KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

COLLEGE OF ENVIROMNENTAL DESIGN
DEPARTMENT OF CITY & REGIONAL PLANNING

Term Paper Presentation on

GIS-Based Applications In Petroleum Exploration

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Dec.25, 2012

OUTLINES

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GIS FOR OIL INDUSTRY

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CASE STUDY II

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REFERENCES

OVERVIEW

- **GIS is a organized set of hardware, software, geographic information, and user to efficiently obtain, store, manipulate update, analyze and display geographic reference data.**

- **GIS is employed in petroleum industry in many aspects to improve the way of acquiring, processing, management, and delivering all information related to exploration, development and production .**
- **Evaluation of petroleum potentiality.**

GIS FOR OIL INDUSTRY - example

- ✓ **SAUDI ARAMCO: More than 10 yrs in developing GIS enterprise for exploration surveys, evaluate contractors performance, analyze field geophysical data.**

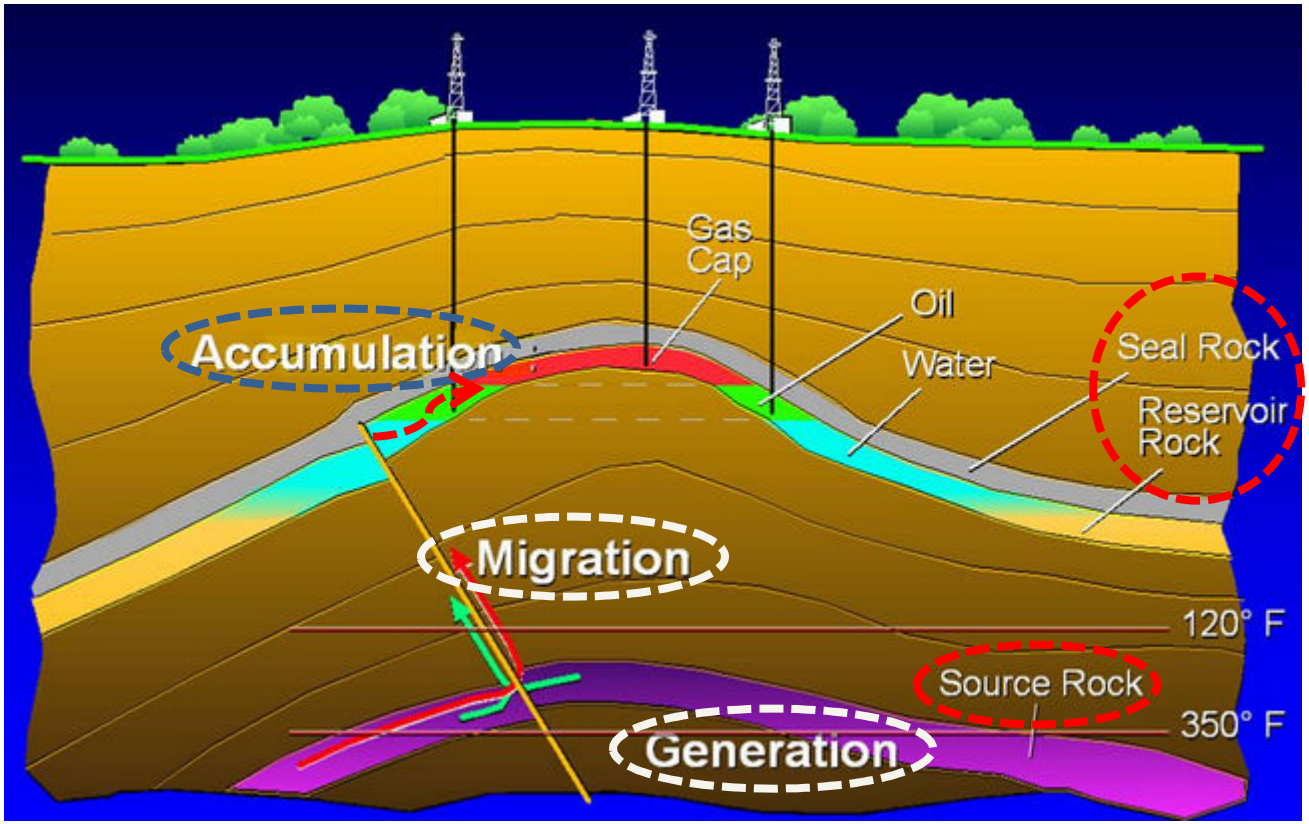
- ✓ **Petroleum Development Oman project (PDO): GIS for Mapping and Integration of well data and analyses of trap configuration For the productive fields.**

- ✓ **OMV Petrom Romania: using GIS applications for exploration and production to avoid data redundancy, allowing easy and multi-access ways to data, and developing the overall exploration and production work flow.**
- ✓ **Hurricanes in the Gulf of Mexico: GIS spatially represented the predictable hurricane passageways, evaluate risk factors to make petroleum companies awake for the future hurricanes.**

- *GIS best practice; GIS for Petroleum, ESRI 2007*
- *Kevin McLay et al., 2003*

WE HAVE TO KNOW !

Petroleum system = Elements + Processes



(Petroleumsupport.com)

CASE STUDY I GIS-based modeling of secondary hydrocarbon migration pathways; northern Songliao Basin, northeast of China

- **What's Hydrocarbon secondary migration?**

- **Movement of Hydrocarbon (oil or gas) within carrier bed to proper entrapment site (trap)**

