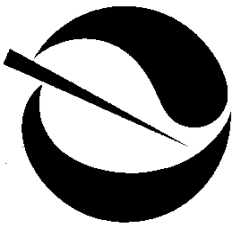
Geology Symposium 2007



May 9th & 10th
Cal/EPA Building
1001 "I" Street
Sacramento, CA

Geology Symposium 2007
Acknowledgements

We would like to recognize the many people who have worked for the past year to make this geology symposium possible.

First and foremost the Steering Committee would like to thank the following Managers. Without their strong support the 2007 Geology Symposium would not have happened:

- Ms. Maureen Gorsen – Director, Department of Toxic Substances Control
- Ms. Dorothy Rice – Executive Director, State Water Resources Control Board
- Mr. Hamid Saebfar – Acting Deputy Director, Site Mitigation and Brownfields Reuse Program
- Mr. Scott Ferguson – Chief Enforcement and Special Projects Unit
- Mr. Stewart Black – Acting Branch Chief, Site Mitigation and Brownfields Reuse Program, Engineering and Geologic Services Branch

Conference planning and technical programming tasks were organized by the 2007 Geology Symposium Steering Committee. This years Committee included:

- Mr. Scott Warren (DTSC),
- Mr. Laurent Meillier (RWQCB)
- Mr. John Naginis (DTSC)

The Technical Steering Committee would also like to thank the following people who have worked behind the scenes to support this years Symposium:

- Ms. Kendra Chan for her facilities support and assistance with preparation of the Symposium Program.
- Ms. Barbara Andersen for her assistance with symposium registration.
- Ms. Carole Sinsko-Doller for her assistance with symposium registration

Finally we would like to thank each of the presenters who have taken the time out of their busy schedules to prepare the technical talks you will be hearing over the next two days.

WELCOME TO THE GEOSYM '07

THE FIRST INTERAGENCY GEOLOGY SYMPOSIUM
ORGANIZED BY THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL AND STATE REGIONAL WATER QUALITY CONTROL BOARDS

MAY 9th and 10th
SACRAMENTO, CA

Questions regarding this program should be directed to the following GeoSym '07 committee members:

Laurent Meillier: LMeillier@waterboards.ca.gov
John Naginis: JNaginis@dtsc.ca.gov
Scott Warren: SWarren@dtsc.ca.gov
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PRESENTATION

SCHEDULE

State of California Geological Symposium Presentation Schedule
May 9 and 10th, 2007
CalEPA HQ Sacramento, CA

Time	Wednesday May 9	Thursday May 10	Time
8:00 - 8:15		Welcome Remarks	8:00 - 8:15
8:15 - 8:30		CRWQCB – Meillier – Geographically Based Databases of Use to State Geologists	8:15 - 8:30
8:30 - 8:45			8:30 - 8:45
8:45 - 9:00			8:45 - 9:00
9:00 - 9:15		ESRI – Chenevey – ARC GIS for GeoSciences	9:00 - 9:15
9:15 - 9:30			9:15 - 9:30
9:30 - 9:45			9:30 - 9:45
9:45 - 10:00	Welcome Remarks	CRWQCB – Roberson – Use of Batch Test to Establish Soil Cleanup Levels for Leaching and Ground Water Protection Concerns	9:45 - 10:00
10:00 - 10:15	CalTrans - Hansen - CalTrans Paleontology		10:00 - 10:15
10:15 - 10:30			10:15 - 10:30
10:30 - 10:45		UC Berkeley – Hunt – Perchlorate as an Example of Groundwater Arising from dense brines	10:30 - 10:45
10:45 - 11:00	Sandia Nat Labs NM - Roberts - Quantifying Parameter Uncertainty in Well-Test Analysis		10:45 - 11:00
11:00 - 11: 15			11:00 - 11: 15
11: 15 - 11:30		USEPA - Gill - Nano Technology	11: 15 - 11:30
11:30 - 11: 45	DTSC – Campbell – Role Liquefaction Vertical Migration of Contaminants through Laterally Extensive Fine Grained Deposits		11:30 - 11: 45
11: 45 - 12:00			11: 45 - 12:00
12:00 - 13:00	Lunch	Lunch	12:00 - 13:00
13:00 - 13:15	USGS - Vroblesky - In Well Convection	CRWQCB - Woodward - Boon - Distribution And Transport of Copper From Abandoned Mines Through Shasta Lake to the Sacramento River	13:00 - 13:15
13: 15 - 13:30			13: 15 - 13:30
13: 30 - 13:45			13: 30 - 13:45
13:45 - 14:00	Prohydro - Britt – Active and Passive Flow Dynamics in Wells		13:45 - 14:00
14:00 - 14:15		DTSC – Garbaccio – Background Concentrations of Metals in Soil, a Progress Report	14:00 - 14:15
14:15 - 14:30			14:15 - 14:30
14:30 - 14:45	DTSC - Cooke - Membrane Interface Probe: Delineating DNAPL Oxnard CA	DTSC - Fears - GIS Based Investigation Dry Cleaners In Visalia	14:30 - 14:45
14:45 - 15:00			14:45 - 15:00
15:00 - 15:15	DCA Geology and Geophysicists Board – Dunfield – Professional Standards: Technical Integrity and Functional Accountability	ProHydro - Britt - SNAP Sampler	15:00 - 15:15
15:15 - 15:30			15:15 - 15:30
15:30 - 15:45		CRWQCB – Gross – Hannel – Leaking UST over Fractured Bedrock w/ Closed Municipal Wells to Case Closure	15:30 - 15:45
15:45 - 16:00	DTSC - Gorsen - Opening Remarks		15:45 - 16:00
16:00 - 16:15		DTSC – Johnson – Roundtable- Representative Sampling of Groundwater for Hazardous	16:00 - 16:15
16:15 - 16:30	Poster Session		16:15 - 16:30
16:30 - 16:45			16:30 - 16:45
16:45 - 17:00		Closing Remarks	16:45 - 17:00

Poster Sessions
CRWQCB - Booth - Leviathan Mine
ProHydro - Britt - Snap Sampler Demo
DWR - Hoirup - Suspect Tsunami Deposits
Point Reyes National Seashore, Marin County, California
DTSC & CRWQCB - Warren & Meillier - Ambient vs. Background Concentrations of Metals in Soils

GeoSym 07 Presentations
Abstracts and Posters Listed in Chronological Order

May 9, 2007

1. **Caltrans Paleontology**
   Peter Hansen, PG (Caltrans Central Region Paleontology Branch)

2. **Quantifying Parameter Uncertainty in Well-Test Analysis**
   Randall Roberts and Richard Beauheim (Sandia National Labs, NM)
   John Avis (INTERA Engineering)

3. **The Role of Liquefaction in Vertical Migration of Contaminants Through Laterally Extensive Fine-Grained Deposits**
   Alice Campbell, PG (Cal/EPA, Department of Toxic Substances Control)

4. **In Well Convection**
   Don Vroblesky, Ph.D. (U.S. Geological Survey)

5. **Active and Passive Flow Dynamics in Wells**
   Sanford Britt, PG, CHG (ProHydro, Inc.)

