

# Wednesday's Lecture and Friday's Discussion

- ▶ Read ch. 17 of Cunningham and Cunningham (2008) for Wednesday (handed out in class)
- ▶ Friday's discussion will be on global hunger and the agrifood industry

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# Mineral resources and their extraction

## Ecological consequences of the mining industry

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Biology 1030

10 October 2011

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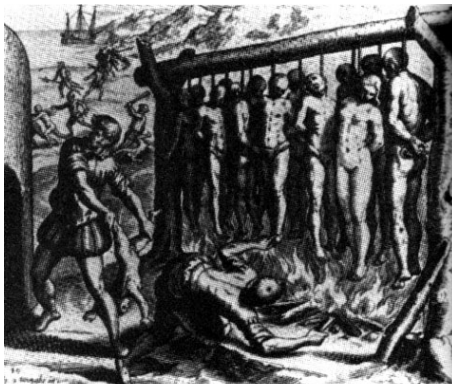
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# The traditional narrative

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# Another perspective



"[The Spaniards] took babies from their mothers' breasts, grabbing them by the feet and smashing their heads against rocks. . . . They built a long gibbet, low enough for the toes to touch the ground and prevent strangling, and hanged thirteen [natives] at a time in honor of Christ Our Saviour and the twelve Apostles. . . . Then, straw was wrapped around their torn bodies and they were burned alive."

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# The “brave men” of Wounded Knee



*Famous Battery "E" of the 1st Artillery. These brave men and the Hotchkiss guns that Big Foot's Indians thought were toys, Together with the fighting 7th what's left of Gen. Custer's boys, Sent 200 Indians to that Heaven which the ghost dancer enjoys. This checked the Indian noise, and Gen. Miles with staff Returned to Illinois.*

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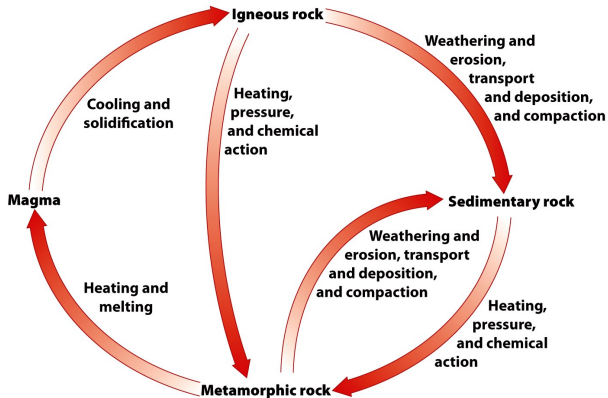
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# Rock cycle



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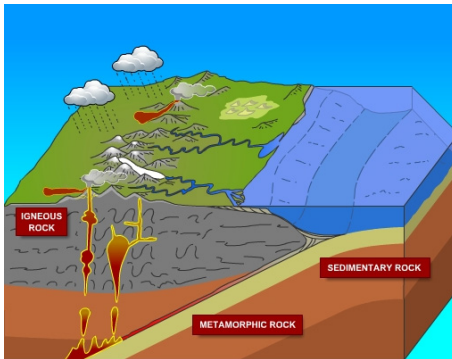
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# Rock types



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# Metallic and non-metallic minerals

<b>Metallic</b>	<b>Non-Metallic</b>
Iron ( $740 \text{ Mta}^{-1}$ )	Gemstones
Aluminum ( $40 \text{ Mta}^{-1}$ )	Sand
Manganese ( $22.4 \text{ Mta}^{-1}$ )	Gravel
Copper ( $8 \text{ Mta}^{-1}$ )	Salt
Chromium ( $8 \text{ Mta}^{-1}$ )	Limestone
Nickel ( $0.7 \text{ Mta}^{-1}$ )	Soil
	Phosphates

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# Aluminum (Bauxite)

Australia	38%
Guinea	15%
Jamaica	10%

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# Iron

China	24%
Brazil	15%
Australia	12%

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# Copper

Chile	23%
US	19%
Canada	6%
Russia	6%

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# Lead

Australia	19%
China	14%
US	14%

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# Nickel

Russia	24%
Canada	19%
Indonesia	10%

From Cunningham and Cunningham (2008)

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# Zinc

Canada	15%
Australia	14%
China	13%

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# Mercury

China	24%
Algeria	14%
Spain	10%
Kyrgyzstan	10%

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# Tin

China	27%
Indonesia	18%
Peru	12%

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# Primary ecological effects

- ▶ Groundwater accumulates in the pit and forms a toxic “soup”

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# Strip mine



Dig expansive trenches to remove *overburden*, then fill with loose rock in *spoil banks*

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# Primary ecological effects

- ▶ Removal of surface vegetation and soil
- ▶ Extensive and rapid erosion

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# Shaft/slope (underground) mine



Extract minerals underground and transport to surface

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# Primary ecological effects

- ▶ Risk of collapse
- ▶ Explosion (natural gas and coal)
- ▶ Leakage of toxins into groundwater
- ▶ Underground fires (coal)
  - ▶ Consume up to 200 Mt coal/annum
  - ▶ Release as much CO<sub>2</sub> as all cars in US
  - ▶ Also release toxic mercury, arsenic, selenium, radon, and other fumes

