

# The EIA suggestions for CO<sub>2</sub> Storage

Liu Lan-Cui, Dong Cao  
Chinese Academy of Environmental  
Planning,  
Ministry of Environmental Protection



China Australia Geological Storage of CO<sub>2</sub>

中澳二氧化碳地质封存



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- The environmental impact of CO<sub>2</sub> storage
- Environmental impact assessment regulations
- Considerations for CCS technology

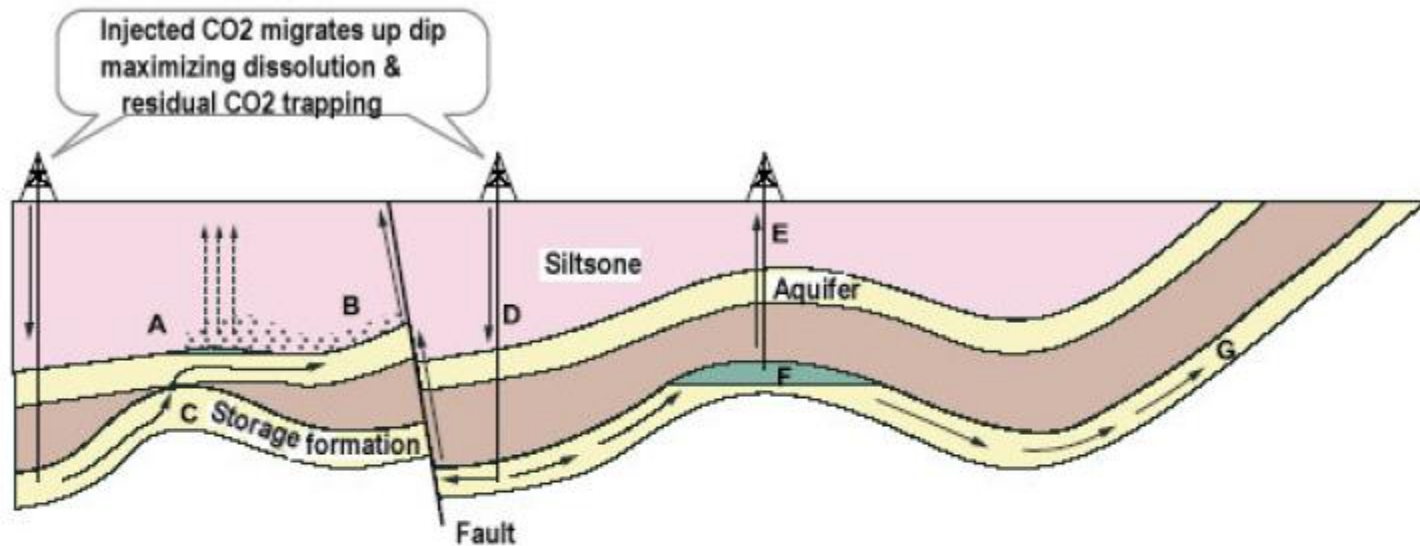


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# Potential escape of storage

