Mining / Engineering Research at HUSEP

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Science Motivation

- Engineering Research Opportunities in the Subsurface: Geohydrology and Geo-mechanics (CMS-0234136, May 2003)
- An NSF-Sponsored Workshop on Deep Underground Science and Engineering Laboratories (DUSELs), Johannesburg, Sept 2003
- DUSEL S1 process, 2004-2006
- Geological and Geotechnical Engineering in the New Millennium, NAS-NRC, 2006
Documented Knowledge Gaps

NRC, 2006 (Long et al.)
- Characterize subsurface
- Account for time effects
- Use enhanced computing, information, and communication technologies

ARMA, 2003 (Elsworth and Fairhurst)
*The effect of scale on:*
- Complex coupled-process interactions
- Rock deformation and the state of stress
- Fractures and transport of fluids

ARMA, 1999 (Glaser and Doolin)
- Characterization of fractured rock masses
- Quantification of uncertainty in characterization
Proposed Solutions

ARMA, 2003 (Elsworth, Smeallie, and Heuze) (Rock Mx Workshop)
- Varied in situ stress, fluid pressure, temperature, and chemistry
- Ability to measure and modify these environments
- Five deep labs
  - flow and paleoclimate lab and observatory
  - induced fracture processes lab
  - coupled-processes lab
  - ultra-deep biogeochemical observatory
  - seismic observatory

ARMA, 2003 (Elsworth and Fairhurst) (pre-DUSEL Workshop)
- Run-of-mine experiments
- Cavern construction experiments
- Purpose-built experiments
  - Large block tests
  - Mine-by and drift-structure tests
  - Educational opportunities
Boundaries

- Address key science questions
- Fund PhD candidates (?)
During Construction

- EM Geophysics - Nabigian
- DAT – Einstein
- AMADEUS – Westman
- Cavern modeling – ?? Keiffer
- Cavern monitoring – Ge
- Rapid Tunneling – Kuchta
- *In situ* stress measurement – unknown
Purpose-Built

- Three (?) pillar clusters, at depths of 600, 1200, 1800 m (?)
- Characterization and Monitoring – Ge, Glaser, Westman
- Modeling – Keiffer (?)
- Coupled Processes – Elsworth, Mauldon
- Induced Fracture – Elsworth (?)
A possible approach – Proposed Pillar Clusters

- Five pillars per cluster (5m, 10m, 5m, 10m, 5m)
- Clusters at 600m, 1200m, 1800m
- Located at a distance of 50m from ramp

Test plan:
- Characterize
- Alter / Coupled Processes (TMHCB)
- Apply load by increasing tributary area around pillar
- Monitoring throughout all stages
Construct

5 m
Characterize
Construct
Characterize
Alter – THCB
& Characterize
Induce Failure (M) & Characterize
Perpetual

- Test and Training Facility
Research Budget

- Could think in terms of PhD candidates, budget $250k per student, which includes equipment.
- Goal - $10M, perhaps $3M for construction of purpose-built, and $7M for research.