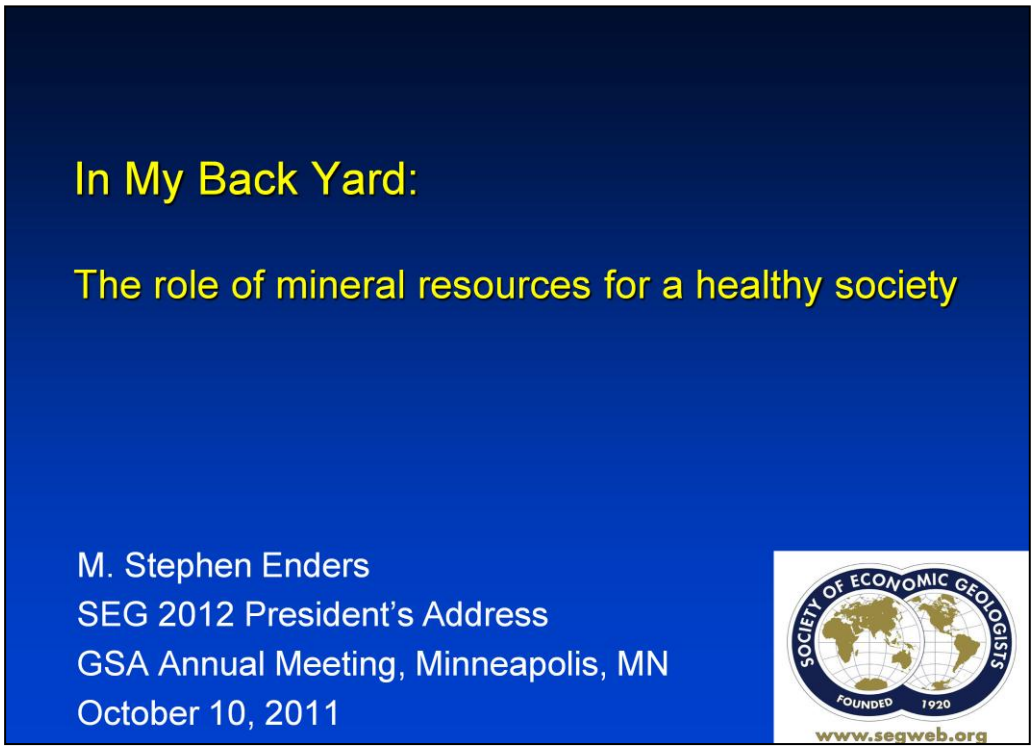


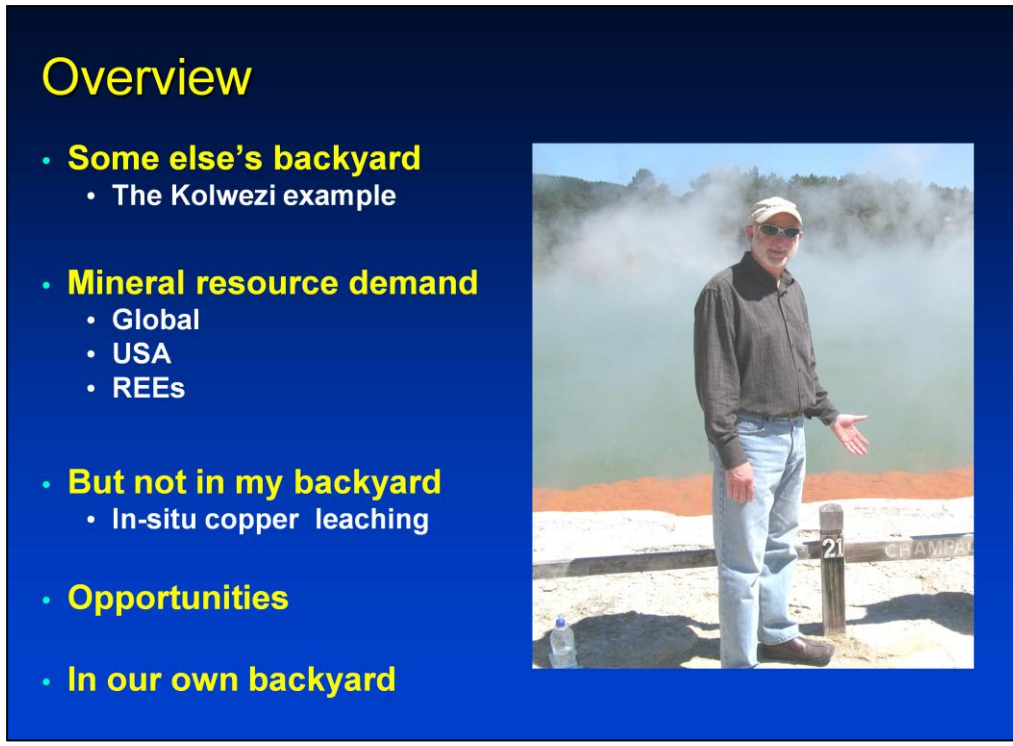

1) Good afternoon; and thank you to Eric Cheney and Cathy Skinner for generously agreeing to provide time in this interesting session for my SEG Presidential Address.

2) The topic of *"A Healthy Society, Geosciences, and Natural Resources"* is quite broad, and my mind went a lot of different directions searching for what I wanted to talk about today.

