

**UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION**

**Atomic Safety and Licensing Board**

**Before Administrative Judges:**

ASLBP BOARD 09-876-HLW-CAB01 William J. Froehlich, Chairman Thomas S. Moore Richard E. Wardwell	ASLBP BOARD 09-877-HLW-CAB02 Michael M. Gibson, Chairman Alan S. Rosenthal Nicholas G. Trikouros	ASLBP BOARD 09-878-HLW-CAB03 Paul S. Ryerson, Chairman Michael C. Farrar Mark O. Barnett
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**In the Matter of** )  
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**U.S. DEPARTMENT OF ENERGY** ) **Docket No. 63-001**  
 )  
**(High Level Waste Repository)** ) **May 12, 2009**

**STATE OF NEVADA'S  
NEW CONTENTIONS BASED ON FINAL NRC RULE**

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I. **INTRODUCTION**

The Commission's Notice of Hearing, CLI-08-25, \_\_\_ NRC \_\_\_ (2008), 73 Fed. Reg. 63029 (Oct. 22, 2008), provides in paragraph VII that Nevada and other petitioners may amend their contentions to the extent that the NRC's final rule implementing the EPA standards for the post-10,000-year performance assessment offers "fresh grounds." Such contentions are timely if filed on or before May 12, 2009, sixty days from the publication of NRC's rule in the Federal Register, which occurred on March 13, 2009 (74 Fed. Reg. 10811). In accordance with the Notice of Hearing, and 10 C.F.R. 2.309, the following new contentions are hereby filed. Each of these contentions address a specific aspect of the NRC rule which offer "fresh grounds" in terms of new regulatory language not contained in the EPA rule.

**NEV-SAFETY-202 - CONTINUATION OF CLIMATE CHANGE FEPs**1. A statement of the contention itself

As provided in SAR Subsections 2.2.1.2 and 2.3.1.1, and as reflected in related SAR subsections, climate-change processes included as FEPs in the TSPA for the first 10,000 years are neither carried forward for the next 990,000 years, as the rule requires, nor represented by NRC's specified deep percolation rate for that subsequent period.

If the climate change processes addressed by this contention are not included as FEPs for the first 10,000 years, and not taken into account beyond 10,000 years for that reason, or if the climate change processes addressed by this contention are included as FEPs for the first 10,000 years, but 10 C.F.R. § 63.342 (c) is construed so that climate-change processes included as FEPs in the TSPA for the first 10,000 years are not carried forward for the next 990,000 years, then there are special circumstances with respect to the subject matter of this proceeding such that application of 10 C.F.R. § 63.342(c), which places limits on features, events and processes to be considered in the post-10,000-year period, does not serve the purposes for which it was adopted, and this contention is a rule challenge under 10 C.F.R. § 2.335.

2. A brief summary of the basis for the contention

SAR Subsection 2.2.1.2 identifies certain FEPs related to climate change as included in the TSPA, but Subsection 2.3.1.1 provides that these play no role in the performance assessment after 10,000 years. After 10,000 years, no FEPs or TSPA models are used to estimate net infiltration. Instead, the deep percolation flux as stated in NRC's proposed rule is used. However, this violates the requirement in 10 C.F.R. § 63.342(c) that FEPs included in the 10,000-year performance assessment must also be included in the post-10,000-year performance assessment. Moreover, even if the specification of deep percolation flux in 10 C.F.R. §

63.342(c)(2) were construed to supersede the requirement in 10 C.F.R. § 63.342(c) that FEPs included in the 10,000-year performance assessment must also be included in the post-10,000-year performance assessment, DOE's TSPA fails to include the deep percolation in NRC's final rule, which is different from the one NRC proposed. Finally, it is of overriding importance that the range of climatic conditions that could apply in the post-10,000-year period has not been determined. In these circumstances, the specification of a range of deep percolation rates, whether it is that adopted by the DOE in the SAR or that set out by the NRC in the revised final rule, is not underpinned by scientific argument that accounts for recent advances in scientific knowledge.

3. A demonstration that the contention is within the scope of the hearing

This contention questions DOE's interpretation of, and compliance with, applicable requirements in 10 C.F.R. Part 63 and is within the scope of the hearing as provided in paragraph one of Section II of the Notice of Hearing ("The matters of fact and law to be considered are whether the application satisfies . . . the NRC standards in 10 C.F.R. Part 63 for a construction authorization. . .").

This contention also raises an issue whether there are special circumstances with respect to the subject matter of this proceeding such that application of 10 C.F.R. § 63.342(c), which implicitly places limits on features, events and processes to be considered in the post-10,000-year period, does not serve the purposes for which it was adopted. It is within the scope of this proceeding to certify the contention to the Commission, as required by 10 C.F.R. § 2.335(d).

4. A demonstration that the contention is material to the findings NRC must make to license Yucca Mountain

10 C.F.R. § 63.31(a)(2) states that the NRC may authorize construction of the Yucca Mountain repository if it determines that there is reasonable expectation the materials described

in the application can be disposed of without unreasonable risk to the health and safety of the public. To make this finding, 10 C.F.R. §§ 63.102(j) and 63.113 require that a performance assessment be performed to show compliance with the post-10,000-year dose standard in 10 C.F.R. § 63.311(a)(2). This performance assessment must comply with 10 C.F.R. §§ 63.102(j), which provides (with limited exceptions) that a performance assessment must include features, events and processes (FEPs) "that might affect performance," and 10 C.F.R. § 63.342(c), which (again with limited exceptions) provides that the post-10,000-year performance assessment shall project the continued effects of FEPs included in the 10,000-year performance assessment. This contention questions DOE's interpretation of, and compliance with, 10 C.F.R. § 63.342(c) and therefore is material to the findings NRC must make.

If 10 C.F.R. § 63.342(c) is construed so that climate-change processes included as FEPs in the TSPA for the first 10,000 years are not carried forward for the next 990,000 years, but are instead represented by the specified percolation rate, or if for some other reason the climate-change processes addressed by this contention are not included as FEPs for the first 10,000 years, and not carried forward for that reason, then the implicit limitation in 10 C.F.R. § 63.342(c) has the effect of excluding this contention, regardless of its effects on performance, dose to the RMEI, and the NRC's ability to find that there is reasonable expectation the materials described in the application can be disposed of without unreasonable risk to the health and safety of the public. Moreover, in promulgating the recent amendments to Part 63, the Commission provided that a waiver of a provision of the new rule under 10 C.F.R. § 2.335 would be appropriate if the provision "no longer provides a reasonable basis for demonstrating compliance based on new scientific evidence." 74 Fed. Reg. 10811, 10824 (March 13, 2009). This

contention is based on scientific evidence, not considered in the rulemaking, indicating that 10 C.F.R. § 63.342(c) no longer provides a reasonable basis for demonstrating compliance.

Therefore, whether 10 C.F.R. § 63.342(c) should apply so as to exclude the FEP which is the subject of this contention, or be waived, presents a material issue.

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

The deficiencies which are the subject of this contention are apparent on the face of the SAR. SAR Subsection 2.2.1.2 identifies certain FEPs as included in the TSPA and bearing on the application of 10 C.F.R. § 63.342(c), including the climate-change FEPs 1.3.01.00.0A, 1.4.01.01.0A and 2.3.11.03.0A. These climate-change FEPs relate to the general consideration of climate change, increases in recharge caused by climate modification, and infiltration and recharge in general, respectively. However, SAR Subsection 2.3.1.1 provides that these play no role in the performance assessment after 10,000 years. After 10,000 years no FEPs or TSPA models are used to estimate net infiltration, and instead, the deep percolation flux as stated in NRC's proposed rule is used. However, this violates the requirement in 10 C.F.R. § 63.342(c) that FEPs included in the 10,000-year performance assessment must also be included in the post-10,000-year performance assessment.

Moreover, even if the specification of deep percolation flux in 10 C.F.R. § 63.342(c)(2) were construed to supersede the requirement in 10 C.F.R. § 63.342(c) that FEPs included in the 10,000-year performance assessment must also be included in the post-10,000-year performance assessment, DOE's TSPA fails to include the deep percolation rates in NRC's final rule, which are different from those proposed. Specifically, NRC proposed (and the SAR uses) a constant in time value of deep percolation flux based on a log-uniform probability distribution from 13 to 64 mm/yr, but the final rule specified a constant in time value of deep percolation flux based on a

lognormal distribution with an arithmetic mean of 41 mm/yr and a standard deviation of 33 mm/yr, truncated so that the deep percolation rates vary between 10 and 100 mm/yr.

Climate change, due to both natural factors, such as changes in the insolation flux at the top of the atmosphere, and human-induced factors such as the release of greenhouse gases from the burning of fossil fuels, will occur over the next 10,000 years and beyond. NEV-SAFETY-09 and NEV-SAFETY-10 argue that the DOE representation of climate change over the next 10,000 years is deficient and fails to represent the full range of conditions that could occur.

Furthermore, NEV-SAFETY-11 argues that the DOE projection of a cooling trend in climate change before and beyond 10,000 years fails to take into account the likely effects of greenhouse-gas induced warming, which are likely to result in any cooling trend being deferred for at least several tens of thousands of years.

Beyond 10,000 years, although the same climate-related processes are relevant as before 10,000 years, their absolute and relative significance in determining climate will change and will continue to vary with time. In the period beyond 10,000 years, climatic conditions at Yucca Mountain will be determined by complex, changing interactions between insolation changes driven by changes in the orbital characteristics of the Earth, which have characteristic timescales of between 21,000 and 400,000 years, natural variations in greenhouse-gas concentrations in the atmosphere, the slow reduction in greenhouse-gas concentrations resulting from human activities over the last few centuries and continuing at the present day, and internal variability within the climate system at sub-orbital timescales. The effects of these complex interactions have been studied for Europe through the use of Earth Models of Intermediate Complexity in conjunction with snapshot studies using Atmosphere-Ocean General Circulation Models and Regional Climate Models (*see* "Development and Application of a Methodology for taking Climate-driven

Environmental Change into account in Performance Assessments" (BIOCLIM, 2004, Deliverable D10-12) (Châtenay-Malabry, France)). However, neither DOE nor NRC has conducted corresponding studies for Yucca Mountain. Therefore, the range of climatic conditions that could apply in the post-10,000-year period has not been determined. In these circumstances, the specification of a range of deep percolation rates, whether it is that adopted by the DOE in the SAR or that set out by the NRC in the revised rule, is not underpinned by scientific argument that accounts for recent advances in scientific knowledge.

The paragraph above presents special circumstances with respect to the subject matter of this proceeding such that application of 10 C.F.R. § 63.342(c), if construed to preclude consideration of this matter, does not serve the purposes for which it was adopted, which were to specify which FEPs must be included in the post-10,000-year performance assessment in order to assure that the results of the assessment would contribute meaningfully to the safety finding required by 10 C.F.R. § 63.31(a)(2), and also to eliminate certain FEPs from consideration based solely on information available and considered in the rulemaking. The above was not considered in the rulemaking, and this failure results in a performance assessment that does not contribute meaningfully to the safety finding required by 10 C.F.R. § 63.31(a)(2). The specific aspect of the subject matter of the proceeding at issue is the inclusion of appropriate FEPs in the performance assessment. Affidavits, as required by 10 C.F.R. § 2.335, are provided in Attachment 3 to Nevada's December 19, 2008 Petition to Intervene (Affidavit of Dr. Michael C. Thorne, as related to contentions NEV-SAFETY-09, 10, 11, and 12), and Attachment 15 of Nevada's December 19, 2008 Petition to Intervene (Affidavit of Dr. Jonathan Overpeck, as related to NEV-SAFETY-09, 10, 11, and 12) and are attached hereto.

6. There must be sufficient information to show that there is a genuine dispute with DOE, along with specific references to the portions of the LA being controverted

This contention raises a genuine dispute with DOE because it challenges DOE's interpretation of, and compliance with, applicable requirements in 10 C.F.R. Part 63, as DOE sets forth in SAR Subsections 2.2.1.2 and 2.3.1.1. It also challenges a regulation which DOE must address in its application. The basis for the genuine dispute is provided in paragraph 5 above.

**NEV-SAFETY-203 - EROSION FEP SCREENING AFTER 10,000 YEARS**1. A statement of the contention itself

Even if DOE's exclusion of land-surface erosion (FEP 1.2.07.01.0A), as reflected in SAR Subsections 2.2.1.1 and 2.2.1.2 and similar subsections, were correct for the first 10,000 years (but see NEV-SAFETY-41), land surface corrosion cannot be excluded from the TSPA in the period between 10,000 years and 1,000,000 years because topography modifications will continue to the point that topography is grossly altered. Within this latter period, portions of the Paintbrush Tuff may become completely eroded, with significant affects on infiltration and seepage, and the emplacement drifts may be exposed to the earth's surface, eliminating the upper geologic barrier entirely, with the result that doses to the RMEI will be increased significantly. Therefore, there are special circumstances with respect to the subject matter of this proceeding such that application of 10 C.F.R. § 63.342(c), which places limits on features, events and processes to be considered in the post-10,000-year period, does not serve the purposes for which it was adopted. This is a rule challenge under 10 C.F.R. § 2.335.

2. A brief summary of the basis for the contention

Erosion modeling and actual observations show that down-cutting into the superficial formations will significantly change the boundary conditions for infiltration and seepage modeling well before 10,000 years. As this process continues, not only will incision occur, but the whole crest of the mountain will gradually degrade, and beyond 10,000 years, this process will continue to depths below the elevation of the emplacement drifts.

3. A demonstration that the contention is within the scope of the hearing

This contention raises an issue whether there are special circumstances with respect to the subject matter of this proceeding such that application of 10 C.F.R. § 63.342(c), which implicitly

places limits on features, events and processes to be considered in the post-10,000-year period, does not serve the purposes for which it was adopted. It is within the scope of this proceeding to certify the contention to the Commission, as required by 10 C.F.R. § 2.335(d).

4. A demonstration that the contention is material to the findings NRC must make to license Yucca Mountain

10 C.F.R. § 63.31(a)(2) states that the NRC may authorize construction of the GROA at the Yucca Mountain site if it determines that there is reasonable expectation the materials described in the application can be disposed of without unreasonable risk to the health and safety of the public. To make this finding, 10 C.F.R. §§ 63.102(j) and 63.113 require that a performance assessment be performed to show compliance with the post-10,000-year dose standard in 10 C.F.R. § 63.311(a)(2). This performance assessment must comply with 10 C.F.R. §§ 63.102(j), which provides (with limited exceptions) that a performance assessment must include features, events and processes (FEPs) "that might affect performance," and 10 C.F.R. § 63.342(c), which (again with limited exceptions) provides that the post-10,000-year performance assessment shall project the continued effects of FEPs included in the 10,000-year performance assessment. The implicit limitation in 10 C.F.R. § 63.342(c) has the effect of excluding this contention, regardless of its effects on performance, dose to the RMEI, and the NRC's ability to find that there is reasonable expectation the materials described in the application can be disposed of without unreasonable risk to the health and safety of the public. Moreover, in promulgating the recent amendments to Part 63, the Commission provided that a waiver of a provision of the new rule under 10 C.F.R. § 2.335 would be appropriate if the provision "no longer provides a reasonable basis for demonstrating compliance based on new scientific evidence." 74 Fed. Reg. 10811, 10824 (March 13, 2009). This contention is based on new

scientific evidence, not considered in the rulemaking, indicating that 10 C.F.R. § 63.342(c) no longer provides a reasonable basis for demonstrating compliance.

Therefore, whether 10 C.F.R. § 63.342(c) should apply so as to exclude the FEP which is the subject of this contention, or be waived, presents a material issue.

5. A concise statement of the facts or expert opinions supporting the contention, along with appropriate citations to supporting scientific or factual materials

The LA excludes land-surface erosion as a FEP (FEP1.2.07.01.0A), claiming that it is of low consequence. DOE bases this exclusion on two similar analyses of isotope data (Stuckless, J.S. and Levich, R.A., eds. (2007), "The Geology and Climatology of Yucca Mountain and Vicinity, Southern Nevada and California," Memoir 199, Boulder, Colorado: Geological Society of America. TIC: 259378) and concludes that erosion rates are in the range 0.4-2.7 cm in 10,000 years or 0.2-6 cm in 10,000 years, depending on the dating method used (*see* SAR Subsections 2.2.1.1 and 2.2.1.2). Because DOE excludes land-surface erosion for the 10,000-year assessment, it is not required to be included in the post-10,000-year assessment.

However, debris flows at Yucca Mountain triggered by thunderstorms in 1984 and 2003 each locally removed much more material than suggested by these estimates. (Coe, J.A., Glancy, P.A., Whitney, J.W. (1997) "Volumetric Analysis and Hydrologic Characterization of a Modern Debris Flow Near Yucca Mountain, Nevada" GEOMORPHOLOGY, Vol. 20 at 11-28; *c.f.*, Syed, K.H., Goodrich, D.C., Myers, D.E., and Sorooshian, S. (2003) "Spatial Characteristics of Thunderstorm Rainfall Fields and Their Relation to Runoff," JOURNAL OF HYDROLOGY, Vol. 271, Issue 1-4 at 1-21 for description of general characteristics of such events.) The recent numerical modeling study of Stuewe, *et al.* (Stuewe, K., Robi, J. and Matthai, S. (2008) "Erosional Decay of the Yucca Mountain Crest," GEOMORPHOLOGY (in press), LSN# NEV000005187), using a straightforward and robust method to estimate how much the scarps of

recently active faults have been eroded, finds much higher rates than do Stuckless and Levich (2007). Stuckless and Levich's (2007) findings do not contradict these conclusions because those findings merely generalized local measurements on a small number of bedrock outcrops to the erosion process of the entire Yucca Mountain region.

Stuewe, *et al.*'s (2008) highly resolved numerical erosion model is based on a stream power approach in which the rate of erosion is assumed to be proportional to the size of the catchment as a proxy for water flux and to the square of the topographic gradient. The proportionality constants in the model are determined using the structural history of the region. Over the last 11 million years, extensional tectonics has dissected the region into a series of well-defined tilted fault blocks and the ratio of fault displacement and gully incision during this time has been used to scale the numerical model. Using these data, the model predicts that there will be 300 m of erosion after 500,000 years and that the Yucca Mountain crest will denude to the level of the proposed repository drifts within between 500,000 years and 5 million years. This prediction is based on conservative estimates for all involved parameters. Erosion may be more rapid if other processes are involved. For example, the model does not consider continuing uplift or catastrophic surface processes as have been recorded in the region. Also the model concept and the fixed spatial discretization employed promotes the formation of relatively wide V-shaped valleys, the formation of which requires removal of significantly more mass to reach the same level of incision as compared to canyons or valleys with convex flanks as are common in this part of Nevada (*cf.*, Braun, J. and Sambridge, M. (1997) "Modelling Landscape Evolution on Geologic Time Scales: A New Method Based on Irregular Spatial Discretization," Basin Research Vol. 9 No. 1 at 27-52).

The two arguments presented above relating to observed current rates of erosion and the long-term effects of erosion both demonstrate that the ongoing erosion process will be of special significance to safety assessment in the long term, between 10,000 and 1,000,000 years. This arises because the process will affect (1) the infiltration flux by changing the surface morphology and soil thickness, (2) the seepage and operation of the postulated natural barrier systems (the Paintbrush Tuff may get locally completely eroded between 100,000 years and one million years), and (3) the emplacement drifts may be exposed at the Earth's surface in 500,000 years.

The above presents special circumstances with respect to the subject matter of this proceeding such that application of 10 C.F.R. § 63.342(c), which limits post-10,000-year features, events and processes, does not serve the purposes for which it was adopted, which were to specify which FEPs must be included in the post-10,000-year performance assessment in order to assure that the results of the assessment would contribute meaningfully to the safety finding required by 10 C.F.R. § 63.31(a)(2), and also to eliminate certain FEPs from consideration based solely on information available and considered in the rulemaking. The above was not available or considered in the rulemaking, and a failure to consider it would result in a performance assessment that would not contribute meaningfully to the safety finding required by 10 C.F.R. § 63.31(a)(2). The specific aspect of the subject matter of the proceeding at issue is the inclusion of appropriate FEPs in the performance assessment. Affidavits, as required by 10 C.F.R. § 2.335, are provided in Attachment 3 of Nevada's December 19, 2008 Petition to Intervene (Affidavit of Dr. Michael C. Thorne, as related to contentions NEV-SAFETY-41), and Attachment 21 of Nevada's December 19, 2008 Petition to Intervene (Affidavit of Dr. Stephan K. Matthai, as related to NEV-SAFETY-41) and are attached hereto.

6. There must be sufficient information to show that there is a genuine dispute with DOE, along with specific references to the portions of the LA being controverted

This contention presents a genuine dispute with DOE because, as reflected in SAR Subsection 2.2.1.2, DOE excludes land surface erosion (FEP 1.2.07.01.0A) from the post-10,000-year performance assessment based solely on 10 C.F.R. § 63.342(c), which (with limited exceptions) provides that the post-10,000-year performance assessment shall project the continued effects of FEPs included in the 10,000-year performance assessment, implying that others need not be so considered, and the application of 10 C.F.R. § 63.342(c) to this effect is being challenged.

The dispute is a genuine one for the reasons given in paragraph 5 above.

II. **CONCLUSION AND PRAYER FOR RELIEF**

Based on the foregoing, the Department of Energy's License Application should be denied.

Respectfully submitted,

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Dated: May 12, 2009

**UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION**

**Atomic Safety and Licensing Board**

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**U.S. DEPARTMENT OF ENERGY** ) **Docket No. 63-001-HLW**  
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**(High Level Waste Repository)** ) **May 12, 2009**

**CERTIFICATE OF SERVICE**

I hereby certify that the foregoing State of Nevada's New Contentions Based on Final NRC Rule has been served upon the following persons by the Electronic Information Exchange.

