The Henderson Mine

- Owned by Climax Molybdenum Company (CMC), a subsidiary of Phelps Dodge (PD) Corporation
- Established in 1970’s
  - A modern mine developed under strict environmental regulation and self imposed high standards
- One of the 10 largest underground hard rock mines operating in the world w/ a vast infrastructure
- Mine Product: Molybdenum (Moly) ore
  - Low grade, high volume mining requiring highly efficient infrastructure
- Mining Method: Panel Caving (Block Caving)
- Mining Capacity: ~40,000 - 50,000 ton/day
  - Actual operation: ~20,000 - 30,000 ton/day
    ⇒ under-utilized infrastructure
- Expected Mine Life: another ~20 years
Henderson Mine Location (Empire, Colorado) ~60 miles Denver

Henderson Mine

Airport

Denver

Colorado State University

Knowledge to Go Places
Henderson Mine Complex & Surrounding

The 11.7 km² mine site is entirely privately owned. Rock never leaves the Henderson property.

High speed conveyor ~10 miles
Harrison Mountain
~12,300’

High speed conveyor

Mining Area
~1,800 ft
• Existing tailing site and all necessary environmental permits

• Henderson 2000 modernization project: ~$150M
80 ton trucks dump rock at crusher.
Gyratory crusher reduces to – 4 in.
1 mile PC1 and 10.5 mile long PC2 underground conveyors.
4 mile long PC3 surface conveyor to mill site.
~40k - 50kton/day capacity
#2 Shaft for hoisting (a total of 5 shafts)

- Collar at 10,350 ft above sea level down to 7,500 ft
  \[ \Rightarrow \text{5 min trip} \]
- 28 ft diameter w/ two independent hoisting compartments
- The large hoist: 23' long by 8'6" wide by 13' tall
  \[ \Rightarrow \text{accommodates a standard-size (20 ft) ISO container} \]
  \[ \Rightarrow \text{Maximum load: 30 tons (50 tons w/o cage)} \]
  \[ \Rightarrow \text{200 people can transported at once} \]
- Fiber communication down the shaft to the other underground areas

- High capacity water and sewage treatment plant
- Electric power station: 2 x 24 MW feeds
- Tailing site: existing permit allows the deposition of over 340Mton
  \[ \Rightarrow \text{\sim338Mton expected to be deposited during the mine life} \]
Comments on Infrastructure

- Modern
  - Mine established in 1970’s
  - Henderson 2000 modernization project: ~$150M
    ⇒ High speed conveyer, etc.
- Vast and Underused infrastructure
  - Henderson operation in 1980’s: ~2,000 employees
  - After Henderson 2000: ~500 employees
    ⇒ shaft cages, water treatment plant, etc. underused
- Separate rock removal and person/equipment moving systems
- Henderson mine: low grade, high volume operation
  - Must be efficient
    ⇒ low cost operation
Henderson DUSEL Vision

• Create an underground lab that is unique and optimizes science output
  – Careful conceptual design to meet all science and engineering demands
  – Recognize other existing labs internationally

• Create a lab that is truly national and international and will last many decades
  – Long term stability and access
  – Dynamic scientific program

• Create a lab that will serve as an intellectual center
  – Permanent staff
  – Surface facility
• Staged approach that allows scientific experiments to be carried out concurrent with the construction
  – Flexible “meet the need” approach
  – Upper campus + experiments (within a year)
  – Central campus + experiments (within three years)
  – Lower campus + experiments (within five years)
  – Geo/bio Outposts + experiments

• Optimize the usage of the vast existing infrastructure and mining expertise
  – Cost effective facility

• Create a laboratory that is environmentally sound and absolutely safe
  – Utilize the tremendous amount of expertise that exists in the Henderson mine
HUSEP Collaboration

International Advisory Board

Executive Committee
C.K. Jung, Spokesperson/Chair
R. Wilson, Deputy Spokesperson
M. Kuchta, D. Pernick, S. Schultz, S. Teuscher, E. Zimmerman

Henderson Mine/Phelps Dodge
F. Menzer
D. Propernick, S. Teuscher

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S. Teuscher, Chair

Government&Community Committee
S. Schultz, Chair
R. Wilson, Co-Chair

Broader Impacts Committee
D. Glass, Chair
S. Pfiffner, Co-Chair, B. Jones, Co-Chair

Henderson Coordination Committee
D. Propernick, Chair, S. Teuscher, Co-Chair
HUSEP Executive Committee
Standing Committee Chairs

Collaboration Council
HUSEP Executive Committee
Standing Committee Chairs and Co-Chairs

Mining & Engineering Committee
M. Kuchta, Chair
B. Nelson, Co-Chair; L. Petersen, Co-Chair, E. Westman, Co-Chair