- **modeling of migration pathways is important to locate the traps**

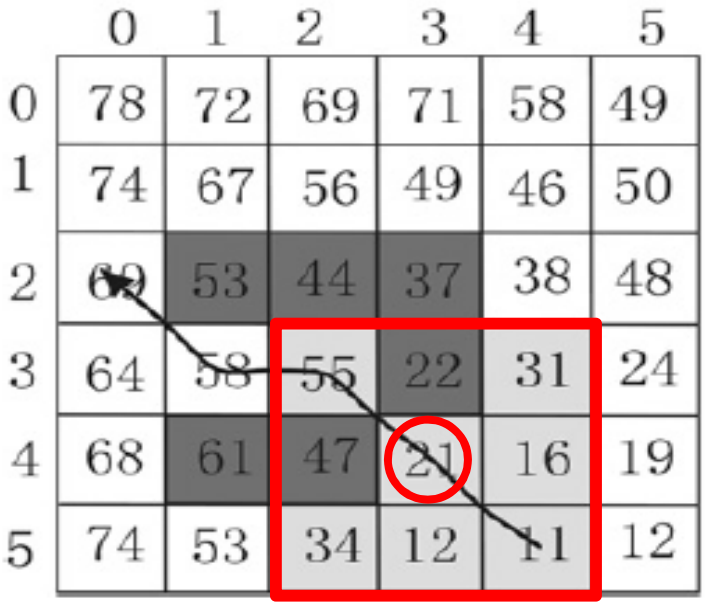
(Richard C. Selly, 1998)

DEM algorithms

- **A GIS-based application model**
- **Used widely in hydrological modeling to analyze the directions of water flow**
- **This principle can be applied reversely in hydrocarbon migration modeling**

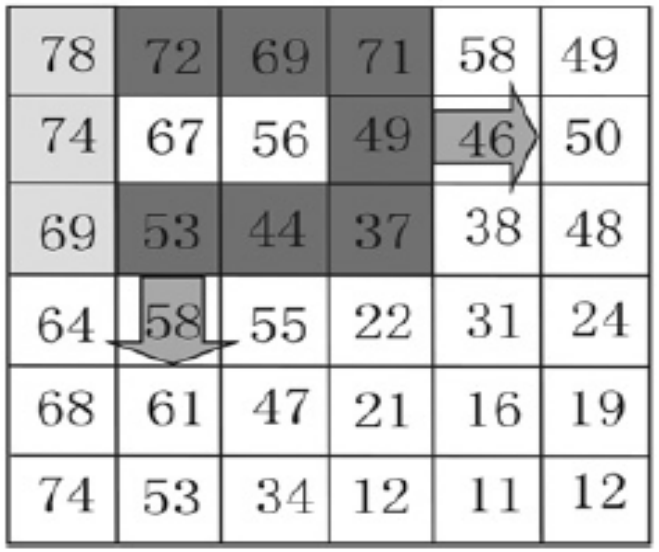
Li et al., 2002

- **Assume 3 x 3 search window**
- **Point source is a point in the carrier bed from which hydrocarbon begins to take definite route(s)**
- **Point source was put in the center of search window**



	0	1	2	3	4	5
0	78	72	69	71	58	49
1	74	67	56	49	46	50
2	69	53	44	37	38	48
3	64	58	55	22	31	24
4	68	61	47	21	16	19
5	74	53	34	12	11	12

hydrocarbon migration



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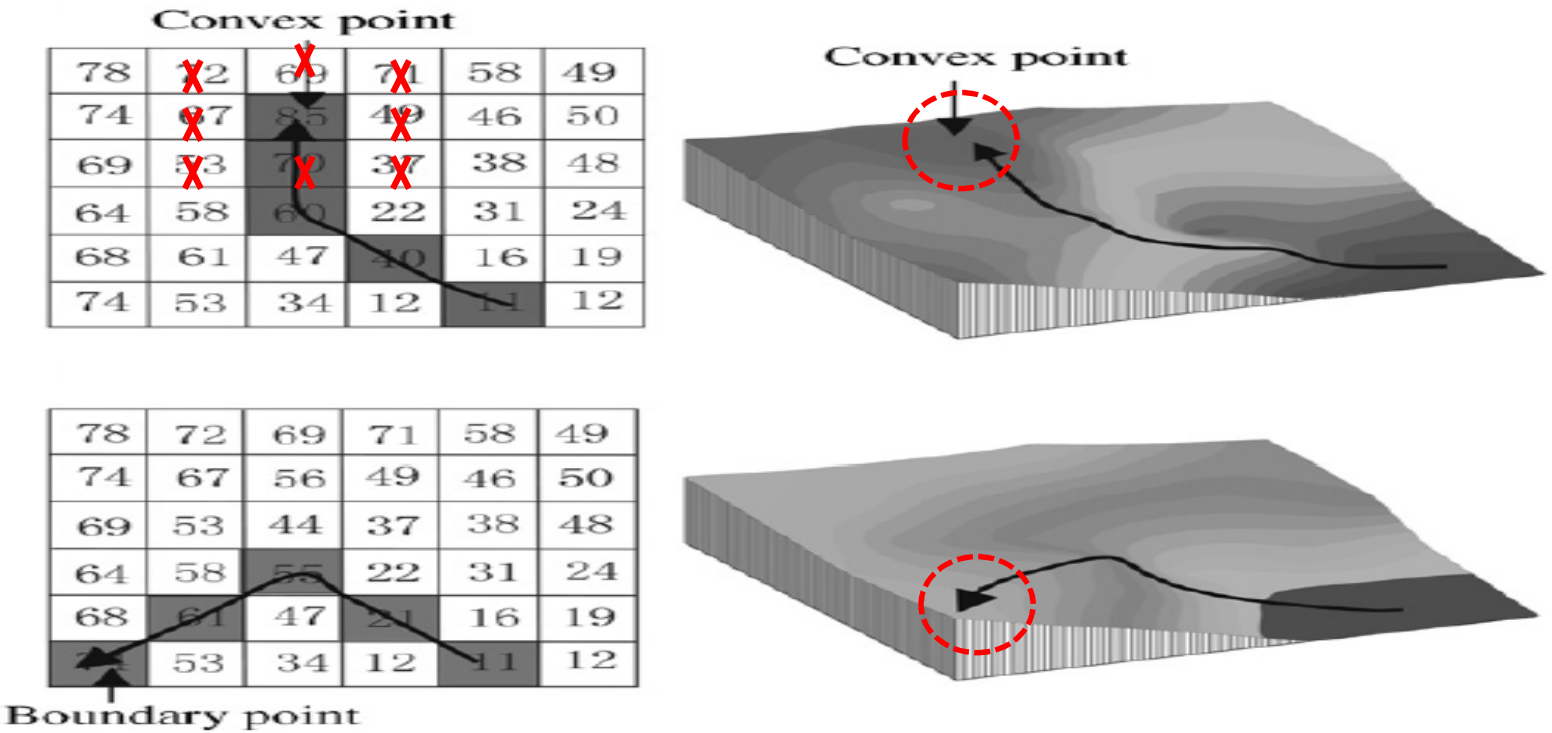
	74	53	34	12	11	12

