二酸化炭素地中隔離の概要

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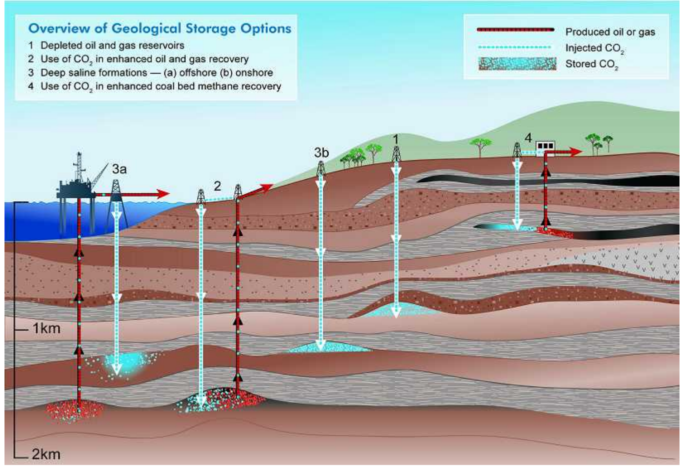
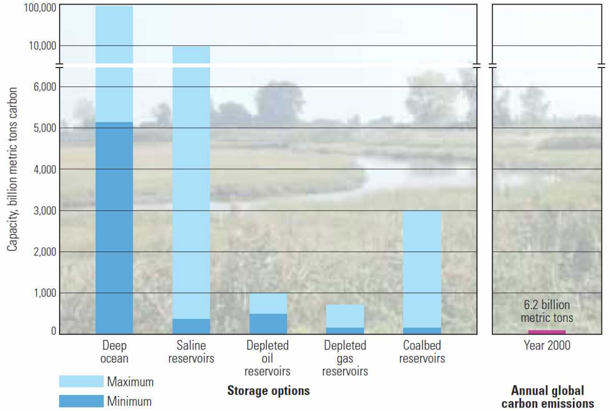
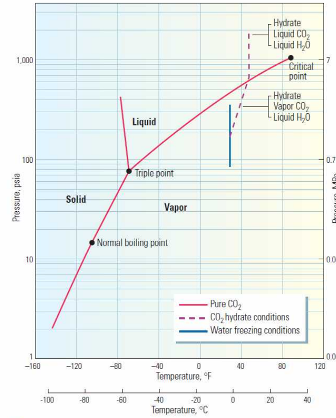




^ CO_2 storage options. Ocean storage represents the largest potential for carbon storage, but is thought to carry a higher level of environmental risk. The remaining four are geologic storage options, of which the largest capacity is estimated to be in saline reservoirs. The annual global carbon emissions in the year 2000 were 6.2 billion metric tons [6.8 billion short tons].



^ CO_2 phase diagram. The diagram describes the relationship between temperature and pressure on the resultant phase of CO_2. Subsurface storage of CO_2 is accomplished at supercritical conditions. To ensure this, both the phase behavior of CO_2 and the reservoir conditions must be understood, since the reservoir temperature and pressure conditions are likely to change throughout the life of a CO_2 storage project.

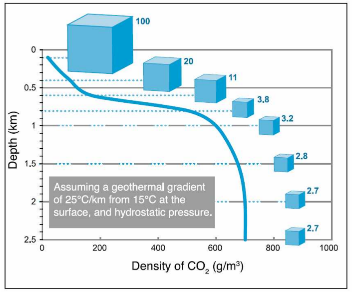


Figure 5.2 Variation of CO_2 density with depth, assuming hydrostatic pressure and a geothermal gradient of 25°C km^{-1} from 15°C at the surface (based on the density data of Angus *et al.*, 1973). Carbon dioxide density increases rapidly at approximately 800 m depth, when the CO_2 reaches a supercritical state. Cubes represent the relative volume occupied by the CO_2 and down to 800 m, this volume can be seen to dramatically decrease with depth. At depths below 1.5 km, the density and specific volume become nearly constant.

