Homestake DUSEL

Contributions to the S-1 Approach

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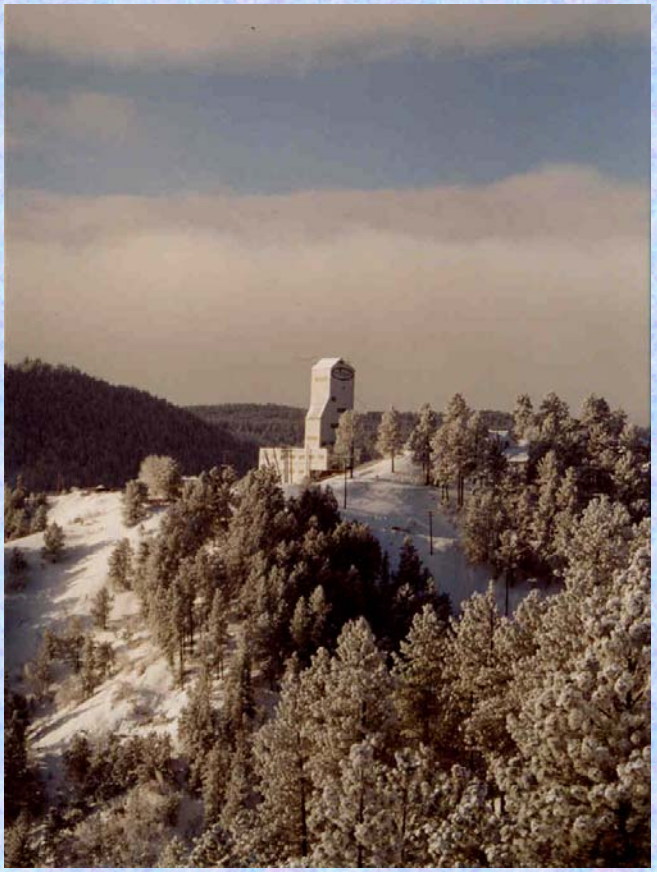
The Homestake Mine



