42nd IAEE INTERNATIONAL CONFERENCE
LOCAL ENERGY, GLOBAL MARKETS
MONTREAL MAY 29 – JUNE 1, 2019

IDENTIFICATION OF MAIN CONTROL FACTORS OF OIL RESERVE ABUNDANCE IN DEEP RESERVOIR

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Questions

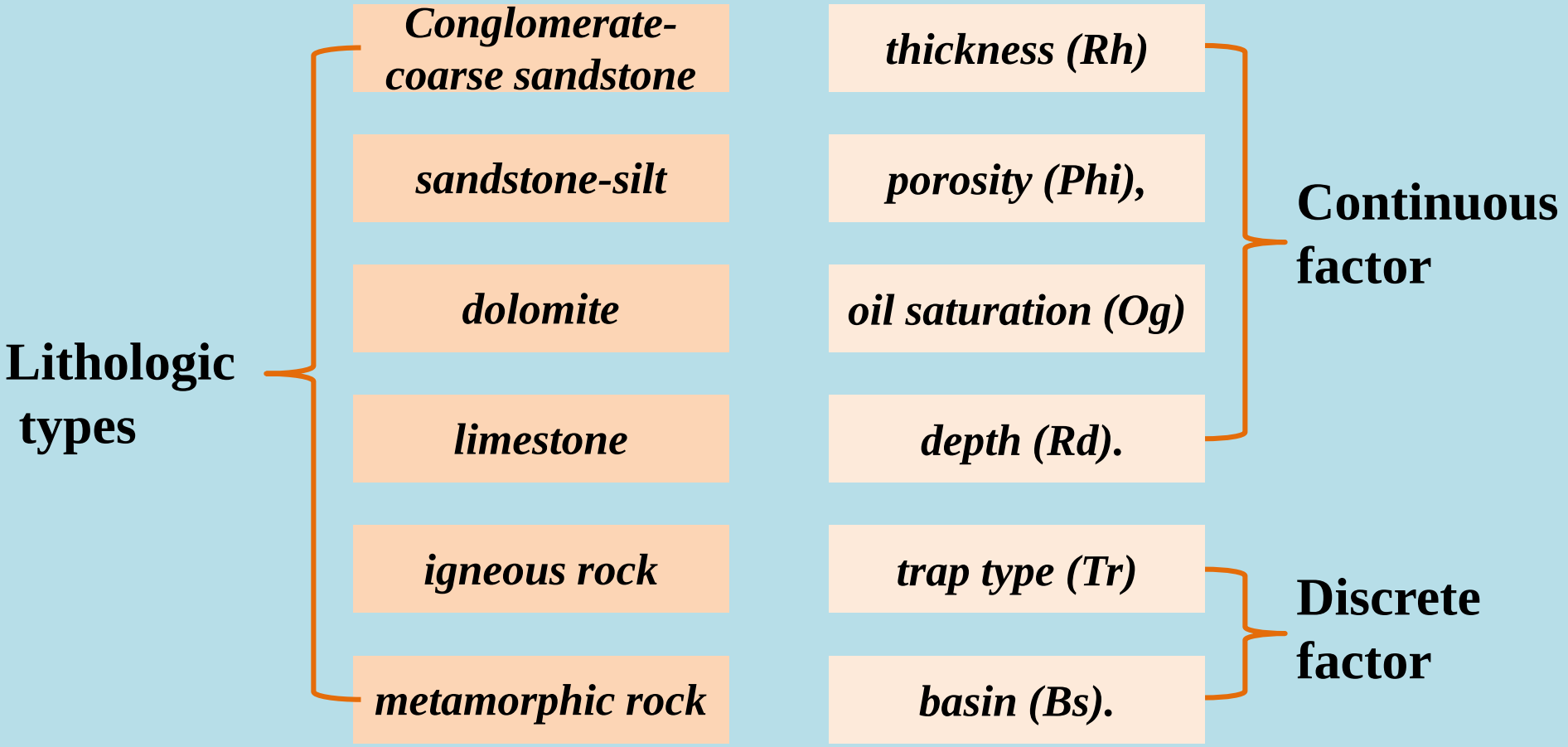
- What is **deep reservoir**?
- How do we get **the oil proved reserves abundance（OPRA）** in the region with low level exploration?
- How to identify the main control factors of the **OPRA**?