water flow

(after Xuefeng Liu et al., 2008)

migration Scenarios

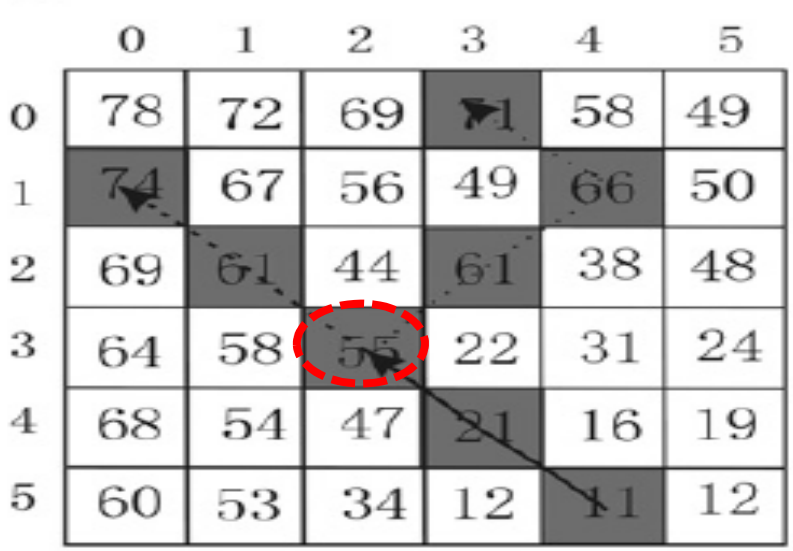
Termination point (convex point) means Possible trap



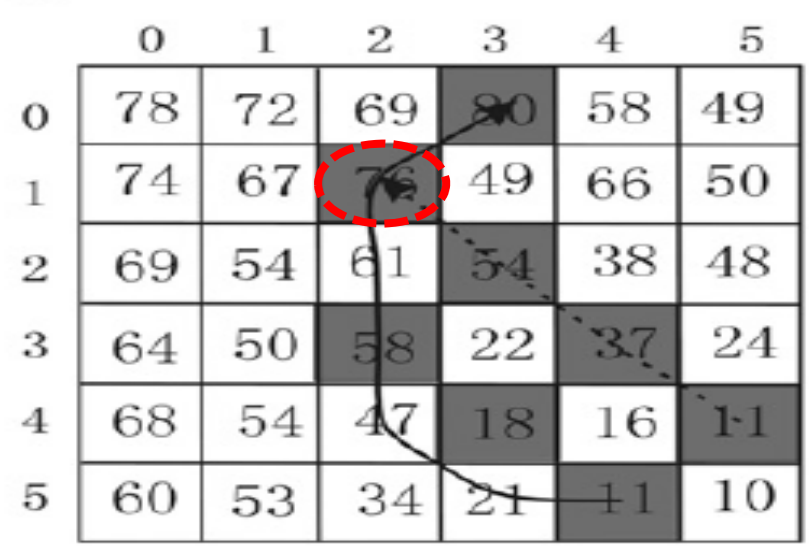
Boundary point (migration expands out of algorithm)

