

Environmental Impact and Risk Assessment for CO₂ Geological Utilization and Storage

二氧化碳地质利用和封存的环境影响风险评价

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中文摘要

- CO₂地质利用和封存过程的环境风险主要是指CO₂地质封存工程（灌注井、监测井、灌注设备、地下封存系统等）安装、建设和运行过程中因CO₂泄漏，对场地及周围一定区域内人群及生态环境系统产生危害、对土壤环境、地表水和地下水环境产生污染等的风险。



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报告主旨

- 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价制度规定，针对二氧化碳地质封存环境风险评价的环境风险评价指标、可接受的风险评价水平、评价方法等进行探索性研究。



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Outline

提纲

- CO₂ geological storage (CGS) and its related environmental impact and risk
- General aspects of environmental impact assessment (EIA)
- Considerations and suggestions for EIA of CGS

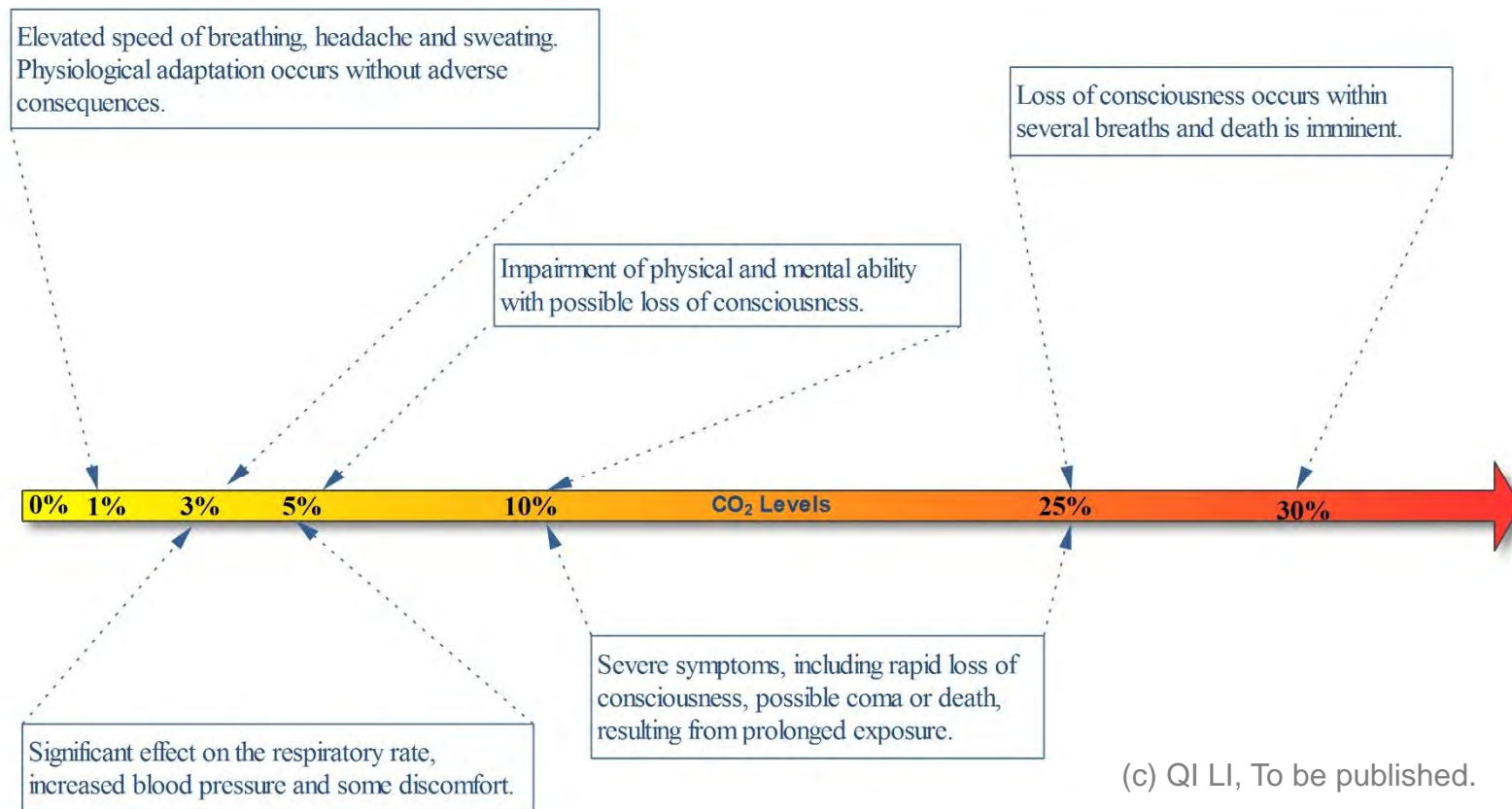


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Effects of different CO₂ levels on human health from a point view of risk assessment