世界初の大規模CO2地中隔離 (Sleipner)

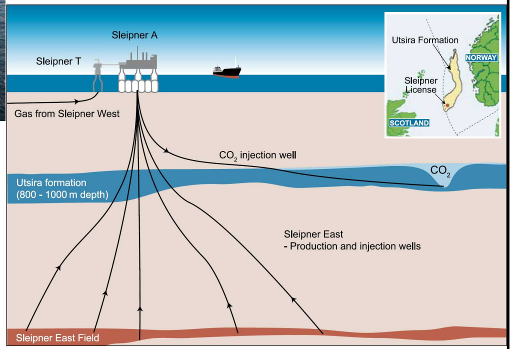
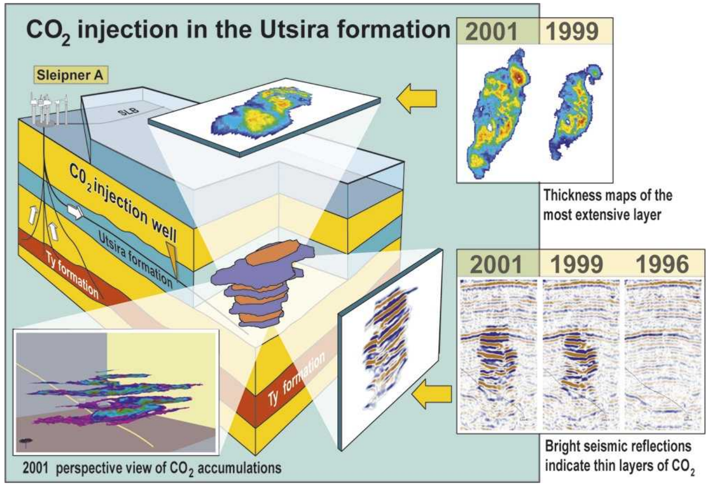


Figure 5.4 Simplified diagram of the Sleipner CO_2 Storage Project. Inset: location and extent of the Utsira formation.

CO2濃度：9%
　→2.5%
炭素税：55USD/tCO2
　　↓
100万tCO2/年



CO2地中隔離プロジェクト

- **実用プロジェクト**
  - Sleipner
    - 100万tCO2/y
  - Weyburn
    - 100万tCO2/y
  - In Salah
    - 100万tCO2/y
  - Snohvit
    - 75万tCO2/y
  - Gorgon
    - 500万tCO2/y

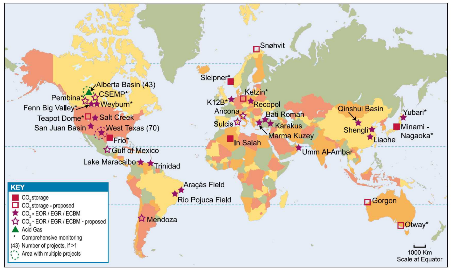
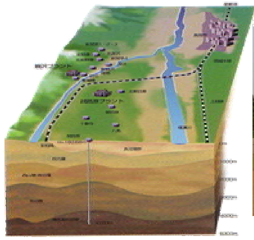
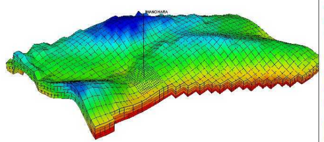
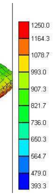


Figure 5.1 Location of sites where activities relevant to CO_2 storage are planned or under way.