6. **An Introduction to the Membrane Interface Probe**
   Pete Cooke, PG (Cal/EPA, Department of Toxic Substances Control)

7. **Professional Standards: Technical Integrity and Functional Accountability**
   George Dunfield, PG (California Board for Geologists and Geophysicists, Professional Standards Unit)

8. **Closing Remarks**
   Maureen Gorsen, Director (Cal/EPA, Department of Toxic Substances Control)

9. **Poster Session**

   Cleanup Activities at Leviathan Mine
   Richard Booth, PG, CHG, and Richard Carey, PG (Cal/EPA, California Regional Quality Control Board, Lahontan Region)

   Snap Sampler Demo
   Sanford Britt, PG, CHG (ProHydro, Inc.)

   Caltrans Paleontology
   Cathy Crandall (Caltrans, Fresno)

   Suspect Tsunami Deposits at Point Reyes National Seashore in Marin County, CA
   Don Hoirup, Jr., PG, CEG, CHG (A-Typical Day's Research & Consulting)

   Ambient vs. Background Concentrations of Metals in Soils
   Scott Warren, PG, CEG, CHG (Cal/EPA, Department of Toxic Substances Control)
   Laurent Meillier, PG (Cal/EPA, California Regional Water Quality Control Board, Lahontan Region)

May 10, 2007

1. **Geographically Based Databases of Use to State Geologists**
   Laurent Meillier, PG (Cal/EPA, California Regional Water Quality Control Board, Lahontan Region)

2. **The Use of ArcGIS for Statewide Geosciences Applications**
   Michael Chenevey (ESRI, California Region)

3. **Use of Batch Test to Establish Soil Cleanup Levels for Leaching and Ground Water Protection Concerns**
   Roger Brewer, Ph.D. (Hawaii Department of Health)
   Keith Roberson, Ph.D. (Cal/EPA, California Regional Water Quality Control Board, San Francisco Bay Region)

4. **Perchlorate as an Example of Groundwater Contamination Arising from Dense Brines**
   James Hunt (University of California at Berkeley)

5. **Nanotechnology**
   Michael Gill (U.S. EPA, Region IX)

6. **Distribution and Transport of Copper from Abandoned Mines through Shasta Lake to the Sacramento River**
   Philip Woodward, PG, and Mathew Boone (Cal/EPA, California Regional Water Quality Control Board, Central Valley Region)

7. **Background Concentrations of Metals in Soil, a Progress Report**
   Bruce Garbaccio, PG (Cal/EPA, Department of Toxic Substances Control)

8. **GIS-Based Investigation Dry Cleaners in Visalia, CA**
   Rick Fears, PG, and Mike Vivas, PE (Cal/EPA, Department of Toxic Substances Control)

9. **Differential Recoveries in VOC Sampling**
   Sanford Britt, PG, CHG (ProHydro, Inc.)

10. **From Leaking UST Over Fractured Bedrock with Closed Municipal Wells to Case Closure – A Success Story**
    Warren Gross, PG, CEG, CHG, and Jeffrey Hannel, PG, CEG (Cal/EPA, California Regional Quality Control Board, Central Valley Region)

11. **Representative Sampling of Groundwater for Hazardous Substances – Round Table Panel**
    Theo Johnson, PG (Cal/EPA, Department of Toxic Substances Control)

ABSTRACTS

Abstract GeoSym07

Peter Hansen
March 14, 2007

Caltrans Paleontology

State and federal laws protect paleontological resources as an environmental resource, and Caltrans is responsible for protecting these resources during construction projects. These environmental laws require that environmental impacts be studied and disclosed in environmental documents, and CEQA requires that projects with environmental impacts not be approved if there are feasible alternatives.

Preliminary studies for environmental documents consist of a review of the project scope, geologic maps, geologic and paleontologic literature, and a field survey. If there is a potential to encounter fossils during excavation, a more detailed study is undertaken to determine the extent of the actual impact and the significance of the impact, and the results are included in the environmental document. Environmental document studies are followed by the preparation of preliminary mitigation plans, cost estimates for the construction budget, and construction contract special provisions. During construction, a contracted mitigation paleontologist provides field monitors to watch for fossils during excavation and salvage any fossils found.

Federal and state laws require that properly qualified experts conduct these studies. These studies and determinations are necessarily based on the interpretation of the local geology to know what fossils might be found. Because these studies are done for public decision-making documents and require the interpretation of the local geology, the work falls under the Geologists and Geophysicists Act and requires that a licensed Geologist supervise the geologic portion of the studies. Many of the mitigation paleontologists doing this work are not licensed, and Caltrans contract requirements that mitigation paleontologists be licensed geologists have met with resistance.

Current projects with paleontology salvage in the Central Region of Caltrans include projects on State Routes 41 and 33 between Kettleman City and Cholame at Reef Ridge and Cottonwood Pass, the I-580/I-205 Truck Bypass project west of Tracy, and State Route 99 in Madera County near the Fairmead Landfill, which is one of the largest and most productive fossil localities currently being excavated.

Biographical Sketch

Peter Hansen, P.G., presenter

Peter Hansen is an Engineering Geologist for the California Department of Transportation in Fresno. He works in the District 6 Central Region Environmental, Hazardous Waste and Paleontology Branch and is the Central Region Paleontology Coordinator. Mr. Hansen is a California Professional Geologist with a B.S. in Geology from CSU, Fresno. He has 7 years of experience with Caltrans performing paleontology studies, conducting geologic fieldwork and coordinating paleontology monitoring and

mitigation projects. Mr. Hansen also helped develop an ArcView paleontology database of geologic formation along state highways throughout the Central Region.

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Quantifying Parameter Uncertainty in Well-Test Analysis

Randall M. Roberts* and Richard L. Beauheim, Sandia National Laboratories
John D. Avis, INTERA Engineering

Well-test analysis is the method by which hydraulic parameters of interest are inferred from transient pressure and flow-rate data – it is an inverse problem. As such, it is open to the following questions: 1) how uncertain are the estimated values of the fitting parameters; 2) how long must a test run to reduce the uncertainty to an acceptable level – it is possible to collect both too little data (large uncertainty) and too much data (effectively redundant and, therefore, a waste of time and money); 3) which test sequences provide the most information in the least amount of time; and 4) which types of data transforms increase sensitivity to the hydraulic parameters of interest? The overall premise is simple – one would like to get the most information in the least amount of time and have well-constrained estimates of the parameters of interest that are statistically meaningful and defensible.

A new well-test analysis code nSIGHTS (n-dimensional Statistical Inverse Graphical Hydraulic Test Simulator) has been developed that allows the analyst to address these questions in real time, i.e., the inherent uncertainties can be quantified statistically as a test is being run. The statistics are investigated graphically to provide an intuitive approach to the problem. Taking this statistical approach a step further, nSIGHTS can be used to generate synthetic test responses based on available information and also to add expected amounts of noise to the data. The statistical tools can then be used to optimize a test design by investigating all of the above questions before mobilizing and starting a field test. Jacobian analysis is used to determine which part of a test provides information about a particular parameter. Perturbation analysis and solution-space maps reveal optimal constraints.

