

# The Discovery of Daqing Oilfield in China\*

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## Abstract

Daqing oilfield, the largest oilfield in China, was discovered in 1959. Four years later the field reached full scale development, producing 22.2 million barrels (3 million tons) of crude oil, which accounted for about half of China's domestic production in that year. Prior to the discovery of Daqing, oil fields such as Yanchang, Yumen, Karamay etc., were largely found in the west of the country in old marine depositional basins. The Chinese geoscientists developed a theory of terrestrial oil generation and evoked the exploration strategic shift from the west to the east to non-marine depositional basins like Songliao, which ultimately resulted in the Daqing oilfield discovery.

Since 1955, the Ministry of Geology (MOG) and the Ministry of Petroleum Industry (MPI) jointly explored the Songliao Basin through geophysical prospecting work and delineated the structural anticline belt. By the late September of 1959, MPI drilled the discovery well, Songji 3, and obtained about 148 barrels per day (20 tons/day) of commercial flow from Lower Cretaceous reservoirs. This discovery proved that the hydrocarbon system existed in the Songliao Basin. Followed by 3 more exploration wells on structure highs, all had a commercial flow. The exploration drilling had proved about 920 km<sup>2</sup> of oil-bearing area in Daqing oilfield.

Unfortunately, by this time, the Soviet Union announced its intention to stop their technical and economic aid to China. As a result of this action, China had to develop the entire field on its own. In the early 1960s, with the support from the central Chinese communist party and the state council, MPI mobilized nearly the whole country to campaign the field development which achieved a remarkable outcome. In 1964, the Daqing oilfield produced almost half of China's oil and made the country self-sufficient in oil. From 1976 to 2002, Daqing maintained its plateau of oil 1 million barrels/day (500 million tons/year), a period of 27 years and produced a cumulative total of 13 billion barrels (1.8 billion tons).

Today, looking back at the history of the Daqing discovery, many Chinese scholars still argue about who discovered the oilfield. Due to the political influence and academic bias, there is no widely accepted consensus in Chinese academia on this question. However, three Chinese geologists, Li Siguang, Huang Jiqing, and Xie Jiarong are generally regarded as key contributors to the Daqing discovery.



# AAPG

## The Discovery of Daqing Oilfield in China

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ACE 101: Bridging Fundamentals and Innovation

# The Name of Daqing

- ❖ “大庆” pronounces as “Daqing” literally translating in English means “Big Celebration”. By Chinese tradition, every tenth anniversary is a big or important date. The discovery of Daqing oilfield is near the tenth anniversary of New China, so it is called Daqing, a great gift to New China.
- ❖ In 1964 Chairman Mao issued the Supreme Directive “In industry, learn from Daqing” and “model worker” Iron Man, Wang Jingxi; Daqing became the national symbol of self-reliance and Chinese-led industrialization
- ❖ Today, Daqing is a major city in Heilongjiang province, Northeast of China, a city with population about 3 million, a center of petroleum and petrochemical industry.

# Timeline of New China during Daqing Discovery

1949-1976: Socialist transformation under Mao Zhedong

1976-1989: Rise of Deng Xiaoping and economic reforms



P.R. of China was born (Oct 1, 1949)



Korea War (1950-1953)



Cultural Revolution began in May 1966

Soviet Union pulled out all economic aid and advisers from China in 1960



Mao Zedong died in 1976

Economic Reforms and Openness in 1979



Strategic shift to the east of China in 1955



Iron-Man Wang Jinxi Discovery well (Songji 3) drilled in 1959 and found the commercial oil flow; Oil campaign at Daqing started in 1960



Nov. 15, 1970, Iron-man Wang Jinxi had stomach cancer and died at 47

The field reached its plateau 50 million tons per year in 1976

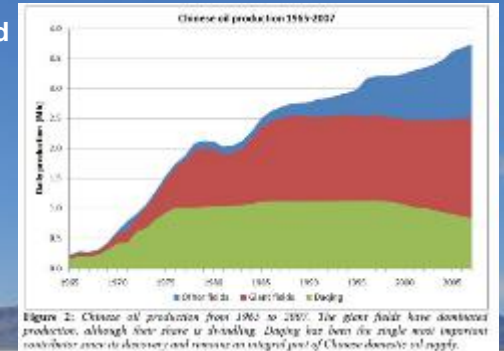


Figure 2: Chinese oil production from 1965 to 2017. The green field here dominates production, although over time it is being displaced by the red field (single well) and the blue field (multiple wells) and remains an integral part of Chinese domestic oil supply.