World-class gold deposit –
produced 40 million ounces of gold

H-DUSEL

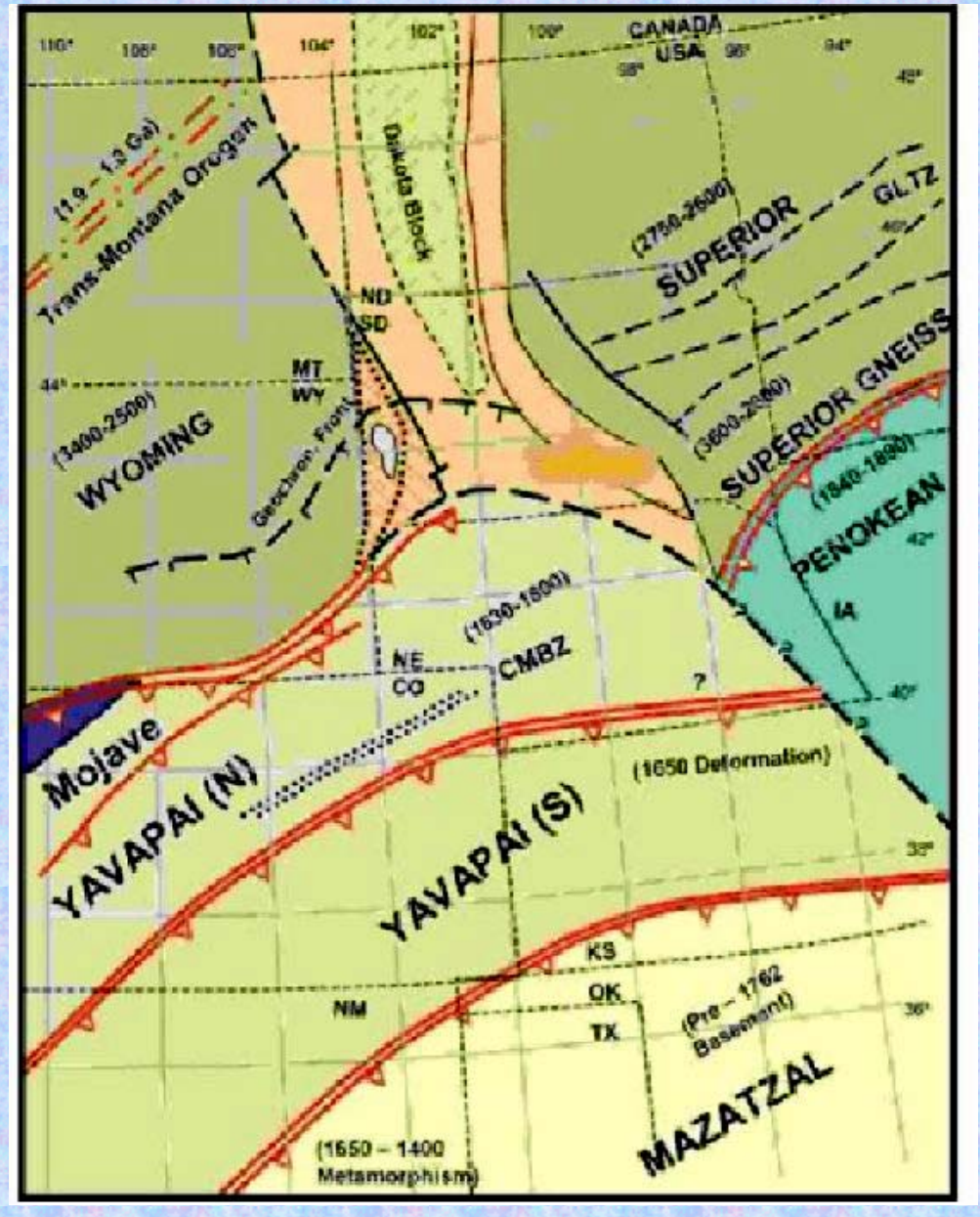
- General Geologic Setting

  - Regional
  - Local
  - X-section of the potential laboratory

- Attributes from the standpoint of a Homestake site

- Classes of experiments that are supported by a Homestake site

Crystalline basement of the mid-continent



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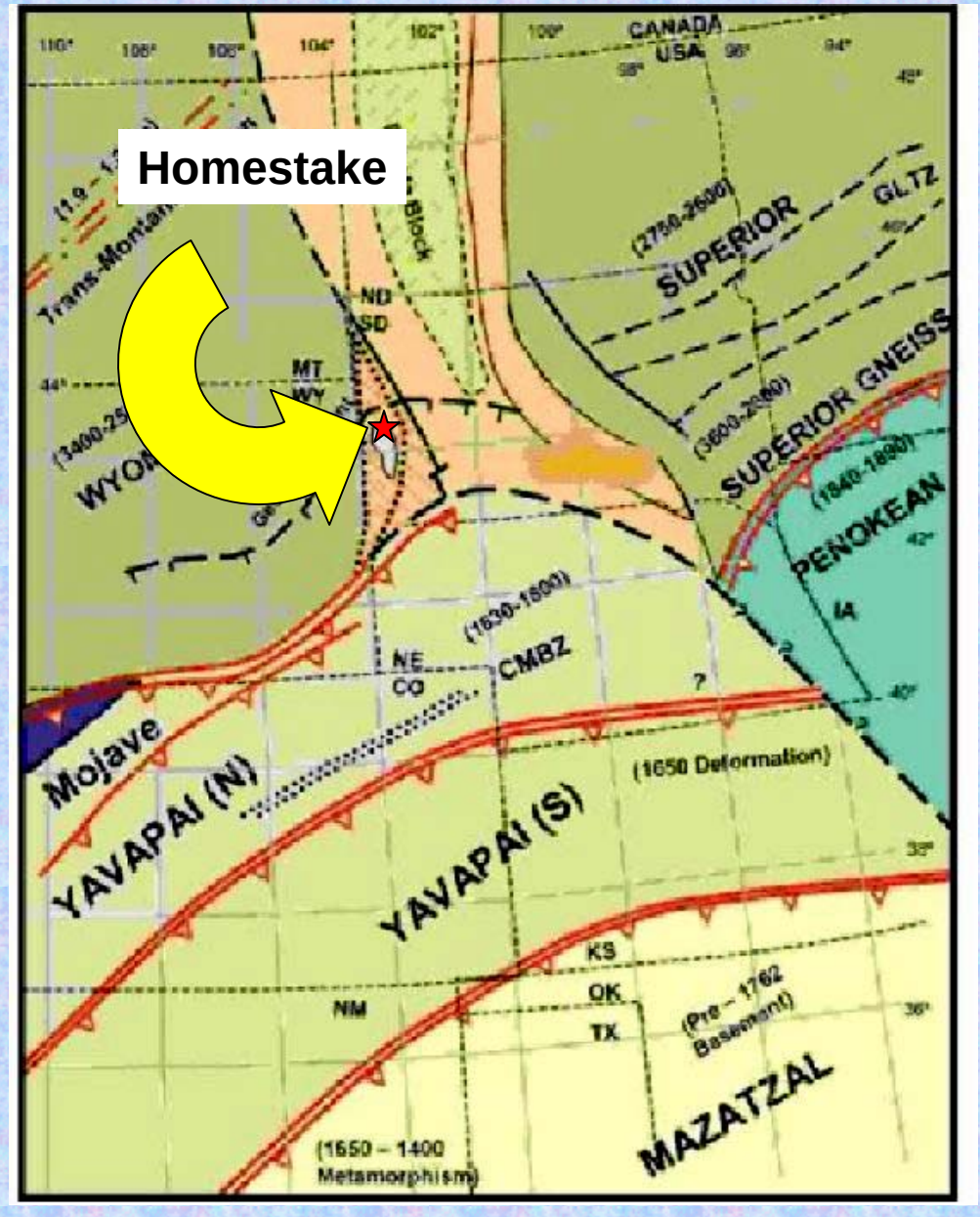