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CAB 01

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*(signed electronically)*  
Susan Montesi

## **Attachment 3**

### **Affidavit of Michael C. Thorne**

BEFORE THE U.S. NUCLEAR REGULATORY COMMISSION

In the Matter of )  
 )  
U.S. DEPARTMENT OF ENERGY )  
 )  
License Application to Construct a )  
Geologic Repository at Yucca Mountain )  
 )

Docket No. 63-001

**AFFIDAVIT OF MICHAEL C. THORNE**

I, Michael C. Thorne, the undersigned affiant, do hereby make the following statements based upon my own knowledge, information, and belief.

1. My name is Michael C. Thorne, and my curriculum vitae is attached to this Affidavit as Attachment A. I am executing this Affidavit in support of the State of Nevada Petition to Intervene as a Full Party (Petition) in the above-captioned proceeding.

2. Within the Petition are numerous contentions, each comprised of several paragraphs. I hereby adopt as my own opinions the statements contained within Paragraph 5 of those specific contentions identified in Attachment B to this Affidavit.

3. Also within the Petition are numerous contentions relating to the TSPA. I hereby adopt as my own opinions the statements contained within Paragraph 6 of those specific contentions identified in Attachment C to this Affidavit.

4. I understand that attorneys for the State of Nevada will assign unique numbers to each of the contentions just prior to the filing of the Petition and will include those unique numbers in Attachments B and C.

Further, the affiant sayeth not.

*Michael C. Thorne*

Michael C. Thorne

*Signed before me on this  
8<sup>th</sup> December 2008*

*Hilary Garnett*

HILARY JANE GARNETT  
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ENGLAND



The above-named affiant personally appeared before me this 8<sup>th</sup> day of December, 2008, and executed this affidavit.

Hilary Garnett  
Notary Public

My Commission expires: on death

HILARY JANE GARNETT  
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**ATTACHMENT A**

**CURRICULUM VITAE**

**MICHAEL C. THORNE**

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**(Director: Dr M C Thorne)**

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Michael Charles Thorne

Qualifications: PhD FSRP    Year of birth: 1950    Nationality:    British

**PROFESSIONAL ACTIVITIES AND MEMBERSHIP**

Visiting Fellow at the Climatic Research Unit, School of Environmental Sciences, University of East Anglia

Fellow of the Society for Radiological Protection and a Past President of the Society

Member of the Editorial Board of the Journal of Radiological Protection

Member of the National Dose Assessment Working Group (NDAWG) and Chairman of the Habits Subgroup

Member of the Eco-ethics International Union

Consultant to the Institute for Energy and Environmental Research, Washington DC.

Quintessa Associate

Director, Mike Thorne and Associates Limited

**ACADEMIC RESPONSIBILITIES**

Formal supervision of two PhD students at the University of East Anglia:

P Burgess, Future Climatic and Cryospheric Change on Millennial Timescales: An Assessment using Two-dimensional Climate Modelling Studies, PhD awarded 1998.

M Hoar, Reconstructing Climate Gradients across Europe for the Last Glacial-interglacial Cycle, PhD awarded 2004.

Informal supervision of PhD students at the University of Edinburgh (development and retreat of ice sheets) and at Imperial College of Science, Technology and Medicine (radionuclide transport in vegetated soil columns – experimental studies and modelling interpretations).

Teaching on the MSc course on Environmental Radioactivity at the University of Surrey.

Teaching on the MSc course in Environmental Technology at Imperial College of Science, Technology and Medicine.

Supervision of Post-doctoral research activities at the Universities of East Anglia; University of Newcastle and Imperial College of Science, Technology and Medicine on behalf of various commercial clients.

## **CAREER HISTORY (Selection of Projects)**

### **Mike Thorne and Associates Limited, 2001 onward**

***Development of Climate and Landscape Change Scenarios, Biosphere Factors and Characteristics of Potentially Exposed Groups for the LLWR near Drigg, West Cumbria***  
***Client - Nexia Solutions Ltd***

Project building on previous work for BNFL relating to the LLWR and for the NDA relating to vulnerabilities of various sites.

***Radiological Impact of NORM Discharges to the Marine Environment***  
***Client - Scotoil Services Ltd***

Support to an appeal against a SEPA decision to curtail such discharges from North Pier, Aberdeen.

***Development of Proposals for Setting Radiation Protection Standards based on Consideration of More Sensitive Individuals in a Population***  
***Client – Institute for Energy and Environmental Research, Washington DC***

Overall project review and development of techniques for calculating radiation doses to the early embryo from internally incorporated radionuclides.

***Review of Impacts of Coastal Erosion at Hunterston***  
***Client – ERM Limited***

Evaluation of the potential radiological implications of coastal erosion on the VLLW pits at Hunterston Nuclear Power Station.

***Advice on Dose Reconstruction***  
***Client – S A Cohen & Associates for NIOSH***

Advice on dose reconstructions for workers at DOE facilities from 1941 onward.

***Advice on Effects of Radionuclides on Organisms other than Man***  
***Client – Nuclear Safety Solutions Limited, Canada***

Provision of guidance on dosimetry, reference levels and effects relevant to selected protected species.

***Participation in Safety Assessment Studies for the Baita Bihor Repository, Romania***  
***Client – Quintessa/for the European Union***

Compilation of inventory data, shielding studies and development of both operational and post-closure safety cases.

***Review of the Yucca Mountain Project***  
***Client – State of Nevada***

Co-ordination of technical activities involved in a review of the proposed License Application by US DOE for disposal of radioactive wastes at Yucca Mountain.

***Co-ordination of biosphere research and participation in BIOCLIM***  
***Client – UK Nirex Ltd (NDA/RWMD)***

Co-ordination of research on climate change, ice-sheet development, near-surface hydrology and radionuclide transport, as well as participation in an international programme on the implications of climate change for radioactive waste disposal. Also includes development of new models for radionuclide transport in the biosphere and for the gas pathway.

***Development of a Handbook on Radionuclide Behaviour in the Environment***  
***Client – Serco Assurance***

Development of a handbook for Environment Agency staff outlining the behaviour of a wide variety of radionuclides in terrestrial and aquatic environments.

***Development of a Simplified Dose Assessment Model***  
***Client – Serco Assurance***

Development of a simplified spreadsheet-based dose assessment tool for use by Environment Agency staff in determining Authorisations.

***Provision of Biosphere Advice***  
***Client – Ciemat, Spain***

Provision of advice on models and data relevant to geological disposal of radioactive wastes

***Provision of Advice on Safety***  
***Client – NNC Ltd/Defra***

Provision of expert advice to the UK Committee on Radioactive Waste Management (CoRWM).

***Effects of Radiation on Organisms Other Than Man***  
***Client – AEA Technology/Serco Assurance***

Study for ANDRA to identify appropriate indicator organisms and develop appropriate dosimetry and effects models for those organisms.

***Member of the Site Investigation Expert Review Group (SIERG)***  
***Client – SKB***

Oversight reviews of site investigation activities and the associated research and assessment programmes.

***Advice on the Short-, Medium- and Long-term Effects of Climate Change on Nuclear Licensed Sites***

***Client – BNFL and Nexia Solutions Ltd***

Interpretation of results from the international BIOCLIM project in relation to decommissioning and solid radioactive waste management, with particular emphasis on the potential significance of sea-level changes. Review of information on coastal vulnerabilities at NDA sites.

***Advice on Submarine Reactor Accidents and the Development of Detailed Emergency Planning Zones***

***Client – Electrowatt-Ekono***

Assistance to MoD in revising emergency planning criteria in the light of recent changes of views on Emergency Reference Levels and other technical developments. Also studies on tritium analyses and migration from transfer tanks.

***Review of Continuing Operational Safety Cases***

***Client – Electrowatt-Ekono***

Review of COSRs developed by BNFL for contaminated land.

***Development of a New Soil-Plant Model for use in Radiological Assessments***

***Client – Food Standards Agency/Quintessa***

Development of the specification for a new soil-plant model (PRISM) to replace that implemented in the SPADE suite of codes (implementation of the model has been by Quintessa) and extension of that work to new models for  $^3\text{H}$  and  $^{14}\text{C}$ .

***Review of Probabilistic Safety Assessment and Criticality Issues relating to a Proposed Surface Storage Facility for Spent Nuclear Fuel***

***Client – State of Utah***

Review of the potential for criticality in breached storage casks and of the probability of breaching by aircraft impacts. Also, supervision of various criticality and radiation shielding calculations.

***Development of Models for Radionuclide Transfers to Sewage Sludge and for Evaluating the Radiological Impact of Sludge applied to Agricultural Land***

***Client – Food Standards Agency***

Includes a review of literature and the development and implementation of probabilistic models for such transfers.

***Development of Biokinetic Models for Radionuclides in Animals***  
***Client – Serco Assurance***

Development of updated biokinetic models for use by the Food Standards Agency in their SPADE and PRISM modelling systems.

***Review Studies for the Proposed Australian National Radioactive Waste Repository***  
***Client – RWE NUKEM***

Reviews of reports on animal transfer factors and of the potential effects of climate change on the repository plus development of a model for the biokinetics of the  $^{226}\text{Ra}$  decay chain in grazing animals.

***Development and Application of a Model for Assessing the Radiological Impacts of  $^3\text{H}$  and  $^{14}\text{C}$  in Sewage Sludge***  
***Client – NNC Ltd***

Development of a model based on physical, chemical and biochemical principles for the uptake of  $^3\text{H}$  and  $^{14}\text{C}$  into sewage sludge and their subsequent distribution and transport after application of the sludge to agricultural land.

***Support for development of the Drigg Post-closure Radiological Safety Assessment***  
***Client - BNFL***

Support in the areas of FEP analysis, biosphere characterisation, human intrusion assessment and the effects of natural disruptive events. In addition, provision of advice of future research initiatives that should be pursued by BNFL.

***Review of Parameter Values***  
***Client – AEA Technology/Serco Assurance***

Review of biosphere parameter values for use in the ANDRA assessment model AQUABIOS.

***Development of a Database related to Emergency Planning***  
***Client – AEA Technology (Rail)***

Identification of relevant international, overseas and national legislation, regulations and guidance, and production of brief summaries of the documents.

***Dose Reconstruction for Workers on a Uranium Plant***  
***Client - McMurry and Talbot***

Dose reconstruction for the plaintiffs in a case relating to the Paducah Gaseous Diffusion Plant.

***Dose Reconstruction for a Worker Exposed to Pu and Am***  
***Client – Pattinson and Brewer***

Dose reconstruction for a worker exposed by a puncture wound in the finger while working at a glove box.

**AEA Technology, 1998-2001**

***Revision of Exemption Orders Made Under the Radioactive Substances Act***

***Client – DETR***

Review of requirements for revision and preparation of a draft text for the purposes of consultation.

***Assessment of Remediation Options for Uranium Liabilities in Eastern Europe***

***Client - European Commission***

Studies of remediation requirements relating to mines, waste heaps and hydrometallurgical plant in Bulgaria, Slovakia and Albania.

***Evaluation of Unusual Pathways for Radionuclide Transport from Nuclear Installations***

***Client – Environment Agency***

Review of literature and conduct of formal elicitation meetings to determine potential pathways and evaluate their radiological significance.

***Support Studies on the Drigg Post-closure Performance Assessment***

***Client - BNFL***

Support in the areas of FEP analysis, biosphere characterisation, human intrusion assessment and the effects of natural disruptive events. In addition, provision of advice of future research initiatives that should be pursued by BNFL.

***Development of Models for the Biokinetics of H-3, C-14 and S-35 in Farm Animals***

***Client - FSA***

Review of relevant literature, development of appropriate biokinetic models and implementation in stand-alone software.

***Integration of Aerial and Ground-based Monitoring in the Event of a Nuclear Accident***

***Client - FSA***

Desk-based review and simulation study designed to determine optimum monitoring strategies for different types of accidents.

***Elicitation of Parameter Values for use in Radiological Impact Assessment Models***

***Client - FSA***

Expert elicitation study to provide distributions of parameter values for use in the suite of assessment models currently used by the FSA for routine and accidental releases.

***Biosphere Research Co-ordination and Assessment Studies***

***Client - United Kingdom Nirex Ltd***

Continuation of a programme of work originally undertaken at Electrowatt Engineering (UK) Ltd

***Site Investigation and Risk Assessment - Hilsa Lines***

***Client - Portsmouth City Council***

Radiological assessment of a radium-contaminated site.

**Electrowatt Engineering (UK) Ltd, 1987-1998**

***Development of a Siting Policy for Nuclear Installations: Harbinger Project and Follow-up Study***

***Client - HSE/NSD***

Review of existing policy and development of alternatives as a precursor to application to a wide range of installations, not restricted to commercial reactors.

***Support to the Rock Characterisation Facility Public Enquiry***

***Client - UK Nirex Ltd***

Preparation of position papers and rebuttals of evidence.

***Rongelap Resettlement Project***

***Client - Marshall Islands Government***

Participation in an oversight committee evaluating the radiological safety of Rongelap in the context of resettlement by its evacuated community.

***Evaluation of Inhalation Doses from Uranium***

***Client - Baron & Budd***

Provision of expert witness support in a class action relating to environmental exposure from a uranium plant.

***Biosphere Studies Relating to Drigg***

***Client - BNFL***

Provision of advice on time-dependent biosphere modelling for the Drigg low-level radioactive waste disposal facility.

***Radiation Doses to an Individual as a Consequence of Working on the San Onofre Nuclear Power Plant***

***Client - Howarth & Smith***

Interpretation of personal and area monitoring data for legal purposes.

***Interpretation of Uranium in Urine Data for the Fernald, Ohio Feed Materials Processing Center***

***Client - Institute for Energy and Environmental Research***

Interpretation of urinalysis and lung counting data, and appearance as an expert witness in the associated trial.

***Determination of Failure Probabilities for use in PRA***

***Client - Nuclear Installations Inspectorate***

Development of new approaches to the use of Bayes Theorem in defining component failure probabilities for use in PRA when statistics on actual failures are limited.

***Review of Inventory Information***

***Client - UK Nirex Ltd***

Review of uncertainties in inventories of individual radionuclides.

***ALARP Study of Options for the Treatment, Packaging, Transport and Disposal of Plutonium Contaminated Material***

***Client - UK Nirex Ltd***

Use of multi-attribute utility analysis to establish which option is preferred.

***Expert Judgement Estimation of Intrusion Model Parameters***

***Client - British Nuclear Fuels plc***

Project Manager of a study assessing the risks of human intrusion into Drigg radioactive disposal site using expert judgement techniques.

***Brainstorming Study of Risks Associated with Building Structures***

***Client - Building Research Establishment***

Participation in a classification study of the health risks associated with buildings including both injuries and disease.

***Radiological Consequences of Deferred Decommissioning of Hunterston A***

***Client - Scottish Nuclear Ltd***

Project Manager of a study of the radiological impacts of groundwater transport of radionuclides, releases to atmosphere and intrusion.

***Reviews of Safety Documentation***

***Client - UK Nirex Ltd***

Review of safety related documentation for Packaging and Transport Branch.

***The Sheltering Effectiveness of Buildings in Hong Kong***

***Client - Ove Arup & Partners***

Project Manager of a study evaluating the shielding effectiveness of all types of building in Hong Kong for volume sources of photons in air and surface deposition sources.

***Assessment of the Radiological Impact of Releases of Radionuclides from Premises other than Licensed Nuclear Sites***

***Client - Ministry of Agriculture, Fisheries and Food***

Project Manager of a study to identify representative premises, obtain data on their releases of radionuclides and assess radiological impacts using a new methodology developed for the project.

***Assessment of the Radiological Implications of Uranium and its Radioactive Daughters in Foodstuffs***

***Client - Ministry of Agriculture, Fisheries and Food***

Project Manager of a review study of concentrations of uranium and its daughters in foodstuffs, taking local and regional variations in uranium concentrations in soils, sediments and waters into account.

***Radionuclides in Sewage***

***Client - Her Majesty's Inspectorate of Pollution***

Project Manager of a study including a desk review on alternative methods of disposal of sewage sludges, interpretation of monitoring data relating to radionuclide discharges from Amersham International to the public sewer system, development of a model for radionuclide transport in sewers, and collection and analysis of effluent, foul water, sediment, sludge and other samples suitable for use in model validation studies.

***Accident Consequence Calculations***

***Client - Nuclear Installations Inspectorate***

Project Manager of a study to assess the radiological consequences of various atmospheric releases using the MARC code.

***Definition of Threshold Recording Levels for Drums of ILW***

***Client - UK Nirex Ltd***

Project Manager of a study of the implications of post-closure radiological impacts of radioactive waste disposal in defining Threshold Recording Levels for radionuclides in individual waste drums.

***Definition of Expert Judgment Exercises Relating to Nuclear Safety***

***Client - Commission of the European Communities***

Project Manager for a study defining expert judgment exercises relating to conceptualisation, representation and input data specification. Included a comprehensive review of available formal expert judgment procedures, and mathematical and behavioural aggregation techniques.

***Definition of Research Requirements Relating to the Use of Expert Judgment in Parameter Value Elicitation for Reactor Safety Studies in a UK Context***

***Client - Nuclear Safety Research Management Unit, HSE***

Development of proposals for using combined behavioural and mathematical aggregation procedures in formal elicitations of expert judgment.

***Development Priorities for the Drigg Technical Development Programme***

***Client - British Nuclear Fuels plc***

Provision of detailed advice to BNFL on future design options, and research and development priorities, in relation to radioactive waste disposal at Drigg.

***Channel Tunnel Safety Studies***

***Client - Channel Tunnel Safety Authority***

Provision of advice and guidance on safety criteria appropriate to the Fixed Link, on the classes of Dangerous Goods that may properly be carried and on the overall characteristics of the proposed Safety Case.

***Development of Societal Risk Criteria***

***Client - Marathon Oil***

Interpretation of F-N curves in the context of the offshore oil/gas industry, taking risk aversion into account.

***Impacts of Salt Dispersal on Plant Communities***

***Client - Sir William Halcrow***

Evaluation of salt dispersal from a major road in winter in relation to adjacent Sites of Special Scientific Interest.

***Offsite Consequence Assessments  
Client - Nuclear Electric***

Studies of the offsite radiological impacts of atmospheric and liquid releases of radioactive materials from Magnox stations.

***Dry Run 3  
Client - Her Majesty's Inspectorate of Pollution***

Uncertainty and bias studies involving formal expert judgment procedures to develop a conceptual model of those factors and interrelationships which are of significance in determining the post-closure radiological impact of a deep geological repository for radioactive wastes. This project also included advice on data and models to be used for post-closure radiological assessments.

***Radiological Assessments of Drigg  
Client - British Nuclear Fuels plc***

Project Manager for post-closure radiological impact assessments of the Drigg LLW disposal site. Also included specification and development of computer codes relating to the radiological impact of fires, releases of radioactive gases produced by microbial action and metal corrosion, and human intrusion.

***Biosphere Co-ordination  
Client - UK Nirex Ltd***

Co-ordination of the UK Nirex Ltd Biosphere Research Programme from its inception, including requirements definition, technical management of all projects and QA surveillance as the Client's Representative.

***Biosphere Support for the Nirex Disposal Safety Assessment Team  
Client - AEA Technology***

Development of approaches for assessing the radiological impact of releases of radionuclides to the biosphere, plus advice on radiological protection criteria, definition of individual risk, implications of conventionally toxic chemicals in wastes and a variety of other matters.

***Evaluation and Radiological Assessment of Liquid Effluent Releases from Various Premises  
Client - Her Majesty's Inspectorate of Pollution***

Reviews of monitoring data and evaluations of radiological impact, primarily related to Harwell, Aldermaston, Capenhurst and Amersham International.

***Evaluation of the Radiological Impact of Overseas Nuclear Accidents  
Client - Her Majesty's Inspectorate of Pollution***

Studies of the impact of potential overseas nuclear accidents on the UK, with emphasis on survey and monitoring requirements, and the selection of appropriate radiation detection equipment for monitoring.

***Bilsthorpe Power Station***

***Client - British Coal/East Midlands Electricity***

Preparation of an Environmental Statement with emphasis on atmospheric dispersion of SO<sub>2</sub> and NO<sub>x</sub>.

***Gas Generation in Radioactive Waste Disposal Facilities***

***Client - AEA Technology***

Development of a coupled microbial degradation and corrosion model for gas generation in repositories for LLW and ILW.

***Effects of Chernobyl on Drinking Water Supplies***

***Client - Her Majesty's Inspectorate of Pollution***

Evaluation of the radiological implications of enhanced concentrations of radionuclides in water supplies in England and Wales subsequent to the Chernobyl accident.

***Sea Disposal of Radioactive Wastes***

***Client - UK Nirex Ltd***

Participation in an Environmental Impact Assessment of the proposed resumption of sea-dumping of radioactive wastes.

***UK Research Related to Radioactive Waste Management***

***Client - Her Majesty's Inspectorate of Pollution***

Identification of gaps in the UK national research effort related to radioactive waste management.

***Research Requirements for Repository Design and Site Investigations***

***Client - UK Nirex Ltd***

Review of research requirements for repository design and site investigations in relation to LLW and ILW disposal in near-surface and deep repositories.

***International Commission on Radiological Protection, Sutton, Surrey, England, 1985-1986***

Scientific Secretary responsible for arranging and minuting meetings, administrative arrangements, technical review of reports, editing of the Commission's journal, liaison with other international organisations and public relations.

**ANS Consultants Ltd, Epsom, Surrey, England, 1979-1985**

Reviews of data on the distribution and transport of radionuclides in terrestrial and aquatic ecosystems (see publications list).

Development of a dynamic model for radionuclide transport in agricultural ecosystems and implementation of the model on various microcomputer systems.

Photon and neutron shielding studies of radiochemical plant, together with area classification and ALARA studies.

A review of UK use of the criticality code MONK and other approaches to criticality safety assessment.

Radiological and conventional safety aspects of Magnox reactor decommissioning.

Development of metabolic models for inclusion in ICRP Publication 30.

Development of pharmacodynamic models for toxic chemicals.

Review of neutron activation analysis in studies of radionuclide transport in soils and plants.

Experimental studies on radionuclide transport in soils and plants using various photon-emitting radionuclides.

Support for DoE work on probabilistic risk assessment of LLW and ILW disposal.

Review of UK research requirements for HLW disposal.

