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Innovations of land reclamation and ecological restoration in coal mining areas in China

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Outline

1. Background

2. Innovations of reclamation technology in China 中国复垦技术的一些创新

- **Concepts and ideas 概念和理念的创新**
- technology of concurrent mining and reclamation
- subsidence land reclamation filled with river sediments
- reclamation of coal waste piles with spontaneous combustion

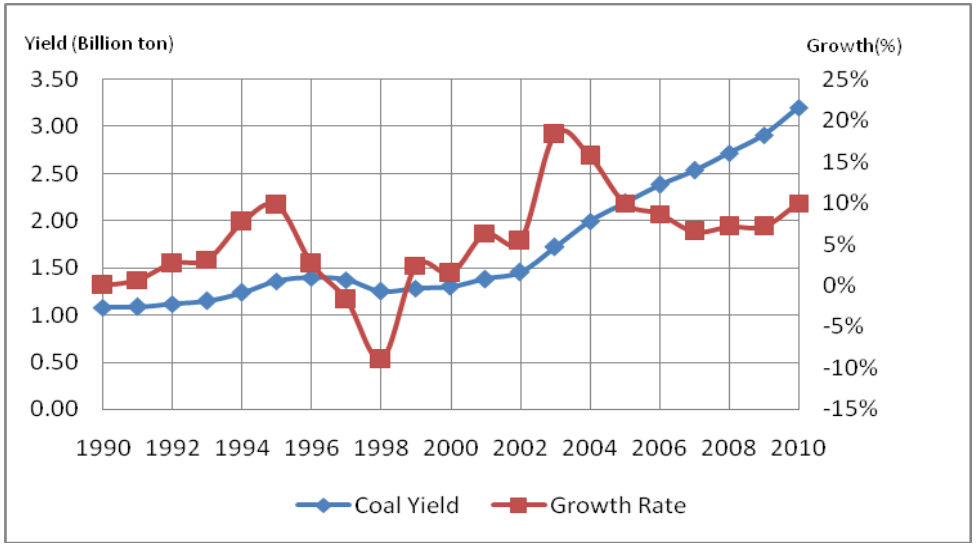
3. Summary

1. Background

- Impact of coal mining on eco-environment 采矿对环境的影响
- significance and important role of land reclamation and ecological restoration in promoting green mining土地复垦与生态重建的意义和作用
- Some failure cases of land reclamation (problems of traditional reclamation technology)复垦失败的案例及原因

1. Background

(1). Impact of coal mining on environment in China



Coal yield and growth rate from
1990 to 2010 in China

Coal is the most important resource in China.
China's coal production was 3.8 billion tons in 2014.
90% from underground mining

(1). **Impact of coal mining on environment in China**

Coal mining has produced a lot of environmental problems while it makes great contribution to economic growth

