Unconventional Petroleum Geology and Resources in China*

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Abstract

The China National Petroleum Assessment (2003-2007) evaluated coalbed methane, oil shale and oil sands resources in Chinese onshore basins. In the geohistory, fourteen-staged coal accumulations (including early Carboniferous, late Carboniferous, and early Permian) formed a large number of coal-bearing basins. In the 42 evaluated basins, coalbed methane resources in place are 37 trillion cubic meters, and recoverable resources are 11 trillion cubic meters. Coalbed methane resources are mainly distributed in the eleven big basins (including the Ordos, Qinshui, and Erlian basin), recoverable resources of which account for 58% of the countrywide resources. Discovered oil shale deposits in China are mainly of lacustrine origins. The oil shale accumulation models were established in deep-water of depressions, shallow-water of rifts, swamps of rifts, and lagoons. Recoverable resources of oil shale are 243.2 billion tons, and recoverable resources of shale oil are 12 billion tons in the 25 evaluated basins. The nine basins (including the Songliao, Ordos, and Lunpola basin) contain more than 100 million tons of recoverable shale oil resources. Several large-scaled tectonic movements formed multiple-phased hydrocarbon generation, accumulation, and reservoir formation, alteration and destruction, which made oil sands distributed in the edges of many basins. In the 24 assessed basins, oil resources in place of oil sand are 6 billion tons, and oil recoverable resources of oil sand are 2.3 billion tons. The seven basins (including the Jungar, Tarim, and Qiangtang Basin), oil in oil sands recoverable resources of which are more than 100 million tons, attain 87.6% of the nationwide resources.

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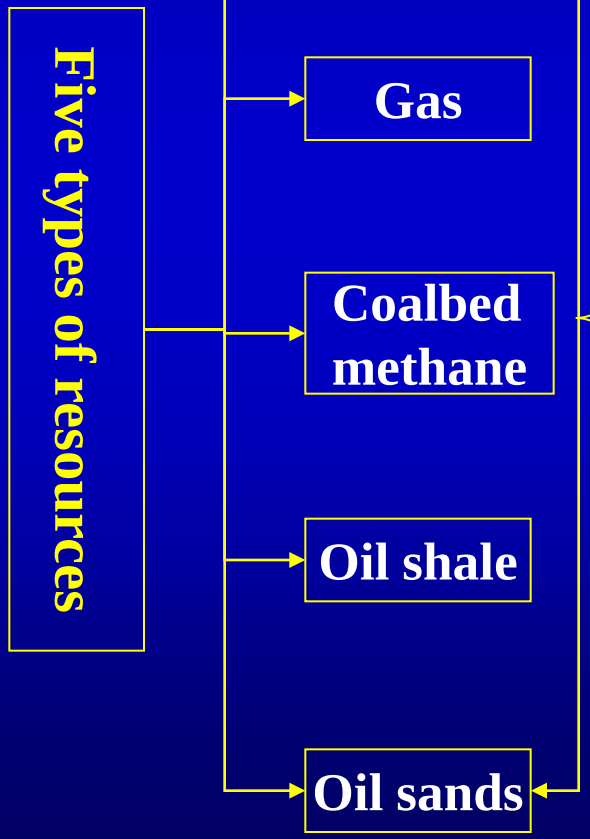
Contents

Evaluation Contents of China National Petroleum Assessment (2003-2007)



Resource category: resources in place, recoverable resources

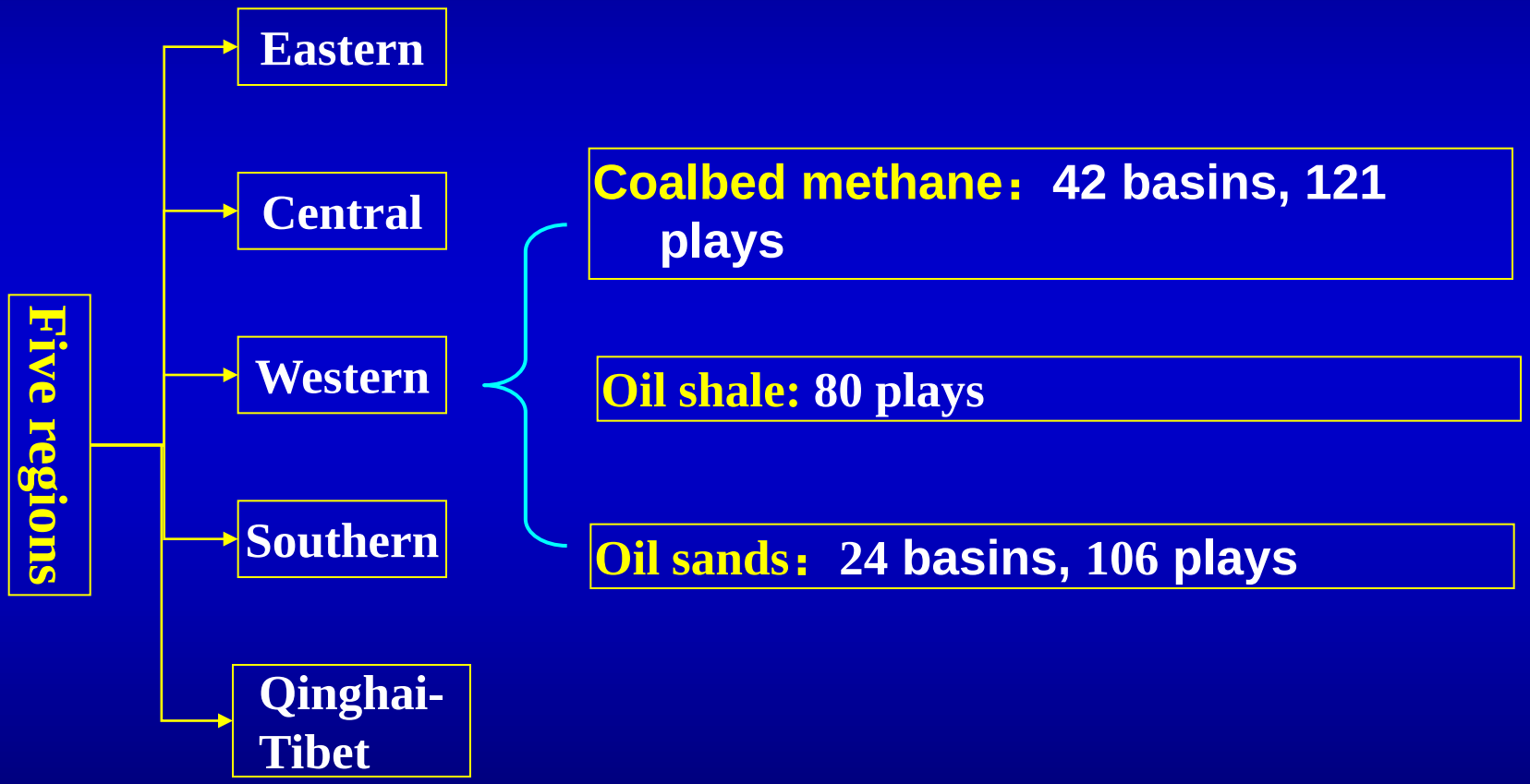
Formations: lower Paleozoic, upper Paleozoic, Mesozoic, Cenozoic

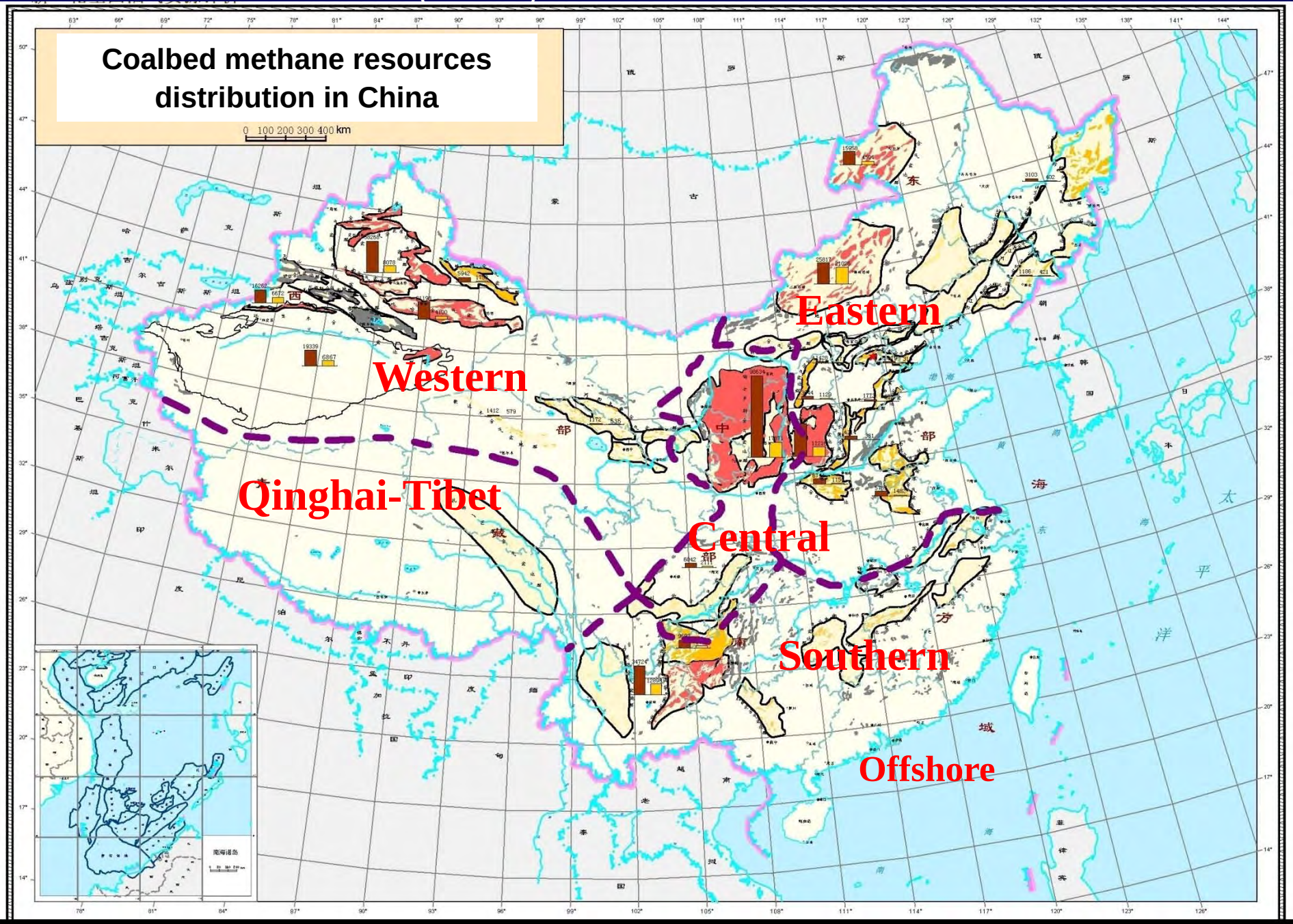
Depth: coalbed methane (<1500m, and 1500-2000m), oil shale(<100m, and 100-500m), oil sands (<500m, and 500-1000m)