Post-closure radiological impact assessment of the proposed LLW and ILW facility at Elstow, Bedfordshire.

Development of a generalised biosphere model for use in probabilistic risk assessments of solid radioactive waste disposal.

Initial development of a mathematical model for use in assessing the radiological impact of contaminated groundwater.

Development, computer implementation and comprehensive documentation of a model to calculate the radiological impact of intrusion into radioactive waste repositories.

Development of a general-purpose computer code for solving first-order differential equations using a hybrid Predictor-Corrector/Runge-Kutta method.

Studies on the potential radiological consequences of Magnox reactor accidents.

**Medical Research Council Radiobiology Unit, Chilton, Didcot, Oxon, England, 1974-1979**

Development of dosimetric and metabolic models for use in ICRP Publication 30.

Studies on the metabolism of plutonium in bone and relationships to blood flow.

Theoretical studies on radionuclide metabolism and dosimetry.

Development of techniques in neutron-induced autoradiography and alpha imaging.

Image analysis studies of plutonium in bone, uranium in lungs, lysosomal inclusions in cells and heterochromatin.

Studies on the clearance of inhaled  $\text{UO}_2$ .

Alpha spectroscopy in support of toxicity studies with Ra-224.

Data analysis in connection with experimental animal studies on the potential efficacy of neutron therapy using 42 MeV neutrons.

**University of Sheffield, 1971-1974**

Experimental studies on the reaction  $\gamma + p \rightarrow \pi^0 + p$  at photon energies between 1 and 3 GeV, using a linearly polarised photon beam.

**SELECTION OF PUBLICATIONS**

A measurement of the beam asymmetry parameter for neutral pion photoproduction in the energy range 1.2 - 2.8 GeV. P.J. Bussey, C. Raine, J.G. Rutherglen, P.S.L. Booth, L. Carroll, G.R. Court, A.W. Edwards, R. Gamet, C.J. Hardwick, P.J. Hayman, J.R. Holt, J.N. Jackson, J. Norem, W.H. Range, F.H. Combley, W. Galbraith, V.H. Rajaratnam, C. Sutton and M.C. Thorne. London Conference (1974) Abstract 997.

The measurement of the polarisation parameters  $\Sigma$ ,  $P$  and  $T$  for positive pion photoproduction between 500 and 1700 MeV. P.J. Bussey, C. Raine, J.G. Rutherglen, P.S.L. Booth, L.J. Carroll, P.R. Daniel, C.J. Hardwick, J.R. Holt, J.N. Jackson, J.H. Norem, W.H. Range, F.H. Combley, W. Galbraith, V.H. Rajaratnam, C. Sutton, M.C. Thorne and P. Waller. Nuclear Physics, B104, (1976) 253-276.

The polarised beam asymmetry in photoproduction of eta mesons from protons 2.5 GeV and 3.0 GeV. P.J. Bussey, C. Raine, J.G. Rutherglen, P.S.L. Booth, L.J. Carroll, P.R. Daniel, A.W. Edwards, C.J. Hardwick, J.R. Holt, J.N. Jackson, J. Norem, W.H. Range, W. Galbraith, V.H. Rajaratnam, C. Sutton, M.C. Thorne and P. Waller. Physics Letters, 61B, (1976) 479-482.

Aspects of the dosimetry of plutonium in bone. M.C. Thorne. Nature, 259, (1976) 539-541.

The toxicity of Sr-90, Ra-226 and Pu-239. M.C. Thorne and J. Vennart. *Nature* 263, (1976) 555-558.

Radiation dose to mouse testes from Pu-239. D. Green, G.R. Howells, E.H. Humphreys and J. Vennart with Appendix by M.C. Thorne. Published in "The Health Effects of Plutonium and Radium", Ed. W.S.S. Jee, (J.W. Press, Salt Lake City, Utah, 1976).

The distribution and clearance of inhaled uranium dioxide particles in the repository tract of the rat. Donna J. Gore and M.C. Thorne. In "Inhaled particles IV", Ed. W.H. Walton, (Pergamon Press, Oxford, 1977) pp. 275-284.

Theoretical aspects of the distribution and retention of radionuclides in biological systems. M.C. Thorne. *J. Theor. Biol.*, 65, (1977) 743-754.

Aspects of the dosimetry of emitting radionuclides in bone with particular emphasis on Ra-226 and Pu-239. M.C. Thorne. *Phys. Med. Biol.*, 22, (1977) 36-46.

A new method for the accurate localisation of Pu-239 in bone. D. Green, G. Howells and M.C. Thorne. *Phys. Med. Biol.*, 22, (1977) 284-297.

The measurement of blood flow in mouse femur and its correlation with Pu-239 deposition. E.R. Humphreys, G. Fisher and M.C. Thorne. *Calcif. Tiss. Res.*, 23, (1977) 141-145.

The distribution of plutonium-239 in the skeleton of the mouse. D. Green, G.R. Howells, M.C. Thorne and J. Vennart. In "Proceedings of the IVth International Congress of the International Radiation Protection Association Vol. 2 (Paris 1977).

The visualisation of fissionable radionuclides in rat lung using neutron induced autoradiography. D.J. Gore, M.C. Thorne and R.H. Watts. *Phys. Med. Biol.*, 23 (1978) 149-153.

Lymphoid tumours and leukaemia induced in mice by bone-seeking radionuclides. J.F. Loutit and T.E.F. Carr with an appendix by M.C. Thorne. *Int. J. Radiat. Biol.*, 33, (1978) 245-263.

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The initial deposition and redistribution of Pu-239 in the mouse skeleton: implications for rodent studies in Pu-239 toxicology. D. Green, G.R. Howells and M.C. Thorne. *Br. J. Radiol.*, 52, 426-427 (1979).

Bran and experimental colon cancer. M.C. Thorne. *Lancet*, ii, 13 January 1979, p.108.

Quantitative microscopic studies of the distribution and retention of Pu-239 in the ilium of the female CBA mouse. D. Green, G.R. Howells and M.C. Thorne. *Int. J. Radiat. Biol.*, 36, 499-511 (1979).

Techniques for studying the distribution of alpha emitting and fissionable radionuclides in histological lung sections. T. Jenner and M.C. Thorne. *Phys. Med. Biol.*, 25, 357-364 (1980).

Morphometric studies of mouse bone using a computer-based image analysis system. D. Green, G.R. Howells and M.C. Thorne. *J. Microscopy*, 122, 49-58 (1981).

A semi-automated technique for assessing the microdistribution of  $^{239}\text{Pu}$  deposited in bone. D. Green, G.R. Howells and M.C. Thorne. *Phys. Med. Biol.*, 26, 379-387 (1981).

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A study of the sensitivity of a dynamic soil-plant-animal model to changes in selected parameter values. M.C. Thorne, P.J. Coughtrey and G.F. Meekings. In: *CEC Symposium on the Transfer of Radioactive Materials in the Terrestrial Environment Subsequent to an Accidental Release to Atmosphere*. Dublin, April 1983.

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Development of Increased Understanding of Potential Radiological Impacts of Radioactive Gases from a Deep Geological Repository: Dose Factors for Acetylene and Ethylene, M C Thorne, Mike Thorne and Associates Limited Report to UK Nirex Limited MTA/P0011b/2005-7: Issue 2, 2006.

Development of Increased Understanding of Potential Radiological Impacts of Radioactive Gases from a Deep Geological Repository: Hold-up of Rn-222, M C Thorne, Mike Thorne and Associates Limited Report to UK Nirex Limited MTA/P0011b/2005-8: Issue 2, 2006.

Development of Increased Understanding of Potential Radiological Impacts of Radioactive Gases from a Deep Geological Repository: Post-closure Significance of H-3, M C Thorne, Mike Thorne and Associates Limited Report to UK Nirex Limited MTA/P0011b/2005-9: Issue 2, 2006.

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LLWR Lifetime Project: R&D on Climate Change and Site Evolution, Mike Thorne and Associates Limited Report to Nexia Solutions Ltd, MTA/P0022/2007-1: Issue 2, March 2007.

Sensitivity Studies on Cl-36 Transport in Soils and Plants for Use in the BIOPROTA Model Inter-comparison Project, Mike Thorne and Associates Limited Report to the Nuclear Decommissioning Authority, MTA/P0011B/2007-1: Issue 1, May 2007.

**ATTACHMENT B**

Contentions Adopted By  
**Michael C. Thorne**  
(Paragraph 5) In Accordance  
With Affidavit

NEV-SAFETY-08

NEV-SAFETY-09

NEV-SAFETY-10

NEV-SAFETY-11

NEV-SAFETY-12

NEV-SAFETY-13

NEV-SAFETY-19

NEV-SAFETY-41

NEV-SAFETY-74

NEV-SAFETY-112

NEV-SAFETY-117

NEV-SAFETY-118

NEV-SAFETY-119

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NEV-SAFETY-122

NEV-SAFETY-147

NEV-SAFETY-148

NEV-SAFETY-159

NEV-SAFETY-160

NEV-SAFETY-161

NEV-SAFETY-163

NEV-SAFETY-164

NEV-SAFETY-170

NEV-SAFETY-180

NEV-NEPA-01

NEV-NEPA-11

NEV-NEPA-18

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**ATTACHMENT C**

Contentions Adopted By <b>Michael C. Thorne</b> (Paragraph 6) In Accordance With Affidavit
NEV-SAFETY-09
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NEV-SAFETY-164

## **Attachment 15**

### **Affidavit of Jonathan Overpeck**

BEFORE THE U.S. NUCLEAR REGULATORY COMMISSION

\_\_\_\_\_)  
 In the Matter of )  
 )  
 U.S. DEPARTMENT OF ENERGY )  
 )  
 License Application to Construct a )  
 Geologic Repository at Yucca Mountain )  
 \_\_\_\_\_)

Docket No. 63-001

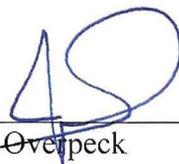
**AFFIDAVIT OF JONATHAN OVERPECK**

I, Jonathan Overpeck, the undersigned affiant, do hereby make the following statements based upon my own knowledge, information, and belief.

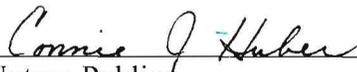
1. My name is Jonathan Overpeck, and my curriculum vitae is attached to this Affidavit as Attachment A. I am executing this Affidavit in support of the State of Nevada Petition to Intervene as a Full Party (Petition) in the above-captioned proceeding.

2. Within the Petition are numerous contentions, each comprised of several paragraphs. I hereby adopt as my own opinions the statements contained within Paragraph 5 of those specific contentions identified in Attachment B to this Affidavit. I understand that attorneys for the State of Nevada will assign unique numbers to each of those contentions just prior to the filing of the Petition and will include those unique numbers in Attachment B.

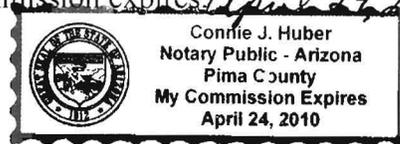
Further, the affiant sayeth not.

  
 \_\_\_\_\_  
 Jonathan Overpeck

The above-named affiant personally appeared before me this 12 day of December, 2008, and executed this affidavit.

  
 \_\_\_\_\_  
 Notary Public

My Commission expires: April 24, 2010



**ATTACHMENT A**

**CURRICULUM VITAE**

**JONATHAN OVERPECK**

*JONATHAN TAYLOR OVERPECK*  
*CURRICULUM VITAE*

**ADDRESSES**

*Work:*

Institute for Environment and Society (IES)  
University of Arizona  
715 N. Park Ave., 2<sup>nd</sup> Floor  
Tucson, AZ 85721  
Telephone: (520) 622-9065  
Email: jto@u.arizona.edu

*Home:*

5230 N. Via Condesa  
Tucson, AZ 85718  
Telephone: (520) 615-3633

**PERSONAL:** Born June 29, 1957 in Iowa, USA.

**EDUCATION**

December 1985 – Ph.D. in Geological Sciences, Brown University, Rhode Island

June 1981 – MSc in Geological Sciences, Brown University

June 1979 – AB in Geology (Honors), Hamilton College, New York

Summer 1978 – Geologic Field Mapping in Montana, Indiana University

**HONORS**

2008 – NOAA Oceanic and Atmospheric Research Outstanding Scientific Paper Award

2007 – Nobel Peace Prize – shared for role as a Coordinating Lead Author of the Fourth Assessment of the Intergovernmental Panel on Climate Change (IPCC).

2007 – Shared winner of Atmospheric Science Librarians International's Scientific and Technical Category for "high impact comprehensive publication" for *Climate Change 2007: The Physical Science Basis*.

2005 – Bjerknes Lecturer, American Geophysical Union

2005 – John Simon Guggenheim Fellowship Award

2004 – Birbal Shani Institute of Palaeobotany, Lucknow, India Prof. T.M. Harris Medal for 2004 (awarded for best Indian co-authored paper in field in 2004)

2001 – American Meteorological Society's Walter Orr Roberts 2001 Award

1999 – US Department of Commerce Gold Medal

1996 – US Department of Commerce Outstanding Performance Award

1995 – National Geophysical Data Center Director Award

1994 – US Department of Commerce Bronze Medal

1992 – US Department of Commerce Outstanding Performance Award

1991 – US Department of Commerce Unusually Outstanding Performance Award

1979 – Sigma Xi

1978 – Hamilton College Senior Fellowship

## PROFESSIONAL APPOINTMENTS

- 2008-present – Founding *Co-Director*, Institute for Environment and Society, Univ. of Arizona, Tucson
- 2006-present – *Director*, UA Translational Environmental Research Program and associated UA Technology and Research Initiative Fund (TRIF).
- 2006-present – *Affiliated Faculty Member* – James E. Rogers College of Law, Univ. of Arizona, Tucson
- 2004-present – *Joint Professor*, Dept. of Atmospheric Sciences, Univ. of Arizona, Tucson
- 1999-2008 – *Director*, Institute For Study of Planet Earth, Univ. of Arizona, Tucson
- 1999-present – *Professor*, Dept. of Geosciences, Univ. of Arizona, Tucson
- 1992-00 – *Adj. Assoc. Professor*, Dept. of Geological Sciences, University of Colorado
- 1990-9 – *Fellow*, Institute for Arctic and Alpine Research, Univ. of Colorado
- 1992-9 – *Director (and Founder)*, World Data Center for Paleoclimatology, Boulder, Colorado
- 1990-9 – *Head (and Founder)*, NOAA Paleoclimatology Program, NGDC, Boulder
- 1991-7 – *Adjunct Research Scientist*, Lamont-Doherty Geological Observatory,
- 1986-90 – *Associate Research Scientist*, Lamont-Doherty Geological Observatory
- 1985-86 – *Post-doctoral Res. Scientist*, Lamont-Doherty Geological Observatory
- 1985 – *Teaching Fellow*, Stratigraphy and Sedimentation, Brown University
- 1980-84 – *Research Assistant*, Brown University
- 1979 – *Teaching Assistant*, Mineralogy, Brown University
- 1979 – *Geologist*, U.S. Geological Survey, Menlo Park, California
- 1977 – *Field Assistant*, AMAX Exploration, Helena, Montana

## PRIVATE-SECTOR PARTNERSHIPS and TECH TRANSFER

- 2006 – *present* – *Climate Appraisal Services LLC* – lead science partner
- 2006 – Competed Options Agreement, as well as Technical Information License Agreement, between *Climate Appraisal Services* and The Arizona Board of Regents on behalf of The University of Arizona
- 2006 – Launched *Climate Appraisal Services LLC* at *ClimateAppraisal.com* – the first address-based service for climate and environmental risks.

## GRANT AWARDS (Not including NOAA 1991-99)

- 2008 – Qatar Foundation. *The Qatari Initiative for Solar Power and Desalinization* A proposed partnership with the University of Arizona submitted by invitation (Co-PI with 4 others).
- 2008-2013 – NSF “IGERT: Landscape Change: Interactions between biological processes, physical processes, and people” – 5 years – \$3,092,812 (CO-PI With 4 others). *Pending*.
- 2008-2013 – NOAA “Abrupt Climate Change Dynamics and Impacts: Increasing Societal Resilience to Future Climate Change” – 5 years – \$9,986,678 (PI with 4 Co-PIs). *Pending*.
- 2007-2008 – NOAA “Reconciling Projections of Future Colorado River Stream Flow” – 1 year – \$250,000 (Co-PI with 7 others at several institutions)

- 2007-2012 – NOAA “Integrating Climate Science for Decision-Support, Mitigating Risk and Promoting Resilience” – 5 years – \$4,899,080 (PI with 8 other UA Co-PIs)
- 2007-2009 – NOAA “Variability in the Eastern Equatorial Pacific Climate, ENSO and North American Drought Impacts over the last 2000 years” – 2 years – \$96,832 (UA component; Overpeck is project PI of overall project)
- 2006-2009 – NSF “Collaborative Research: High-resolution, Low-Latitude Paleoclimatology From Newly Acquired Sediment Drill Cores from Lake Bosumtwi, Ghana” – 3 years – \$244,687 (UA component)
- 2006-2008 – NSF “Paleoclimatic Change, Landscape Evolution, and Cultural transformations in Far Western Tibet, 2500 BP-present” – 3 years – \$725,789 (Co-PI with 5 others, including Prof. Jon Pelletier).
- 2005-2009 – NSF “Collaborative Research: A Synthesis of the Last 2000 Years of Climatic Variability from Arctic Lakes” – 4 years – \$1.85M (Co-PI with 12 others).
- 2004-2005 – NSF “Collaborative Research: High-Resolution, Low-Latitude Paleoclimatology Through Scientific Drilling of Lake Bosumtwi, Ghana,” – 1.5 years. \$677,889 (Co-PI with three others).
- 2004-2006 – NSF “Management of Ecosystems in the US Southwest and Related Areas of Northern Mexico in the Context of Complex Uncertainties” – 1 year – \$77,500 (Decision making under uncertainty planning proposal, Co-PI with 4 others).
- 2003-2005 – NSF “Acquisition of an analytical facility for high-resolution paleoclimatology” – 3 years – \$339,915 (Co-PI with 4 others).
- 2002-2005 – ARCUS “ARCSS Committee Chair Support” – 3 years – \$54,000/year (PI)
- 2002-2006 – NSF “ITR: Development of an enhanced computer assisted analysis system for earth science: investigation of laminated sediments and tree rings” – 3 years – \$436,480 (PI with 2 others).
- 2002-2004 – NSF “Varved Records of Decade- to Century-Scale Climate Variability in the Tropical Atlantic Sector” – 2 years – \$167,000 (PI with 1 other).
- 2002-2004 – NSF “Scientific Drilling at the Bosumtwi Impact Structure, Ghana, West Africa” – approx. 3 years – \$1,200,000 (CoPI with 3 others).
- 2002-2007 – NOAA “Climate Assessment for the Southwest Project (CLIMAS)” – 5 years – \$5,437,806 (PI with 12 others).
- 2000-2003 – EPA “Climate and human contributions to fire affecting ecosystems in the U.S. Southwest” – 3 years – \$1,260,993 (Co-PI with 5 others)
- 2000-2005 – Multiagency “Desert Southwest Cooperative Ecosystem Study Unit (DS-CESU) – cooperative agreement – no set award amount (multiple CoPI’s)
- 2000-2002 – National Science Foundation Grant ATM “Century-scale variability in the Asian southwest Monsoon” 2-years – \$119,402 (PI with J.Cole)
- 1998 to 2001 – National Science Foundation Grant ATM-98100254 “Lake Bosumtwi, Ghana: High-resolution paleoclimatology and seismic reflection site survey” 3-years – \$518,944 (PI with C. Scholz)
- 1997 to 2000 – National Science Foundation Grant ATM-97 “Radiocarbon, Ocean and Climate Changes over the Last Deglaciation” 3-years – \$300,000 (Co-PI with K. Hughen and S. Lehman)

- 1997 to 2001 – National Science Foundation Grant ATM-PALE 9709918 “ Labrador Sea variability over decade to millennial time-scales” 4-years – \$564,000 (PI with G. Miller)
- 1997 to 2000 – NASA Grant LCLUC-0003: Assessing Future Stability of U.S. High Plains Landcover: Integration of Process Modeling with Landsat, In Situ Modern and Paleoclimate Data” 3 years – \$530,000 (PI with 4 Co-PIs)
- 1996 to 1999 – National Science Foundation Grant ATM-9631282: "Climatic Change of the Last 500 Years: Simulations versus Data" 3 years – \$270,000 (PI)
- 1995 to 1997 – NASA Graduate Student Fellowship in Global Change Research: "A 14,000 Year Record of Decade- to Century-scale Tropical Climate Variability from Annually-laminated Sediments of the Cariaco Basin, Venezuela" 2 years – \$44,000 (funds graduate student Konrad Huguen).
- 1995 to 1997 – National Science Foundation Grant OCE-9521058: "Interannual to Century-scale Variability in the Tropical Caribbean/ Western Atlantic: Varve-based Reconstructions from the Anoxic Cariaco Basin" 2 years – \$52,000 (PI).
- 1994 to 1997 – National Science Foundation Grant ATM94-02657: "A PALE Lake Sediment Calibration Network for the Eastern Canadian Arctic" 3 years – \$350,000 (PI with G. Miller).
- 1993 to 1996 – National Science Foundation Grant ATM-930072: "Eastern Arctic Climate of the Past 2,000 years: The Lake Sediment Record." 3 years – \$262,000 (PI with R. Anderson).
- 1991 to 1994 – National Science Foundation Grant ATM-9006307: "Project ARRCC – Analysis of Rapid and Recent Climatic Change." 3 years – \$720,000 (PI with 5 others).
- 1991 to 1994 – National Science Foundation Grant ATM-9019023: "Paleoecologic Tests of Climate Model Simulations for the Past 18,000 Years in Eastern North America." 3 years – \$170,000 (Co-PI with S. Jackson).
- 1991 to 1993 – National Science Foundation Grant OCE91-15923: "Interannual- to Millennial-scale Environmental Variability as Recorded in the Laminated Sediments of the Cariaco Basin, Venezuela: Late Quaternary to Present." 2 years – \$200,000 (PI with L. Peterson).
- 1990 to 1992 – National Science Foundation Grant DPP90-00371: "High-resolution Holocene Climatic Reconstructions from the Eastern Canadian Arctic." 3 years – \$216,000 (PI).
- 1989 to 1991 – NOAA: "Project ARRCC – Analysis of Rapid and Recent Climatic Change." 2 years – \$121,217 (PI with David Rind).
- 1990 to 1992 – National Science Foundation Grant OCE89-11484: "High-resolution Paleoenvironmental Study of the Cariaco Basin, Venezuela: Late Quaternary to Present." 2 years – \$477,000 (PI with L. Peterson and D. Murray).
- 1989 – C.N.R.S. Laboratory Travel Award for study in France- 10,000 FF (Recipient).
- 1989 to 1991 – EPA Grant: "Modeling Future Climate and Vegetation Change." Awarded through NASA/GISS, 3 years – \$200,000 (PI).
- 1988 to 1990 – National Science Foundation Grant ATM88-15506: "Century to Millennium-scale Variability of the Indian Monsoon over the Past 40,000 years." 2 years – \$170,000 (PI).