3) In the end, I decided to highlight the need for a civil, thoughtful and informed debate about the role of mineral resources for a healthy society

4) Simply put, I believe it's no longer morally or ethically responsible to maintain the high standard of living that most of us enjoy so long as it is "Not in My Backyard"!

5) In fact, I think there is a more urgent need to address issues around mineral resources & society than there is around global warming & society.



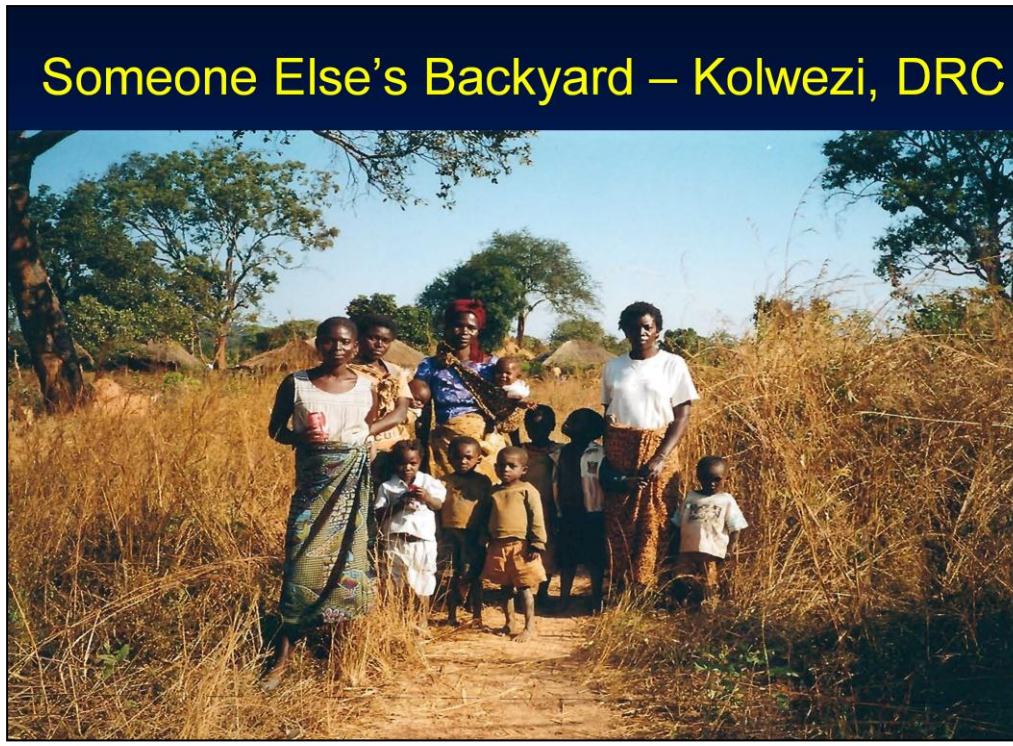

1) So this afternoon, I want to share my perspective on this with you based on a just a few examples starting with my experience several years ago at Kolwezi in the DRC.

2) Then, I want to talk about the fundamentals of mineral resource demand today, and a current example of classic not-in-my-backyard thinking going on in Phoenix, Arizona right now.

3) This all leads me to believe that there is a better way than this, and that we all need to start in our own backyard. This is all about perspective – yours, mine and the rest of society.

4) In this photograph, I'm standing in front of the Champagne Pool at the Rotorua Hot Springs in New Zealand. This is a gold deposit that occurs in a National Park. But the water quality is a mess – acid mine drainage-like and the air quality is impacted by sulfurous and carbon dioxide fumes. In another location and circumstances – perhaps this would be a superfund site!

5) It's a matter of perspective. I'll give you another example: When I was Chief Geologist at the Morenci Copper Mine in Arizona, my mother was taken back by the scale of landscape impact until I explained this was a rock-based manufacturing facility. Under that perspective, it seemed just fine…




1) This takes me all the way to the DRC in Africa where I ran into "someone else's backyard".

2) This is a photo of a very typical community in southern DRC and northern Zambia. It is extremely poor and mostly subsistence living. So poor, that I didn't even see any recognizable trash anywhere…

3) Nonetheless, the villagers were smiling, the children were playing and they gratefully accepted a few cans of coca cola that we handed out.


1. But they were living next to the huge Kolwezi mining and processing complex that the Belgians developed in the 1960's, the government of Zaire later nationalized, and was finally shut down in 2001-2003.

2. This complex consists of a huge open pit mine 2.5X1.5km, an underground mine – now flooded & collapsed, and processing facilities for oxide and sulfide ores that average about 6% Cu and 0.5% Co. Of course it is also associated with numerous waste dumps, tailings dams, and related facilities without any semblance of environmental controls.

