China Shale Gas Developing Perspectives

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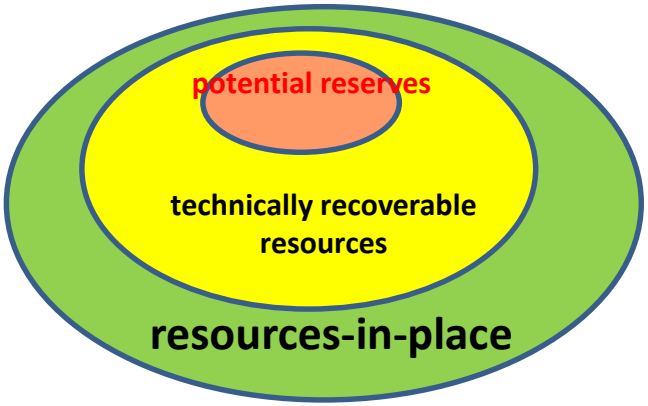
Global Shale Gas resources

- Gas-in-place and technically recoverable volumes are often confused
- The top 18 countries with assessed technically recoverable shale gas resources combine about 1/3 of conventional reserves.
- Technically recoverable ≠ economically producible reserves



Source: H-Holger Rogner, IIASA, KTH

	Risked gas-in-place	Technically recoverable	Proved conventional gas reserves
	tcm	tcm	tcm
U.S.	131.5	32.9	8.5
China	134.4	31.6	3.1
Argentina	91.9	22.7	0.3
Algeria	96.8	20.0	4.5
Canada	68.3	16.2	2.0
Mexico	63.2	15.4	0.4
Australia	57.9	12.4	3.8
South Africa	44.1	11.0	-
Russia	54.4	8.1	32.9
Brazil	36.2	6.9	0.5
Poland	21.6	4.2	0.1
UK	3.8	0.7	0.2
Pakistan	16.6	3.0	0.6
Venezuela	23.1	4.7	5.6
Ukraine	16.2	3.6	0.6
France	20.6	3.9	-
Libya	17.4	3.5	1.5
Egypt	15.1	2.8	2.0
India	16.5	2.7	1.3
Others	83.5	14.3	119.4
Total assessed shale deposits	1,013.2	220.7	187.3

Key Uncertainties

- Global shale deposits (source rocks) are abundant
- Potentially all sedimentary basins endowed with source rocks allover the world contain shale gas
- No two shale deposits are alike
- Resource availability
  - Occurrences, resources-in-place, technically recoverable resources, reserves and supplies: OGIP, URR, TRR, ERR or P1/P2/P3 related
- Market prices (break-even prices)
- Full production costs & market prices
- Field production profiles
- Investment & cash flow implications
- Technology and infrastructure
- Environmental concerns and perception
- Vested interests & geopolitics

China Shale Gas Industry——Current Situations

CNPC

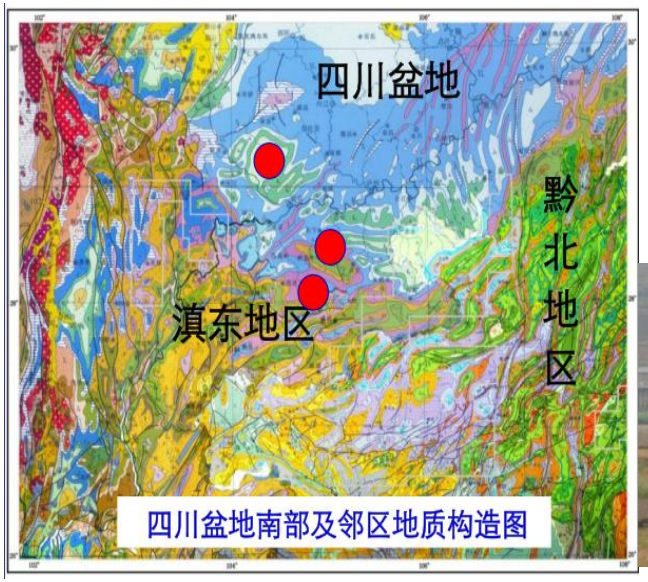
Confirmed Weiyuan-Changnin, Fushun-Yongchuan in Sichuan and Zhaotong in Yunnan as the shale gas areas. (30 wells and accumulated gas 30 million cubic metres)

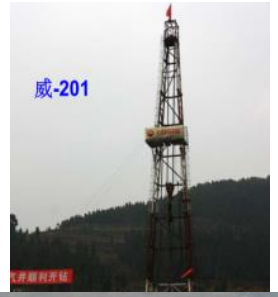
Sinopec

In the areas of Eastern Guizhou, Southern Anhui, Northeast Sichuan (more than 10 wells, 6/10 got the well stream gas).