(1). Impact of coal mining on environment in China

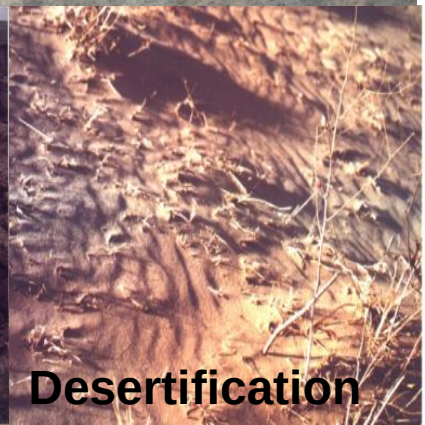
1）land damage



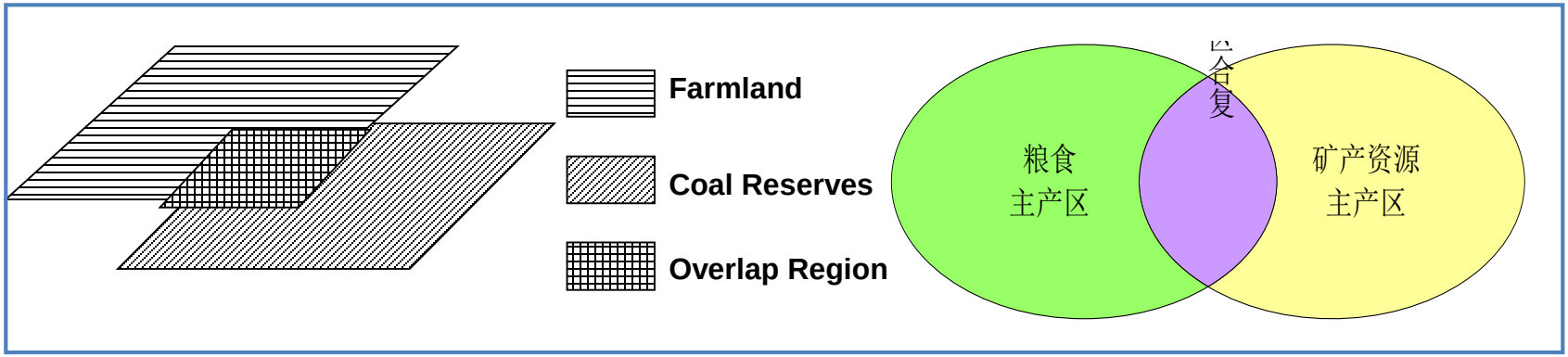


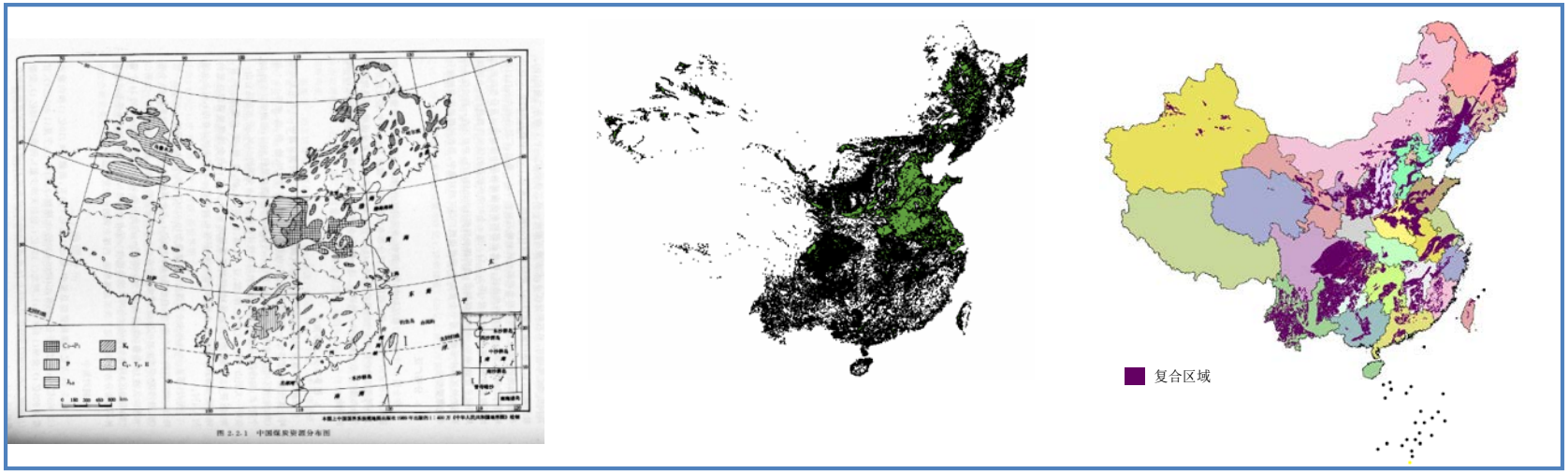
•**subsidence：** **over 1 million ha of subsided land;70 thousands ha of land will be subsided every year**

Farmland loss, land degradation and geological disasters

The Overlap Region (OR)





COAL RESERVES

FARMLAND DISTRIBUTION

OVERLAP REGION

Large overlapped area

-40% of overlap area between farmland and total coal reserves

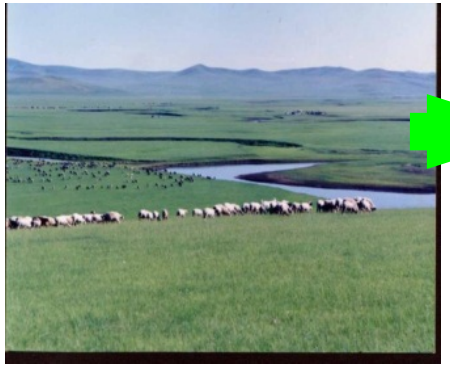
-10% of overlap area between proved coal reserves and farmland

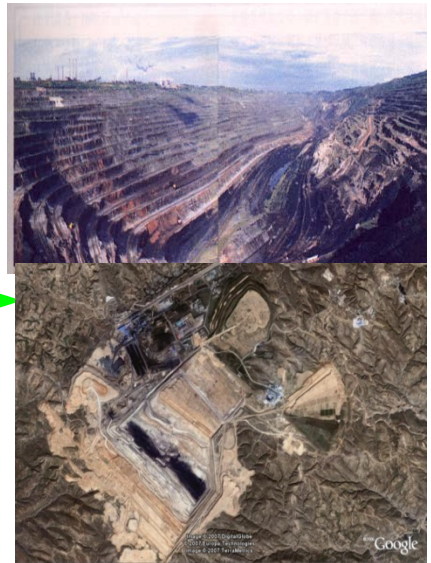
(1). Impact of coal mining on environment in China

1）land damage

•Occupied by coal wastes：thousands of coal wastes piles, total 6 GT , 0.35 GT/a

Beautiful Pasture





Open pits、dumps：land loss 0.1 ha/10thousands tons, 3000ha/a

(1). Impact of coal mining on environment in China

2）pollution on air, water and soil, and health problems

Harm to human health

1. Impact of coal mining on environment in China

3）damage of human settlement and rural landscape
----- huge work on village movement and settlement

因采煤塌陷造成房屋开裂现状

- **Houses damage**
- **Rural infrastructure damage such as road, bridge, drainage and so on**

• it is estimated that: more than 10 million people will have to move and settle in other places

(1). Impact of coal mining on environment in China

4）social problems ---- affect regional social stability and harmonious

Conflicts between farmers and miners

Some conflict events

1. Background

- (2). significance and important role of land reclamation and ecological restoration in promoting green mining

How to minimize and repair the environmental damage? Green Mining is the only way for coal industry!

Is green mining possible?