The method and data

The depth is more than 3500m.The data cover 775 oil reservoirs and seven factors from different region of China

Basin	Trap	Block	Year	Resevoir	Area (km^2)	Thickness (m)	Porosity (%)	Oil Saturation(%)	Proved reserves ($\times 10^4 t$)	depth (m)
Bohai Ba	tural rese	泽74-1x潜山	2002	omitic limest	1.0	29.9	5.0	61.81	84.00	3770
Tarim	buried hill	轮古17井区	2002	limestone	3.3	25.7	3.0	7.35	17.00	5467
Tarim	buried hill	轮古17井区	2002	limestone	3.3	19.3	5.0	40.76	118.00	5467
Tarim	buried hill	轮南54-轮古12	2002	limestone	29.2	19.2	0.4	26.98	55.00	5491
Tarim	buried hill	轮南54-轮古12	2002	limestone	29.2	25.4	3.0	46.08	932.00	5491
Bohai Bay	buried hill		1978	dolomite	2.9	126.0	6.0	60.21	1200.00	3904
Tarim	tructural reservoir		1994	dolomite	24.1	3.3	12.0	37.92	329.00	4830
Bohai Bay	al reservoirl	板深28-3	1998	sandstone	1.1	7.3	14.0	88.06	90.00	3725
Bohai Bay	l reservoirfa	港80-1	2000	sandstone	0.7	3.6	13.0	43.65	13.00	3520
Bohai Bay	l reservoirfa	港80-1	2000	sandstone	1.8	14.2	13.0	34.43	104.00	3678
Bohai Bay	l reservoirfa	港80-1	2000	sandstone	2.1	10.5	13.0	31.08	81.00	3788
Bohai Bay	l reservoirfa	港80-1	2000	sandstone	2.0	5.3	13.0	35.92	45.00	4000
Bohai Bay	fault block	岔71	1998	sandstone	0.7	19.5	12.0	87.97	131.00	3704
Bohai Bay	fault block	板深51	1992	sandstone	4.0	15.9	20.0	42.81	495.00	3705
Bohai Bay	fault block	塘34等4块	1993	sandstone	6.3	8.2	17.1	48.69	391.00	3500
Bohai Bay	lithologic	塘36	1995	sandstone	2.1	9.2	16.0	50.17	141.00	3500
Bohai Bay	lithologic	塘36	1995	sandstone	0.9	12.7	22.0	50.00	295.00	3725
Bohai Bay	ctural reser	留62-87	1999	fine sandstone	0.4	26.2	14.0	50.98	68.00	3560
Tarim	tructural res	A+B-C	1991	sandstone	8.2	43.6	13.6	52.28	2311.00	5756
Tarim	tructural res	DH4	1992	sandstone	1.6	17.6	14.0	54.41	195.00	6100
Tarim	tructural res	DH6	1992	sandstone	3.5	9.0	14.0	54.13	217.00	6028
Tarim	tructural res	东河4块	1993	fine sandstone	1.7	6.1	14.0	52.28	69.00	6085
Tarim	tructural res	东河14，20井区	1994	fine sandstone	6.9	7.7	13.7	56.22	372.00	5450
Qaidam	al reservoirl	砂西	1995	fine sandstone	0.1	17.0	13.9	47.00	227.00	3805