migration Scenarios

Divergence point



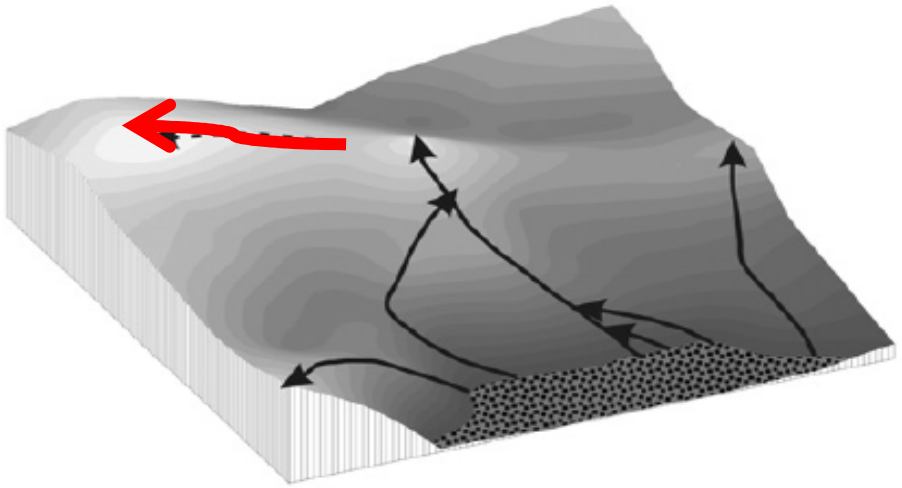
Convergence point



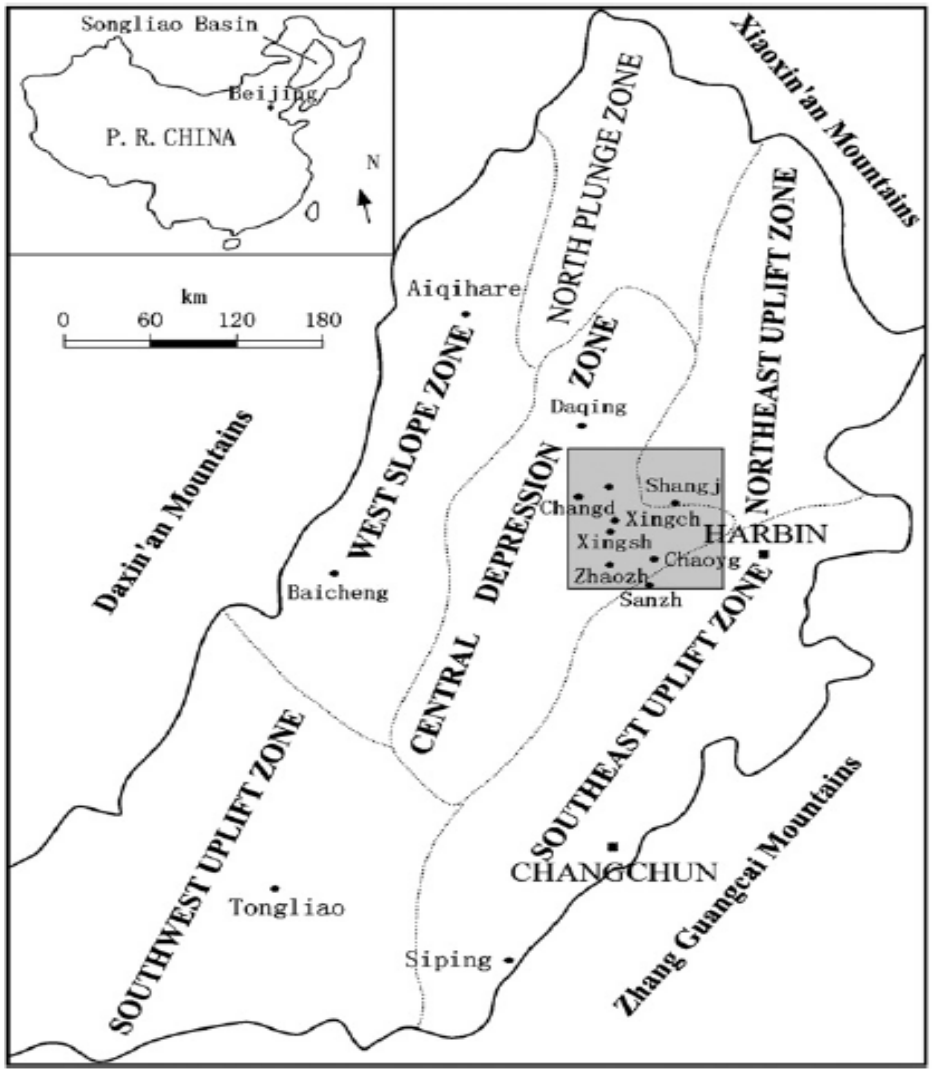
Real life (complex model)

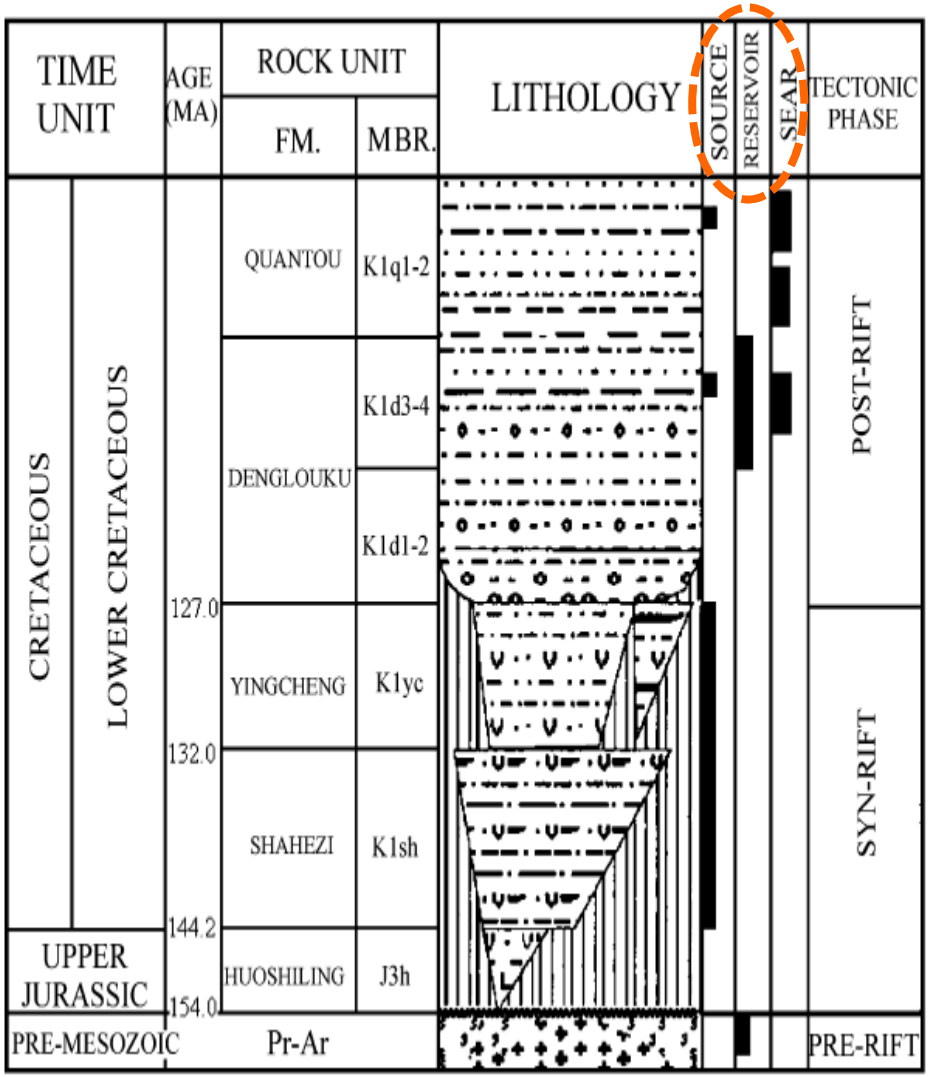
- **Sometimes we can get a remigration point**
- **The amount of accumulated petroleum is greater than trap capacity**

	0	1	2	3	4	5	6	7	8
0	70	80	70	54	40	54	60	65	70
1	80	90	80	70	54	42	56	60	65
2	90				70	55	45	46	49
3	78	72	69	71		70	60	54	55
4	74	67	55	59		50	55	60	
5	69	53	45			45	41		38
6	64	45		30			35	36	32
7	68		47					30	25
8		53		11	11	11	11		20