160 members, 70 Institutions, 9 countries
Industry Partner: Henderson/Phelps Dodge

- Henderson Mine Operation
  - Mining operation with zero-accident policy
    ⇒ excellent safety record
  - Seasoned staff with expertise in mining
  - Friendly, congenial, cooperative, (even patient) staff
  - Actively participating member of the HUSEP collaboration
    ⇒ eager to bring DUSEL to Henderson

- Phelps Dodge Corporation
  - Sees DUSEL as a good model for productive land use after mine closing, community relations and image
  - Friendly, science sympathetic senior executives
State and Local Support for Henderson

- Arapaho non-profit community organization
- **State Level:** non-partisan support
  - Direct Involvement of Lt. Governor’s Office
  - State Senate-House Joint Resolution
  - Governor’s Letter of Support
  - Support from the Dept. of Local Affairs
  - Support from the Dept. of Natural Resources
  - Support from the Commission for Economic Development & International Trade
- **Local Community Level**
  - Strong support from Clear Creek County (mine site)
  - Strong support from Grand County (mill site)
  - Many supporting letters
- Creation of Colorado State Special Commission (“mini-cabinet”) for HUSEP
- No Opposition!
$20M for Henderson DUSEL visitor center and other surface facilities, providing that Henderson is selected for DUSEL

Non-political initiative

- Initial request for $20M made by the HUSEP collaboration about two years ago
Henderson DUSEL Conceptual Design

DUSEL mostly decoupled from the mining activities

pristine rock

perturbed rock

Henderson Mountain
Elev. 12,300 ft

Red Mountain
Elev. 12,300 ft

Silver Plume Granite

Urad Porphyry
(Oligocene)

Outline of Henderson Orebody

7500 Level

Crusher

7065 Level

Geoscience/Engineering Campus

Outposts

Conveyor

LA Ramp

Access Ramps

Post-Urad Intrusions

(Oligocene)

(11+ Stocks)

Internal Shaft

Deep Exploration Station

Ventilation Rises

DUSEL-001

DUSEL-002

Central Campus
6800’

Midway Shaft Station - 5850’

Upper Campus 7700’

Vasquez Pass Shear Zone

Silver Plume Granite (1.4 Ga)
Henderson DUSEL
Exploration Core Drill Holes

Drill-hole 02 (on-going)
Drill-hole 01

Rock type: granite
Very good rock quality
No show stoppers!
No Moly or Gold ...

Funded by the collaborating universities and State of Colorado
Cores from the Henderson DUSEL Core
Drill #1
Initial Science: Bio-sampling at Henderson

- Ancient water, anoxic for thousands of years, meets oxygen in the shaft, and oxides of minerals precipitate
- Water passed through filters for several hours to collect samples
  - being analyzed for DNA
  - First preliminary results obtained
    - Discovery of three new bacteria phyla
      - Named: Henderson 1, Henderson 2 and Henderson 3
    - Analagous to discovering new mesons in the 1960's
- Analysis of the core samples for biological study also on-going
New Discovery: Three New Bacteria Phyla

A “Map” of Life

Euryarchaeota

Crenarchaeota

Archaea

Eucarya

You are here

0.1 changes / site

N.R. Pace, Science, 1997
Major HUSEP Activities Since S2 Award

- 6 Topical Workshops w/ Accompanying Outreach Workshops
  - Henderson DUSEL Management Workshop: August 25
  - Biological Science at Henderson DUSEL Topical Workshop at CU, Boulder: October 20-21
  - Strategic Vision and Design Criteria Workshop at CU, Boulder: October 20-22
  - Physics at Henderson DUSEL Topical Workshop at CSU, Fort Collins: November 18
  - Geoscience at Henderson DUSEL Topical Workshop at CSU, Fort Collins: November 18
  - Engineering at Henderson DUSEL Topical Workshop at CSM, Golden: December 15
- Science and Engineering at Henderson DUSEL Capstone Workshop at Stony Brook, New York, May 4 - 7, 2006
  - 120 registrants in addition to 60 high school teachers for the accompanying outreach workshop
Summary

• A National Deep Underground Science and Engineering Lab will house experiments that tackle some of the most important science questions today with potential of major discoveries
  – One of the few hopes for the future of particle and astro-particle physics community
  – DUSEL provides a 4-D observatory for the geo/bioscience community: large scale (km$^3$) and long term (multi-decade)
  – DUSEL provides an excellent opportunity to the US M&E community to lead deep underground construction technique
  – DUSEL with a truly next generation Large Multi-purpose Detector and a neutrino superbeam will allow US to lead the world community
  ⇒ a Unique Facility

• The Henderson Mine presents an excellent (practical, cost-effective and non-controversial) site for DUSEL

• Operating mine provides vast amount of advantages for DUSEL construction and operation
The End