

# **Regulatory Status and Challenges in NORM Industries in China Coal Mining and Rare Earth Mining**



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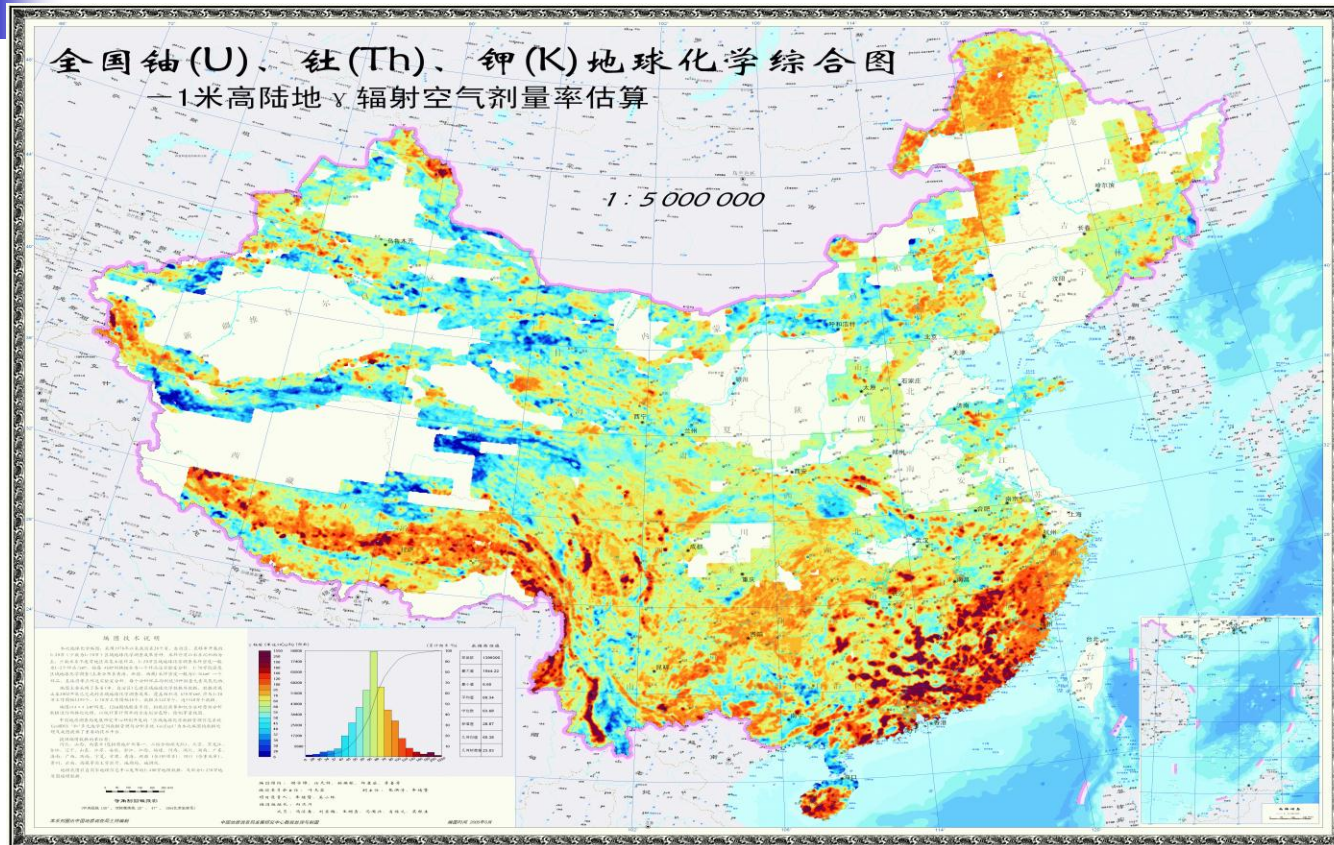