日本における実証試験





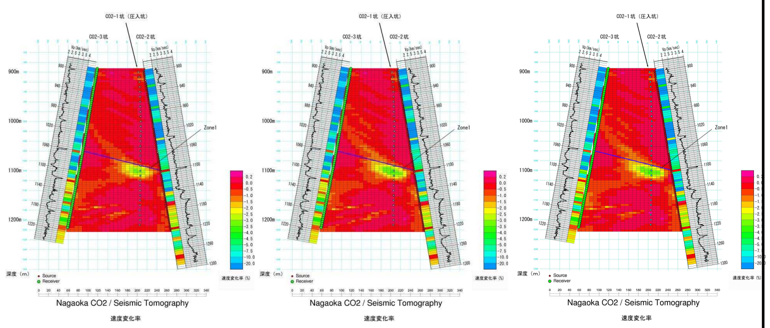


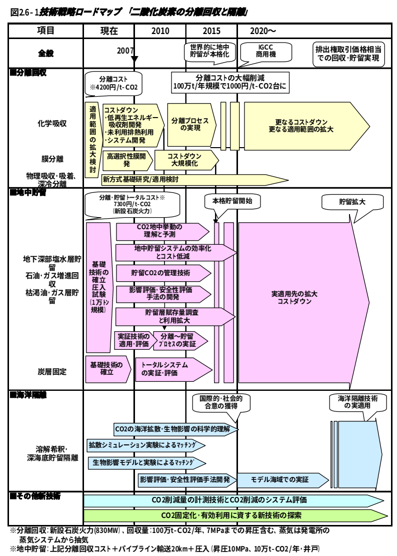

CO2地中封じ込め
長岡・帝石ガス田で国が研究開発
削減の切り札に
02年度から実証試験

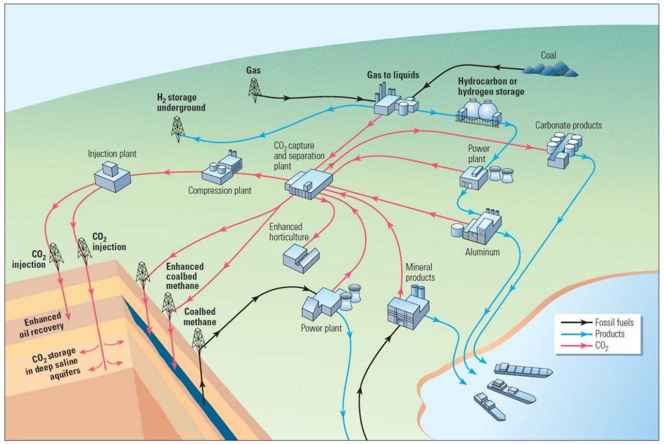

朝日新聞
CO2 地下1100㍍に封印
温暖化防止へ技術開発

日本における実証試験

- 坑井間トモグラフィーによるモニタリング

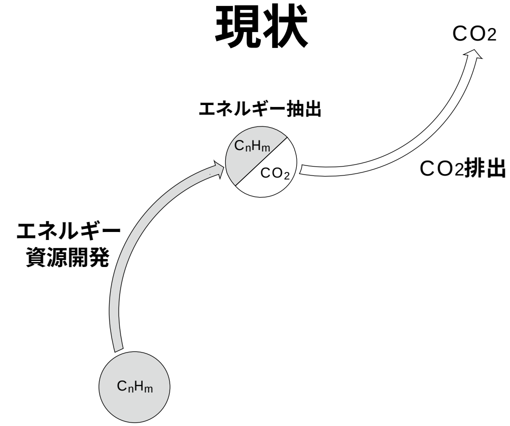




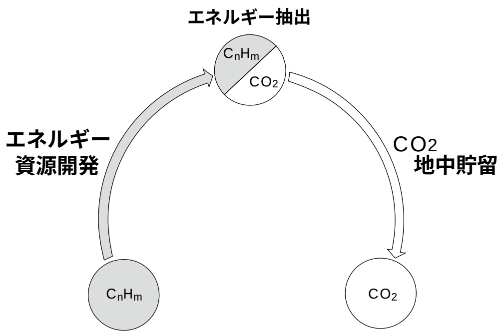


^ Expertise in CO_2 processing and storage. The broad expertise of the oil and gas service sector spans much of the process map of CO_2 sequestration, especially the secure storage of CO_2 in the subsurface. Relevant processes are labeled in bold.

