

# Neodymium:

## A Story of Geographic Connections and Spatial Reasoning

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“I’ve been an oil man all my life -  
and this is one crisis we will not solve by drilling.  
We need to invest in other forms of energy.”

T. Boone Pickens.

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Important point:

Every wind generator needs some magnets,  
and the best magnets are made of an alloy  
of iron (lots of it), boron, and neodymium.



## For background, let's build a graph.

## Relative Abundance of Chemical Elements



20

40

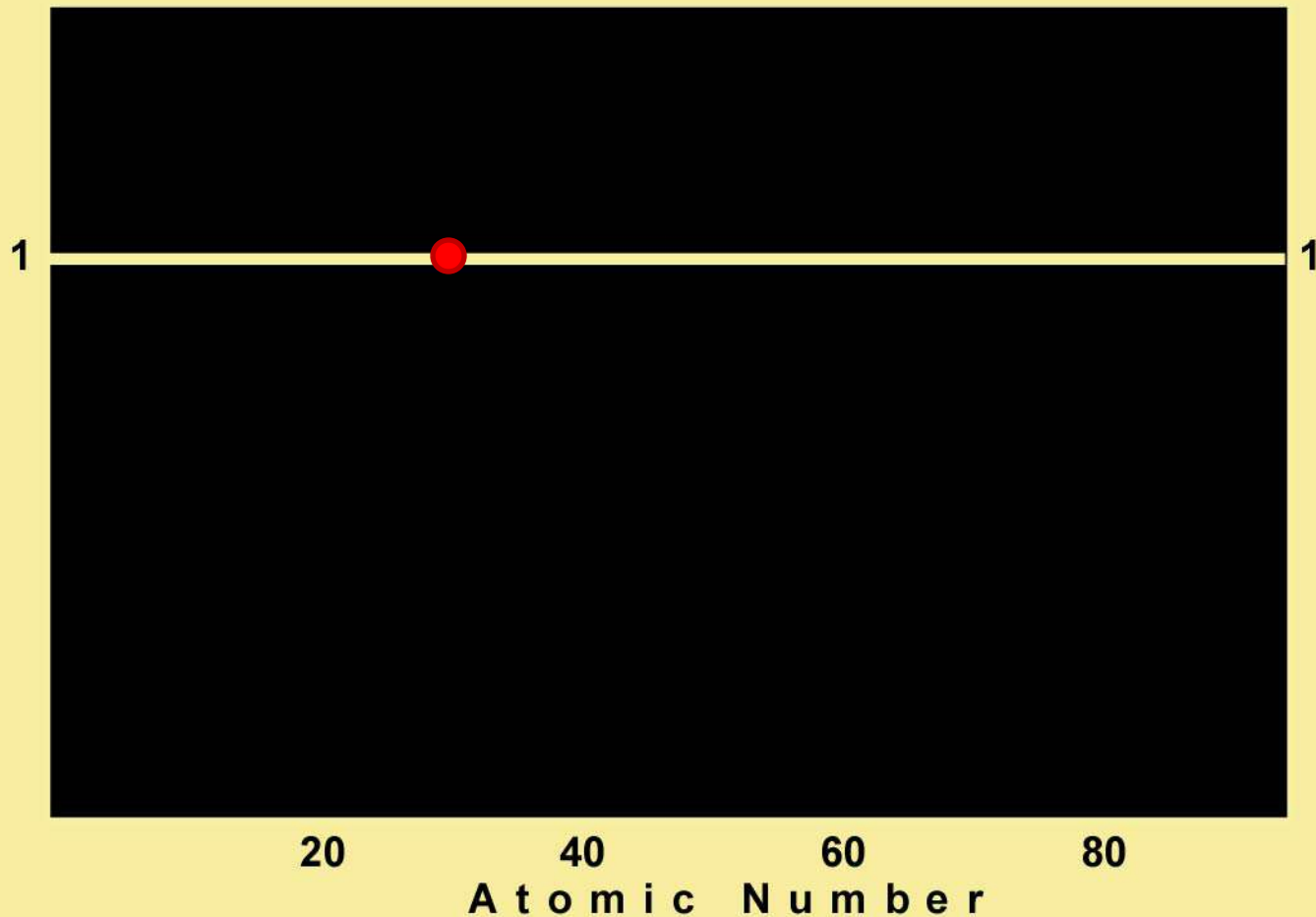
60

80

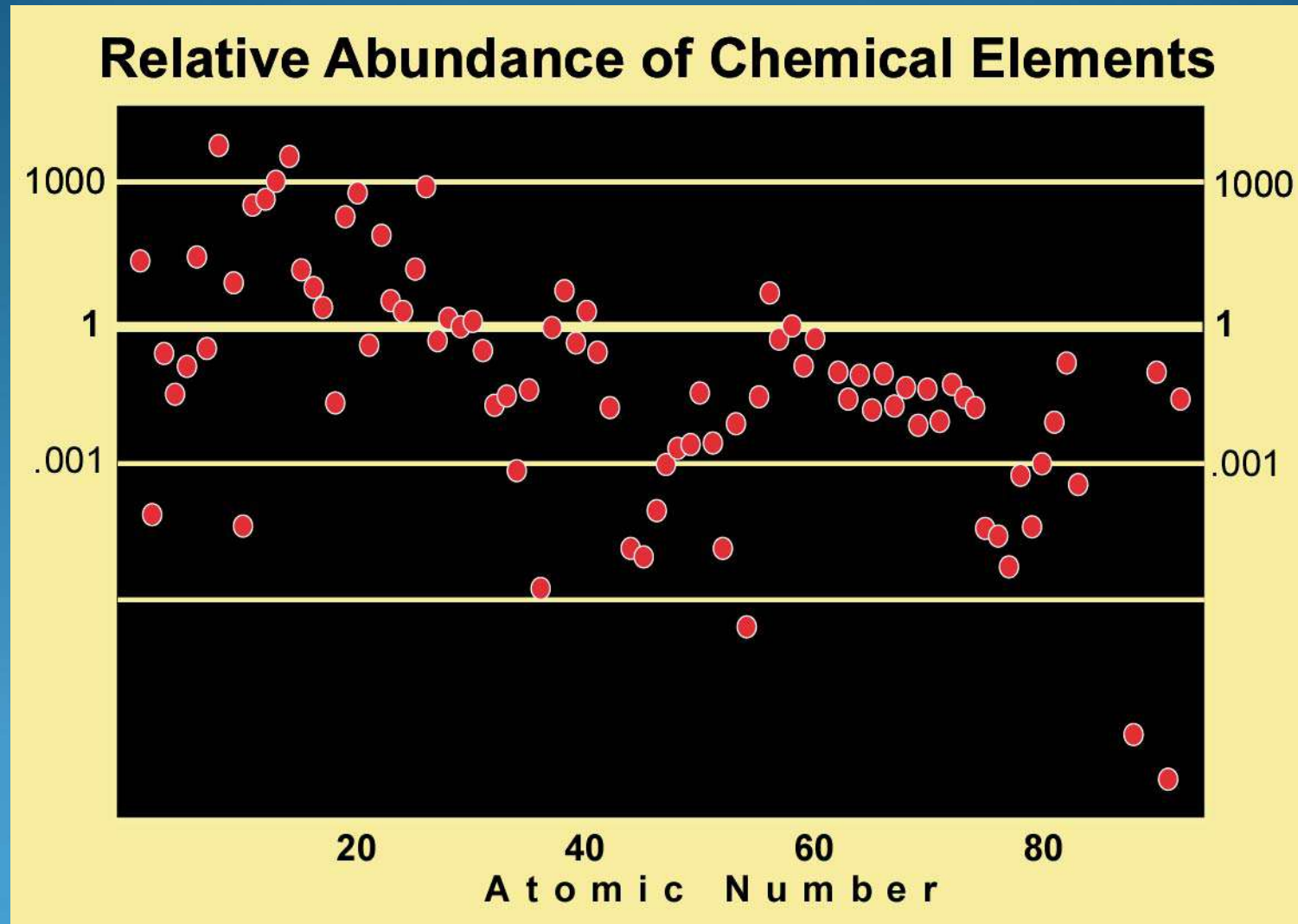
## Atomic Number

Arbitrarily pick copper as a reference element ( $A=1$ ).

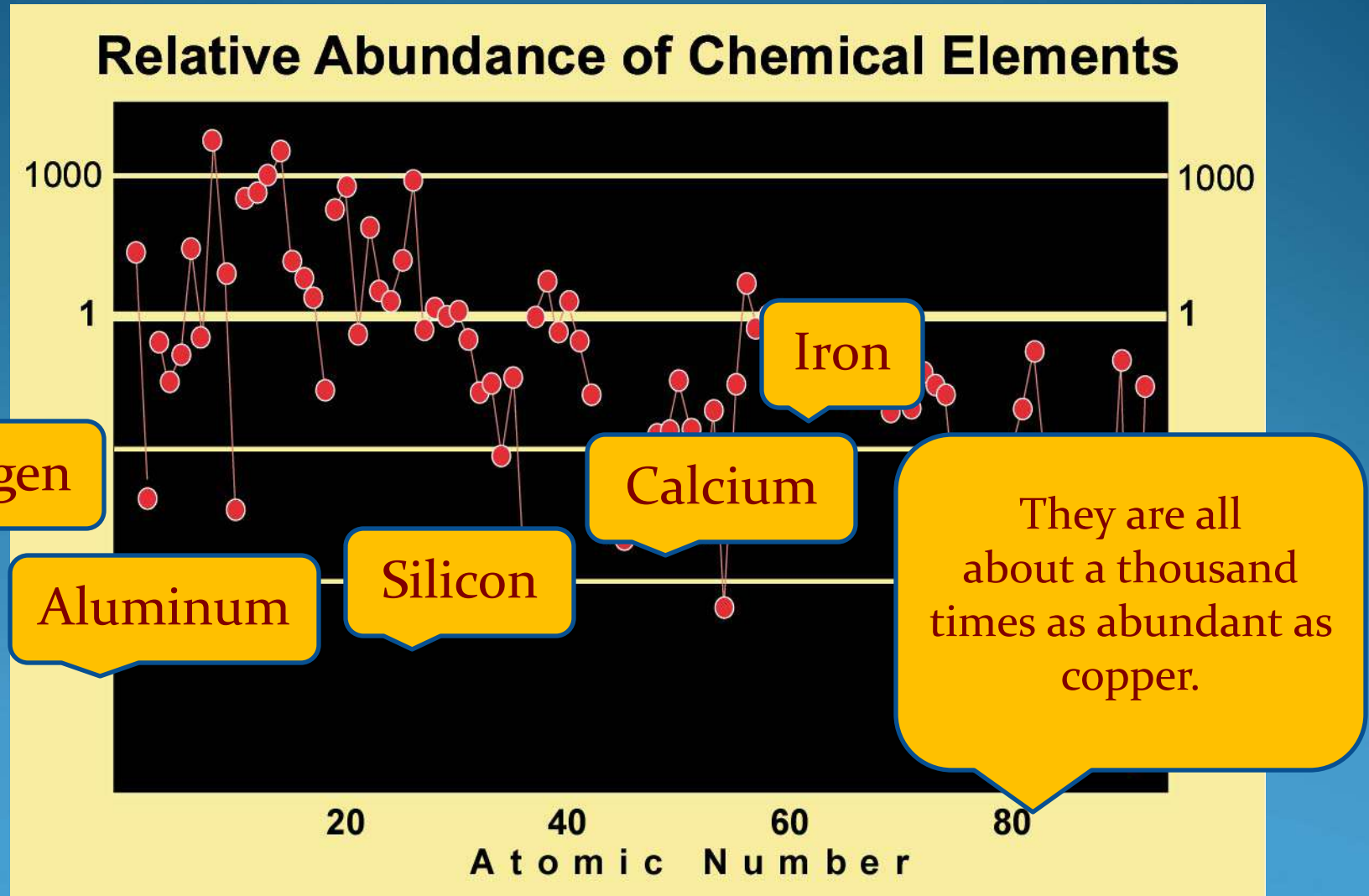
## Relative Abundance of Chemical Elements



Here they are. (No, this will not be on the quiz tomorrow!)