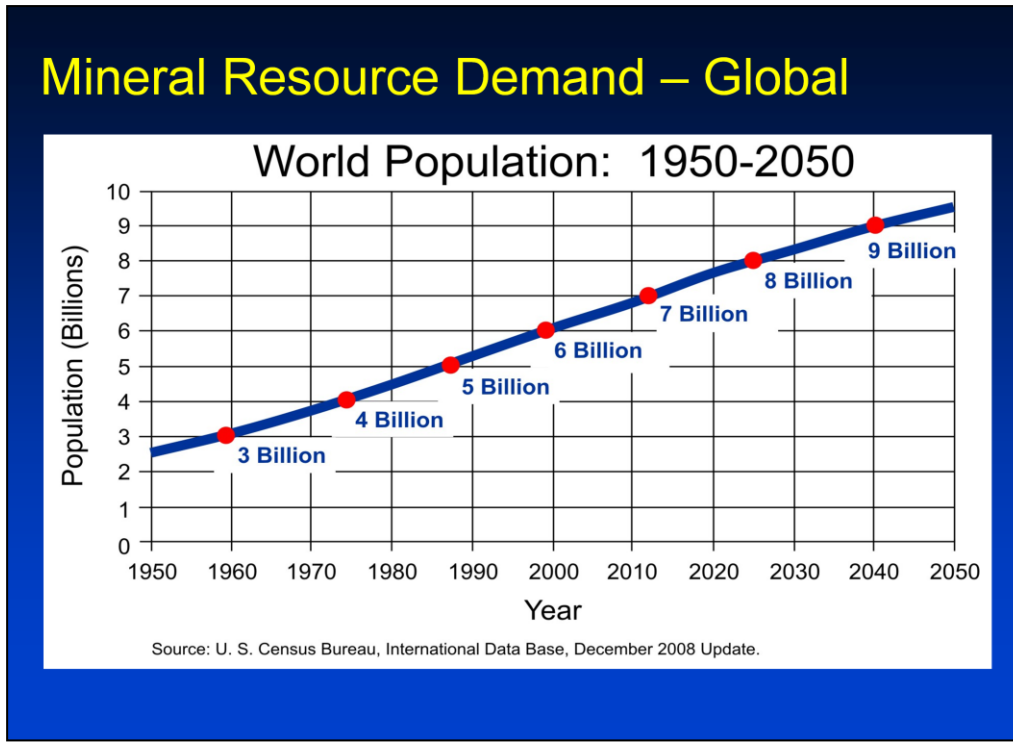
3. This place wasn't safe either. I saw barefoot villagers commuting across the pit from one village to another, and what few workers who were left wearing flip-flops, shorts, T-shirts and no hard hats or other PPE.

4. I was dumbfounded and realized that I had finally arrived in someone else's backyard. These people got all of the environmental and social impact, but little of the economic benefit. This is not a healthy society…

5. Many of us maintain a very high standard of living that is strongly dependent on foreign supplies of mineral resources, but we should not accept that it is OK so long as it is in someone else's backyard.

6. We defer responsibility for adhering to our own high-standards of environmental & social practice to other countries with much lower standards than our own.

7. And at the same time we restrict mineral development on public & private land with an attitude that we don't want to disturb our own environment or unsettle our own communities. **Simply put –we are importing the value and exporting the impact!**




1. Let's take a loot at mineral resource demand from a global perspective, one that has already been addressed by several other speakers in this session today.

2. From a fundamental perspective, the demand for mineral resources is not going to disappear – so we can continue to ignore the problem.

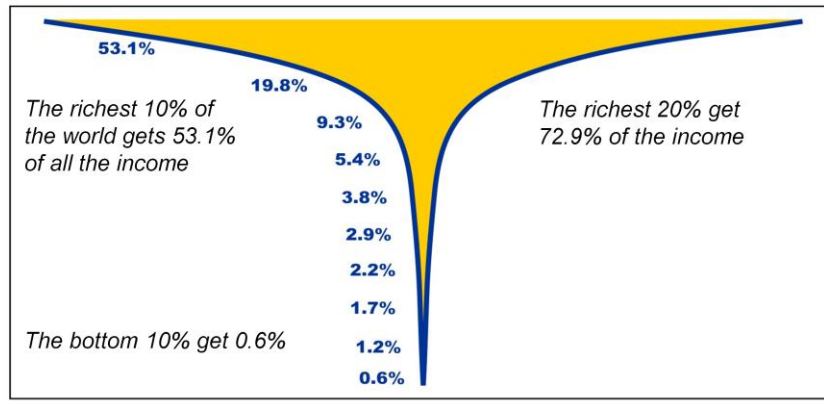
3. This chart shows a prediction of world population of 9 billion people by the year 2040.

4. Barring another global pandemic like the Black Plague, nuclear war or something even worse, society is going to have to explore for, develop and deliver the mineral resources required of an increasing population.

5. But, population growth is not the whole story.

# Mineral Resource Demand – Global

## Trends In Global Income Distribution 1970-2000 And Scenarios For 2015




Source: United Nations Development Program. Human Development Report Office Occasional Paper (2005).