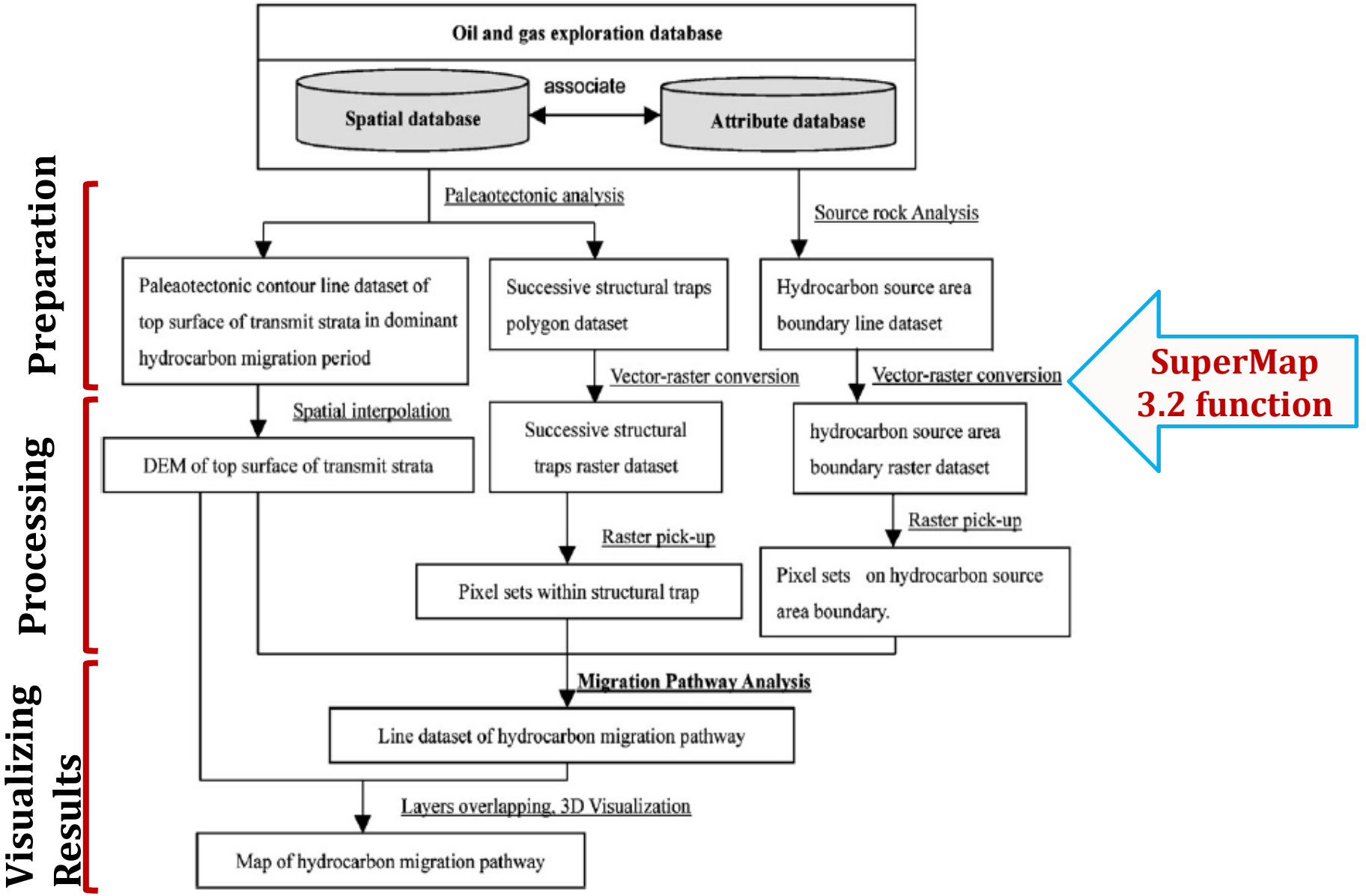
Songliao Basin, NE China





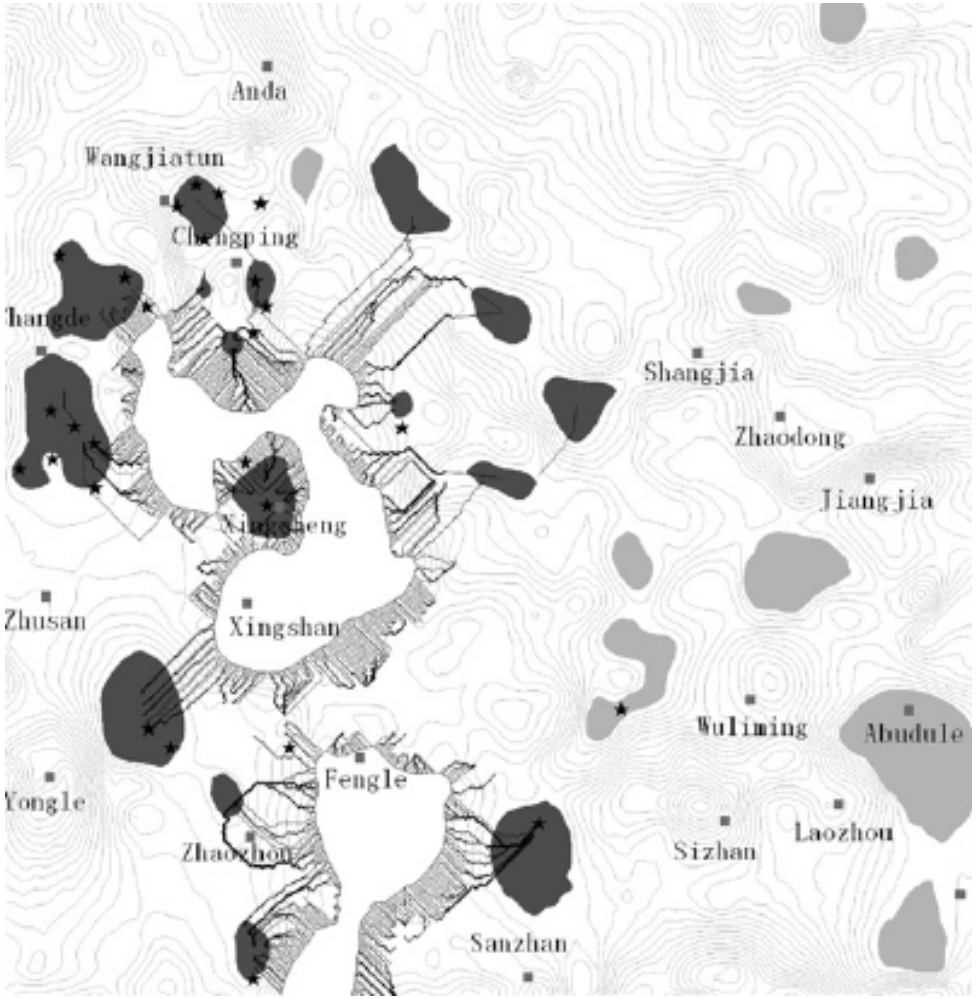
(After Xuefeng Liu et al., 2008)

