



UNIVERSITY OF SOUTHERN CALIFORNIA

Environmental Engineering Program

Department of Civil Engineering

Environmental Engineering Seminar

Environmental Geochemistry Techniques for the Evaluation of Urban OilFields Health and Safety Hazards

By

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Abstract

Environmental Geochemistry is an indispensable scientific discipline used to evaluate the health and safety risks posed by urban oilfields. These oilfields have the potential for releasing large quantities of toxic chemicals to the air within urban communities located over or adjacent to the oilfields. The environmental hazards are associated with oilfield gases migrating to the surface along faults and improperly maintained well bores. In addition, oilfield surface operations have the potential for releasing large quantities of Hazardous Air Pollutants (HAPS) into the surrounding urban communities. Case studies will be described which illustrate how these techniques have been successfully used in actual projects. Finally, the relationship of these approaches to the regulatory framework will be highlighted.

Friday, February 13, 2004

1:00-2:00pm

Seeley G Mudd Bldg., Room 101

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ENVIRONMENTAL HAZARDS ASSOCIATED WITH URBAN OILFIELD OPERATIONS

- **HAZARD IDENTIFICATION:**
 - **GAS MIGRATION TO THE SURFACE**
 - **SOIL CONTAMINATION**
 - **WATER CONTAMINATION**
 - **AIR TOXICS FROM SURFACE OPERATIONS**

- **SITE CHARACTERIZATION:**
 - **GEOCHEMICAL**
 - **GEOLOGICAL**
 - **HYDROGEOLOGICAL**

- **METHODOLOGY/APPROACH:**
 - **CRUDE OIL CHEMISTRY**
 - **OILFIELD GAS CHEMISTRY**
 - **SOIL AND AIR SAMPLING**
 - **LABORATORY PROCEDURES**

HYDROCARBON CONTAMINATION RESULTING FROM URBAN OILFIELD OPERATIONS

- **ENVIRONMENTAL HAZARDS:**
 - **OILFIELD GAS MIGRATION TO THE SURFACE**
 - **HYDROCARBON CONTAMINATION OF SOILS**
 - **AQUIFER CONTAMINATION**
 - **AIR TOXICS FROM SURFACE OPERATIONS**

- **METHODOLOGY:**
 - **GEOCHEMICAL SITE CHARACTERIZATION**
 - **GEOLOGICAL SITE CHARACTERIZATION**
 - **HISTORICAL SITE USAGE**
 - **HYDROGEOLOGICAL SITE ASSESSMENT**

- **SCIENTIFIC APPROACH:**
 - **SYSTEMS ENGINEERING APPROACH**
 - **OILFIELD CHEMISTRY**
 - **OILFIELD OPERATIONS**

GEOCHEMICAL METHODOLOGY

- **SOIL GAS MONITORING:**
 - SHALLOW SOIL GRAB SAMPLES
 - PERMANENT SOIL PROBES
 - SPECIAL REQUIREMENTS FOR H₂S

- **AIR SAMPLING:**
 - POINT SOURCE EMISSIONS
 - AIR MODELING/MIGRATORY PATHWAYS

- **WATER SAMPLING:**
 - BRINE WATER
 - AQUIFER CONTAMINATION

- **CRUDE OIL SAMPLING:**
 - API RATING
 - AROMATIC COMPOSITION
 - CONDENSATE COMPOSITION

- **RAW GAS SAMPLING:**
 - BTEX COMPOSITION
 - H₂S COMPOSITION

REGULATORY FRAMEWORK

- **FEDERAL CLEAN AIR ACT HAZARDOUS AIR POLLUTANTS (HAPS):**
 - **BENZENE**
 - **TOLUENE**
 - **OTHER BTEX CHEMICALS**
 - **n-HEXANE**

- **GOVERNORS LIST OF TOXIC CHEMICALS UNDER PROPOSITION 65 (HEALTH & SAFETY CODE 25249.6)**
 - **ALL BTEX CHEMICALS**
 - **MANY MORE**