Yanchang Petroleum

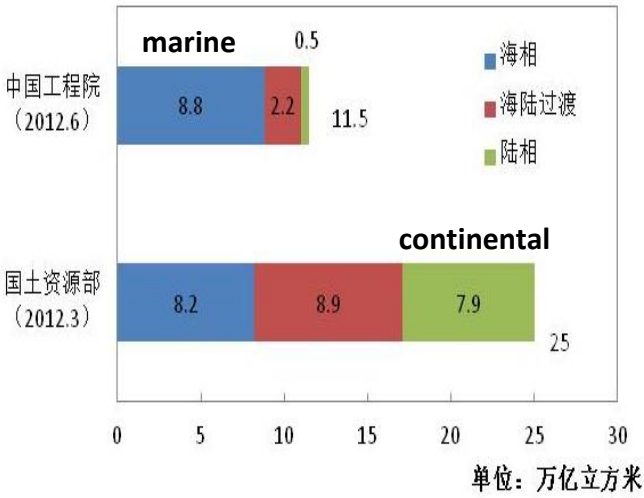
Erdos Basin(5 wells, continental shale gas)





Shale Gas Resources need to be further assessed and confirmed

Date	Institutions	Recoverable resources (thousand billion)
June 2008	China University of Geosciences	15-30
Dec. 2009	China University of Geosciences	26
Sep. 2010	Exploration and Development Research Institute of PetroChina	21.5-45
April 2011	EIA	36.1
March 2012	Ministry of Land and Resources	25.08（not including Tibet）
July 2012	Chinese Academy of Engineering	11.5



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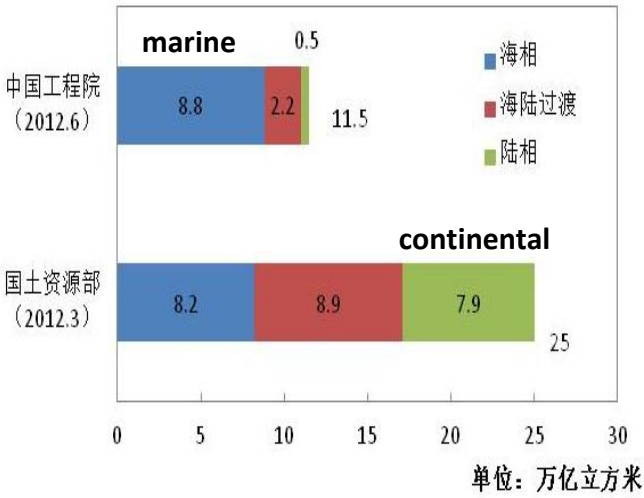

Cost Comparison

Selecting similar base conditions in **Geology parameters, mine depth, shale thickness, contents of TOC**, etc.--**Haynesville** vs **Changnin-Weiyuan in Sichuan**

unit: 10 thousand Yuan	One horizontal well in Sichuan Basin	One horizontal well in Haynesville
engineering cost before drilling	780	Covered in the mining royalty
drilling engineering and matching constructions cost	3800	1720-2750（average 1875）
wells engineering and matching constructions cost	5200	2560-4125（average 2810）
gas producing cost	about 0.4yuan/cubic metres	Fixed cost---250 thousand Yuan/year **variable cost**---0.1yuan per cubic metres
mining royalty	NA	16% of sales

Conclusions

1. Although rich resources in Shale gas, need more explorations and further confirmed(B/C assessment)
2. Lack technologies and management experiences in developing shale gas(Strong professional).
3. High costs, low benefits in initial period, leading to high risks in investment(always the case)
4. High environmental problems, including high pressure on the water resources, farmland, and densely populated areas, often uneven terrain
5. Immature infrastructure, especially pipelines
6. Obstacles in production system access
7. Need a set of effective and complete supervision system
8. Experiences from USA can not be duplicated simply