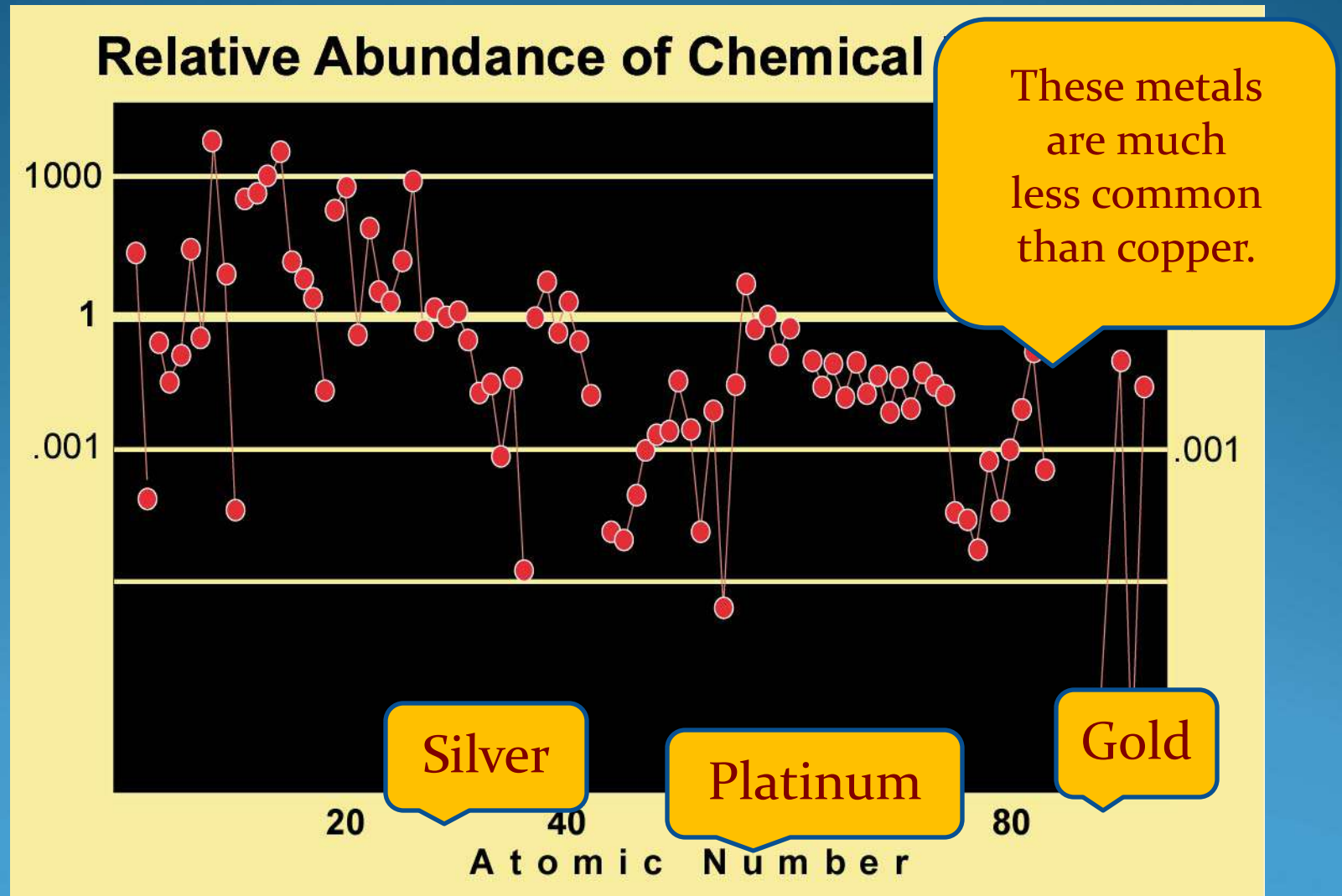


Here are the major rock-forming elements.