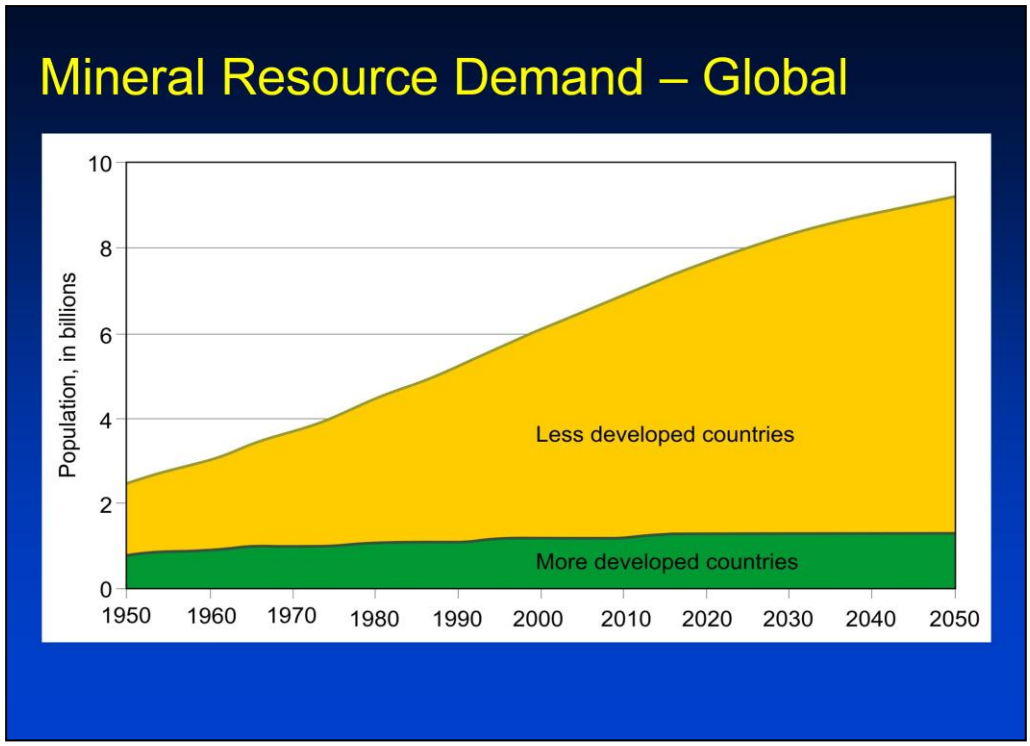
1. Its also about standard of living, or as Murray Hitzman pointed out – level of consumption.

2. This chart from the UNDP shows the distribution of global income for the period 1970 to 2000 considering scenarios through 2015.

3. What you can see is that the richest 20% of the world gets 73% of the income.

4. And the bottom 10% get only 6/10ths of a percent.

5. You all know what I'm getting at here… There will be an increasing demand by most of the world for a better and healthier standard of living.




1. This is the same graph of projected population growth that I showed two slides ago.

2. Only, now it shows the split between the more developed and less developed countries. So, it is not difficult to see the impact of both an increase in population combined with an increase in per capita consumption of mineral resources in the developing world.

3. The conclusion is that despite the vagaries of financial, political and economic cycles, the world will inevitably require more mineral and other resources. And, this will occur sooner, faster and stronger than any imagined impact from global warming!

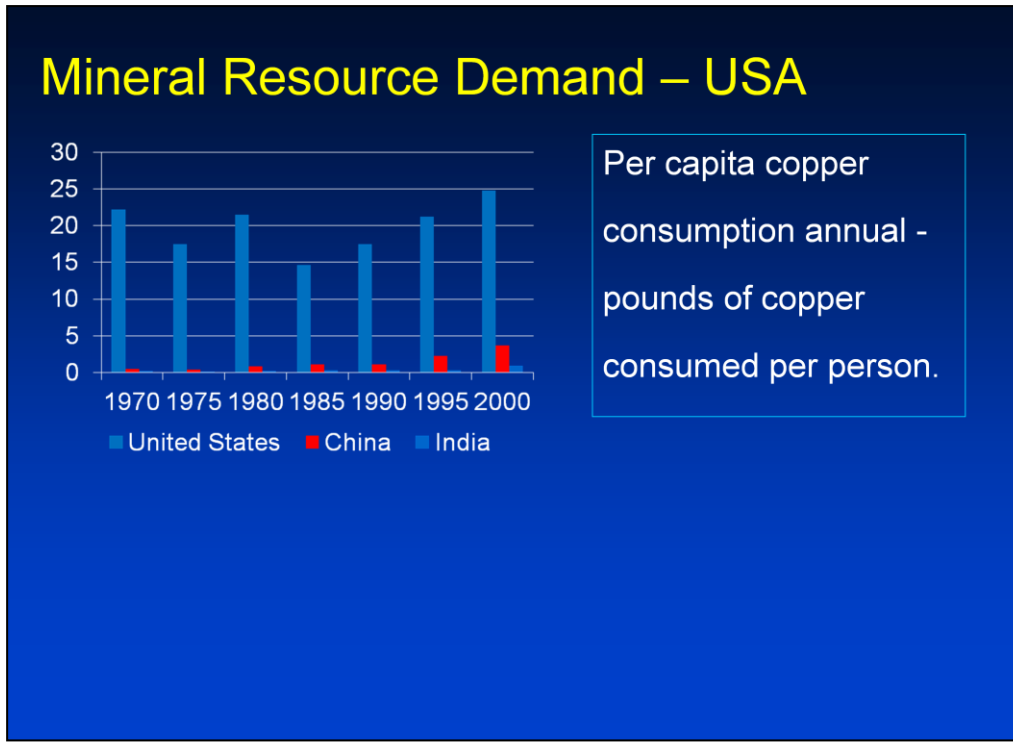
4. Let's take a simple look at the North American standard of living to get a sense for the order of magnitude of this demand.