Surface environments: onshore (plain, desert, etc.), offshore

Rank: coalbed methane (Type Ⅰ, Ⅱ, Ⅲ), oil shale and oil sands (ranked by oil contents)

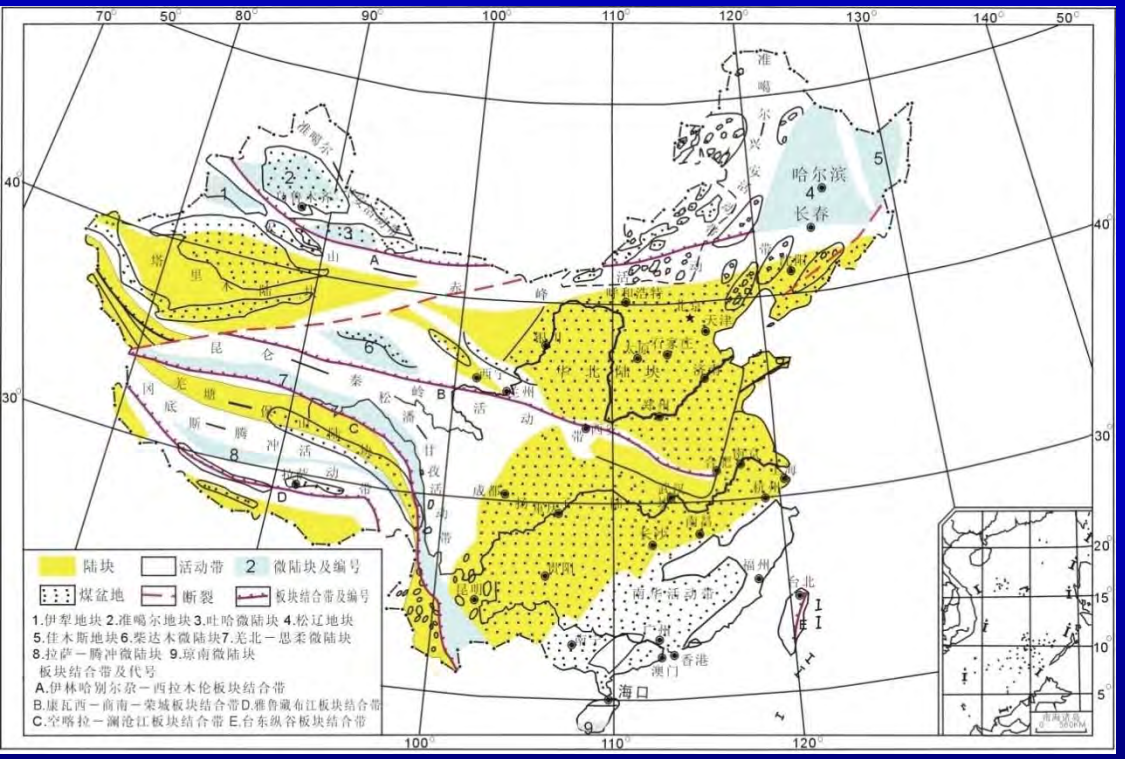
Evaluation Scope




Coalbed methane resources distribution in China
0 100 200 300 400 km
Eastern
Western
Qinghai-Tibet
Central
Southern
Offshore

Contents

(1) Tectonic evolution and coal accumulation



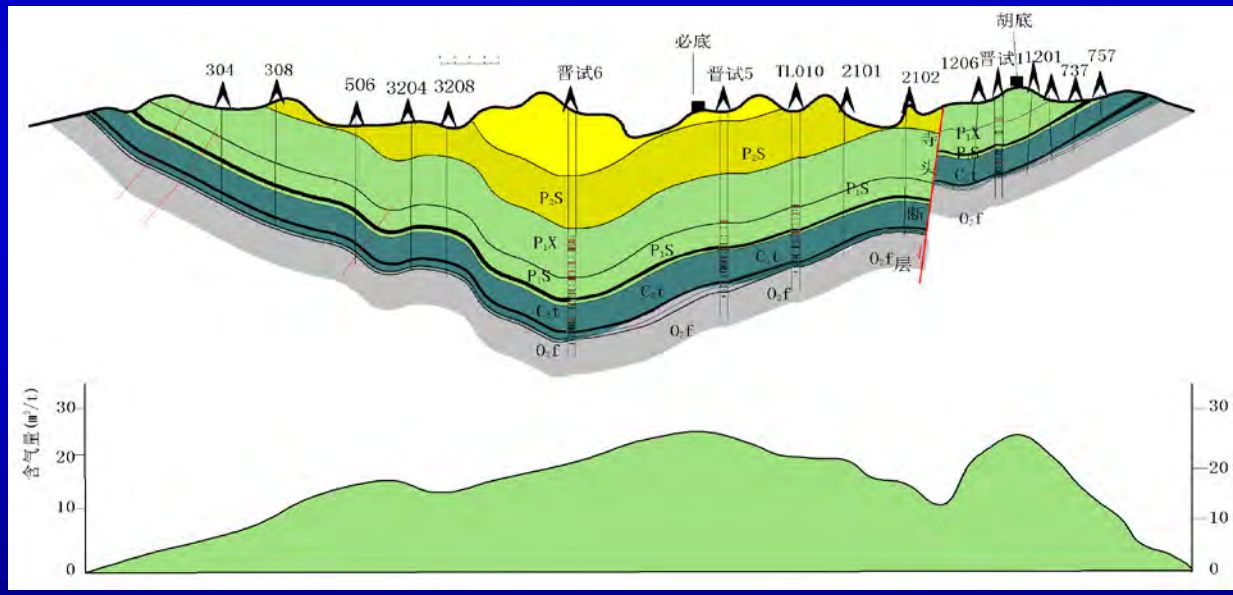
Geotectonic background of China
(Xinmin Zhang, et al, 2002)

- Chinese continent is made up of four plates, nine micro- plates, and six orogens. Coal basins are mainly distributed on plates and micro-plates.
- There are 14 coal accumulation periods (including late Carboniferous, early Permian)during Chinese geohistory.

(2) Coalbed methane accumulation conditions

❑Tectonic thermal events, effective thickness of overburden formation, and hydraulic energy influence coalbed methane accumulation.

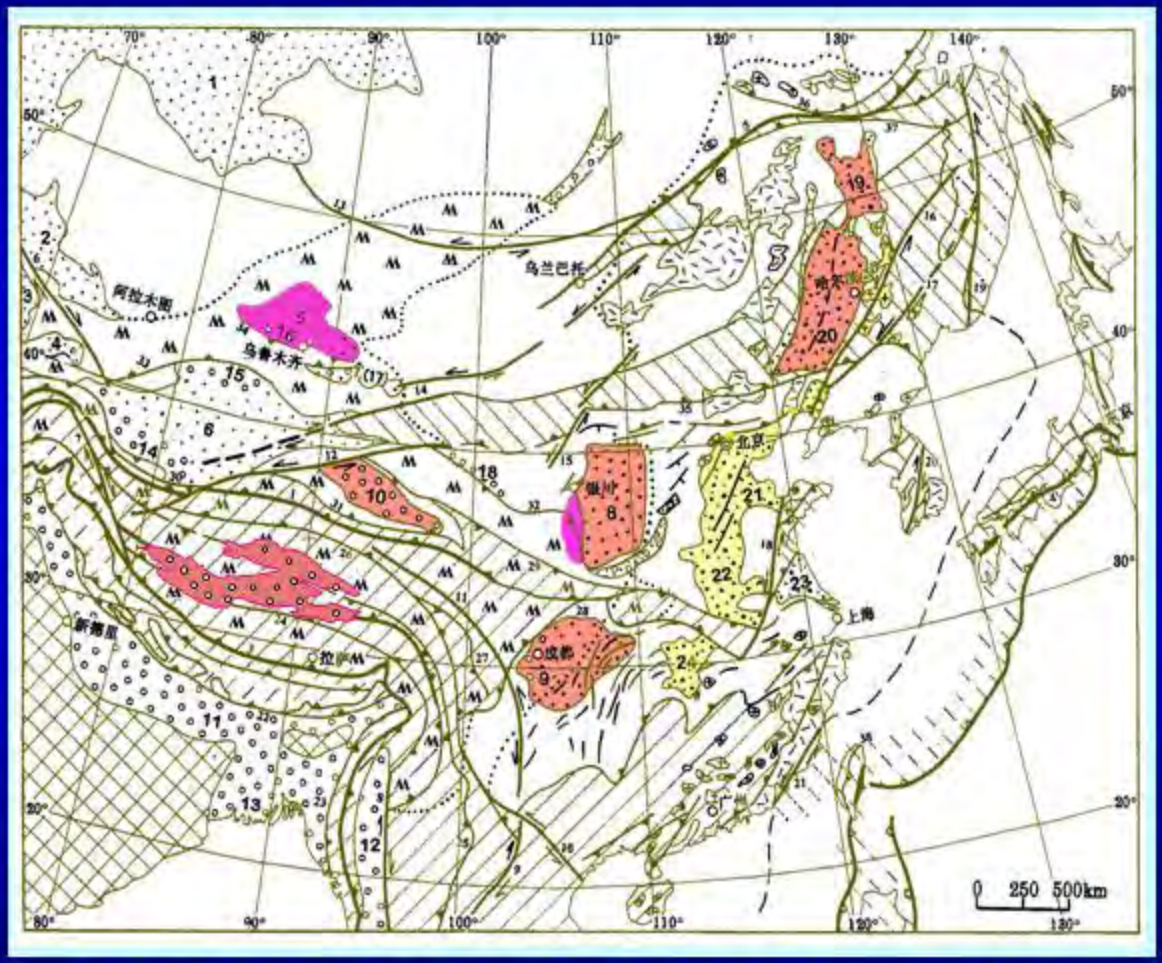
❑Stable structures in coal accumulation periods, and weaker tectonic alteration after coal accumulation are favorable for coalbed methane accumulation.