- 1988 to 1989 – National Science Foundation Grant DPP88-00749: "High-resolution Paleoclimatic Time Series from Annually Laminated Lake Sediments: Baffin Island and Northern Labrador." 1 year – \$64,617 (PI with G. Jacoby).
- 1987 to 1988 – EPA Grant: "Assessing the Response of Vegetation to Future Trace-Gas-Induced Climate Change: The Application of Ecological Response Surfaces." Awarded through NASA/GISS, 1 year – \$50,000 (PI with P. Bartlein).
- 1987 – Subcontracts, EPA Contract to Columbia University and NASA Goddard Institute for Space Studies (J. Hansen, R. Levenson, and C. Chu, principal investigators): "Global Climate Model Development and Sensitivity Experiments." 1 year – \$20,000 and \$10,000.
- 1986 to 1988 – National Science Foundation Grant ATM86-12376: "Precisely Dated Time Series and the Synoptic Climatology of the Past 12,500 years in Eastern North America." 2 years – \$148,580 (PI with G. Jacoby).

### POST-DOCTORAL SUPERVISION

- 2002 to 2003 – Dr. Nan Schmidt  
 1997 to 1998 – Dr. Connie Woodhouse  
 1996 to 1997 – Dr. Elsa Cortijo  
 1995 to 1996 – Dr. Terri King

### GRADUATE STUDENT SUPERVISION

Sarah Trube (PhD)	2008 to present	Univ. of Arizona – GEO (Co-Advisor)
Sarah White (MS)	2008 to present	Univ. of Arizona – GEO (Advisor)
Nicholas McKay (PhD)	2007 to present	Univ. of Arizona – GEO (Advisor)
Cody Routson (PhD)	2007 to present	Univ. of Arizona – GEO (Advisor)
Jessica Conroy (PhD)	2003 to present	Univ. of Arizona – GEO (Advisor)
Toby Ault (PhD)	2005 to present	Univ. of Arizona – GEO (Comm. Mem.)
Adam Csank	2007 to present	Univ. of Arizona – GEO (Comm. Mem.)
Jennifer Rice (PhD)	2006 to present	Univ. of Arizona – GRD (Comm. Mem.)
Rachael Novak (MS)	2005 to present	Univ. of Arizona – GEO (Advisor)
Sephania McAfee (PhD)	2005 to present	Univ. of Arizona – GEO (Co-Advisor)
Anna Felton (MS)	2005 to 2006	Univ. of Arizona – GEO (Comm. Mem.)
Toby Ault (MS)	2005 to 2006	Univ. of Arizona – GEO (Comm. Mem.)
Kevin Anchukaitis (PhD)	2004 to 2007	Univ. of Arizona – GEO (Comm. Mem.)
Scott St. George (PhD)	2004 to present	Univ. of Arizona – GEO (Comm. Mem.)
Jessica Conroy (MS)	2003 to 2006	Univ. of Arizona – GEO (Advisor)
Allison Drake (MS)	2003 to 2005	Univ. of Arizona – GEO (Advisor)
Thomas Damassa (MS)	2002 to 2005	Univ. of Arizona – GEO (Comm. Mem.)
David Brown (PhD)	2002 to 2004	Univ. of Arizona – GRD (Comm. Mem.)
John Burkhart (PhD)	2002 to 2005	Univ. of Arizona – HWR (Comm. Mem.)
Cristina Luiz (MS)	2001 to 2004	Univ. of Arizona – GEO (Comm. Mem.)
Jim Morrison (PhD)	2003 to 2004	Univ. of Arizona – GEO (Advisor)
Camille Holmgren (PhD)	2001 to 2005	Univ. of Arizona – GEO (Comm. Mem.)

Jennifer Miller (PhD)	2001 to 2006	Univ. of Arizona – GEO (Comm. Mem.)
Katherine Likos (MS)	2000 to 2002	Univ. of Arizona – GEO (Advisor)
Tim Shanahan (PhD)	2000 to 2001	Univ. of Arizona – HWR (Comm. Mem.)
	2002 to 2006	Univ. of Arizona – GEO (Advisor)
Simone Alin (PhD)	2000 to 2002	Univ. of Arizona – GEO (Comm. Mem.)
Carrie Morrill (PhD)	1998 to 1999	Univ. of Arizona – GEO (Co-Advisor)
Carrie Morrill (PhD)	1998 to 1999	Univ. of Colorado (Co-Advisor)
Noah Daniels (MS)	1998 to 1999	Univ. of Colorado (Co-Advisor)
Mary Davis (PhD)	1998 to 2002	Ohio State Univ. (Committee Member)
Alex Robertson (MS)	1996 to 2000	University of Colorado (Advisor)
Jorunn Hardardottir (PhD)	1996 to 1999	Univ. of Colorado (Committee Member)
Frank Urban (MS)	1996 to 1999	Univ. of Colorado (Co-Advisor)
Ulrike Huber (PhD)	1996 to 1999	Univ. of Colorado (Committee Member)
Nathalie Smith (MS)	1996 to 1997	Univ. of Colorado (Committee Member)
Jennifer Mengan (PhD)	1996 to 2001	Univ. of Colorado (Co-Advisor, Comm. Mem)
Mike Kerwin (PhD)	1995 to 2000	University of Colorado (Advisor)
David Gorodetsky (MS)	1995 to 1996	Univ. of Colorado (Committee Member)
Lisa Doner (PhD)	1994 to 2000	Univ. of Colorado (Committee Member)
Konrad Hughen (PhD)	1992 to 1997	University of Colorado (Advisor)
Jay Moore (MS)	1995 to 1996	Univ. of Colorado (Committee Member)
Peter Sauer (PhD)	1993 to 1997	Univ. of Colorado (Committee Member)
Regina Figge (PhD)	1992 to 1996	Univ. of Colorado (Committee Member)
Lisa Barlow (PhD)	1992 to 1994	Univ. of Colorado (Committee Member)
Lysanna Anderson (PhD)	1991 to 1997	Univ. of Colorado (Committee Member)
Colin Price (PhD)	1990 to 1992	Columbia Univ. (Committee Member)

## COURSES TAUGHT

2009	<i>Western North American Drought Seminar</i> , The University of Arizona
2005-present	<i>Fundamentals of Past Climate Dynamics</i> – New graduate-level, The University of Arizona
2003	<i>Paleoclimate Seminar</i> , The University of Arizona
2002-present	<i>Paleoclimate Seminar</i> , The University of Arizona
2001-2003	<i>Life on Earth (included honors section)</i> , the University of Arizona
2001	<i>Paleoclimate Dynamics (North Atlantic Variability)</i> , the University of Arizona
2000	<i>Life on Earth (new course for non-science freshmen and sophomores)</i> , the Univ. of Arizona
2000	<i>Paleoclimate Dynamics (African and Asian Monsoons)</i> , the University of Arizona
1996	<i>Introduction to Climate System Modeling</i> at The University of Colorado, Boulder – Independent Study for three students. Co-taught with R. Webb
1994	<i>Methods of Quantitative Paleoenvironmental Reconstruction and Time Series Analysis</i> at the Univ. of Colorado, Boulder – graduate seminar. Co-taught with R. Webb and D. Anderson
1985	<i>Stratigraphy and Sedimentation</i> at Brown University. Included leading spring a 10-day trip to study carbonate environments in South Florida

## **SUPERVISON/MANAGEMENT TRAINING EXPERIENCE**

- 2002 – Completed “Human Subjects” Training/Certification
- 1997 – NOAA Workshop for People with Disabilities
- 1996 – US Gov’t Senior Executive Service Approved Course:  
“The Aspen Institute Executive Seminar for the Public Sector”
- 1995 – Department of Commerce Approved Management Course:  
"Merit System Principles: Understanding and Applying Them"
- 1995 – Department of Commerce Approved Diversity Management Course: “Conflict Resolution”
- 1994 – Department of Commerce Approved Management Course:  
"Improving Your Listening and Communication Skills"
- 1992 – Department of Commerce Approved Management Course: "Equal Employment Opportunity Training for Supervisors and Managers."
- 1992 – Department of Commerce Approved Management Course: "People Skills for Supervisors and Managers"

## **SERVICE ON UNIVERSITY COMMITTEES**

- 2008 to present – Member, Vice President for Research Advisory Council for Strategic Advancement
- 2008 – Member, Provost’s Advisory Council for Strategic Advancement
- 2007 to present – The University of Arizona president’s point person for the American College and University Presidents Climate Commitment
- 2007 to present – Member, Biosphere 2 Advisory Board.
- 2006 to present – UA Translational Environmental Research Faculty Advisory Committee (member and chair).
- 2005 to 2006 Academic Year: on sabbatical, San Juan Mountains, Colorado
- 2005 to present – University of Arizona advisory committee for the UA NSF AMS Facility
- 2004 – University of Arizona representative to the Arizona governor’s tri-university water sustainability planning group
- 2003 to 2005 – Member, Provost Focused Excellence Study Team for “Earth Science and Environmental Programs”
- 2003 to 2005 – Member, Executive Committee, University of Arizona -USGS Earth Surface Processes Research Institute (ESPRI)
- 2003 UA-USGS ESPRI Council of Advisors
- 2002 to 2003 – Co-Chair, UA Flandrau Science Center’s Science and Technology Working Group (to provide science and technology input in the planning and development of a new 100,000 sq. ft. science center for the University of Arizona)
- 2002 – Member, Biosphere2 Center Research Advisory Board, Columbia University
- 2002 – Member, External Review Committee, University of New Mexico, Center for Advanced Studies
- 2001 to present – University of Arizona Representative to US Council of Environmental Deans and Directors

- 2001 – Chair, UA Institute for the Study of Planet Earth Program Review Self-Study Committee  
 2001 to 2002 – Member, UA Dean Search Comm., College of Social and Behavioral Sciences  
 2000 – UA Udall Fellowship Selection Committee  
 2000-2002 – Member of University of New Mexico Center for Advance Studies External  
 Advisory Panel  
 2000 to 2001 – University of Arizona Campaign Water Committee  
 2000 – Member, Lab. for Tree Ring Res. Faculty Search Comm, Univ. Arizona  
 2000 to 2001 – Member and Co-Chair, Dept. of Atmos. Sci. Faculty Search Committee, Univ.  
 Arizona  
 2000 to 2001 – College of Science rep. for Prop. 301 Water Initiative, Univ. Arizona  
 2000 – Promotion and Tenure Committee, Dept. Geosci., Univ. Arizona  
 2000 to present – Member, Global Change PhD Minor Faculty  
 1999 to 2000 – Self-Study Future Directions Committee, Dept. Geosci., Univ. Arizona  
 1996 to 1997 – Strategic Plan Committee, INSTAAR, University of Colorado  
 1995 to 1996 – Research & Uniqueness & Funding Committee, INSTAAR, University of  
 Colorado  
 1993 to 1995 – Executive Committee, INSTAAR, University of Colorado  
 1992 to 1997 – Future Funding Committee, INSTAAR, University of Colorado  
 1992 to 1998 – Computer Committee, INSTAAR, University of Colorado

#### **SERVICE ON NATIONAL and INTERNATIONAL SCIENCE and EDUCATION COMMITTEES**

- 2008 to present – member, U.S. National Academy of Science, Committee on Ecological  
 Impacts of Climate Change  
 2008 to present – member, Federal Advisory Committee focused on “Climate change and the  
 United States: Analysis of the effects and projections for the future – Unified Synthesis  
 Product”  
 2008 to present – Member, University Corporation for Atmospheric Research Membership  
 Committee  
 2007 – Member, U.S. National Science Foundation advisory panel for the FY 2007 Human and  
 Social Dynamics competition. Washington, DC.  
 2006 to 2007 – Member, Committee charged with drafting society’s new Statement on Climate  
 Change Impact, American Meteorological Society  
 2004 to 2006 – Member, American Geophysical Union Global Environmental Change Executive  
 Committee  
 2002 to 2005 – Member, Board on Higher Education, American Meteorological Society  
 2004 to 2007 – Convening Lead Author, Working Group 1, Chapter 6 (Paleoclimatology)  
 UN/WMO Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment.  
 Also, Lead Author for the Technical Summary, and also Lead Author for the Summary  
 for Policy Makers.  
 2004 to 2005 – Member, Subcommittee for Global Change Research of the Department of  
 Energy’s Biological and Environment Research Committee (BERAC)  
 2003 to 2005 – Member, NOAA Ad Hoc Group on Paleoclimatology

- 2003 to present – Member, NOAA Climate Working Group – formally the NOAA Climate and Global Change Working Group (also on Executive Committee of the latter)
- 2002 to 2007 – Chair/Member, NSF Arctic System Science (ARCSS) Committee (Chair to 2006)
- 2001 to 2003 – member, U.S. National Academy of Science, Committee on Coping with Increasing Demands on Government Data Centers
- 2000 to 2003 – member, U.S. National Academy of Science, Committee on Abrupt Climate Change: Science and Policy
- 1999 to 2004 – Co-chair (with M. Cane), US PAGES/CLIVAR Working Group
- 1999 to 2002 – member, NSF Study of Environmental Arctic Change (SEARCH) Steering Committee
- 1998 to 2008 – member, NSF Arctic System Science (ARCSS) Committee
- 1997 to 2003 – member, U.S. National Research Council National Committee for International Quaternary Association (INQUA)
- 1997 to 1999 – member, Ocean Drilling Program (ODP) Science Committee (SCICOM)
- 1995 to 2002 – Co-Chair (with J-C Duplessy), IGBP PAGES-WCRP CLIVAR Working Group
- 1994 to 1998 – member, Arctic System Science Data Management Working Group
- 1994 to 1999 – member, Steering Committee, US/NSF Earth System History Research Initiative
- 1993 to 1999 – member of IGBP PAGES (Past Global Changes) Scientific Steering (SSC) and Executive Committees, Vice Chairman SSC 1998-99.
- 1993 to 1999 – member, IGBP DIS (Data and Information System) Scientific Standing Committee
- 1991 to 1998 – member, Steering Committee, "Paleoclimate of Arctic Lakes and Estuaries (PALE)," NSF Sponsored research initiative with broad international participation.

## **NATIONAL AND INTERNATIONAL WORKSHOPS CONVENED**

- June, 2008 – PAGES/CLIVAR workshop “Reducing and representing uncertainties in high-resolution proxy climate data,” Treste, Italy (member, organizing committee)
- May, 2008 – NOAA RISA National Climate Service Visioning Workshop, Denver, CO (member, organizing committee)
- October, 2006 – Climate Variability & Change in the San Juan Mountains: A Scientist-Stakeholder Dialogue, Durango CO (member, organizing committee)
- July, 2006 – Retreat of the NOAA Climate Working Group focused on improving NOAA’s ability to provide the nation with drought information, Santa Fe, NM (member, organizing committee).
- May, 2006 – Workshop focused on methodologies for improved analysis of laminated lake and marine sediments, Tucson, AZ (Organizer and host)
- May, 2006 – Workshop focused on Arctic climate variability and change over the last 2000 years (co-organizer and host). Tucson, AZ
- May, 2005 – Second Sustainability Under Uncertainties in Arid and Semiarid Ecosystems workshop, Tucson, AZ (member, organizing committee).
- January, 2005 – First Sustainability Under Uncertainties in Arid and Semiarid Ecosystems workshop, Tucson, AZ (member, organizing committee).
- August, 2004 – Second NSF Retreat on Arctic System Science Synthesis, Lake Tahoe (lead convener with others on NSF Arctic System Science Committee).

- June, 2004, 1st International CLIVAR Science Conference, Baltimore, Maryland (member, organizing committee).
- February, 2004, NOAA Workshop “Enhancing Decision-making Through Integrated Climate Research: Alaska.” Anchorage, Alaska (member, organizing committee).
- November, 2003 – CLIVAR/PAGES/IPCC Workshop: A multi-millennia perspective on drought and implications for the future, Tucson, AZ (co-convended with K. Trenberth).
- August, 2003 – NSF Retreat on Arctic System Science Synthesis, Big Sky, MT (lead convener with others on NSF Arctic System Science Committee).
- March, 2003 – International Limnogeology Congress, Tucson AZ (organizing committee).
- May, 2002 – NRC Workshop on coping with Increasing Demands on Government Data Centers, Austin, TX (co-convended with several others on NRC Committee).
- September, 2001 – International Continental Drilling Programme Workshop on Scientific Drilling at the Lake Bosumtwi Impact Structure, Potsdam, Germany (co-convended with C. Koeberl, B. Milkereit, and C. Scholz).
- June, 2001 – NOAA funded workshop: International Workshop on Applications and Human Dimensions of Monsoon Research, Tucson, AZ (co-convended with B. Morehouse, A. Ray, and R. Webb).
- March, 2001 – NOAA and USDA funded Fire and Climate in the Southwest 2001, Tucson, AZ (co-convended with four others).
- February, 2001 – NOAA and USDA funded Fire and Climate 2001, Tucson, AZ (co-convended with four others).
- October, 2000 – IGBP PAGES Workshop: High-Resolution Climate Variability of the Holocene, Avignon, France (co-convended with K. Briffa, D. Raynaud, J- Duplessy and R. Bradley).
- September, 2000 – NRC Abrupt Climate Change: Science and Policy Workshop, Palisades, NY (co-organized with R. Alley et al.).
- November, 1999 – Joint WCRP-IGBP PAGES-CLIVAR Workshop on “Climate Variations of the Last 300 to 1000 Years”, Venice, Italy (co-convended with J-C. Duplessy).
- June, 1999 – NOAA/NASA Workshop: Assessing the full range of central North America Droughts and Associated Landcover Change, Boulder, Colorado (co-convended with R. Webb and C. Woodhouse)
- January, 1999 – Joint WCRP-IGBP PAGES-CLIVAR Data Management Workshop, Boulder, CO (co-convended with R. Webb and D. Anderson).
- April, 1998 – IGBP PAGES (Past Global Changes) First Open Science Meeting, London, England (Co-organized with 5 other).
- April, 1997 – Joint IGBP-World Data Center sponsored workshop on meeting the scientific data management needs of the IGBP, Boulder (co-organized with G. Szejjwach)
- September, 1996 – Joint CLIVAR (World Climate Research Program)-PAGES (International Geosphere Biosphere Program) sponsored “PAGES-CLIVAR Working Group” workshop on climate variability and predictability, Villefrance, France (co-convended with J-C. Duplessy)
- March. 1996 – NSF sponsored Earth System History Workshop “Geologic records of terrestrial processes and systems,” Portland OR (co-organized with P. Olsen, N. Piasias and T. Webb III).

- November, 1994 – Joint CLIVAR (World Climate Research Program)-PAGES (International Geosphere Biosphere Program) sponsored workshop on climate variability and predictability, Venice Italy (co-convended with J-C. Duplessy)
- August, 1993 – IGBP PAGES Sponsored "Global Paleoenvironmental Data," Bern Switzerland (co-convended with J. Pilcher).
- January 1988 – NSF sponsored meeting of the Coordination Group for "The global reconstruction and modeling of interannual, decadal, and century-scale climate variability," New York (co-convended with G. Jacoby).

### **SYMPOSIA and SPECIAL SESSIONS CONVENED**

- December, 2003 – “The Last Interglacial” 2003 Fall Meeting of the American Geophysical Union, San Francisco (co-convended with G. Miller and B. Otto-Bleisner).
- December, 1997 – "Tropical Ocean and Climate Records From the Anoxic Cariaco Basin” 1997 Fall Meeting of the American Geophysical Union, San Francisco (co-organized with L. Peterson and F. Muller-Karger)
- December, 1995 – "Abrupt Climatic Change During the Current Interglacial” 1995 Fall Meeting of the American Geophysical Union, San Francisco (co-organized with L. Keigwin)
- October, 1992 – "WDC/IGBP Paleoclimate Data" 13th International CODATA Conference, Beijing, China.
- May, 1992 – "Decadal to millennial-scale climatic variability" 1992 Spring Meeting of the American Geophysical Union, Montreal (co-chaired with D. Murray).
- February, 1992 – "High-resolution studies of past climate" 1992 American Society of Limnology and Oceanography Aquatic Sciences Meeting, Sante Fe, New Mexico (co-chaired with W. Curry).
- August 1989 – "The past as a key to understanding future global change," 74th Annual Meeting of the Ecological Society of America, Toronto, Canada (co-convended with G. King).

### **FIELD EXPERIENCE**

- 2007- Co-leader, Lake coring expedition to Tibet
- 2004 – Co-leader, Lake coring in the Galapagos
- 2000 – Co –leader, Lake coring expedition to Ghana
- 1999 – Co –leader, Lake coring expedition to Ghana
- 1999 – Leader, Lake and tree coring expedition to Northern Labrador
- 1998 – Co-leader, Lake coring expedition to Southern Greenland
- 1997 – Co-leader, Lake coring expedition to Southern Greenland
- 1997 – Climbed Cerra Aconcagua, 6962m (with D. Anderson)
- 1996 – Co-leader, Lake coring Baffin Island, Canada and West Greenland.
- 1996 – Co-leader, Lake coring expedition to Ghana.
- 1995 – Co-leader, Lake coring expedition to Tibet.
- 1995 – Co-leader, Lake coring expedition to Nepal.
- 1994 – Co-leader, Lake coring expedition to Tibet.
- 1993 – Leader, Lake coring expedition to Nepal.
- 1993 – Leader, Arctic lake coring expedition, Baffin Island, Canada.