PRINT

The Canadian mining industry is trying very hard to turn mining's image around. But is environmentally friendly mining even possible and can we be convinced? **Long history to overcome**

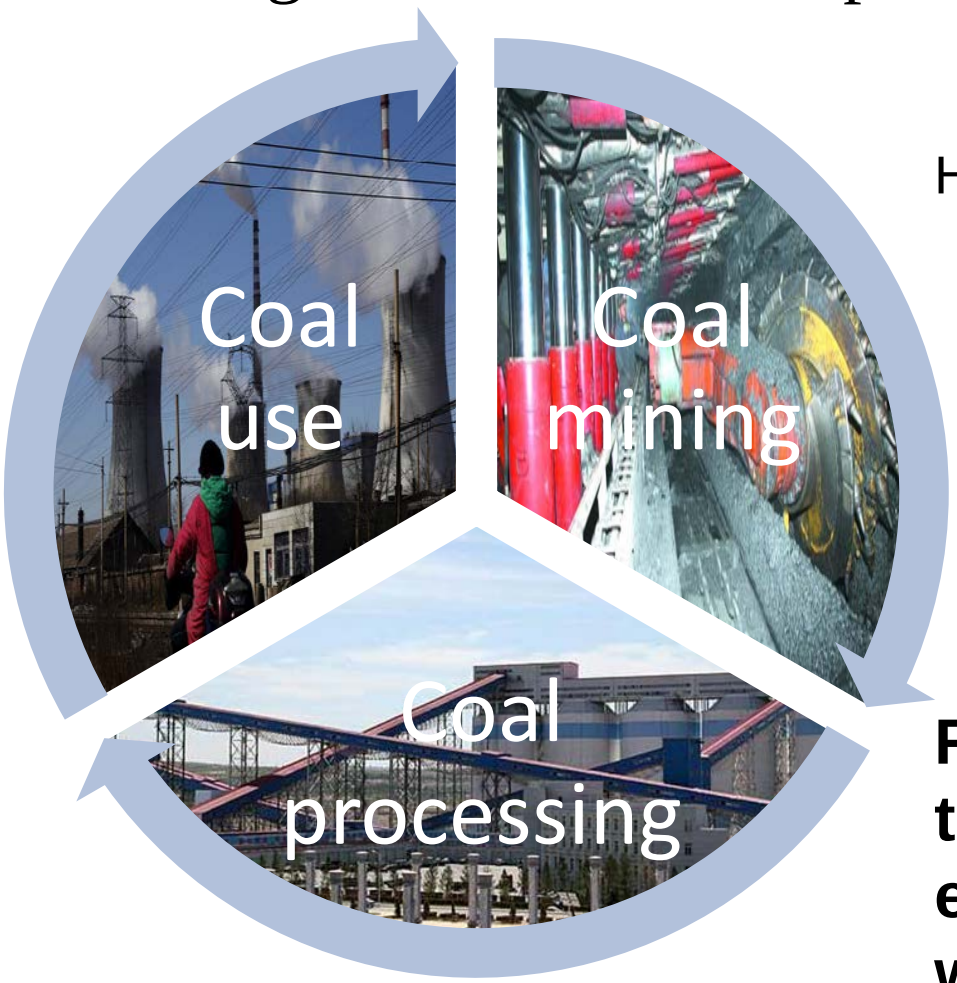
The Mining Association of Canada (MAC), reeling from the all-too-frequent black eyes that Canadian-based mining companies have received in the press over the past decade, is doing its utmost to convince the public that "sustainable mining" is not an oxymoron. Unfortunately, they're battling a long and dirty history, one fraught with environmental devastation and social indifference. The catalogue of environmental disasters and human tragedies caused by the mining industry

Photo: istockphoto.com/Chris Fertnig

Is green mining possible, and how to implement green mining?

1. Background

- (2). significance and important role of land reclamation and ecological restoration in promoting green mining



How to realize green mining?

Source control?

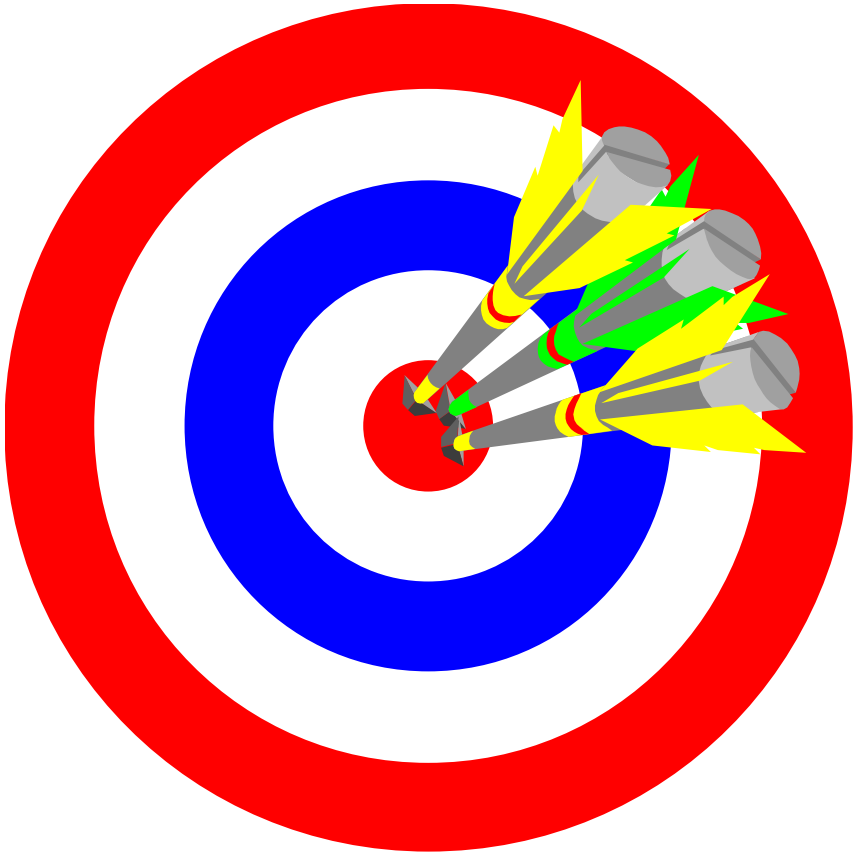
Process management?

end-of-pipe solution (post – mining reclamation) ?