Acknowledgements

This research is funded by WIPP programs administered by the Office of Environmental Management (EM) of the U.S. Department of Energy. Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

* Presenting Author

Biographical Sketch

Randall Roberts is a Senior Member of Technical Staff at Sandia National Laboratories in Carlsbad, New Mexico. He manages the design and testing of Sandia's numerical well-test analysis code, nSIGHTS. Mr. Roberts has 20 years of experience performing well-test analysis for nuclear-waste repository agencies around the world.

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Richard Beauheim is a Distinguished Member of Technical Staff at Sandia National Laboratories, and is currently Lead Hydrologist for the Waste Isolation Pilot Plant in Carlsbad, New Mexico. He

is also the Task Leader for borehole hydraulic testing at the Bruce Nuclear Site in Ontario, Canada.

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John Avis, B.A.Sc., P.Eng is a Principal and Senior Project Engineer at INTERA Engineering in Ottawa, Ontario. He has over 25 years experience in development of well-test analysis software, data visualization, and contaminant transport modelling for various Canadian and international low-level and high-level radioactive waste disposal projects.

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The Role of Liquefaction in Vertical Migration of Contaminants Through Laterally Extensive Fine-grained Deposits

Alice Campbell, GSU Glendale (DTSC)

Abstract

The role of liquefaction in creating vertical conduits within extensive horizontally stratified lacustrine, estuarine, alluvial, and deltaic deposits been underestimated during site characterization and remedial action planning. Vertical migration through clay layers has conventionally been attributed to defective wells or improperly abandoned wells, although in general these wells cannot be demonstrated to exist, or cannot move the quantity of water required, or would have to be in improbable locations. Many of these sites also have steep vertical gradients induced by municipal groundwater extraction which is the driver for downward migration. The rate and extent of contaminant migration is often out of proportion to the lateral extent shown and hoped for on cross sections. Recently, drilling at a site in Torrance revealed a possible explanation for puzzling patterns of vertical migration through shallow sediments. Based on review of boring logs, it appears that 'extensive' clays shown on cross sections are breached in many places by vertical cracks or seams filled with loose sand and rolled-up clay balls.

Sites located in areas subject to liquefaction at any time during the Holocene or late historical time will need specific analysis of depositional environments during site characterization. Reanalysis of boring logs often reveals telltale units of clay embedded in a fine sand matrix. This improbable structure may explain vertical leakage at random, extensive areas within a site, and complicate characterization or remediation efforts. More attention to careful continuous core log descriptions, including examination of clean sands with a hand lens, may reveal additional areas of prehistoric liquefaction. Assumptions about the absolute integrity of units such as the Corcoran Clay, the Bellflower Aquitard, and other traditional barriers needs to be critically re-evaluated.

Biographical Sketch

Alice Campbell joined DTSC in 2004, and is an engineering geologist for the Glendale Geologic Services Unit, with a specialty in hydrogeology. Ms. Campbell has 32 years of technical experience in hydrogeology, including clean water studies, groundwater contamination studies, hydrogeochemistry, and groundwater modeling, She was a hydrogeologist specializing in landfills at SCS Engineers from 1995 to 2004. Before that, she worked as a hydrogeologist and engineering geologist for Law/Crandall fom 1975-1978 and 1980-1995, with a brief stay in Arizona doing hydrothermal and engineering studies. She taught undergraduate and graduate level courses in groundwater and groundwater modeling for about 5 years.

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In Well Convection

Abstract

Convective transport of dissolved oxygen (DO) from shallow to deeper parts of wells was observed as the shallow water in wells in South Carolina became cooler than the deeper water in the wells due to seasonal changes. Wells having a relatively small depth to water were more susceptible to thermally induced convection than wells where the depth to water was greater because the shallower water levels were more influenced by air temperature. The potential for convective transport of DO to maintain oxygenated conditions in a well screened in an anaerobic aquifer was diminished as ground-water exchange through the well screen increased and as oxygen demand increased. Transport of DO to the screened interval can adversely affect the ability of passive samplers to produce accurate concentrations of oxygen-sensitive solutes, such as iron other redox indicators and microbiological data. A comparison of passive sampling to low-flow sampling in a well undergoing convection, however, showed general agreement of VOC concentrations. During low-flow sampling, the pumped water may be a mixture of convecting water from within the well casing and aquifer water moving inward through the screen. This mixing of water during low-flow sampling can substantially increase equilibration times, can cause false stabilization of indicator parameters, can give false indications of the redox state, and can provide microbiological data that are not representative of the aquifer conditions. Data from this investigation show that simple in-well devices can effectively mitigate convective transport of oxygen. The devices can range from inflatable packers to simple, inexpensive baffle systems.

ACTIVE AND PASSIVE FLOW DYNAMICS IN WELLS

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Physical model tests were conducted to simulate the effects of in-well flow dynamics during ambient and pumped conditions. Horizontal laminar flow is a common assumption for background flow conditions when interval sampling using low-flow or no-purge sampling techniques. Applying this assumption, a chemical concentration from a point inside a well corresponds to the concentration in the formation outside the well. Does water really enter one side of a well and exit the other side of the well at the same elevation? What impact do small-scale density differences have on in-well flow phenomena? What do influent velocity heterogeneities contribute to in-well flow phenomena?

Two physical sand-tank models were constructed to observe flow-through in a simulated monitoring well. One model was constructed to simulate a relatively homogeneous moderately-high permeability sand. A second was constructed to simulate stratified conditions more likely to occur in the natural environment. To observe flow behavior in the simulated well, a dye "stringer" was introduced upgradient of the simulated well. In all tests, regardless of flow rate, small density differences, or lithologic heterogeneity, the dye stringer eventually mixed vertically throughout the model monitoring well. Horizontal laminar flow was never achieved under any tested scenario. What was observed was a flow-weighed concentration averaging effect. Commonly, at moderate simulated groundwater flow velocities (10-15 cm per day), flow-weighed mixing reached dynamic equilibrium within 24 to 48 hours. Concentration stratification occurred in some test scenarios. In these cases, dye density was the control of stratification rather than entry point of the dye.

In-well flow dynamics, mixing and stratification also act to cause variability during purging. These factors will impact 1) the time required to reach purge parameter equilibration, 2) whether parameter stability actually reflects chemical stability, and 3) whether low to moderate volume purging (0.5 to 2 well volumes, common in "low-flow" purging protocol) can consistently reflect flow-weighted average concentrations in hydraulically heterogeneous and contaminant-stratified environments. These investigations suggest that low-volume purging may result in neither an interval sample nor a flow-weighted average but may yield concentrations somewhere between these two endpoints. Additionally, density effects and vertical well-bore flow may cause some of the inflowing water to actually move *away* from the pump intake. Understanding these dynamics is critical to determination of adequate sampling techniques for risk and remedial decision-making.

Biographical Sketch:

Sanford (Sandy) Britt is a Principal Hydrogeologist with ProHydro, Inc., the developer of the Snap Sampler. Mr. Britt is a Professional Geologist and Certified Hydrogeologist in California. Mr. Britt is a member of the Interstate Technology and Regulatory Council (ITRC) Passive Sampler Team. Previous to his work on the Snap Sampler, Mr. Britt was a regulator with the California Department of Toxic Substances Control and worked in private environmental consulting.

