



# Mining and Metallurgical Society of America

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## Minerals For A Green Society

February 4, 2010 -- Washington DC

Location: Cosmos Club

2121 Massachusetts Ave., NW, Washington DC 20008.

### Introduction, Agenda and Speaker Summaries

*The mission of the Mining and Metallurgical Society of America (MMSA) is to raise awareness of the modern minerals industry and its critical role in enabling society's transition to a green economy and a sustainable future. MMSA makes no formal policy recommendations, but is committed to providing and directing policy makers to reliable sources of information and expertise about the domestic minerals industry. The purpose of this symposium is to facilitate informed discussion and interchange on the issues of importance to a viable U.S. Economy.*

#### SYMPOSIUM MISSION

1. Identify the individuals and organizations that are responsible for the collection, analysis and dissemination of mineral information;
2. Bring them together with producers and consumers of minerals, and with policymakers who influence the security of domestic mineral supply;
3. Bring attention to deficiencies in the nation's mineral security and information infrastructure and make recommendations for corrective action; and
4. Promote the ongoing exchange of information among these individuals and organizations.

The symposium focuses on the need for and availability of minerals in the development of a 'green society,' whether it be by use of solar, wind, other types of renewable energy, and critical minerals needed for modern technology and infrastructure.

The goals of the meeting are to:

- Highlight facts about minerals that are critical for our changing society, including potential vulnerabilities for the U.S. from disruptions in global supply,
- Discuss the relative roles that primary (virgin ore) and secondary (scrap) materials currently play in meeting demand, and
- Provide an opportunity for networking among individuals who are concerned about mineral-supply issues and who can take action to assure U.S. competitiveness in a green economy.

The security of this nation's mineral supply has always been a matter of primary focus for MMSA. Assessment of that security requires timely and reliable information about mineral supply and use. A number of MMSA's founders and early members were pioneers in the collection and distribution of mineral information. MMSA member Rossiter Raymond was one of the first United States Mineral Commissioners, and was noted for his comprehensive reports on mining in the western regions of the United States in the 1860's and 1870's. Raymond was also a mining journalist who helped develop periodicals that were essential to disseminating information about mining technology and commodity market statistics. MMSA was also a key proponent of creation of the U.S. Bureau of Mines, an agency of government that would conduct research and provide mineral information of many types.

Over the years, mineral supply issues have changed to reflect changes in industrial and military requirements. Government's role in the collection, analysis and dissemination has also changed, particularly since the closing of the U.S. Bureau of Mines. Mineral supply and use information is now gathered by a number of private and public organizations, but analysis and dissemination of that information is fragmented. While the USGS Minerals Information is recognized as the "premier source of mineral information...the quantity and depth of data have been reduced in recent years." (NRC Report: *Minerals, Critical Minerals, and the U.S. Economy*).

MMSA will continue to focus the energies of its members on mineral supply issues, and the need for a competitive, as well as socially and environmentally responsible domestic mining industry. To that end, MMSA organized this symposium to discuss the issues involved in ensuring a secure supply of minerals to the nation. Particular emphasis is placed on the minerals key to the feasibility of emerging green technologies and renewable energy sources, as well as measures necessary to decrease our reliance on foreign sources.

The principal purpose of the symposium is to identify the individuals and organizations most directly involved in minerals supply and use matters, and to promote better communication among them in the future. A secondary purpose of the symposium is to emphasize the need for robust institutional arrangements for securing, analyzing, and disseminating mineral information *and* that well-educated materials and resource professionals are essential to maintaining this information and fostering the technological innovation that will be required to transition to the New Green Economy.

### **About MMSA:**

The Mining and Metallurgical Society of America is a professional organization dedicated to increasing public awareness and understanding about socially and environmentally responsible mining practices, that mined materials are essential to modern society and human well-being, and that the minerals industry has a key role to play in enabling society's transition to a sustainable future. Since its inception in 1908, MMSA has provided valuable information and guidance to federal, state, and local governments on a number of important public policy issues dealing with mining. MMSA also makes substantial contributions to educational programs that develop K-12 curriculum about how minerals are used and produced, and collaborates with other minerals industry organizations to support the training of the next generation of minerals and materials industry professionals through its Presidential Scholarship program.

**Session 1- Opening and Overview - Minerals we need and where we get them  
(9am - 10:30am)**

*Chair: Jon Price*

<b>Content</b>	<b>Presenter</b>
Opening Statement	<i>Mark Jorgensen, Vice President, MMSA</i>
Why We Are Here	<i>Jonathan Price, State Geologist and Director, Nevada Bureau of Mines and Geology</i>
Keynote - <i>Global Scramble for Natural Resources - Its Impact on Americans</i>	<i>Dr. Vince Matthews, Director and State Geologist, Colorado Geological Survey</i>
<i>The Mineral Footprint<sup>TM</sup> of Green Choices</i>	<i>Dayan Anderson, President, Mineral Footprint Network</i>
<i>Minerals, Critical Minerals, and the U.S. Economy</i>	<i>Dr. Roderick Eggert, Professor and Director, Division of Economics and Business, Colorado School of Mines</i>
<i>Key Mineral Information</i>	<i>Kate Johnson, Program Coordinator, Mineral Resources, U.S. Geological Survey</i>
Coffee Break (10:30-10:50)	

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# The Global Scramble for Natural Resources--Its Impact on Americans

By

Vincent Matthews, Ph. D. State Geologist of Colorado  
Director of the Colorado Geological Survey



## *Keynote Presentation to Minerals for a Green Society*

- Most of the world's economies are increasing their use of energy and mineral commodities, but China's unparalleled economic growth is a major driver in the increased consumption of natural resources.
- The world is depleting its natural resources at an exponential rate (50% of all copper mined and 50% of all oil consumed since 1985).
- Spot prices of minerals and mineral fuels escalated more than the price of crude oil between 2003 and 2008.
- America suffered a largely hidden, natural-resources-driven inflation between 2003 and 2008 that is already being renewed as natural-resource-commodity prices resume their upward trend.
- The supply of conventional fuels (coal, uranium, oil, & natural gas) that provide 94% of the nation's energy will become much more difficult for America to obtain during the next decade because of increased global competition for scarce supplies.
- Alternative energy technologies require minerals that are increasingly in short supply to America.
- China's strategy of assuring its supply of natural resources, threatens America's future ability to obtain the raw materials it needs.
- Pressure to develop America's remaining natural resources will probably increase dramatically as global supplies tighten.
- Americans are largely unaware about how vulnerable our nation is.
- America should try to extract itself from the current advocacy-oriented lack of an energy policy and begin a realistic dialogue/education effort about the global natural resource situation that exists, and viable options to deal with looming shortages.