Reclamation is the key to repair the environmental damage, which is the part of green mining.

In General,

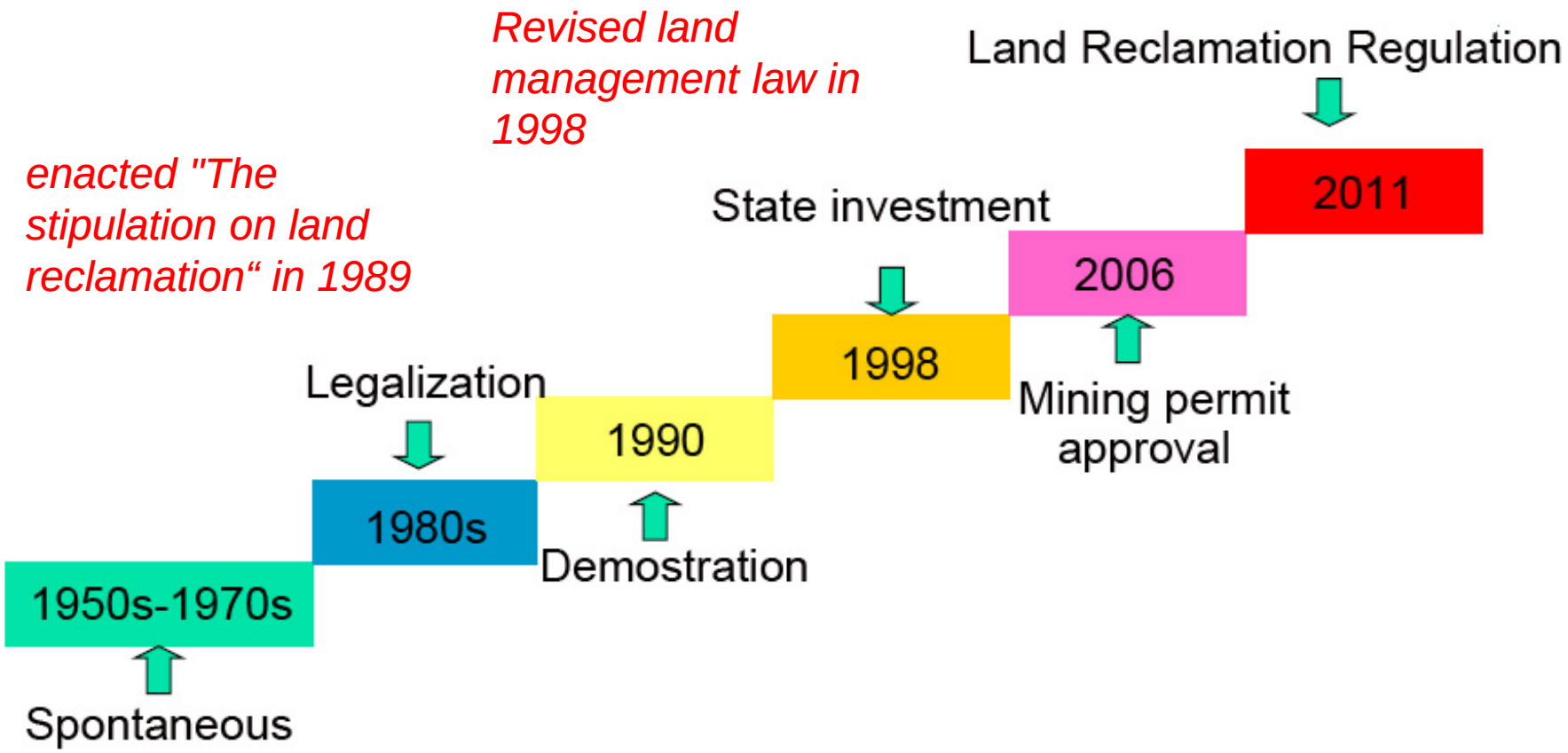
Land Reclamation



has become an urgent task in China

1. Background

History of mined land reclamation in China



Milestones of land reclamation in China

Mined land reclamation has been paid much attention since 1980’s in China.

Huaibei, Anhui Province

Jining, Shandong Province

Jiawang, Jiangsu Province

Zhungeer, Inner Mongolia

Lu'an, Shanxi Province

- After 30 years land reclamation, roughly 25% of the damaged land has been reclaimed, this made significant economic, social and environmental benefits.

1. Background

- (3). Some failure cases of land reclamation (problems of traditional reclamation technology)

Reclaimed land

Because of multi-seam excavation

Subsided again

Reclamation must be done after complete subsidence?---long time?

1. Background

- (3). Some failure cases of land reclamation (problems of traditional reclamation technology)

Subsided land

Reclaiming by hydraulic dredge pump,
----- Popular reclamation technique

Problems:
1.Poor soil: mixture of topsoil and subsoil;
2.High content of water;
3. Salinizatoion