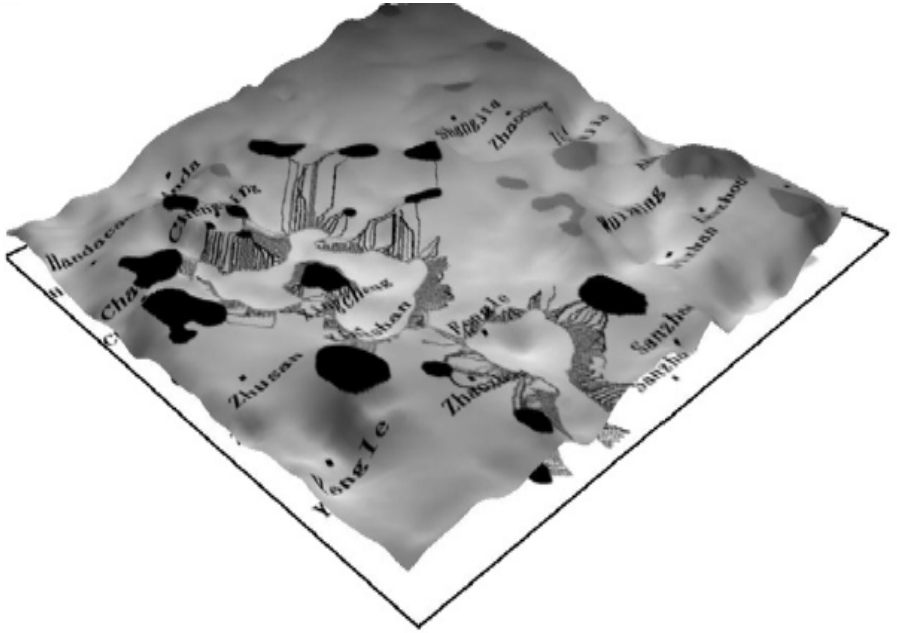
SuperMap 3.2



(After Xuefeng Liu et al., 2008)