不同二氧化碳浓度对人体健康的影响

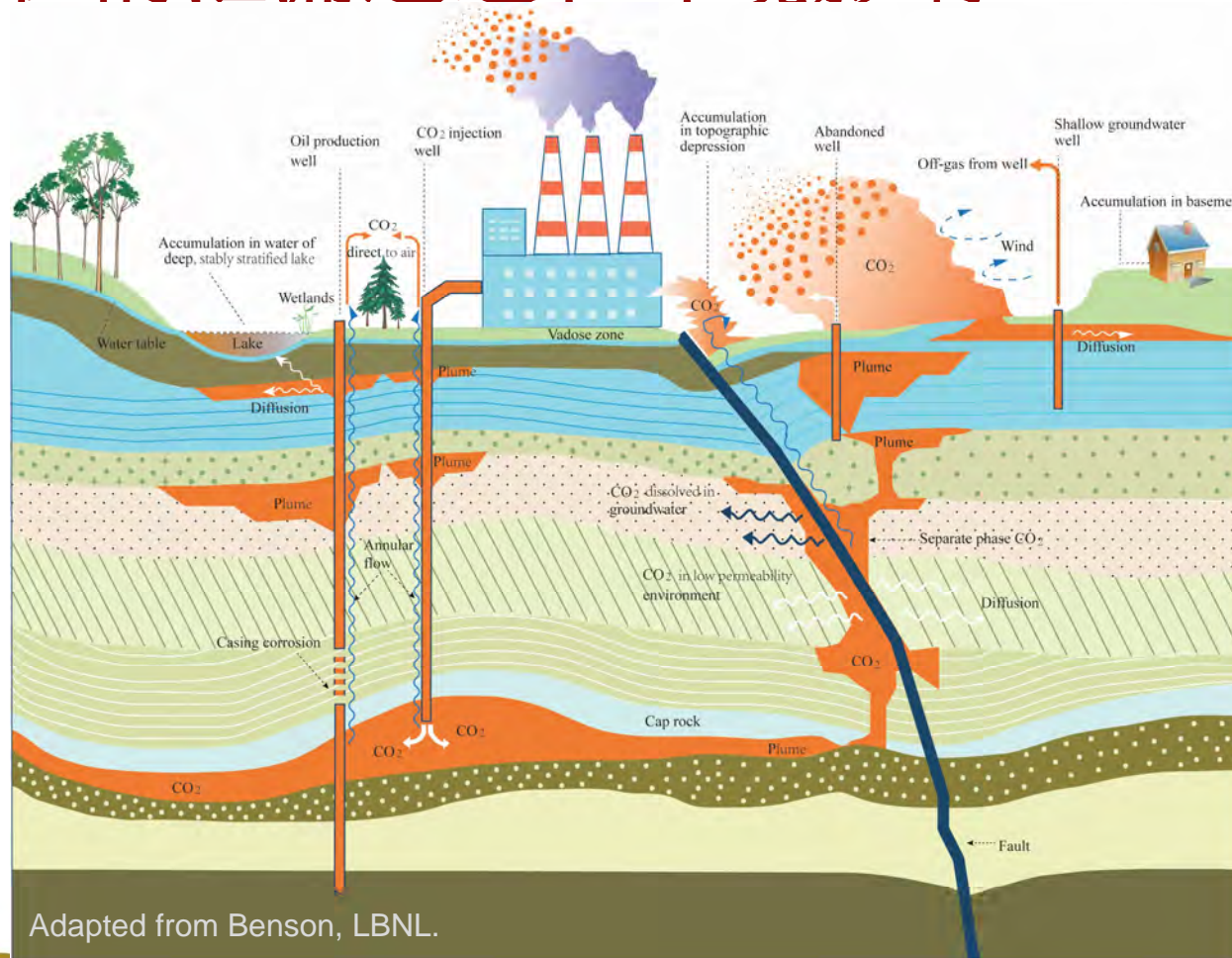


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Potential Escape and Environmental Impact