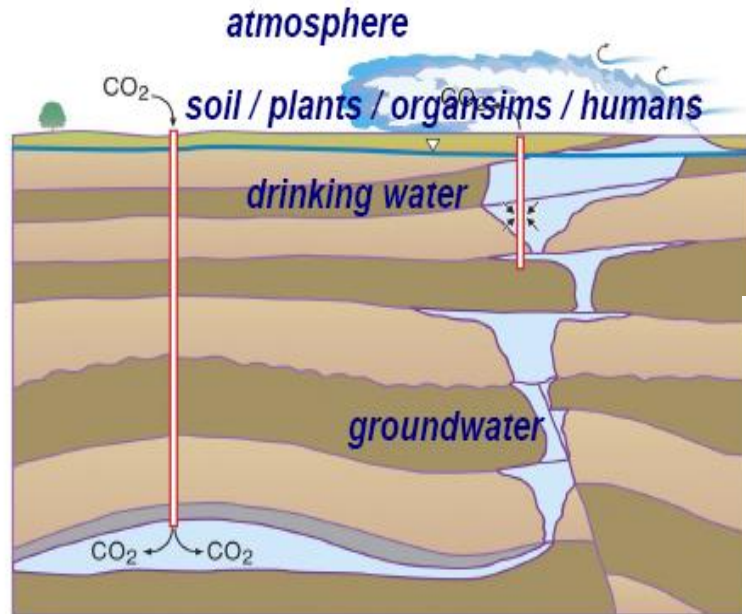


## Potential Escape Mechanisms

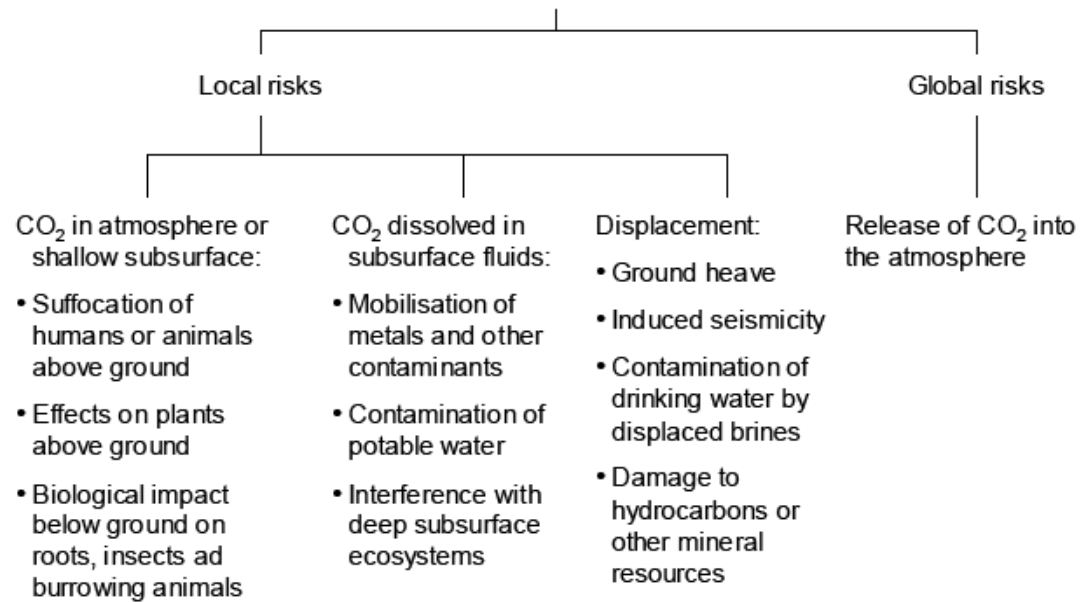
<p>A. CO<sub>2</sub> gas pressure exceeds capillary &amp; passes through siltstone</p>	<p>B. Free CO<sub>2</sub> leaks from A into upper aquifer up fault</p>	<p>C. CO<sub>2</sub> escapes through 'gap' in cap rock into higher aquifer</p>	<p>D. Injected CO<sub>2</sub> migrates up dip, increases reservoir pressure &amp; permeability of fault</p>	<p>E. CO<sub>2</sub> escapes via poorly plugged old abandoned well</p>	<p>F. Natural flow dissolves CO<sub>2</sub> at CO<sub>2</sub> / water interface and transports it out of closure</p>	<p>G. Dissolved CO<sub>2</sub> escapes to the atmosphere or ocean</p>
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# Potential Environmental impact and risks



## Risk of geologic storage of CO<sub>2</sub>



# The negative of CO<sub>2</sub> leakage

	No adverse effects	Adverse effects	Lethal/severe effects
Groundwater	< 0.2 % CO <sub>2</sub> is in general a normal concentration in groundwater	0.2 - 2 % CO <sub>2</sub> : Elevated low acidity without significant impacts.  > 2 % CO <sub>2</sub> : Mild acidity and corrosion	> 6 % CO <sub>2</sub> : Acidity, well corrosion, and irrigation loss
Freshwater ecosystems	The impact of a CO <sub>2</sub> leakage into a body of water will depend on the amount and rate of release, the buffering capacity of the water body, and its mixing dynamics.		
Fish	<1%	1-6 % CO <sub>2</sub> : Fish has been observed to show signs of significant stress	> 2 % CO <sub>2</sub> concentration in water can be lethal to fish