Relationship between depth and gas contents of coal in the Qinshui basin

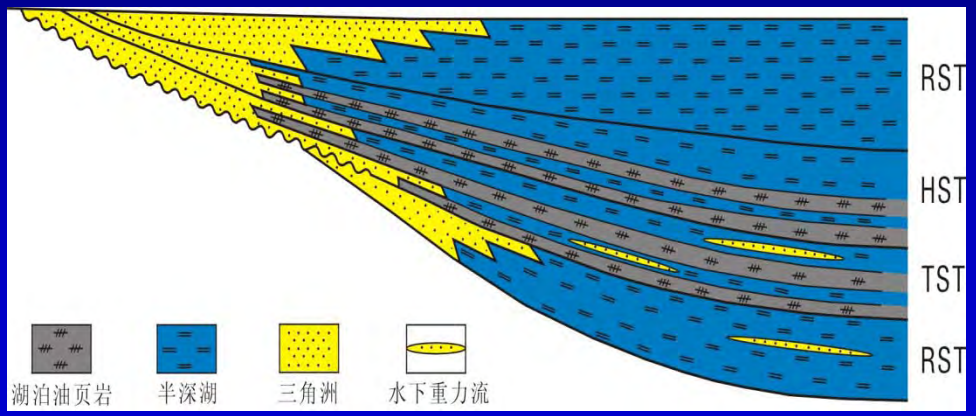
(1) Oil shale basins in China

- Discovered Oil shale deposits are mainly distributed in larger basins (including the Songliao and Ordos basins).
- Oil shale becomes younger from northwest to southeast in China.

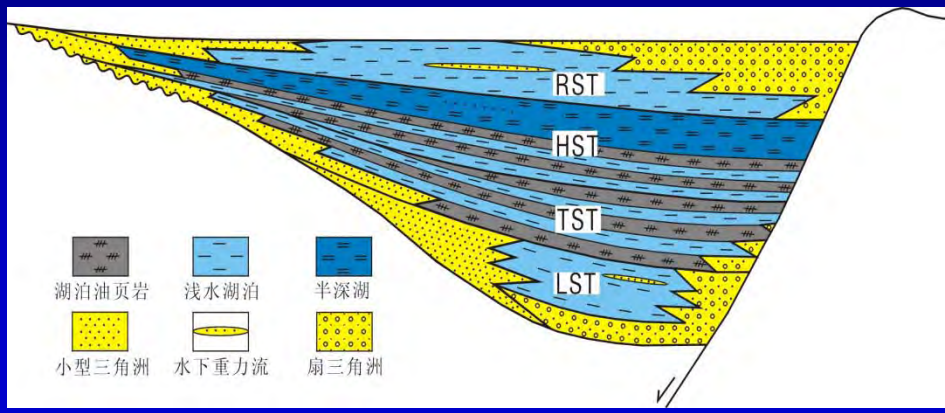


Oil shale basins distribution in China (the geotectonic background is from Jisun Ren, 2005)