The method and data



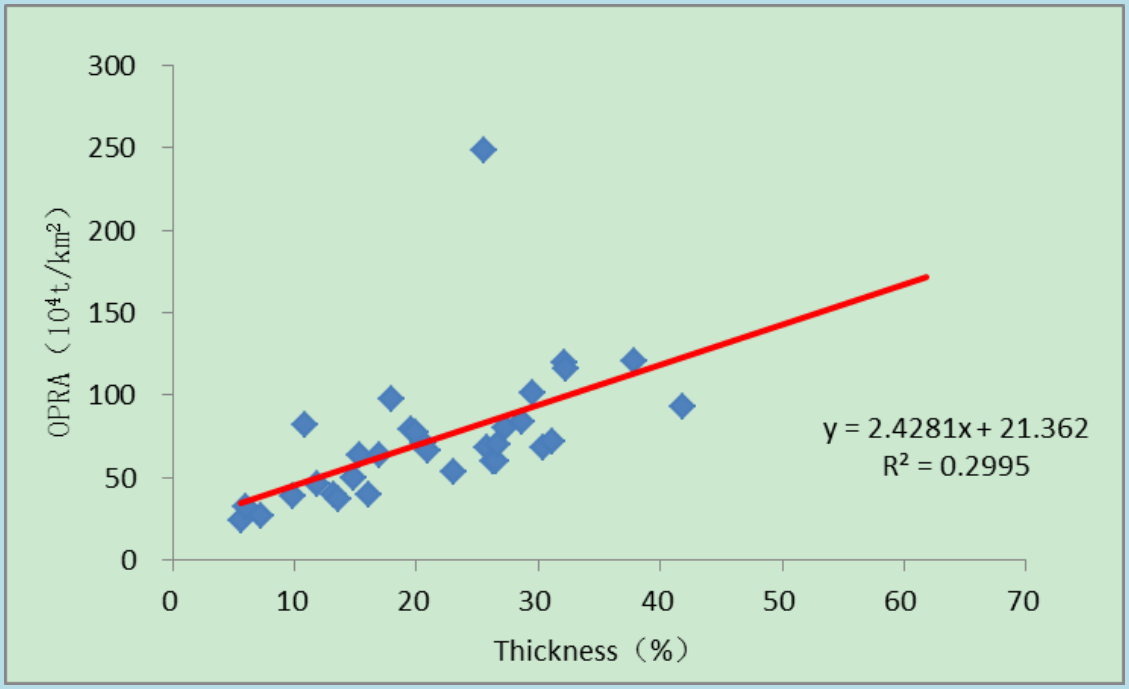
The method and data

Linear relationship between OPRA and factors → Extracting correlation coefficient（R） → Factors weight calculation

control factors identification

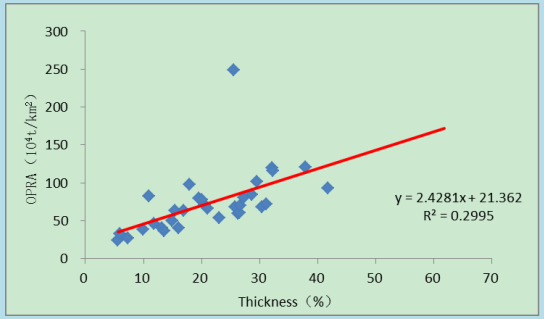
How to get the R?

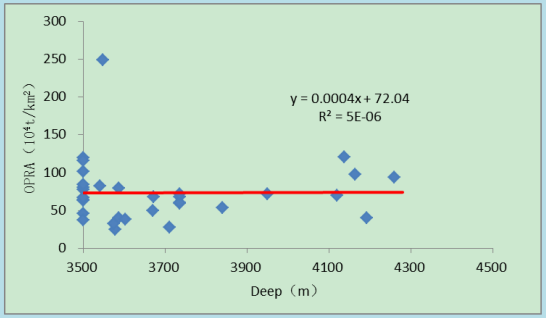
Take the conglomerate and coarse sandstone reservoir for example, the relationship between the OPRA and reservoir thickness is obtained by linear regression model . Unsquared （R^2）and get the correlation coefficient （R）



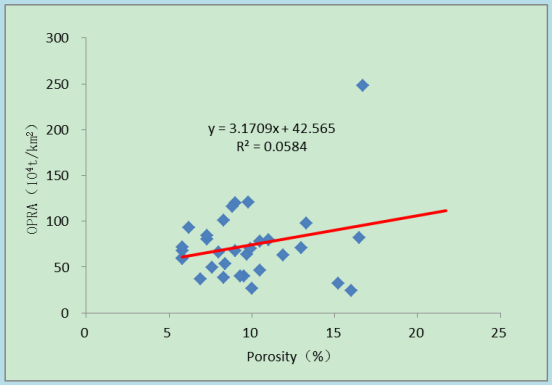
R^2=0.2995
R=0.5473

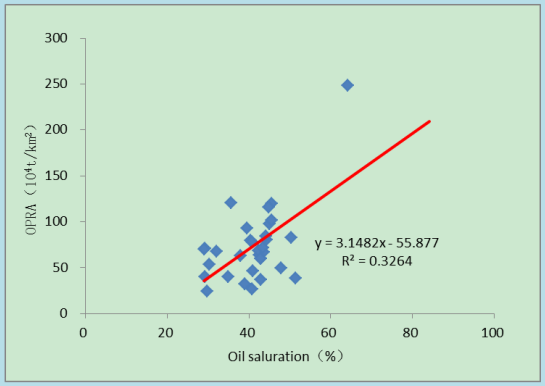
The conglomerate and coarse sandstone reservoir