SuperMap 3.2 visualize function





Depth contour

The predicted accumulation areas of natural gas by modeling

The structures outside the predicted accumulation areas

The modeled migration pathways of natural gas

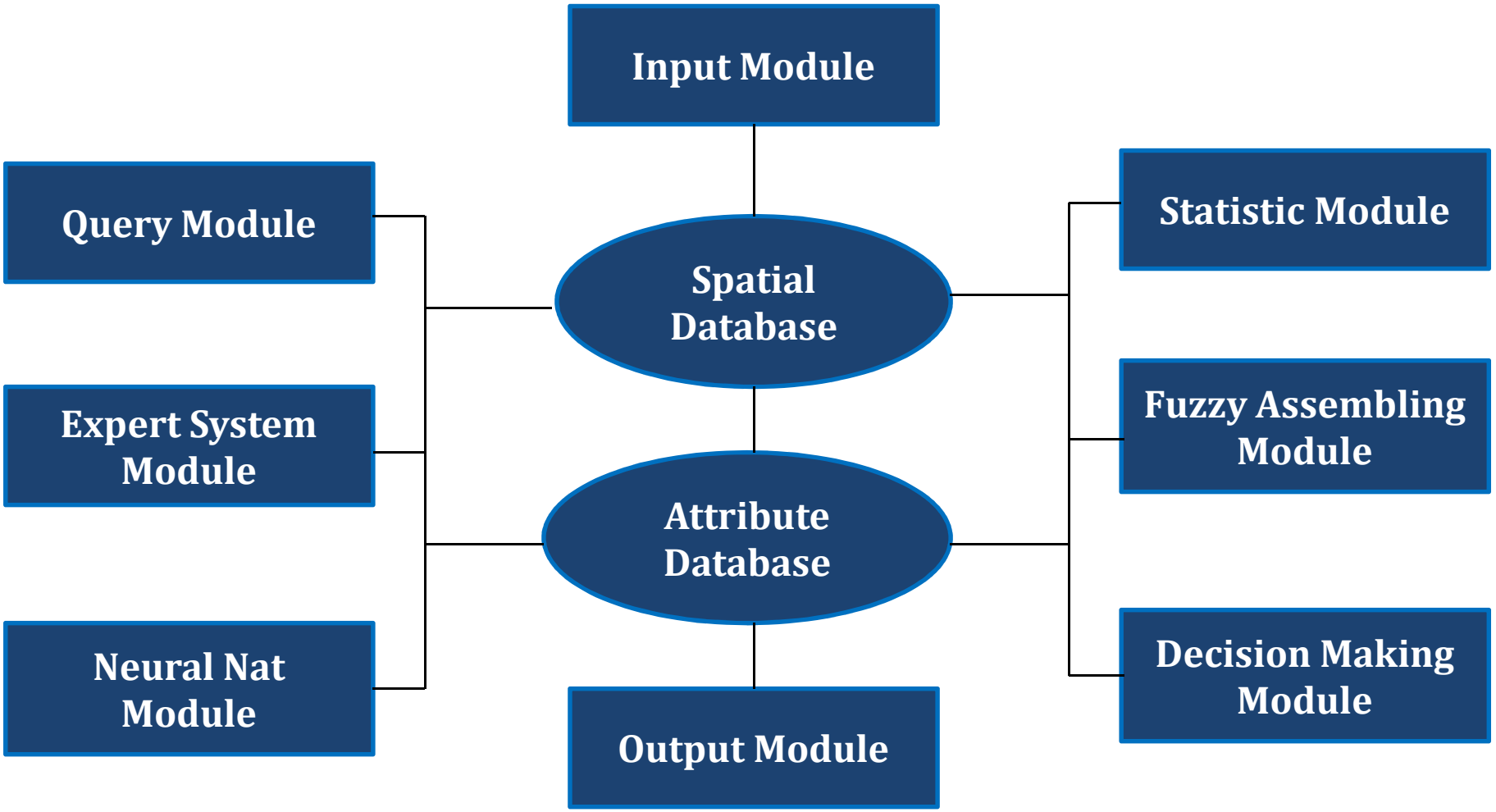
The source areas of natural gas

Location of gas-producing drilling wells

Sizhan Town and its annotation

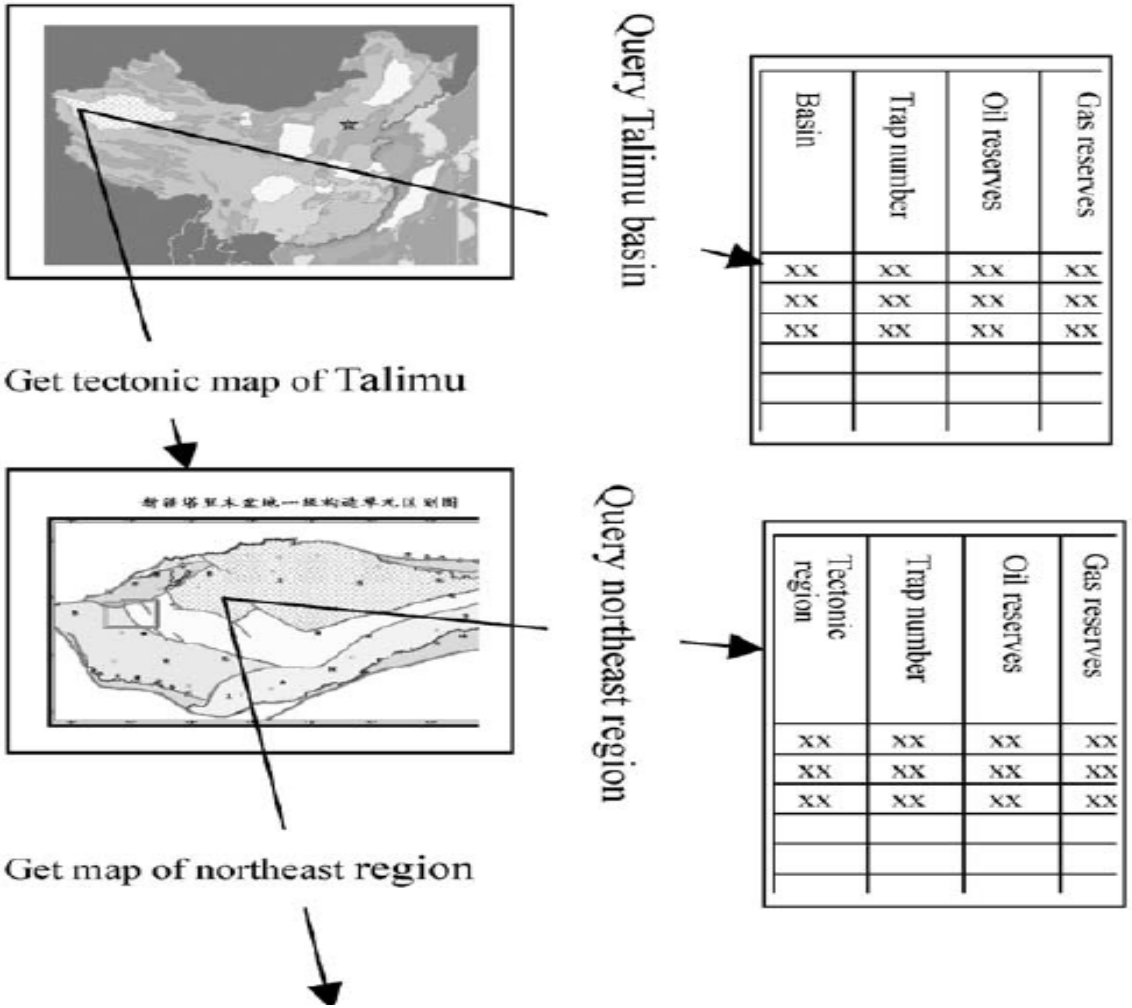
(after Xuefeng Liu et al., 2008)

CASE STUDY 2: The establishment of a trap information system based on GIS



Basic framework of the GIS-based trap system

SINOPEC (W. Chuan & P. Suping, 2003)