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An Introduction to the Membrane Interface Probe

Pete Cooke, P.G., California Environmental Protection Agency, Department of Toxic Substances Control

Abstract

The Membrane Interface Probe (MIP) is a relatively new push-rig soil sampling tool available for site contaminant characterization. The MIP is a percussion-tolerant sensor that can continuously log volatile organic compounds that diffuse through its semi-permeable membrane to truck-mounted detectors. Used simultaneously with the soil conductivity logging tool, the MIP is a semi-quantitative screening tool assisting in the delineation of volatiles such as chlorinated solvents and petroleum hydrocarbons. Contamination in the vapor phase, absorbed phase and dissolved phase can be detected in ground water and soil. The soil around the semi-permeable membrane is heated, volatilizing contaminants and accelerating the diffusion through the membrane. Diffusion occurs due to a concentration gradient between the contaminated matrix and a clean carrier gas directly behind the membrane. The carrier gas sweeps behind the membrane and transports the contaminants to gas phase detectors at the surface. MIP logging detects the presence of VOCs using three sensing devices: a flame ionization detector (FID), a photo ionization detector (PID) and an electron capture detector (ECD). From the logged data site geology, hydrogeology, contaminant class and contaminant extent can be presented as cross sections and as three dimensional images.

The MIP was used at a former oil field waste dump in Oxnard , California. Soil matrix and soil gas sampling results indicated that site was impacted with VOCs, among other contaminants. Ground water sampling results indicated concentrations of contaminants suggesting the presence of DNAPLs, such as 1,2-dichloroethane, tetrachloroethethylene, trichloroethylene and vinyl chloride. A truck-mounted MIP rig was used to help delineate the extent of DNAPL concentrations as well as the subsurface lithology. Maps, cross sections and three dimensional images were produced from the MIP data. Based on the MIP results and imaging, a focused excavation will remove the DNAPL-impacted soil as a first step towards ground water restoration.

Biographical Sketch

Pete Cooke provides geologic support to project managers at Cal/EPA's Department of Toxic Substances Control in Glendale, California. He has been with DTSC for over six years, overseeing a variety of site remediation projects. He received a Master's degree in Geology at California State University, Los Angeles in 2000 and is licensed with the state as a Professional Geologist.
Pete Cooke is a Professional Geologist licensed in the State of California. He supports the Site Mitigation and Brownfields Reuse Program within the California Environmental Protection Agency's Department of Toxic Substances Control. He received his Master of Science in Geology from California State University, Los Angeles, in 2000.

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PROFESSIONAL STANDARDS:
TECHNICAL INTEGRITY AND FUNCTIONAL ACCOUNTABILITY

George Dunfield, PG, California Board for Geologists and Geophysicists, Professional Standards Unit

California Board for Geologists and Geophysicists (Cal-BGG) is mandated by law to monitor and develop professional responsibility of environmental geologists, engineering geologists and hydrogeologists for the protection of the public from both unlicensed and substandard professional practice of geology or geophysics in its various branches (e.g., any source-pathway-receptor analysis relating to the earth and its constituent rocks, minerals, liquids, gases and other materials).

Effective enforcement of the Cal-BGG Code of Professional Standards (California Code of Regulations Title 16, Div. 29 §3065) is integral to public safety. Cal-BGG fosters professional accountability in environmental geology through enforcement that mitigates a) failures to maintain professional responsible charge of environmental decision-making, b) misrepresentation of Site Conceptual Model data and its relative significance, c) inadvertent practice of geology by unlicensed environmental "Project Managers," and d) failures to acknowledge and respond to existing geologic conditions or the professional geologic work of others.

In California today, geology (and hydrogeology) may cause, control or influence local conditions that support or threaten public health and safety, critical infrastructure, including schools, hospitals and highways, affordable housing, safe and sustainable water supplies, economic well-being of 35 million people, and the daily lives of individual citizens and their communities. Geology also guides Brownfields redevelopment decisions and the Basin Planning process. Cal-BGG's role is to promote and enforce high professional standards of practice commensurate to these significant societal challenges where geology and the public interest intersect.

BIOGRAPHICAL SKETCH

George Dunfield is Chief of the Professional Standards Unit at the California Board for Geologists and Geophysicists where he has represented the state of California as an expert witness in litigation relating to professional geologic standard of practice issues and with almost 20 years of experience in the professional consulting (as co-owner of a small environmental-geotechnical consulting firm), research (NASA/Ames Research Center: Nomad Mars Rover Program and Drillex experiments) and regulatory (CAL-EPA and CAL-BGG) environments.

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Geographically Based
Databases of Use to State Geologists

Presented by:
Laurent Meillier, P.G
Regional Water Quality Control Board
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The State geologist has an array of databases available for environmental and risk assessments. Often underused, this information is readily accessible on a geographic backbone facilitating user interactivity and information download. Envirostor, GeoTracker and CIWQS constitute the main components of this toolbox. Envirostor was built to interface between the public and DTSC regulators for the management of brownfields. The user may search for property deed restrictions and obtain risk based toxicological information at the site under review. Further, the general public may choose to get involved with remedial actions decisions considered at the site. GeoTracker the State and Regional Boards counterpart to Envirostor was originally rolled out to manage underground storage tanks sites which have contaminated water resources with the MtBE oxygenate. It has grown beyond this earlier mission to encompass all sites which may have contaminated water and soil resources from unauthorized petroleum, VOCs and inorganic releases. The user may analyze a broad scan of information ranging from land use controls to graphing a specific constituent of concern concentration against time. The case worker could link regulatory cases stored in GeoTracker and Envirostor to access a singular portal for data management purposes. In an effort to improve SWIM (Surface Water Information Management), the SWRCB unveiled CIWQS for caseload compliance and enforcement tracking. It manages water quality information and stores dischargers' submittals. Its enforcement tracking capability is useful to both the public and staff. This system remains under development and its functionality has not yet been fully released.

Biographical Sketch –

Laurent Meillier, P.G., presenter
Regional Water Quality Control Board. Lahontan Region.

Laurent Meillier works for the Enforcement and Special Projects Unit at the LRWQCB. Laurent has a MS in Geology from UCSB. He has worked as an engineering geologist for the Regional Board for close to 6 years. His current assignments span administrative civil liability cases across the Lahontan region as well as permitting of land disposal units and recycling water projects.

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The Use of ArcGIS for Statewide Geosciences Applications: Visualizing, Managing, and Analyzing Spatial Data Related to Geological Hazards and Resources

Presented by
Michael Chenevey
ESRI Account Executive, California Region

Abstract

ESRI's ArcGIS is a collection of powerful tools that can be leveraged to provide visualization, analysis, and spatial data management for statewide geologic applications. Geology professionals use GIS to locate and analyze data related to geologic hazards such as fault structures, slope hazards, and areas of environmental protection. They use GIS to locate and analyze geologic resources such as rock and mineral occurrences and areas of mining activity (both historical and current). They use GIS to collaborate with other agencies (local, state, federal, and others), professional consultants, and private persons for data sharing, quality control, and promotion of knowledge transfer. The purpose of GIS for statewide applications is to improve the quality of decision-making regarding the public's health and safety, its economy, and its business decisions. Recent collaboration among geoscientists has resulted in a range of geologic map data models and a standardized geologic symbology set.