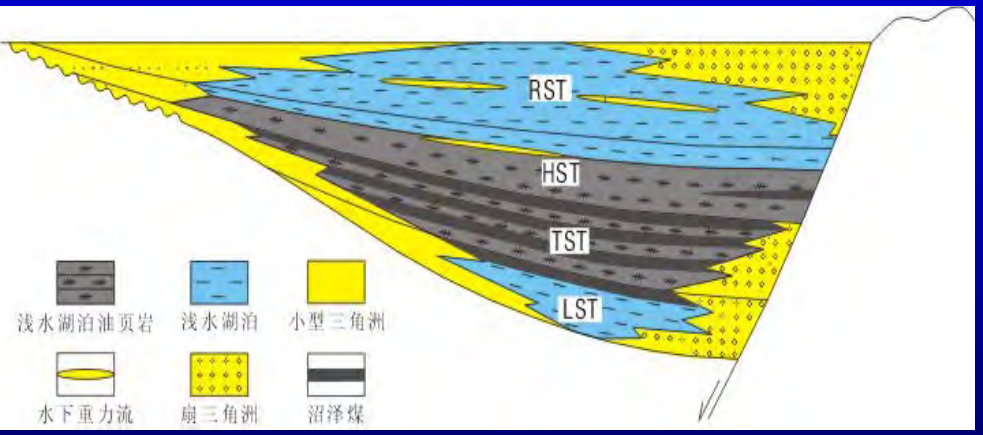
(2) Oil shale accumulation models



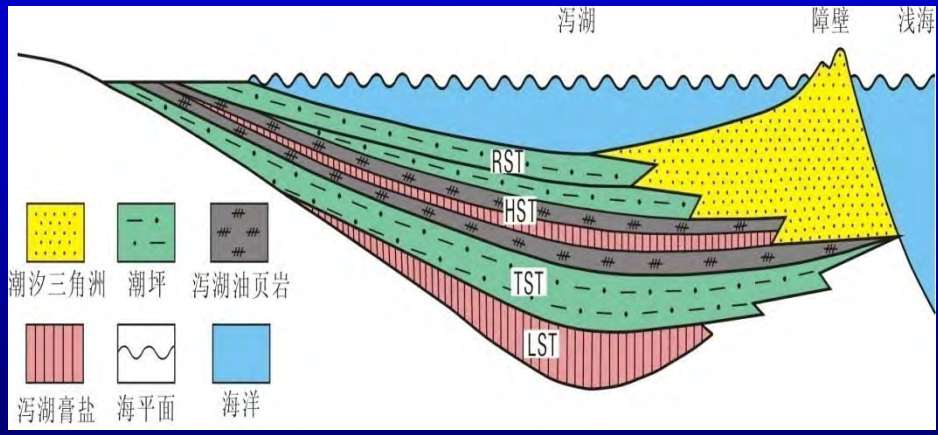
Deep-water of depressions



Shallow-water of rifts



Swamps of rifts



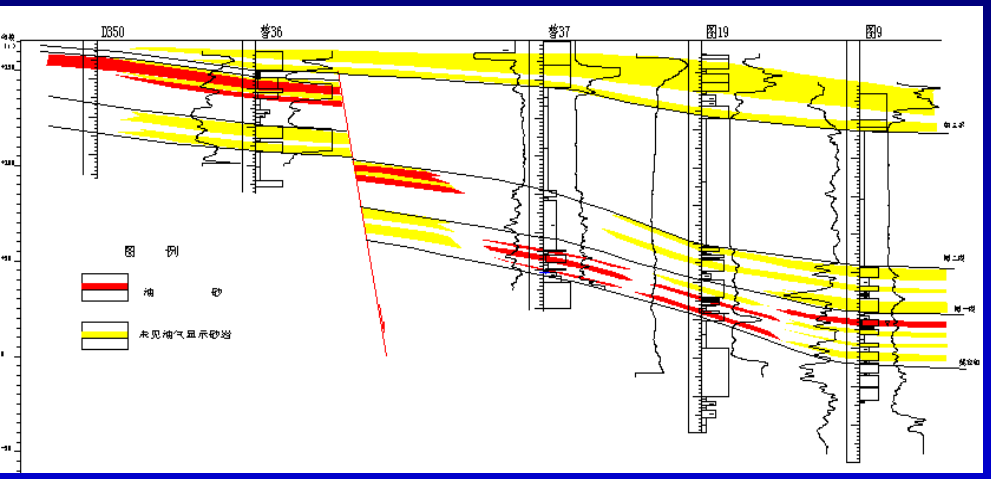
Lagoons of shelves

(1) Two main formation periods (Himalayan, Yanshanian）

Oil sands features and formation periods statistics in China

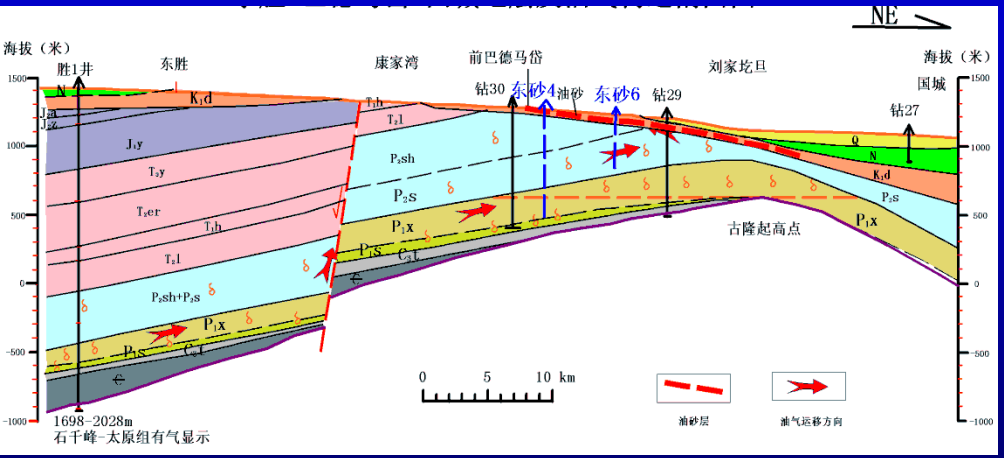
Regions	Basins	Plays	Formations	Lithology	Formation period of palaeoreservoir	Formation period of ores
Eastern	Songliao	Tumuji	K_1	Fine sandstone		Yanshanian -Himalayan
	Erlian	Jieergalangtu	K_1	Sandstone	Yanshanian	Himalayan
		Badala lake	K_1		Yanshanian	Himalayan
Central	Sichuan	Houba	J	Quartz sandstone	Caledonian	Himalayan
		Tianjingshan	D_1	Quartz sandstone	Indosinian	Himalayan
	Ordos	Dongsheng	K_1	Feldspar sandstone	Yanshanian	Himalayan
		Miaowan-Silangmiao	T_3	Fine sandstone	Yanshanian	Late Yanshanian -Himalayan
Western	Jungar	Heiyoushan	T_2	Coarse sandstone, sandy conglomerate	Indosinian -Yanshanian	Late Yanshanian -Himalayan
		Hongshanzui	K_1	Sandstone	Yanshanian	Late Yanshanian -Himalayan
		Kalaza	J_2	Sandstone, sandy conglomerate	Yanshanian	Himalayan
	Tuha	Qiketai	J_2	Interbedded sandstone and shale		Yanshanian
	Qaidam	Youshashan	N	Fine, medium sandatone	Himalayan	Himalayan
		Gancaigou	E_3、N_2	Sandy conglomerate	Himalayan	Himalayan

(2) Model of oil sands formation

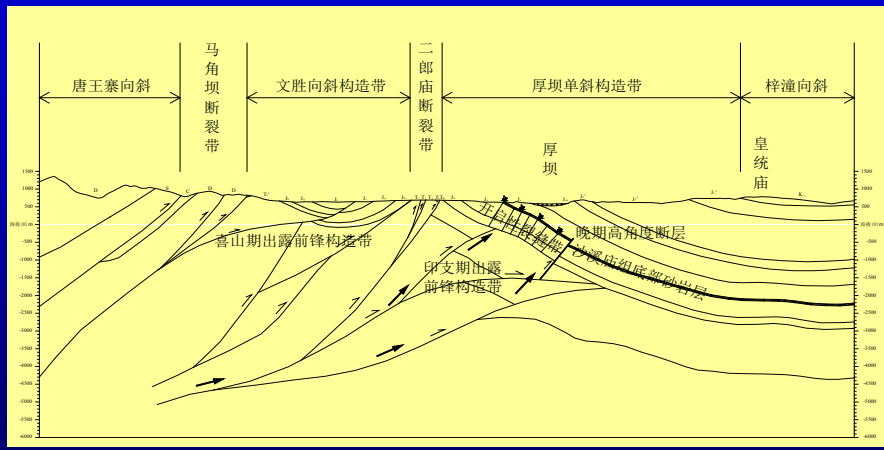


Slope migration model at the western Songliao basin

- Slope migration model
- Uplift destruction model
- Secondary migration model



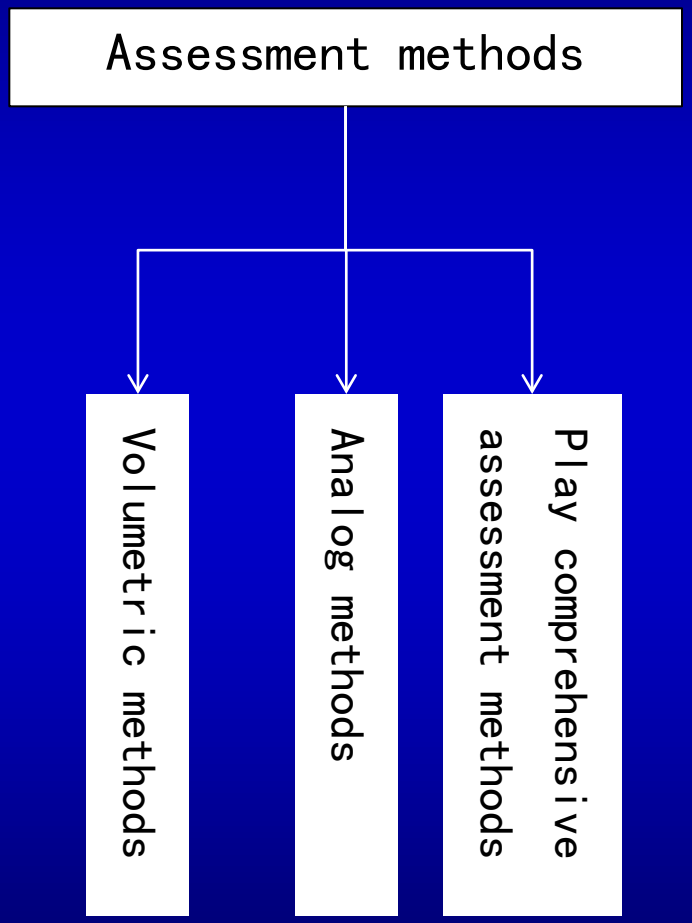
Uplift destruction model at Dongsheng of the Ordos basin