潜在的泄漏通道和环境影响



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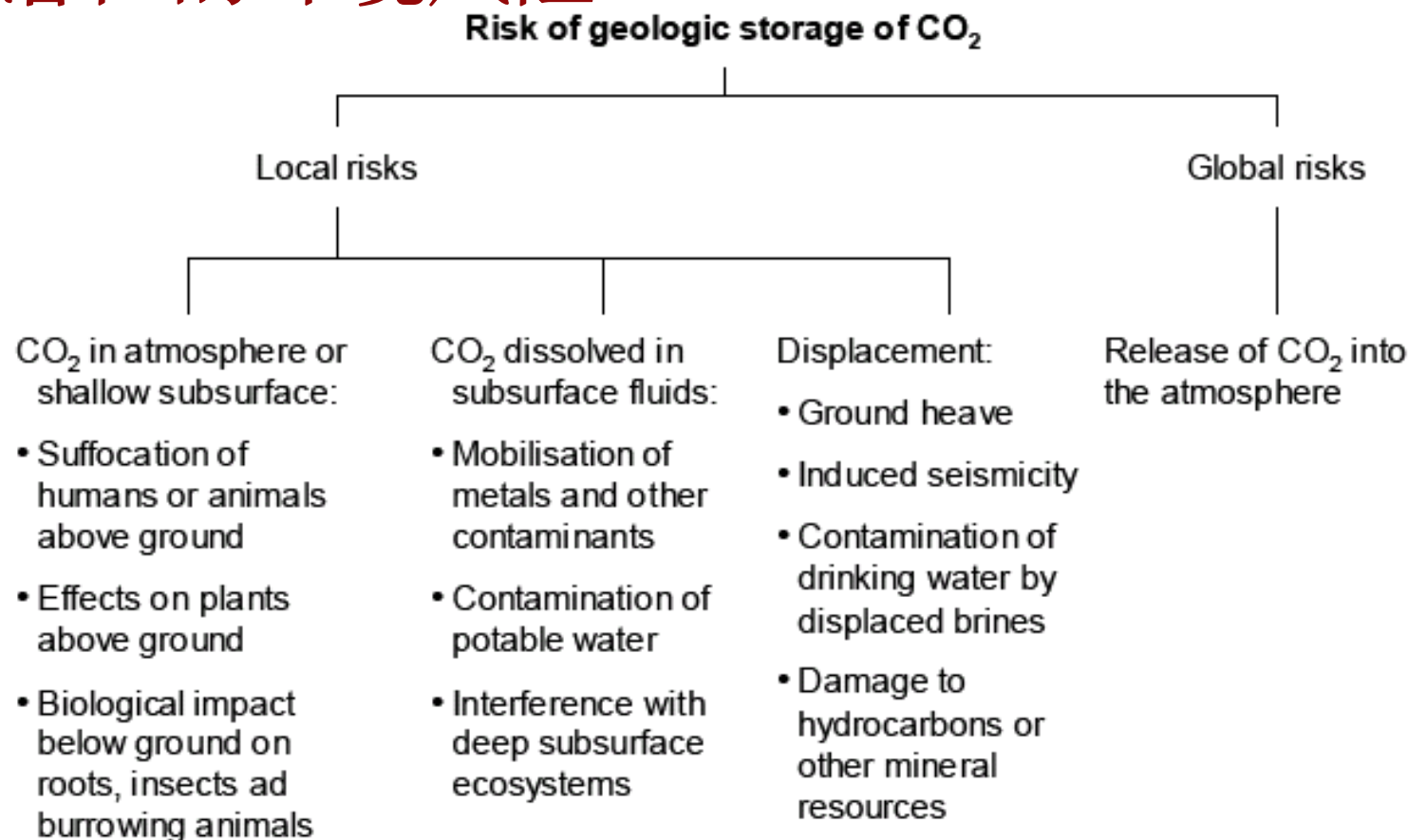
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Potential Environmental Risks

潜在的环境风险



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EIA Requirements

环评需要

All CCS projects will be subject to environmental assessment

Permits

Environmental Guidelines for Carbon Dioxide Capture and Geological Storage – 2009

Directive 2009/31/EC of the European Parliament and of the council

Amendment of Marine Pollution Prevention Law

The Storage of Carbon Dioxide (Licensing) Regulations 2010



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Key Issues Concerned in EIA Framework

环评框架中关心的关键问题

- ◆ Timeframes
- ◆ Unacceptable or acceptable leakage rate
- ◆ Assessment methodology
- ◆ Uncertainty
- ◆ The role of natural and industrial analogues



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What is aim of the environmental impact assessment?