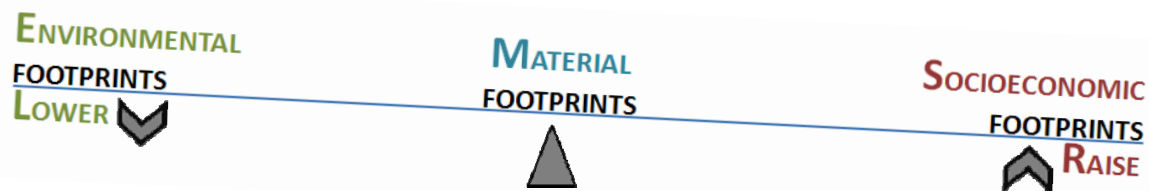
**Vincent Matthews, Ph. D.**  
**State Geologist of Colorado**  
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Vince Matthews is the State Geologist of Colorado and the Director of the Colorado Geological Survey. He received Bachelors and Masters degrees in Geology from the University of Georgia and a Ph. D. from the University of California, Santa Cruz. Dr. Matthews held tenured positions at two universities and has taught geology at the University of California, University of Northern Colorado, Arizona State University, the Frank Lloyd Wright School of Architecture, and the University of Texas of the Permian Basin. As an executive in the natural resources industry for Amoco, Lear, Union Pacific, and Penn Virginia; Matthews explored for oil & gas in virtually every basin in the U.S., including Alaska and the Gulf of Mexico. Part of his experience in the natural resources industry included responsibility for coal, lime, and limestone activities in New Jersey, Virginia, and Tennessee.

# The Mineral Footprint™ of Green Choices

Dayan J. Anderson  
President, Mineral Footprint Network

- The transition to a Green Economy will require a focus much broader and more holistic than the current ‘carbon footprint’ paradigm allows.
- Our **human footprint** is in fact comprised of numerous footprints: **environmental socioeconomic**, and **material** footprints. The interaction, interdependence and feedback between these footprints must not be ignored, and should be respected and integrated to best achieve a sustainable society.
- In order to **lower** our environmental footprints, and **raise** our socioeconomic footprints, we must have the technical and economic capacity, both now and in the future, to **leverage** our material footprints.



- As policy makers, you must be cognizant of how your decisions might reinforce, constrain or worse yet, sever the linkages between these footprints.
- Climate change, energy independence and sustainability cannot be addressed without an awareness and understanding of the diverse and ever-changing material requirements (aka, material sets) that will ‘make or break’ the technologies, infrastructure and systems required for the New Green Economy.
- Awareness and understanding of these material sets requires both knowledgeable materials and minerals professionals, and citizens who possess well-rounded educations. The nation needs to diligently expand its educational focuses in engineering and sciences.
- The materials and minerals information that society needs to make intelligent choices, from researchers and engineers, to investors and businesses, to consumers and policy makers is **dynamic**, and needs constant monitoring and attention.
- Minerals, metals and materials information must be continually collected, managed, coordinated and disseminated as public domain data. It is paramount—to the nation’s economy and national security—that a properly funded federal program *with survey enforcement authority* be the champion of such information and the system that sustains it.
- We not only need to commit research funding toward ‘inventing better widgets’, we must also allocate funding to the research that will improve and revolutionize the exploration for, extraction, processing and recycling of the raw materials needed to ‘build the better widgets’.

**Recommendations from the 2008 National Research Council Report:  
*Minerals, Critical Minerals and the U.S. Economy***

- Full information on the mineral life cycle, and the critical mineral cycle particularly, requires information on recycling and scrap generation and inventories of old scrap; in-use stocks; reserves and resources; downstream uses; subeconomic resources; material flows; and international information in each of these areas. *Federal mineral information collection presently does not include these factors.* (emphasis added)
- Well-educated resource professionals are essential in industry, the federal government, and academic institutions for fostering the innovation that is necessary to ensure the availability of critical minerals resources at acceptable costs and with minimal environmental damage.

**Dayan J. Anderson**

**President, Mineral Footprint Network**

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Dayan J. Anderson received her BS in Mining Engineering from the Colorado School of Mines in 1997. She is a senior mining engineer associate with Micon International Ltd., with experience in mine operations, strategic mine planning, reserve estimation, GIS analysis, and environmental management for various coal, industrial minerals, base and precious metals operations.

She is a MASc candidate at the University of British Columbia, Norman B. Keevil Institute of Mining Engineering assisting with research commissioned by Natural Resources Canada. This intergovernmental effort is reviewing the performance of the Canadian Mining Industry against numerous sustainability indicators. Dayan is focusing on the topics of biodiversity, orphaned and abandoned mines, GHG emissions and energy use. She is pursuing a concurrent MS in Environmental Studies at Green Mountain College, working with the California Department of Fish and Game in the development of a habitat selection model for bighorn sheep in the vicinity of limestone operations in the San Bernardino Mountains.

She is a member of the International Society for Sustainability Professionals, a Councilor of the Mining and Metallurgical Society of America, and serves on the Sustainable Development of the Society for Mining, Metallurgy and Exploration and the Engineering Solutions for Sustainability committee of the American Institute of Mining, Metallurgical and Petroleum Engineers. She is a member of the Women's Mining Coalition, Northwest Mining Association, Women in Mining, and the Mineral Information Institute's Leadership Council. She is founder of the Mineral Footprint Network, a non-profit research collaborative engaged in developing a set of K-12 educational materials and consumer-oriented tools about minerals, materials stewardship and sustainable mining practices. She is currently working on two book projects: *Redefining Footprints: a Consumer Guide to Sustainability*, and *Industrial Ecology for Mining Engineers*.