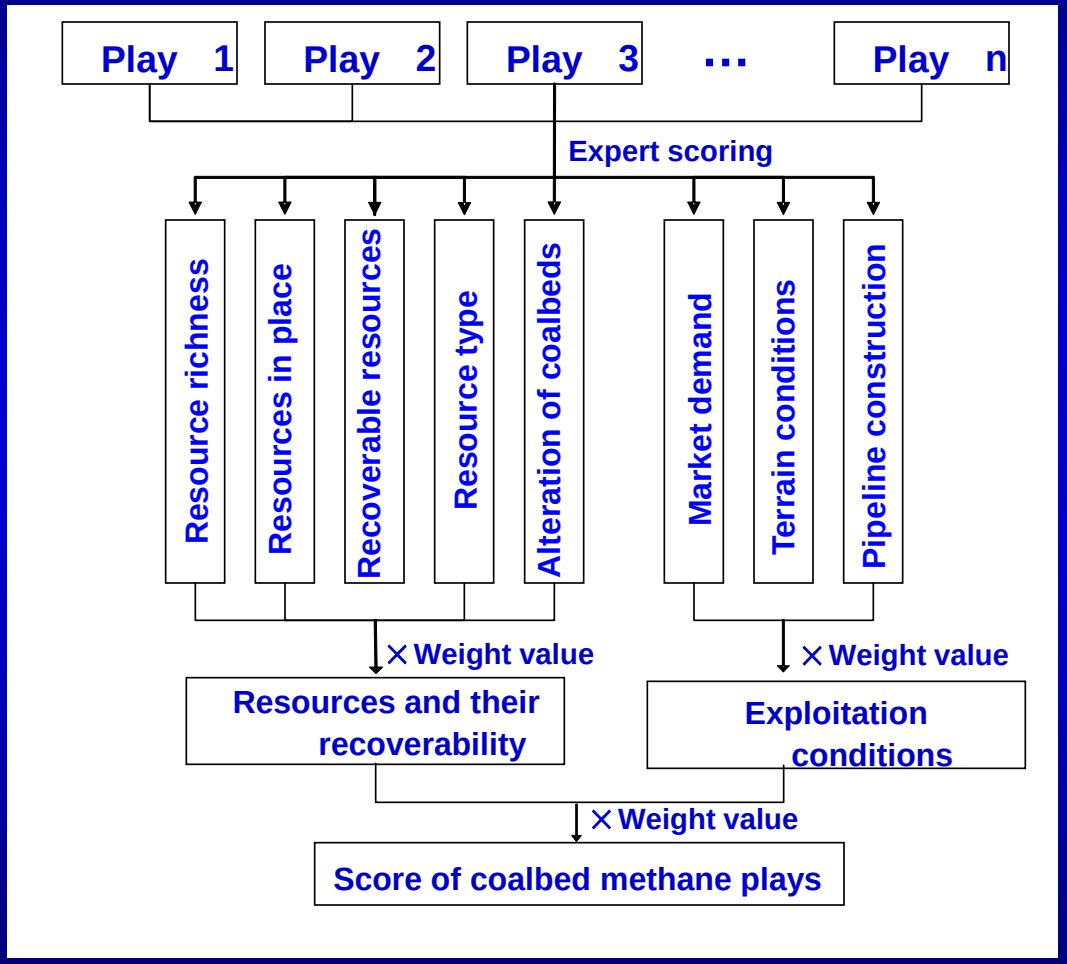


Secondary migration model at Houba of the Sichuan basin

Contents

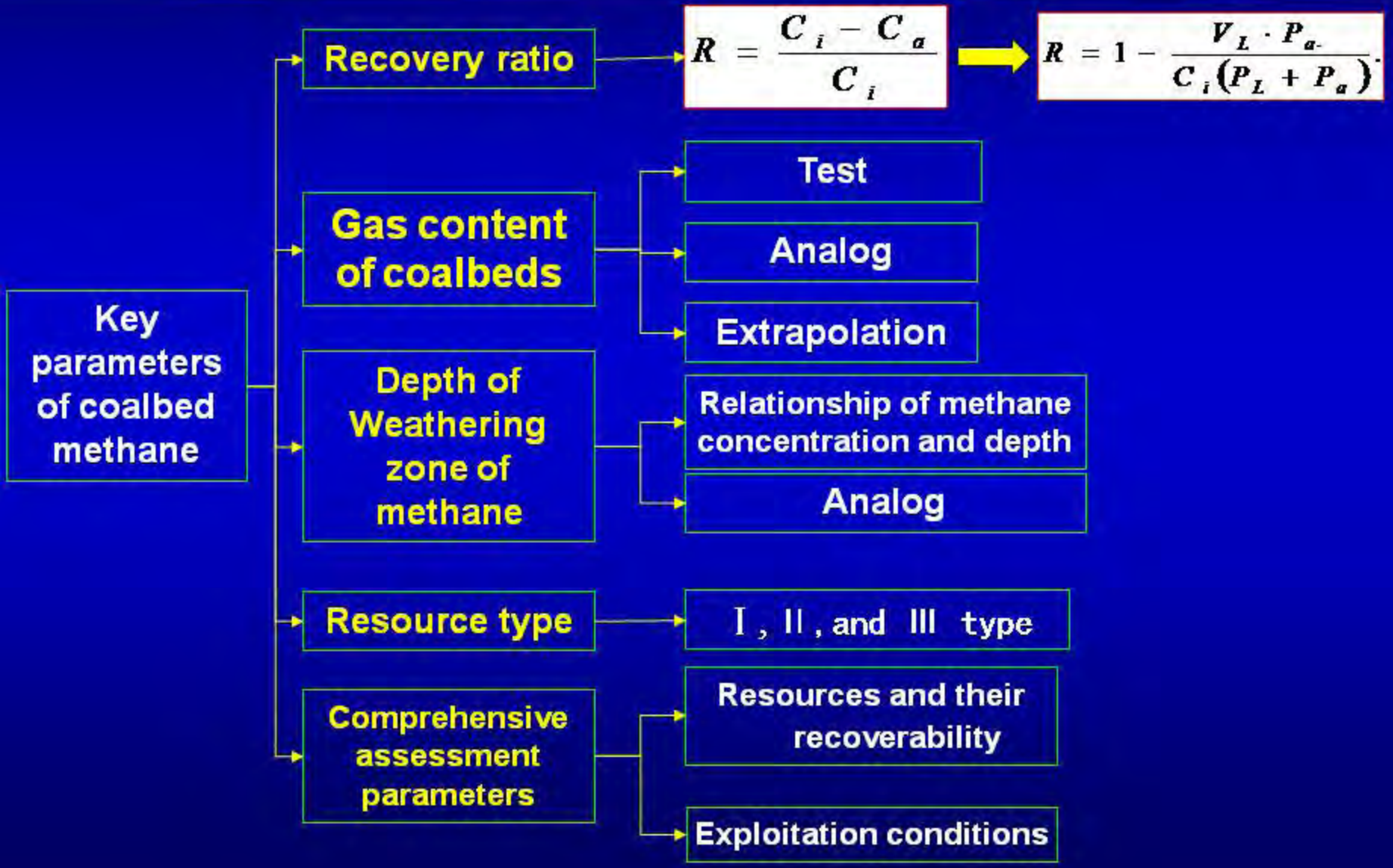
(1) Assessment methods



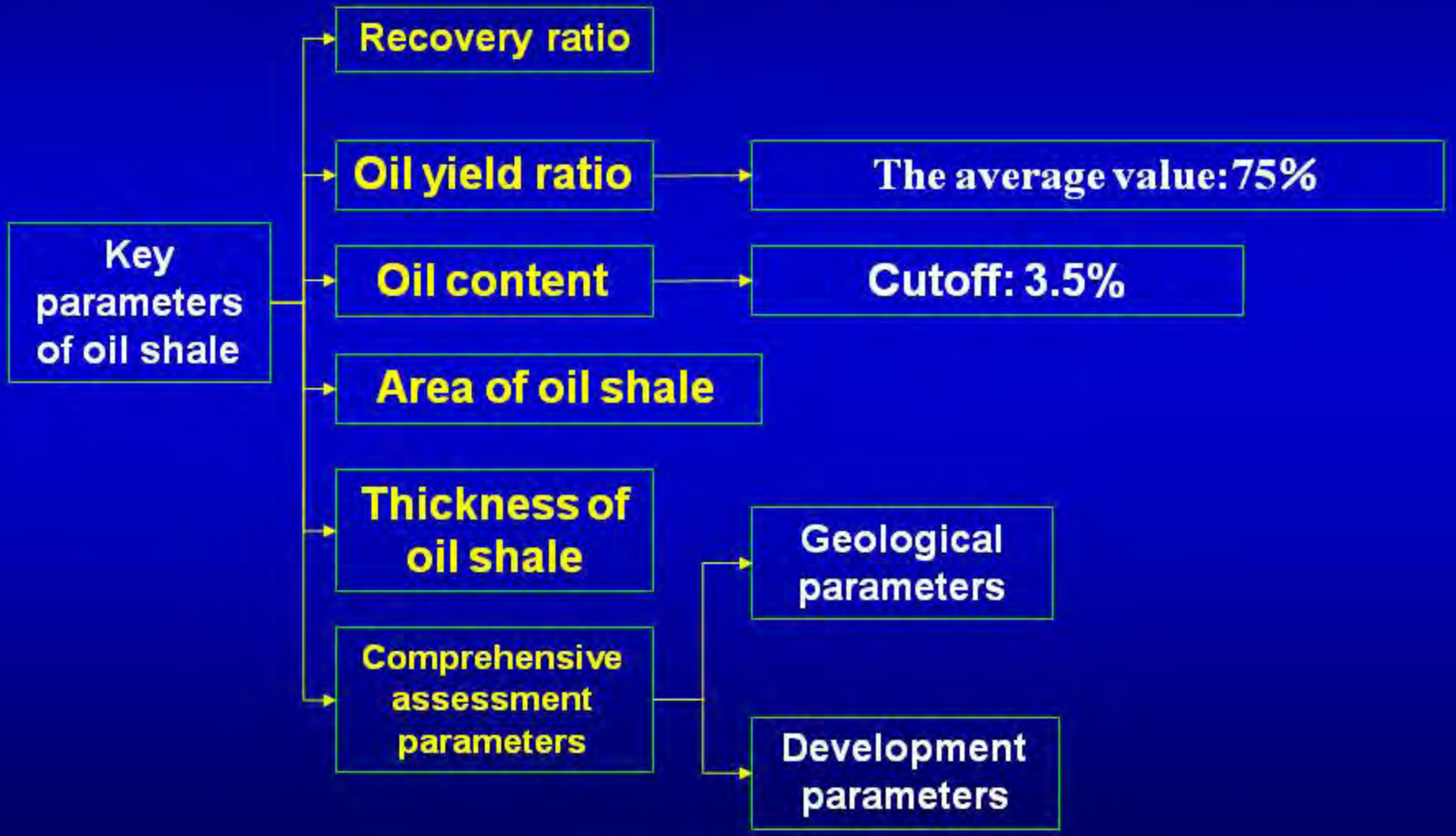


Assessment workflow of coalbed methane plays

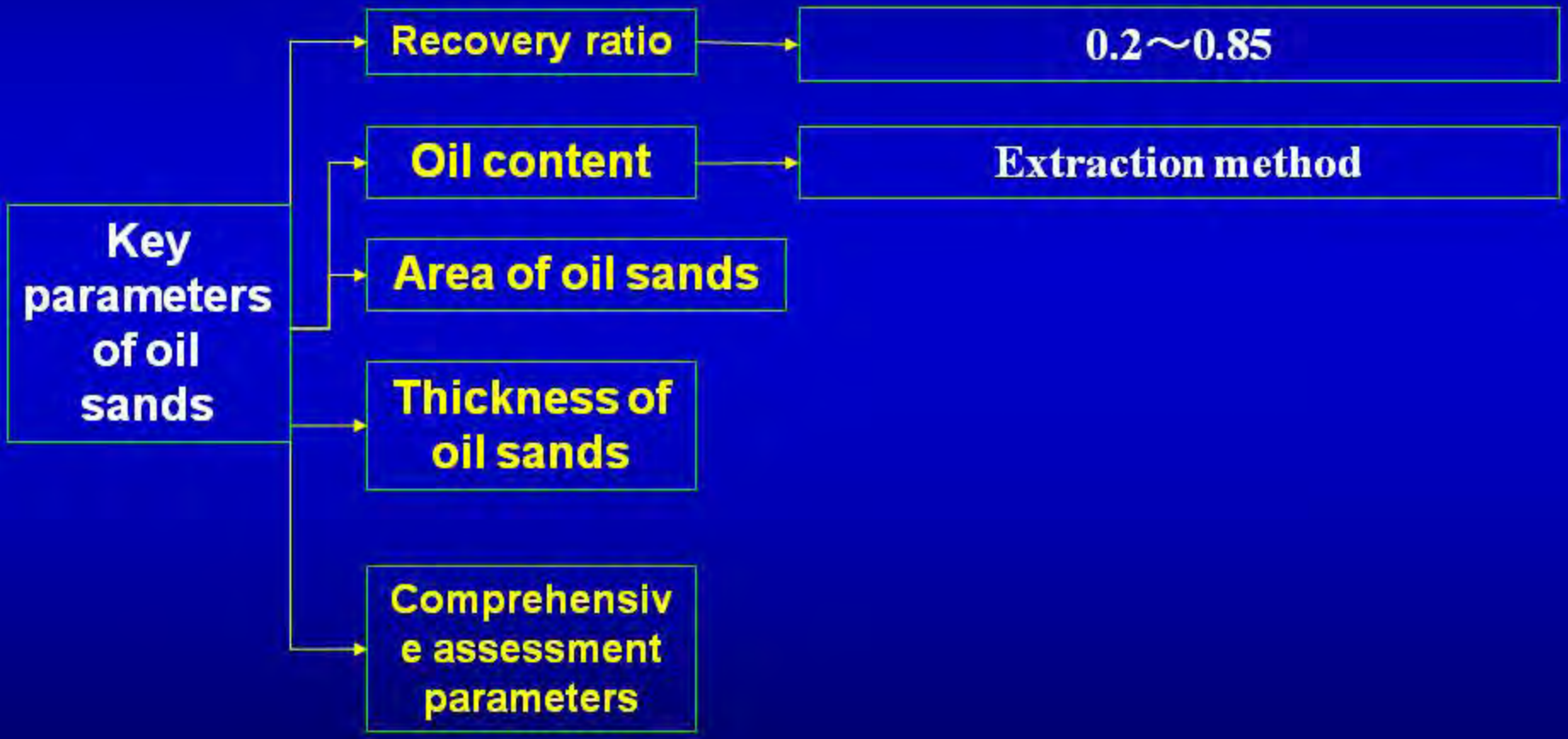
Parameters of coalbed methane