环评目标

- 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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Law of the People's Republic of China on Environmental Impact Assessment 环境影响评价：中国相关法律

- 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 subjected to EIA.



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Environmental Risk Assessment

环境风险评价界定和目的

- Environmental risk assessment (ERA) 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

环境影响评价相关技术指南

- 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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There is no EIA guidelines suitable to CO₂ geological storage in China

中国尚无适用的二氧化碳地质封存环评指南

- The absence of these guidelines is not helpful for the project application and implementation, and even for the governmental management.
- The absence of these guidelines will cause activities will not meet the environmental protection standards, or the cost will be higher because the activities owners will follow the lower or higher standard to implement.



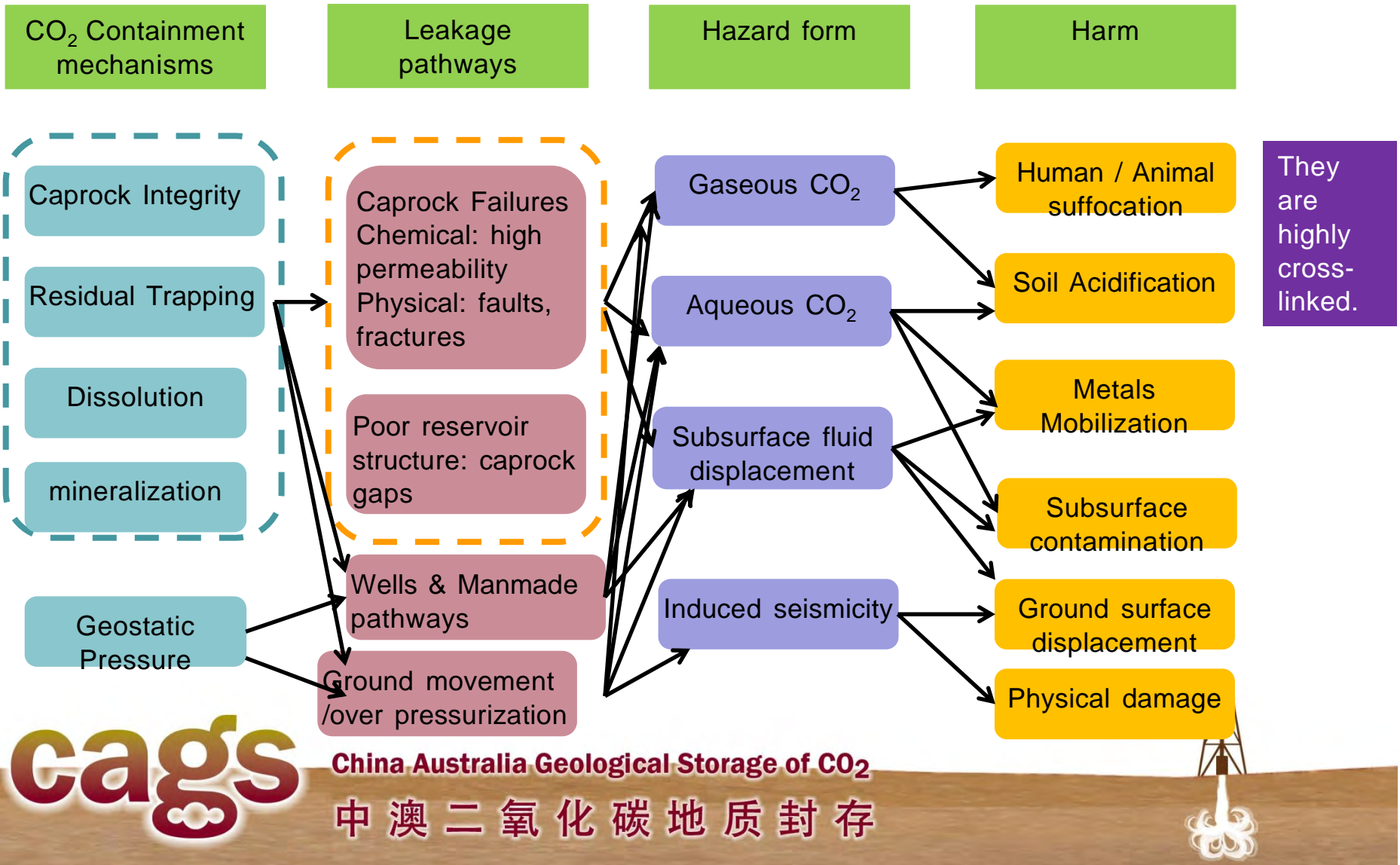
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Linked Risk Elements of Geologic Storage