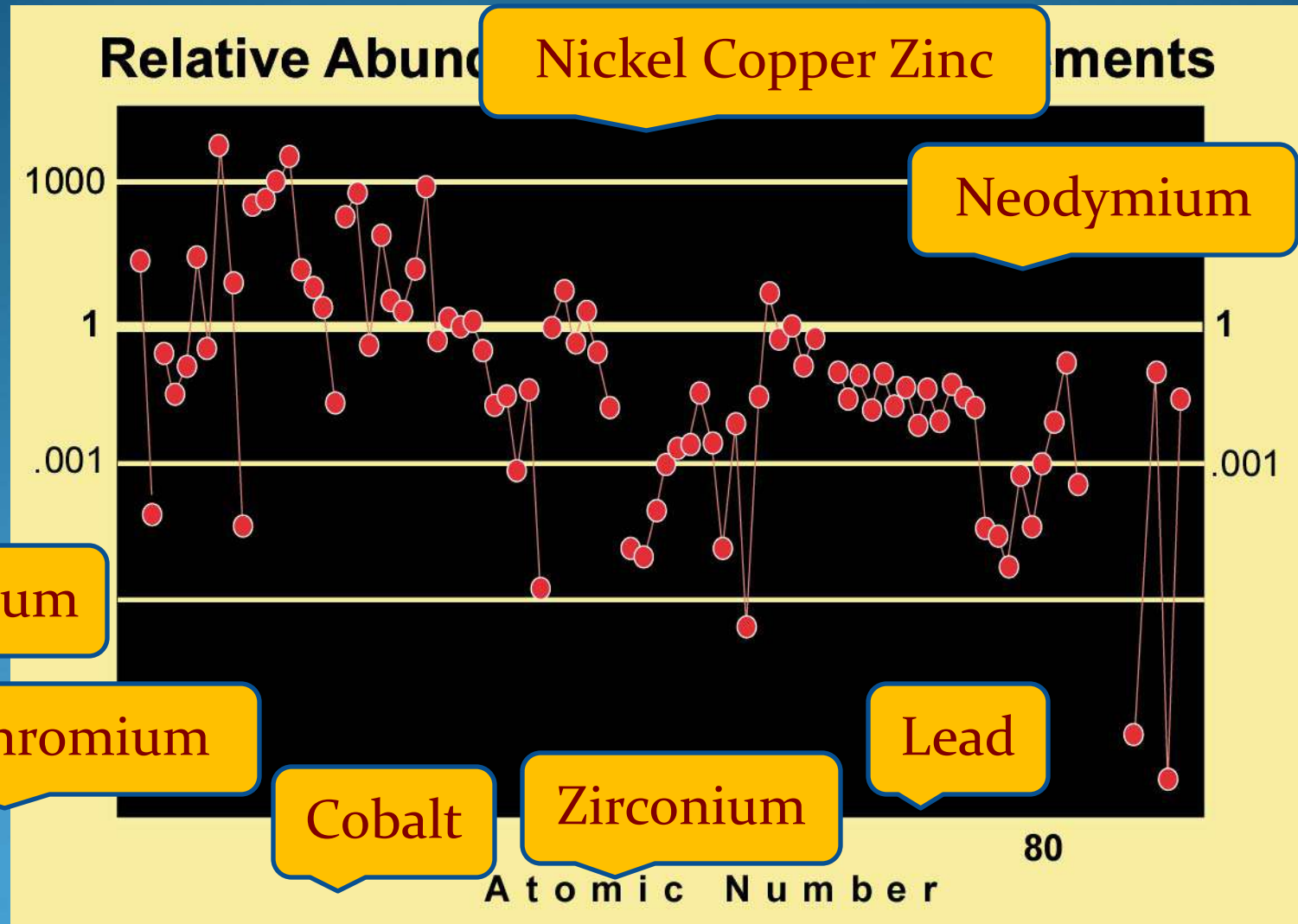




Here are some rare (and therefore valuable) elements.



Many industrial materials are about as common as copper.



What do gold, silver, platinum,  
iron, cobalt, chromium, molybdenum,  
copper, nickel, zinc, tin, lead,  
and most other metals  
have in common?

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They tend to occur in pockets, layers, veins,  
and other geologic structures  
where the metals are  
concentrated.

Neodymium  
and the other  
“rare earths”  
do not.

In the 1960s, the United States was the #1 producer of neodymium, which was used for

“6 major mines”

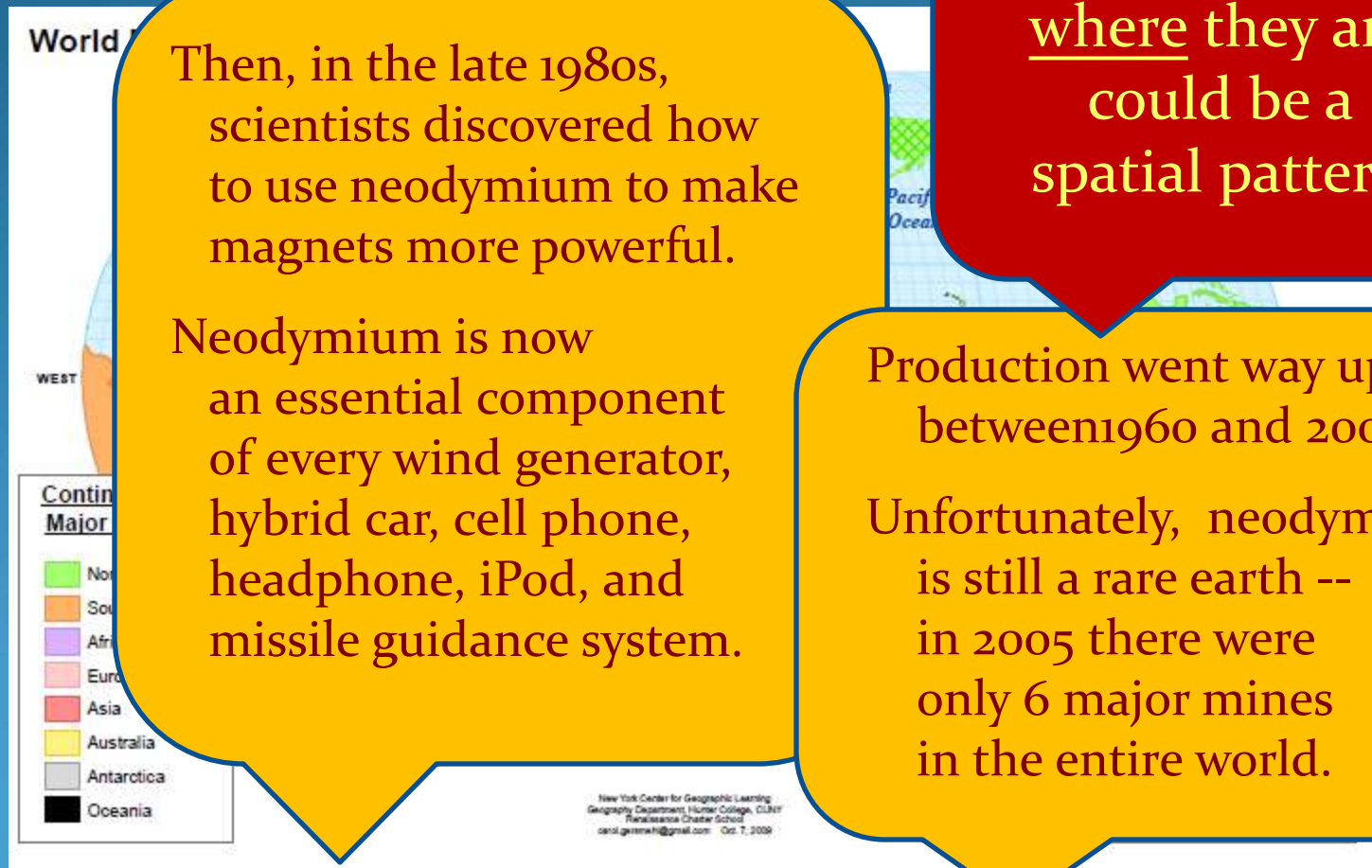
where they are  
could be a  
spatial pattern

Then, in the late 1980s, scientists discovered how to use neodymium to make magnets more powerful.