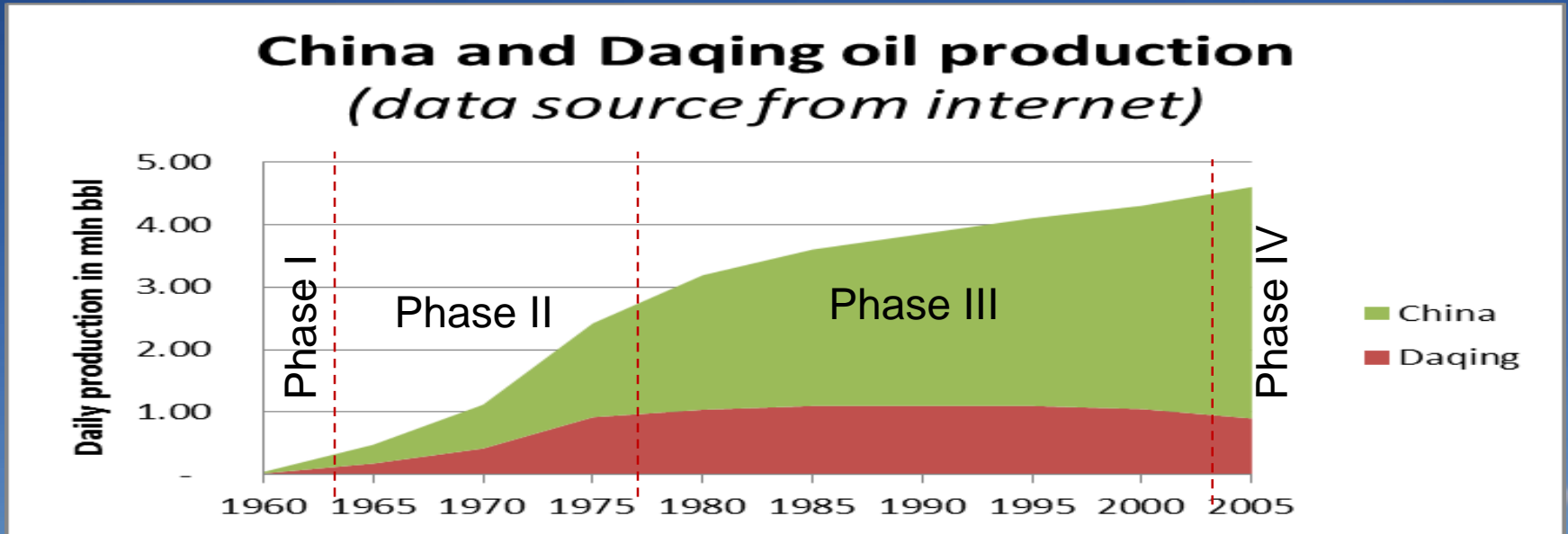
# Overview of Daqing Oilfield

The Daqing Oilfield was discovered in 1959, and developed and built since 1960. Up until 2007, it had the cumulative proven oil reserves of 42 billion barrels (5.67 billion tons) of oil, and produced the cumulative crude oil total of 13 billion barrels (1.821 billion tons) about 47% of China onshore oil production. For 27 years the field maintained of a production plateau of more than 367 million barrels (50 million tons)/year or **1 million barrels/day** and followed this with 12 more consecutive years of stable production of 296 million barrels (40 million tons). It is known as “an oilfield miracle in the world oil development history.”

Daqing is located in the central Songliao Plain. The field is a large-scale composite anticline (also called anticline trend) structure. The structural highs from north to south are Lamadian, Saertu, Xingshugang, Taipingtun, Gaotaizi, Putaohua, and Aobaoda, roughly 4,100 km<sup>2</sup> of oil-bearing area. The reservoirs are Mesozoic Cretaceous terrestrial sandstones buried to depths from 900m to 1200m, with porosity of 25-30% and permeability of 500-1000 md. The crude oil is characterized by high wax content (20% ~ 30%), high freezing point (25 °C ~ 30 °C), high viscosity (at ground condition viscosity 35), and low sulfur content (less than 0.1%), and gravity between 0.83 and 0.86.