二氧化碳地质封存风险单元之间的联系



The Difficulty to Risk Assessment

风险评价的困难

- From a risk assessment perspective, this makes precise risk quantification very difficult since any number of processes can lead to a resulting harm.
- Most of the hazards can occur due to any of the hazard pathways, meaning that quantification requires not only the likelihood of the hazard occurring, but also the likelihood that it occurs from each one of the leakage pathways.
- This cross-linking illustrates the difficulty in formulating robust risk estimates, and implies that it will be difficult to reduce the uncertainty of the risk assessments.



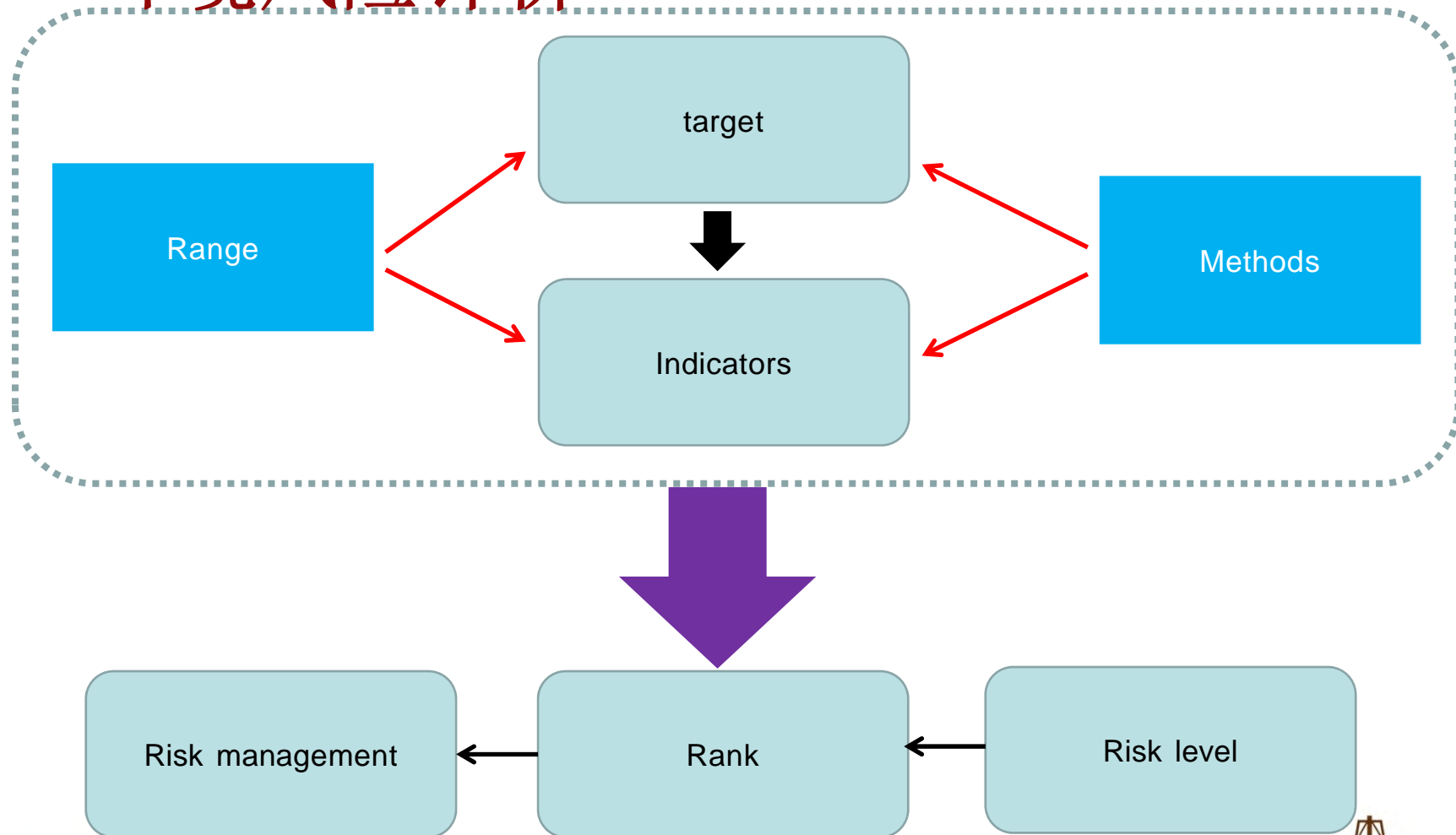
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Environmental Risk Assessment