1. I know many of you have probably seen this already in many different ways, but I still want to point out that every North American born today will depend on or consume 3.6 million pounds of minerals, metals and fuels over their lifetime.

2. How many of you own a car or house? Almost everyone in this audience…

3. I'll give you an example: the average automobile today contains about 50 lbs of copper in its motors, wiring and other components. And the average home contains about 400 pounds.

4. With this in mind, let's compare & contrast the USA's copper consumption to that of India and China…




1. This chart shows the per capita copper consumption in the USA relative India and China.

2. If the developing world consumes on the order of only 10% of what the typical North American does, you can easily imagine the accelerating demand for mineral and other resources even with a modest increase in either population or standard of living.

3. Here is another thing to think about: the world today consumes enough copper to deplete the reserves of any of our world-class copper mines in just one year.

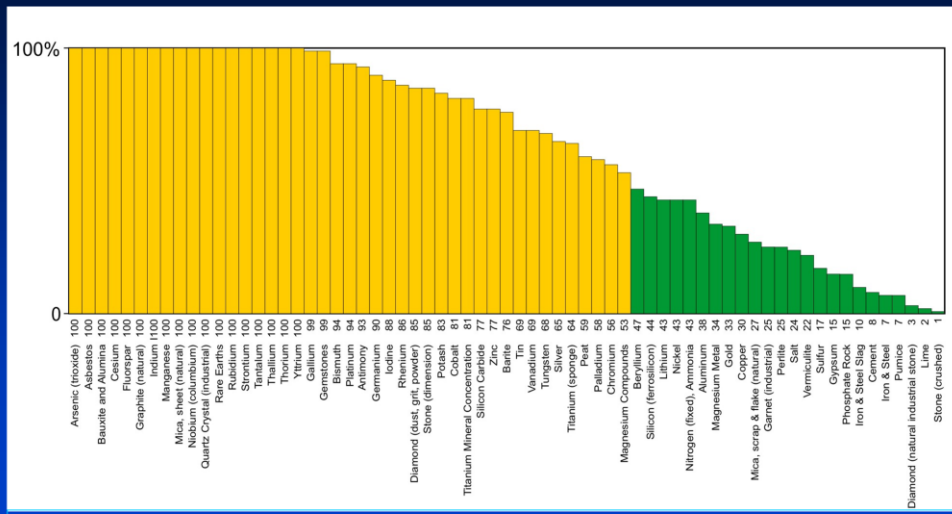
4. Yet, the average time to explore for, discover, develop, construct and begin operations at a new copper mine is 28 years!

5. We have our work cut out for us if we continue to do things like we have in the past, can you imagine the environmental and social impact.

6. But this may not really of much concern to us, of course, if the impact is in somebody else's backyard!

7. Let's talk about that for a moment…

# Mineral Resource Demand – USA




*From Mining Engineering 2010 Annual Review, Vol.63, No. 5, May 2011*

1. Today we are more globally interconnected and interdependent than at any time in human history.

2. And, our global supply chains for mineral resources are highly dependent on economic cooperation. So, let's talk about our own backyard for a moment…

3. This is a recently published chart from Mining Engineering's 2010 Annual review that illustrates the US reliance on foreign imports for 67 non-fuel minerals that are critical to our lifestyle.

4. This tells part of the story about just who's backyard mineral resources are coming from.

5. The yellow color highlights 43 of those minerals that we have to import to supply over 50% of our needs. These minerals are not just the rare & critical metals that we are suddenly hearing about over the past year or so.

6. They also include: minerals like potash, zinc, tin, tungsten, and magnesium.

7. And, we also import a substantial amount of nickel, aluminum and copper.

8. These are essential and fundamental mineral resources that are needed to sustain a healthy society.


1. I think the apparent REE crisis of late is a homerun pitch for us to hit one out of the park – and bring needed attention to the role of ALL mineral resources needed to sustain a healthy society.

2. Until recently, we imported 100% of our rare earth elements.

3. Although these are much more abundant than our press will lead us to believe, they are difficult to process, and the Chinese have kept prices artificially low to stifle competition and control the market.

4. What is so important is that these are "Enabling Metals" which are essential to many of our modern tools and technologies. Perhaps the "E" in REE should stand for "Enabling", which may be even more descriptive than Murray Hitzman's "Electronic" elements.

5. I show just a few of them as examples that we are relying on to help transform our energy and social footprint on the world.

# Mineral Resource Demand – REE's

*Amid Tension, China Blocks Crucial Exports to Japan*

Rare earth metals export ban, a Chinese own goal
Posted By Shiro Armstrong On 19 September 2011 @ 10:00 pm In China,Trade

Author: Shiro Armstrong, ANU

China briefly stopped exports of rare earth elements to Japan last year following a maritime collision near Diaoyu/Senkaku islands and the subsequent political fallout.

The reaction from Japan and other major buyers was alarm and protest as the metals are crucial to high-tech industries and China supplies over 90 per cent of rare earths globally (holding an estimated 37 per cent of the world's reserves).

1. But almost all of our rare & critical metals, and much of our other non-fuel minerals are mined in someone else's backyard! In fact, China produces 93% of the world's supply of REEs.

2. Although there are some minerals and metals that simply do not occur in abundance in North America, many of them do – but we continue to restrict development of them.

