senior Research Scientist

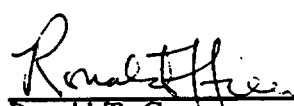
10/11/94
Date


William M. Murphy
Principal Scientist

10/12/94
Date

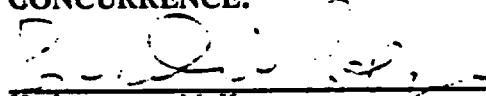

David A. Pickett
Research Scientist

10/11/94
Date


Ronald T. Green
Senior Research Scientist

10/11/94
Date

CONCURRENCE:

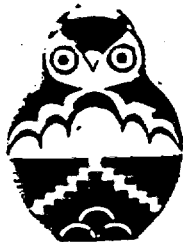

H. Lawrence McKague/
Manager, Geologic Setting *for HLM*

10/17/94
Date

Budhi Sagar
Technical Director

Date

AGENDA



6th CEC Natural Analogue Working Group Meeting

September 12-16, 1994

Bishop's Lodge

Santa Fe, New Mexico

FINAL AGENDA



SUNDAY, SEPTEMBER 11

(LOBBY)

6:00 – 8:00 p.m.

Registration and Welcome Reception (*Patio*)

Hors d'oeuvres and No-Host Bar



MONDAY, SEPTEMBER 12

(EL CHARRO)

8:00 a.m.

Continental Breakfast

(THUNDERBIRD)

- | | | |
|-----------|-------|--|
| 8:30 a.m. | (15') | Welcome — <i>Bob Levich (USA)</i> |
| 8:45 a.m. | (10') | Introduction/Logistics — <i>Dave Curtis (USA)</i> |
| 8:55 a.m. | (10') | Workshop Objectives — <i>John Smellie (Sweden)</i> |
| 9:05 a.m. | (25') | "The Value of Natural Analogues" — <i>Bill Miller (UK)</i> |

SESSION 1: PRESENTATION OF NATIONAL PROGRAMMES/PROJECTS

Morning Session

Co-Chairperson: *English Pearcy*
Co-Chairperson: *Rod Ewing*

- | | | |
|------------|-------|---|
| 9:30 a.m. | (40') | "Analog Support for the Canadian Concept for Disposal"
— <i>Jan Cramer (Canada)</i> |
| 10:10 a.m. | (25') | "NRC Natural Analogue Program: A Regulatory Perspective"
— <i>Linda Kovach (USA)</i> |
| 10:35 a.m. | | <i>Coffee Break</i> |
| 11:05 a.m. | (25') | "Development and Use of Natural Analogue Studies by
U.S. Department of Energy" — <i>Paul Cloke (USA)</i> |
| 11:30 a.m. | (30') | "Overview of the Swiss Natural Analogue Programme, 1994"
— <i>Russell Alexander (Switzerland)</i> |

12:00 – 3:30 p.m.

Lunch Break/Recreation



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(THUNDERBIRD)

Afternoon Session

- | | | |
|-----------|-------|--|
| 3:30 p.m. | (20') | "Natural Analogue Studies in Australia" — <i>Peter Airey (Australia)</i> |
| 3:50 p.m. | (30') | "Swedish Natural Analogue Programme" — <i>John Smellie (Sweden)</i> |
| 4:20 p.m. | (30') | "Natural Analogue Studies in Finland" — <i>Runar Blomqvist (Finland)</i> |
| 4:50 p.m. | (20') | "The 'El Berrocal' Project: An Example of a Natural System Characterisation Exercise" — <i>Pedro Herman (Spain)</i> |
| | | |
| 5:10 p.m. | | <i>Coffee Break</i> |
| | | |
| 5:40 p.m. | (30') | "British Natural Analogue Programme" — <i>Miro Ivanovich (UK)</i> |
| 6:10 p.m. | (30') | "The OKLO Natural Fission Reactors as Natural Analogues of Radioactive Waste Repositories" — <i>Didier Louvat (France)</i> |
| 6:40 p.m. | (20') | "The Dunarobba Forest as Natural Analogue: Analysis of the Geoenvironmental Factors Controlling the Wood Preservation" — <i>Salvatore Lombardi (Italy)</i> |
| 7:00 p.m. | (15') | "Natural Analogue For a Repository in Rock Salt: The German Approach" — <i>Walter Steininger (Germany)</i> |
| | | |
| 7:15 p.m. | | <i>Adjourn</i> |