Dayan serves on the board of the San Bernardino National Forest Association, is a lifetime member of the Society for the Conservation of Bighorn Sheep and a volunteer for the California Department of Fish and Game. In her "spare" time, she enjoys rockclimbing, bagpiping, and working on her film project entitled *Sharing the Mountain* – a documentary on bighorn sheep conservation and industry in the United States and Canada.



# **CRITICAL MINERALS: A MATRIX AND 4 PROPOSITIONS**

## **Minerals, Critical Minerals, and the U.S. Economy**

**Roderick G. Eggert**

Mineral and Energy Economics Program  
Division of Economics and Business  
Colorado School of Mines - Golden, Colorado USA 80401

A recent report by the National Research Council (2008) defines a critical mineral or material as one that is both essential in use (difficult to substitute away from) and subject to supply risk. The report then evaluates the ‘criticality’ of eleven minerals or mineral families; of these, it finds that indium, manganese, niobium, platinum-group minerals, rare-earth elements are the most critical. The report recommends that the federal government enhance the types and range of data and information it collects, disseminates and analyzes on minerals and materials; and that federal agencies develop and fund activities, including basic research and policy analysis, to encourage U.S. innovation in technologies related to critical minerals and to better understand global mineral availability and use.

More generally and beyond the scope of the report, I offer four propositions about critical minerals and materials:

- First, limits on mineral resource availability are more about costs, distribution, and time frame than about tons.
- Second, market pressures are effective in encouraging (a) investment that re-energizes supply and (b) users to provide ‘insurance’ against supply risks.
- Third, Chinese mercantilism should be a concern rather than an obsession.
- Fourth, nevertheless there is an important role for government, which should focus its activities on:
  - o Encouraging undistorted international trade
  - o Ensuring that policies and procedures for domestic mineral development appropriately integrate commercial, environmental, and social considerations
  - o Facilitating provision of information on which private and public decisions are made (including information on long-term availability and supply)
  - o Facilitating research and development, especially on recycling of specialty metals used in small quantities in emerging uses

### Reference

National Research Council, 2008. Minerals, Critical Minerals, and the U.S. Economy (Washington, D.C., National Academies Press, [www.nap.edu](http://www.nap.edu)).

**Roderick G. Eggert**  
**Professor and Director, Division of Economics and Business**  
**Colorado School of Mines**

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Roderick G. Eggert is Professor and Director of the Division of Economics and Business at the Colorado School of Mines, where he has taught since 1986. Previously he taught at the Pennsylvania State University and held research appointments at Resources for the Future (Washington, D.C.) and the International Institute for Applied Systems Analysis (Austria). Between 1989 and 2006, he was Editor of *Resources Policy*, an international journal of mineral economics and policy. He has a B.A. in earth sciences from Dartmouth College, a M.S. in geochemistry and mineralogy from Penn State University, and a Ph.D. in mineral economics also from Penn State. His research and teaching have focused on various aspects of mineral economics and public policy, including the economics of mineral exploration, mineral demand, mining and the environment, microeconomics of mineral markets, and mining and sustainable development. He served for two terms on the Committee on Earth Resources of the U.S. National Research Council (NRC). He chaired the recent NRC committee that wrote the 2008 book *Minerals, Critical Minerals, and the US Economy* (National Academies Press).

## **Key Mineral Information**

**Kate Johnson**  
**Program Coordinator, Mineral Resources**  
**U.S. Geological Survey**

*(See separate brochure for summary of this talk.)*

**Kate Johnson**  
**Program Coordinator, Mineral Resources**  
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Kathleen M. Johnson is the Program Coordinator for the U.S. Geological Survey's Mineral Resources Program, a position she has held since 1998. MRP is the sole US Federal provider of scientific information for objective resource assessments and unbiased research results on mineral potential, production, consumption, and environmental effects. Planners and decision-makers at Federal, State, and local levels use this information to inform decisions that affect both supply and development of mineral commodities.

Kate joined USGS in 1975, working on field projects in Alaska and has conducted mineral resource and glacial studies in Alaska; mineral resource assessments in Idaho, Nevada, Utah, Texas, and New Mexico; and minerals projects in Papua New Guinea, Venezuela, and Tanzania. In 1989 she established the USGS Minerals Information Office, a public facility providing access to USGS minerals information, in Spokane, Washington.

Kate has geology degrees from Smith College and Syracuse University. She has held leadership roles in the Association for Women Geoscientists, American Geological Institute, Society of Economic Geologists, Geological Society of America, Spokane Federal Executive Association, and the Mineral Resources Sustainability Program, a cooperative program of the International Union of Geological Sciences (IUGS) and the United Nations Educational, Cultural, and Scientific Organization (UNESCO).

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**Session 2- Strategic Minerals and Case Studies**  
**(10:50 - Noon)**

*Chair: Mark Jorgensen*

Content	Presenter
<i>Rare Earth (Lanthanide) Elements</i>	<i>Mark Smith, CEO, Molycorp Minerals</i>
<i>The Role of Lithium</i>	<i>Dennis Bryan, Senior Vice President of Development, Western Lithium Corporation</i>
<i>Copper</i>	<i>Will Wilkinson, Vice President for Africa for Freeport-McMoran Exploration Corp. and President of Society for Mining , Metallurgy, and Exploration (SME).</i>
<b>Lunch</b> 12-1:30pm	<i>Wayne Allard, Former U.S. Senator</i>

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## **Rare Earth (Lanthanide) Elements**

By

**Mark Smith**

**CEO of Molycorp Minerals:**

Rare Earths and rare earth permanent magnets are essential to clean energy and defense technologies on which our nation's (and many other nations) economy, security and future depend. Applications such as HEVs, wind turbines and energy efficient lighting are critically dependent on these elements.

Currently, these technologies are nearly 100% reliant on Chinese-sourced materials. As global magnet requirements continue to grow at double digit rates (fueled primarily by the development of green energy technologies), China's domestic demand is also soaring and it has been forecast that their production will soon match their internal consumption.

