



## Mine Water Issues in China

**Changshen Wang**

E-mail: [cougar3wcs@163.com](mailto:cougar3wcs@163.com)

China University of Mining & Technology

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## Why do I put forward this topic?

- **"Contemporary reviews of mine water studies in Europe"**

(Christian & Rob 2005)

- **WISA/IMWA (South Africa, 2008)**  
"mine water and the environment"

- **"Different situations, different mine water concerns In China"**



China delegates in South Africa, 2008



## What shall I do ?

- Introduce the unique geologic & hydrogeologic conditions of coalmines in China
- Discuss the key coal mine water issues in China



A coal mine in Northwest China



Salvage from a flooded mine



## China's coal fields



Coal accumulation provinces in China



## Hydrogeologic conditions China's coal fields



- legends :**
- 1-Early Palaeozoic Karst mine water inrush, Permian-carboniferous Coalfields, North China ;
  - 2-Karst water inrush hazards, late Permian Coalfields, South China ;
  - 3-Cretaceous fractured sandstone water inrush, Northwest China ;
  - 4- Early Jurassic fractured sandstone water inrush, Northwest coalfields, China ;
  - 5-Fractured groundwater hazards, Mesozoic coalfields, Southwest, China ;
  - 6- Tertiary fractured groundwater hazards, Tertiary coalfields

Types of Mine water Issues



## Coal fields and Geologic conditions of North-China coal fields

Quaternary				
Tertiary	N			The Mesozoic and Tertiary generally missed
Triassic	L			
Permian	U	Upper Shi-be-zi		Upper coal seams (since 1950s)
	L	Lower Shi-be-zi		Lower coal seams (since 1990s)
Carboniferous	U	Tan-yuan		The Silurian and Devonian generally missed
	M	Ben-xi		
Ordovician	M			
Cambrian				

10-50m  
500-700m

Stratigraphic column of Feng-feng Coalfield in North-China

### Hydrogeologic conditions of Noth China coal fields

Quaternary					
Tertiary	N				
Triassic	L				
Permian	U	Upper Shi-he-zi			
	L	Lower Shi-he-zi			
		Shao-xi			
Carboniferous	U	Tai-yuan			
	M	Bo-xi			
Ordovician	M				
Cambrian					

Porous aquifers


Fractured sand stone aquifers

Thin karst aquifers

Regional karst aquifers

### Mine water issues in Noth China coal fields


- preventing mine water-inrush (Since the 1950s)
- Types of mine water-inrush:
  - Water-inrush from the Quaternary porous aquifers
  - Water-inrush from overlying fractured sandstone aquifers
  - Water-inrush from the underlying Taiyuan karst aquifers
  - Water-inrush from underlying Ordovician-Cambrian karst aquifers (through faults and sinkholes)
  - Water-inrush from goaf water




Mine water-inrush

### Mine water issues in Noth China coal fields

- Catastrophic hazards
  - Ordovician-Cambrian karst water-inrush
    - Ordovician karst water inrush & flooding through a sink-hole, Fan-ge-zhuang Mine, Hebei, in 1983(Q=2053m<sup>3</sup>/min)
- Mine water-inrush accidents mostly be controlled (by the end of 1990s)



water-inrush through the sink-hole



Mine water drainage

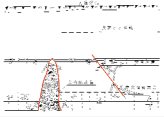
### Updated research on Noth-China issues

- the top of Ordovician strata partially-fully filled by calcite, pyrite and clay can serve as relative aquifuge
- successful underground geophysical exploration techniques
- floor-grouting techniques to consolidate weak floor, faults, pit-holes


*"Study on the basic theory about the mechanism of water inrushing of coal mines and its prevention" ("973 Programme")*

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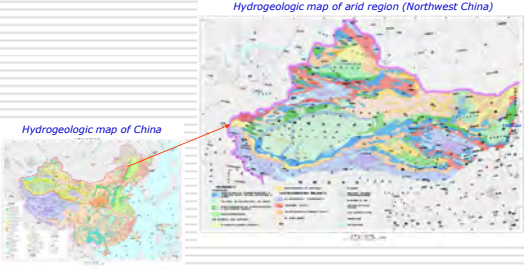


Methodologies of karst water prevention



Surface grouting project

### Hydrogeologic conditions in Northwest China



Hydrogeologic map of China

Hydrogeologic map of arid region (Northwest China)

### Coal fields and conditions in Northwest China

Formation	Column	Description	thickness
Q <sub>4</sub> med		风积砂、冲积积砂	28.5m
Q <sub>1</sub> med		砂砾石含水层	
J <sub>2</sub>		岩性以砂质泥岩与细砂岩为主	27.5m
J <sub>1</sub> 2 <sup>3</sup>		薄层砂岩	

Formation	Column	Description	thickness
Q <sub>4</sub> med		风积砂、冲积积砂层	3-7m
K <sub>1</sub> 2h		岩性以砂质泥岩与细砂岩为主	
J <sub>2</sub> a		岩性以砂质泥岩与细砂岩为主	
J <sub>2</sub>		岩性以砂质泥岩与细砂岩为主	120-190m
J <sub>1</sub> 2 <sup>3</sup>		薄层砂岩	

### Issues in Northwest China

**Schematic map of water bursting-inrush (the Jurassic coal seam covered by thick base Mesozoic rock)**

**Schematic map of water and sand inrush (the Jurassic coal seam covered by thin base Mesozoic rock)**

### Updated research on Northwest Chian issues

- Institutional regulations (To Protect Surface and groundwater Water sources)
- Administrative policies (water resource management)
- Technical measures
  - Delineate water protection areas;
  - weak aquifer water pooling
  - goaf water pooling;
  - Backfilling techniques;

**Schematic map of backfilling**

### Mine water issues in South china

**typical column of the South-China.**

### Other Environmental Problems

- Surface subsidence dystroy land & buildings and vast village transfer expence;

**Land damage**

Year	Areas of surface subsidence
1990	30×104km <sup>2</sup>
1993	40×104km <sup>2</sup>
1999	60×104km <sup>2</sup>

*Total Areas of surface subsidence*

### Other Environmental Problems

- Surface subsidence dystroy land & buildings and vast village transfer expence;
- Spoil heaps (more than 1600) take up land and pollute water and air
- Pollute water resources;
- Aggravate Water demand stress;

**Mining wastes groundwater resources**

Year	Mining water	utility
2005	4200×10 <sup>6</sup> km <sup>2</sup>	26%
2010	5000×10 <sup>6</sup> km <sup>2</sup>	70%

*Mining water and utility*

## Conclusions

- The mine water issues in China are different from those in the 1990s.
- The coalmines in North-China will have to confront challenge of higher Ordovician water pressure; the main solution is to use the top Ordovician as relative aquifuge.
- The key issues in Northwest China are to protect the water value resources and the vulnerable environment; water protection zone delineating, weak aquifer water pooling, goaf water pooling, goaf filling, etc have been used.
- Those coalmines in South China are always cautious against the danger from overlying and underlying Permian karst aquifers.

***Thank you.***

Welcome to contact with me:

***Changshen Wang***

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