TUESDAY, SEPTEMBER 13

(EL CHARRO)

8:00 a.m. Continental Breakfast

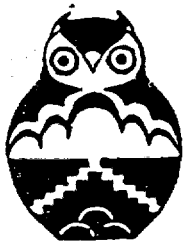
SESSION 2: NEAR FIELD PROCESSES AND PA IMPLICATIONS

(THUNDERBIRD)

Morning Session

Co-Chairperson: *Ferruccio Gera*
Co-Chairperson: *William Glassley*

- | | | |
|------------|-------|--|
| 8:30 a.m. | (45') | "Radionuclide Release Rates from Spent Fuel" — <i>Dave Curtis (USA)</i> |
| 9:15 a.m. | (30') | <i>Discussion</i> |
| 9:45 a.m. | (45') | "Long-Term Performance of Canister Embedment" — <i>Roland Pusch (Sweden)</i> |
| 10:30 a.m. | (30') | <i>Discussion</i> |
| | | |
| 11:00 a.m. | | <i>Coffee Break</i> |



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FINAL AGENDA

11:30 a.m. (45') "Natural Analogues for Canister Performance?"

— Juhani Vira (Finland)

12:15 p.m. (30') Discussion

12:45 – 4:00 p.m. Lunch Break/Recreation

(THUNDERBIRD)

Afternoon Session

4:00 p.m. (45') "Radiolysis in Nature and Natural Analogue Studies of
Radiolytical Processes" — Beda Hofmann (Switzerland)

4:45 p.m. (30') Discussion

5:15 p.m. Coffee Break

5:45 p.m. (45') "Testing Geochemical Models of Radionuclide Solubility and
Speciation in Natural Analogue Studies" — Jordi Bruno (Spain)

6:30 p.m. (30') Discussion

7:00 p.m. Adjourn

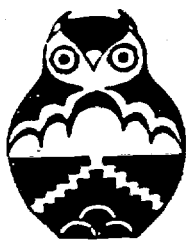
(POOLSIDE TERRACE)

7:00 – 9:00 p.m. Poster Session
Wine and Food



WEDNESDAY, SEPTEMBER 14

REGIONAL TOURS



6th CEC Natural Analogue Working Group Meeting

September 12–16, 1994

Bishop's Lodge
Santa Fe, New Mexico

FINAL AGENDA



THURSDAY, SEPTEMBER 15

(EL CHARRO)

8:00 a.m.

Continental Breakfast

SESSION 3: FAR FIELD PROCESSES AND PA IMPLICATIONS

(THUNDERBIRD)

Morning Session

Co-Chairperson: David Lever

Co-Chairperson: Ardyth Simmons

- | | | |
|-------------------|--------|--|
| 8:30 a.m. | (45') | "Natural Analogues in Understanding the Role of Colloids and Natural Organics in Contaminant Transport" — <i>John McCarthy (USA)</i> |
| 9:15 a.m. | (30') | <i>Discussion</i> |
| 9:45 a.m. | (45') | "Matrix Diffusion — How Confident Are We?"
— <i>Ivars Neretnieks (Sweden)</i> |
| 10:30 a.m. | (30') | <i>Discussion</i> |
| 11:00 a.m. | | <i>Coffee Break</i> |
| 11:30 a.m. | (45') | "In-Situ Distribution Coefficients Derived from Uranium and Thorium Decay Series Isotopes in Water-Rock Systems: Promise and Practice" — <i>William Murphy (USA)</i> |
| 12:15 p.m. | (30') | <i>Discussion</i> |
| 12:45 – 1:45 p.m. | | <i>Lunch Break/Recreation</i> |
| 2:00 p.m. | (120') | <i>Video Session</i>
"Process Analogues: Examples From the New Zealand Hydrothermal Systems" (USA)
"Planning for the Future" (Canada)
"Traces of the Future" (CEC)
"OKLO" (France) |

(THUNDERBIRD)

Afternoon Session

- | | | |
|-----------|-------|--|
| 4:00 p.m. | (45') | "Geochemical Transport Modeling" — <i>Kirk Nordstrom (USA)</i> |
| 4:45 p.m. | (30') | <i>Discussion</i> |
| 5:15 p.m. | | <i>Coffee Break</i> |