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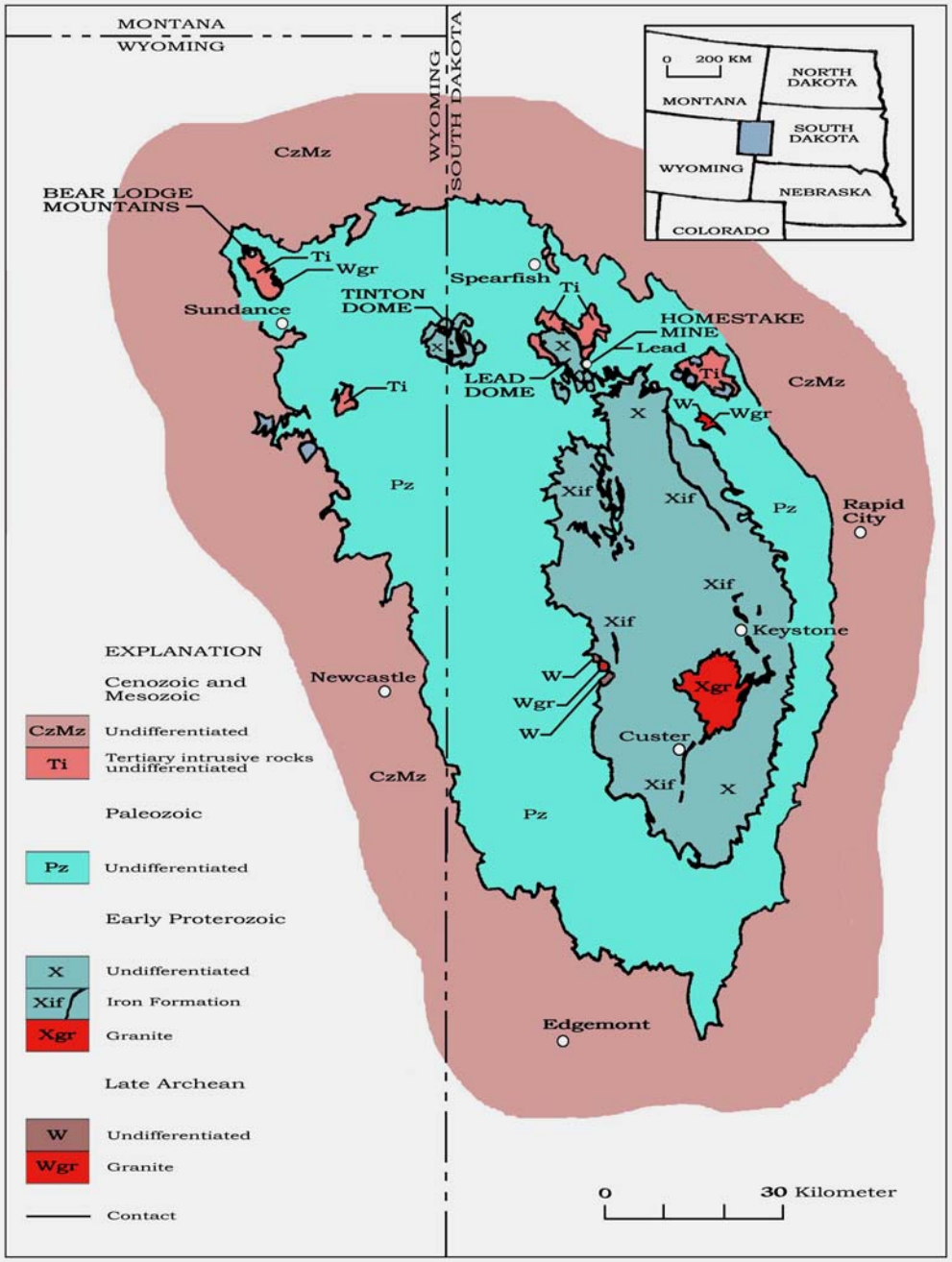


Location

- Northern Black Hills of western South Dakota.
- An elongate domal Laramide uplift 100 km long and 60 km wide.
- Core of Precambrian phyllite, schist, and granite flanked by Phanerozoic sedimentary rocks.

Modified from Caddey, et al. (1991)

General Geology

- Rocks are approximately 2 billion years old; tuff unit dated at 1.94 b.y.
- Metamorphic rocks consist of muscovite- and/or biotite phyllite/schist, dolomite, metaclastics, iron-formation, and amphibolite.
- Metamorphic grade ranges from lower greenschist to middle amphibolite facies.
- Complexly deformed geologic terrain.

