

The Appalachian Research Initiative for Environmental Science (ARIES): A new paradigm for coal research

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38°10'22.16" N 81°49'17.22" W elev 1263 ft

Eye alt 3464 ft

Coal mining (primarily Appalachian mountaintop mining) is being challenged not only by regulators but also by researchers and in the court of public opinion

- Studies published in recent past claim severe health impacts of mountaintop mining in the community, ranging from cancer to baby/infant disease and mortality
- It is alleged, that coal mining perpetuates poverty in the mining regions and communities
- It is suggested that social and community fabric and character suffers irrecoverably by the coal operations in that area

Why Science-Based Approaches?

- Most issues and problems have scientific and engineering components
- Scientific-based discussions allow for communication, cooperation and collaboration with all stakeholders
- Optimum planning, operation and post-mining use of mining projects relies on science-based approaches
- Government policies and regulations must be based on science-based solutions and practices NOT on politics or self-serving agendas



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Imagery Date: 4/13/2011 1996

38°05'22 50" N 81°54'37 70" W elev. 1205 ft

Eye alt 5144 ft

What does the science really show?

***The Appalachian Research
Initiative for Environmental
Science (ARIES)***

The Road to ARIES

- **Concept Kick off**: Advisory Board Meeting of VCCER of VT, December 2009
 - ❑ Vital for the industry to develop and support a research initiative addressing potential upstream (mining, drilling and processing) and downstream (water, land, air) environmental impacts of the mining, gas and energy sectors in Appalachia
 - ❑ The focus should be on conducting scientific inquiry and research, fostering publication and contributing to the relevant literature, and engaging in outreach efforts to share and disseminate research results
 - ❑ The concept of establishing “**The Appalachian Research Initiative for Environmental Science (ARIES)**” was approved by the VCCER Advisory Board
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The Realization of ARIES

- A number of meetings and strategic sessions were held in 2010 and early 2011, with participation of the major Appalachian coal producers, coal associations and essential coal infrastructure companies
- A vision statement was created and the participating companies were asked to decide on funding and level of support
- Sustainability of such an initiative requires multi-year commitment and financial support (5-Years)
- A core university group, with expertise in the ARIES areas of interest, was identified and established to implement the goals and vision of this initiative

ARIES Funding

- Industrial Affiliate Partners committed to fund ARIES with a grant of \$15 million over the next five years
- A research strategy was chartered and approved for 2011-2016
- ARIES is committed to an “open door” policy, encouraging other companies and universities to join in the future

ARIES Announced March 31, 2011

Major Research Areas of ARIES

- Energy production in Appalachia
 - Coal mining
 - Natural gas
 - CBM
 - Shale gas
 - Electricity generation
 - Petroleum
 - Renewables
- First priority focus is coal mining

ARIES Member Companies

- Alpha Natural Resources
- Arch Coal
- Natural Resource Partners
- TECO Coal Corporation
- Patriot Coal Corporation
- Cliffs Natural Resources
- Mepco
- Norfolk Southern Corporation
- CSX Corporation

Coal associations are participants

In discussions with other companies interested to join

ARIES Partner Universities

- Virginia Tech
 - VCCER at VT is the managing entity for ARIES
- West Virginia University
- University of Kentucky
- Ohio State University
- Pennsylvania State University
- University of Pittsburgh
- University of Pennsylvania
- Marshall University*
- Edward Via College of Osteopathic Medicine*

* Joined later

Current Status of ARIES

- Research plans have been implemented for six areas of work at participating institutions
 - First year is fully funded at about \$3 million
 - Second year planning underway
 - Emphasis is in multi-institutional and interdisciplinary approach for each focus area
 - Organization is set up to foster communication among researchers
 - Outreach is an important component of ARIES
 - Plans to organize a major international meeting in the region (April 14-18, 2013, Charleston, WV)
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ARIES Research Team

In total, ARIES currently includes over 40 Academic Researchers, approximately 50 Graduate Students, from almost 30 Academic Departments representing Colleges of Engineering, Science, Agriculture, Forestry, Liberal Arts and Human Sciences, Arts and Sciences, Public Health, Business and Medicine at nine member institutions...

Research Area Details

- Areas 1-4 focus on water issues
 - Impacts
 - Treatment
 - Prediction
 - Prevention (Material handling)
 - Area 5 focuses on improved, environmentally-friendly, mining methods and processes
 - Area 6 focuses on community well being and human health issues
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Specific Research Areas under ARIES

- **Area 1:** Assessment of Mining Impacts on Ecosystem Health and Diversity (WVU, VT, MU)
- **Area 2:** Treatment and Minimization of Constituent Discharges (VT, WVU, UK, PSU, MU)
- **Area 3:** Prediction of Constituent Releases by Overburden and Refuse (VT, UK, WVU)
- **Area 4:** Overburden Handling and Fill Design (UK, VT, WVU, PSU)
- **Area 5:** Next-generation Eco-friendly Mining Systems (VT/WVU, UK, UPitt)
- **Area 6:** Evaluating impacts and optimizing contributions of mining on community well-being (VT, UPitt, PSU, OSU, VCOM, UPenn)



Area 1: Assessment of Mining Impacts on Ecosystem Health and Diversity (WVU, VT, MU)

□ *What are the impacts of coal mining on water and aquatic organisms?*

- Mike Strager (WVU) – Regional geospatial database on water issues
- Todd Petty (WVU) – Modeling ecosystem response
- Stephen Schoenholtz (VT) – Mechanisms underlying biotic response
- Mindy Armstead (MU) – Develop cause-effect relationships
- John Craynon (VT) and Paul Ziemkiewicz (WVU) – Look at best regulatory approaches



Area 2: Treatment and Minimization of Constituent Discharges (VT, WVU, UK, PSU, MU)