ArcGIS can be used as an end-to-end solution for locating, collecting, storing, analyzing, and visualizing geologic data. For instance, surface field data collection can be performed with GPS units running GIS software. Data can then synchronized to a centralized server-based GIS through a desktop system and can then be shared with others locally or around the world via Web servers and standard Web browsers.

ArcGIS desktop-based software provides powerful tools for managing, analyzing, and visualizing complex geologic data. Both 2-D and 3-D spatial data can be input with a variety of means, ranging from manual or automated digitizing, to loading data directly from AutoCAD, or directly loading tables or spreadsheets. Data can then be analyzed using a variety of spatial methods, such as overlay or proximity analysis. Data can output to a local computer, multiple computers over local or wide area networks, made available over the Web for a wide audience with either PC's or mobile handheld devices. Geologic data can also be printed and distributed using advanced cartographic techniques and standardized symbology.

Server-based spatial data provides the means to manage and distribute standardized data and analysis tools over local and wide area networks and the Internet. Standardized geologic map data models, such as the North American Geologic Data Model (NADM) provide consistent data structure and attributes for the geologic community and assist in data sharing.

Current GIS technology allows both 2-D and 3-D visualization and analysis using lightweight and often free desktop clients such as ArcGIS Explorer. This tool can be used to provide simple yet powerful spatial functionality to non-technical endusers, managers, and industry leaders.

ArcGIS provides a consistent supported platform for using GIS. The ArcGIS tools are designed to complete an enterprise system, allowing a wide variety of users access to consistent data wherever they work in the world.

Biographical Sketch – Michael Chenevey, presenter

Michael Chenevey, currently an Account Executive with ESRI, holds both a B.S and M.S. in Geology and has nearly 10 years of professional experience working for various precious metal mining

companies in Utah and Nevada. His post-mining experience has been in enterprise Information Technology consulting, and before coming on board with ESRI last year, he worked as a GIS consultant/project manager in Northern California.

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Farmers Know Best: Use of Batch Tests to Establish Soil Cleanup Levels Where Leaching and Groundwater Protection are the Primary Concerns

Roger C. Brewer, Hawai'i Department of Health, and Keith E. Roberson, Regional Water Quality Control Board, San Francisco Bay Region

Leaching of contaminants from soil and subsequent impacts to groundwater resources is the ugly duckling of Environmental Risk Assessment (ERA), often ignored or lurking in the shadows behind its better understood stepsisters of direct exposure, vapor intrusion, ecotoxicity, and gross contamination. At a screening level, however, the need to protect groundwater quality from leaching often ends up driving risk-based site cleanups for a number of common environmental contaminants.

Leaching-based site cleanup criteria are sometimes orders of magnitude more conservative than risk-based criteria developed for direct exposure or ecotoxicity concerns. Are the leaching models currently recommended in USEPA and State ERA guidance documents accurate predictors of soil leaching potential? Probably not. RPs, consultants, and some regulators have expressed concern that these generic leaching models may greatly over-predict chemical leaching. One important weakness in the models is the use of published *sorption* constants ("Koc" or "Kd" values) to predict *desorption* of contaminants from soil. Agricultural researchers studying pesticide mobility in soils have long known that the desorption process is not constant over time or across a range of site conditions. For example, clays can play an important role in the sorption and immobilization of contaminants to soil, and this factor is generally not considered in generic leaching models.

Laboratory "batch tests" such as the USEPA Synthetic Precipitation Leaching Procedure (SPLP) test attempt to address this dilemma and can provide more accurate data. This test method accounts for some of the complicating factors that control leaching of contaminants from soil. SPLP test results compiled from several sites with a variety of contaminant types show that desorption and leaching processes indeed yield much less contaminant mass than would be predicted by generic models. The results of SPLP tests, however, are often misinterpreted and misused. Test results should not be used to directly compute target groundwater concentrations. Instead, the data should be used to first estimate site-specific, desorption coefficients for contaminants of concern. These coefficients can then be incorporated into simplified leaching models to calculate site-specific cleanup levels for groundwater protection. This presentation provides an example of how this multi-step process was used for a site in California to develop site-specific soil cleanup goals for perchlorate. At this site, SPLP test results showed that perchlorate, a highly soluble salt, leaches readily from soils into groundwater (no surprise there), but it does not leach as completely as one would assume based on its generic sorption coefficient. Acceptable Residual Contaminant Levels (ARCLs) and soil remediation goals derived through this process are less conservative (and probably more realistic) than cleanup goals determined through a generic evaluation of perchlorate leaching potential.

Biographical Sketches

Roger C. Brewer, PhD
Roger Brewer has a PhD from the University of Alabama and is currently a Senior Scientist with the Hawai'i Department of Health. Before moving to Hawai'i two years ago, Roger spent five years with the San Francisco Bay Regional Water Quality Control Board. Roger also has several years of international consulting experience.
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Keith E. Roberson, PhD
Keith Roberson has a PhD from the University of Tennessee and is an Engineering Geologist with the San Francisco Bay Regional Water Board. He has been on the Board staff for over seven years. Before joining the Board, Keith was a hydrogeologist with an environmental consulting firm for nine years.

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Presenting Author: Keith Roberson

Perchlorate as an example of groundwater contamination arising from dense brines

James R. Hunt
Department of Civil and Environmental Engineering
University of California at Berkeley

Perchlorate has become a pervasive groundwater contaminant that is challenging to remediate due to its non-reactivity in most subsurface environments. As with all subsurface contaminants, source terms must be identified and mitigated to minimize the time required for remediation. Industrially, perchlorate was utilized as highly soluble salts, and processing activities frequently released concentrated perchlorate solutions with liquid densities greater than water. Perchlorate represents just one example where brines have been released to the subsurface containing contaminants that can degrade large volumes of groundwater. The migration of dense brines in the subsurface has been researched for many years and this provides considerable data and predictive modeling approaches. Simple models are combined with a generalization of experimental measurements on brine dispersion to define when dense brines will present problems in the subsurface. Examples are drawn from field sites to illustrate plume persistence. For perchlorate and a number of other contaminants, dense brines will become long-term sources of groundwater contamination.

BIOGRAPHY: James R. Hunt is a Professor of Civil and Environmental Engineering at the University of California at Berkeley where he has taught since 1980. His undergraduate and graduate education was in environmental engineering and his research program quantifies contaminant transport pathways in coastal, groundwater, soil, and surface waters. Contaminants of interest have included particles, trace metals, radionuclides, and organic solvents. Recently he completed research on trace metal distribution within contaminated estuarine sediments and the clogging of porous media during particle filtration. Ongoing research includes the use of mercury isotopes for the identification of mercury sources and the analysis of hydrologic data to assess the impacts of water resource development on fish migration in coastal rivers of California.