6th CEC Natural Analogue Working Group Meeting

September 12-16, 1994

Bishop's Lodge

Santa Fe, New Mexico

FINAL AGENDA

- 5:45 p.m. (45') "Conceptualization of Hydrogeochemical Systems: Uncertainty, Bias, and Subjectivity" — *David Read (UK)*
6:30 p.m. (30') *Discussion*
7:00 p.m. *Adjourn*

(SUNSET DINING ROOM)

- 7:30 – 9:30 p.m. Banquet
Speaker: Dr. John R. Phillips — "Nonproliferation Inspection Activities in Iraq"



FRIDAY, SEPTEMBER 16

(EL CHARRO)

- 8:00 a.m. Continental Breakfast

SESSION 4: NATURAL ANALOGUES AND PERFORMANCE ASSESSMENT

(THUNDERBIRD)

Morning Session

Co-Chairperson: Ivars Neretnleks
Co-Chairperson: Linda Kovach

- 8:30 a.m. (45') "The Uses of Natural Analogue Input in Repository Performance Assessment: An Overview" — *Ian McKinley (Switzerland)*
9:15 a.m. (30') *Discussion*
10:00 a.m. *Coffee Break*
10:30 a.m. (60') "The Use of Natural Analogues in Public Relations" — *Jan Lindqvist (Sweden)*
11:30 a.m. (30') *Discussion*
12:00 p.m. (10') Closing Remarks — *Henning von Maravic (CEC, Brussels)*
12:10 p.m. *End of Meeting*

LIST OF PARTICIPANTS



6th CEC Natural Analogue Working Group Meeting

Sponsored by:

U.S. Department of Energy Los Alamos National Laboratory
European Commission U.S. Nuclear Regulatory Commission

Hosted by:

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

9/20/94

LIST OF PARTICIPANTS

Dr. Peter Airey
ANSTO-Lucas Heights Research Lab.
Private Mail Bag
Menai, NSW
2234 Australia
Phone: 61-2-717-3272
FAX: 61-2-717-9293

Mr. Arnold Bonne
International Atomic Energy Agency
Wagramerstrasse 5, P. O. Box 100
A-1400 Vienna
Austria
Phone: 43-1-2360-2662
FAX: 43-1-234-564

Dr. Russell Alexander
GGWW, University of Bern
Min-pet & Geol. Institutes
Baltzerstrasse 1
CH-3012 Bern
Switzerland
Phone: 41-31-631-8520
FAX: 41-31-631-4843

Dr. Jordi Bruno
INTERA Information Technologies SL
Centre d'Empreses de Noves Tecnologies (CENT)
Parc Tecnologic del Valles
08290 Cerdanyola
Spain
Phone: 34-3-582-4410
FAX: 34-3-582-4412

Dr. Rip Anderson
Sandia National Laboratories
Mail Stop 1328
P. O. Box 5800
Albuquerque NM 87185-1328
USA
Phone: (505) 848-0692
FAX:

Steve Castor
Nevada Bureau of Mines & Geology
University of Nevada
Mail Stop 178
Reno NV 89557
USA
Phone: (702) 784-1768
FAX: (702) 784-1709

Dr. Runar Blomqvist
Geological Survey of Finland
Nuclear Waste and Applied Geology Unit
Betonimiehenkuja 4
02150-Espoo
Finland
Phone: 358-0-4693-2469
FAX: 358-0-462205

Dr. Paul Cloke
SAIC
101 Convention Center Dr., Suite 400
Las Vegas NV 89109
USA
Phone: (702) 794-7823
FAX: (702) 794-7008

LIST OF PARTICIPANTS (Cont.)

Richard Codell
U.S. Nuclear Regulatory Commission
Mail Stop 7J3
Washington DC 20555
USA
Phone: (301) 415-8167
FAX: (301) 415-5399

Holly A. Dockery
Sandial National Laboratories
MS 1326, Org. 6312
Albuquerque NM 87505
USA
Phone: (505) 848-0730
FAX: (505) 848-0738

Dr. Jan Cramer
AECL Whiteshell Laboratories
Pinawa, Manitoba
Canada, ROE 1LO
Phone: (204) 753-2311 x2736
FAX: (204) 753-2455

Susan Duerden
Her Majesty's Inspectorate of Pollution
P3/009, 2 Marsham Street
SW1P 3EB London
UK
Phone: 44-71-276-5233
FAX: 44-71-276-6544

Dr. Bruce M. Crowe
Los Alamos National Laboratory
MS J900/527
101 Convention Center Dr., Suite 820
Las Vegas NV 89109
USA
Phone: (702) 794-7096
FAX: (702) 794-7099