Poor soil, low land productivity

1. Background

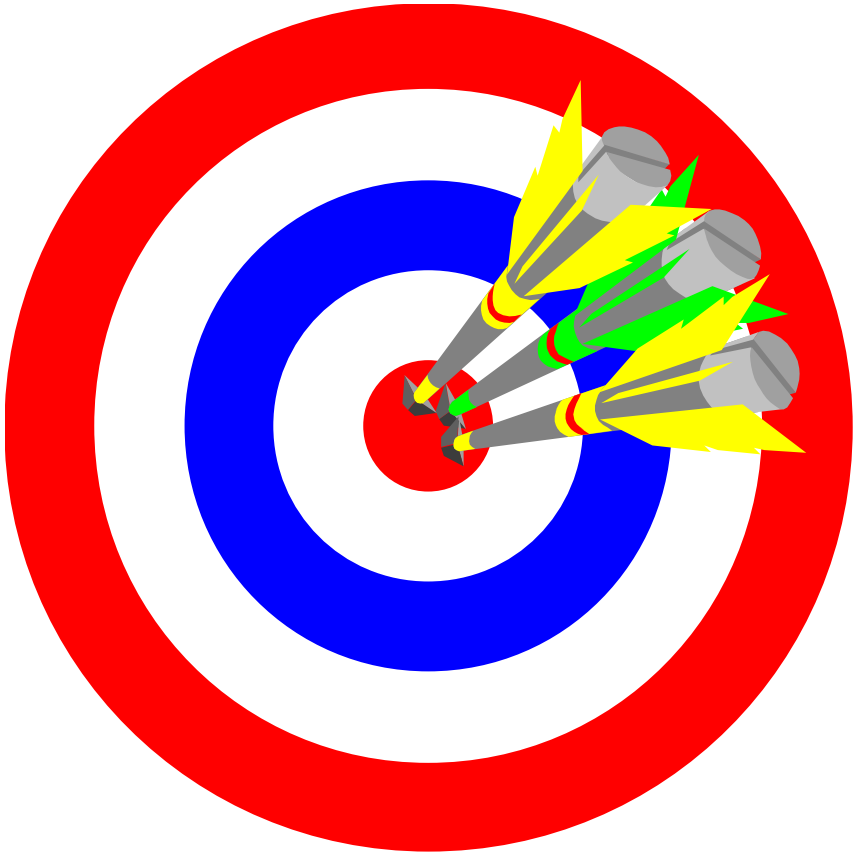
- (3). Some failure cases of land reclamation (problems of traditional reclamation technology)

Reclaimed subsidence land filled with coal wastes , fly ash

Problems:

Soil contamination: high heavy metal content

Innovagation



Is needed to improve the reclamation technology

2. Innovations of reclamation technology in China

- Concepts and ideas
- Technology of concurrent mining and reclamation
- Subsidence land reclamation filled with river sediments
- Reclamation of coal waste piles with spontaneous combustion

2. Innovations of reclamation technology in China

- (1). **Concepts and ideas**

WHAT IS LAND RECLAMATION?

Reclamation = recultivation ?
is a land related issue only?

implies that the site will be habitable to organisms originally present in approximately the same composition and density after the reclamation process has been completed

It is not only a land related issue, but a comprehensive issue that includes land reuse and environmental restoration.