Nanotechnology: What is It?
Michael Gill
USEPA Region IX

Nanotechnology is the term applied to use of materials that range in size from 1-100 nanometers (nm) in size. The diameter of a strand of human hair is about 10,000 nm. Dramatic changes in the mechanical, optical, chemical, and electronic properties of materials occur on the nanoscale. This presentation will cover an overview of nanotechnology, including applications and potential human health and ecological implications. With nanotech applications ramping up at an incredible pace worldwide, regulatory agencies are trying to keep up by studying the potential effects on workers and others who may be exposed to nanoparticles. There is also an effort to determine if it is necessary to regulate nanomaterials.

Biographical Sketch

Michael Gill received his BS in electrical engineering from Northeastern University in Boston and his MSEE from Renssalear Polytechnic Institute in Troy, NY. He practiced electrical engineering in the 1980's until he made a career change to the environmental field in 1992.
He is currently the EPA Office of Research and Development (ORD) Technical Liaison to EPA's San Francisco office. This position is one of technical support and information brokering. In this position since 1998, he provides hazardous waste technical support to Superfund/RCRA staff and he also participates in research planning, environmental technology demonstrations, and workshop planning. He has been with EPA since 1992, when he took a position as a Remedial Project Manager in the Superfund program.

The Distribution And Transport of Copper From Abandoned Mines Through Shasta Lake to the Sacramento River, by Philip Woodward and Mathew Boone

In the late 1990's, copper concentrations in the water exiting Shasta Dam into the Sacramento River increased in the winter from approximately 1 ppb to over 4 ppb, approaching the receiving water limit for the protection of salmonids of 5.6 ppb. These elevated concentrations are present in the discharge from Shasta Dam before discharges from Iron Mountain Mine (IMM), a major source of copper downstream of Shasta Dam, enter the Sacramento River. The increase in copper in the dam discharge caused problems in providing dilution flows downstream required to mitigate discharges from IMM in order to protect the fishery in the Sacramento River.

Tracking the metals distribution within the lake called for the collection of hundreds of water samples and water quality parameters throughout the lake at various depths, locations, and different times of the year. Potential factors affecting the metals distribution besides changes in the sources include the affects of temperature stratification, winter turnover, and turbidity. Due to differences in annual precipitation and storm intensity, data had to be collected over several years.

The data revealed the vertical distribution of metals within the lake is controlled by temperature stratification. Lateral variations can be attributed to proximity to sources of copper, such as abandoned mines, and annual variations in precipitation. The recent winter increases in copper exiting Shasta Dam can be attributed to the operation of the temperature control device (TCD) on the upstream face of the dam. The Bureau of Reclamation completed construction of the TCD in 1997 to prevent temperature increases in the Sacramento River below the dam from exceeding levels that impact salmon eggs and larvae in the summer months. To preserve this deep cold water pool in the winter months when temperature is not critical, the configuration of the TCD is changed to draw water from the upper portion of the lake. The data shows that it is in this upper, warmer water where the concentration of copper and other metals increases in the winter months, and it is this water that is passed through he dam into the Sacramento River. The colder deeper water does not contain the elevated copper concentrations.

Philip Woodward will be the speaker
Presentation will be PowerPoint

Authors

Philip Woodward is a Senior Engineering Geologist with the Redding office of the Central Valley Regional Water Quality Control Board. In his 20 years with the Board, he has worked in groundwater cleanup, waste containment and disposal, and supervised the Waste Containment/Groundwater Unit of the Redding Office. Mr. Woodward currently works primarily on mining related issues.

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Mathew Boone is a graduate of California Polytechnic State University, San Luis Obispo, with a Bachelor of Science degree in Forestry and Natural Resources Management. Work experience

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Background Concentrations of Metals in Soil, a Progress Report

Bruce Garbaccio, P.G., Geological Services Unit, Glendale, California

Metals concentrations in soil are often indications of impact due to human activities. Common occurrences include lead from lead based paint, arsenic from pesticide-herbicide application, and chromium from plating operations.

For many metals such as lead, zinc, and copper, there is a significant difference between typical background concentrations and health based cleanup goals. Typical background concentrations for lead are 10 to 30 mg/kg, whereas cleanup goals of 255 mg/kg (LAUSD cleanup goal) and 150 mg/kg (Residential CHHSL) are often used.

For less abundant metals (antimony, arsenic, cadmium) determination of the background concentration is more significant, as the "gap" between background concentration and risk based concentrations is much closer. For arsenic, the two ranges actually overlap.

Common geological associations such as Cr-Ni-Cu-Mg in mafic and ultramafic rocks tend to become less prominent as soil formation (low temperature) processes take over. For example, there is an association of cadmium with zinc in ore deposits from a variety of environments. This correlation does not appear to hold true for California soils, however, it may be observed in soils overlying mineral deposits.

Metals associations showing an anthropogenic influence include antimony and lead which are combined in the metal used to make automobile batteries.

Non-point sources, such as lead from automobile exhaust, or application of arsenic based pesticides-herbicides often blur the distinction between background and ambient concentrations.

Biographical Sketch

Bruce Garbaccio, P.G. is an Engineering Geologist working for the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC). His primary job duties include oversight and review of environmental studies at new and existing school sites. Prior to joining the DTSC, Mr. Garbaccio spent 12 years as an environmental consultant, and 3 years as an exploration geologist (industrial minerals). Mr. Garbaccio has a BS degree in Geology from the California State University, Los Angeles, and has taken graduate level courses in geology, hydrogeology, and geochemistry.

Use of GIS for Discovering and Investigating Contamination from Dry Cleaners in Visalia California

Presented by:
Rick L. Fears, P.G. and Mike Vivas, P.E.
Department of Toxic Substances Control
Northern California Central Cleanup Operations Branch

Abstract

Under the direction of James Tjosvold, P.E., Branch Chief of the Department of Toxic Substances Control's (DTSC), Northern California Central Cleanup Operations Branch (NCCCOB), staff utilized a Geographical Information System (GIS) to assist in conducting the Dry Cleaner Discovery Project (Discovery Project). Funding for the Discovery Project was provided through a grant from the United State Environmental Protection Agency Region 9 (U.S. EPA). Under the grant, DTSC developed a Dry Cleaner Site Discovery Process and applied it to the City of Visalia (Visalia). The Discovery Process outlines a protocol for conducting initial discovery-level assessments of dry cleaning operations both statewide and locally, employing GIS for the graphical depiction of information and data.

As an initial step in the Discovery Project, DTSC performed a statewide query of the California Department of Health Services (DHS) California Drinking Water Database (CDWD) to identify water supply wells impacted with perchloroethylene (PCE). DTSC identified and mapped 1537 public drinking water wells in 41 California counties impacted by PCE. 480 of these wells, in 29 counties, showed PCE detections above the State of California Department of Health Services maximum contaminant level (MCL) of 5.0 parts per billion (ppb).

As a result of the statewide query, DTSC identified and mapped 21 public water supply wells impacted by PCE in Visalia. DTSC used GIS to compile the information obtained from multiple sources onto a single map. This information is being used to help guide an investigation of dry cleaners that may be potential sources of the PCE detections in the public wells in Visalia.