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# Placer mine



From streams and panning to water cannons

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# Primary ecological effects

- ▶ Extreme sedimentation (to the point of stream fill)

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# Mountaintop removal/mining



Literally remove the top of the mountain (up to 215 m or 715 ft.) to get at the mineral (usually coal) and fill nearby valleys (and the streams that created them) with overburden

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# Primary ecological effects

- ▶ Forests are clear-cut
- ▶ Toxic substances in the fill rock
- ▶ Destruction of entire stream ecosystems—900 km of streams buried in West Virginia alone

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# General environmental issues

- ▶ Companies rarely fund required restoration projects
- ▶ Restoration cannot reverse losses of endemic species
- ▶ Effects on human health are also irreversible

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## Conflict over stream destruction: Clinton

- ▶ 1998: Lawsuit filed by environmental lawyers against federal agencies (Army Corps of Engineers, EPA) claiming that mountaintop removal (and stream filling) violate Clean Water Act
- ▶ 1999: Federal judge rules in favor of environmental lawyers. Clinton administration, faced with potential shutdown of all mountaintop mining, agrees to negotiate “fill rule” agreement with industry to and to undertake a scientific review of environmental impacts
- ▶ 2000: Negotiations between EPA and industry stall. West Virginia coal industry joins Bush campaign, raises \$275,000

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# Conflict over stream destruction: Bush

- ▶ 2001: Bush administration instructs EPA to redirect scientific review to focus on “centralizing and streamlining coal-mine permitting,” demands all proposals for limiting valley fills be removed
- ▶ 2002: Bush administration issues fill rule that sides entirely with industry
- ▶ 2004: Bush administration responds to further litigation on stream-fill by issuing a “clarification” that effectively re-writes the CWA

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## Conflict over stream destruction: Obama

- ▶ 2009: EPA attempts to implement more scientifically rigorous analysis of mountaintop-removal permits
- ▶ January 2011: EPA vetoes CWA permit for (Arch Coal, Inc., second largest coal company in US, subsidiary) Mingo Logan Coal Company's Spruce No. 1 Mine in Logan County, West Virginia, nation's largest proposed mountaintop removal
- ▶ October 2011: Federal judge prohibits EPA from subjecting stream-fill applications to more rigorous review
- ▶ More information: <http://goo.gl/2oHLh>, <http://goo.gl/9g1ti>, <http://goo.gl/y0Q1x>, <http://goo.gl/DKkr5>, <http://goo.gl/IXHUr>, <http://goo.gl/y0w0x>

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## Growth of Hobet mine, West Virginia

- ▶ 1992: Mine extends across entire Stanley Fork Stream Valley
- ▶ 1996: Filling of Connelly Branch begins
- ▶ 2000: Connelly Branch almost entirely filled
- ▶ 2004: Expansion to mountaintops north of Mud River begins
- ▶ 2009: EPA intervenes in permit to expand into Berry Branch
- ▶ 2010: EPA declares mitigation practices in compliance with CWA
- ▶ <http://goo.gl/9Mdqs>

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# Hobet mine, West Virginia



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# Hobet mine, West Virginia



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# Kennecott Eagle Mine Project

- ▶ Rio Tinto subsidiary Kennecott Eagle Minerals Company blasting nickel/sulfide mine at Eagle Rock, Yellow Dog Plains
- ▶ Keweenaw Bay Indian Community members argue Eagle Rock a sacred site of worship, but argument was rejected by state, which only recognizes buildings as places of worship
- ▶ Native American activists occupied site April–May 2010 to prevent blasting, but were evicted by police
- ▶ In May 2010 Huron Mountain Club, Keweenaw Bay Indian Community, National Wildlife Federation and Yellow Dog Watershed Preserve filed motion in Ingham county circuit court for stay until ruling on mine legality
- ▶ In September 2011, Judge Paula J. M Manderfield denied the stay

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## More Information

- ▶ <http://goo.gl/Lk5r1>
- ▶ <http://goo.gl/MfWbY>
- ▶ <http://goo.gl/jb4uH>
- ▶ <http://goo.gl/NeknC>
- ▶ <http://goo.gl/AzRxn>
- ▶ <http://goo.gl/a0U13>
- ▶ <http://goo.gl/pRMtt>

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# Smelting

- ▶ Produces toxic substances that must be disposed of
- ▶ Emits toxic fumes
- ▶ Devices to control atmospheric contamination turn the toxins into solid waste that still must be disposed

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# Inco's Copper cliff processing facility



Sudbury, Canada

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# Widespread ecological effects

- ▶ 40 sq. miles: completely barren
- ▶ 140 sq. miles: shrub and herbaceous only
- ▶ 1,700 sq. miles: vegetation affected
- ▶ Sudbury considered one of the most polluted cities
- ▶ <http://goo.gl/7uaY5>
- ▶ <http://goo.gl/zu6gR>

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# Strategies to reduce environmental impacts of extraction

- ▶ Replacement — Develop synthetic alternatives
- ▶ Recycling — Melt down minerals to raw materials for use in production
- ▶ Reuse — Reuse the existing commodities

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# References I

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