Neodymium is now an essential component of every wind generator, hybrid car, cell phone, headphone, iPod, and missile guidance system.

Production went way up between 1960 and 2000,

Unfortunately, neodymium is still a rare earth -- in 2005 there were only 6 major mines in the entire world.



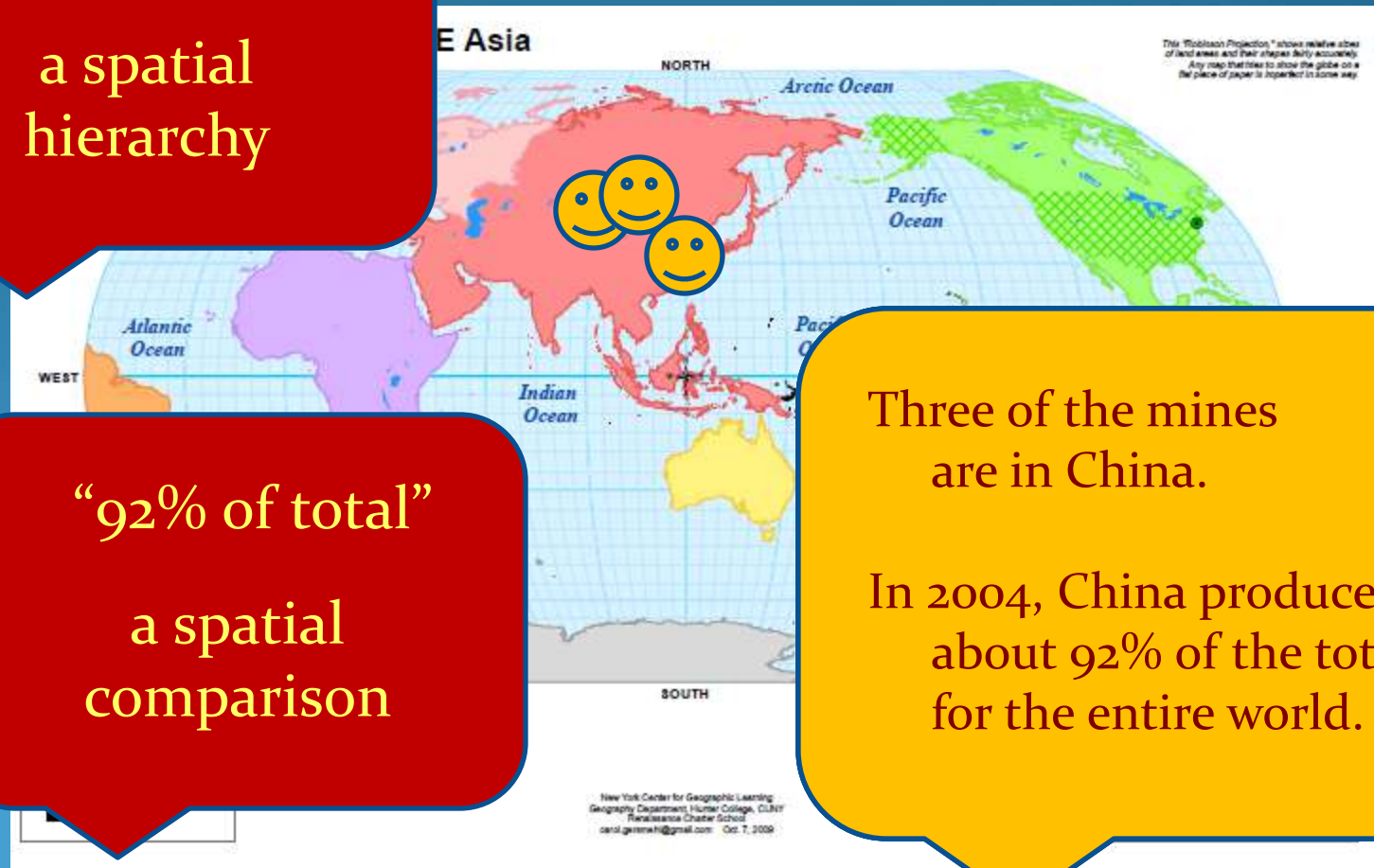
# Who is getting rich by mining neodymium?

“inside China”

a spatial  
hierarchy

“92% of total”