The Rest of the World must seek alternate sources for these strategic materials or risk serious shortages, thereby subjecting the clean energy and defense technologies we are all depending on to serious questions.

**Mark A. Smith**  
**Chief Executive Officer**  
**Molycorp Minerals, LLC**  
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**Mark A. Smith** is Chief Executive Officer, member of the Board of Directors and a shareholder of Molycorp Minerals, LLC. Prior to Molycorp Minerals, Mr. Smith was the president and chief executive officer of Chevron Mining Inc. a wholly-owned subsidiary of Chevron Corporation. Mr. Smith was appointed president and chief executive officer in April 2006. Chevron Mining Inc. operated five mines one of which was the Mountain Pass, CA rare earth mine.

Prior to Molycorp Minerals, Mr. Smith was the president and chief executive officer of Chevron Mining Inc. a wholly-owned subsidiary of Chevron Corporation. Mr. Smith was appointed president and chief executive officer in April 2006. Chevron Mining Inc. operated five mines and was engaged in a joint venture with CONSOL Energy Inc to develop the Youngs Creek Mine, a surface coal mine in Wyoming.

Prior to this appointment, Mr. Smith was a vice president for Unocal Corporation, where he was responsible for managing the real estate, remediation, mining and carbon divisions. Mr. Smith worked for Unocal for over 22 years.

Mr. Smith received his Bachelor of Science degree in agricultural engineering from Colorado State University in 1981 and his Juris Doctor, *cum laude*, from Western State University, College of Law, in 1990. He is a registered professional engineer and an active member of the State Bar of California and Colorado. Mr. Smith and his wife live in Denver, Colorado. In his spare time, he enjoys golf, running, and reading.



**The Role of Lithium**  
By  
**Dennis Bryan**  
**V. P. of Development**  
**Western Lithium Corporation**

The future role of lithium is one of strategic and vital importance to the United States and to the advancement of technology worldwide. The expanding role of lithium includes primarily its role in advanced battery technologies for powering more energy efficient vehicles and for power storage applications. There is no shortage of lithium but resources are limited to certain geological environments and countries around the globe. The United States contains lithium resources adequate to satisfy our needs; the challenge is competing economically in the world market and successfully addressing potential impediments to domestic development.

The lithium story:

- Introduction – lithium and its properties
- Current uses –
  - Glass & ceramics
  - Batteries
  - Greases, pharmaceuticals, metallurgical and other
- Significant new growth areas
  - New battery technologies
  - Automobiles
  - Storage
- Current Production and Anticipated Growth
- World lithium resources
  - Types and locations of deposits
    - Brines – South America, China, United States
    - Hard Rock – Australia, Canada, China, Serbia
    - Other – United States
  - Type dictates usage to some extent
- World lithium producers
- Prices – past, present and future projections
- Domestic supply
  - Existing known sources
  - Potential new suppliers
- Potential Impediments to development
  - Lack of comprehensive Mineral Policy
  - Potential downside of Mining Law reform
  - Restrictive regulations – Federal, state & local
  - Restriction of access to Public Lands
  - NIMBY attitude – competing land uses
  - Lengthy regulatory environment

**Dennis P. Bryan, P.E.**  
**Senior V.P. of Development**  
**Western Lithium Corporation**  
**Reno, Nevada**

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Dennis received a BS in Geological Engineering from the South Dakota School of Mines in 1970 and MS degree in Geology from the Mackay School of Mines, University of Nevada, in 1972.

He has been a consultant in the industrial minerals sector of the mining industry for the majority of his career. His experience incorporates all facets of the industrial minerals including exploration, evaluation, testing, market studies, due diligence for acquisitions, environmental and reclamation permitting, mine planning and resource estimation. He has found, and been involved in, the development of several aggregate resources, both normal weight and natural lightweight aggregates, in the Western U.S., including one in which he held an ownership position.

For the past two and a half years he has been with Western Lithium Corporation as Senior Vice President of Development. Western Lithium is developing one of the world's largest known lithium deposits, a hectorite clay located in northern Nevada, to support the new generation of hybrid/electric vehicles.

He is a long-time member of the Society of Mining, Metallurgy and Exploration (SME) serving as both Chairman of the Industrial Minerals Division and as a member of the SME Board of Directors from 1998 to 2001. In Nevada, Dennis serves as a Commissioner for the State of Nevada Commission on Mineral Resources, representing the small miner and prospector and the industrial minerals sector of the mining industry in the State.

# Copper

By  
**William H. Wilkinson**

- Copper is a strategic metal in the U.S. economy
  - Driven by housing and automobiles
  - Alternative energy generation
    - Huge Copper consumers
- Copper is the most efficient conductor of electricity and a highly durable engineering material that is 100% recyclable without degradation
- Strong demand in “Green” technologies
  - Due to superior thermal and electrical conductivity properties
  - Standard for environmentally sound wiring and plumbing
- Economic recovery and expansion of alternative energy generation expected to increase consumption
- “Green” technologies (alternative energy) are generally more Copper intensive than traditional technologies
- Foreign dependence of copper is increasing
  - Domestic Copper production being discouraged
  - Currently import
- Majority of resources are located in politically challenged regions
- U.S. has significant resources, but not being developed
  - There is potential for new discoveries
- U.S. facing tremendous competition for Copper resources worldwide
- Major competitors are China, India, Japan and Korea
- Discussions about increasing “green” energy are generally inconsistent with anti-mining policies (J. R. Burnell, TPG, 2009)
- Key U. S. Policy Issues
  - Permitting delays
  - Decreased access to potential resources due to land withdrawals
  - Ever tightening environmental regulations
  - Regulatory uncertainties
    - Modifying permits after approval
  - Community relations challenges
  - U.S. should promote its exploration/mining industry at home and abroad
    - Canadian approach possible model to follow
  - U.S. should consider a constructive attitude toward exploration and development of strategic commodities
    - Development provides resource security
    - Development provides high paying jobs

**William H. Wilkinson**  
**Vice President, Africa**  
**Freeport-McMoRan Exploration Corp.**  
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Dr. Wilkinson is Vice President, Africa, for Freeport-McMoRan Exploration Corp. in Phoenix, AZ. He is responsible for project direction, reconnaissance and acquisitions throughout the continent which has led to a major discovery. He has nearly 35 years of experience in mineral exploration and has worked in base and precious metal exploration in 25 countries on five continents. Dr. Wilkinson has worked in the southwestern United States for Anaconda, Duval Corporation, Westmont Mining and Phelps Dodge prior to Freeport.