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	No adverse effects	Adverse effects	Lethal/severe effects
Terrestrial ecosystems			A standard amount of CO <sub>2</sub> used to preserve food from insects, microbes, and fungi, is 40%
Invertebrates			
Mammals	< 1 % (estimated on the basis that most mammals react similar to human beings when exposed to CO <sub>2</sub> ). Hibernating mammals have higher tolerance levels.		
Plants	Slightly raised (500–800 ppm) levels of CO <sub>2</sub> usually have the effect of stimulating growth in C <sub>3</sub> plants, whereas the response in C <sub>4</sub> and CAM plants is less obvious. In the long term, ecosystem changes in favour of the C <sub>3</sub> plants may be expected. There seems to be little benefit in CO <sub>2</sub> concentrations above 800 ppm, but plants can be expected to tolerate concentrations of 1000 ppm (1 %) comfortably. Plants are fairly tolerant to short-term exposure.	> 5 % CO <sub>2</sub> : Deleterious effects on plant health and yield.  5 to 30% CO <sub>2</sub> : Severe effects to be expected in this range.	>20% CO <sub>2</sub> in soil gas: Long term exposure (weeks or months) has been observed to lead to dead zones where no macroscopic flora has survived  > 30 % CO <sub>2</sub> in soil gas is defines as a lethal concentration level for plants .



	No adverse effects	Adverse effects	Lethal/severe effects
Deep subsurface ecosystems	Not enough information about subsurface ecosystems, such as the distribution and physiology of microbes in the subsurface, is known to make a reliable estimation of concentration limit values.		
Human health	<p>&lt; 1 % CO<sub>2</sub></p> <p>Swedish occupational safety regulations:</p> <p>Hygienic threshold value for exposure during a working day: 0.5 %</p> <p>Short time threshold value (average exposure during 15 minutes): 1 %</p>	<p>1 - 3 % CO<sub>2</sub>: Increased breathing, headache and sweating. Physiological adaptation occurs without adverse consequences.</p> <p>3 - 5 % CO<sub>2</sub>: Significant effect on respiratory rate, increased blood pressure and some discomfort</p> <p>&gt; 5 %, physical and mental ability is impaired and loss of consciousness can occur.</p>	<p>&gt; 10 % CO<sub>2</sub>: Severe symptoms, including rapid loss of consciousness, possible coma or death, result from prolonged exposure</p> <p>&gt; 25-30 % CO<sub>2</sub>: Loss of consciousness occurs within several breaths and death is imminent</p>



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# Environmental impact assessment regulations



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# What is aim of the Environmental impact assessment

- An environmental impact assessment is an assessment of the possible positive or negative impact that a proposed project may have on the environment, together consisting of the environmental, social and economic aspects.
- The purpose of the assessment is to ensure that decision makers consider the ensuing environmental impacts when deciding whether to proceed with a project.