- 1991 – Leader, Arctic lake coring expedition, Baffin Island, Canada.
- 1990 – Co-chief Scientist, R/V Washington, Cruise PLUME 7, Cariaco Basin, Venezuela.
- 1989 – Leader, Arctic lake coring expedition, Baffin Island, Canada.
- 1989 – Leader, Arctic lake and tree coring expedition, northern Labrador, Canada.
- 1986 – Scientist, R/V Conrad, Cruise RC27-04, Arabian Sea.
- Four winters – Leader, lake coring trips to Upper Midwest US and Canada.

## SELECTED PRESS INTERACTION

- October, 2008 – Featured and quoted in stories in the *Arizona Daily Star* (front page) and *Tucson Citizen* regarding the new Institute for Environment and Society at the University of Arizona
- May 1, 2008 – Quoted in story on decadal climate prediction and the next 10 years of climate change, *Christian Science Monitor*
- April, 2008 – Featured in three-day Earth Day series on drought and climate change in the Southwest, *Arizona Daily Star*, Tucson, Arizona.
- April, 2008 – Featured on Earth Day, *KOLD TV NEWS 13*, Tucson, Arizona.
- March 28, 2008 – Part of an hour-long NPR program *On Point*, focused on the Medieval Warm Period and implications for the future, particularly in the U.S. West.
- March 24-28, 2008 – Featured in week-long TV series “Winds of Change” on climate change, KPNX-TV 12 News, Phoenix, AZ
- March, 2008 – *Nature Geoscience* paper stories (Neff et al., 2008) reported on by NPR (story on *All Things Considered*) and *New York Times*.
- February 1, 2008 – Quoted in a front-page story in the *Washington Post* on climate change and the west being attributed to human causes.
- December 29, 2007 – Featured in story about California climate change in an AP story
- December 28, 2007 – Featured in climate change and La Niña story in the *Arizona Republic*
- November 18, 2007 – Featured in front-page story on climate change in the *San Francisco Chronicle*
- November, 2007 – Featured in *History Channel* documentary “‘A Global Warning’.
- October 22, 2007 – Featured along with Vice President Gore in NPR program “U.N. Panel Shares Nobel with Gore”. Also, featured in multiple newspaper stories around Arizona for sharing Nobel Peace Prize for role as a Coordinating Lead Author in the IPCC Fourth Assessment.
- September, 2007 – Featured in widely published *Associated Press* stories on rising sea level.
- September, 2007 – Featured in story on university campus sustainability in the *Arizona Daily Star*.
- September, 2007 – Featured in story on Arizona climate change and the Western Climate Initiative in the *Havasupai News-Herald* (Arizona)
- August, 2007 – as of this month, we’ve had over 100 requests from journalists, media, educators and other outreach entities for future sea level data, images and information. This does not count general use of our lab web resource.
- August 24-29, 2007 – Interviewed for KUAT-FM Arizona Spotlight on subject of water sustainability; also was the guest for a 1-hour live talk-radio segment on KVOI-AM, and a shorter interview on KJLL-AM, both focused on the same topic.

- July, 15, 2007 – Graduate student Rachael Novak featured in NPR All Things Considered radio show “[CLIMATE CONNECTIONS: Drought Threatens Navajo's Crops, Culture](#)”.
- July, 2007 – Featured in a half-hour documentary by Blur to Focus Productions and The NM State Engineer, entitled: “*Climate Change: What does it mean for New Mexico?*”
- July, 2007 – Featured in two stories in the *Wilmington Star* (NC) on future climate and sea level change.
- July 9, 2007 – Featured in NPR *Morning Edition* show “[CLIMATE CONNECTIONS: A Family Vacations Amidst Changing Landscape](#)” as well as in an NPR *All Things Considered* show “[CLIMATE CONNECTIONS: Ancient Culture Prompts Worry for Arid Southwest](#).”
- June, 2007 – Filmed at Mesa Verde for History Channel documentary on climate change.
- May, 2007 – Featured in article in *Nature* on start-up company Climate Appraisal Services.
- March, 2007 – Featured in story in *USA Today* (and follow-on stories elsewhere) on start-up company Climate Appraisal Services.
- February, 2007 – Widely featured in national and international press for role in UN Intergovernmental Panel on Climate Change
- November, 2006 – Featured in stories in the Arizona Republic and Arizona Daily Star regarding Supreme Court global warming case.
- November, 2006 – Featured in Associated Press story on climate change, Arctic wildfire and greenhouse gas feedback.
- October 30, 2006 – Featured in story in the *Albuquerque Journal* on future drought and reduced river flow in the Southwest.
- October, 2006 – Featured in stories in the *Denver Post*, *Farmington Daily Times* and *Grand Junction Sentinel* on climate change and the impacts of this change in the U.S. West and San Mountains of Colorado. Also was focus of 30minute radio interview on the same topic (KDUR, Durango).
- August 24, 2006 – Featured in NPR on *All Things Considered* interview about the freshening of the Arctic and potential impacts on the North Atlantic.
- August 11 & 15, 2006 – Featured in stories in the *Wall Street Journal* and *USA Today* about accelerating mass loss of the Greenland Ice Sheet
- May, 2006 – Featured in major climate change series in *USA Today*
- May, 2006 – Taped two 30 minute shows (one on global warming, and one on drought) for *Earthtalk Today* with Alexandra Paul and Peter Kreidler (in Los Angeles, CA).
- March and April, 2006 – Expensive global media coverage of two *Science* papers (with cover). Included front page coverage in papers in the US and Canada, NPR interview, and talk radio. Also reported on in *Time Magazine*, *Scientific American.com*
- January 30, 2006 – Featured in *Geotimes* online story on record 2005 global temperatures
- December, 2005 – Feature guest on Earth Changes TV radio show (ca. 45 minutes of talk radio)
- August, 2005 – extensive press coverage of *EOS* paper, at least 130 print media articles in first week. Press interest still alive at end off year. Included request from U.S. Congress for article.
- May 26, 2005 – Guest on KUAT TV *Arizona Illustrated* TV show

- February 16, 2005 – Featured in front-page article on climate change and forest health in the *Arizona Daily Star*.
- February 14, 2005 – Featured in front-page article on the climate change debate in the *Wall Street Journal*.
- February 6, 2005 – Featured in article on drought and climate change in the *Washington Post*.
- February 5, 2005 – Guest on talk radio show “Weather Talk with Paul Huttner”
- January 24, 2005 – Featured in cover story on past climate change in the West. *High Country News*.
- January 30, 2005 – Featured in article on global warming in the *Arizona Daily Star*.
- January 10, 2005 – Featured in article on Arctic climate change – United Press International (including the *Washington Times*)
- January 5, 2005 – Guest on KUAT TV *Arizona Illustrated* TV show.
- December, 2004 – Co-author full page Op-Ed “Perspective” on climate change in December 13, 2004 *Tucson Citizen*.
- July, 2004 – Featured in Weather Channel special on climate change: “Forecast Earth: A Planet in Change”
- June, 2004 – Participant in CLIVAR (World Climate Research Programme Climate Variability and Predictability Programme) Open Science Conference Press Conference, Baltimore MD
- May 25, 2004 – Participant in press conference and pre-screening of 20<sup>th</sup> Century Fox Feature Movie: "Day after Tomorrow," Tucson, AZ.
- April 22, 2004 (Earth Day Week) – Sea level research and web site (UA Dept of Geoscience Environmental Studies Lab) featured on National Geographic Web site main page.
- April, 14, 2004 – Live interview on KTAR Radio, Phoenix morning show – drought issues
- April, 2004 – Interviewed for NPR Feature on abrupt climate change
- April, 2004 – Interviewed for article(s) on arctic environmental change for *New Yorker* magazine.
- April, 2004 – Interviewed for Evening News, Channel 4 TV, Tucson
- October 29, 2003 – Featured in articles on arctic climate that appeared in the *Seattle Post-Intelligencer* and elsewhere.
- June 15, 2003 – Featured in story on water crisis in the *Houston Chronicle*
- June 22, 2003 – Featured in story “Climate Boom & Bust: High Population Suffers More in Dry Times” in the *Albuquerque Journal*.
- May 21, 2004 – Interviewed about drought on KUAT-TV show *Arizona Illustrated*.
- May 9, 2003 – Featured in story on drought in the *Arizona Daily Star*
- April, 2003 – Multi-day film shoot in Tucson region for documentary “The Venus Theory – a documentary film on climate change” (52 minutes) Talent House, Helsinki 2004.
- December 16, 2002 – Guest for 20 minutes on KPRA (Berkeley CA) radio morning show
- December 8 2002 – Featured in climate change stories in Los Angeles Times and Seattle Times
- May 9, 2001 – Authored invited 2-page “Insight and Opinion” article titled “Global warming is all too real,” *Albuquerque Tribune*

- April 19, 2001 – Featured in story on NSF-sponsored Holocene climate change workshop, Richmond Times-Dispatch
- April 12, 2001 – Featured in story on global warming and mathematics in Tucson Citizen
- March 15 2001 – Guest on one-hour AM990 (KTKT-Tucson) Reed Schmidlin talk radio show
- March 8, 2001 – Featured in lead story on Tucson Channel 13 (CBS) report on global warming and how it could impact the US and US Southwest
- January, 19 2001 – Featured in climate change story – Honolulu Star-Bulletin “Climate prediction could ease global warming’s impact, geologist says”
- Spring, 2000 – Featured in Los Angeles Times front page story on climate change, 2000
- April, 2000 – Featured in NOVA/Frontline 2-hour documentary “What’s up with the weather?”
- February, 2000 – Guest Opinion titled “Global Warming Is Not Pseudo-Science” published in Sunday Feb. 13 issue of Arizona Daily Star (co-authored with Julie Cole).
- December, 1999 – Science results featured on www by University Science ([unisci.com/](http://unisci.com/)) and Yahoo! News
- December, 1999 – Interview with University of Arizona News Services aired on state-wide radio program
- December, 1999 – Interviewed for article on paleoclimatology in the Christian Science Monitor – 1 page article appeared Jan 18, 2000
- August, 1999 – Interviewed by South Africa Broadcast Company television story on climate change and first World Data Center in Africa.
- July, 1999 – Interviewed on National Public Radio Story on Siberian Environmental Change
- July, 1999 – Interviewed by US News & World Report for background on climate story
- June, 1999 – Interviewed for South African radio show – climate change
- May, 1999 – Interviewed for NOVA/Frontline documentary on global warming
- May, 1999 – Interviewed for global warming article in “Rolling Stone”
- April, 1999 – Interviewed for global warming story in “Popular Science”
- March, 1999 – BBC film team accompanied Overpeck research team on Arctic field expedition for three days of filming/interviewing for documentary on Atlantic climate change. Results featured in 60 minute documentary “The Bill Chill”
- December, 1998 – Lead scientist in NOAA Press Conference on drought variability (at National Press Club, Washington). Reported live on national network television and radio programs, plus reports appeared around nation in print media
- July, 1998 – Interviewed on National Public Radio’s “All things considered” – helping to put the summer 1998 heat wave in perspective
- February, 1998 – Arctic Warming Press Kit requested by, and provided to Executive Office of the President, Council on Environmental Quality
- January, 1998 – Interview on Arctic environmental change distributed by Arctic Science Journeys radio news service
- December, 1997 – Interviewed for story in Earth Magazine that was published early in next year
- November, 1997 – Lead scientist in joint NOAA-NSF Press Conference on Arctic Climate Change, Washington, DC. Reported on in newspapers across US and Canada (often

on front page), as well as on TV (CNN) and National Public Radio. Also covered in Europe.

November, 1997 – Interviewed for background on 4-day series on Global Warming that appeared in the Washington Post during the week of Nov. 10.

August, 1997 – Quoted in Washington Post “Horizon” feature on Little Ice Age. Included photos taken during 1997 Greenland field season

March, 1997 – Research mentioned in “Computer Life”

January, 1997 – Featured in “Science News”

December, 1996 – Featured in “Washington Times”

December, 1996 – Featured as lead article in Discovery Section of “Boulder Daily Camera”

November, 1996 – Focus of 8-page interview in “Environmental Review”

September, 1996 – Participated in “State of the Climate” briefing at the National Press Club, Washington. Broadcast on CSPAN and reported by over 150 newspapers nation-wide.

June, 1996 – Appeared on “ABC Nightly News”

June, 1996 – Featured in “Sea Technology”

May, 1996 – Featured in “New York Times”

March, 1996 – Featured in cover story in “Science News”

Pre-1996 – Didn’t keep track of press interaction, but was featured several times in print media, including “Wall Street Journal” and “Washington Post.” Also appeared on National Public Radio.

## **SERVICE ON EDITORIAL BOARDS**

Spring, 2007 – Founding Editor (with M. Miller and B. Morehouse) of the new “*Environmental Science, Law, and Policy*” book series, University of Arizona Press and partners (to present).

May, 2006 – Appointed to Board of Reviewing Editors, *Science* (to present)

January, 1993 – Appointed to the Editorial Advisory Board of *Quaternary Science Reviews* (to present)

January, 1993 – Appointed to the Editorial Board of *Geology* (2-year term).

## **OTHER PROFESSIONAL ACTIVITIES**

May, 2008 – Invited to present testimony at hearing on “Water Supply Challenges for the 21<sup>st</sup> Century”, Committee on Science and Technology, U.S. House of Representatives, Washington, DC.

April, 2008 – Invited Speaker, Texas A&M University, College Station, TX

April, 2008 – Invited Speaker, University of Washington public evening lecture

April, 2008 – Invited Speaker, Rotary Club luncheon lecture, Seattle, WA

April, 2008 – Invited Speaker, Pacific Science Center Evening Lecture, Seattle, WA

March, 2008 – Invited speaker, “Solar Rock” event, Tucson, AZ

March, 2008 – Invited dinner speaker, Spring meeting of the Montrose Memorial Hospital staff and friends.

- March, 2008 – Invited Speaker, Yale Club, Tucson, AZ
- March, 2008 – Invited Speaker, Arizona Science Center, Phoenix, AZ
- March, 2008 – Invited Speaker, Honors College Luncheon
- March, 2008 – Invited Speaker, BIO5 and other units, University of Arizona, Tucson, AZ
- February, 2008 – Invited Speaker, Institute of Arctic and Alpine Research, University of Colorado, Boulder, CO.
- January, 2008 – Invited Speaker, Frankel Foundation Board Retreat, Phoenix, AZ.
- November, 2007 – Invited Speaker and Panel Member, Climate Change and the Role of Higher Education in Arizona: *Preparing our Students for a Changing World*, Phoenix, AZ.
- October, 2007 – Invited Speaker, Water Policies and Planning in the West: Ensuring a Sustainable Future, Western Governors’ Association and the Western States Water Council, Salt Lake City, UT.
- October, 2007 – Invited Speaker, Department of Soil, Water and Environmental Sciences, University of Arizona, Tucson.
- October, 2007 – Invited Evening Speaker, Arizona Association for Environmental Educators conference, Tucson, Arizona.
- October, 2007 – Invited speaker, series of three lectures sponsored by the State Engineer of New Mexico, Albuquerque and Santa Fe, New Mexico.
- October, 2007 – Invited Speaker – New Mexico Climate Change Ecology and Adaptation Workshop, Albuquerque, New Mexico.
- October, 2007 – Invited Evening Speaker on Climate Change, Public Forum Co-sponsored by The Nature Conservancy and the University of Chicago, Chicago, Illinois.
- October, 2007 – Invited Workshop Participant, "Future Climate Change Research and Observations: GCOS, WCRP and IGBP Learning from the IPCC Fourth Assessment Report," Sydney, Australia
- September, 2007 – Taaffe Lecturer, Ohio State University, Columbus, Ohio.
- September, 2007 – Invited Speaker, Border Institute-IX: Security, Development and the Environment at the U.S.-Mexican Border.
- August, 2007 – Invited Speaker, 2007 Regional Water Symposium: “Sustainable Water, Unlimited Growth, and Quality of Life: Can We Have It All?”, Tucson, AZ
- July, 2007 – Invited Seminar Speaker, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China
- May, 2007 – Invited Speaker, “Dividing the Waters: Science for Judges Workshop IV,” Boulder, Colorado
- March, 2007 – During a visit to the U.S. House of Representatives, gave an hour-long briefing "Global Warming and the Impacts in the American West" hosted by the House Committee on Science, and also met w/ staffers of two western Congressmen (Rep. Renzi and Rep. Matheson).
- March, 2007 – Invited Speaker – National Science Foundation Earth System History Meeting, Washington, DC.
- March, 2007 – Invited Speaker, OUT LOUD Program, Telluride, Colorado.
- March, 2007 – Invited Speaker, Arizona Board of Regents Meeting.
- March, 2007 – Invited Speaker, UK Royal Society Meeting on Climate Change.
- February, 2007 – Briefed Congresswoman Giffords on climate change, the IPCC, and what it means for Arizona.

- February, 2007 – Met with Congressman Bart Gordon, and participated a House Committee on Science and Technology Briefing on “Sea Level Rise – The State of the Science;” in the afternoon repeated the briefing for staff members of the U.S. Senate Committee on Environment and Public Works
- February, 2007 – Invited Speaker, UN/WMO IPCC Working Group I Plenary.
- December, 2006 – Invited Speaker, American Geophysical Union Fall Meeting
- December, 2006 – Invited Panelist, Interfaith Discussion of Climate Change, Tucson, AZ
- November, 2006 – Invited speaker, Earth System Science Partnership, Beijing, China.
- October, 2006 – Invited speaker, Governor of New Mexico’s Fourth Annual Drought Summit
- October, 2006 – Invited speaker, San Diego Natural History Museum
- October, 2006 – Invited speaker, University of Arizona College of Science Public lecture series “Global Climate Change,” Tucson
- October, 2006 – Invited speaker, Climate Variability & Change in the San Juan Mountains: A Scientist-Stakeholder Dialogue, Durango, CO
- October, 2006 – Invited evening speaker, Fort Lewis College, Durango, CO
- September, 2006 – Invited speaker, Arizona Academy Village, Tucson
- August, 2006 – Invited speaker – 36<sup>th</sup> American Quaternary Association Biennial Meeting, Bozeman, MT.
- July, 2006 – Invited participant, UN/WMO Intergovernmental Panel on Climate Change Fourth Lead Authors Meeting, Bergen, Norway.
- June, 2006 – Invited participant and speaker, IGBP PAGES/ WCRP CLIVAR Workshop on ‘Past Millennia Climate Variability’, Wengen, Switzerland.
- June, 2006 – Invited speaker (1 hour plenary) – 11<sup>th</sup> Annual Community Climate System Model Workshop, Breckenridge, CO.
- May, 2006 – Invited speaker – MountainFilm, Telluride, CO
- May, 2006 – Scientific co-author/member of *Amici Curiae* brief to the U.S. Supreme Court – focused on climate change
- April, 2006 – Dinner speaker, Climate and Energy Funders Group, Phoenix, AZ.
- February, 2006 – Invited speaker, Alaska Forum on the Environment, Anchorage, AK.
- January, 2006 – Invited speaker (1 hour plenary), 5<sup>th</sup> Annual conference of the Quivira Coalition – ‘Bridging the Urban-Rural Divide’, Albuquerque, NM.
- January 2006– Elected Vice President of the Board for the Mountain Studies Institute, Silverton, Colorado
- December, 2005 – Invited seminar speaker, Fort Lewis College
- December, 2005 – Invited participant and speaker, UN/WMO Intergovernmental Panel on Climate Change Third Lead Authors Meeting, Christchurch New Zealand
- November, 2005 – Invited speaker, Climate, Oceans and Policies – Challenges for the 21<sup>st</sup> Century Conference, Royal Norwegian Embassy and The Carnegie Institution, Washington, DC.
- October, 2005 – Invited speaker and participant, Climate Change and Conservation Workshop, The National Center for Ecological Analysis and Synthesis (NCEAS), Santa Barbara, CA.
- September, 2005 – Invited speaker and participant, National Research Council Board on Atmospheric Sciences and Climate Workshop on Multiple Environmental Stresses, Irvine, CA.