环境风险评价



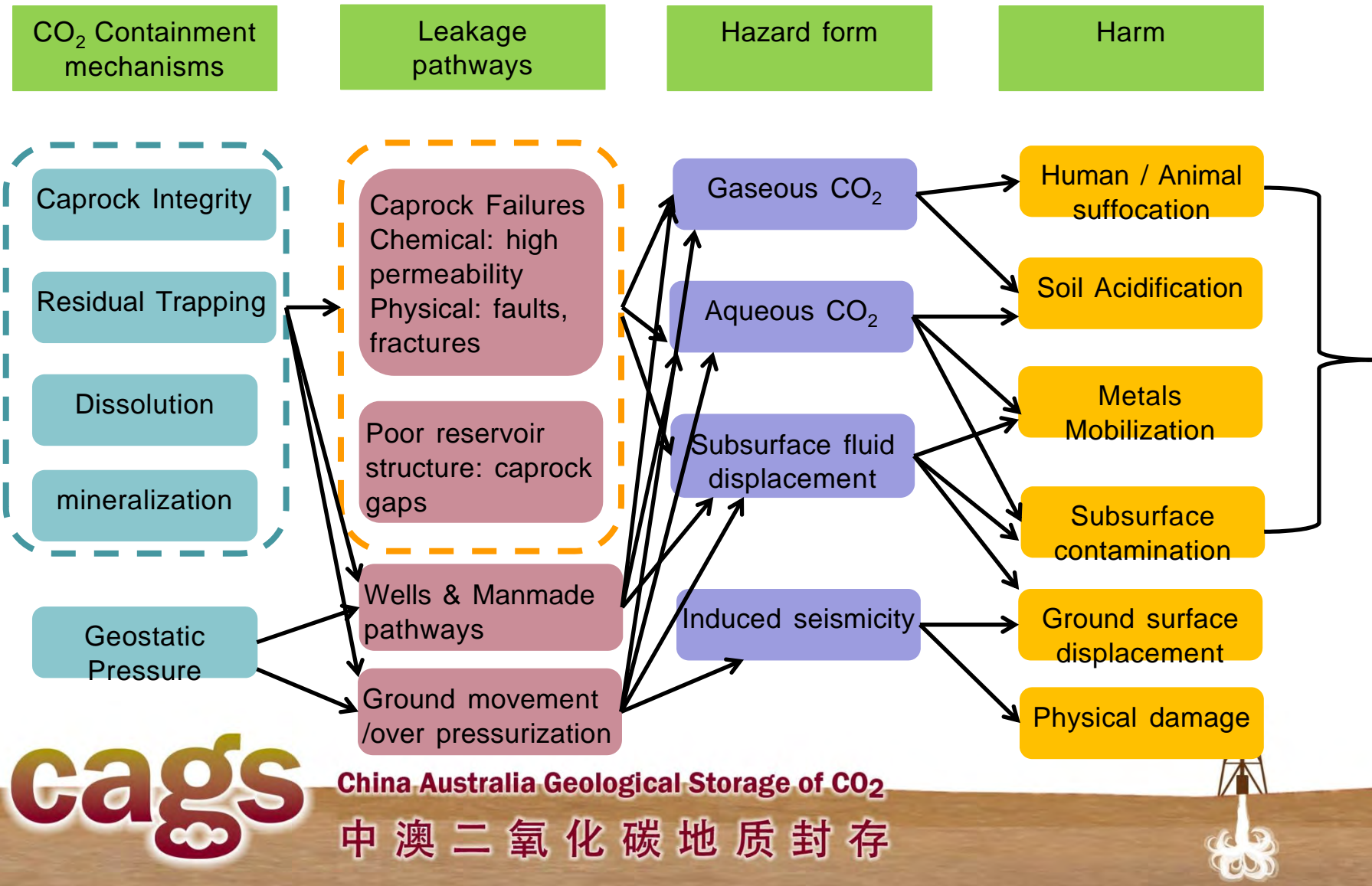
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