□ *What are the current and innovative technologies to treat water impacted by coal mining?*

- Paul Ziemkiewicz (WVU) – identification of available treatment technologies
- Emily Sarver (VT) – accelerated weathering of problematic source material
- Bill Burgos (PSU) – biologic Fe(II)-oxidation
- Richard Warner (UK) – alternative treatment systems
- Mindy Armstead (MU) – minimizing treatment volumes
- John Craynon (VT) – technical and economic feasibility

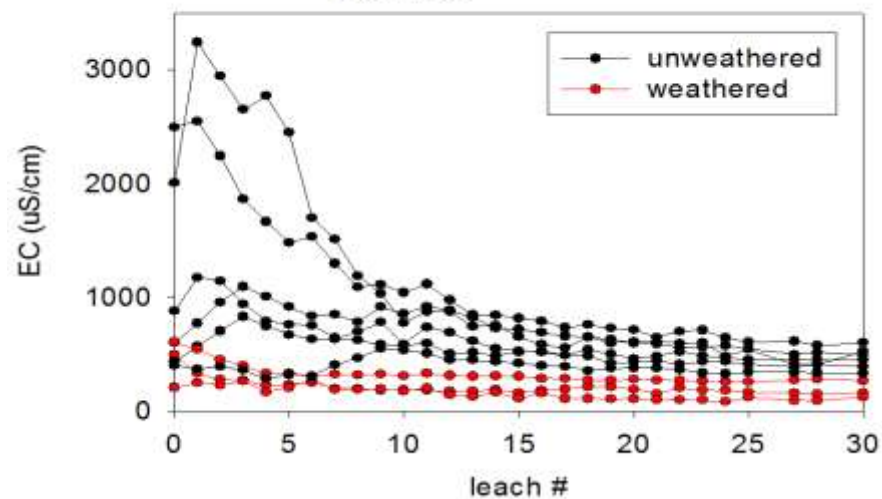


Area 3: Prediction of Constituent Releases by Overburden and Refuse (VT, UK, WVU)

- *How can we predict where coal mining operations may impact water?*
 - Lee Daniels (VT) – spoil sampling
 - Jeff Skousen (WVU) – detailed laboratory spoil analysis
 - Richard Warner and Chris Barton (UK) – field screening techniques
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MUDSTONE: weathered vs unweathered 8 samples



Area 4: Overburden Handling and Fill Design (UK, VT, WVU, PSU)

□ ***Are there ways to handle coal mining materials and water flow to prevent water impacts?***

- Richard Warner (UK) – spoil isolation and low permeability spoil barriers
 - Carl Zipper (VT) – alternative fill construction techniques
 - Jeff Skousen (WVU) – alternative fill construction techniques
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Area 5: Next-generation Eco-friendly Mining Systems (VT/WVU, UK, UPitt)

□ *How can coal mining and coal processing be done to improve environmental performance?*

- Surface mining – Vlad Kecojevic (WVU), Braden Lusk (UK), Carmen Agouridis (UK)
 - Underground mining – Mike Karmis (VT), Tony Iannacchione and Jason Monnell (Pitt)
 - Coal preparation – Jerry Luttrell (VT), Rick Honaker (UK), Mark Klima (PSU)
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Area 6: Evaluating impacts and optimizing contributions of mining on community well-being (VT, UPitt, PSU, OSU, VCOM, UPenn)

- ❑ *What are the economic benefits and impacts of coal mining?*
 - ❑ *Based on valid epidemiological studies, are there human health impacts from coal mining?*
 - ❑ *What are the positive and negative contributions of coal mining to “community well-being”?*
 - ❑ *What are the benefits and impacts of coal mining on society and communities in Appalachia?*
 - ❑ *What can all interested parties - industry, government and communities - do to ensure that coal mining contributes to sustainable development?*
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Area 6: (cont.)

- Economics – Andy Kleit and RJ Briggs (PSU)
 - Sociology – Linda Lobao et al. (OSU)
 - Cultural impacts – TBD
 - Exposures and pathways – Nick Basta (OSU)
 - Public Health
 - Epidemiology – Jeanine Buchanich et al. (Pitt)
 - Comparative health studies – Susan Meacham et al. (VCOM)
 - Mechanisms – Emily Sarver and Leigh Anne Krometis (VT)
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Benefits of ARIES

- Answers basic questions about cause and effect
 - Allows for development of best practices and innovation
 - Reduces environmental costs through addressing key issues and problems
 - Removes regulatory conflicts by enhancing focus on real problems and science
 - Informs the public discussion and creates opportunity for “**social license**”
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Possible Topics of Future Research

- Restoration of stream form and function
- Water issues related to natural gas extraction
 - Fracking water
 - Use of coal mine water for gas recovery
- Use and disposal of coal combustion residues
- Water issues in electricity generation
- Upland reclamation and wildlife issues
- Potential “crossover” research, e.g.:
 - Use of lessons about TDS, selenium, etc. in gas production and electrical generation
 - Expansion of community well being to address concerns in gas production and electricity generation

Observations

- Since coal mining (and use) will be important for decades to come, focus needs to be on doing it the best possible way based on good science
 - Other aspects of energy production also need the development of good science
 - Regulations and other structures that can lead us to “sustainable development” need to have good science to get full participation and acceptance
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Conclusion

- ARIES is a new paradigm for research
 - ❑ Funded and supported by industry but directed by researchers
 - ❑ Independent research conducted at universities
 - ❑ Focus on wide dissemination of results and peer-reviewed publications
 - ❑ Realistic timeframes for research and reporting
 - ❑ Focused on developing good science
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ARIES

- For more information:

<http://www.energy.vt.edu/ARIES>

Or call:

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QUESTIONS?