Parameters of oil shale

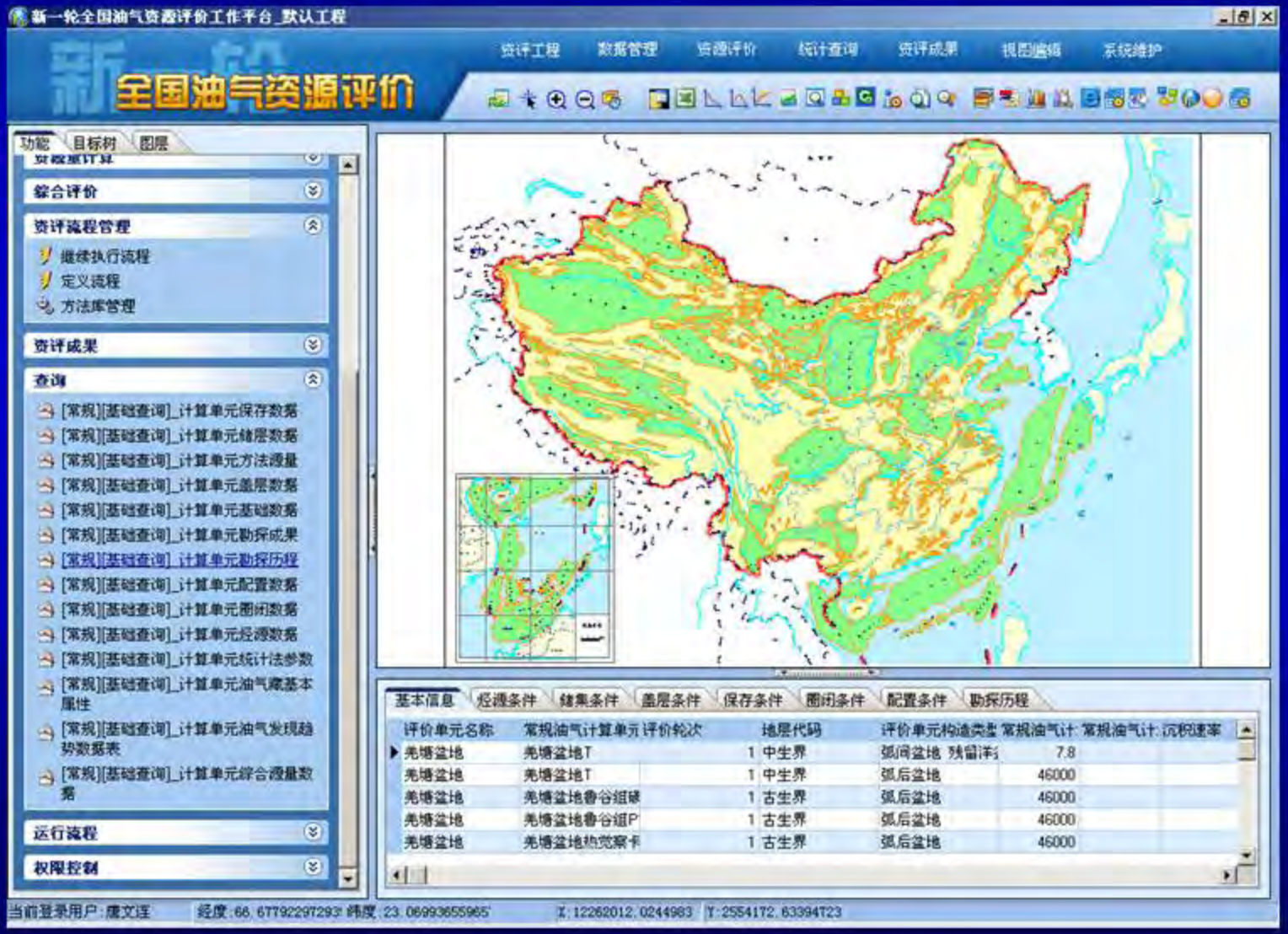


Parameters of oil sands



3. Assessment Methods

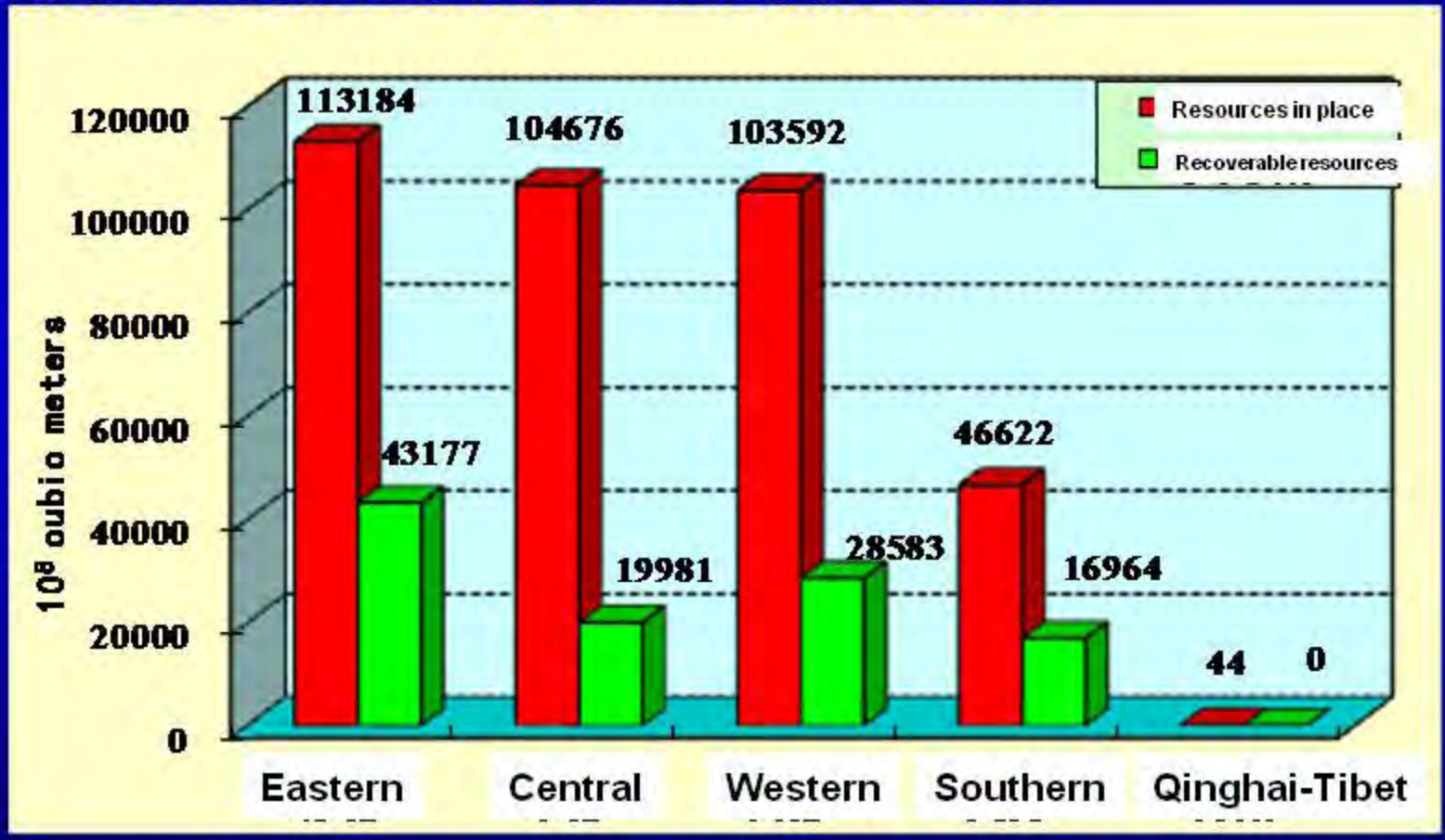
(3) Assessment software and database system



Contents

Coalbed methane resources

Coalbed methane resources in place are 37 trillion cubic meters, and recoverable resources are 11 trillion cubic meters.