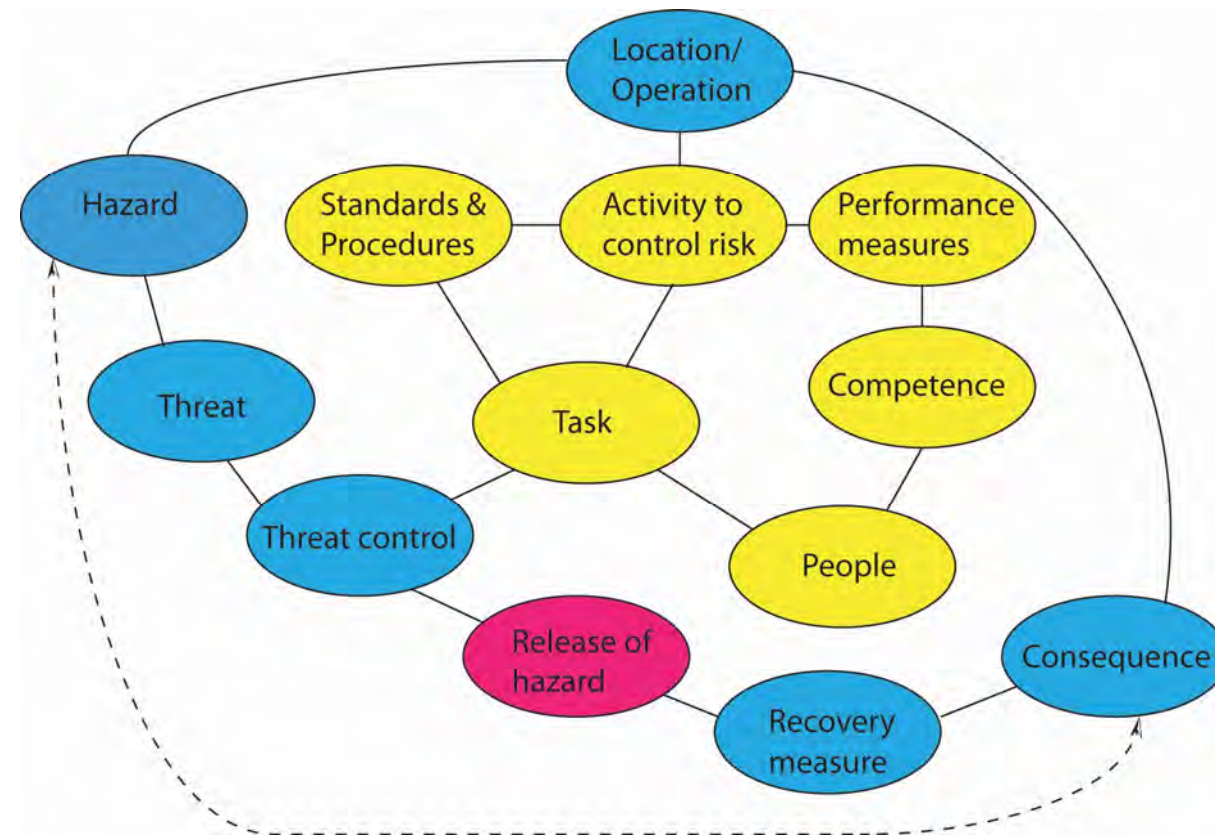
Environmental Risk Assessment Indicators