a spatial  
comparison

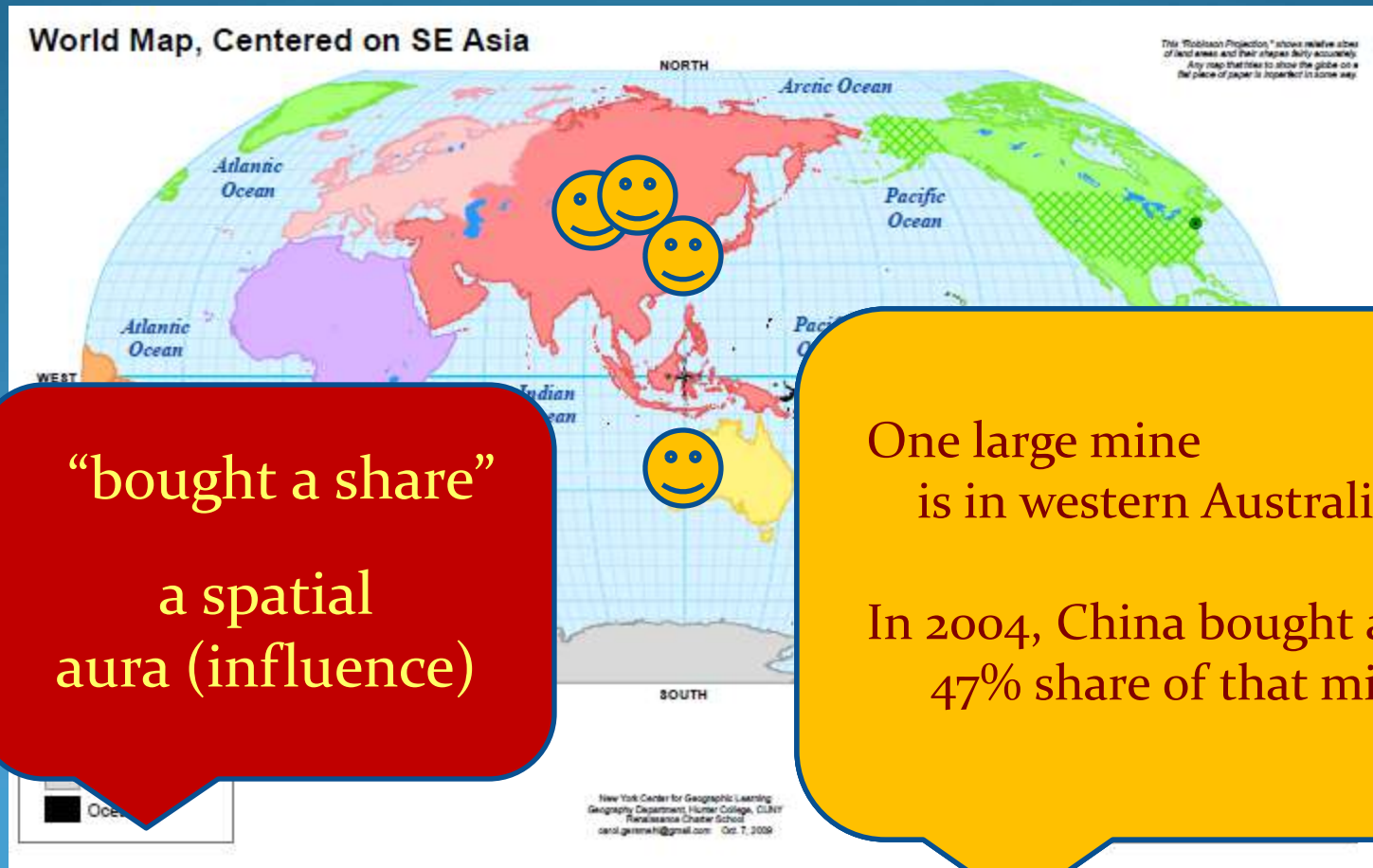


Three of the mines  
are in China.

In 2004, China produced  
about 92% of the total  
for the entire world.



# Who is getting rich by mining neodymium?



“bought a share”  
a spatial  
aura (influence)

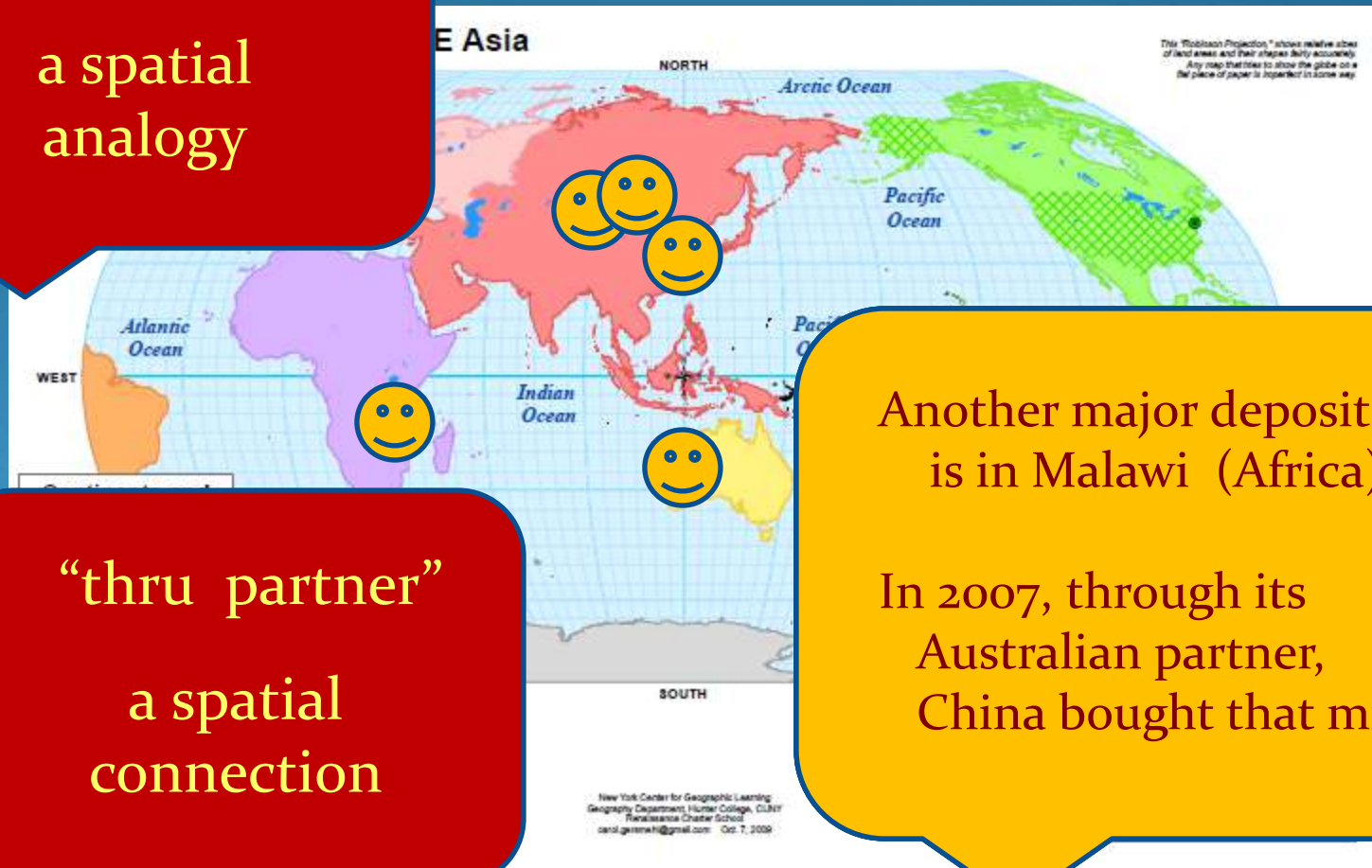
One large mine  
is in western Australia.