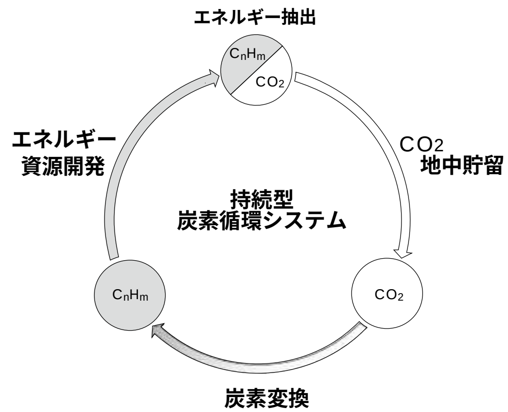
現状



二酸化炭素地中隔離



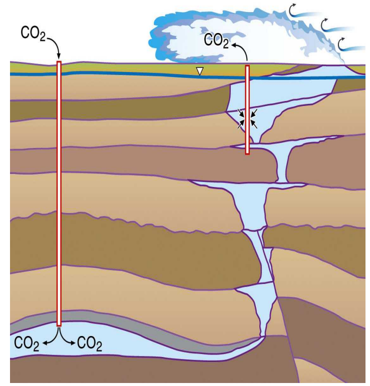
持続型炭素循環システム



補足資料

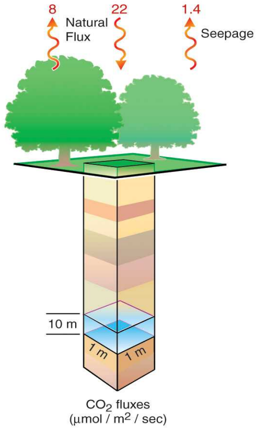
漏れのメカニズム

- 浮力により亀裂等に沿って上向きに移動
- 不透水層に沿って横方向へ拡散
- 圧力低減により拡大
- 亀裂等との遭遇確率が増大

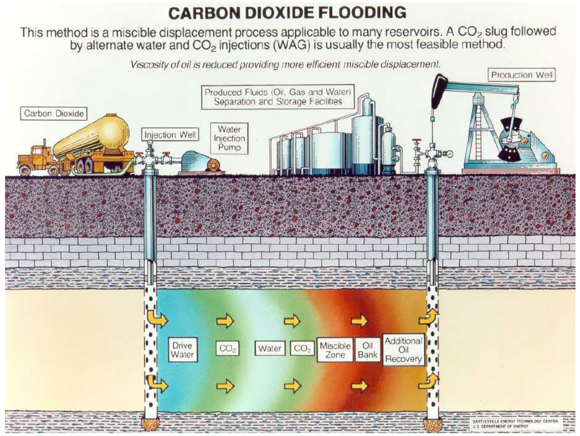


洩れと自然循環量の関係

- **洩れ計算**:
  1000m以深の10m厚さの層
  30%孔隙率, 10%隔離容量
  1%/年の洩れ
  → 1.4μmol/m²/sec
- **温帯性広葉樹林**:
  夜間発散：8μmol/m²/sec
  昼間吸収：22μmol/m²/sec



CO_2ミシブル攻法



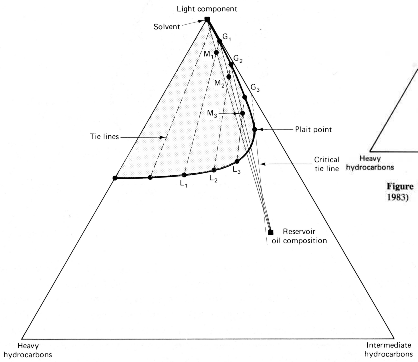


Figure 7-14 Schematic of the vaporizing gas drive process (adapted from Stalkup, 1983)

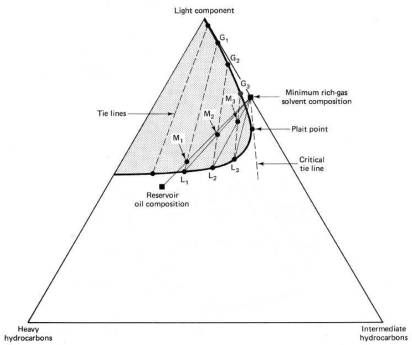


Figure 7-15 Schematic of the rich-gas drive process (adapted from Stalkup, 1983)

Dilution path	Type
I_1-J_1	Immiscible
I_1-J_2	Multiple contact (developed) Miscibility (rich gas)
I_2-J_1	Multiple contact (developed) Miscibility (vaporizing gas)
I_2-J_3	First-contact miscible

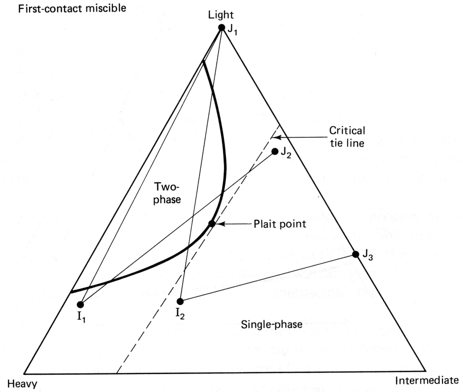
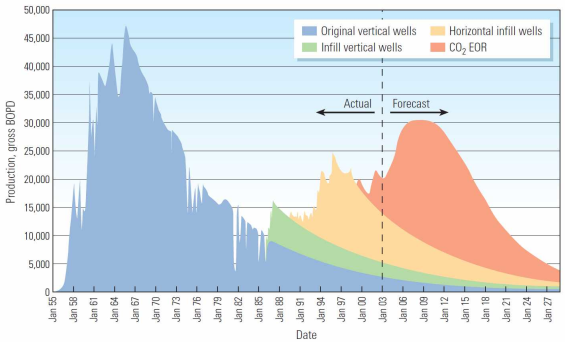


Figure 7-17 Summary of miscibility and developed miscibility

EORによる増油効果



^ Weyburn field production. The CO_2 EOR storage project has clearly increased daily production rates and is predicted to significantly extend the production plateau of the Weyburn field.