DTSC's investigation will include a passive soil gas screening survey, sampling of several existing groundwater monitoring wells which are installed on sites on the RWQCB's LUST list, grab groundwater sampling, and sampling of dedicated monitoring wells. The work plan that is under development will be implemented this summer. A summary report, providing conclusions about the potential of the identified dry cleaners to be sources of PCE contamination detected in public wells, and recommendations for future actions will also be completed for the project. DTSC is planning to use GIS and environmental modeling systems to analyze the data obtained and depict PCE plumes in soil gas and groundwater.

Biographical Sketch –

Rick L. Fears, P.G., presenter
Hazardous Substances Engineer and Project Manager Northern California - Central Cleanup Operations Branch

Rick Fears is a Project Manager for the Department of Toxic Substances Control. Rick has a Bachelor of Arts Degree from Humboldt State University and more than 20 years experience in the fields of engineering and environmental geology. At DTSC Rick is the Statewide Project Manager for Naturally Occurring Asbestos (NOA) and has produced numerous GIS products for DTSC, including GIS Work for NOA, Statewide Dry Cleaner Discovery, Statewide Mining Discovery, Statewide Aerial Crop Duster Discovery and other site specific work products.

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Mike Vivas is a Project Manager in the Department of Toxic Substances Control Site Mitigation and Brownfields Reuse Program, Cleanup Operations Branch. Mike is the project manager for the Visalia Dry Cleaner Discovery Project and DTSC's former Lodi Groundwater Site. He also manages several abandoned mine land sites and two town gas plant sites. Mike has a Bachelor of Arts Degree in Geography from the University of Hawaii, Hilo and a Bachelor of Science Degree in Mechanical Engineering Technology from California State University at Sacramento. He has over 20 years experience in the field of hazardous substances engineering.

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Differential Recoveries in VOC Sampling:
Low Flow, the Snap Sampler™, and Remedial Decision-Making

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Groundwater off-gasses dissolved volatile organic compounds (VOCs) when exposed to air, especially when agitated. Protocols and education regarding proper sampling and bottle-filling techniques have been developed to limit this source of VOC loss. However, off-gassing loss is only one factor in the potential variations found in VOC sampling results. A study conducted at the Former McClellan Air Force Base in Sacramento, California, illustrates off-gassing losses, but also highlights another factor which may be equally or more important. Exposure of sample to unequilibrated polymers (e.g. new pump discharge tubing) is a significant potential source of VOC loss through sorption—especially at low flow rates. Sorption and exposure together yielded substantial and statistically significant differences in VOC concentrations among the several active and passive sampling techniques tested at McClellan. The study adds urgency to investigating the role of sorption loss and off-gassing during purging, especially low flow purging, and during sample bottle filling in open air.

In the McClellan study, several passive, no purge, groundwater samplers were tested and compared to commonly-used low flow sampling techniques and volume purge sampling. One sampler in the study, the Snap Sampler, seals groundwater samples downhole and avoids exposing sample to ambient air during sample bottle preparation. The Snap Sampler provides a control for exposure to air and exposure to unequilibrated polymers. The study showed in many cases that common purging and pouring techniques resulted in VOC losses. Losses are attributed to use of a non-dedicated electric submersible pump; new polyethylene tubing; and pouring sample into laboratory containers at the well head. Depth to the sampling position was 30 meters or more and depressurization may also have contributed to VOC losses. On average, low flow sampling recovered only 59% of the VOCs recovered by the Snap Sampler at the same sampling depth (n=29). Other sampling methods showed smaller differentials, including 89% recovery for the volume purge method (n=28), 80% recovery for the polyethylene diffusion bag (n=77), 77% recovery for the porous pipe diffusion sampler (n=77), and 75% recovery for the regenerated cellulose diffusion sampler (n=78). The overall differences are larger than those that have led the USEPA to discourage the use of bailers and peristaltic pumps for VOC sampling. However, these are especially large differences compared to other similar studies, and the differences may not always affect remedial decision-making. For plume characterization and remediation, one important aspect of these findings is that the recoveries were not equal for all chemicals. At McClellan, the recovery of low flow relative to the Snap Sampler for 1,1-Dichloroethene was 44%; for 1,2-Dichloroethane, 82%; for Carbon Tetrachloride, 56%; for Chloroform, 85%; for cis-1,2-Dichloroethene, 77%; for Tetrachloroethene, 41%; and for Trichloroethene, 58%. These wide disparities indicate that traditional purge-and-pour sampling, even with low flow sampling techniques, can yield misleading representations of actual downhole VOC concentrations, and VOC concentration ratios.

Abstract for the Battelle International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 21-24, 2006.

Biographical Sketch:

Sanford (Sandy) Britt is a Principal Hydrogeologist with ProHydro, Inc., the developer of the Snap Sampler. Mr. Britt is a Professional Geologist and Certified Hydrogeologist in California. Mr. Britt is a member of the Interstate Technology and Regulatory Council (ITRC) Passive Sampler Team. Previous to his work on the Snap Sampler, Mr. Britt was a regulator with the California Department of Toxic Substances Control and worked in private environmental consulting.

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Making the Best of a Bad Situation: From leaking UST Over Fractured Bedrock with Closed Municipal Wells to Case Closure – A Success Story

Warren Gross and Jeff Hannel, CRWQCB - Fresno

A routine leaking underground storage tank case received instant notoriety and priority attention when two nearby water supply wells in the tranquil foothill community of Yosemite Lakes Park were closed due to methyl tertiary-butyl ether (MTBE) pollution. At the request of the Regional Water Board, the service station operator implemented an expedited site assessment. The assessment utilized lineament mapping and seismic refraction survey techniques to locate monitoring and remediation wells in the fractured granitic bedrock. Downhole video and packer testing was utilized to evaluate the fracture network geometry and assess its hydraulic characteristics. Concurrently, the vadose zone at the operating service station was characterized and interim source zone remediation was implemented in the form of soil vapor extraction to remove gasoline constituents.

The impacted aquifer is a fractured bedrock system with limited recharge potential that provides the only source of community water supply. The impacted wells had been the greatest historical drinking water producers for the community. An on-site groundwater pump and treat system consisting of an air stripper with carbon polish was installed and water from wells surrounding the service station with hydraulic connection to the petroleum hydrocarbon plume were pumped to the treatment system. The pollutants within the plume consisted primarily of MTBE and tertiary-butyl alcohol (TBA), with lesser BTEX and other more biodegradable gasoline constituents

Coordination with the California Department of Health Services secured funding for a wellhead treatment system for the community water supply wells, though not until the on-site system had substantially reduced MTBE concentrations. The fractured bedrock remediation system has completed aquifer cleanup at the leaking tank site and surrounding areas, insuring that the need for wellhead treatment will be short-lived. Case closure is imminent. Any summer water shortages in this community will be attributable to Mother Nature – not this UST site or the MTBE industry.

Our presentation summarizes the leaking UST site assessment/remediation and community water system wellhead treatment and discusses the difficulties and successes of this project.