In 2004, China bought a  
47% share of that mine.

# Who is getting rich by mining neodymium?

“another deposit”

a spatial  
analogy



“thru partner”

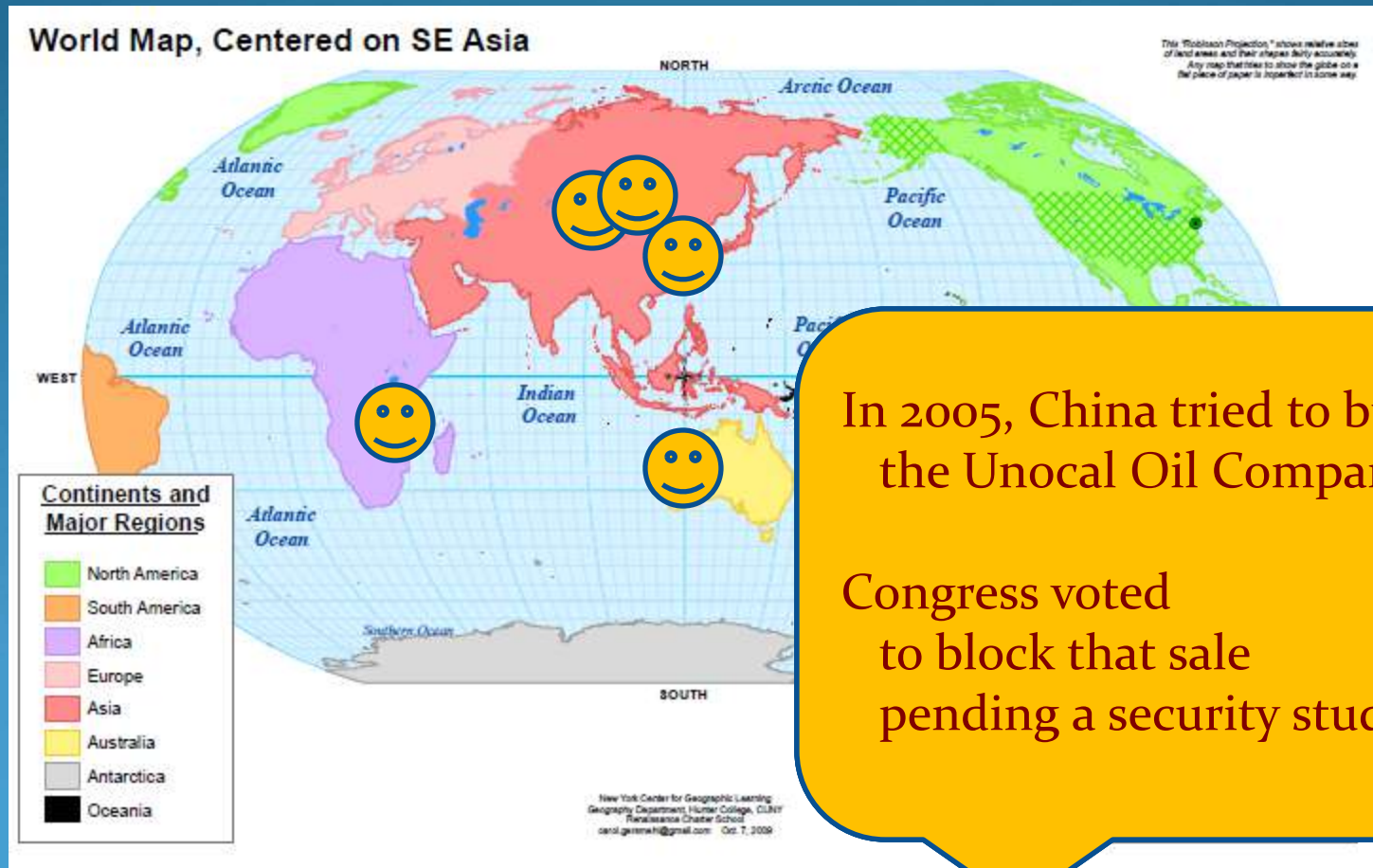
a spatial  
connection

Another major deposit  
is in Malawi (Africa).

In 2007, through its  
Australian partner,  
China bought that mine.



# Who is getting rich by mining neodymium?



In 2005, China tried to buy the Unocal Oil Company.

Congress voted to block that sale pending a security study.