Dr. Wilkinson received his B.S. and M.S. degrees in geology from the New Mexico Institute of Mining and Technology, with a three-year break for service in the U.S. Army. He received his Ph.D. degree in geosciences in 1981 from the University of Arizona. Dr. Wilkinson is the 2009 President of the Society for Mining, Metallurgy and Exploration (SME), is a Distinguished Member of SME and a charter Registered Member of SME. He is a Certified Professional Geologist of the American Institute of Professional Geologists and is a member of the Society of Economic Geologists, Mining Foundation of the Southwest, Mining and Metallurgical Society of America, Arizona Geological Society and Nevada Geological Society. He has been an avid mineral collector since the fourth grade, which provided the impetus to study geology and explore for new mineral deposits.

# **Minerals for a Green Society**

By  
**Former U.S. Senator Wayne Allard**

Former Senator Wayne Allard, DVM, demonstrates in his speech the vital importance of many mined elements in our everyday lives by selecting a few very common elements and showing how they are important to plant and animal biological systems, manufacturing, renewable energy, health care, our nation's security and even Hollywood. He then selects a few of the most commonly used rare earth elements and shows their strategic importance to America's efforts to go to renewable energy and a high technology military defense system. These are so vital to our economy that when the government increases the costs of mining and processing these mined elements, policy makers' efforts to balance the budget and improve our balance of trade becomes very difficult. This leads to a cursory review of the issues before Congress and the President. Senator Allard calls for more involvement and effort to let Congress and the executive know how their policy can impact mining and metallurgy

- How minerals are important to every aspect of our lives
- Biological Systems, Manufacturing, Renewable Energy, Health Care, Defense Systems
  - Iron (Fe)
  - Fluoride (Fl)
  - Manganese (Mn)
  - Sodium (Na)
  - Potassium (K)
  - Calcium (Ca)
  - Copper (Cu)
  - Carbon ( C)
  - Silver (Ag)
  - Gold (Au)
- Strategic Importance of Rare Earth Elements
  - Defense systems
  - Renewable Energy
  - USGS study on rare earth elements
  - China's role in production of rare earth elements
- Effect of increasing the cost of mining and metallurgy with regulation, taxes, and limiting access to public lands
- Review of Issues before Congress and the Administration
- Call to Action

**Former U.S. Senator Wayne Allard**  
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Former U.S. Senator Wayne Allard served 12 years in the United States Senate. Prior to his time in the Senate he had served 6 years in the U.S. House of Representatives and 8 years in the Colorado State Senate. In these legislative bodies he concentrated on natural resource issues, budget, business, and defense issues. During his time in the Congress he returned more than \$4.5 million back from his office expense accounts. He fought to hold down taxes, regulations, and balance the budget by reducing spending obligations.

Dr. Allard graduated from Colorado State University with a Doctor of Veterinary Medicine degree and was 20 years in private practice before entering public life. He felt that those politicians who had to live with the laws they passed would do the best job of legislating so he supported term limits.

In January of 2009 after leaving the senate Dr. Allard established the Wayne Allard Associates, LLC which is a business development and public affairs entity and the Prion Research Institute, a nonprofit that promotes research on infectious proteins. He is a senior counselor at The Livingston Group which is a lobbying group in D.C. that works with natural resource issues. In addition he is serving on the advisory panel for the United States Air Force Academy Eisenhower Center for Space and Defense Studies and is on the board of directors of Forward Steps, a nonprofit that supports foster kids who want to go to college.

### Session 3- Access to Minerals from the Consumer Viewpoint (2pm - 3:00 pm)

*Chair: Paul Jones*

Content	Presenter
<i>Managing Materials for the 21st Century Military.</i>	<i>Robert Latiff, Director, Intelligence and Security Research Center, George Mason University, and Major General, USAF</i>
<i>Role of China in Global Mineral Supply and Demand</i>	<i>Douglas Silver, Chairman and CEO, International Royalty Corp.</i>
<i>Photovoltaics</i>	<i>Ken Zweibel, Director, The GW Solar Institute, George Washington Univ.</i>
3:00 to 3:20 - Break	

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# **Managing Materials for a 21<sup>st</sup> Century Military**

By

**Robert Latiff, Director,  
Intelligence and Security Research Center,  
George Mason University, and Major General, USAF**

- National Research Council Report – Committee on Assessing the National Defense Stockpile (CANDS)
  - Formed as a result of Congressional direction
  - Sponsored by National Defense Stockpile Center, Defense Logistics Agency
- Stockpile operating under Cold War principles
  - Numerous changes in strategy, world situation, availability, etc
  - Few changes in stockpile policy, operation, modeling
- Numerous reports and recommendations to improve stockpile
  - No significant action
  - DOD essentially ignored the issue for a decade or more
- Concluded
  - Stockpile was not properly structured
  - Some stockpiling may be needed for the most critical items
  - Much different modeling needed
  - More flexibility required for DOD to be successful
  - Must have data on actual DOD usage and needs
- DOD and NDSC Report to Congress contained similar conclusions
  - DOD modifying modeling process
  - DOD collecting essential data
- Recent foreign actions on rare earths have caused a resurgence of interest in impacts of shortages on DOD
- Follow-up to NRC and DOD recommendations is essential

**Robert Latiff**  
**Director, Intelligence and Security Research Center,**  
**George Mason University, and Major General, USAF**  
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**Dr. Robert H. Latiff** is currently a Research Professor and Director of the Intelligence and Security Research Center, George Mason University. He is also active as a private consultant. Most recently, Dr. Latiff was Vice President and Chief Technology Officer in the Space and Geospatial Intelligence Business of Science Applications International Corporation (SAIC) Chantilly, VA.