# Background (1/2)

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- **The natural radiation exposure levels vary greatly in different regions in China. The average annual effective dose to the public from the natural radiation exposure is about 3.1 mSv.**
- **Natural radiation by human activities is the major contributors to the public and occupational exposure. Such as annual effective dose to the public from indoor radon is 0.64 mSv/a, and from coal-fired power plants is  $1 \times 10^{-2}$  mSv/a.**
- **Reason of higher indoor radiation is use of waste or slag as building materials.**

# Background (2/2)



Geochemistry Integrated Map for Uranium, Thorium and Potassium in China for  $\gamma$  ray air absorb exposure dose radiation level above 1 meter from the ground



# Regulatory status relating to the NORM Industries (1/7)

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- **“The Law on Prevention and Control of Radioactive Pollution” was established by National People’s Congress (NPC) in year of 2003.**
- **It is a major law relating to nuclear safety, radiation safety and radiation environmental protection. Among others, some provisions of the law are deal with the basic regulatory principle for the NORM industries.**



# Regulatory status relating to the NORM Industries (2/7)

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- **The Law requests that the owner of a non-uranium mine containing higher natural radioactive nuclide should conduct an Environmental Impact Assessment (EIA) and the EIA report need to approve by EPAs.**
- **Site inspections for some NORM industries or activities carry out by EPAs.**



# Regulatory status relating to the NORM Industries (3/7)

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- **The Chinese BSS titled “Basic standards for protection against ionizing radiation and for the safety of radiation sources” (GB18871-2002), issued by Government in 2002. It defines the natural radiation sources related human activities should be incorporated into the scope of management of radiation protection.**
- **The MEP issued a Decree titled “The List of Regulation on Radiation Environment for Exploring and utilizing of Mineral Resources (First batch)” in 2013. The key points of the Decree:**
  - **the exploring and utilizing activities of mineral resources should be at the list;**
  - **the activity concentration  $\geq 1\text{Bq/g}$  for any nuclide of Uranium or Thorium for raw ore, intermediate products, tailings (slag or residues).**



# Regulatory status relating to the NORM Industries (4/7)

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- **Specific regulatory procedure:**
  - **to any new project or activity that concern higher natural radiation level once within the list of Decree and also meets activity concentration criteria ( $\geq 1\text{Bq/g}$ ),**
  - **owner should prepare a documents titled “special report assessment of radiation environmental impact” at planning stage of the project or the mines or plants before construction or beginning of activities;**
  - **the document needs approved by relevant EPA.**