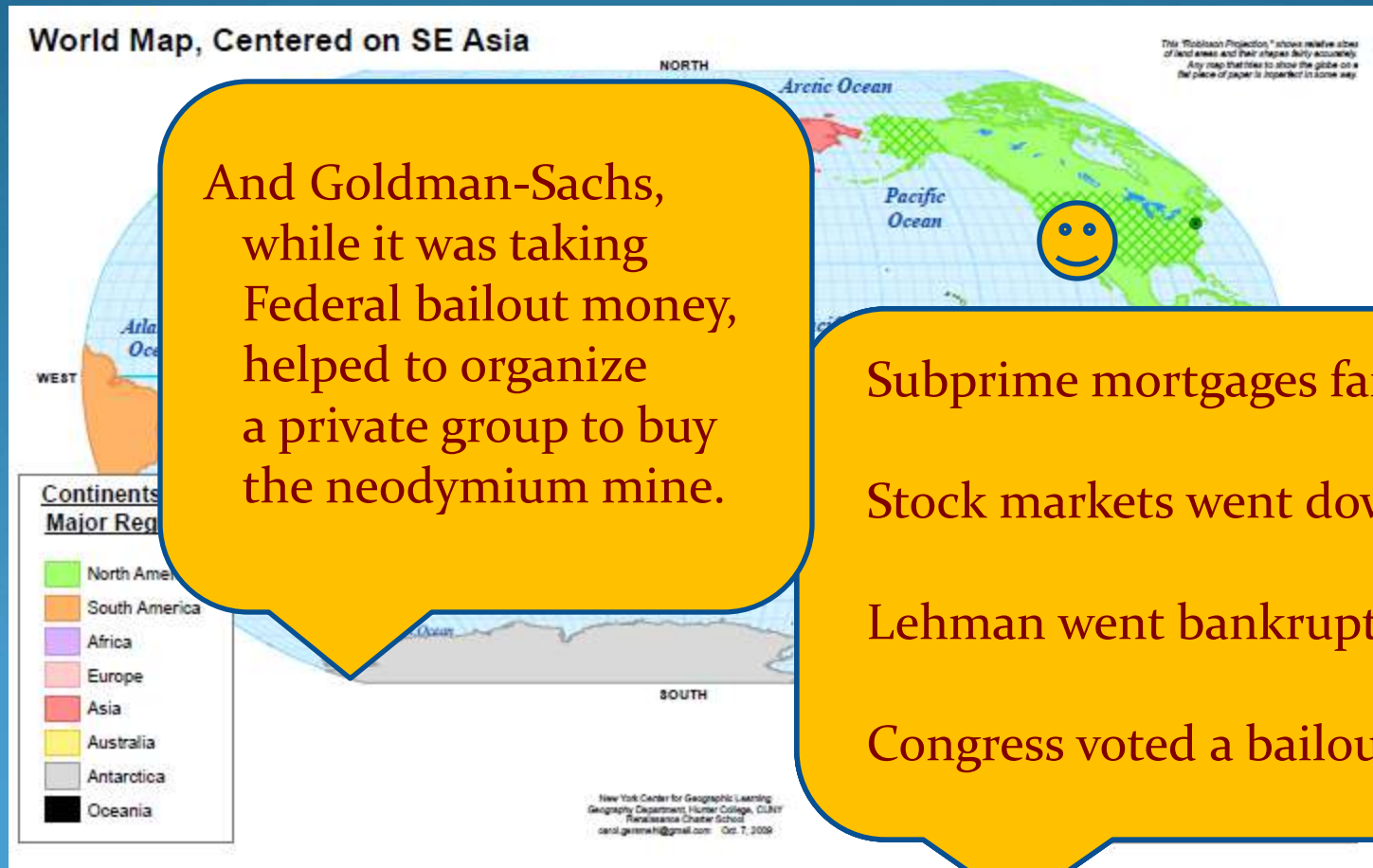
# Who is getting rich by mining neodymium?



NO ONE, at the time,  
noted that Unocal owned  
the last neodymium mine.

China withdrew its offer;  
Chevron bought Unocal.

# Who is getting rich by mining neodymium?



And Goldman-Sachs, while it was taking Federal bailout money, helped to organize a private group to buy the neodymium mine.

Subprime mortgages failed.

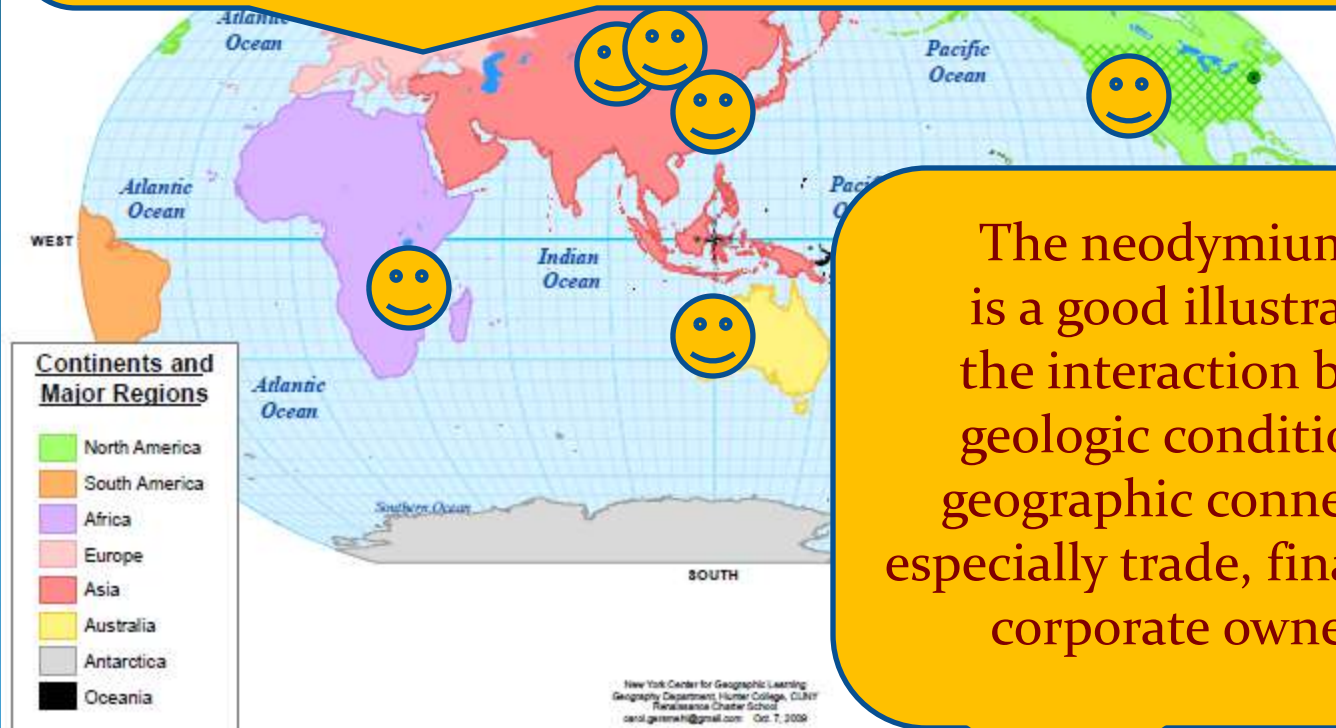
Stock markets went down.

Lehman went bankrupt.

Congress voted a bailout.

# Who is getting rich by mining neodymium?

P.S. the price of neodymium went up from \$6 to \$70, but you cannot buy any stock in the company, and you cannot find out very much about it, because it is no longer a public company.



The neodymium story is a good illustration of the interaction between geologic conditions and geographic connections – especially trade, financial, and corporate ownership.



## World Map, Centered on SE Asia

This "Robinson Projection" shows relative sizes of land areas and their shapes fairly accurately. Any map that tries to show the globe on a flat piece of paper is imperfect in some way.

