# Managing Coal Bed Methane Produced Water for Beneficial Uses, Initially Using the San Juan and Raton Basins as a Model

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# Coal Bed Methane Production and Produced Water Issues and Concerns

- **Projected energy needs in 2020:**
  - **Natural gas demand will increase by 60%**
  - **CBM is expected to supply much of the increased natural gas demand in the next 10-15 years**
- **CBM production creates significant volumes of produced water:**
  - **millions of gallons per day in many basins, injection is often not appropriate**
  - **can impact shallow fresh water resources**
  - **disposal can be an environmental issue**
- **Produced water management is a major concern of the CBM industry.**

**Representative CBM Produced Water Data**

| Basin | State | Produced Water TDS | Water production (Bbl/d/well) |
|---|---|---|---|
| Powder River | Wyo., Mont. | 500 | 400 |
| Raton | Colo. NM | 1500 | 266 |
| San Juan | Colo., NM | 8000 | 25 |
| Unita | Utah | 15000 | 215 |

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# CBM Produced Water Management and Treatment Issues

- **Cost effective treatment options depend on each basin's gas/produced water ratio.**
- **CBM produced water treatment often requires more than TDS removal for beneficial use:**
  - **pre-treatment to remove organics**
  - **treatment to reduce TDS**
  - **post-treatment to condition waters to meet SAR requirements for surface applications**
- **Basins often lack the infrastructure needed for most management options.**
- **We need to identify and develop less complicated and more cost-effective CBM produced water treatment systems.**

| Basin | Natural Gas Production (MCF/d/well) | Water production (Bbl/d/well) |
|---|---|---|
| Powder River | 145 | 400 |
| Raton | 198 | 266 |
| San Juan | 806 | 25 |
| Unita | 511 | 215 |

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# CBM Produced Water Treatment Costs and Impacts

- Treatment of produced water for beneficial use has significant appeal in most arid western states to conserve valuable water and as a way to reduce costs.
- In the San Juan Basin, CBM produced water disposal costs $1-4/bbl because of the limited infrastructure.
- Presently that averages about $150,000/day and could double as further CBM wells are developed and produced.
- Similar costs exist or could occur in other basins.
- Treatment of produced water for rangeland or agricultural applications has the most appeal for many CBM areas. (Final water quality needs are not too restrictive and the infrastructure needs are minimized).

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# CBM Produced Water Utilization for Agricultural Applications

## Treatment System Elements

| | Pre-treatment | Treatment | Post-Treatment |
|---|---|---|---|
| <2000 ppm TDS | Organics, H2S | NONE | SAR Compatibility, metals |
| 2,000 – 4,000 ppm TDS | Organics, H2S metals | RO or other desal technology | SAR Compatibility, metals |
| >4000 ppm TDS | Organics, H2S metals | RO or other desal technology | SAR Compatibility, metals, and concentrate disposal |

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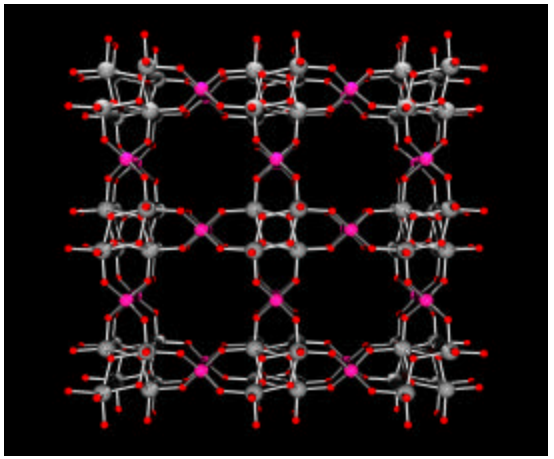
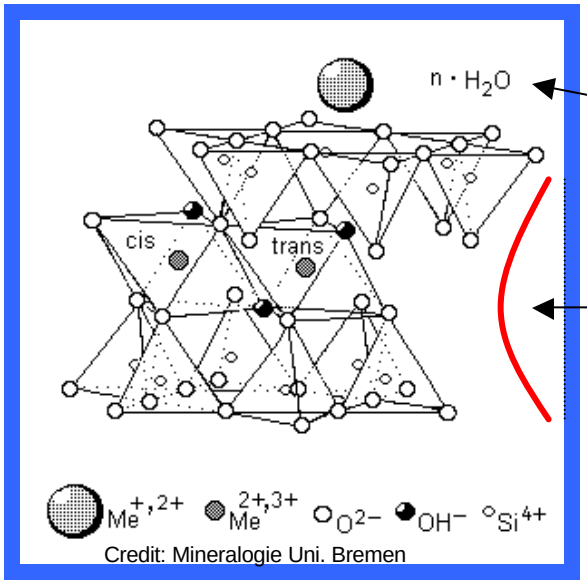
# Zeolites and Smectites for CBM Produced Water Treatment

- Are common, high capacity, low cost, industrial minerals
- Surface chemistry can be modified to remove a range ofcontaminants (e.g. arsenic, other metals, and specific ions as well).