2. Innovations of reclamation technology in China

- (1). **Concepts and ideas**

Pre-mining

Mining

reclamation

Land reclamation

Post-treatment measures

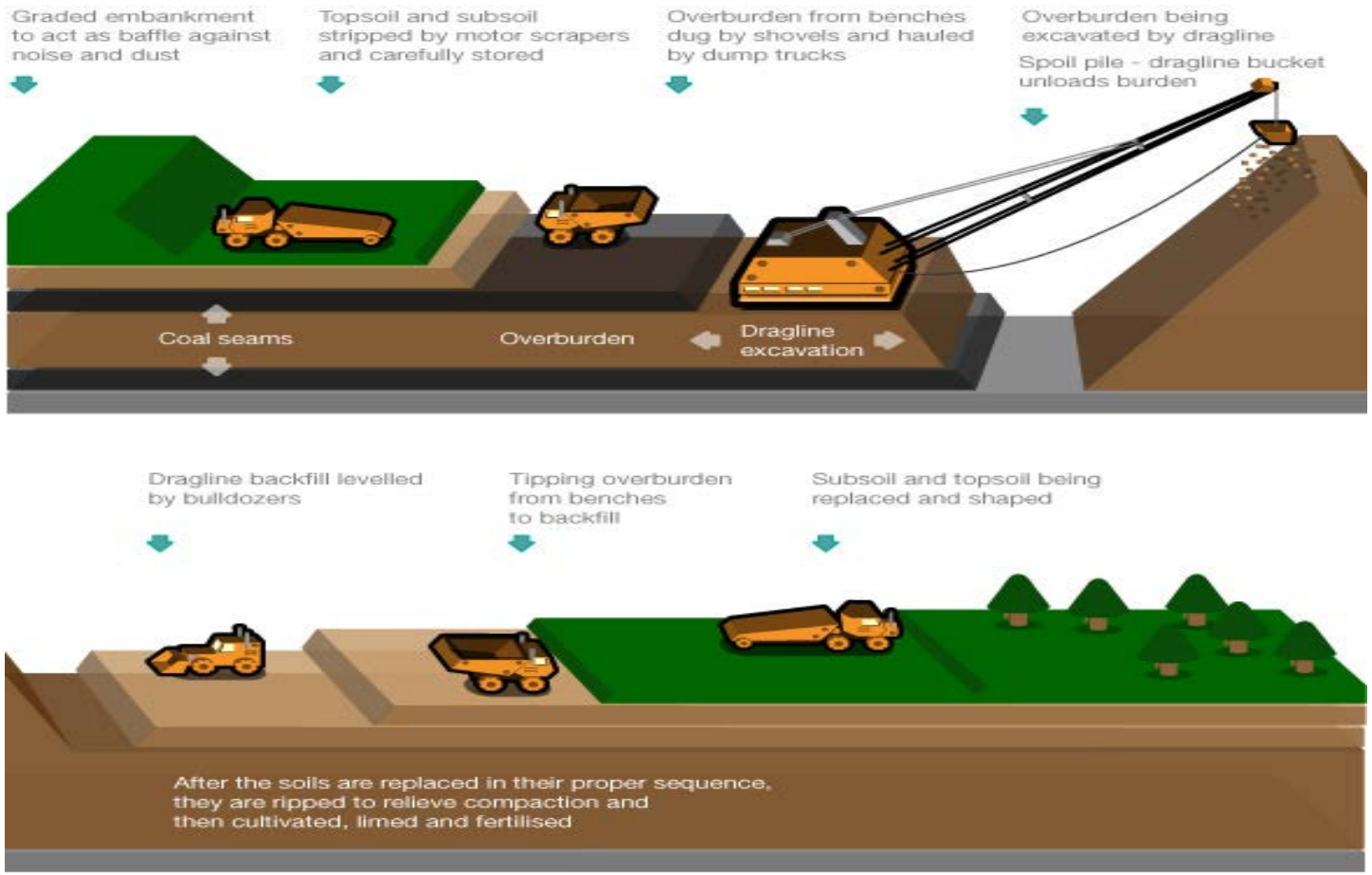
end-of-pipe solution

Pre-mining reclamation
Source Control
Concurrent mining and reclamation
Process management

Pre-treatment measures and concurrent mining and reclamation

2. Innovations of reclamation technology in China

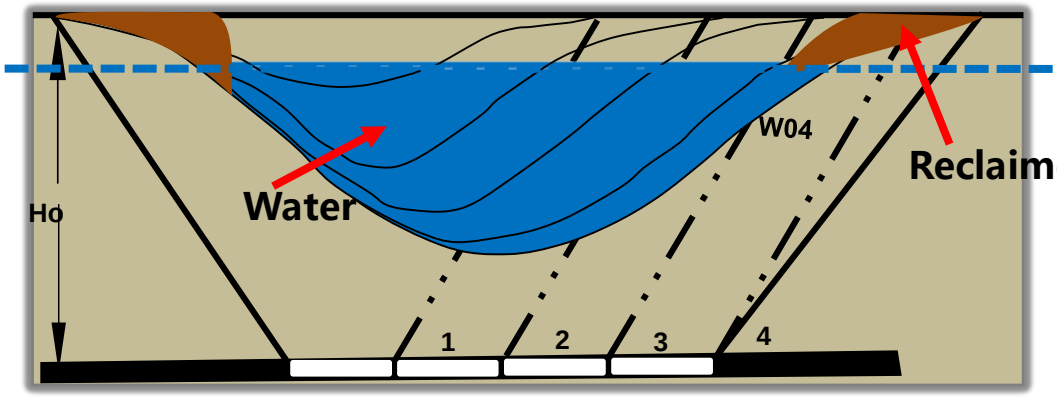
- (2). **Technology of concurrent mining and reclamation**