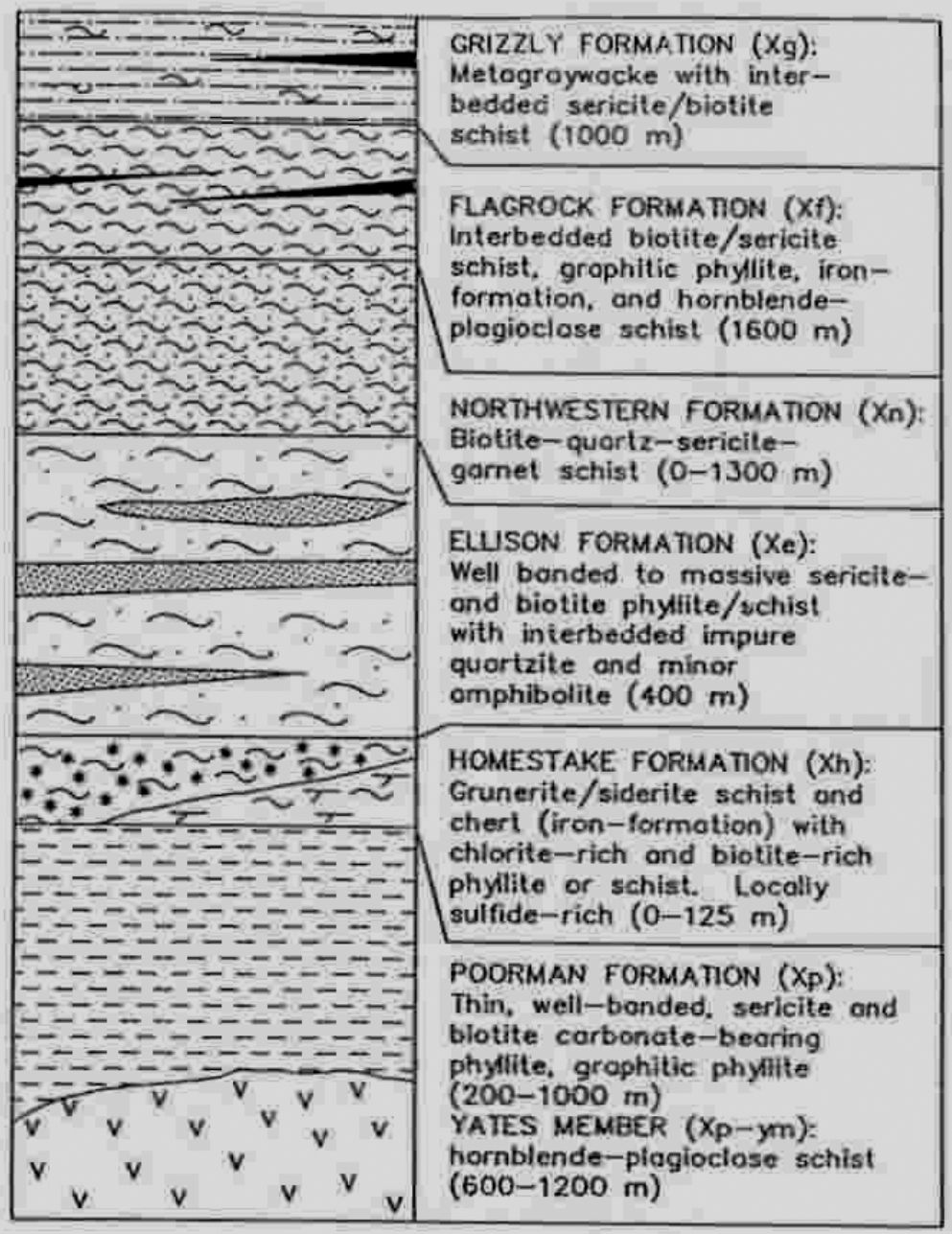
Geologic Events

- Intrusion - rhyolites and phonolites ~53 my
- Regional uplift and erosion ~65 my
- Deposition beginning in middle Cambrian
- Uplift and erosion
- Metamorphism ~ 1.75 by
- Metamorphism~1.84 by
- Deposition ~ 1.9 by

Homestake stratigraphy

Three most pertinent units

- Ellison formation
- Homestake formation
- Poorman formation



Bachman and Caddey, 1990

Poorman Formation

– base (Yates Member) consists of metamorphosed tholeiitic basalt with possible back-arc basin affinities

– remaining Poorman lithologies are metamorphosed equivalents of dirty dolomite, banded carbonate-rich claystone and siltstone, marl, iron formation, carbonaceous pyrrhotite-bearing siliceous exhalite, and interbedded tuffs.

– interpreted as chemical precipitates with fine-grained terrigenous detrital material

Campbell, 2004

Yates Member or Lower Unit

- Serves as the approximate base of the Poorman Formation.
- Hornblende-plagioclase schist.
- Massive, blocky exposures; fine- to medium-grained; exhibits local relic pillow structures; no vesicles.
- Occurs as several large masses at base of Poorman Formation.
- Numerous interbedded lithologies along margins; conformable contacts.
- Local alteration zones.

Campbell, 2004

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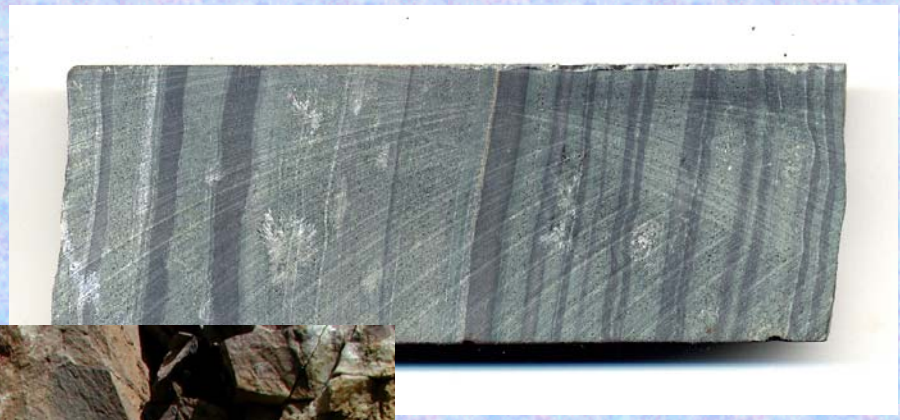
Homestake Formation

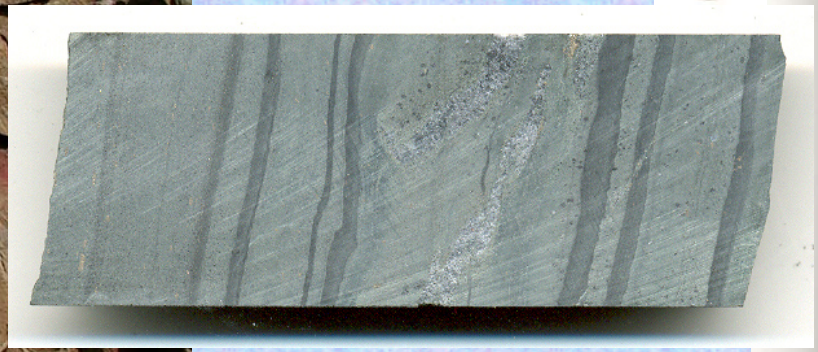
– transition to Fe and Mg carbonate chemical precipitation and iron formation

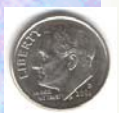
– Multiple horizons of carbonate facies iron formation interlayered with marl

Campbell, 2004

Homestake Formation







Ellison Formation

– metaclastic sequence

– dominated by feldspathic litharenite with abundant shale, siltstone, and tuffaceous units

Campbell, 2004

Ellison Formation

- Heterolithic unit comprised of metaclastics, muscovite and biotite phyllite, and sericite-ankerite-albite-quartz phyllite.
- Thickness ranges from 700 to 1,500 m.