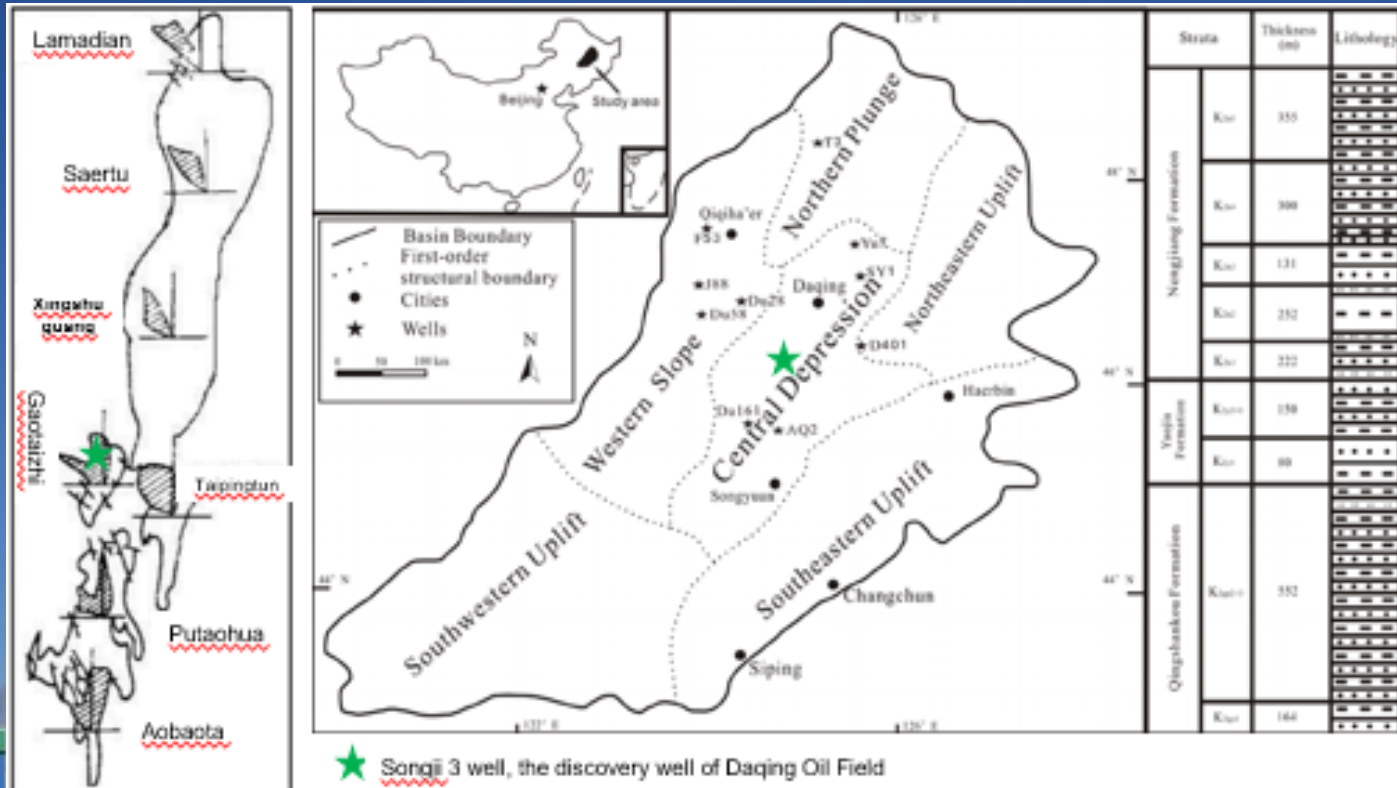
The Daqing oil field proves that the non-marine deposition can generate oil and form a world class oilfield, which enriches and further develops the theory of petroleum geology, and changes the China's oil industry.

# Daqing Oilfield Production



Daqing oil field development: Phase I–oil campaign; Phase II–full scale ramp-up; Phase III–high rate stabilization; Phase IV–sustainable development.

# Geology of Daqing Oilfield



# The Sedimentary Basins in China



- The basins in the west are marine deposition with old geologic age.
- The basins in the east are non-marine deposition with younger geologic age.
- The exploration began in the west and shifted to the east after New China was established.

From Crude Oil Peak: <http://crudeoilpeak.info/global-peak/china>



# Two Government Agencies in Oil Exploration

	<b>MOG (Ministry of Geology)</b>	<b>MPI (Ministry of Petroleum Industry)</b>
Establishment	In 1954, MOG formed Mineral Survey Committee focusing on oil and gas exploration due to the State Council's supreme priority	In 1950, General Administration of Petroleum under Ministry of Fuel Industry and became Ministry of Petroleum Industry on July 30, 1955
Task/purpose	Oil resources survey and hydrocarbon research	Oil exploration and development (including oil field development)
Leadership	Western educated scholars	Former military generals
Characteristic	Knowledge in petroleum geology and working alone with Russian experts	Strong execution capability, quick learning, able to deliver difficult tasks
Contribution	Exploration strategic shift from West to East, and geological and geophysical surveys prior to the discovery	The discovery well Songji 3 drilling and full field development, organizing and directing Daqing oil campaign
Evolution	Ministry of Natural Resources (similar to USGS)	CNPC (China National Petroleum Company)