3. Given what happened over the last year with China's restriction of rare earth elements to Japan and the potential for that to happen to other countries, like ours, or for that to happen with other countries or minerals – **I'm not comfortable with that!**

4. I want more control over our destiny – and what happens in our own backyard!

5. So, just what is happening in our own backyard?

## But Not in My Backyard – In Situ Leaching

"Brewer hails acid-pumping mine" AZSTARNET Aug 4, 2011

"Suns owner will try to get Gov Brewer to change her copper mine position" BLOG Aug 16, 2011

"Underground acid mining threatens Florence communities" AZCENTRAL Aug 28, 2011

"Opponents contend Florence project may threaten groundwater"

1. There are so many examples to point to, but I want to focus on just one this afternoon.

2. Many of you are probably familiar with the rich endowment of copper mineralization in the earth's crust in the Southwest US and the legacy – both good and bad – of copper mining in Arizona.

3. There are a number of well known copper discoveries that have never been developed including the Posten Butte copper deposit near Florence, Arizona.

4. Well, there's a company there called Curris Resources who's trying to develop this deposit as an in-situ leaching operation, which is recovering metals without mining.

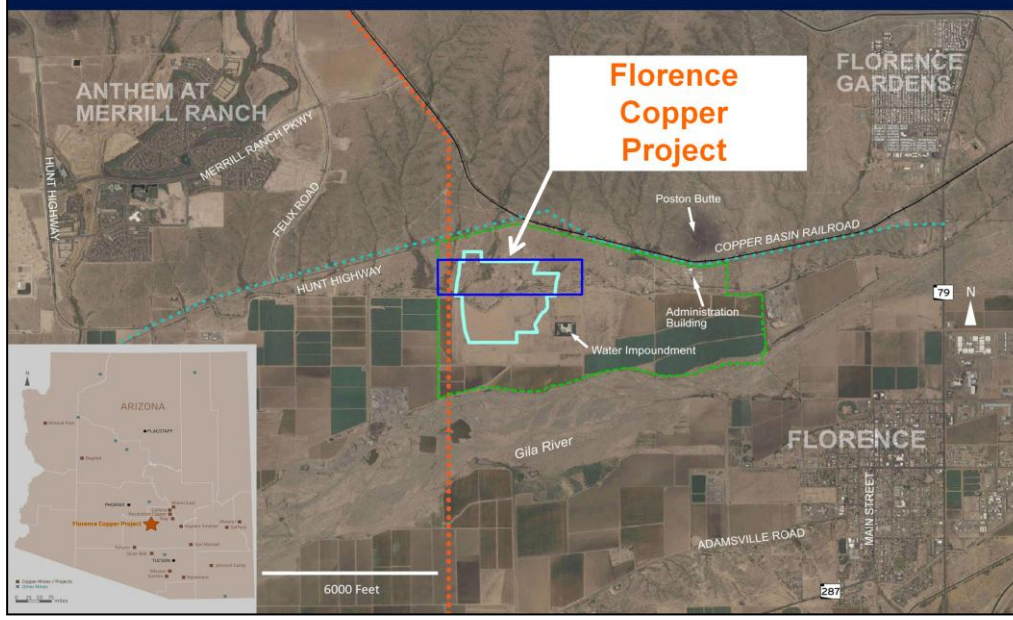
5. But, they've run right into the heart of the "Not In My Backyard" attitude.

6. Just watching the daily news and blogs, some of which I show here, you can see the tug and pull of the proponents and opponents to this proposed project.

7. Even the Governor and the Arizona State Land Department are in favor of this development. But as you can imagine, the real estate developers say "not in my backyard".

8. This is at once a simple and a complex situation. Just look at the bias in the first headline on this slide about Governor Brewer's comments. It looks like she is supporting acid-mine drainage rather than copper production.