He is a member of the National Materials Advisory Board of the National Academies and in 2007 chaired the Committee on Assessing the National Defense Stockpile. He also serves on the Intelligence Committee of the Armed Forces Communications and Electronics Association (AFCEA). Dr. Latiff retired from the US Air Force in 2006 at the rank of Major General.

General Latiff's last active duty assignment was at the National Reconnaissance Office where he was Deputy Director for Systems Engineering and also Director, Advanced Systems and Technology. He has served on the staffs of Headquarters U.S. Air Force and the Secretary of the Air Force.

General Latiff received his commission from the Army Reserve Officer Training Corps program at the University of Notre Dame where he also received his Ph.D. and his M.S. in materials science and his B.S. in physics. He completed the National Security Fellows Program at Harvard's JFK School of Government and he is currently enrolled at Georgetown University, pursuing a degree in the Humanities. General Latiff is a recipient of the National Intelligence Distinguished Service Medal and the Air Force Distinguished Service Medal.

# Role of China in Global Mineral Supply and Demand

Douglas Silver

Chairman and CEO, International Royalty Corp.

## Takeaway Points

1. Explosive Growth in Chinese foreign mineral investments
  - a. Locking up iron supplies to support large-scale domestic
  - b. Infrastructure development(railroads, office buildings, ship building, bridges, etc..)
    - Australian iron is closest to China geographically (lower freight costs) and hosts the
  - c. Highest production volumes and highest grades
    - Brazil is the next best location for large volumes and high grades
  - d. Opportunistically acquiring other metals
  - e. Also pursuing energy commodities (uranium, coal, oil and gas)
  - f. Tighten the monopoly on the Rare Earth metals
  - g. At least 50% of imported ores are being used domestically in China
  - h. Converting U.S. dollars into hard assets
2. Investments being made by one or more mechanisms:
  - a. Equity investments in corporations
  - b. Earn-in agreements on mineral and mining properties
  - c. Project financing in exchange for off-take agreements
  - d. Project loan financing to create indirect control of assets
3. Current purchases have been fairly benign
  - a. Small, mediocre deposits (small tonnage, low-grade or high cost)
  - b. Most attempts at large purchases have failed (e.g. Noranda, Rio Tinto)
4. However, they are learning and becoming more competitive
  - a. Bought \$200 million in Glencore International bonds in 2010
  - b. Equity stakes in Teck, MMX, Oz Minerals, Fortescue, Felix
  - c. Several multi-billion project loans put in place in 2009
  - d. Acquisitions for U.S. dollars may not be economically sensitive
5. Controlling natural resources provides a competitive advantage to China
  - a. All wars fought over natural resources (including people)
  - b. Investing in natural resources leads to development of local and national infrastructure
  - c. which carries favor with the host country leading to increased military assistance and
  - d. opportunities for political manipulation
  - e. This is about commercial warfare not military
  - f. China is recycling U.S. dollars to help manage foreign exchange reserves

## Summary

1. In a global economy, everyone must compete, including the United States.

2. Decreasing number of areas available in the USA for exploration and mine development due to expanding urban areas and lands set aside.
3. Very difficult to permit metal mines in a timely manner due to lack of a politically supported national mineral policy. Currently takes about 15 years from discovery to production.
4. Chinese are paying fair value for their foreign acquisitions.
5. United States' lack of a proactive mineral policy means our country will be facing increased risks of:
  - Insufficient rare earth metals supplies
  - Much higher raw materials costs
  - Critically increased dependency on foreign ore sources, many of which reside in countries unfriendly to the USA.

### **Recommendations**

1. Provide the USGS Mineral Information Team with sufficient funding to do their job of tracking mineral statistics. The Congress' decision to cut their funding by tens of millions of dollars is potentially forfeiting billions of dollars of new commerce while also jeopardizing national security. They need research funding to study critical issues such as material flow patterns and undiscovered resources.
2. Create the equivalent of "special economic zones" for exploration and development of specific strategic minerals.
3. Stockpile specific minerals
4. Balance anti-development tactics with good, real science-based regulations that consider real economic impacts.
5. Consider implementing flow-through funding of foreign projects as a mechanism for locking in foreign mineral supplies for the USA.

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Mr. Silver has a Bachelor of Arts from the University of Vermont, a Masters of Science in Economic Geology from the University of Arizona and is a certified general appraiser. Mr. Silver has 25 years of experience as an active professional in the minerals industries, having served in a variety of capacities, including Exploration Geologist, Business Development Specialist, Mineral Economist, Corporate Advisor and Director of Investor Relations.

Mr. Silver has acknowledged expertise in international mineral appraisals, management consulting and strategic planning research and has served as a strategic advisor to small and large mining companies. Prior to and during the past 15 years, Mr. Silver has provided management and mineral economic consulting services through his company Balfour Holdings, Inc.

# Key Minerals in Photovoltaics

By

Ken Zweibel

Director, The GW Solar Institute,  
George Washington University

## Rationale

- Solar PV growing fast – over 40%/yr
- Now 5-6 GW/yr
- Semiconductor (approximate, at 10% efficiency)
  - 10 km<sup>2</sup> surface per GW
  - 10 m<sup>3</sup> per GW
  - About 20 MT/GW (@ 2 gm/W, eventually, but more now as layers are not optimized for thinness)
- DOE ‘Solar Vision’ projects 10% PV by 2030 (600 GW in US, 3000 GW worldwide)

## Rationale - Key Technologies

- Commercial and Competitive for Long-Term
  - Silicon
  - CdTe
- Emerging and Promising
  - CuInSe<sub>2</sub> alloys with Ga and S
  - III-V multijunctions for concentrators (GaAs alloys with In, P; and Ge or GaAs substrates)
- Commercial but Less Competitive
  - Amorphous and thin film silicon
- Emerging and Less Certain of Success
  - Dye “Gratzel” cells
  - Plastic cells

## Major Materials

- Specialty
  - Commercial
    - Silicon
    - Silver
    - Tellurium
    - Cadmium
  - Emerging
    - Indium
    - Selenium
    - Molybdenum
    - Gallium
    - Germanium
    - Arsenic

- Ruthenium

– Many minor materials (Ni, P, Zn, Sn, S, N, H, more)

## Bottlenecks

- Risk and timing of investment
  - Unpredictability and rapid alteration of demand
  - “Silicon shortage”!
- Extraction
  - Is there enough?
  - Is it economically accessible in a timely manner?
- Refining
  - Is it technically feasible?
  - Is it economically favorable?
- Sources
  - Accessible for purchases or politically controlled?