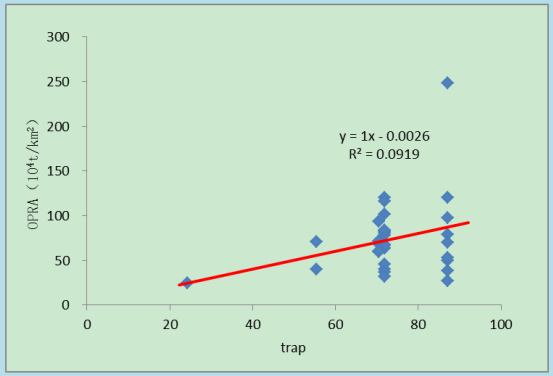


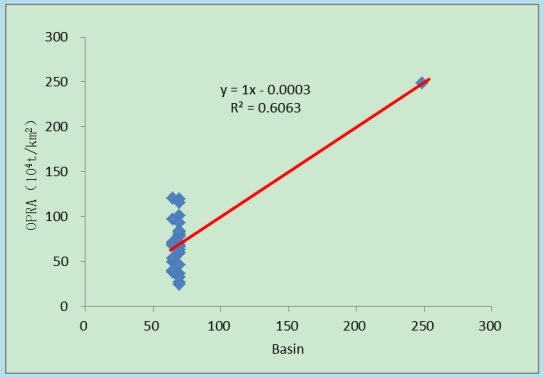
factors	Thick-ness	Poro-sity	Oil Satura tion	Deep	Trap	basin
	（m）	（%）	（%）	（m）		
R^2	0.2995	0.0584	0.3264	0	0.0919	0.6063
R	0.5473	0.2417	0.5713	0	0.3032	0.7787
weight	22.4	9.9	23.4	0.0	12.4	31.9





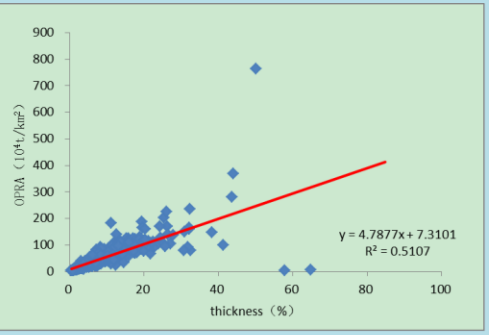
$$W_i = \frac{R_i}{\sum_{i=1}^{n} R_i} \times 100$$

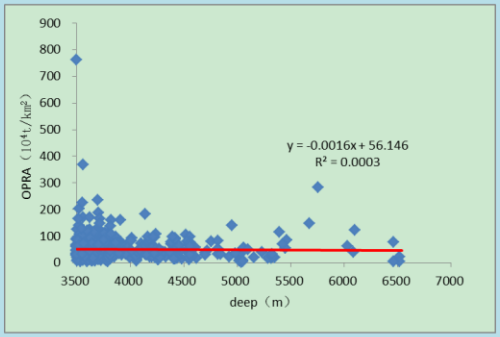


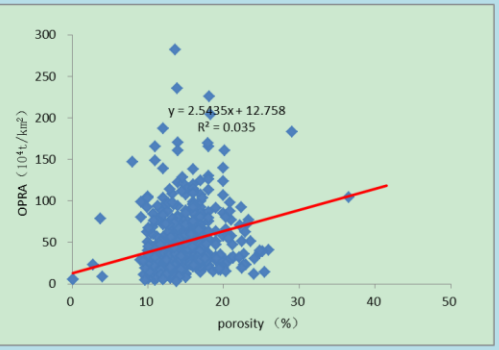


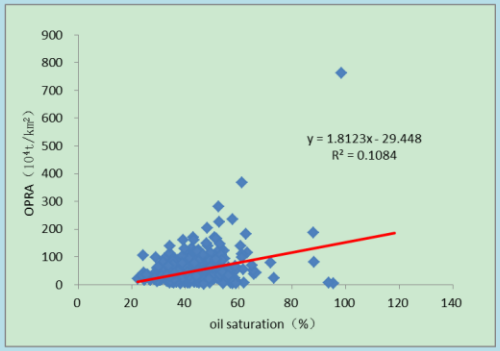
The main factors are basin, oil saturation and thickness.