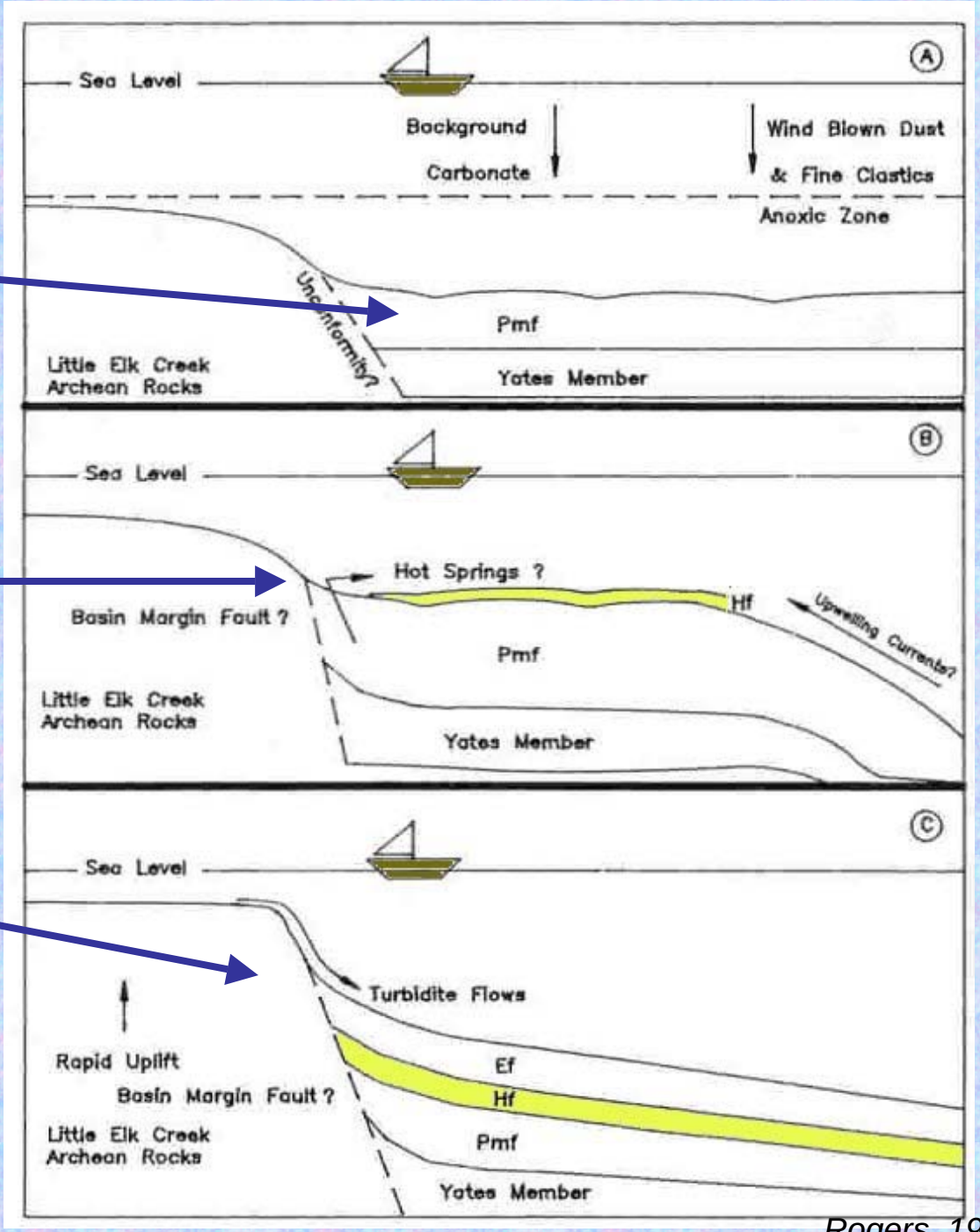
Campbell, 2004

Environments of deposition

Poorman deposition (Yates Member)