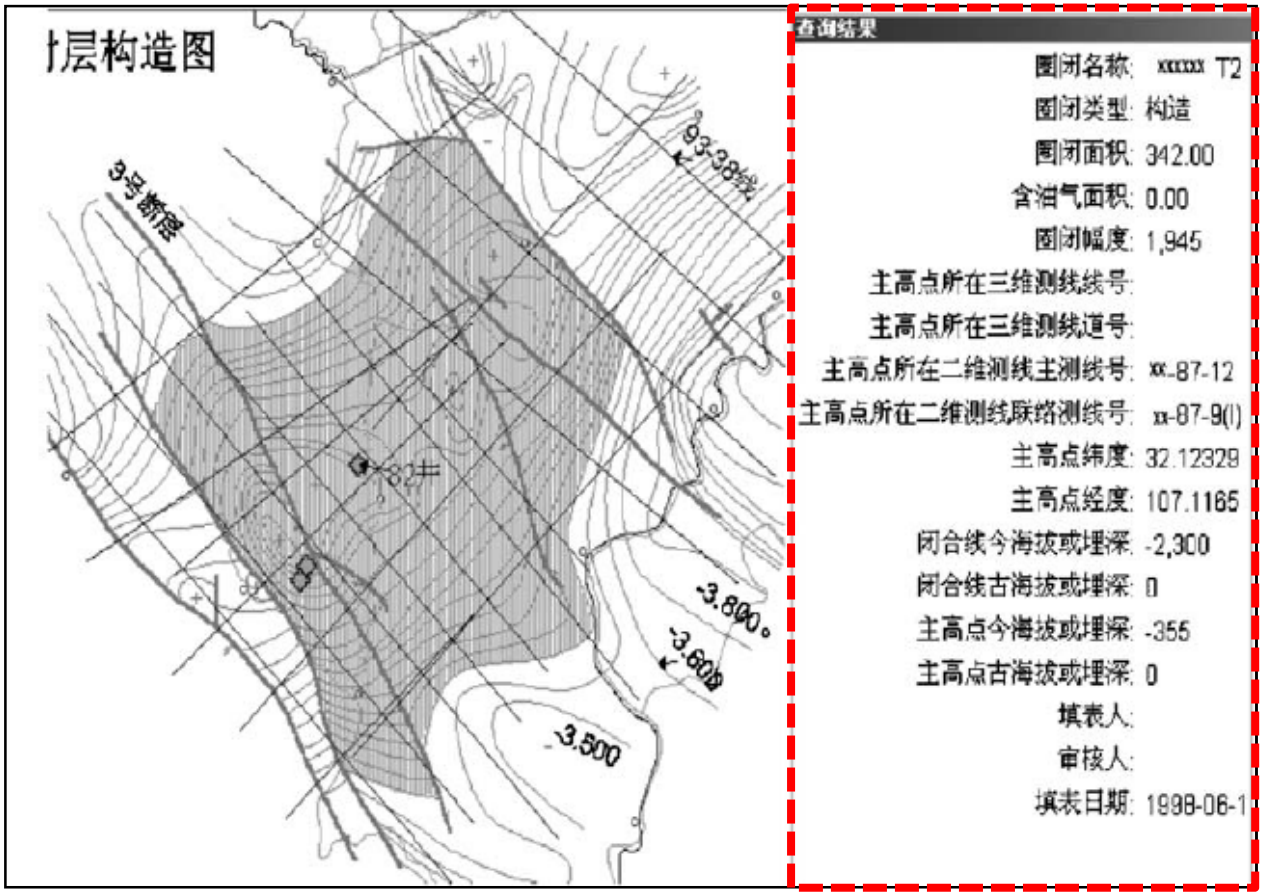


some function of user map interface

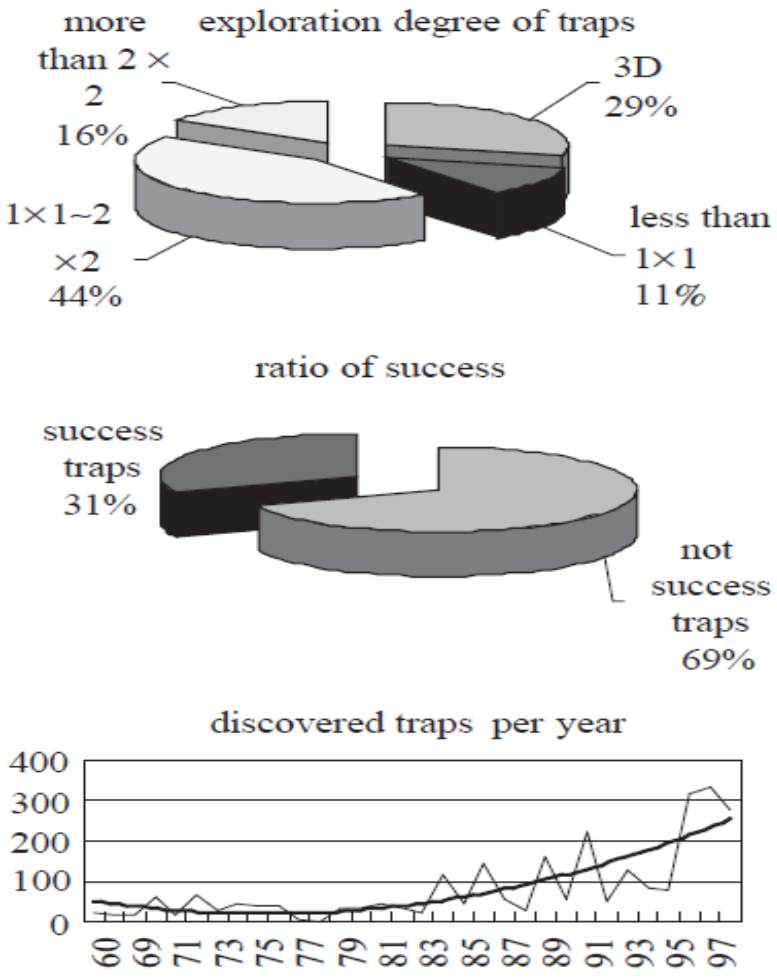
(W. Chuan & P. Suping, 2003)

Results of trap query

- User can search attribute data
- Shape of trap
- location of trap
- examine some related images such as faults, seismic lines, and wells.



(W. Chuan & P. Suping, 2003)



Statistical diagrams of trap information

(W. Chuan & P. Suping, 2003)

CONCLUSION

- **GIS approved as an effective technique in tracking the secondary migration pathways.**
- **GIS modeling was applied on known traps, so results corresponded with geological data.**
- **Beside altitude and geometry data, migration modeling need significant data as burial depth, capillary pressure, permeability and faults distribution (if found).**
- **GIS ability of storing, updating, manipulating, analyzing and displaying had been invest to establish a functional trap information system.**

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