# But Not in My Backyard – In Situ Leaching

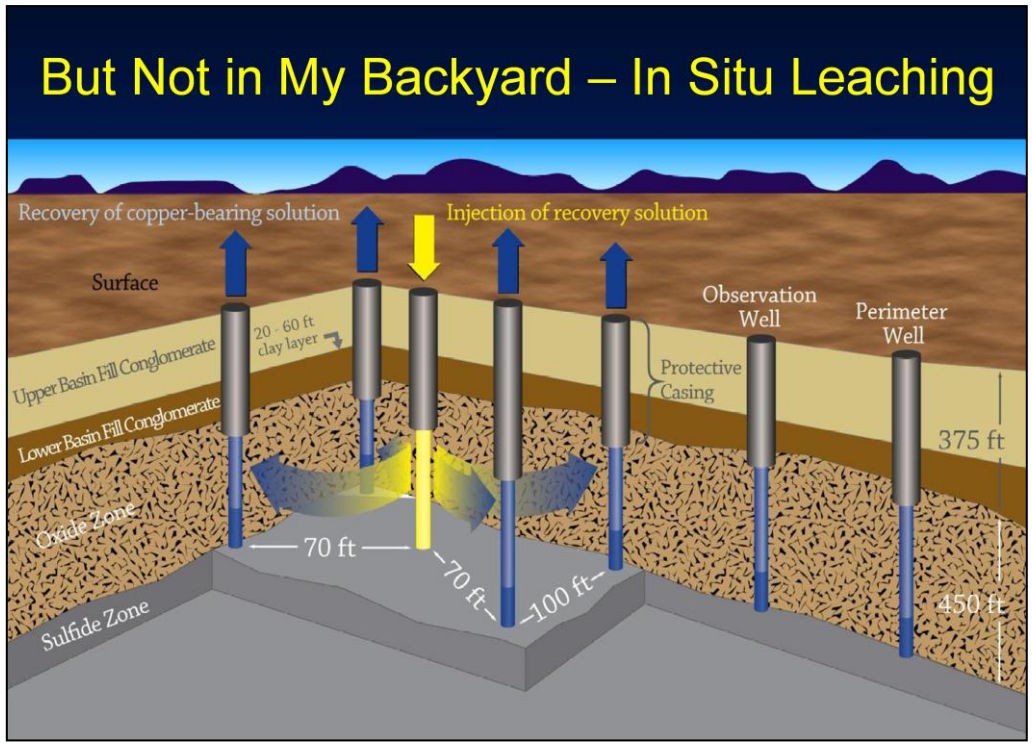



1. I'll give you a bit more background on this proposed project…

2. It's located south of Phoenix in central Arizona about 2 miles northwest of the town of Florence.

3. This area is primarily undeveloped desert and agricultural lands, that once were considered attractive investments during the real estate boom.

4. The simplicity is in how the operation would actually work…




1. This is a block diagram showing the development plan for the deposit, which would operate much like the uranium, potash, and salt in-situ leaching operations.

2. In this case, recovery solutions containing dilute sulfuric acid would be injected into the oxide copper zone, where they would dissolve the leachable copper minerals and then the copper-solution would be recovered in a network of adjacent wells and processed in a standard SX/EW plant.

3. I'm not necessarily supporting this particular project, because there is a lot of study yet to be done to demonstrate its technical, economic and environmental feasibility.

4. I do want to use it as an example of the foolishness of a "not in my backyard" attitude.

5. Here is a potentially outstanding opportunity to combine low-impact resource development and extraction, co-located next to one of the United States largest cities, where post mine use could be developed into residential or commercial real estate use, which was the original intent to begin with.


1. So, this brings me to the point of talking a bit about the opportunities for mineral resource development in a healthy society.

2. I firmly believe that “we can do much better”!. In fact, we have both an obligation and a demand from society to do so. How many of you think so, too?

3. I have a vision for the future, one that, frankly, is shared by more and more of us working on the cutting edge of responsible and sustainable mineral development. We range from researchers in academia to a variety of professionals in both small and large companies.

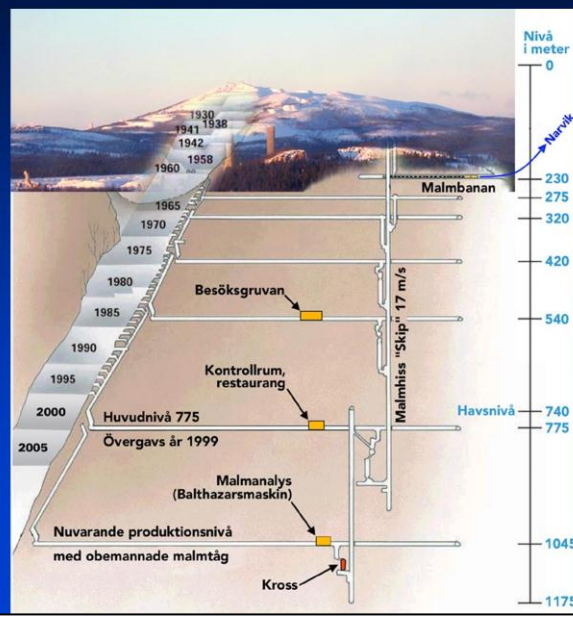
4. The concept here, to put this a bit in medical terms, is to transition our society from butchering our ore deposits and surrounding lands to provide the mineral resources on which we survive…

5. To one of being more of a surgeon about this, extracting only the valuable minerals and metals from the earth’s crust, leaving a healthier planet behind.

6. Of course, this takes more technology and specialists. It will take research & development, and most importantly innovation.

7. But society needs to be aware, that just like health care, there will be an ever increasing cost to provide those mineral resources, and it will have to be willing to pay for them, and develop them – even if it is in their own back yard..

# Opportunities – Kiruna, Sweden




Automation

Selective mining

Underground processing

1. So, this is already being done to some degree in a number of mining operations around the world.

2. This is an example of automated underground mining  from the Kiruna iron mine in northern Sweden.  This particular ore body is amenable to large-scale underground mining where the mine operators work in offices at the surface.

3. It is entirely possible, that some mines could also be developed such that much of their mineral processing is done underground.

4. Even today, many mines now dispose of some of their tailings from mineral processing underground.

5. All of this is to reduce the environmental and social footprint of the mining operation, while keeping operating and capital costs to a minimum, such that we can continue to provide the mineral resources to society in a sustainable and economic fashion.