## Issue Materials

- Fundamental (amount, economics, competing uses)
  - Te
  - In
  - Ga
  - Se
  - Maybe
- Ag
- Cu
- Mo

## Issue Materials by Technology

- CdTe
  - Te
- CuInSe<sub>2</sub>-alloys
  - In
  - Ga
  - Se
- Silicon
  - Ag
- Bulk
  - Cu for wires

## **PV Scenarios**

- Solar Vision 2030 (about 10% US electricity from PV, 20% from solar)
  - About 600 GW (US)
- Implies about 3000 GW (worldwide)
- Implies 600 GW/yr annual production in 2030 worldwide (for 24% annual growth rate)

## **Major Issues and Opportunities**

- Reductions in material intensity (g/W) for thinner layers, higher efficiencies
- Te
  - Dependence on Cu refining
  - Lack of refining from Au, Pb, Zn, other
  - Lack of Te-ore, e.g., bismuth telluride
  - Undersea Te on ridges
- In
  - Lack of concentrated ores

- Serious competition with TCOs for flat panel displays, conductive pastes, and similar *high-value* electronics
- Ga – is it a special case due to high amount in crust?
  - About same as Pb

## **Concluding Remarks**

- Most important recent commercial PV technology, CdTe, has uncertain future past 2015 due to Te
- Most important emerging commercial technology, CIGS, has In (and Se, Ga) issues
- All PV technologies (even Si through Ag) have important involvement with mineral extraction and refining worldwide
  - Lack of US commitment to extraction and refining inside our borders is a concern for US manufacturing competitiveness in PV for these materials

## **Ken Zweibel**

**Director, GW Solar Institute**  
**George Washington University**  
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Ken Zweibel has almost 30 years experience in solar photovoltaics. During his 26 years at the National renewable Energy Lab (NREL), Zweibel led their development of thin film PV, serving as program leader for the Thin Film PV Partnership Program until 2006. The Thin Film Partnership worked with most U.S. stakeholders in thin film PV (companies, universities, scientists) and is often credited with being important to the success of thin film PV in the U.S. Zweibel subsequently cofounded and became Chairman and President of a thin film CdTe PV start-up, PrimeStar Solar, a majority of which has been purchased by General Electric. Zweibel authored the “Solar Grand Plan,” an article appearing in Scientific American (January 2008).

Since July 2008, Zweibel has been Director of the Solar Institute at The George Washington University in Washington, D.C. The Institute conducts research into the economic, technical, and public policy issues associated with the development and deployment of solar energy to meet global energy and environmental challenges. Zweibel has been on the Steering Committee of the “DOE Solar Vision” since June 2009, when it began an effort to develop a deployment plan for solar through 2030. Zweibel also keeps an active blog on solar energy, <http://thesolarreview.org/>.

**Session 4- Roundtable Discussion  
(3:20pm - 4:45pm)**

*Moderator: Luke Danielson*

Content	Presenter
<p><u>Topics:</u></p> <ul style="list-style-type: none"> <li>– Strategic minerals and vulnerability</li> <li>– Mineral needs for the future and where they will come from</li> <li>– Long term planning for mineral stockpiles</li> <li>– Substitution and recycling</li> </ul>	<p><u>Panel Participants:</u></p> <p><b>Michael Kaas</b>, retired mining engineer with the U.S. Bureau of Mines</p> <p><b>Dr. Murray Hitzman</b>, Charles F. Fogarty Professor of Economic Geology, Colorado School of Mines, and Chair of the National Research Council’s Committee on Earth Resources</p> <p><b>Douglas Silver</b>, CEO, International Royalty Corporation</p> <p><b>Jim Sims</b>, Western Business Roundtable</p> <p><b>Corby Anderson</b>, Colorado School of Mines</p>
4:45pm to 4:50 p.m. —Wrap up Discussion, Closing Remarks	Jonathan Price
4:50 pm to 5 pm - Break	
5pm - Reception	

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## Panel Members

### **Luke Danielson - Moderator**

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Mr. Danielson is a practicing lawyer and President of the Sustainable Development Strategies Group. He teaches courses related to sustainable development of natural resources at the University of Denver College of Law, Simon Fraser University, and a variety of other institutions. He is a Visiting Lecturer at the Centre for Energy, Petroleum, and Mineral Law and Policy, and author of a number of publications dealing with the development impacts of natural resource projects, and the potential for such development to play a role in poverty reduction.

He was for eight years a member of the Colorado Mined Land Reclamation Board and was a principal author of Colorado's current permitting laws for mining. He taught for three years at the University of Chile in environmental law, including a specialized doctoral course on environmental legislation applicable to mining. He was a consultant to both the Chilean Ministry of Mines and CONAMA, the national environmental agency, in the development of environmental regulations applicable to the mining sector.

Professor Danielson has assisted financial institutions with identification and management of risks at large natural resource development projects in several countries, and has consulted to a number of national governments, including the Peoples Republic of China, Romania, Peru, Chile, and Cuba in development of environmental regulations applicable to natural resource issues of various types. He has also consulted to both mining companies and nongovernmental organizations.

He was the Director of the Mining Policy Research Initiative of the International Development Research Centre, in charge of funding and conducting research on the social, economic, and environmental aspects of mineral development in the 23 countries of Latin America and the Caribbean. He has recognized expertise in dealing with environmental, community and social concerns associated with mining development.

Professor Danielson was the Director of the worldwide Mining Minerals and Sustainable Development Project at the International Institute for Environment and Development. He is a member of the Mining and Metallurgy Society of America, the International Consortium for Law and Development, a Trustee of the Lowell Institute for Mineral Resources at the University of Arizona, and a life member of the Wyoming Wildlife Federation.