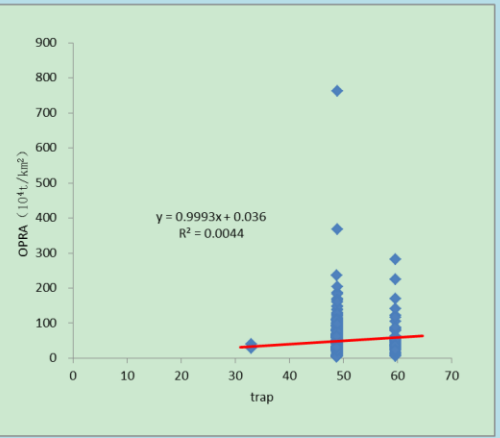
Results: The sandstone-silt reservoir

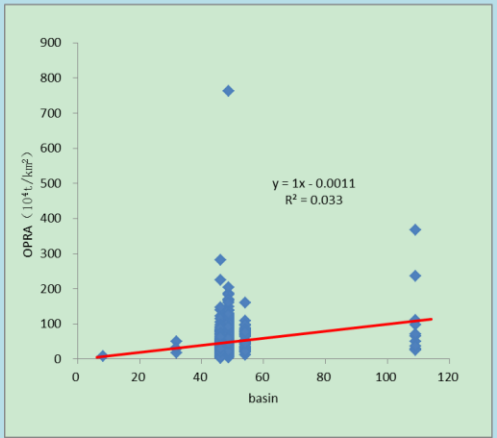








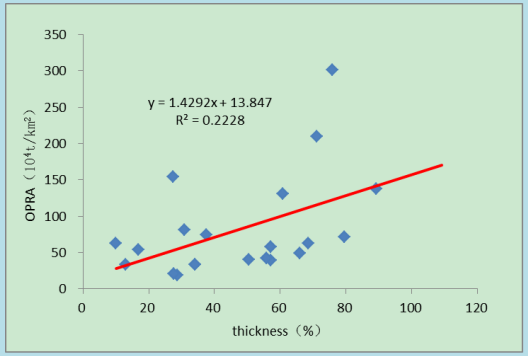


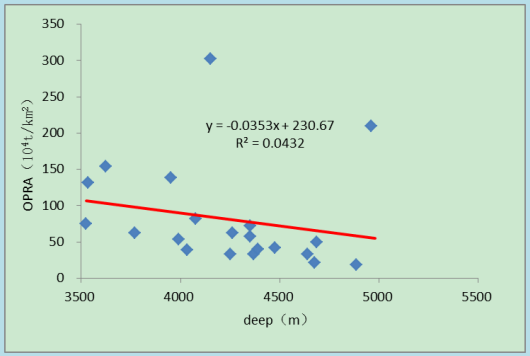


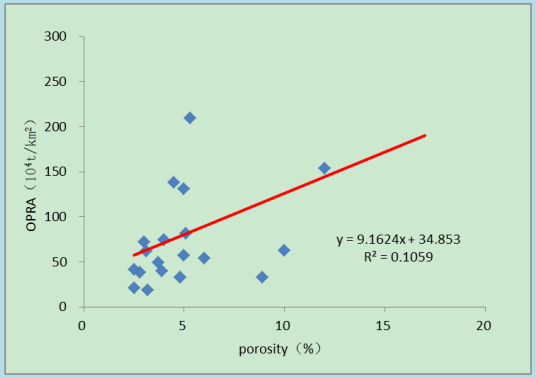
factors	Thick-ness	Poro-sity	Oil Satura tion	Deep	Trap	basin
	（m）	（%）	（%）	（m）		
R^2	0.5107	0.035	0.1084	0.0003	0.0044	0.033
R	0.715	0.187	0.329	0.017	0.066	0.182
weight	47.8	12.5	22.0	1.2	4.4	12.1

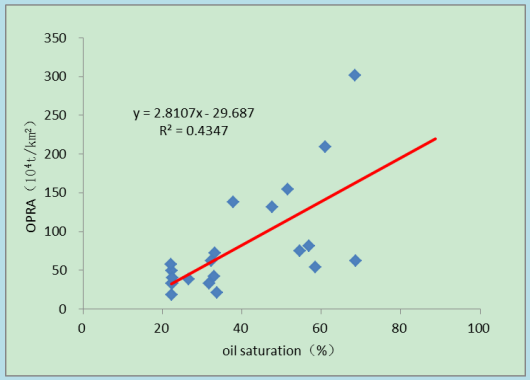
The main factors are thickness and oil saturation.