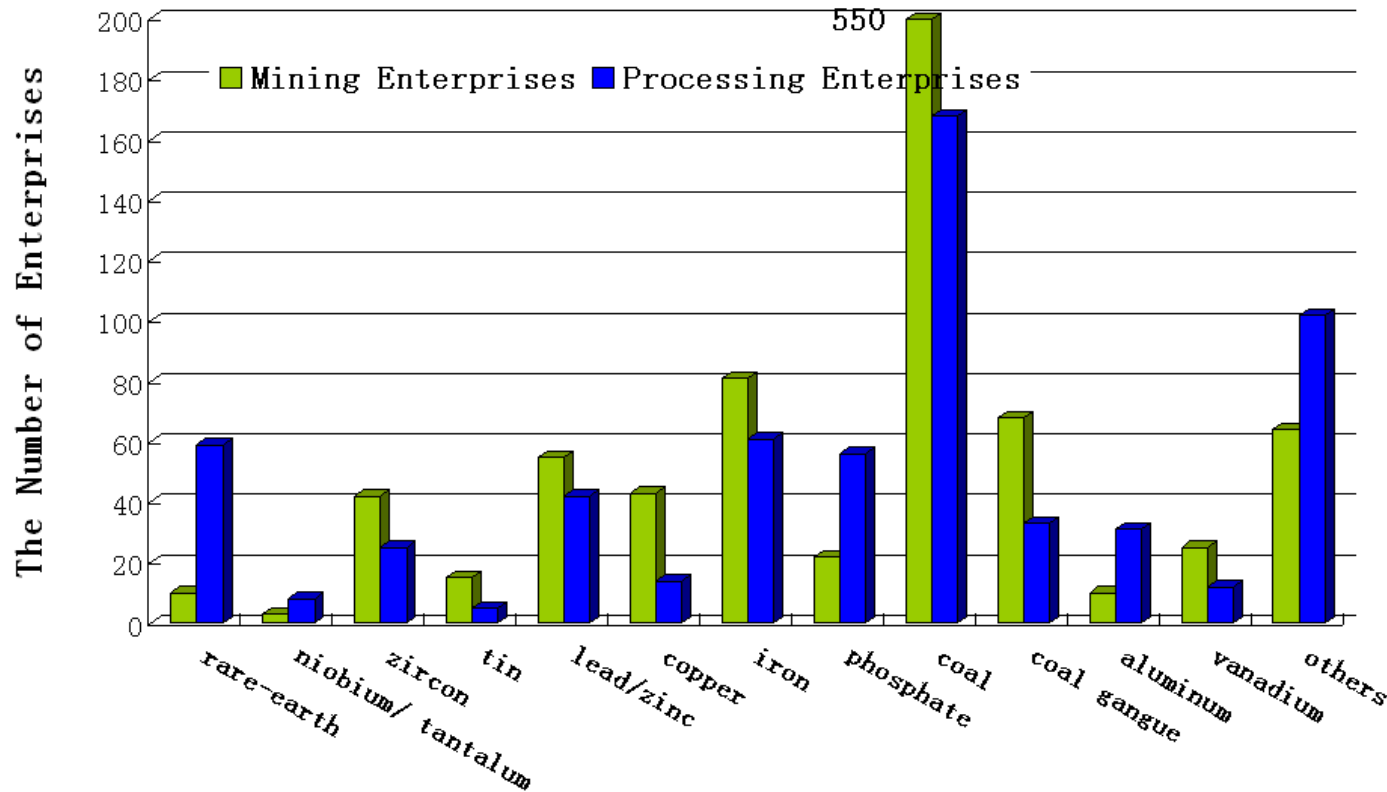


# Regulatory status relating to the NORM Industries (5/7)

No.	Business	Industrial Activities
1	Rare earths	All kinds of rare earth ore (including monazite, bastnaesite, xenotime and ionic rare earth ore) mining, ore dressing and smelting
2	Niobium & Tantalum	Niobium, tantalum ore mining, ore dressing and smelting
3	Zirconium & Zirconium Oxide	Mining, ore dressing and smelting of zircon (sand) and baddeleyite
4	Vanadium	Vanadium ore mining and smelting
5	Stone Coal	Stone coal mining and utilization

**The List of Regulation on Radiation Environment for Exploring and utilizing of Mineral Resources (First Batch)**

# Regulatory status relating to the NORM Industries (6/7)



**The distribution of number of enterprises survey conducted by MEP in 2007**



# Regulatory status relating to the NORM Industries (7/7)

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- **The mineral resources with higher radioactivity levels are rare earths, niobium/ tantalum and zircon. The average external  $\gamma$  dose rates respectively:**
  - **Rare earths, 5709 nGy/h,**
  - **Niobium/ tantalum, 3263 nGy/h**
  - **Zircon, 1592 nGy/h**
- **The average concentration of  $^{238}\text{U}$ ,  $^{226}\text{Ra}$  or  $^{232}\text{Th}$  in these mineral resources is exceeded by 1Bq/g.**



# **NORM exposure to public from coal mining (1/4)**

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- **Three main sources of radon emissions from coal mine:**
  - **the emissions into the environment by ventilation systems through underground mining;**
  - **continuous radon release and discharge during the storage period of the raw coal and coal gangue on surface storage sites;**
  - **discharge and release of dissolved radon from underground mining water.**
- **Among them, radon emissions by coal mine ventilation systems are the major source.**