Biographical Sketch

Mr. Gross is a Certified Engineering Geologist and Certified Hydrogeologist with a B.S. in Geology from USC (1980) and an M.S. in Geology from San Diego State (1984). He is an Engineering Geologist in the Underground Storage Tank (UST) Unit of the California Regional Water Quality Control Board (CRWQCB), Region 5 (Fresno). Prior experience includes 16 years in environmental consulting with a wide variety of environmental assessment/remediation and hydrogeologic experience.

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Mr. Hannel graduated from CSU Fresno with a B.S. in Geology in 1986 and is a Professional Geologist and Certified Engineering Geologist. He then worked in private industry until 1999

performing numerous environmental investigations and cleanups as well as geophysical and geologic investigations. Mr. Hannel came to the Fresno office of the CRWQCB in 1999 where he has worked as an engineering geologist primarily in the UST unit.

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REPRESENTATIVE SAMPLING
OF GROUNDWATER FOR HAZARDOUS SUBSTANCES

Theo Johnson Senior Engineering Geologist DTSC

Round Table Panel

The goal of this Guidance Manual for Groundwater Investigations is to promote consistent sampling methods in order to minimize variability in groundwater sampling data caused by equipment or procedures. Samples representative of in-situ groundwater conditions are those collected by methods minimizing artifacts caused by sampling equipment or procedures resulting in the generation of effective, meaningful, and representative groundwater chemistry data.

This document is intended to provide guidelines for the sampling and analysis of groundwater used for the characterization of hazardous substance release and hazardous waste sites. The purpose of this document is to aid in the selection of sampling devices and analytical methods, provide recommended quality assurance and quality control (QA/QC) procedures, and to provide a standardized approach for the presentation of the resulting data. The recommendations in the guidance represent the minimum criteria judged necessary to obtain quality data and assure reasonable and independently verifiable interpretations.

POSTERS

Cleanup Activities at Leviathan Mine, Alpine County
California Regional Water Quality Control Board, Lahontan Region

Richard Booth Senior Engineering Geologist PG HG
Doug Carey Engineering Geologist PG

Leviathan Mine is an inactive sulfur mine that the State of California acquired in the early 1980s in order to clean up water quality problems caused by historic mining. Jurisdiction over Leviathan Mine rests with the State Water Resources Control Board, which, in turn, has delegated jurisdiction over clean up work to the California Regional Water Quality Control Board, Lahontan Region (Lahontan Water Board).

The former sulfur mine is located on the eastern slope of the Sierra Nevada Mountains in Alpine County, California, in the upper portions of the Bryant Creek watershed, a tributary to the East Fork of the Carson River. The state-owned portion of the Leviathan Mine site encompasses approximately 475 acres with mining disturbance evident on approximately 230 acres. In May 2000, the United States Environmental Protection Agency (USEPA) placed Leviathan Mine on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List, thus making Leviathan Mine a federal Superfund site.

In 1985, the Lahontan Water Board completed construction of a pollution abatement system at Leviathan Mine that included construction of five lined evaporation ponds to capture and evaporate acid mine drainage (AMD) from remnant underground mine workings. To prevent pond overflows, the Lahontan Water Board treats pond water during the summer months to increase pond storage capacity for the subsequent winter and spring months. The Lahontan Water Board assembled a lime treatment system during the 1999 field season and has continued to operate the lime treatment system during the summer months from 2001 through 2006.

Following unusually wet winters in 2005 and 2006, and the resulting large quantities of AMD contained in the pond system, the Lahontan Water Board implemented additional pond water treatment capabilities in an effort to prevent untreated discharges to Leviathan Creek. A smaller and more portable treatment system was assembled and tested in the spring of 2005 and proved effective at treating AMD. The portable treatment system, with minor improvements, was employed again at full scale in the spring of 2006.

The Lahontan Water Board's treatment of AMD contained in the pond system is described as lime neutralization. A source of alkalinity, such as lime (calcium hydroxide or $Ca[OH]_2$), is mixed into the AMD from the pond system. The addition of alkalinity causes an increase in pH and the precipitation of dissolved constituents, including metals contained in the AMD. The precipitated metals are then separated from the solution, and the final products are 1) a nearly metal-free effluent with near neutral pH, and 2) waste sludge.

Cathy Crandall

Caltrans Paleontology

Increasing mobility on California's roads and highways includes partnering with local agencies to conduct environmental studies for Federal, State, and local laws, regulations, and ordinances. Those studies include paleontological evaluation by Caltrans geologists. Due to the diversity of California's geology, many of the studies result in field monitoring where excavation occurs in sedimentary and metasedimentary deposits known to contain vertebrate, invertebrate, and plant fossils.

Biographical Sketch

Cathy Crandall, Graphic Designer

Cathy Crandall is a Caltrans Graphic Designer for District 06 in Fresno. Her work involves creating professional, educational graphic displays featuring the fieldwork and study of Caltrans Archeologists, Historians, Geologists and Paleontologists. For the upcoming Geology Symposium she has created a graphic display that shows the various Caltrans highway projects that have resulted in important paleontology finds.

Suspect Tsunami Deposits
Point Reyes National Seashore, Marin County, California

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Abstract

Anomalous sand layers are inter-bedded within estuary mud deposits of Point Reyes National Seashore (PORE), Marin County, California. The alternating mud and sand deposits resemble tsunami deposited sediments located along northern California, Oregon, Washington, and southern British Columbia (Cascadia) coastline, and other locations around the world.

The purpose of this study was to determine if the stratigraphic record within the marshes of PORE reveals significant deviation from the typical sedimentation process, (low-energy, long-duration), to a brief, high-energy sedimentation event. Record of these high-energy events may represent past tsunami inundation that could have affected the region.

To assess the lateral nature and extent of the subsurface deposits I employed both passive and intrusive test methods. As a screening tool, I observed the primary and secondary tidal channels that incise the marsh surface and viewed in detail, tidal channel banks where the stratigraphic position of a sand layer is well exposed. For conformation of the screening I conducted sampling traverses using a plunge-core device, dug one test pit, and pushed multiple blunt-penetrometer soundings.

Within the Home Bay marsh, I found deposits of alternating coarse and fine-grained sediment couplets that appear to drape the marsh at depth with sand-silt-clay laminae that occasionally cap the couplets. These sediments may represent past tsunami inundation on a former marsh surface, based on several fundamental identifying characteristics including:

- Comparative grain-size distribution--larger grain size than surrounding sediments.
- Grading--normal and inverse, non-graded (massive).
- Thickness, geometry, and spatial distribution--apparently continuous (draping) and tapering.
- Layering--sand-mud couplets and alternating sand-silt-clay laminae.
- Sedimentary contacts--basal contact is abrupt, upper contact ranges from gradual to abrupt.
- Rip-up clasts--clasts of bay mud incorporated into sand and silt matrix.
- Source area and physiography--sand layers are similar to Limentour Spit (beach) sands.
- Age dating/fossils--*pending laboratory analysis (funding).*

Should pending laboratory analysis (age dating, microfossil, etc.) support that the anomalous sand layers were deposited by tsunami, researchers, emergency managers, and planners, will be able to use these findings to extend the tsunami catalog and ultimately improve assessment of the tsunami risk affecting California's coastal communities and elsewhere around the world.