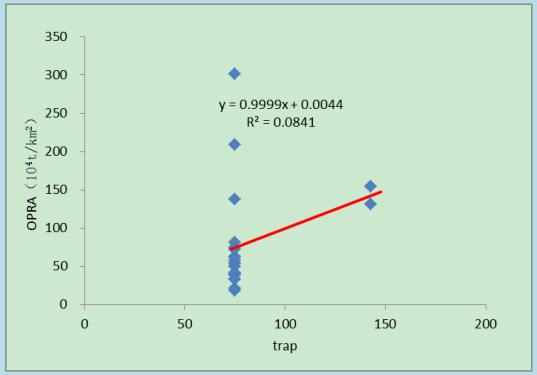
Results: The dolomite reservoir

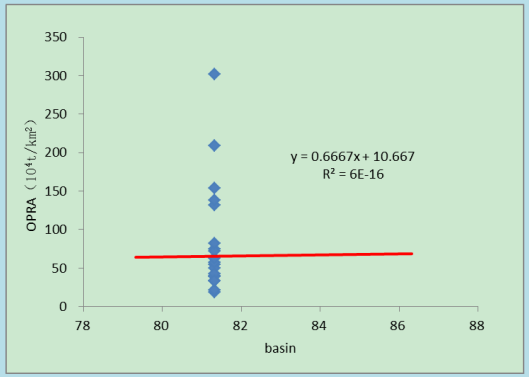








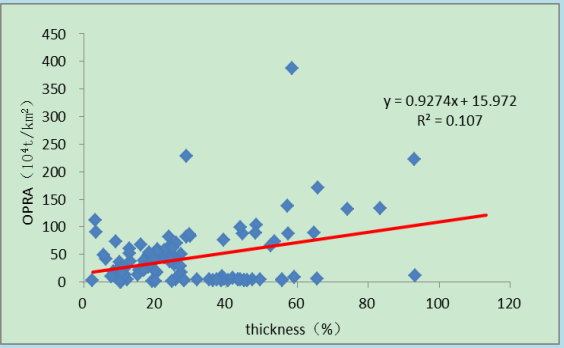


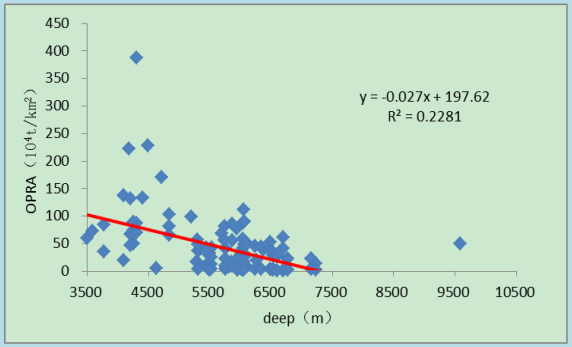


factors	Thick-ness	Poro-sity	Oil Satura tion	Deep	Trap	basin
	(m)	(%)	(%)	(m)		
R^2	0.2228	0.1059	0.4347	0.0432	0.0841	0
R	0.472	0.325	0.659	0.208	0.29	0
weight	24.1	16.6	33.7	10.6	14.8	0.0

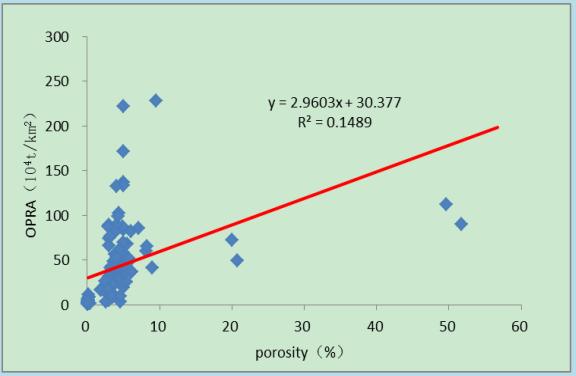
The main factors are oil saturation and thickness.

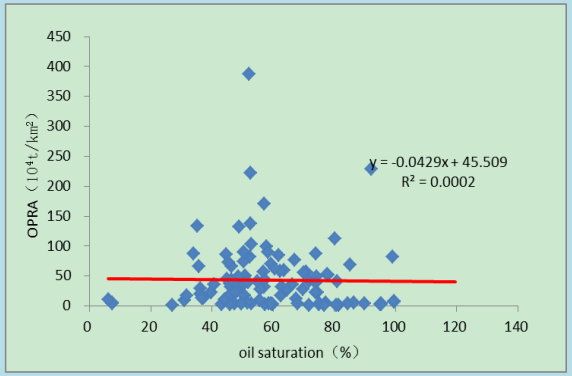
Results: The limestone reservoir



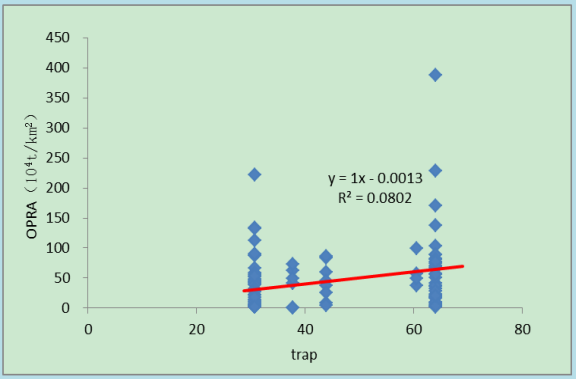


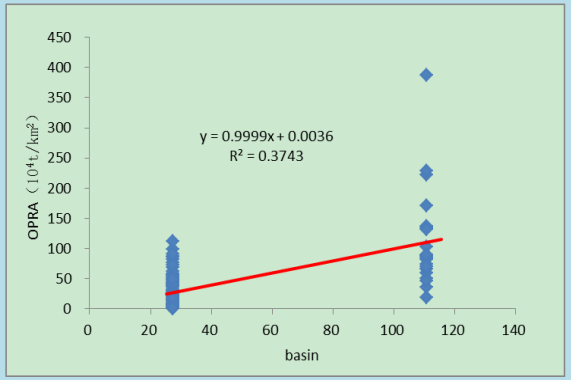
factors	Thick-ness	Poro-sity	Oil Satura tion	Deep	Trap	basin
	（m）	（%）	（%）	（m）		
R^2	0.107	0.1489	0.0002	0.2281	0.0802	0.3743
R	0.327	0.386	0.014	0.478	0.283	0.612
weight	15.6	18.4	0.7	22.7	13.5	29.1