Homestake deposition

Ellison deposition



Rogers, 1990

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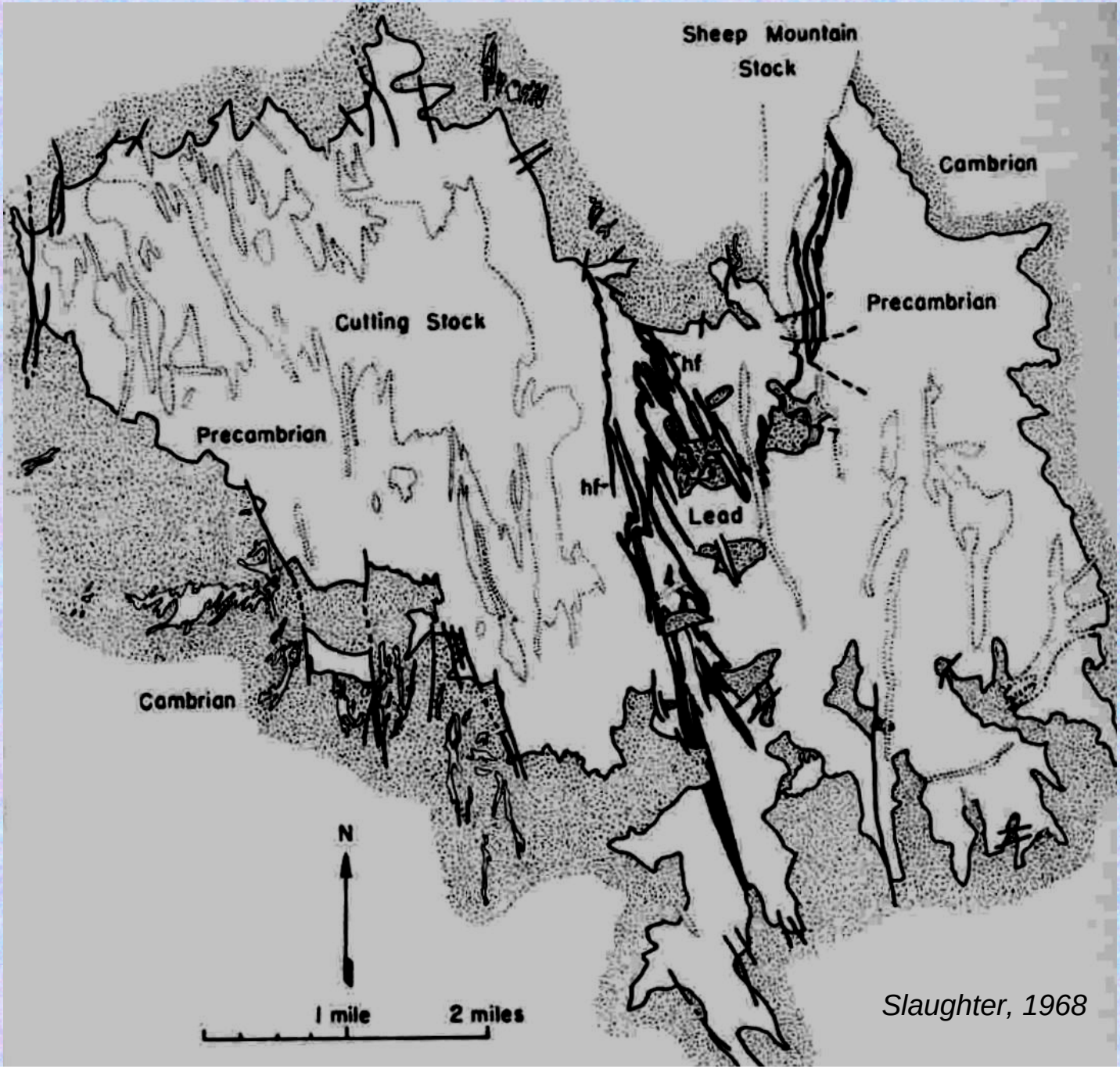
Local Geology



Slaughter, 1968

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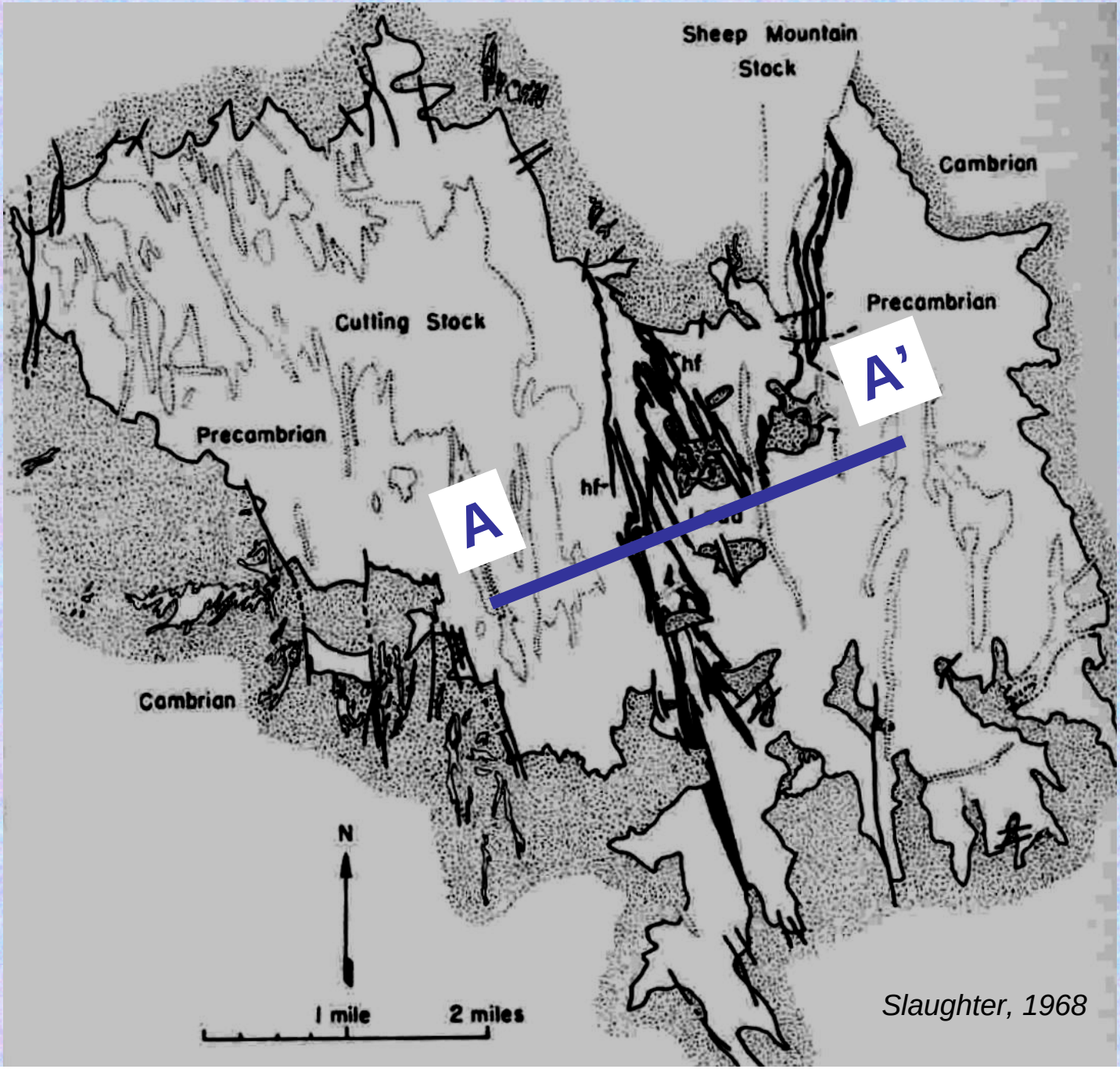
Local Geology