- **AIR TOXICS HOT SPOT LEGISLATION (AB2588)**
 - **ALL OF THE ABOVE**

- **SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT**

- **LOCAL REGULATION (e.g., CITY OF L.A. METHANE ORDINANCE)**

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PUBLIC HEALTH AND SAFETY ISSUES AND CONCERNS

- **URBAN DEVELOPMENT OVER AND
ADJACENT TO OIL AND GAS FIELDS:**
 - LEAKING WELL PROBLEMS
 - NEAR SURFACE SOIL CONTAMINATION
 - AQUIFER CONTAMINATION
 - AIR TOXIC EMISSIONS

- **OILFIELD HEALTH HAZARDS:**
 - CARCINOGENIC CHEMICALS
(CANCER CAUSING)
 - BIRTH DEFECT CHEMICALS
 - NEUROTOXINS
(BRAIN INJURY CHEMICALS)

- **EXPLOSION HAZARD:**
 - GAS MIGRATION INTO CONFINED
SPACES
 - 5% (50,000 PPM) LOWER EXPLOSIVE
LIMIT

GEOCHEMICAL ASSESSMENT AND INTERPRETATION OF TEST RESULTS

- **SOURCE IDENTIFICATION; SOURCE GASES:**
 - THERMOGENIC
 - BIOGENIC (MICROBIAL)

- **NEAR SURFACE MICROBIAL ALTERATION**
 - PREFERENTIAL MICROBES
 - NEAR SURFACE MIXING
 - OXIDATION TRANSFORMATION

- **GAS MIGRATION FUNDAMENTALS**
 - INDIVIDUAL CONSTITUENTS BEHAVE DIFFERENTLY
 - OILFIELD SOURCE IDENTIFICATION

- **TRACER GAS CONSTITUENTS**
 - SULFUR COMPOUNDS (e.g., OXIDANTS)
 - HELIUM
 - IODINE

DTSC INVOLVEMENT IN THE ENVIRONMENTAL SITE ASSESSMENT

- **MANDATORY UNDER NEW LEGISLATION PASSED FOR SCHOOL SITE SELECTION:**
 - **BELMONT HIGH SCHOOL FIASCO TRIGGERED LEGISLATIVE CHANGE**
 - **UNIFORM STANDARDS FOR ENVIRONMENTAL SITE ASSESSMENT HAVE EVOLVED**

- **ENVIRONMENTAL ISSUES HAVE BEEN DRIVEN BY OILFIELD HAZARDS:**
 - **SOIL GAS CHARACTERIZATION**
 - **H₂S DRIVEN OILFIELD CHEMISTRY**
 - **DRIVEN BY GEOLOGICAL HAZARDS**

UNIVERSITY OF SOUTHERN CALIFORNIA AS A PROFOUND COMMUNITY RESOURCE

- **EXPERTISE IN OILFIELD CHEMISTRY:**
 - **PETROLEUM ENGINEERING**
 - **ENVIRONMENTAL ENGINEERING**
 - **HYDROCARBON RESEARCH
LABORATORY**
 - **MICROBIAL EXPERTISE**

- **HEALTH RISKS:**
 - **CANCER RISKS**
 - **NEUROTOXIN RISKS (e.g., H₂S)**
 - **BIRTH DEFECT RISKS**

- **NEUTRAL AND UNBIASED ADVISER TO
GOVERNMENTAL ENTITIES**

- **FACILITATE STUDENT PARTICIPATION IN THE
REGULATORY PROCESS, (e.g.):**
 - **DEPARTMENT OF TOXIC AND
SUBSTANCES CONTROL (DTSC)**

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CONCLUSIONS AND RECOMMENDATIONS

- **THE ACADEMIC AND RESEARCH PROGRAMS AT USC HAVE HAD A SIGNIFICANT IMPACT UPON THE PUBLIC POLICY ISSUES THAT HAVE EVOLVED FROM THE RECOGNITION OF OILFIELD HAZARDS.**
- **STUDENTS AT USC ARE PROVIDED THE OPPORTUNITY TO RECEIVE ENVIRONMENTAL EDUCATION AND TRAINING THAT IS AT THE VERY FOREFRONT OF SCIENTIFIC KNOWLEDGE**
- **STUDENTS AT USC ARE PROVIDED THE OPPORTUNITY TO INTERACT WITH THE GOVERNMENTAL REGULATORY PROCESS (e.g., DTSC), BECAUSE OF THE ADVANCED SCIENTIFIC EDUCATION AND TRAINING THEY HAVE RECEIVED AT THE UNIVERSITY.**

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