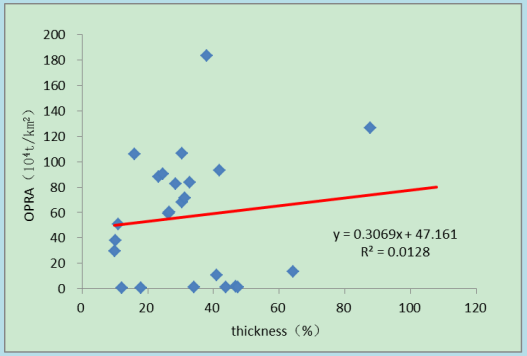


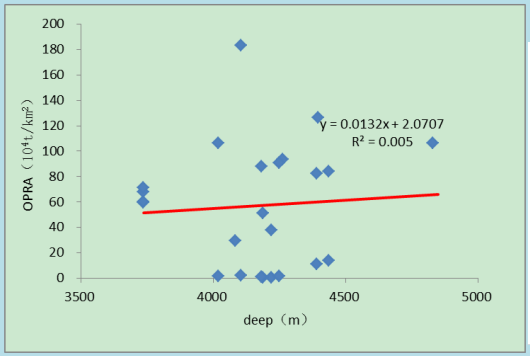
The main factors are basin and depth.



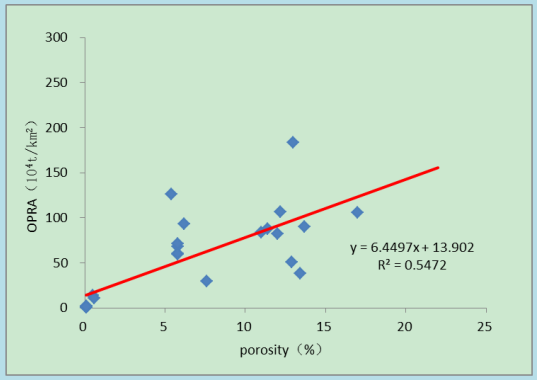


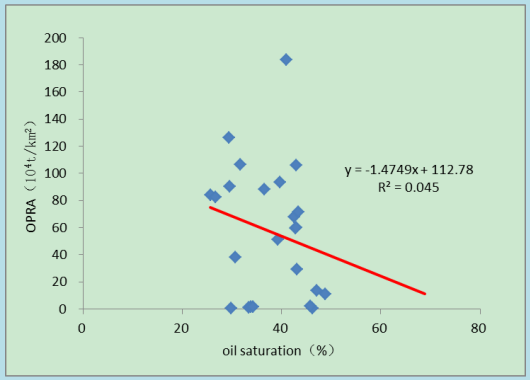
Results: The igneous rock reservoir

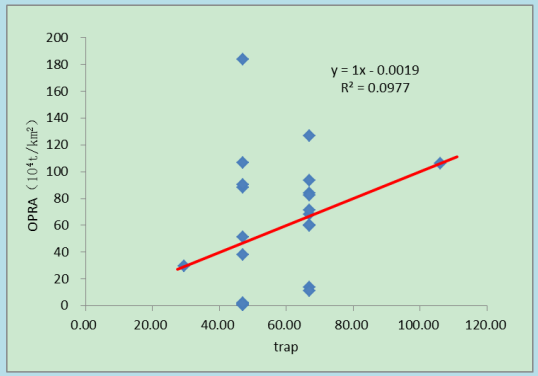


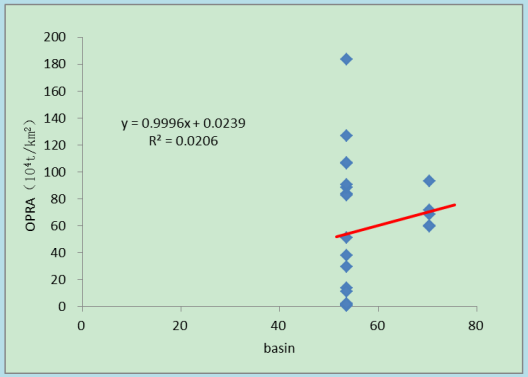


factors	Thick-ness	Poro-sity	Oil Satura tion	Deep	Trap	basin
	（m）	（%）	（%）	（m）		
R^2	0.0128	0.5472	0.045	0.005	0.0977	0.0206
R	0.113	0.74	0.212	0.071	0.313	0.144
weight	7.1	46.5	13.3	4.4	19.6	9.0