# Oil Exploration Pre-New China

- ❑ Two American geologists, F. G. Clapp and M. L. Fuller from Standard Oil (Mobil) conducted several geological surveys in Northern China in early 20<sup>th</sup> century (1914 to 1929)
  - ❑ 63 oil seeps, non-commercial wells
  - ❑ Only hydrocarbon potential in Shaanxi basin (western China)
- ❑ Russian commercial counselor, B. P. Torgasheff in 1930 first claimed Northeast China and Xinjiang basins could be exploration prospects and other areas have no potentials
- ❑ In 1930s, Japanese occupation created Manchuria Oil Company to run oil exploration and exploitation
  - ❑ Drilled 87 wells with total depth 35,200 meters
  - ❑ Found some gas and asphalt in Songliao plain
- ❑ General conclusion, China was a poor hydrocarbon resource country due to non-marine depositions and lack of organic source rocks

# The Course of Oil Exploration in New China

## Prospecting Investigation in Northeast China

- ✓ First time listed by geological experts as a prospect area in 1950
- ✓ Russian experts suggested to conduct a regional study in Songliao plain in 1954
- ✓ Chinese geologists investigated oil seeps and asphalts in early 1950s
- ✓ In 1955, MOG had the first Petroleum Conference and drafted Songliao Petroleum Geological Work Method report
- ✓ From 1956 to 1957, MOG ran a 1:1,000,000 aero-magnetic and gravity survey, and completed 5 electrical sections with basin edge outcrop and shallow drilling, and established basin stratigraphy and potential hydrocarbon systems
- ✓ In 1958, MPI setup a Petroleum Geophysical team for Songliao exploration and added 1,000 experienced workers
- ✓ Meantime, MOG allocated 4 seismic teams, 3 gravity-magnetic survey teams, and 3 electrical investigation teams in Songliao plain

# The Course of Oil Exploration in New China

## Petroleum Drilling and Exploration in Songliao Basin

- ✓ Beginning of 1958, MPI and MOG jointly conducted a regional geological reconnaissance in Songliao plain
- ✓ In May of 1958, the drilling team No. 501 of MOG encountered oil saturated sands in southern Songliao basin which proves the existence of oil source
- ✓ On July 9, Songji 1 well spudded at Renmin town, Anda county of Heilongjiang province for stratigraphic test
- ✓ On August 6, Songji 2 well spudded in Jilin, the southern Songliao for stratigraphic test, and MPI also encountered oil saturated sands and hydrocarbon shows, but not commercial flow in the test
- ✓ In 1958, MOG completed 28000 km<sup>2</sup> gravity survey and 2863 km electrical profile, and drilled 267 boreholes
- ✓ The geological works indicated the most favorable area is in the central depression, near Datong town, with 4000 to 5000 meters of sedimentary rocks

# The Course of Oil Exploration in New China

## First Commercial Well and Oil Field Discovery

- ✓ In late 1958, MPI decided to drill Gaotaizi structure with Songji 3, the third stratigraphic test well, which is located at the high of electrical profile and seismic section, Datong town, Anda county of Heilongjiang
- ✓ On April 11, 1959, the drilling team No. 32118 of MPI spudded the well with designed well depth 3200 meters but the well encountered oil saturated sands at 1109 to 1171 section of Cretaceous Yaojia Formation
- ✓ After coring of oil saturated sandstones, MPI decided to complete the well for oil test
- ✓ On September 26, 1959, the oil test showed the flow from Songji 3 well was at 66 to 89 bbl/day (9 to 12 tonnes per day) and stable production flow without choking
- ✓ Songji 3 well marked the discovery of Daqing oil field and the party secretary of Heilongjiang suggested to change the name of Datong town to Daqing, so MPI named the discovered field as Daqing oilfield

# The Course of Oil Exploration in New China

## Delineation of Daqing Oilfield

- ✓ During Songji 3 well drilling, MOG discovered a large prospect at the south of Gaotaizhi, Putaohua structure
- ✓ On May 13, 1959, MPI planned to drill 9 wildcats along the structural highs and spudded the first well, Pu 1 on October 1
- ✓ In the early of 1960, the wildcats obtained the commercial flow, proving a continuous large oil field in Putaohua, Gaotaizhi, and Taipingtun area
- ✓ In late of 1959, the seismic data interpretation indicated there is a large composite anticline structure, from Lamadian in the north to Aobaota in the south
- ✓ In 1960, MPI decided to test Lamadian, Saertu, and Xingshugang 3 northern structures with 3 wildcats discovering thicker commercial pays
- ✓ By this time, the exploration result concluded the oil fields in the northern structure are better than the oil fields in the south, total area more than 920 km<sup>2</sup>
- ✓ On July 10, 1960, Soviet informed Chinese government to stop all the cooperation and technical assistance