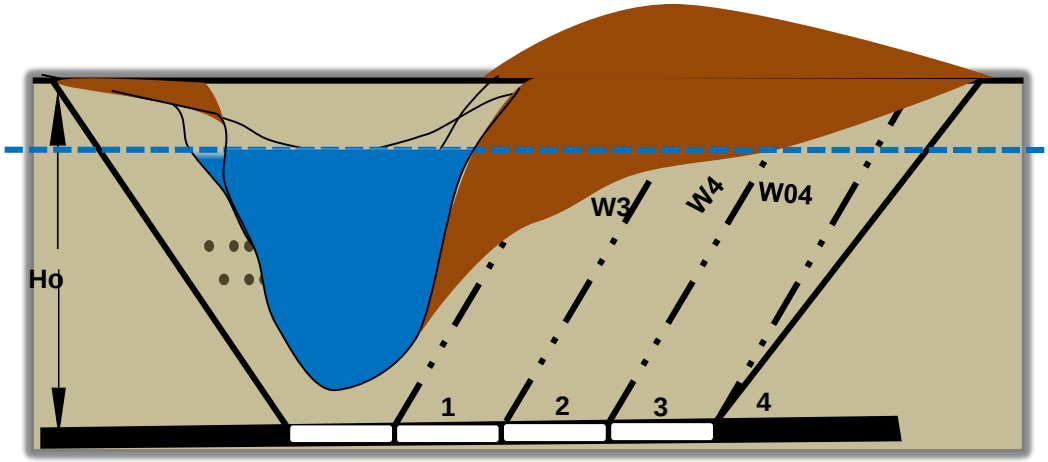
Surface coal mines

2. Innovations of reclamation technology in China

- (2). **Technology of concurrent mining and reclamation**



Traditional



Concurrent mining and reclamation

Underground coal mines

Restore much more land comparing traditional reclamation techniques

2. Innovations of reclamation technology in China

- (2). **Technology of concurrent mining and reclamation**

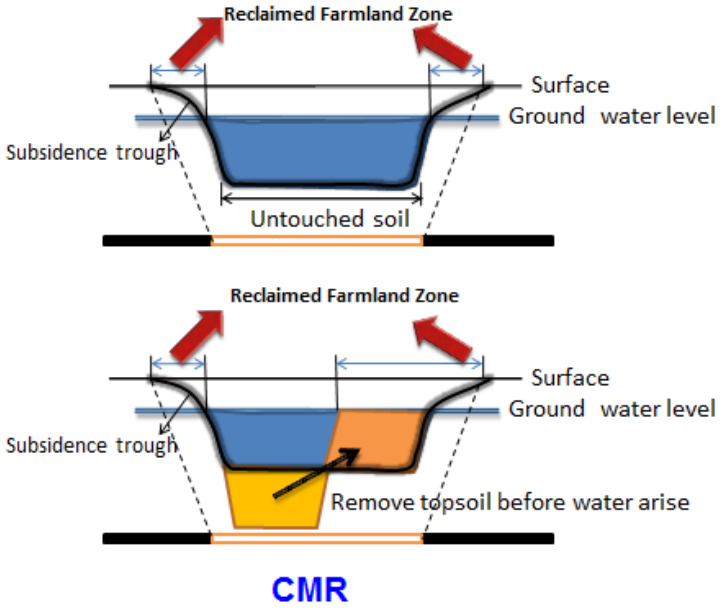
Keys of the technology

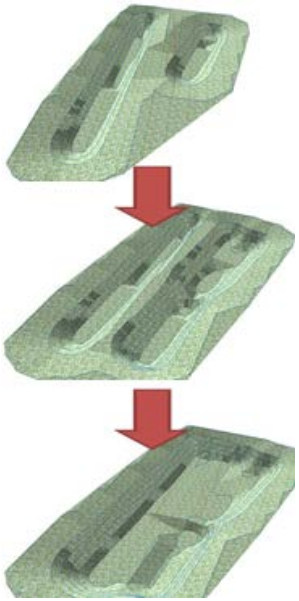
- Selecting the position for reclamation and dividing the stages of reclamation
- Determining the optimum time point for reclamation
- Determining the elevation of reclaiming land

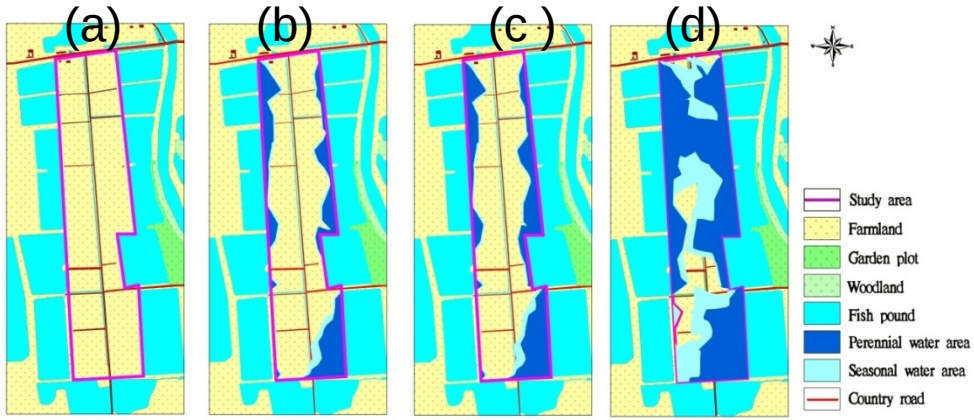
Concurrent mining and reclamation for underground coal mines

2. Innovations of reclamation technology in China

- (2). **Technology of concurrent mining and reclamation**







The farmland reclamation percentages at stage (b) and (c) could be increased 37.6% and 32.6%, respectively, compared against traditional reclamation until the land stabilizes (stage (d)).

A case study in Anhui Province

2. Innovations of reclamation technology in China

(3). Subsidence land reclamation filled with river sediments

Yellow River Sediments Backfilling (YRSB)

The Yellow River: rich in sands

Subsided Farmland: Lack of backfilling materials

Project supported by National Key Technology R &D program (2012BAC04B03)

2. Innovations of reclamation technology in China

(3). Subsidence land reclamation filled with river sediments

Filling reclamation of mining subsidence land with Yellow River sediment in Jining city, Shandong Province

Being reclaimed

After reclamation

2. Innovations of reclamation technology in China

(3). Subsidence land reclamation filled with river sediments

Keys to be solved for filling subsided land with Yellow river sediments

- **High efficient method of taking sediments from Yellow river**
- **Pipeline transportation with long distance**
- **Fast filling, drainage, soil reconstruction and restoration of high quality farming**

