The National Academies Study Process

and a proposed study on

Subsurface Characterization, Modeling, Monitoring, and Remediation of Fractured Porous Rocks

Presentation to the Federal Remediation Technologies Roundtable
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THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

- National Academy of Sciences (1863)
- National Research Council (1916)
- National Academy of Engineering (1964)
- Institute of Medicine (1970)

Abraham Lincoln with the founders of the Academy signing the Academy charter of March 3, 1863. Painting by Albert Herter.
What is COGGE?

Committee on Geological and Geotechnical Engineering
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- **J. Carlos Santamarina** Georgia Institute of Technology
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- **Gregory B. Baecher**, University of Maryland
  Department of Civil and Environmental Engineering
COGGE Mission Statement

- To identify, investigate, and report on questions relating to geological and geotechnical engineering to government, industry, academia, and the public;
- To inform public policy on geological and geotechnical engineering issues;
- To identify new technologies and potential applications; and
- To promote the acquisition and dissemination of knowledge.
Types of Activities

- Consensus reports
- Symposia, roundtables, and forums on national issues
- Proceedings from conferences and workshops
- “White papers” that take a stand on pressing scientific concerns
COGGE Sponsors

- National Science Foundation
- US Nuclear Regulatory Commission
- NIOSH Mining Safety and Health Research Program

Past and Present Study Sponsors

FEMA, EPA, NSF, USNRC, DoD, DoE, BLM, Bureau of Reclamation, FHWA, Gas Research Institute, Dowell-Schlumberger, Inc.
Current Activities

Current Studies

- Underground Engineering for Sustainable Development
- Integrating Dam and Levee Safety and Community Resilience
- Induced Seismicity in Energy Applications

In Development

- The Role of Geotechnology in Sustainable Energy Production
- Criteria for Liquefaction Susceptibility Assessment
Today’s topic

Subsurface Characterization, Modeling, Monitoring, and Remediation of Fractured Porous Rocks
Spatial Variability

(a) Uncorrelated network (Fig. 4 and 6)

(b) Isotropically correlated Network (Fig. 6)

1. COV(R²)=0.49
2. COV(R²)=1.26
3. COV(R²)=1.95
Hydro-Biological

The diatoms - 1990

1. Estimated pore size $d_{pore}$ [mm]

Estimated reduction assuming a "tube model" with $t = 7 \mu m$

Estimated reduction assuming a "tube model" with $t = 70 \mu m$

Biological clogging can be mechanically constrained

2-orders of magnitude reduction

Initial hydraulic conductivity $k_{initial}$ [cm/s]

Hydraulic conductivity after bioclogging $k_{final}$ [cm/s]
Reactive Fluid Transport

Reactive fracture surfaces (CaCO₃)

[CO₂(aq)]

Kim
Advection-Diffusion-Reaction

\[ d v \frac{Pe}{D} = \frac{\text{rate Diffusion}}{\text{rate Advection}} \]

\[ \frac{\text{Advection rate}}{\text{Diffusion rate}} = \frac{v d}{D} \]

\[ Da = \frac{\alpha l}{v} \]

Fredd & Fogler 1988, 1998
Fredd & Miller’s 2000
Golfier et al. 2002
Hydro-Chemo-Mechanical

90% glass bead + 10% NaCl

Shin

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Cyclic Stress: AC Advection

Cyclic Stress: AC Advection

Chemical diffusion

D~0.0015 mm^2/s

D~1.9 mm^2/s

VF/VL= 60 - 0.57 Hz - 1.1 cc/s
VF/VL=190 - 0.23 Hz - 1.2 cc/s
VF/VL=170 - 0.28 Hz - 1.5 cc/s
VF/VL=400 - 0.13 Hz - 1.6 cc/s

Goldstein
Study Objectives

Plan and hold a workshop to examine state-of-the-art in

- Subsurface fracture and matrix characterization and the development of conceptual models
- Detection of fluid and contaminant pathways and travel times
- Detection and modeling of factors that affect change in geotechnical and hydrological properties over time
- Groundwater and contaminant transport modeling, monitoring, and remediation and how these can aid decision making during the lifecycle of a facility
- Early indicators of system failure resulting in unintentional fluid release
- Potential mitigation measures to eliminate or reduce system failure
Findings and Conclusions

A final report will be issued that will discuss

- Where research and development could improve the current state of the art
- Where incorporation of scientific and technical advances could enhance the state-of-practice and inform federal regulations and implementing guidelines
- Other areas identified by partnering sponsors
Study Process

THE STUDY PROCESS

SCOPE & CONTRACT

COMMITTEE APPOINTMENT

DATA COLLECTION

ANALYSIS & DELIBERATION

WRITING

REVIEW

PUBLICATION

DISSEMINATION

FACA § 15

DEFINING THE STUDY

COMMITTEE SELECTION AND APPROVAL

COMMITTEE MEETINGS, INFORMATION GATHERING, DELIBERATIONS, AND DRAFTING REPORT

REPORT REVIEW

Reports

New products:
- Popular versions
- Shorter briefs for specialized audiences
- Multi-report compendia (print & CD-ROM)
- Annotated bibliographies on interdisciplinary topics
- Expanded web features
- Video, broadcast programming

Mechanisms:
- Dissemination meetings
- Sponsor/hill briefings
- News conferences
- Science centers
- OpEds
- Talk shows

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NA Committee Selection

- Nominations sought from many sources
- Staff interview candidates
  - well balanced
  - free from conflicts of interest
  - range of expertise

All reports undergo extensive internal and external review
Study Logistics

- **10 committee members**, expertise in appropriate geotechnical and geohydrological disciplines plus members familiar with related statutes and regulations, design and operation of related facilities, remediation practices, and current public concerns.

- **19 month activity**
  - Once contract in place, committee selected and approved
  - Committee holds workshop and 3 meetings over a 12-month period
  - Report enters review at 12 months
  - Prepublication version of report released at 15 months
  - Final version of report becomes available at 19 months