# **NORM exposure to public from coal mining (2/4)**

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- **About  $3.24 \times 10^9$  Bq/million tons (coal products) for various types of coal mines in China with a normalized additional average annual radon emissions;**
- **Based on above normalized year additional radon emissions, according to electricity production in thermal power plants of typical coal consumption, the normalized radon emissions from coal mining are about  $9.72 \times 10^{11}$  Bq/GWa.**



# **NORM exposure to public from coal mining (3/4)**

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- **Radon release rate for raw coal and coal gangue storage sites is range of  $1\sim 40$  mBq/  $m^2s$ , so as an typical site area of  $5000$   $m^2$ , radon emissions through this source are in the range of  $0.16\sim 6.4$  GBq/a.**
- **The radon concentrations in the mining water from coal mine are in the range of hundreds to  $10,000$  Bq/ $m^3$ .**
  - **For example, a typical production of  $1.9$  million t/a. of raw coal, mining water arising from coal mine is about  $1.5 \times 10^5$   $m^3/a$ , meanwhile, with the release amount of radon within the mining water is around  $0.03\sim 1.5$  GBq/a.**



# **NORM exposure to public from coal mining (4/4)**

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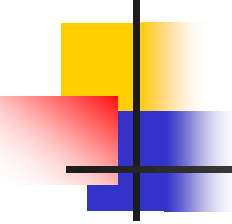
- **During period of years from 1980 to 2012, additional normalized collective effective dose for public caused by coal-fired power plants yearly, man-Sv/GWa;**
- **The normalized collective effective dose from the airborne effluent release to public for a coal power plant is at range of  $2.8 \times 10^3 \sim 1.4 \times 10^4$  man-Sv/GWa;**
- **The annual collective effective dose to the public, arising from the buildings constructed with bone-coal bricks countrywide is 3,300 man-Sv/a.**

# Occupational exposures from mining (1/1)

- **Occupational exposures for some NORM industries are significant in China.**
  - **The survey results shown the metal mines and the coal mines are relatively higher compared with other mines.**

Workplace	Annual average monitored workers	Annual collective effective dose (man-Sv)	Average individual effective dose (mSv/a)
Coal mine	6,500,000	1.46 E4	2.40
Metal mine	1,000,000	5.53 E3	5.53
Other mines	3,000,000	2.06 E3	0.69
Total (average)	10,500,000	2.20 E4	2.10





# Challenges, discussions and conclusions (1/3)

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- **NORM radiation caused by human activities is the major additional dose exposure both to the public and occupational workers.**
- **There are about 10 million people working in mining in China, and 100 million people living in the houses of higher concentrations of radon.**
- **NORM radiation is becoming a significant issue. The additional external exposure for workers is 0.69 – 5.53 mSv/a, in some cases the occupational exposure are higher than nuclear industry, and the effective dose probably exceeding 1.0 mSv/a for public is exist, indoor radiation level is higher in the buildings using coal ash or slag materials, internal exposure control is quite important.**



# Challenges, discussions and conclusions (2/3)

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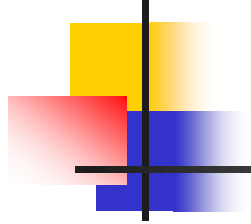
- **The operational organizations in some areas of NORM industries should take measures to lower the exposure of workers. The government should take some measures to lower the public exposure.**
- **In case of high concentration of radon in room in which people lived should take some remedial measures.**



# Challenges, discussions and conclusions (3/3)

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- **To strengthen the regulatory control on non-uranium mines is very essential, the regulatory body should establish regulations and guides relating to non-uranium mines.**
- **The EPAs should carry out inspections regularly for working sites of NORM industries and their surrounding areas to ensure the safety of the workers and public, as well as waste discharges being under control.**
- **Radiation safety training courses should be conducted regularly for employee worked in sectors of industries and regulatory bodies to strengthen the knowledge of radiation safety and radiation protection.**



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**Thank you for your attention!**