Dr. Rod Ewing
University of New Mexico
Dept. of Earth Sciences
Northrup Hall
Albuquerque NM 87131
USA
Phone: (505) 277-4163
FAX: (505) 277-0090

Dr. David B. Curtis
Los Alamos National Laboratory
Group CST-7, MS E517
P. O. Box 1663
Los Alamos NM 87545
USA
Phone: (505) 667-7391
FAX: (505) 665-3750

Dr. June T. Fabryka-Martin
Los Alamos National Laboratory
Group CST-10, Mail Stop J514
P. O. Box 1663
Los Alamos NM 87545
USA
Phone: (505) 665-2300
FAX: (505) 665-4955

Dr. Paul R. Dixon
Los Alamos National Laboratory
Group CST-8, Mail Stop J514
P. O. Box 1663
Los Alamos NM 87545
USA
Phone: (505) 667-0152
FAX: (505) 665-4955

Dr. Erik Frank
Swiss Federal Nuclear Safety Insp., HSK
CH-5232 Villingen-HSK
Switzerland
Phone: 41-56-993945
FAX: 41-56-993907

LIST OF PARTICIPANTS (Cont.)

Dr. Ferruccio Gera
ISMES S.p.A.
Via dei Crociferi 44
Rome I-00187
Italy
Phone: 39-6-69-94-1145
FAX: 39-6-678-1348

Dr. Kai Jakobsson
Finnish Centre for Radiation and Nuclear Safety
P. O. Box 14
FIN-00881 Helsinki
Finland
Phone: 358-0-7598-8308
FAX: 358-0-7598-8382

Dr. William Glassley
Lawrence Livermore National Laboratory
Earth Sciences Division
L-204, P. O. Box 808
Livermore CA 94550
USA
Phone: (510) 422-6499
FAX: (510) 422-1002

Dr. Linda Kovach
United States Nuclear Regulatory
Commission
Div. of Engineering, NS NLS-260
Washington DC 20555
USA
Phone: (301) 415-6266
FAX: (301) 415-5385

Dr. Pedro Hernan
ENRESA
Calle Emilio Vargas 7
Madrid E-28043
Spain
Phone: 34-1-51-95-255
FAX: 34-1-59-15-795

Dr. David Lever
AEA Technology
424.4 Harwell
Didcot
OX11 0RA Oxfordshire
UK
Phone: 44-235-43-3882
FAX: 44-235-43-3674

Dr. Beda Hofmann
Natural History Museum of Bern
Earth Science Department
Bernastrasse 15
CH-3005 Bern
Switzerland
Phone: 41-31-350-72-40
FAX: 41-31-350-74-99

Dr. Robert Levich
U.S. DOE/YMSCO
101 Convention Center Dr., Suite P-200
Las Vegas NV 89109
USA
Phone: (702) 794-7946
FAX: (702) 794-7325

Mr. Miro Ivanovich
AEA Technology
B551 Harwell, Analytical Services Group
Harwell Oxon OX11
UK
Phone: 44-235-43-2884
FAX: 44-235-43-4917

Mr. Jan Lindqvist
SKB
Box 5864
S-10248 Stockholm
Sweden
Phone: 46-8-665-2800
FAX: 46-8-661-5719

LIST OF PARTICIPANTS (Cont.)

Prof. Salvatore Lombardi
Univ. di Roma "La Sapienza"
Dip. Scienze della Terra
Piazza Aldo Moro 5
I-00185 Rome
Italy
Phone: 39-6-445-6634
FAX: 39-6-445-4729

Didier Louvat
Commissariat a L'Energie Atomique
Centre D'Etudes Nucleaires de Cadarache
DESD/SGE - Bat. 307
St. Paul-Lez-Durance F-13108 Cedex
France
Phone: 33-42-25-25-19
FAX: 33-42-25-62-72

Dr. John McCarthy
Oak Ridge National Laboratory
Environmental Sciences Division
P. O. Box 2008, Bethel Valley Road
Oak Ridge TN 37831-6036
USA
Phone: (615) 576-6606
FAX: (615) 576-8543

Dr. Ian McKinley
NAGRA
National Cooperative for the Disposal of Radioactive Waste
Hardstrasse 73
5430 Wettingen
Switzerland
Phone: 41-56-371-289
FAX: 41-56-371-317