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# SEA-Storage

Environmental Quality Objective (EQO)	On-shore storage: Sandy soil with weak buffer capacity and oligotrophic lake in area above reservoir			On-shore storage: Clay-rich soil with strong buffer capacity and eutrophic lake in area above reservoir			Off-shore storage		
	Concept works according to plan - no leakages	Long term low leakage rate	Short term high leakage rate	Concept works according to plan - no leakages	Long term low leakage rate	Short term high leakage rate	Concept works according to plan - no leakages	Long term low leakage rate	Short term high leakage rate
1. Reduced Climate Impact	0	-2	0	0	-2	0	0	-2	0
2. Clean Air	0	0	-2	0	0	-2	0	0	-1
3. Natural Acidification Only	0	-1	0	0	0	0	0	-1	0
4. A Non-Toxic Environment	0	-1	-1	0	-1	-1	0	-1	-1
5. A Protective Ozone Layer	0	0	0	0	0	0	0	0	0
6. A Safe Radiation Environment	0	0	0	0	0	0	0	0	0
7. Zero Eutrophication	0	0	0	0	-1	0	0	0	0
8. Flourishing Lakes and Streams	0	-1	-1	0	-1	-1	0	0	0
9. Good-Quality Groundwater	0	-2	-1	0	0	0	0	0	0
10. A Balanced Marine Environment...	0	0	0	0	0	0	-1	-2	-2
11. Thriving Wetlands	-1	-1	-1	-1	-1	-1	0	0	0
12. Sustainable Forests	0	-1	0	0	-1	0	0	0	0
13. A Varied Agricultural Landscape	0	0	0	0	0	0	0	0	0
14. A Magnificent Mountain Landscape	-1	-1	-1	-1	-1	-1	0	0	0
15. A Good Built Environment	0	0	-2	0	0	-2	0	0	0
16. A Rich Flora and Fauna	-1	-2	-1	-1	-2	0	-1	-2	0
Sum	-1,3	-8,7	-5,8	-1,3	-6,7	-3,8	-2,0	-8,0	-4,0
Average	-0,12	-0,79	-0,53	-0,12	-0,61	-0,35	-0,18	-0,73	-0,36



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# Law of the People's Republic of China on Environmental Impact Assessment

- The law is formulated for **the purpose of implementing the strategy of sustainable development, preventing adverse impact on the environment due to execution of plans and construction projects**, and facilitating the coordinated development of the economy, society and environment.
- Development of **plans and construction projects** that have environmental impact within the territory of People Republic of China and other sea areas should be subject to EIA.



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# Environmental risk assessment

- Environmental risk assessment is one of parts of EIA.
- The purpose of ERA is to identify and forecast human health and environmental damage from material leakage caused by the potential danger, harmful factors, emergent accidents.



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# Guidelines related to EIA

- **Technical guidelines for EIA: General program**
- **Technical guidelines for EIA: Atmospheric environment**
- **Technical guidelines for EIA: ground water environment**
- **Technical guidelines for EIA: surface water environment**
- **Technical guidelines for ERA on projects**



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# The requirement for some related project

	EIA book	EIA table	Register table
Thermal power generation	Total	/	/
Desulphurization	Seawater desulphurization	others	/
Oil deport	More than 0.2 million m3		
Gas deport	underground		
Oil and gas pipeline	More than 200 km; environmental sensitive regions		



# Suggestions for EIA



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# Guideline suggestions for EIA

- There is no EIA requirements for CO<sub>2</sub> storage and no guideline .
- Assessment target: environmental risk by potential leakage
- Risk accidents identification: potential CO<sub>2</sub> leakage
- Risk Rank: The first grade for purpose of CO<sub>2</sub> storage to mitigate climate change
- Assessment distance: the maximum transport distance
- Risk avoidance



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# Environmental risk matrix

分类	一级评价指标	二级评价指标	灌注前	灌注中	灌注后
大气	大气	CO <sub>2</sub>			
		硫氧化物			
		氮氧化物			
	噪音 振动 光 气味	粉尘			
		噪音			
		振动			
水	地表水和地下水	光			
		气味			
		pH			
		HCO <sub>3</sub> <sup>-</sup>			
		污染			
土壤	土壤污染	浑浊			
		水温			
生态	动物	有害物质浓度（包括重金属）			
		土壤污染			
	植物	动物			
		植物			
废弃物	微生物	地上微生物			
		地下微生物			
		生活废弃物			
		固体废弃物			
社会经济	就业 能源需求 人与自然 人体健康	高放射性废弃物			
		就业			
		能源需求			
人	人与自然 人体健康	接触机会			
		人体健康			



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# 汇报主要内容

- 在识别二氧化碳地质封存泄漏环境风险的基础上，结合我国的环境风险评估制度规定，针对二氧化碳地质封存环境风险评估的环境风险评估指标、可接受的风险评价水平、评价方法等进行了探索性研究。



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Thanks for your  
attention



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