- September, 2005 – Invited dinner speaker and participant, Conference on Urban Water Supplies and Climate Change in the West, Las Vegas, NV.
- August 2005 – Elected Member of the Board for the Mountain Studies Institute, Silverton, Colorado
- July, 2005 – Gave public lecture on climate change (“Climate Change: What's Ahead for the West”) sponsored by the New Mexico State Environment Department, Santa Fe, NM
- July, 2005 – Invited lunch speaker, State of New Mexico Climate Change Advisory Group Meeting #1, Santa Fe, NM
- July, 2005 – Discussion speaker, Pinhead Institute Town Talk, Telluride, CO.
- June, 2005 – Participant/speaker, San Juan Mountains Research Retreat, Mountain Studies Institute, Silverton, CO
- May, 2005 – Invited speaker and participant, NASA-NOAA Workshop on “Observational and modeling requirements for predicting drought on seasonal to decadal time scales,” University of Maryland
- May, 2005 – Invited participant, UN/WMO Intergovernmental Panel on Climate Change Second Lead Authors Meeting, Beijing, China.
- April, 2005 – Invited Speaker, University of Arizona Dean of Students Faculty Lecture Series; talk title: “Drought: Lessons from the Future.”
- April, 2005 – Dinner Speaker at informal meeting of water managers for Albuquerque and the state of New Mexico
- March, 2005 – Invited speaker, Arizona Geological Society meeting, Tucson, AZ.
- February, 2005 – Invited speaker and participant, Workshop on “Climate Change & Ecosystem Impacts in Southwest Forests and Woodlands,” Sedona, AZ.
- February, 2005 – Guest lecturer, Environmental Law Seminar, University of Arizona.
- April, 2004 – Invited Speaker – “Perspectives on Abrupt Climate and Environmental Change, ”Briefing for the NSF Geosciences Directorate.
- February, 2004 – Testified in support of Arizona State Senate Bill 1227 (State Climate Change Study Committee); Senate Natural Resources and Transportation Committee
- February, 2004 – Panel Member, Plenary Session on “Managing Fish and Wildlife in the face of Climatic Variability,” 37<sup>th</sup> Annual Joint meeting of the Arizona and New Mexico Chapters of The Wildlife Society and the Arizona/New Mexico Chapters of the American Fisheries Society, Safford AZ.
- November, 2003 – Invited Speaker New Mexico Council of Churches conference “Is Global Warming Too Hot to Handle?,” Albuquerque MN
- October, 2003 – Invited Plenary Speaker, Panel Member and Press Conference Participant, Study of Environmental Arctic Change (SEARCH) Open Science Meeting, Seattle, Washington
- September, 2003 – Invited Participant and Speaker, UN Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Second Scoping Meeting, Potsdam, Germany
- May, 2003 – Invited speaker, Inagural Meeting of the Arizona Governor’s Drought Task Force
- April, 2003 – Invited Participant and Speaker, UN Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment First Scoping Meeting, Potsdam, Germany
- April, 2003 – Invited Keynote Speaker, University of New Mexico Center for the Southwest Conference “Heating up: Coping with Climate Change in the Southwest”
- April, 2003 – Invited Plenary Speaker, International Limnogeology Congress, Tucson, AZ

- April, 2002 – Keynote Speaker, NSF Workshop on “Antarctic Peninsula Climate Variability: A Historical and Paleoenvironmental Perspective,” Clinton, NY.
- April, 2002 – Invited Speaker, University of New Mexico
- March, 2002 – Invited seminar speaker, University of New Mexico
- March, 2002 – Invited SEPM 2002 Annual Business Meeting Luncheon Distinguished Speaker, Houston, TX
- January 2002 – Invited lunch speaker. “Regional climate services: The RISA\* Experience” NOAA Climate Services Workshop, Columbia, Maryland.
- December 2001 – Invited plenary speaker “Building Native Nations: Environmental, Natural Resources, and Governance” conference, Tucson, AZ
- August 2001 – Invited plenary speaker, *IGBP PAGES – PEP3: Past Climate Variability Through Europe and Africa*, August 2001, Aix-en-Provence, France.
- November, 2001 – Laboratory for Tree-ring Research, Colloquium, November 2001
- April 2001 – Invited Speaker, NOAA Climate Diagnostics Lab, Boulder, CO
- April 2001 – Attended lunch briefing with Arizona Congressmen Kolbe and Flake to discuss University of Arizona interaction with Columbia University and the Biosphere 2 Center, Washington, DC
- April 2001 – Invited Speaker, NSF Workshop “Reconstructing Late Holocene Climate,” Charlottesville, VA
- April 2001 – Invited speaker, University of Arizona Math Awareness Week
- March 2001 – Invited seminar speaker, Scripps Institute of Oceanography
- March 2001 – Invited seminar speaker, University of Minnesota
- March 2001 – Invited speaker at NSF PARCS workshop, Amherst Massachusetts
- March 2001 – Invited speaker and Earth System Science advisor, University of Wyoming
- February 2001 – “Climate, fire and the need for a national climate service.” NOAA-USDA Fire and Climate 2001 Workshop, Tucson, AZ.
- January, 2001 – Invited speaker at *NASA/IPRC Colloquium on Decadal Climate Variability*, Honolulu HI
- September 2000 – Invited speaker, Annual Meeting of The Nature Conservancy, Tucson, AZ
- July 2000 – Invited participant and speaker, Yale/NBER/IIASA program on International Environmental Economics Workshop on “Potential Catastrophic Impacts of Climate Change”, Snowmass, CO
- August 2000 – Gave invited lecture to UA Ecology and Evolutionary Biology Dept. as part of their seminar series
- May 2000 – Gave talk “A global perspective on climate change” to US Department of State “Senior Seminar,” Tucson, AZ
- March 2000 – Gave invited Holmes lecture, Syracuse University.
- December, 1999 – Gave invited lecture to UA Geography Dept. as part of their seminar series
- October, 1999 – Invited Speaker/Panelist “Hot Topics” Session entitled “Climates Change, Get With It!” at 1999 Annual Meeting of the Geological Society of America, Denver, CO.
- November, 1999 – Invited Panelist and Speaker in “Special Symposium on Global Warming” at the 1999 American Nuclear society Winter Meeting (Long Beach, CA). Talk titled “Measuring climate change: climates and climate changes of the past.”
- August, 1999 – Invited participant and speaker, Aspen Global Change Institute on “Ecological and Agricultural Consequences of Past, Present and Future Climatic Extremes,” Aspen, CO.

- August, 1999 – Gave invited seminar on recent climate change at University of Durban, South Africa
- August, 1999 – Gave three invited short-course/demonstration of The World Data Center-A for Paleoclimatology system, International Quaternary Association Meeting, Durban, South Africa. Included television interviews with South African Broadcasting Service.
- May, 1999 – Invited speaker/participant NASA Team Meeting (Arlie, VA) Presented overview of “Assessing Future Stability of US High Plains Landcover: Integration of Process Modeling with Landsat, In Situ Modern and Paleoclimate Data”
- Spring, 1999 – Invited lecturer, Trinity College, Dublin
- June, 1998 – Invited lecturer, European Commission Advanced Study Course on Holocene Climate Reconstruction, Environmental Change Research Centre, University College, London
- June, 1998 – Invited Participant, US-European Commission Conference “New Vistas in Transatlantic Science and Technology Cooperation,” Washington, DC.
- April, 1998 – Invited Speaker, IGBP PAGES Open Science Meeting, London, England.
- February, 1998 – Invited Participant, Sixth Japan-U.S. Workshop on Global Change Research, Honolulu, Hawaii
- February, 1998 – Nominated for Lead Author, 2000 Intergovernmental Panel on Climate Change (IPCC)
- February, 1998 – Invited Plenary Speaker and Participant, IGBP PAGES 2nd International Workshop on Global Paleoenvironmental Data, Boulder, Colorado
- January, 1989 – Invited Speaker, National Science Foundation Earth System History Interagency Briefing, Washington, DC
- January, 1989 – Invited Speaker, US Global Change Research Program Congressional Seminar Series, Washington, DC
- January, 1998 to 2000 – Invited Content Advisor, Smithsonian Institution’s planned new “Forces of Change” National Museum of Natural History exhibit and “From Grass to Grain” traveling exhibit.
- January, 1997 to 1998 – Senior US Scientist, Gore-Chernomyrdin US-Russia Environmental Working Group.
- December, 1997 – Invited Seminar Speaker – University of Alaska-Fairbanks
- November, 1997 – Preprint of Science paper “Arctic Environmental Change of the Last Four Centuries” sent by Dr. James Baker (Under Secretary for Oceans and Atmosphere) to Vice President Gore, along with explanatory memo).
- November, 1997 – Invited seminar speaker – McGill University, Montreal
- November, 1997 – Invited seminar speaker – University of Montreal, Montreal
- November, 1997 – Invited seminar speaker – UC Santa Cruz, Santa Cruz, CA
- November, 1997 – Invited participant, IGBP PAGES (Past Global Changes) Leader Meeting, Hilterfingen, Switzerland
- September, 1997 – Invited participant and speaker, WCRP CLIVAR Science meeting, Abisko, Sweden.
- June, 1997 – Invited participant and speaker, National Center for Atmospheric Research “Climate System Model” workshop. Breckenridge, CO
- May, 1997 – Invited Speaker, NSF ARCSS OAI Principal Investigators Meeting, Virginia Beach.

- Winter, 1997 – Member – NSF Arctic System Science (ARCSS) Science Integration Plan Writing Team.
- April, 1996 – Plenary Speaker and Working Group Co-Chair, Arctic System Science (ARCSS) All-Hands Workshop, Utah
- Spring, 1996 – Member, Ocean Drilling Program Leg 165 Science Party
- February, 1996 – invited speaker at first ever joint meeting of the NRC (National Research Council) “GOALS” and “DEC-CEN” climate research panels, Irvine, CA.
- October, 1995 – Speaker and Working Group Leader, All World Data Center Meeting, Netherlands
- April, 1995 – Invited participant, speaker and discussion leader "International Himalayan/Tibetan Plateau Paleoclimate Workshop" Kathmandu, Nepal
- 1994-1997 – Collaborator on funded National Science Foundation Grant ATM-94: "Long-term dynamics of the SW Indian monsoon: New high-resolution paleoclimatic data from Tibet" (funding thru Dr. K-B Liu).
- April, 1994 – Invited participant, IGBP PAGES workshop and planning meeting "PEPII – Pole-Equator-Pole Australasia transect," Beijing, China.
- 1991 to present – Invited participant, and representative of the NOAA Paleoclimatology Program, at 2-3 meetings per year of the NOAA Panel on Climate and Global Change
- October, 1994 – Invited participant, NATO Workshop "Climatic variability and forcing mechanisms of the last 2000 years." Tuscany, Italy
- December, 1993 – Guest Editor, Special Issue of *Quaternary Science Reviews*, "Decadal to Millennial-scale Variability in the Climate System"
- December, 1993 – Invited participant and co-author of IGBP PAGES workshop report "PEPIII – Pole-Equator-Pole Europe-Africa Transect," Bern Switzerland.
- October, 1993 – Invited participant, NATO Workshop "Strategies for the use of paleoclimatic data sets in climate model intercomparison and evaluation," Aussois, France.
- April, 1993 – Invited participant, speaker, and group leader at IGBP Workshop "High-resolution records of past climate from monsoon Asia," Taipei, Taiwan.
- March, 1993 – Invited participant and speaker, NSF-Russian Workshop "Paleoclimates of Arctic Lakes and Estuaries," Vladivostok, Russia. Co-authored protocols for international collaboration in the study of Arctic paleoclimates using lake sediments.
- December, 1992 – IGBP PAGES representative to meeting of the IGBP-DIS Standing Committee and to discussions of joint PAGES-IGBP GCTE (Global Change and Terrestrial Ecosystems) research, Canberra, Australia.
- December, 1992 – Invited lecturer at the Research School of Biological Sciences at the Australian National University.
- November, 1992 – Invited participant and speaker at the Advisory Committee on Nuclear Waste Working Group Meeting: "On the impact of long-range climate change in the area of the southern Basin and Range," Washington, DC.
- September, 1992 – Invited participant in NOAA-sponsored workshop "Human Dimensions of Global Change," Washington, DC.

- September, 1992 to May, 1994 – Gave hour-long invited seminars at the University of Colorado (Geological Sciences), the NOAA Geophysical Fluid Dynamics Lab (Princeton), the Colorado School of Mines (Geology), The University of Wyoming (Geology), the University of Massachusetts (Geography and Geology) and the University of Washington (Quaternary Research Center – two lectures).
- December, 1991 – Invited participant, Dahlem Workshop on "Global Changes in the Perspective of the Past," Berlin, Germany.
- November, 1991 – Invited participant and discussion leader, NOAA/NASA/NSF Workshop: "Late Quaternary Paleoclimate Model Boundary Conditions," New York.
- September, 1991 – Invited Guest and Lecturer, Center for Climate System Research, University of Tokyo.
- June, 1991 – Invited member, US delegation to meeting of Working Group VIII (Influences of Environmental Changes on Climate) of the US/USSR Agreement on Protection of the Environment, Bellagio, Italy.
- March, 1991 – Invited participant and Theme Leader, First meeting of the Scientific Steering Committee of the IGBP Past Global Changes (PAGES) Core Project, Mainz, Germany.
- August, 1990 – Invited participant and paleoclimatology representative – U.S. (NSF/NASA) Bilateral Agreement with the People's Republic of China (State Meteorology Agency) Climate Workshop, Shanghai, PRC.
- January, 1990 – Invited participant, GICME II Workshop – "Geological Indicators of Climate from Marine Environments," St. Petersburg, FL.
- November, 1989 – Invited participant, EPA/OPPE "Workshop on Tropical Forests," Washington DC.
- August – September 1989 – Visiting Scientist, Laboratoire de Palynologie C.N.R.S., Montpellier, France.
- July – August 1989 – Invited participant, Second UCAR/OIES Global Change Institute, "Explaining records of past global change," Snowmass, Colorado.
- July, 1989 – Invited contributor and speaker, "Global Climate Change and its Effects on California," Davis, California.
- 1989 – 1990 – Original member of the NOAA Paleoclimate Advisory Panel.
- November-December 1988 – Visiting Scientist, Laboratoire de Palynologie C.N.R.S., Montpellier, France.
- September 1988 – Invited participant, Committee on the Earth Sciences review of methodologies for EPA's reports to Congress, Washington DC.
- August 1988 – Elected Vice-Chairperson/ Chair-Elect of the Paleoecology Section of the Ecological Society of America.
- April 1988 – Invited participant, NSF workshop on Arctic Lake Coring, Boulder, Colorado.
- April 1988 – Review workshop for EPA's Report to Congress on the Effects of a Global Warming, Bethesda, Maryland.
- February 1988 – Invited participant and speaker, NSF/NOAA Paleoecology workshop: "A meeting on the present status and future of studies of the paleosedimentary

- records of nearshore marine and freshwater lakes related to climate and global change," Boston, Massachusetts.
- October 1987 – Invited participant, U.S. EPA Meeting of the Principal Investigators for "The Report to Congress on the Effects of a Global Warming," Alexandria, Virginia.
- September 1987 – Invited participant, U.S. EPA Workshop: "Global Climate Change Research Plan," Raleigh, North Carolina.
- May 1987 – Invited participant and speaker, NSF (Division of Polar Programs) workshop: "The Contribution of Lake Sediments to Arctic Paleoenvironmental Reconstructions," Boulder, Colorado.
- April 1987 – Invited participant, U.S. EPA Workshop: "Ecological Effects of Global Climate Change," Boulder, Colorado.
- April 1987 – Invited participant and speaker: "United Nations Meeting of Experts on Space Technology and its Applications within the Framework of Educational Systems," Lagos, Nigeria.
- 1986 to present – Reviewer for U.S. EPA, NSF, DOE, NOAA, NGS, ODP, USGS, NPS, several foreign funding agencies, and numerous scientific journals.
- 1986 – Consultant to the U.S. EPA.
- 1984 to 1986 – Member COHMAP (Cooperative Holocene Mapping Project).

## PROFESSIONAL MEMBERSHIPS

American Geophysical Union  
 American Meteorological Society  
 American Quaternary Association  
 Ecological Society of America  
 Geological Society of America  
 Sigma Xi

## PUBLICATIONS (Peer-reviewed journals and book chapters)

101. Weiss, J.L., C. L. Castro and J. T. Overpeck. (2008). The Changing Character of Climate, Drought, and the Seasons in the Southwestern U.S.A. *Journal of Climate* (submitted).
100. Conroy J. L., J.T. Overpeck, M. Steinitz-Kannan, and J.E. Cole. (2009). The tropical Pacific–western North American drought teleconnection over the last 1200 years. *Geophysical Research Letters* (in final co-author review).
99. Jones P.D., K.R. Briffa, T.J. Osborn, J.M. Lough, T.D. van Ommen, B.M. Vinther, J. Luterbacher, E. R. Wahl, F.W. Zwiers, M.E. Mann, G.A. Schmidt, C. M. Ammann, B.M. Buckley, K. M. Cobb, J. Esper, H. Goosse, N. Graham, E. Jansen, T. Kiefer, C. Kull, M. Küttel, E. Mosley-Thompson, J.T. Overpeck, N. Riedwyl, M. Schulz, A. W. Tudhope, R. Villalba, H. Wanner, E. Wolff and E. Xoplaki (2009). High-resolution paleoclimatology of the last millennium: a review of current status and future prospects. *The Holocene* (in press).
98. Overpeck, J.T. and J.E. Cole (2008). The rhythm of the rains. *Nature* 451, 1061-1063.
97. Conroy J. L., J.T. Overpeck, M. Steinitz-Kannan, and J.E. Cole. (2009). Unprecedented recent warming in the eastern tropical Pacific. *Nature Geoscience* (in press).

96. Conroy J. L., J.T. Overpeck, J.E. Cole, T.M. Shanahan, and M. Steinitz-Kannan. (2007). Holocene changes in eastern tropical Pacific climate inferred from a Galápagos lake sediment record. *Quaternary Science Reviews* (in press).
95. Neff, J.C., A.P. Ballantyne, G.L. Farmer, N.M. Mahowald, J. Conroy, C.C. Landry, J. T. Overpeck, T.H. Painter, C.R. Lawrence and R. Reynolds (2008). Recent increases in eolian dust deposition due to human activity in the western United States. *Nature Geoscience* (in press).
94. Shanahan, T., J.T. Overpeck, C.A. Scholz, J. W. Beck, Scholz, J. Peck and J.W. King (2007). Abrupt changes in the water balance of tropical West Africa during the late Quaternary. *Journal of Geophysical Research* (in press).
93. Scholz, C.A, T.C. Johnson, A.S. Cohen, J.W. King, J.A. Peck, J.T. Overpeck, M.R. Talbot, E.T. Brown, L. Kalindekafeh, P.Y.O. Amoakoi, R.P. Lyons, T.M. Shanahan, I.S. Castaneda, C.W. Heile, S.L. Forman, L.R. McHarguek, K.R. Beuning, J.Gomez, and J.Pierson (2007). East African megadroughts between 135 and 75 thousand years ago and bearing on early-modern human origins. *Proc. of the National Academy of Sciences* 104, 16416-16421.
92. Shanahan T.M., J.T. Overpeck, J.B. Hubeny, J. King, F.S. Hu, K. Hughen, G. Miller, J. Black, A. Werner (2007). Scanning m-XRF elemental mapping: a new tool for the study of laminated sediment records. *Geochemistry, Geophysics, Geosystems* (in press).
91. Shen, C., K-b Liu, C. Morrill, J.T. Overpeck, J. Peng and L. Tang (2008). Meadow-steppe ecotone shift and major centennial-scale droughts during the Mid-Late Holocene in the central Tibetan Plateau. *Ecology* 89, 1079-1088.
90. Overpeck, J.T. and J.E. Cole (2007) Lessons from a distant monsoon. *Nature* 445, 270-271.
89. Koeberl C., Milkereit B., Overpeck J. T., Scholz C. A., Amoako P. Y. O., Boamah D., Danuor S.K., Karp T., Kueck J., Hecky R. E., King J., and Peck J. A. 2007. An international and multidisciplinary drilling project into a young complex impact structure: The 2004 ICDP Bosumtwi impact crater, Ghana, drilling project – An overview. *Meteoritics & Planetary Science* 42, 483-511.
88. Potter, J. and others. **Climate Change**: An Information Statement of the American Meteorological Society, Boston, MA
87. IPCC, 2007: Summary for Policymakers. *In*: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. (Solomon, S. et al., eds). Cambridge University Press. Cambridge. Pages 1-18.
86. Solomon, S. and others. Technical Summary. *In*: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. (Solomon, S. et al., eds). Cambridge University Press. Cambridge. Pages 19-91.
85. Jansen, E., J.T. Overpeck and 47 others. 2007. Chapter 6: Paleoclimate. *In*: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. (Solomon, S. et al., eds). Cambridge University Press. Cambridge. Pages 433-497.
84. Morehouse, B. G. Christopherson, M. Crimmins, B. Orr, J. Overpeck, T. Swetnam, and S. Yool. (2006). Modeling interactions among wildland fire, climate and society in the context of climate variability and change in the Southwest US. *In*: “Regional Climate Change and Variability,” M. Ruth, K. Donaghy and P. Kirshen, eds., Edward Elgar, Cheltenham, UK, 58-78.