Credit: Mineralogie Uni. Bremen

Basal Plane Interactions – Ca/Na exchange

Edge Interactions – As, metals uptake

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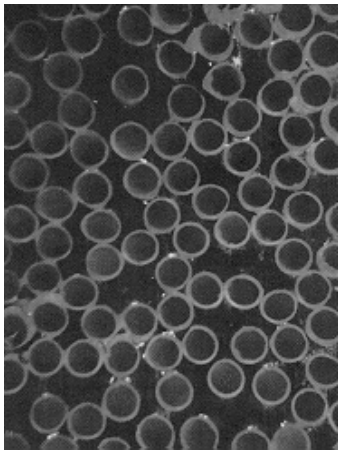
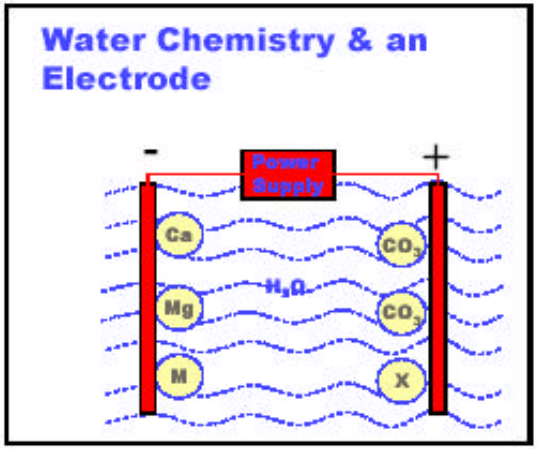
# Proposed Treatment System Element Evaluation

- Pretreatment
  - Surface modified zeolites and emerging pervaporation/microfiltration for low energy reduction of organics
- Treatment
  - Capacitive deionization
  - 15-20% less energy than RO
  - Better match for basin ionic loadings
  - Several vendors with novel electrode configurations will be studied
- Post treatment
  - smectites and surface modified zeolites for SAR adjustment
- Rangeland reseeding applications
  - Treat produced water to 2,000-4,000 ppm TDS



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# Project Tasks and Responsibilities

- **Task 1 - Use Collected Data to Identify and Asses Options For Each Basin**
  - Sandia will lead this effort with project team and advisory group support
  - Evaluate cost-effectiveness of water treatment technologies including modular RO with pretreatment, novel desalination and new membrane approaches, new resins, chemical sorbents, etc.
  - Evaluate cost-effectiveness of disposal or combined treatment and disposal options compatible with basin geology, hydrology, and the environment
  - Evaluate cost-effectiveness of water use or treatment and use compatible with basin characteristics, demographics, and water resource beneficial use

- **Task 4 - Establish Guidelines for CBM Produced Water Management**
  - Sandia will lead the advisory group in using the assessment data to develop a set of templates and guidelines for CBM produced water treatment, use, and disposal
  - Sandia will use the assessment data and developed templates to create a dynamic simulation-based decision support tool to support CBM resource development evaluation, policy direction, and stakeholder understanding

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# Project Deliverables and Schedule

| Deliverables | Schedule |
|---|---|
| Establish Technical Advisory Group | 1QFY02 |
| Collect geologic, hydrologic, and produced water data from 4-5 basins with industry support and put in web-based data base | 2QFY02-3QFY02 |
| Assess cost-effectiveness of produced water management options including treatment, disposal, and beneficial use | 2QFY02- 3QFY03 |
| Develop guidelines and dynamic simulation tools for the assessment of CBM produced water impact on the environment and water resources | 4QFY02-3QFY03 |
| Final report of CBM produced water management guidelines | 4QFY03 |
| Quarterly Progress Reports | Quarterly |

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# Proposed Project Budget

| Participants | FY2003(Request) | FY2004(Request) | FY2005(Request) |
|---|---|---|---|
| Sandia National Laboratories | $195K | $195K | $195K |
| New Mexico State – Agricultural Science Center at Farmington | $10K | $30K | $30K |
| New Mexico Tech – Petroleum Recovery Research Center | $85K | $65K | $65K |
| **Total DOE** | **$290K** | **$290K** | **$290K** |
| | | | |
| Sandia and universities | $120K | $150K | $150K |
| Industry Partners: | | | |
| Bayless Production | $20K | $40K | $30K |
| British Petroleum | $20K | $20K | $30K |
| Burlington Resources | $20K | $20K | $30K |
| Dugan Production | $20K | $20K | $30K |
| D.J. Simmons | $20K | $20K | $30K |
| Energen | $20K | $20K | $30K |
| Merrion Oil | $20K | $20K | $30K |
| Terra Exploration | $20K | $20K | $30K |
| Walsh Engineering | $20K | $20K | $30K |
| XTO Energy | $20K | $20K | $30K |
| **Total In Kind** | **$320K** | **$370K** | **$440K** |

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