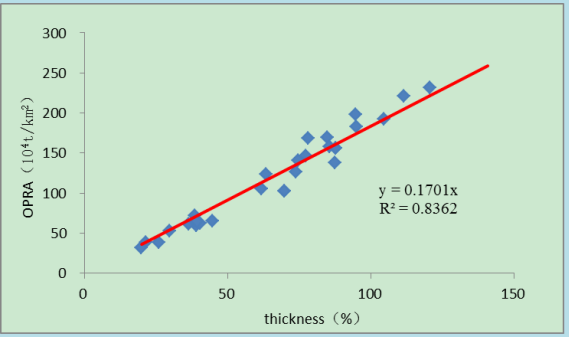


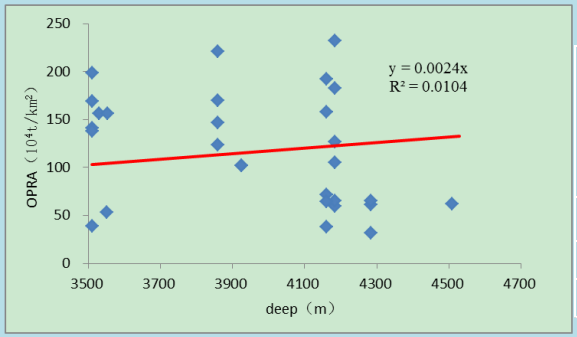




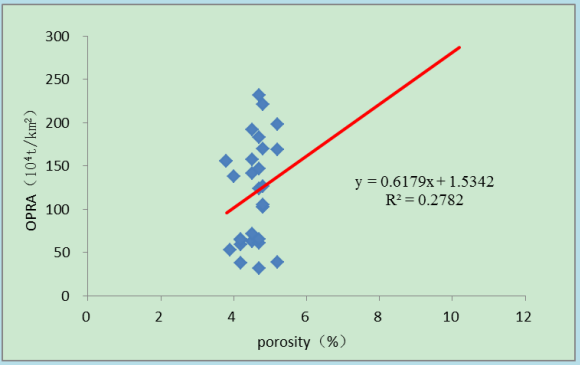
The main factors are porosity and trap type.

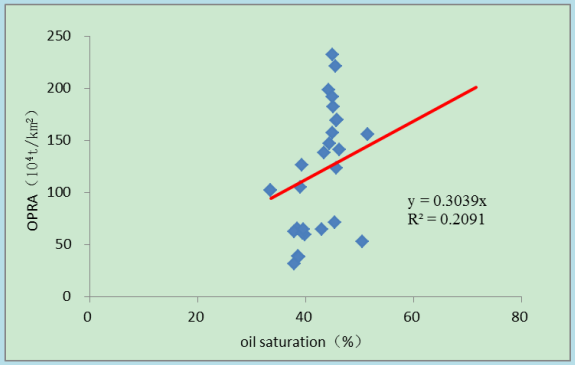
Results: The metamorphic reservoir

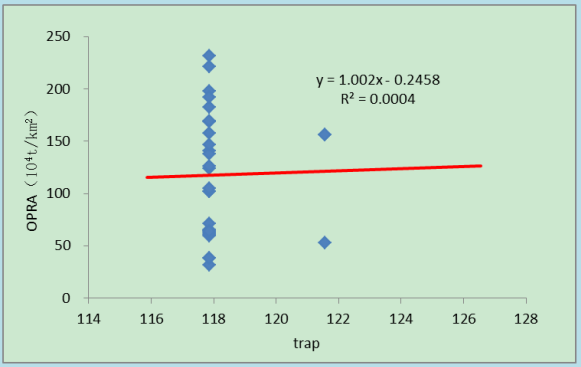


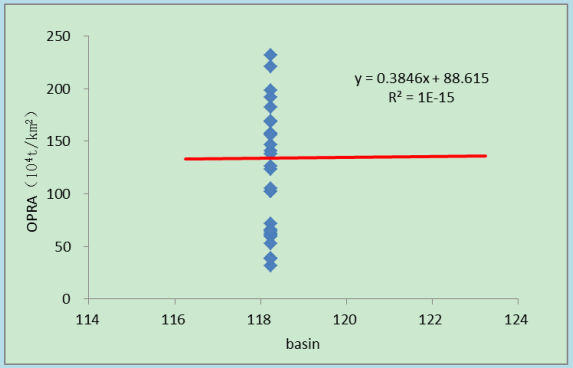


factors	Thick-ness	Poro-sity	Oil Satura tion	Deep	Trap	basin
	（m）	（%）	（%）	（m）		
R^2	0.8362	0.2782	0.2091	0.0104	0.0004	0
R	0.914	0.527	0.457	0.102	0.02	0
weight	45.2	26.1	22.6	5.0	1.0	0.0









The main factors are thickness, porosity and oil saturation.

conclusions

- The main controlling factors of oil proved reserve abundance（OPRA） are different in different lithologic reservoirs
- The quantitative relationship between OPRA and discrete data can also be described
- This method can used in OPRA calculation in the region with low level exploration

Thank you !

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