Thierry Merceron
ANDRA
B.P. 38 Route du Panorama Robert Schuman
Fontenay Aux Roses 92266
France
Phone: 33-1-41-17-82-61
FAX: 33-1-41-17-82-08

Dr. William Miller
INTERA
47 Burton St.
Melton Mowbray LE13 1AF
UK
Phone: 44-664-41-1445
FAX: 44-664-41-1402

Dr. William Murphy
Center for Nuclear Waste Regulatory Analyses
Southwest Research Institute
Post Office Drawer 28510
San Antonio TX 78238
USA
Phone: (210) 522-5263
FAX: (210) 522-5155

Prof. Ivars E. A. Neretnieks
Royal Institute of Technology
Dept. Chemical Engineering & Technology
Stockholm
S-10044 Sweden
Phone: 46-8-790-82-29
FAX: 46-8-10-52-28

Dr. Darrell "Kirk" Nordstrom
U.S. Geological Survey
3215 Marine Street
Boulder CO 80303
USA
Phone: (303) 541-3037
FAX: (303) 447-2505

Dr. Tom Paces
Czech Geological Survey
Klarov 3
Praha 11821
Czech Republic
Phone: 42-2-59-0282
FAX: 42-2-798-0965

LIST OF PARTICIPANTS (Cont.)

Ned Patera
Los Alamos National Laboratory
Group CST-10, MS J514
P. O. Box 1663
Los Alamos NM 87545
USA
Phone: (505) 665-5336
FAX: (505) 665-4955

Chris Reppmann
NAGRA - Switzerland
Bertlingen 4
D-79639 Grenzach
Germany
Phone: 49-76-24-2330
FAX: 49-76-24-6341

Dr. English Percy
Center for Nuclear Waste Regulatory Analyses
Southwest Research Institute
Post Office Drawer 28510
San Antonio TX 78228
USA
Phone: (210) 522
FAX: (210) 522-5155

Dr. Ardyth Simmons
U.S. Department of Energy
Yucca Mountain Project Office
101 Convention Center Dr.
Las Vegas NV 89109
USA
Phone: (702) 794-7946
FAX: (702) 794-7325

Mr. Luis Perez Del Villar
CIEMAT
Avda. Complutense No. 22
28040 Madrid
Spain
Phone: 34-91-346-6389
FAX: 34-1-346-6005

Dr. John Smellie
CONTERRA AB
P. O. Box 493
751 06 Uppsala
Sweden
Phone: 46-18-12-3241
FAX: 46-18-12-3262

Prof. Roland Pusch
Clay Technology AB
IDEON Research Center
S-22370 Lund
Sweden
Phone: 46-46-182-570
FAX: 46-46-134-230

Dr. Walter Steininger
Kernforschungszentrum Karlsruhe
Projekträger des BMFT für Entsorgung (PTE)
Postfach 3640
D-76021 Karlsruhe
Germany
Phone: 49-7247-82-5788
FAX: 49-7247-82-5796

Dr. David Read
WS Atkins E.S.
Woodcote Grove, Ashley Road
Surrey KT18 5BW
UK-Epsom
Phone: 44-372-726140 x 4372
FAX: 44-372-74-0055

Abraham Van Luik
M&O/INTERA
101 Convention Center Dr.
Las Vegas NV 89109
USA
Phone: (702) 794-7441
FAX: (702)

LIST OF PARTICIPANTS (Cont.)

Dr. Juhani Vira
Teollisuuden Voima Oy
Annankatu 42 C
00100 Helsinki
Finland
Phone: 358-0-6180-2538
FAX: 358-0-6180-2570

Dr. Henning von Maravic
CEC-DG XII/F/5 - ARTS 2/32
Rue de la Loi 200, ARTS 2-32
1049 Brussels
Belgium
Phone: 32-2-296-52-73
FAX: 32-2-295-49-91

Mircea A. Weiser
NAGRA - Switzerland
Bahnhofstr. 63
4125 Riehen
Basel/Riehen
Switzerland
Phone: 41-61-641-66-34
FAX: 41-61-641-36-90

Mr. Hidekazu Yoshida
Power Reactor and Nuclear Fuel Development Corporation
(PNC)
TONO Geoscience Center
959-31, Sonodo, Jyorinji
Tokk-shi Gifu-ken 509-51
Japan
Phone: 81-572-54-1271
FAX: 81-572-55-0180