环境风险评价指标



Risk Assessment and Management: total hazard control

风险评价和管理：总体灾害控制



Source: Risktec

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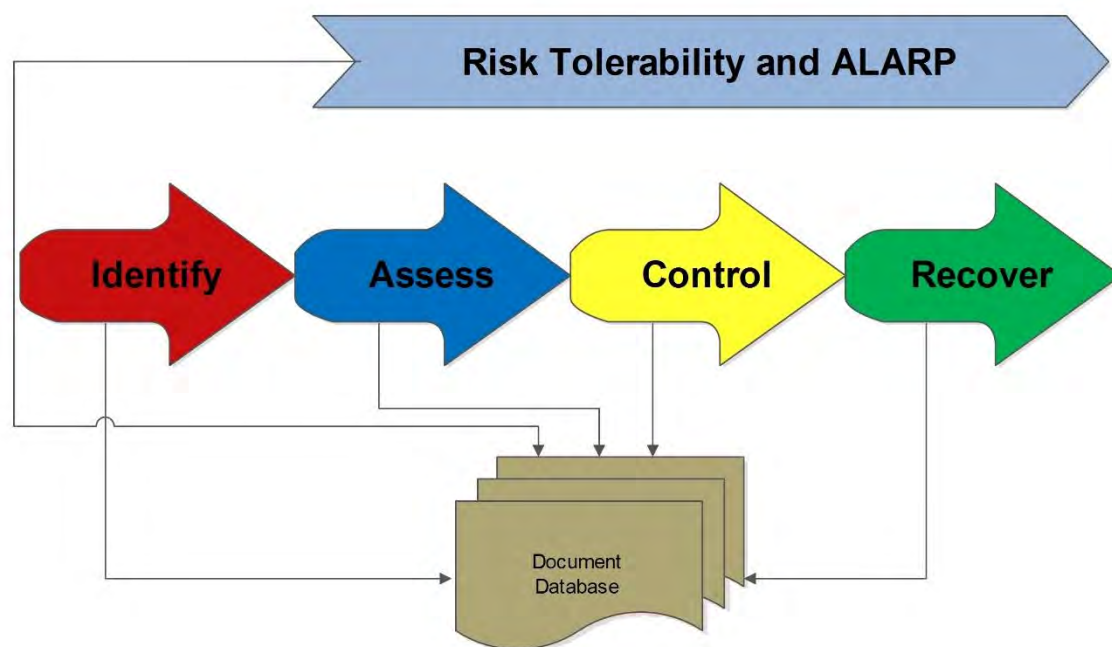
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Risk Assessment and Management: basic model

风险评价和管理：基本模型



Source: UK HSE

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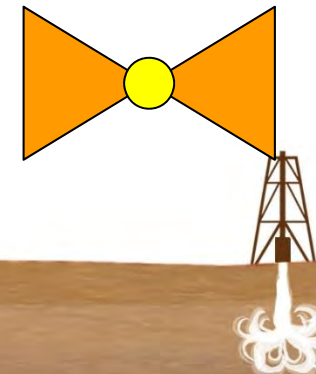
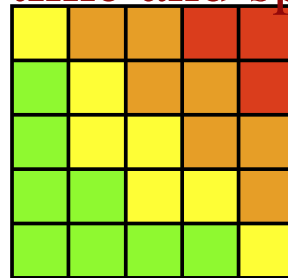
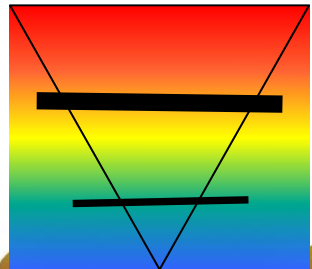
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EIA Suggestions for CO₂ Geological Storage

二氧化碳地质封存的环境影响评价建议

- Risk accidents identification: potential CO₂ leakage from all kinds of pathways.
- Risk Rank: depend on the storage types and volumes.
- Methodology: Deterministic Risk Assessment (DRA) and Probabilistic Risk Assessment (PRA), features, events, and processes (FEP), and the Vulnerability Evaluation Framework (VEF), etc.
- Assessment range: time and space scales.



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ISO TC/SC

国际标准工作

- ISO 14000 Environmental management
- ISO 14001 Environmental management systems
- ISO 31000 Risk management
- ISO/TC 207 - Environmental management
- ISO/TC 265 - Carbon dioxide capture, transportation, and geological storage



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Thanks for your attention!

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