Slaughter, 1968

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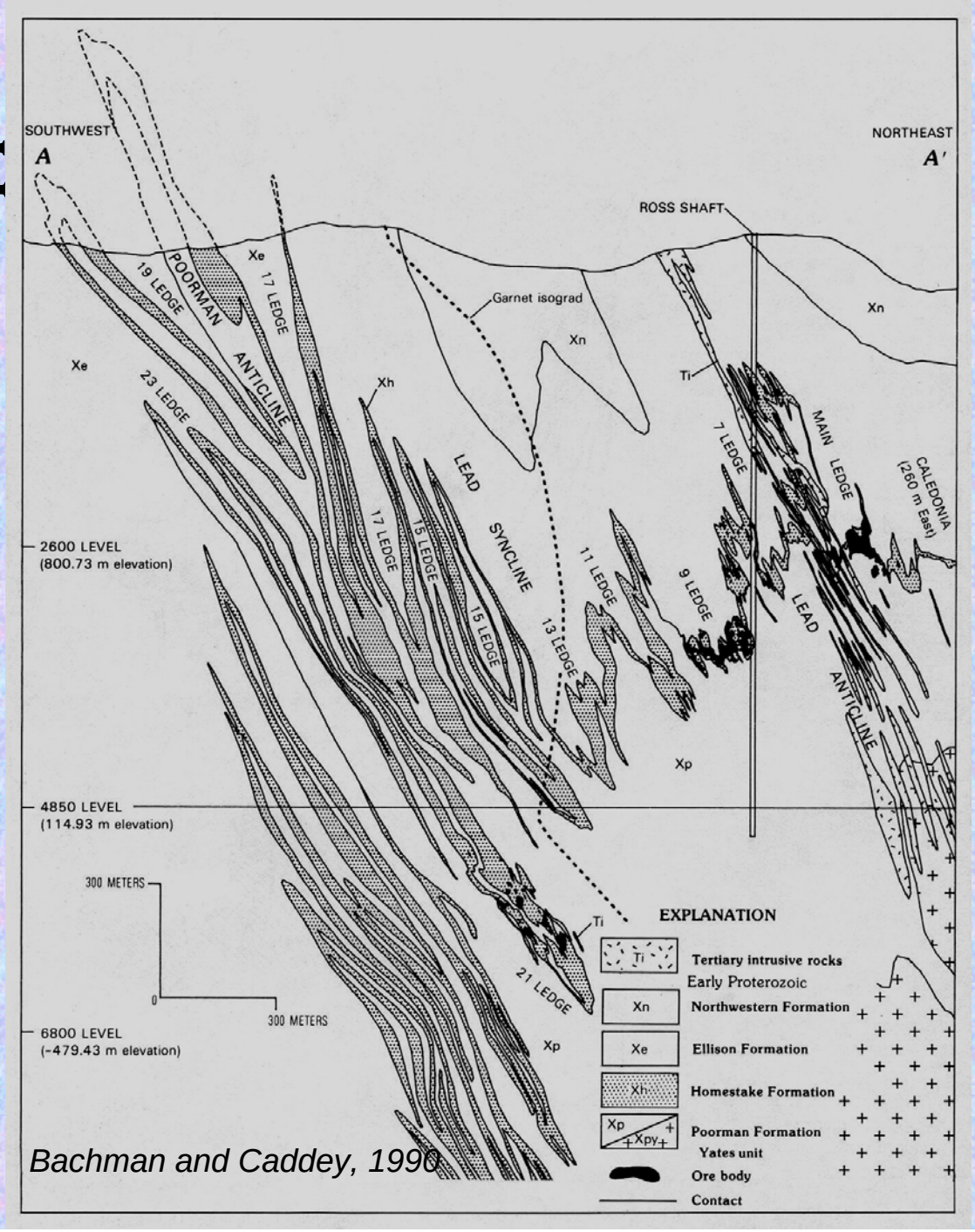
Homestake Mine Cross-Section