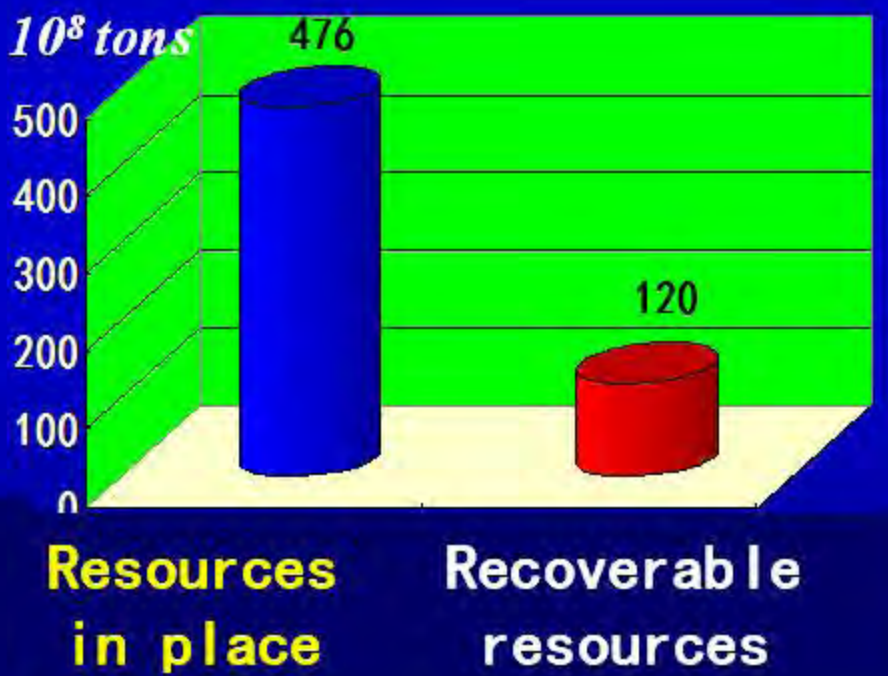


Region distribution of coalbed methane resources in China

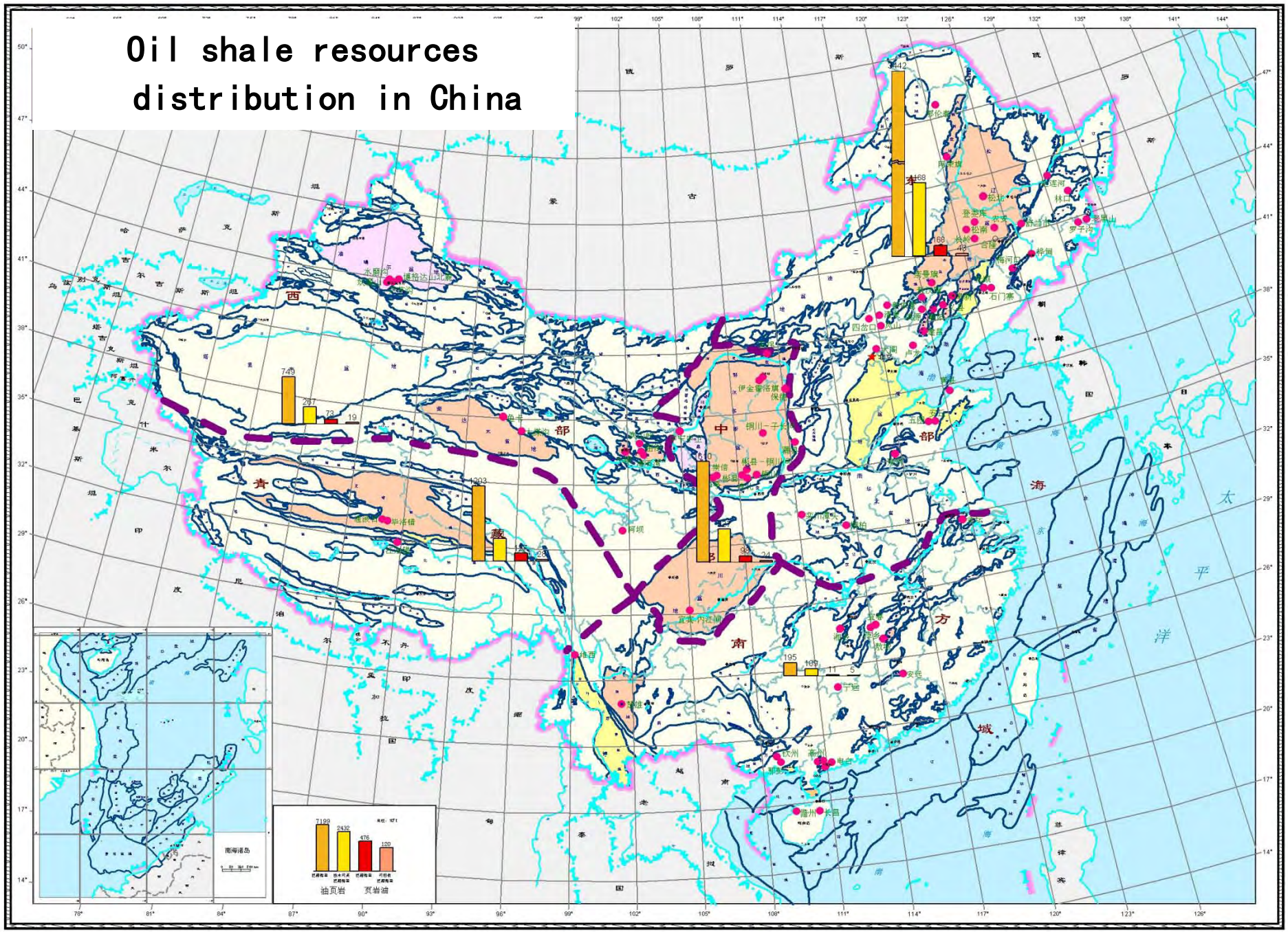
Oil shale resources

Oil shale

Shale oil

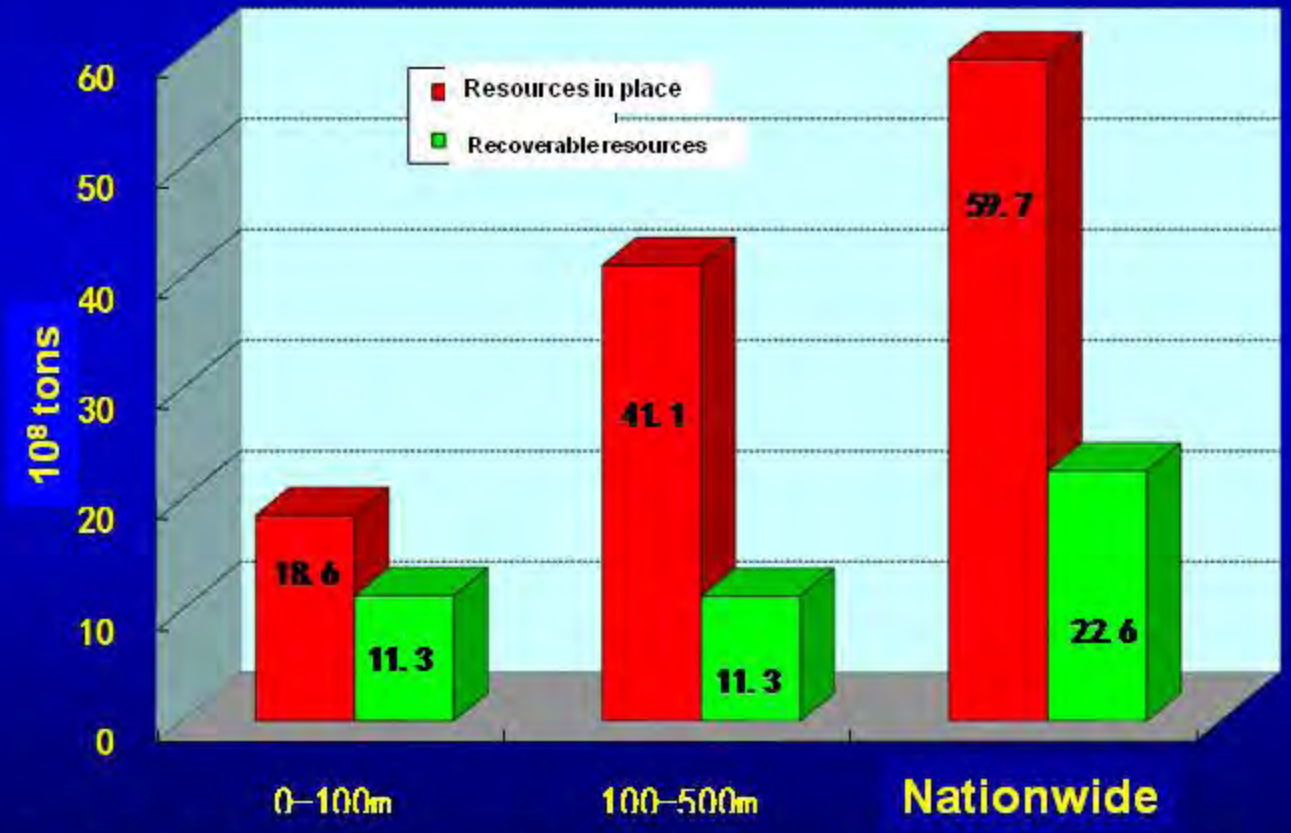


Oil shale resources distribution in China



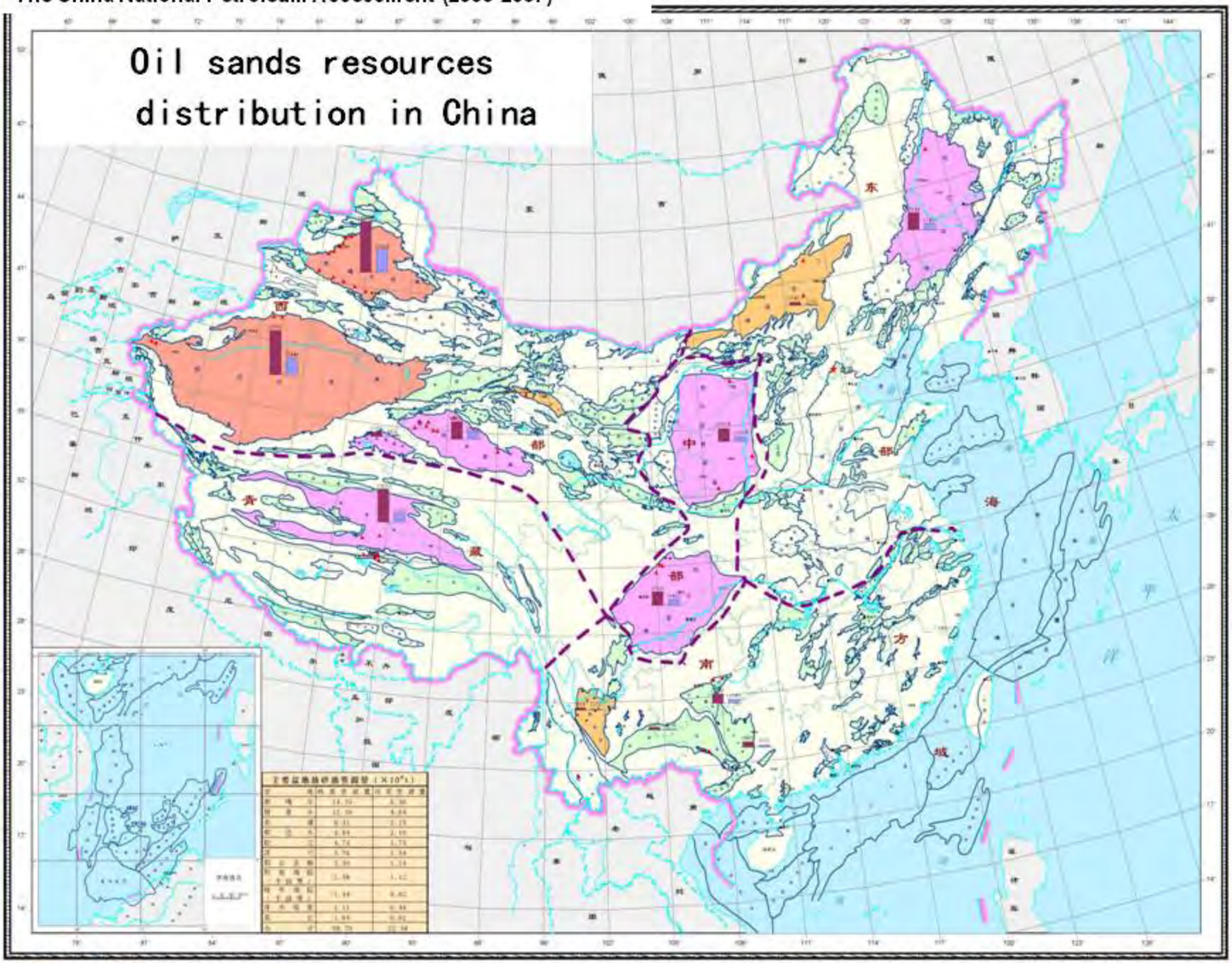
Oil sands resources

- Oil resources in place of oil sand are 6 billion tons, and oil recoverable resources of oil sand are 2.3 billion tons.