2. Innovations of reclamation technology in China

- (4). **Reclamation of coal waste piles with spontaneous combustion**

Pre-treatment

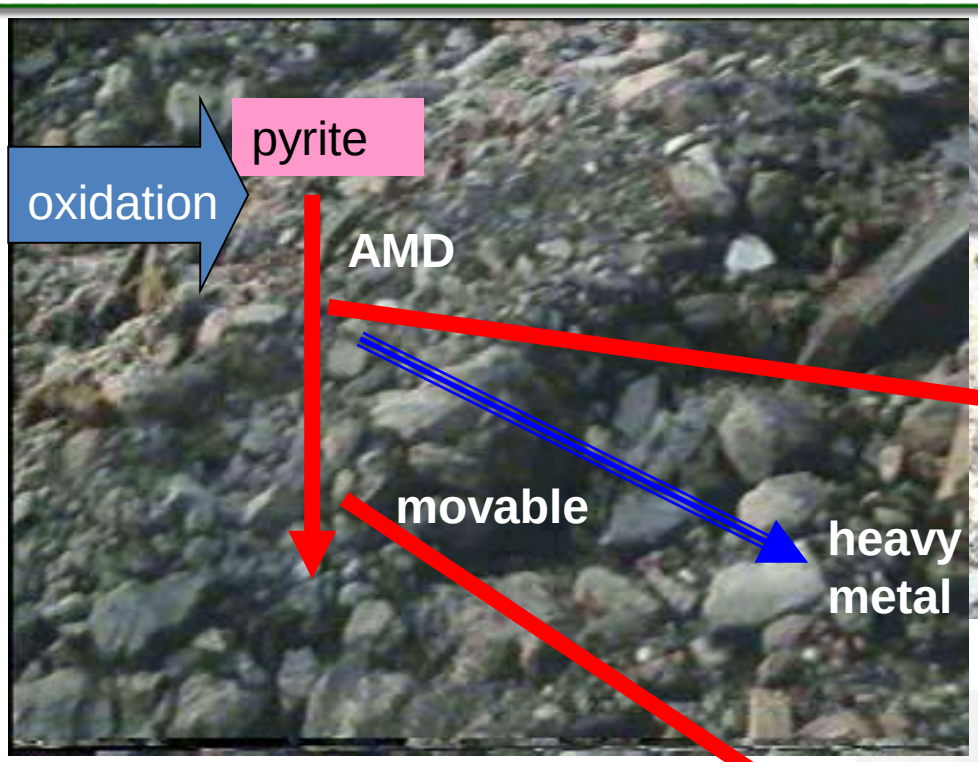
Post-treatment

spontaneous combustion

Coal waste piles with spontaneous combustion

It is difficult to reclaim, easy to re-burn after revegetation;
A lot of failure cases

Mechanism—— oxidation is the key drive resulting combustion



煤矸山造成的酸性水污染AMD

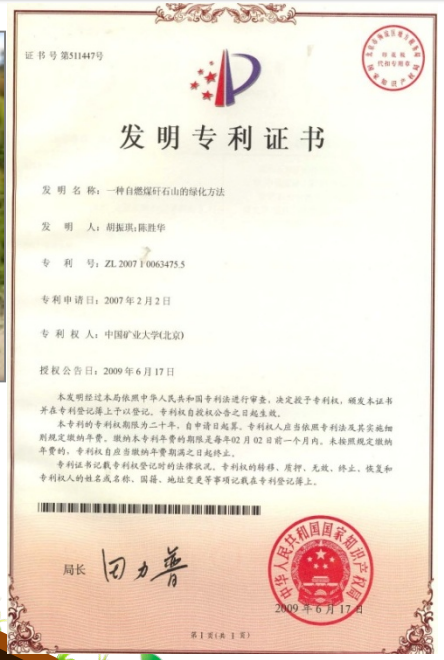
Coal waste piles with acid, heavy metals and spontaneous combustion

- generation of acid and pollution
- control of spontaneous combustion
- AMD control
- revegetaion

spontaneous combustion
煤矸石山自燃

Keys：

- **Inhibit oxidation---- by bactericide and cover technique**
- **New technique for putting out the fire-- grouting**
- **Combination of putting out a fire and fire prevention**
- **Revegetation technology--- grass and shrub**



证书号第511447号

发明专利证书

发明名称：一种自燃煤矸石山的绿化方法

发明人：胡振琪;陈胜华

专利号：ZL 2007 1 0063475.5

专利申请日：2007年2月2日

专利权人：中国矿业大学(北京)

授权公告日：2009年6月17日

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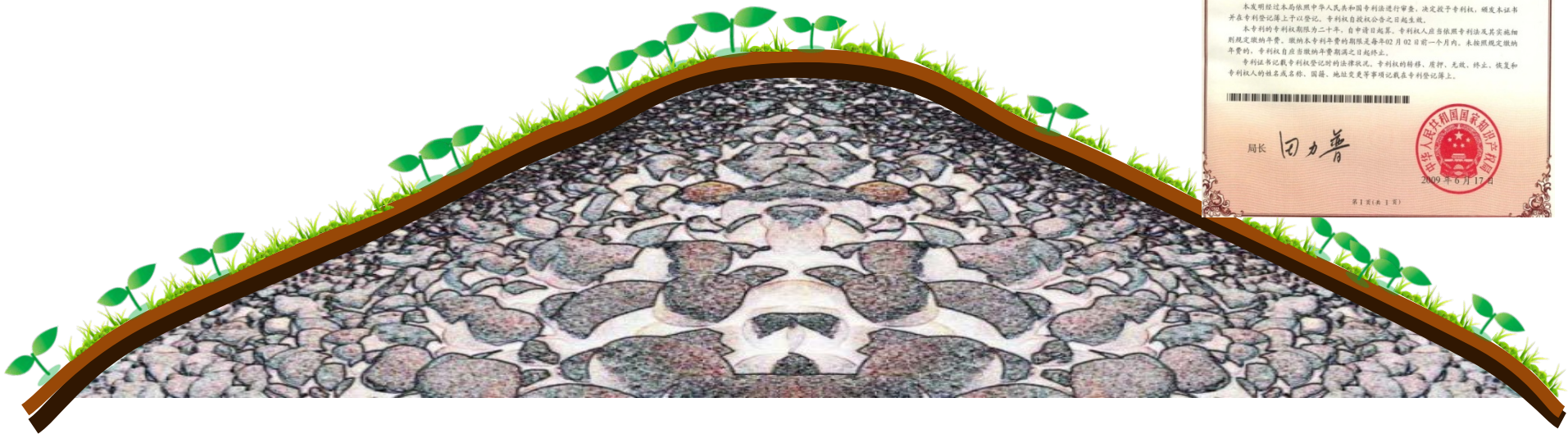

3. Summary

- Reclamation is part of green mining, which is the key **to repair the environmental damage.**
- Renovation on concept and idea of reclamation is very important: The “reclamation” is not only the “land issue”, but also the “environmental issue”. Reclamation should not be the afterward activities (end-of-pipe solution), should be pre-mining or synchronous operation with mining.

3. Summary

- concurrent mining and reclamation is new technology and idea, which could restore much more land, which is the innovation of subsidence land reclamation.
- innovation on filling reclamation: subsidence land reclamation filled with river sediments instead of coal wastes and fly ask, which is environment-friendly reclamation method.
- Innovation on reclamation of coal waste piles with spontaneous combustion is to control re-burn of the coal waste pile.

Thanks!!