Bachman and Caddey, 1990

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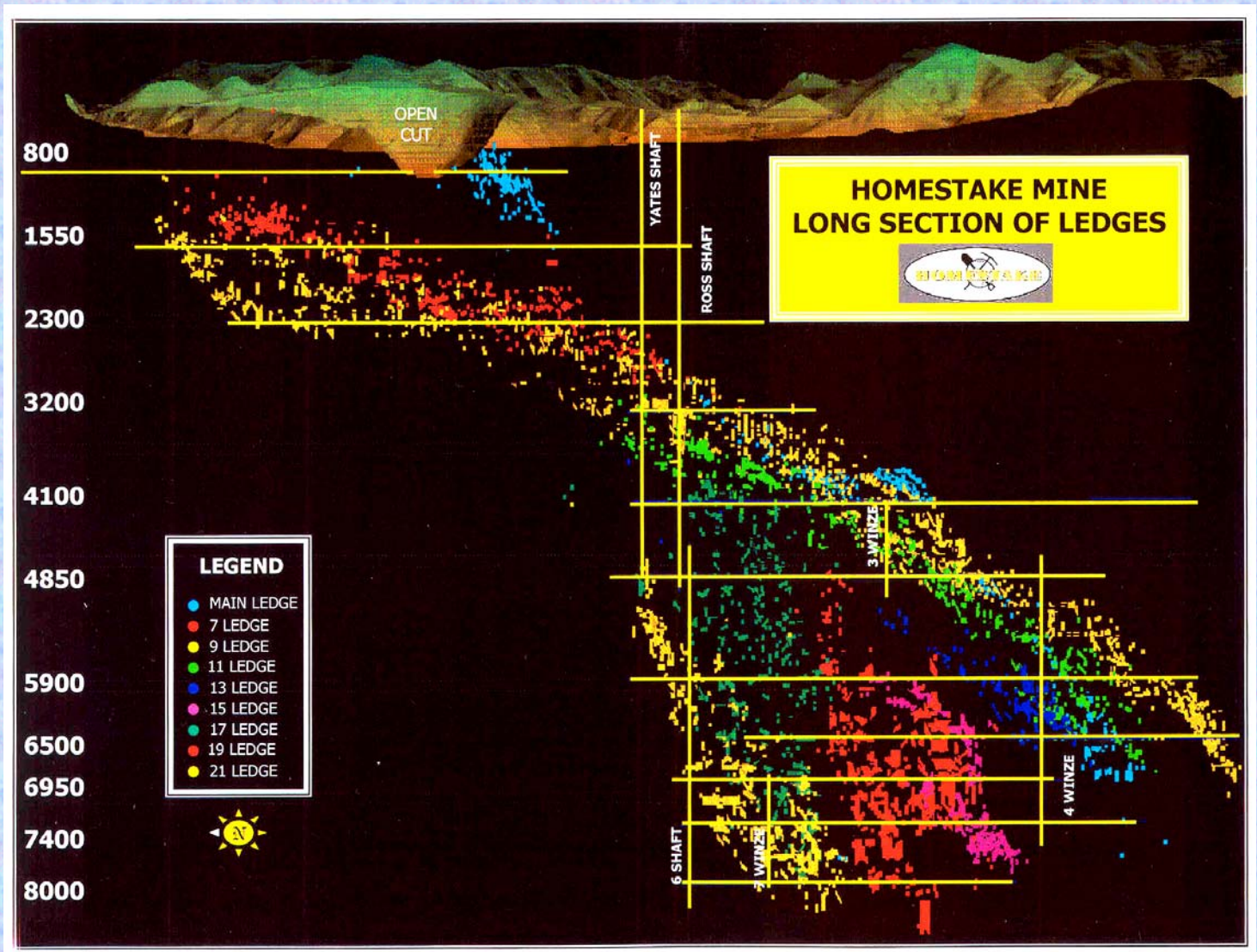
Homestake Mine Longitudinal Section



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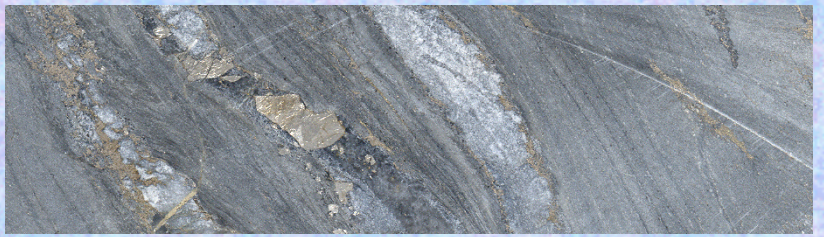
Metamorphic grade

- middle greenschist in the western part of the mine
- middle amphibolite facies in the deep, eastern section of the mine

Diamond Core Drilling

- Represents the best sample obtainable for geologic, structural, and engineering purposes.



Homestake Core Repository

- Can be integrated with Homestake Mine digital (Vulcan database) and paper archive (including geochemistry)

- Current inventory comprises 700,000 feet of core from surface and underground.

Homestake Core Repository

- Prototype for Precambrian iron-formation hosted gold deposits. Produced 40+ million ounces of Au.
- Mine provides in-situ study of a significant block of the Earth's Paleoproterozoic crust
- Physical limits of the proposed laboratory
  - volume of rock exposed by workings -- 2.7 x 2.5 x 5 km
  - 6.5 km of plunge length
  - >500 km of drifts
  - core expands this to 6 x 3 x 14 km

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Information Obtainable From Core

- Mineralogy and rock type.
- Large-scale structural information, fracture type and fracture density.
- Physical properties and critical rock mechanics data for underground engineering purposes.
- Determine distribution of rock types based on sprays of drill holes
- Geochemistry and lithologic pressure-temperature conditions.

Attributes

- mechanical stability
  - –Offset by a desire from some quarters for rock burst studies
- early access
- room to grow”
- multiple exits (safety)
- not encumbered by routine mining operations

Attributes (cont'd)

- Should be well-characterized (large volume of rock --- only pleasant surprises)
- varied rock types
- low water inflow
- possibly low radioactivity

Infrastructure

e.g.

- **Rock handling capability (7000 tons/day)**
- **Locations for waste disposal**
  - **skip to the surface**
  - **dispose/store underground**

Classes of Experiments

Experiments requiring vertical access:

- cloud physics
- drop tube experiments

Experiments requiring great access

- controlled fluid introduction
- may need access above/below

Classes (cont'd)

Experiments requiring distance from physics facilities

- fracture-inducing experiments
- destructive experiments (thermal, shock, fluids)
- new drifts and experiments requiring virgin territory

Classes (cont'd)

Experiments requiring large volumes of rock to be instrumented or studied

- geohydrology
- geochemistry
- seismic studies
- electromagnetic studies

- natural fractures
  - where do you find them?
  - important to have a large volume in which to search

Outreach

- easy access
- interested local population
- local underserved population
- high visitation (tourist area?)