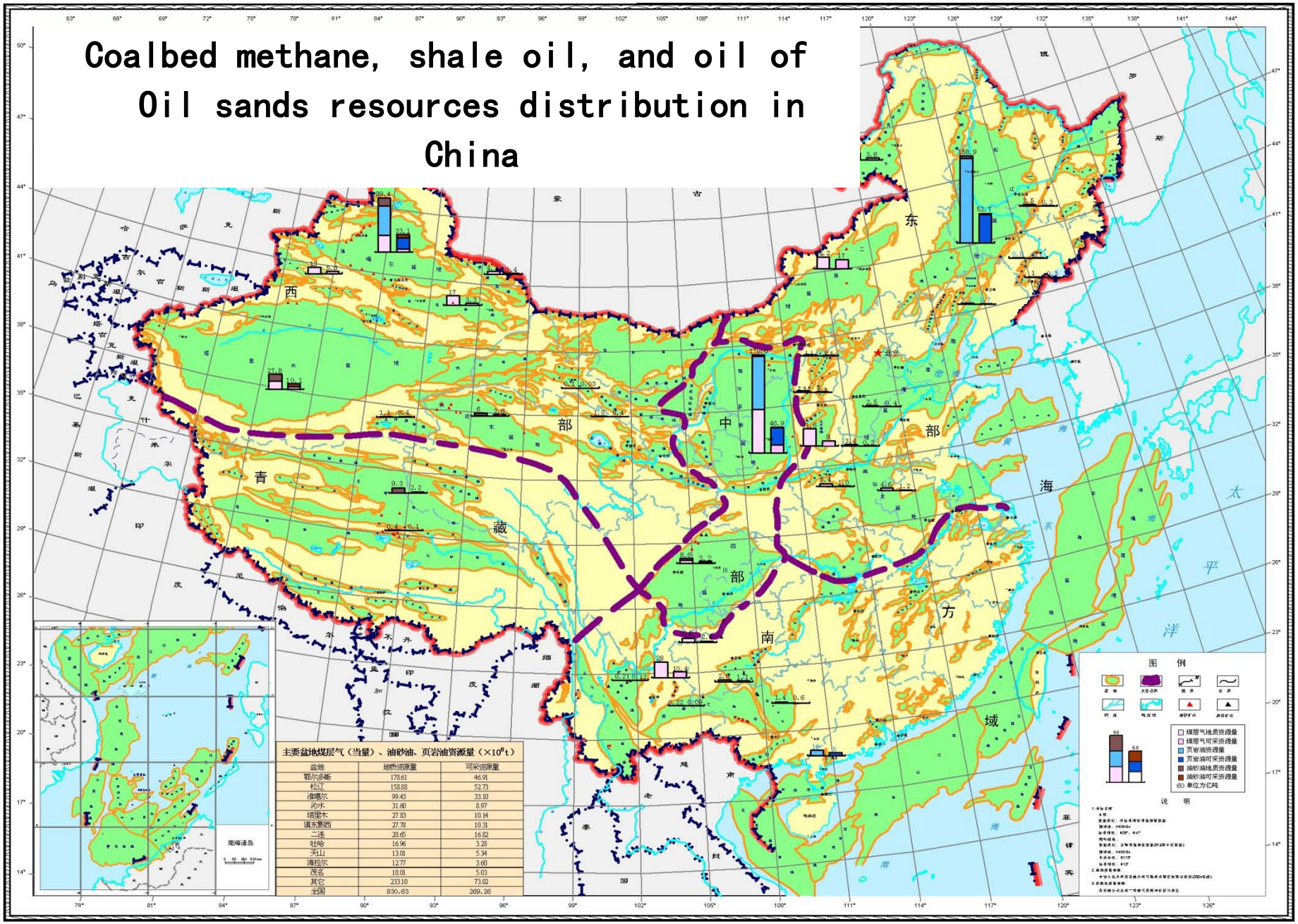


Depth distribution of oil resources in place of oil sands resources in China

The China National Petroleum Assessment (2003-2007)



Coalbed methane, shale oil, and oil of Oil sands resources distribution in China



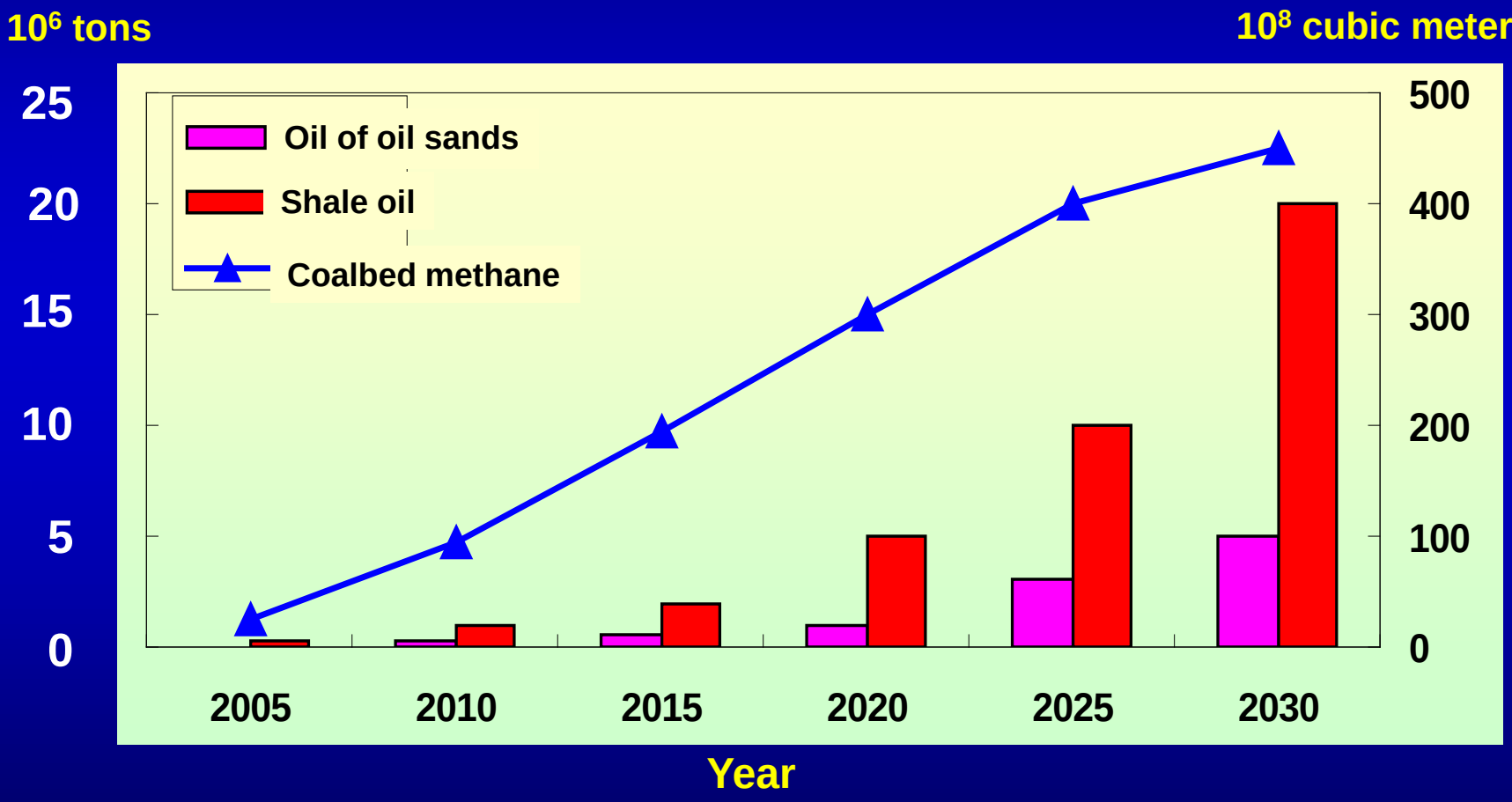
主要盆地煤层气（当量）、油砂油、页岩油资源量（$\times 10^8$t）

盆地	地质资源量	可采资源量
鄂尔多斯	178.61	46.91
松辽	158.88	52.73
准噶尔	99.43	33.10
沁水	31.60	8.97
塔里木	27.83	10.14
滇东黔西	27.78	10.31
二连	20.65	16.82
吐哈	16.96	3.28
天山	13.01	5.34
海拉尔	12.77	3.60
茂名	10.01	5.03
其它	233.10	73.02
全国	830.63	269.26

中国石油大学（北京）
国土资源部油气资源战略研究中心

(10^8 oil equivalent)

(5) Production forecast of unconventional petroleum




Thanks!