1. But let's not fool ourselves with unrealistic expectations.

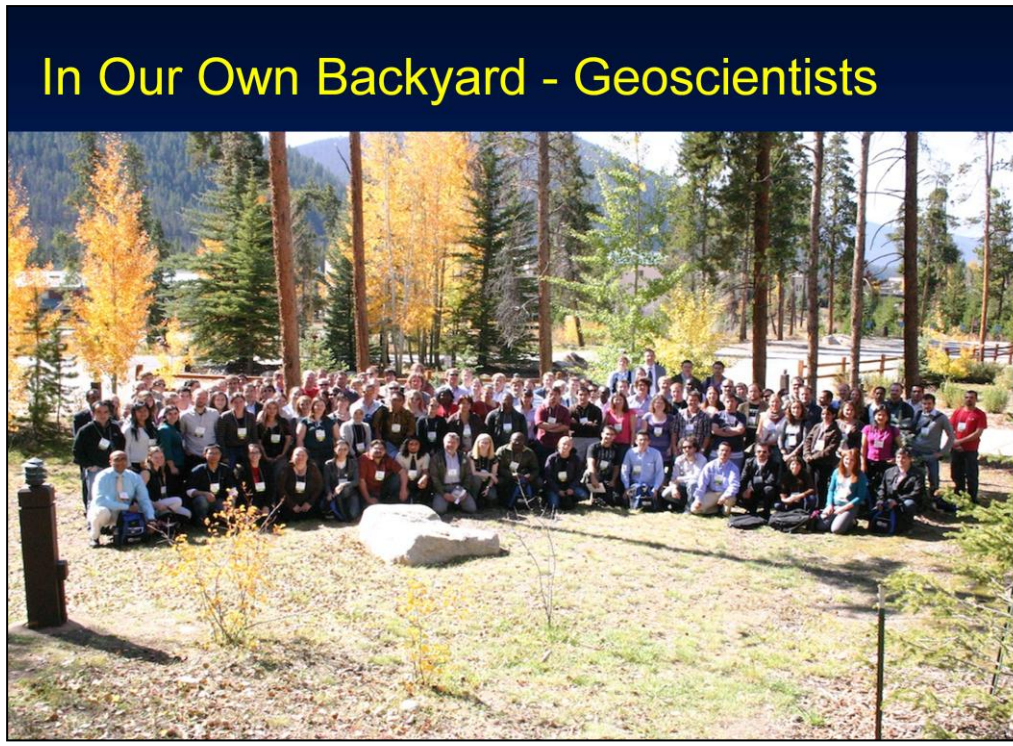
2. All mining, particularly surface mining, makes an irrevocable impact on the environment and social fabric of the locations we work in. For that matter, modern society does, too!

3. This does not have to be negative though, if well thought out and planned with appropriate input from the direct stakeholders and society in general about the tradeoffs in doing so.

4. Although I understand the concept of environmental protection, mineral resource development is about environmental stewardship – not protection (although we do so as part of our stewardship. And that includes stewardship of the mineral and the human resources in our global environment.

5. What lies beneath this somewhat bucolic view Newmont's Martha mine and operations in Waihi, New Zealand is not just the gold.

6. It also represents the underlying conflict, debate and consensus that mineral development and society can co-exist in the same community.




1. Coming back to SEG and GSA, this is the photo we took at the 2010 SEG Keystone meeting last year. Economic geologists are not the only professionals in the geosciences that concern themselves with mineral resources.

2. In fact, every geoscientist inherently deals in mineral resources. We either use them, study them, search for them, or produce them.

3. Some of you may know that the whole science of geology and related fields started with a search for understanding of the coal seams and geotechnical conditions for building canals in Britain in the 19th century.

4. Nothing has really changed that basic kind of need. It is only a larger and more complex situation in today's modern world.

5. I believe we have an obligation to tell the public why mineral resources are important, where they can be found, and how they should be produced – in a sustainable manner that maximizes the benefit to society.

6. I believe that we also have an obligation to support our universities and research institutions that provide education and conduct research in the fields of economic geology, mining and related disciplines.

# In Our Own Backyard - Individuals

1. Geoscientists have a rather unique view of our planet and the world in which we live.

2. Given our training and understanding of earth systems, I believe we need to bring awareness, common sense and good science to the debate about the role of mineral resources in a healthy society as both a moral and practical obligation.

3. And we must do so by clearly communicating and providing explanations that everyone can understand.

4. If we continue to communicate with society using technical jargon or arrogantly dismissing them as science-phobic or anti-development, then we will continue to lose our moral foot-hold with the public, and this minerals “crisis” will get even bigger…


1. As we look at another example of the co-existence of mineral resource development and society, in this case in Kalgoorlie, Australia, I want to close with an interesting thought:

2. Not in my backyard thinking in the US and elsewhere may end up having precisely the opposite effect.

3. As the developing world continues to expand its consumption of mineral resources, and the supply continues to lag behind, partly because of this attitude, then the supply and demand imbalance may continue to widen.

4. In history, this always ends up creating social and geopolitical conflicts like resource nationalization, expropriations, or even wars. And, the US and other developed countries may find themselves locked out of foreign sources of minerals.

5. The result could be a rush to develop internal resources....and out of necessity an abandonment of environmental and social rules we have today, just to speed the process.

6. This could be avoided with rational, timely, and thoughtful development of resources rather than simply saying no to any development. What ever happened to the USA's own approach to resource nationalization?

7. Now here is the kicker, if we get it right, we can then export our technology and share the benefits instead of keeping the benefits and exporting the impact.

8. **Let's start in our own backyards. It is a way towards a healthier society.**