83. Overpeck J.T. and J.E. Cole. 2006. Abrupt change in the Earth's climate system. *Ann. Rev. Environment and Resources* 31, 1-31.
82. Kerwin, M. W., Overpeck, J. T., and Webb, R. S. 2006. Corresponding patterns of modern lake sediment pollen and vegetation in boreal, subarctic, and Arctic regions of eastern Canada. *Review of Palaeobotany and Palynology* (submitted).
81. Shanahan, T., Overpeck, J. T., Wheeler, C. W., Beck, J. W., Pigati, J. S., Talbot, M. R., Scholz, C. A., Peck, J., and King, J. W. 2006. Paleoclimatic variations in West Africa from a record of late Pleistocene and Holocene lake level stands of Lake Bosumtwi, Ghana. *Palaeogeography Palaeoclimatology Palaeoecology* (in press).
80. Shanahan, T.M., J.T. Overpeck, E. Sharp, C.A. Scholz, and J. Arko. 2007. Simulating the response of a closed basin lake to recent climate and land-use changes in tropical West Africa (Lake Bosumtwi, Ghana). *Hydrological Processes* 21, 1678-1691.
79. CAPE\_Last\_Interglacial\_Project\_Members. 2006. Last Interglacial Arctic Warmth Confirms Polar Amplification of Climate Change. *Quaternary Science Reviews* 25, 1383-1400.
78. Overpeck, J. T., Otto-Bliesner, B. L., Kiehl, J. T., Miller, G. H., and Alley, R. 2006. Paleoclimatic evidence for future ice sheet instability and rapid sea-level rise. *Science* 311, 1747-50.
77. Otto-Bliesner, B. L., Marshall, S. J., Overpeck, J. T., Miller, G. H., Hu, A. X., and CAPE-Project-Members. 2006. Simulating arctic climate warmth and icefield retreat in the last interglaciation. *Science* 311, 1751-1753.
76. Orr, B.J., W. Grunberg, A.B. Cockerham, A.Y. Thwaites, S.H. Severson, N.M.D. Lerman, R.M. Miller, M. Haseltine, B.J. Morehouse, J.T. Overpeck, S.R. Yool, T.W. Swetnam, and G.L. Christopherson. 2005. An on-line interface for integrated modeling of wildfire, climate and society for strategic planning for the sky islands. Gottfried, Gerald J.; Gebow, Brooke S.; Eskew, Lane G.; and Edminster, Carl, compilers. Biodiversity and Management of the Madrean Archipelago II. Proceedings. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
75. Huntington, H.P., M. Boyle, G. Flowers, J. Weatherly, L. Hamilton, C. Gerlach, R. Zulueta, C. Nicolson and J. Overpeck. 2006. The influence of human activity in the Arctic on climate and climate impacts. *Climatic Change* (in press).
74. Weiss, J.L. and J.T. Overpeck. 2005. Is the Sonoran Desert Losing Its Cool? *Global Change Biology* 11, 2065-2077.
73. Overpeck, J.T., M. Strum, J.A. Francis, D.K. Perovich, M.C. Serreze and 18 others. 2005. Arctic system on trajectory to new, seasonally ice-free state. *EOS* 86, 309-313.
72. Morrill C, Overpeck JT, Cole JE, Liu KB, Shen CM, Tang LY. 2006. Holocene variations in the Asian monsoon inferred from the geochemistry of lake sediments in central Tibet. *Quaternary Research* 65: 232-43.
71. Shen, C., K.B. Liu, L. Tang and J.T. Overpeck. 2005. Late Quaternary history of the alpine vegetation and climate on the Tibetan Plateau. *Quaternary Science Reviews* (submitted).
70. Peck, J.A., R.R. Green, T. Shanahan, J.W. King, J. Overpeck, and C. Scholz. 2004. A magnetic mineral record of Late Quaternary tropical climate variability from Lake Bosumtwi, Ghana. *Palaeogeography, Palaeoclimatology, Palaeoecology* 215, 37-57.
69. Brooks, K., C.A. Scholz, J.W. King, J. Peck, J.T. Overpeck, J.M. Russell and P.Y.O. Amoako, 2005. Late-Quaternary lowstands of Lake Bosumtwi, Ghana: evidence from high-resolution seismic reflection and sediment-core data. *Palaeogeography, Palaeoclimatology,*

- Palaeoecology* 216, 235-249
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- Overpeck, J.T. 1994. "The paleoclimate record and its role in understanding the greenhouse effect" International Conference on Global Climate Change: Science, Policy, and Mitigation Strategies, Phoenix, AZ
- Webb, R.S., P.J. Bartlein, and J.T. Overpeck. 1993. "The paleoclimate record of long-term climate variability." Ecological Society of America Annual Meeting.
- Barlow, L.K., J.W.C. White, J.T. Overpeck, and R.G. Barry. 1993. "Evaluation of deuterium signals from the GISP2 ice core with Greenland temperature records:

- groundwork for high resolution interpretation for the last 1000 years." AGU Spring Meeting.
- Lin, H-L., L.C. Peterson, D.W. Murray, and J.T. Overpeck. 1993. "Isotopic indicators of late Quaternary hydrography and productivity: foraminiferal O-18 and C-13 records from the Cariaco Basin (Venezuela)." AGU Spring Meeting.
- Overpeck, J., E. Cook, K. Gajewski, and J.S. Clark. 1992. "Assessing the potential of fossil pollen data for reconstructing annual to century-scale climatic change." 12th biennial Meeting of the American Quaternary Association, Davis, California (Plenary talk).
- Overpeck, J. 1992. "Global view of the Little Ice Age: A model perspective." 13th International CODATA Conference, Beijing, China.
- Peterson, L.C., H-L. Lin, J.T. Overpeck, D.W. Murray, S.E. Trumbore, and C. Schubert. 1992. "The late Quaternary record of anoxia in the Cariaco Basin (Venezuela)." AGU Ocean Sciences Meeting, New Orleans, Louisiana.
- Overpeck, J.T. and D. Rind. 1992. "Modeling the possible causes of decade- to century-scale climatic change." American Society of Limnology and Oceanography Aquatic Sciences Annual Meeting, Santa Fe, New Mexico
- Overpeck, J.T., D. Anderson, S. Trumbore, W. Wolfli, and W. Prell. 1991. "Abrupt change in the monsoon climates of Africa and Asia during the last deglaciation." XIII INQUA Congress, Beijing, China
- Overpeck, J.T. 1991. "The Late-Quaternary record of global climate change." American Association of Stratigraphic Palynologists Annual Meeting, San Diego.
- Overpeck, J.T. 1990. "Modeling the transient response of vegetation to climatic change." Geological Society of America Annual Meeting.
- Overpeck, J.T. 1990. "The past as a key indicator for assessing future climate-induced ecologic change." International Symposium on Ecological Indicators, Fort Lauderdale.
- Overpeck, J.T. 1990. "A data-model approach to understanding decade- to century-scale climatic variability: Project ARRCC." Workshop on Climate Studies, Shanghai.
- Overpeck, J., D. Anderson, S. Trumbore, W. Wolfli, and W. Prell. 1990. "The Southwest Indian Monsoon, the Tibetan Plateau, and abrupt climatic change over the last deglaciation." Beijing International Symposium on Climatic Change, Beijing.
- Overpeck J.T. 1989. "Lake sediments, climate modeling, and global climate change." Keynote speaker in workshop on "Large Lakes and Global Climate Change," 24th Congress of the International Association of Theoretical and Applied Limnology, Munich, FRG.
- Peterson, L.C., J.T. Overpeck, N.Kipp, J.Imbrie, and D.Rind. 1989. "A high-resolution record of the last deglaciation from the anoxic Cariaco Basin." Third International Conference on Paleoceanography, Cambridge, Great Britain.
- Overpeck, J.T. and D. Rind 1989. "Climate and biotic change: past, present, and future." Ecological Society of America Annual Meeting, Toronto.
- Overpeck, J.T. 1988. "Modeling the transient response of vegetation to climatic change: a paleoecologic time series perspective." Ecological Society of America Annual Meeting, Davis, California

- Overpeck, J.T. 1987. "Paleoclimatic perspectives on the global carbon cycle: past, present, future." Symposium Inaugurating the University of London Quaternary Research Centre and celebrating Agassiz and 150 years of Quaternary Research, Surrey, England.
- Overpeck, J.T. and E.R. Cook. 1987. "A Quaternary perspective on how trace-gas-induced climate change might affect natural vegetation: data and methods." XII-th Congress of the International Quaternary Association, Ottawa, Canada.
- Overpeck, J.T. 1987. "Pollen, vegetation, climate, and the interval 18,000 to 9000 YR B.P.: numerical techniques in the search for truth." XII-th Congress of the International Quaternary Association, Ottawa, Canada.
- Overpeck, J.T. 1985. "Pollen time series and Holocene climate variability of the Midwest United States." NATO/NSF Conference of Abrupt Climate Change, Grenoble, France.
- Overpeck, J.T. and P.J. Bartlein. 1984. "Time series analysis of a 1000-year high-resolution pollen record from north-central Wisconsin." International Palynological Conference.

**ATTACHMENT B**

Contentions Adopted By <b>Jonathan Overpeck</b> In Accordance With Affidavit
NEV-SAFETY-9
NEV-SAFETY-10
NEV-SAFETY-11
NEV-SAFETY-12
NEV-SAFETY-13
NEV-SAFETY-18
NEV-SAFETY-19

## **Attachment 21**

### **Affidavit of Stephan K. Matthäi**

BEFORE THE U.S. NUCLEAR REGULATORY COMMISSION

In the Matter of )

U.S. DEPARTMENT OF ENERGY )

Docket No. 63-001

License Application to Construct a )  
Geologic Repository at Yucca Mountain )

**AFFIDAVIT OF STEPHAN K. MATTHÄI**

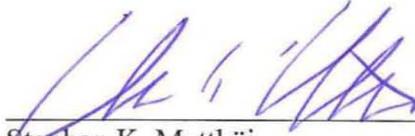
I, Stephan K. Matthäi, the undersigned affiant, do hereby make the following statements based upon my own knowledge, information, and belief.

1. My name is Stephan K. Matthäi, and my curriculum vitae is attached to this Affidavit as Attachment A. I am executing this Affidavit in support of the State of Nevada Petition to Intervene as a Full Party (Petition) in the above-captioned proceeding.

2. Within the Petition are numerous contentions, each comprised of several paragraphs. I hereby adopt as my own opinions the statements contained within Paragraph 5 of those specific contentions identified in Attachment B to this Affidavit. I understand that attorneys for the State of Nevada will assign unique numbers to each of those contentions just prior to the filing of the Petition and will include those unique numbers in Attachment B.

Further, the affiant sayeth not.

Leoben am, 12. DEZ. 2008

  
Stephan K. Matthäi

The above-named affiant personally appeared before me this 15 day of December, 2008, and executed this affidavit.

  
Notary Public



My Commission expires: 16.08.2030

**ATTACHMENT A**

**CURRICULUM VITAE**

**STEPHAN K. MATTHÄI**

Chair of Reservoir Engineering,  
 Department of Mineral Resources and Petroleum Engineering,  
 Montan University of Leoben, Austria  
 Wk: +43 3842 402 3000,  
 Fax: +43 3842 402 8202

E-mail: [stephan.Matthäi@unileoben.ac.at](mailto:stephan.Matthäi@unileoben.ac.at)  
 Homepage: [www.petroleumengineer.at](http://www.petroleumengineer.at)  
 CSMP++ Wiki: [csmp.es.eic.ac.uk/wiki](http://csmp.es.eic.ac.uk/wiki)

Date of Birth: May 6<sup>th</sup>, 1963  
 Place of Birth: Mosbach, Germany  
 Sex/Marital Status: male / married, one child  
 Nationality: German  
 Languages: English, German, French, Italian

**10/2008- present: Professor (Ordinarius)** of Reservoir Engineering, Montan University of Leoben, Austria.

**1/2001-9/2008: Governor's Lecturer**, (formal title: Senior Lecturer) Department of Earth Sciences & Engineering, Imperial College London, South Kensington.

**3/2005: Concours National de la Recherche, habilitation**, (qualification) France.

**10/96-12/2000: Research Associate (Wissenschaftlicher Mitarbeiter)**, Institut für Isotopengeologie und Mineralische Rohstoffe, Swiss Federal Institute of Technology, Zürich, Switzerland.

**6/95-10/96: Postdoctoral Research Fellow**, Rock Fracture Project (RFP), Department of Geological and Environmental Sciences, Stanford University, Stanford, California, USA.

**4/94-6/95: Postdoctoral Research Fellow**, Department of Geological Sciences, Snee Hall, Cornell University, Ithaca, New York, USA.

**5/90-2/94: Ph.D.**, Research School of Earth Sciences, Australian National University, Canberra, Australia. Supervisors: Dr. Mike A. Etheridge and Dr. Stephen Cox. Advisor: Dr. Richard W. Henley.

PhD Thesis: **The Genesis of Intrusive-Related Hydrothermal Gold Deposits.**

**10/83-2/90: Diplom**, Master of Science, Eberhardt Karls University of Tübingen, Germany. Supervisor: Dr. Wolfgang Frisch.

Diplom Thesis: **Deformation and Mineralization History of Emplaced Backarc Basin Crust on the Argolis Peninsula (Greece).**

### Current Research

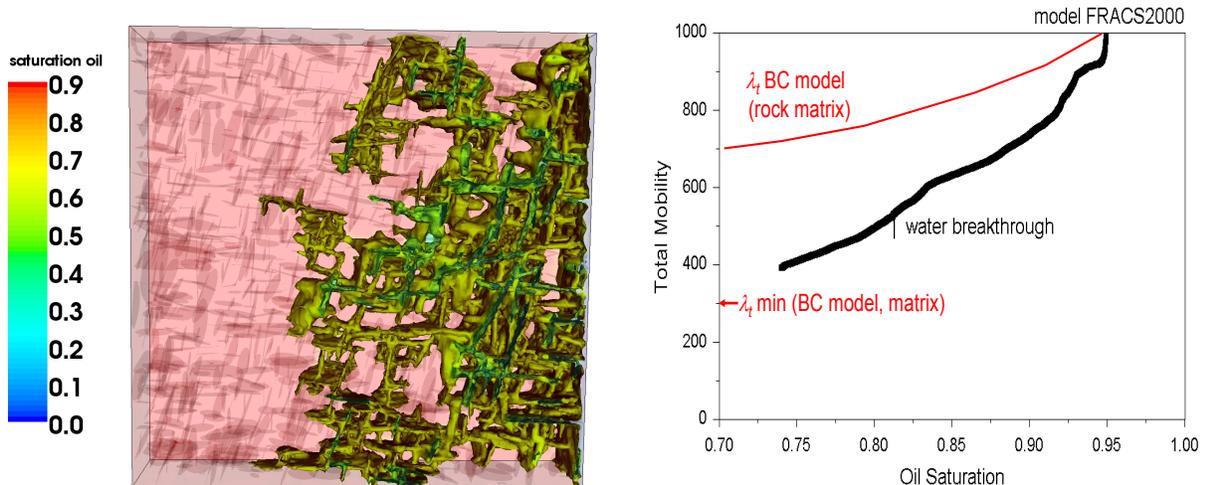
In 2008/2009 my main brief at the Montan University of Leoben is to deliver courses and redesign the curriculum for the Bachelor in Petroleum Engineering and the International Masters in Reservoir Engineering. In parallel, I am assembling a new research team with the

skills required to address reservoir engineering / enhanced and tertiary recovery problems arising in geometrically complex reservoirs by means of multiphysics simulations on unstructured grids. At the same time, third party funding for my former research group at Imperial College London will continue as does my involvement in the industry consortium on “Improved Simulation of Fractured and Faulted Reservoirs” which I initiated there in 2002 together with Martin Blunt.

The focus of my Computational Hydrodynamics group at Imperial (3 PDRAs, 5 PhD students) was to understand the fluid flow and hydro-geo-mechanical couplings in structurally complex, naturally fractured systems such as hydrocarbon reservoirs and geothermal systems. The main goal of this research was to predict emergent phenomena which have a significant impact on the engineering and management of these systems. This mission will continue.

We investigate multi-phase flow and deformation by means of case-study research on exhumed fossil and submerged active systems. We develop, test, and refine process hypotheses for these systems by means of numerical simulations on very large unstructured grids using our own HPC software. Application examples include hydrothermal and geothermal systems, as well as nuclear waste and CO<sub>2</sub> repositories. We have developed a workflow to build, parameterize, simulate, and analyse highly realistic models of well-described sub-surface systems including discrete representations of fractures and faults. Numerical experimentation is facilitated by our original object-oriented finite-element finite-volume software, the Complex Systems Modelling Platform (CSMP++), which we also market commercially.

Research topics we have worked on over the last three years, include (1) relative permeability upscaling (for field-scale multiphase flow simulation) and the scale-variance of transport properties of fractured rock, see Figure 1, (2) stress-sensitivity of fractured hydrocarbon reservoirs, (3) unsteady convection in faults in geothermal reservoirs, (4) compressible steam and brine flow in intrusive-related hydrothermal systems, (5) applicability of percolation theory to actual fracture systems, (6) development and shape modification of fractures under stress including the effects of carbonate dissolution and precipitation, (7) the heat budget of Stromboli volcano, and (8) interpretation of well tests in the vadose zone aided by streaming potential data inversion. Much of this work is supported by the oil industry and government agencies in the UK and elsewhere.



**Fig. 1: Discrete fracture simulation example: (a) Waterflood of a 2 x 2 x 0.2 km model of a reservoir stochastically populated with 2000 fractures with a power-law diameter range**

from 5 to 180 m (Matthäi et al., 2007); geological input data are from San Andreas formation (CA, USA, FRED model by Paul LaPointe, Golder Associates, Inc.). Aperture is consistent with field measurements and ranges between 0.5 and 3.5 mm correlating linearly with fracture diameter. (b) Evolution of total mobility in this model as compared with a Brooks-Corey curve for a strongly heterogeneous medium.

### **International Collaborations**

*(in alphabetical order sorted by last name and excluding industry sponsors)*

**Olivier Bildstein**, Carderache (CEA), Aix-en-Provence, France

**Raphael Blumenfeld**, Cavendish Laboratory, Cambridge University, UK

**Martin Blunt**, Earth Science & Engineering, Imperial College London, UK

**Tom Doe, Bill Dershowitz and Steve Rogers**, Golder Associates Inc., Seattle, USA

**Sebastian Geiger**, Herriot-Watts University, Dept. Petroleum Engineering, Edinburgh, UK

**Rainer Helmig**, Institut Wasserbau, IWS, Technical University of Stuttgart, Germany

**Chris Harris**, Shell, USA, visiting professor at Imperial College London, UK

**Thomas Driesner and Chris Heinrich**, Institute for Isotope Geology and Mineral Resources, Swiss Federal Institute of Technology (ETH), Switzerland

**Michael Hohmeyer and Devendra Rajwade**, SimCosm Inc., Berkeley, CA, USA

**Patrick Jenny**, Institut für Maschinenbau, Civil Engineering, Swiss Federal Institute of Technology (ETH), Switzerland

**Niklas Linde**, Institute of Geophysics, Swiss Federal Institute of Technology (ETH), Switzerland

**Yuri Olmelchenko and Homa Karimibadi**, SciberQuest Inc., Dan Diego, CA, USA

**André Revil**, Colorado School of Mines, Golden, CO, USA

**Steve Roberts**, Centre for Mathematics and its Applications, Australian National University, Canberra, Australia

**Klaus Stüben and Tanja Clees**, FhG Forschungsinstitut SCAI (formerly Fraunhofer Ges.), Sankt Augustin, Germany

**Kurt Stüwe**, Geologisches Institut, Universität Graz, Austria

**Fernando Tornos**, IGME, Salamanca, Spain

**Fiona Whitaker**, Earth and Environmental Sciences, Bristol University, UK

### **Academic Activities**

#### **Memberships**

11/04-present, The Geological Society of London (GeoSoc)

9/04-present, Society of Petroleum Engineers (SPE)

11/85-present, American Geophysical Union (AGU)

4/98-present, European Geophysical Society (EGS)

11/03-present, Swiss Association of Petroleum Geologists & Engineers (ASP/VSP).

**Reviewing for journals**

Advances in Water Resources  
 American Association of Petroleum Geologists Bulletin  
 Economic Geology  
 Geofluids  
 Geophysical Research Letters  
 Journal of Geochemical Exploration  
 Journal of Geophysical Research  
 Journal of Structural Geology  
 Mineralium Depositae  
 SPE Journals  
 SGE Bulletin  
 Water Resources Research

**For granting agencies**

DOE (USA)  
 NERC (UK)  
 EPSRC (UK)  
 ARC (Australia)

**Editorial boards**

2000-present Associate editor: Geofluids, Blackwell Science Publications

**Organised Conferences**

several CSMP software development and modeling workshops, most recently, June 4-8 2007, Château de Meyrargues, France,  
 co-organiser and co-chair of SPE Forum on “Naturally Fractured Reservoirs”, June 18-23 2006, Broomfield, CO, USA,  
 co-organiser 2007 SPE/EAGE Reservoir Characterization and Simulation Conference, October 28-31 2007, Abu Dhabi, UAE,  
 various sessions at past AGU meetings, for instance: “Modeling and Upscaling of Multiphase Flow in Fractured Rock Masses I, II (H12, H13) at fall meeting, December 10-14 2007, San Francisco, CA, USA.

**Teaching**

At Imperial, I have designed, coordinated, and am teaching courses in:

- Numerical Simulation of Hydrothermal Systems
- Heat and Mass Transfer (including lectures on geothermal systems and HDR)
- Igneous Petrology
- Metamorphic Petrology
- C++ Programming
- Handling and Display of Scientific Data
- a wide range of tutorials
- short courses for the oil, gas, and mining industry (for example in 2006: 3-day course on fractured reservoirs for ADNOC (Abu Dhabi) and Petrobras, Brasil). In October, I taught the

SPE/EAGE short course “*Simulation of Multiphase Flow in Naturally Fractured Reservoirs*,” at the 2007 SPE/EAGE Reservoir Characterization & Simulation Conference, Oct 28<sup>th</sup> – 31<sup>st</sup>, Abu Dhabi, UAE. In February 2008, I will be teaching a similar course at the NIOC, Iran.

- workshops on geomodeling: model building in CAD, property assignment and configuration, discretization, and simulation for a range of software tools like GoCad.
- CSMP software courses for users and developers (graduate students, fellow academics, and industry people)

### **My Research Group**

Associated with my chair are three postdoctoral research positions which I am trying to fill at present. In addition I have industry funding for two PhD projects for which I am in the process of recruitment.

At Imperial, I was leading a research group with 3 postdocs, 5 PhD students and, on average, 2 MSci students. I assist in the supervision of several other PhD students in Earth Science & Engineering.

### **PhD students**

Lamb, A. 2007-present, “Formation and influence on fluid flow of polygonal faults in marl-carbonate sequences,” co-supervised by Dr. L. Moen-Maurel, Total.

Maghami-Nick, H. 2007-present, “DFM simulation, and upscaling relative permeability in fractured reservoirs.”

Iding, M., 2006-present, “Permeability effects of super-critical CO<sub>2</sub> migrating through fractured cap rock of gas reservoirs,” co-supervised by Prof. H. Dahle, Norway.

Akanji, L., 2006-present, “Capillary pressure and two-phase flow in micro-fractures in a porous medium: numerical simulation case study.”

Paluszny, A., 2005-present, “Mechanical modeling of fracture propagation and shape modification by dissolution – precipitation processes.”

Tomlinson, R. 2005, “Understanding Hydrothermal Fluid Flow within Faults and Associated Mineralization Using a Combined Field and Numerical Approach.”

Conde, C. 2005-present, “Formation of Giant Massive Sulphide Deposits in Iberian pyrite belt”, Marie Curie Fellow from the University of Salamanca, Spain, co-supervised with F. Tornos, IGME.

Behbahani, H., 2004, “Co- and counter-current imbibition in fractured porous media,” co-supervised by M. Blunt.

Geiger, S., 2004, “Numerical Simulation of the Hydrodynamics and Thermodynamics of NaCl-H<sub>2</sub>O Fluids,” Departement Erdwissenschaften, Swiss Federal Institute of Technology, Zürich, Switzerland, co-supervised with T. Driesner and C. A. Heinrich.