### **L. Michael Kaas “Mike”, retired mining engineer with the U.S. Bureau of Mines** *minermike@att.net; 703-525-3592,*

Michael Kaas is a retired government executive and Professional Engineer whose career included employment with the U. S. Bureau of Mines, Office of the Secretary of Interior, IBM Corporation, and several mining companies. He received a BS degree in mining engineering from The Pennsylvania State University and a MS degree in mineral engineering from the University of Minnesota. He was an early innovator in the

development of computer applications for the mining industry. During his 20 years at the Bureau of Mines, he was responsible for programs in minerals information and analysis, resource evaluation, mineral land assessment, and environmental research.

He is a member and past Director of the Society for Mining, Metallurgy, and Exploration (SME). He is the author of numerous papers on technical topics and mining history. He serves as a volunteer docent at the Smithsonian Institution's Museum of Natural History.

**Dr. Murray Hitzman**, Charles F. Fogarty Professor of Economic Geology, Colorado School of Mines, and Chair of the National Research Council's Committee on Earth Resources  
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Dr. Murray W. Hitzman earned Bachelor's degrees in geology and anthropology from Dartmouth College (1976), an MS in geology from the University of Washington (1978), and a PhD in geology from Stanford University (1983). He has worked throughout the world in the mining industry for the Anaconda Company (1976-82) and Chevron (1982-93). In 1990, he discovered the Lisheen zinc-lead-silver deposit in Ireland and took the project from discovery through feasibility.

Dr. Hitzman worked in Washington, D.C., as the Geological Society of America Congressional Fellow in the office of Senator Joseph Lieberman (1993-94) and as a policy analyst in the White House Office of Science and Technology Policy (1994-96). In 1996, he was named the Fogarty Professor of Economic Geology at the Colorado School of Mines and he served as Department Head from 2002 to 2007.

Dr. Hitzman has published extensively on the geology of mineral deposits and on natural resource policy issues. He has served as the president of the Society of Economic Geologists (2006), Chair of the National Research Council's Committee on Earth Resources (2004-2009), and is currently a member of the NRC Board on Earth Sciences and Resources. He is on the Board of Directors of three mineral exploration and mining companies.

**Douglas Silver**, CEO, International Royalty Corporation  
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Mr. Silver has a Bachelor of Arts from the University of Vermont, a Masters of Science in Economic Geology from the University of Arizona and is a certified general appraiser. Mr. Silver has 25 years of experience as an active professional in the minerals industries, having served in a variety of capacities, including Exploration Geologist, Business Development Specialist, Mineral Economist, Corporate Advisor and Director of Investor Relations.

Mr. Silver has acknowledged expertise in international mineral appraisals, management consulting and strategic planning research and has served as a strategic advisor to small and large mining companies. Prior to and during the past 15 years, Mr. Silver has provided management and mineral economic consulting services through his company Balfour Holdings, Inc.

**Jim Sims**, President and CEO, Western Business Roundtable  
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The Western Business Roundtable is led by President and CEO Jim Sims, a veteran of more than 30 years in the fields of natural resource, environmental regulation and energy policy development at the state and federal levels.

Jim served for 18 years in Washington, D.C., both in senior policy positions in the U.S. Congress and the White House and as an energy and environmental policy advocate. He served for 12 years in the U.S. Senate, including as Chief of Staff to former Senator Robert W. Kasten, Jr. Following his Senate service, Jim helped to found and lead the Geothermal Energy Association for more than 6 years.

He served in the White House in 2001 as President George W. Bush's Director of Communications for the National Energy Policy Development Group, which helped to craft the recommendations behind the President's National Energy Policy. Jim was brought on board the White House task force because of his experience in renewable energy advocacy and development and media relations.

Jim also helped to found several non-profit organizations that work to educate citizens, policymakers and the news media on important public policy issues, including the Americans for American Energy and the NextGen Energy Council. He serves on the Board of Directors of non-profit Center for the New West.

Jim is Chairman of Policy Communications, Inc., a full service public affairs / lobbying firm with offices in Golden, CO and Washington, D.C. His innovative work has been recognized in the New York Times, Washington Post, Time Magazine, Denver Post, Rocky Mountain News, Denver Business Journal, United Press International, Politics Online and other publications.

A former state legislative aide and newspaper reporter, Jim is an honors graduate of Georgetown University. He lives in Golden, Colorado, is a avid woodworker, an

occasional cattle ranch hand and a martial arts veteran -- officially retired (one too many broken bones).

**Dr. Corby G. Anderson QP CEng FIChemE**, Harrison Western Professor of Metallurgical and Materials Engineering, Colorado School of Mines  
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Anderson has over thirty years of applied experience in the global mining, minerals, metals, chemicals, materials, energy and environmental industries. He holds several international applied process patents and has over 200 publications and presentations. He was recently awarded the prestigious Milton Wadsworth Award for Chemical Metallurgy by The Society for Mining, Metallurgy, and Exploration.

Dr. Anderson's education includes PhD - Mining Engineering - Metallurgy University of Idaho 1987; MSc - Metallurgical Engineering - Montana Tech 1984; BSc - Chemical Engineering - Montana State University 1979

Dr. Anderson's experience includes:

Director and Principal Process Engineer, The Center for Advanced Mineral and Metallurgical Processing, Montana Tech, Butte, Montana, 1997 - 2009

Senior Process Engineer, Mining Group, H.A. Simons Ltd., Vancouver B.C., 1996

Chief Process Engineer, Sunshine Mining and Refining, Kellogg, Idaho, 1988-1995

Graduate School, Montana Tech and University of Idaho, 1982-1987

Chemical Engineer, Key Tronic Corporation, Spokane Washington 1981

Chemical Manufacturing Engineer, Morton Thiokol, Brigham City, Utah, 1979-1981

## THANKS FOR ATTENDING THE SYMPOSIUM

As an organization, MMSA has not adopted specific policy recommendations regarding the theme of the symposium: *Minerals for a Green Society*. Please keep in mind, however, that the MMSA membership continues to be available to lend its expertise to decision makers when questions arise regarding mining and mineral-resource issues.

If you have questions about minerals availability, supply, demand, materials use, or you need other information about mineral production and use, please contact the Mining & Metallurgical Society of America and request an expert.

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