Geoethics Issue Starter

Title: The Grey side of Green

Dilemma

How do we evaluate the impacts and tradeoffs for green technology development and the supply and demand patterns for rare strategic minerals?

Background

Emerging energy efficient and renewable energy technologies increasingly rely on the properties of rare minerals. Rare earth minerals are 17 elements in the periodic table which have desirable chemical properties in alloys and new materials. A typical electric vehicle uses 4.5 kg of rare earth materials. Often the suppliers for these materials are outside of the US due to the location of mineral deposits, or due to the economics of extraction, cost of labor, environmental regulations, or government policies. Some of the key elements are listed below.

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| Element | Uses | Supply | Issue |
| Indium, gallium, tellurium | Photovoltaic coatings  Transparent conductors for thin film plastic solar cells | China, (In)  US, Peru (te) | Byproduct of zinc refining |
| Dysprosium, praesodynmium, neodymium | Magnets for wind turbines, automobiles, dysoprosium allows magnets to work at high temperatures | China provide 98% of dysprosium. | Pollution, wastewater, 1 ton=>2000 tons of toxic waste, export quotas |
| Lanthanum, cobalt, cerium, niobium | Batteries, phosphors for lighting, catalytic converters | Congo, brazil | Bioaccumulators |
| Terbium, europium, yttrium | Phosphors for energy efficient lighting | China, US, India, Sri Lanka, Australia (te) |  |
| lithium | batteries | 50% from northern Chile | Exracted from brine, Uses 2/3 of available freshwater, copper and aluminum are bigger impact |

Perspectives to consider

**Climate Change and Energy**- Renewable energy is needed to provide long term energy supplies, and in the short term to slow the process of climate change.

**The environmental impacts of resource extraction**- The mining, refining, and disposal of the tailings. Though the total amount of these elements that are produced are comparatively small much ore must be mined and processed and often there are other toxic metals which are released in the process.

**Security of resource supply**- many of the supplies are concentrated in a few countries. Some elements are extremely rare.

**Economic benefits**- new technologies and make 21st century jobs and reinvigorate resource extraction industries by changing commodities

**Social justice**- In a global economy impacts and benefit may be far separated.

**Lifecycle issues**- Electronics produce enormous amounts of ewaste and difficulty with recycling, green technology may have same issues at the end of the useful life.

Links

The Future of Strategic Mineral Resources <http://web.mit.edu/12.000/www/m2016/finalwebsite/problems/supplydemand.html>

Rare earth mining in China: the bleak social and environmental costs

[www.theguardian.com/sustainable-business/rare-earth-mining-china-social-environmental-costs](http://www.theguardian.com/sustainable-business/rare-earth-mining-china-social-environmental-costs)

Pay dirt: why rare earth metals matter to tech

<http://www.cnet.com/news/pay-dirt-why-rare-earth-metals-matter-to-tech-faq/>

Rare Earth Elements: A Review of Production, Processing, Recycling, and Associated Environmental Issues- US EPA

<http://reviewboard.ca/upload/project_document/EA1011-001_US_EPA_-_Rare_Earth_Elements_-_Associated_Environmental_Issues.PDF>

US DOE- Strategic Minerals Strategy

<http://energy.gov/sites/prod/files/DOE_CMS2011_FINAL_Full.pdf>

Sustainability of Rare Earth Minerals

<http://www.mdpi.com/2075-163X/3/3/304/pdf>

Social Benefits of Clean Energy

<http://www.seedengr.com/Socio-economic%20benefits%20of%20Renewable%20Energy.pdf>