Belayneh, M., 2003, “Analysis of natural fracture networks in massive and well-bedded carbonates and the impact of these networks on fluid flow in dual porosity medium,” co-supervised with J. Cosgrove.

Garofalo, P. S., 2000, “Gold precipitation and hydrothermal alteration during fluid flow through the vein network of the mesothermal gold deposit of Sigma, Abitibi Belt, Canada,”

Departement Erdwissenschaften, Swiss Federal Institute of Technology, Zürich, Switzerland, co-supervised with C. A. Heinrich and J. Ridley.

Over the last eight years, I have also supervised two to three Imperial College MSci and Master students per year from the earth sciences and petroleum engineering, respectively.

### **Scholarships and Prizes**

Overseas-student PhD scholarship (ORSPS) to study at the Australian National University awarded by the Australian government,  
Dominion Mining Ltd, research scholarship for PhD research.

### **Research Grants**

*(only those obtained in current position)*

Statoil, HDT initiative “Simulation of fault-related dolomitisation and micro-porosity generation”, 115k GBP for postdoctoral project, awarded jointly to myself and Fiona Whitaker, Bristol University in January 2008,

ExxonMobil, (FC)2 project: “Effects of wettability alteration on recovery from naturally fractured carbonate reservoirs,” 128k GBP, October 2007,

DTI-EPSRC, Technology Programme: “Improved simulation of oil recovery from fractured reservoirs,” 502k GBP, January 2007, shared with co-investigator M. Blunt.

Total, PhD project: “Flow properties and genesis of polygonal faults in carbonate reservoirs.” 93k GBP, October 2006,

Total, pilot study: “Well-test interpretation in fractured reservoirs,” 10k GBP, October 2006,

ExxonMobil, membership of itf-ISF2 consortium (see below)”, 90k GBP, September 2006,

Hydro, proof of concept study: “Benchmarks of gas flow through fractured reservoirs.” 30k GBP, August 2006,

itf, oil industry consortium: “Improved simulation of faulted and fractured reservoirs 2,” 421k GBP, January 2006,

Carderache, France, “Fracture and fluid flow in bentonite confining nuclear waste,” 8k Eu, June 2005.

Golder Associates Inc., Seattle, USA, “Generation of a 2-phase flow simulator (CSP2PHFLOW Vs.1.0-beta) for FRED Fracture-Only Reservoir Models,” 12k GBP, August 2003,

Golder Associates Inc., Seattle, USA, “Linking FRED with CSP: Simulating well tests and production from fractured reservoirs,” 6k GBP, October 2001,

SHELL, Rijswijk, proof of concept study: “Numerical simulation of capillary-driven flow in fractured carbonate reservoirs,” 9k GBP, November 2003,

itf, oil industry consortium and DTI: “Improved Simulation of faulted and fractured reservoirs 1,” 485k GBP+75k GBP in 2004 from PetroCanada, May 2002.

## Publications

### International Journals

*add 2008 articles*

1. Coumou, D., Matthäi, S.K., Geiger, S., and Driesner, T. "A parallel FE-FV scheme to solve fluid flow in complex geologic media," *Computers & Geosciences*, in press (CAGEO-D-06-00378R2).
2. Matthäi, S.K., Mezentsev, A., and Belayneh, M., "Finite-Element Node-Centered Finite-Volume experiments with fractured rock represented by unstructured hybrid element meshes," *SPE Reservoir Evaluation & Engineering*, 10:6, 740-756 (2007).
3. Linde, N., Jougnot, D., Revil, A., Matthäi, S.K., Arora, T., Renard, D., and Doussan, C., "Streaming current generation in two-phase flow conditions." *Geophysical Research Letters* 34, L03306, doi:10.1029/2006GL028878 (2007).
4. Revil, A., Linde, N., Cerepi, A., Matthäi, S.K., and Finsterle, S., "Electrokinetic coupling in unsaturated porous media," *Journal of Colloid and Interface Science* 313, 315 - 327, ISSN: 0021-9797 (2007).
5. Paluszny, A., Matthäi, S.K., and Hohmeyer, M., "Hybrid Finite Element Finite Volume Discretisation of complex geologic structures and a new simulation workflow demonstrated on fractured rocks." *Geofluids* 7, 186-208 doi: 10.1111/j.1468-8123.2007.00180.x (2007).
6. Belayneh, M., Geiger, S., Matthäi, S. K., "Numerical simulation of water injection into layered fractured carbonate reservoir analogues." *American Association of Petroleum Geologists Bulletin* 90, 1-21 (Oct 2006).
7. Geiger, S., Driesner, T., Heinrich, C. A., Matthäi, S. K., "Multiphase thermohaline convection in the earth's crust: I. A new finite element - finite volume solution technique combined with a new equation of state for NaCl-H<sub>2</sub>O." *Transport in Porous Media* 63, 399 – 434 (2006).
8. Geiger, S., Driesner, D., Heinrich, C. A., Matthäi, S. K., Multiphase thermohaline convection in the Earth's crust: II. Benchmarking and application of a finite element - finite volume solution technique with a NaCl-H<sub>2</sub>O equation of state." *Transport in Porous Media*, 63, 435-461, (2006).
9. Coumou, D., Driesner, T., Geiger, S., Heinrich, C. A. and Matthäi, S. K., "The dynamics of mid-ocean ridge hydrothermal systems: Splitting plumes and fluctuating vent temperatures." *Earth and Planetary Science Letters* 245:1-2, 218-231 (May 2006).
10. Belayneh, M., Masihi, M., Matthäi, S. K., King, P., "Prediction of vein connectivity using the percolation approach: model test with field data," *Journal of Geophysics and Engineering* 3, 219 – 229 (2006).
11. Geiger, S., Driesner, T., Matthäi, S. K., and Heinrich, C. A., "On the dynamics of thermohaline convection in the earth's crust." *Journal of Geophysical Research* 110, B07101 (2005).
12. Geiger, S., Driesner, T., Heinrich, C. A., Matthäi, S. K., "Coupled heat and salt transport around cooling magmatic intrusions," *Geochimica Cosmochimica Acta*, 69, A739 - A739 (2005).
13. Matthäi, S. K., Mezentsev, A. A., Pain, C. C., A high-order TVD transport method for hybrid meshes on complex geological geometry, *International Journal for Numerical Methods in Fluids*, 47, 1181-1187 (2005).

14. Geiger, S., Roberts, S., Matthäi, S. K., Zoppou, C. and Burri, A., "Combining finite element and finite volume methods for efficient multi-phase flow simulation in highly heterogeneous and geometrically complex porous media." *Geofluids*, 4, (2004).
15. Matthäi, S. K. and Belayneh, M., "Fluid flow partitioning between fractures and a permeable rock matrix" *Geophysical Research Letters*, 31:7, L07602, doi:10.1029/2003GL019027 (paper includes the magazine cover and was presented as an AGU publication highlight) (2004).
16. Matthäi, S. K., Heinrich, C. A., Driesner, T., "Is the Mount Isa copper deposit the product of forced brine convection in the footwall of a major reverse fault?" *Geology* 32:4, 357-360 (2004). Also published reply to comment in Octobre 2004.
17. Matthäi, S. K., "Fluid flow and (reactive) transport in fractured and faulted rock" *J. Geochemical Exploration*, 78-79, 179-182 (2003).
18. Geiger, S., Roberts, S., Matthäi, S.K., and Zoppou, C., "Combining finite volume and finite element methods to simulate fluid flow in geologic media." *ANZIAM Journal* 44(E), C180-201 (2003).
19. Geiger, S., Haggerty, R., Dilles, J. H., Reed, M. H., Matthäi, S. K., "New insights from reactive transport modelling: the formation of the sericitic vein envelopes during early hydrothermal alteration at Butte, Montana," *Geofluids* 2:3, 185-193 (2002).
20. Garofalo, P., Matthäi, S. K., Heinrich, C. A., "Three-dimensional geometry, ore distribution and time-integrated mass transfer through the quartz-tourmaline-gold vein network of the Sigma deposit (Abitibi belt, Canada)." *Geofluids* 2:3, 217-225 (2002).
21. Matthäi, S.K., invited review of "Fractures, Fluid Flow and Mineralization." *Geol. Soc. Spec. Publ.* 155, In *J. Structural Geology* 22:2, 277-280 (2000).
22. Weinberg, R. and Matthäi, S. K., invited review of "Deformation-enhanced fluid transport in the Earth's crust and mantle" Elsevier, Amsterdam, Netherlands. In *Tectonophysics*, 313:3, 329-332 (1999).
23. Matthäi, S.K., Aydin, A., Pollard, D. D., and Roberts, S. G., "Simulation of transient well-test signatures for geologically realistic faults in sandstone reservoirs" *SPE Journal*, 3:1, 62-76 (1998), SPE 38442.
24. Matthäi, S. K. and Roberts, S., "The influence of fault permeability on single-phase fluid flow near fault-sand intersections: Results from steady-state high-resolution models of pressure-driven fluid flow" *AAPG Bull.* 80:11, (1996), 1763-1779.
25. Matthäi, S. K., and Fischer, G., "Quantitative modeling of fault-fluid-discharge and fault-dilation-induced fluid-pressure variations in the seismogenic zone" *Geology* 24:2, (1996), 183-186.
26. Matthäi, S. K., and Henley, R. W., "Geochemistry and depositional environment of the gold-mineralized Proterozoic Koolpin Formation, Pine Creek Inlier, Northern Australia: A Comparison with Modern Shale Sequences" *Precambrian Research* 78, (1996), 211-235.
27. Matthäi, S. K., Henley, R. W., Heinrich, C. A., "Gold precipitation by fluid-mixing in bedding-parallel fractures near carbonaceous slates at the Cosmopolitan Howley gold deposit, Northern Australia" *Econ. Geol.* 90:8, (1995), 2123-2142.
28. Matthäi, S. K., Binns, R. A., Henley, R. W., Andrew, A. S., Carr, G. H., Bacigalupo-Rose, S., French, D. H., and McAndrew, J., "Intrusion-related, high-temperature gold-quartz veining at the Cosmopolitan Howley metasedimentary rock-hosted gold deposit, Northern Territory, Australia" *Econ. Geol.*, 90:5, (1995), 1012-1045.

29. Henley, R. W., Matthäi, S. K., and Kavanagh, M. E., "Hypothermal vein mineralisation at the Cosmopolitan Howley gold deposit, Northern Territory" *The Aus. IMM Bull.* 5, Sept. 1994, (1994).
30. v. Engelhardt, W., Matthäi, S. K., Walzebuck, J., "Araguainha impact crater, Brazil. I. The interior part of the uplift" *Meteoritics* 27, (1992), 442-457.

#### **Contributions to Books Edited by Others**

1. Matthäi, S. K., Geiger, S., Roberts, S. G., Paluszny, A., Belayneh, M., Burri, A., Mezentsev, A., Lu, H., Coumou, D., Driesner, T., and Heinrich, C. A., "Numerical simulation of multi-phase fluid flow in structurally complex reservoirs, In: Jolley, S. J., Barr, D., Walsh, J. J., & Knipe, R. J., editor, *Structurally Complex Reservoirs*, Geological Society London Spec. Publ., 292, 405 – 429 (2007).
2. Belayneh, M, Matthäi, S K, Cosgrove, J, "The implications of fracture swarms in the Chalk of SE England on the tectonic history of the basin and their impact on fluid flow in high-porosity, low-permeability rocks," In: Ries, A. C., Butler, R. W. H. & Graham, R. H., editor, *Deformation of the Continental Crust: Geological Society London Spec. Publ.*, 291, 499 – 517 (2007),
3. Matthäi, S. K., Roberts, S. G., Aydin, A., and Pollard, D. D., "Numerical simulation of departures from radial drawdown in a faulted sandstone reservoir with joints and deformation bands" *Geological Society of London, Spec. Publ.* 147 (1998), 157-191.
4. Matthäi, S. K. and Roberts, S., "Transient versus continuous fluid flow in seismically-active faults: An investigation by electric analog and numerical modelling" in "Fluid Flow and Transport in Rocks: Mechanisms and Effects" (Chapmann & Hall), (1996), 263-295.

#### **Proceedings**

1. Geiger, S, Matthäi, S K, Niessner, J, and Helmig, R, "Black-oil simulations for three component - three phase flow in fractured porous media," SPE Europec/EAGE Annual Conference and Exhibition, Richardson, Texas, USA, Society of Petroleum Engineering, 1 – 14 (2007),
2. Matthäi, S. K., Mezentsev, A., and Belayneh, M., "Control-Volume Finite-Element two-phase flow experiments with fractured rock represented by unstructured 3D hybrid meshes", SPE93341, Proc. SPE Reservoir Simulation Symposium, Houston Texas, 31 January – 2 February, (2005).
3. Matthäi, S. K., "Understanding the Influence of Faults and Fractures on Sub-Surface Fluid Flow: What can be achieved by Numerical Simulations Today ?" in "Fault Zone Characterization for Tectonic Numerical Modelling" Connolly, P. ed (Proc. Int. Workshop, 9-12th November, Frankfurt, Germany, 2001).
4. Matthäi, S. K. and Garofalo, "Three-dimensional shear zone and joint geometry and permeability in the Sigma Gold Mine, Canada" in Stanley, C. J. et al. ed (Proc. Fifth Biennial SGA Meeting and the Tenth Quadrennial IAGOD Symposium, London, Aug. 22-24th, London, 2, 1411-1414, 1999).
5. Matthäi, S. K., "Irregular alteration envelopes of mineralized fractures as a product of directed fluid flow and/or chemical dispersion ?" in "Mineral Deposits: Research and Exploration - Where do they meet ?", Papunen, H. ed (Proc. SEG Symposium, August 1997, Turku, Finland, 237-239, Balkema Rotterdam, 1997).

6. Roberts, S.G., and Matthäi, S.K., “High-resolution potential flow methods in oil exploration” in “Computational Techniques and Applications Conference” World Scientific Publications (Proc. Int. Conf. Melbourne, Australia, July 1995).

### **Technical Reports**

1. Matthäi, S. K., “The State-of-the-Art in Upscaling of Two Phase Flow in Fractured Rock,” NDA (formerly NIREX), UK, 72 p. (2007),
2. Geiger, S., Roberts, S., Matthäi, S. K., and Zoppou, C., “Modelling Multi-Phase Flow in the Earth's Crust using Node-Centered Finite Volumes on Unstructured Finite Element Grids” Math. Res. Rep. MRR01-023, The Australian National University, School of Mathematical Sciences, 16 p. (2001),
3. Roberts, S. G., and Matthäi, S. K., “High-resolution potential flow methods in oil exploration” Math. Res. Rep. MRR 003-96, Centre for Mathematics and its applications, School of Mathematical Sciences, Australian National University, Canberra, Australia, 9 p., (1996).

### **Non Refereed Publications**

1. Matthäi, S. K., Geiger, S. and Roberts, S. G., “The Complex Systems Platform CSP5.0: User’s Guide”, 5th ed., ETH Research Reports, 150 p. (2004).

### **Selected Keynote Lectures**

*(selected international presentations from the last 5 years)*

1. “Insights from numerical modeling of reactive fluid flow in fractured porous carbonate,” Bilbao HDT workshop, September 17-20, Bilbao, Spain (2007),
2. “Upscaling multiphase flow in fractured reservoirs,” SSGM Skill Area Symposium, ExxonMobile, Houston, TX, USA, October (2006),
3. “Fracture to field simulation of flow and transport,” Gordon Research Conference on Flow and Transport in Permeable Media, Proctor Academy, NH, USA, July 30– August 4 (2006),
4. “Control-Volume Finite-Element two-phase flow experiments with fractured rock represented by unstructured 3D hybrid meshes”, SPE Reservoir Simulation Symposium (RSS), Houston Texas, January 31– February 2, 2005,
5. “Modeling multiphase flow in fractured porous rock,” Workshop on Modelling Coupled Processes in Porous Media, Utrecht University & TNO-NITG, September 19-20 (2005),
6. “Two-phase flow properties for numerical simulations with discrete fractures,” Fractured Reservoirs Conference, The Geological Society, Burlington House, London, November 16-17 (2004),
7. “Discrete Fracture Simulation,” SPE ATW Workshop, Society of Petroleum Engineers, Millenium Hotel, London, November (2003),
8. “Numerical simulation of multiphase flow in fractured reservoirs,” Statoil Research Summit, Trondheim, September (2003),
9. “Fluid flow and transport in fractured and faulted rock,” Geofluids IV conference, May 12-16 2003, Utrecht, The Netherlands (2003),
10. “Understanding the influence of faults and fractures on sub-surface fluid flow: what can today be achieved by numerical simulations?” Workshop on Fault Zone Characterization for Tectonic Numerical Modeling, Seeheim (Frankfurt), Germany, November 9-12 (2001).

## Presentations

*(selected international conferences during last 10 years)*

1. "Numerical upscaling of relative permeability in fractured porous media," AGU Fall Meeting, San Francisco, EOS Trans. AGU, 88(52), Fall Meet. Suppl., Abstr. H12A-05 (2007),
2. "Characteristics of two-phase flow in complex fractured reservoirs: indications from Discrete-Fracture XFEM-FVM numerical experiments," Complexity in the Oil Industry (COI2007), Natal, Brasil, August 5-9 (2007),
3. "Stress and fluid pressure sensitivity of the effective permeability of fractured hydrocarbon reservoirs," DFG International Conference on Multifield Problems, Technical University of Stuttgart, October 4-6 (2006).
4. "Upscaling of water floods in fractured reservoirs via fracture-matrix flux ratio estimated by well testing," IEA Collaborative Project: Enhanced Oil Recovery Workshop, Saint Germain en Laye, France, September 21-22 (2006).
5. "What can single-well constant-rate pump tests really tell about fractured rocks?" International workshop on Model Concepts for Fluid-Fluid and Fluid-Solid Interactions," Freudenstadt, Germany, March 20-22 (2006),
6. "Upscaling water floods in fractured reservoirs via fracture-matrix flux ratio estimated by well testing," Structurally Complex Reservoirs conference, Geological Society of London, London, February 28– March 2 (2006),
7. "Two-phase flow properties for numerical simulations with discrete fractures," Fractured Reservoirs Conference, The Geological Society, Burlington House, London, November 16-17 (2004),
8. "Node-Centered control volume-finite-element simulation of multiphase flow in fractured rock," poster presentation, Gordon conference "Flow & Transport in Permeable Media", Kings College, Oxford, UK, July 11-16 (2004),
9. "Implicit-pressure implicit-saturation CVFE simulation of multiphase flow in fractured rock," poster presentation, AGU Fall Meeting, San Francisco, December 7-11 (2003),
10. "Fluid-flow partitioning between fractures and matrix: numerical experiments for realistic fracture geometries," AGU-EGS-EUG General Assembly, Nice, April 8-11 (2003),
11. "Rate-dependent recovery and water invasion in numerical models of fractured H.C. reservoirs," Gordon conference "Flow & Transport in Permeable Media," Proctor Academy, NH, USA, August 4-9 (2002),
12. "Drawdown-dependent recovery and water invasion in numerical models of fractured hydrocarbon reservoirs," IMA conference on "Modelling flow in oil reservoirs," BP Institute & Churchill College, Cambridge, UK, April 15-17 (2002),
13. "The Influence of deviatoric stresses in a deforming inhomogeneous rock pile on fluid flow in hydraulically-driven fractures," European Geophysical Society, 25<sup>th</sup> General Assembly, Acropolis, Nice, France, 654 (2000),
14. "Three-dimensional geometry and permeability of gold-mineralized faults in the Sigma and Lamaque Mines, Quebec, Canada," European Geological Union Meeting, March 28 - April 1, Strassbourg, France (1999),
15. "Fluid flow and reactant transport in anticlines," European Geological Union Meeting, March 28 - April 1, Strassbourg, France (1999).

## Software Engineering

**Complex Systems Modeling Platform (CSMP++ vs. 6).** Object oriented ANSI-ISO C++ application programmer interface (API) for simulation of complex process interactions in geometrically complex media. Currently 7 developers and >15 users, internationally:

### Development history

1994: Idea of CSP at Cornell University, NY

Spring 1995: SKM's first implementation of CSP

Autumn 1995: Sabbatical of S.G. Roberts at Stanford University, CA, CSP with Meschach & AMG solver

1996: Review of CSP and suggestions by Bruce Eckel

1996-2000: Main development and implementation of CSP by SKM

2000-2001: S. Geiger develops FV capabilities, CSP-GoCAD interface

2001: CSP3D 4.0 in Std C++ using meta-template programming techniques

2001: ANSYS – CSP interface

2002: Design of IMP-IMPS capabilities and higher-order accurate transport scheme in collaboration with C. Pain; integration and interfacing with CFD tools

2003: SAMG-based large-scale mechanical calculations, generalized 3D IMP-IMPS multiphase flow capabilities including gravity drainage and capillary driven flow

2003: First commercial license is sold, distribution via ETHZ, Switzerland

2004: Introduction of DFEM methods to deal with discontinua, EOS for H<sub>2</sub>O-NaCl mixtures, simulation of two-phase brine-steam convection including boiling and condensation

2005: Parallelisation including SAMGp, fault zone convection model

2006: Generic node-centered FEFVM transport scheme, elasto-plastic deformation including an anisotropic damage model and smeared crack formulation, scaling analysis for parallel computations, prediction of fracture aperture from far-field stress. Documentation in DOxyen, see <http://csmpe.se.imperial.ac.uk/wiki>.

2007: CSP is renamed CSMP++ because of name clash with other commercial software tools, new prototype for run-time mesh adaptive, goal based simulations

2007: Introduction of XFEM techniques for the simulation of saturation discontinuities in multiphase fluid flow

2007: Completion of licensing agreements between ETHZ, Imperial, and team of CSMP developers, see

[http://www.transfer.ethz.ch/downloads/CSMP\\_licensing\\_Prices\\_final\\_071130.pdf](http://www.transfer.ethz.ch/downloads/CSMP_licensing_Prices_final_071130.pdf)

**ATTACHMENT B**

Contentions Adopted By <b>Stephan K. Matthäi</b> In Accordance With Affidavit
NEV-SAFETY-21
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