# Daqing Oilfield Campaign

## Whole Country Mobilization

- In March 1960, MPI hold the first preparatory meeting of Daqing campaign in Haerbin and called up 37 MPI business units and academies let by their leadership to join the campaign
- The ministries of State Council provided steel, automobiles, tractors, cements, timbers, machineries, etc for Daqing exploitation
- In April 1960, based on the exploration result, MPI decided to have a campaign to speed up Daqing oilfield development
- All MPI leaders were in charge of the campaign and steered all the activities
- The central government ordered local governments to support the campaign and sent 30,000 demobilized soldiers to join the campaign labor force
- On May 1 1960, the Daqing petroleum campaign officially kicked off and the development drilling started in the south of the field and then moved to the north Xingshugang, Saertu, and Lamadian where obtained well rate up to 220 ~ 720 bbl/day (30 ~ 100 tonnes per day)

# Daqing Oilfield Campaign

## Oil Campaign Achievements

- The second half of 1960, the campaign activities concentrated on the northern structures, Saertu, Xingshugang, and Lamadian to go for the high rate production areas
- From May to December of 1960, MPI drilled 322 wells and proved 865 km<sup>2</sup> of oil bearing area with 16 billion barrels (2.2 billion tons) of geological reserves or 5.2 billion barrels (0.7 billion tons) recoverable
- In 1960, Daqing oilfield had produced 7 mmbbl (0.97 million tons) of crude oil
- After three and half year campaign, MPI drilled total more than 1000 wells in Songliao region, and developed 146 km<sup>2</sup> oil field with the capacity of 44 million barrels (6 million tons) oil per year, the annual production 8.5 million barrels (1.166 million tons), about 51.3% of China oil production
- On November 17, 1963, in the second National People's Congress, premier Zhou Anlai claimed China had achieved oil products self-sufficient



# Major Reasons of Daqing Oilfield Discovery

- ❖ Chinese geoscientists developed the petroleum geology through terrestrial oil generation
- ❖ MOG conducted geological surveys and geophysical investigation in Songliao basin
- ❖ Highly centralized political and economic system resulted in MOG and MPI joint operation
- ❖ Effective oil workers put great efforts and overcame all kinds of difficulties and hardships

# Three Myths of Daqing Discovery

Myth One: Wiki – The Daqing Oil Field was discovered in 1959 by Li Siguang, Wang Jinxi (known as “Iron man”, who led No. 1205 drilling team) worked on this oilfield (a statement from most articles as well)

Myth Two: Huang Jiqing (the father of China petroleum) wrote a letter to Deng Xiaoping (the paramount Chinese leader after Mao’s death) in 1978 “it is a fact that the discovery of Daqing and other oilfields in East China has nothing to do with Li’s theory of Geo-mechanics” and a quite few people believe the discovery of Daqing is resulted in Huang’s theory of terrestrial hydrocarbon generation and China tectonics

Myth Three: Xie Jiarong who drafted the Songliao prospecting work plan and was one of the decision makers is the key contributor to the discovery of Daqing because he emphasized the practical work instead of the theorems which eventually led to the discovery and he was the first one to believe in the Songliao basin hydrocarbon potential, which was the key drive of China exploration focus that shifted from the west to the east region

# Discussion of Daqing Discovery

Technically, in order to understand how exploration led to the discovery, we should consider the following three questions

- ❑ Who is the first one to have the theory or belief that oil can be found in Songliao basin?
  - ❑ Li's geo-mechanics only suggests there are some sedimentary basins in the east China and some hydrocarbon potential can exist if a basin is large and deep enough
  - ❑ Huang mapped China oil prospect distribution showing Songliao basin is a potential oil bearing region
  - ❑ Xie was the first geologist who corrected the oil only existing in the west of China and had a belief of Songliao prospect for a future exploration target
- ❑ How the exploration strategy shifted from the west to the east was made?
  - ❑ Li as a senior advisor to Chinese top leaders recommended conduct exploration activities in the east
  - ❑ Geological surveys indicated the hydrocarbon system could occur in Non-marine deposition basin (or terrestrial oil generation theory) which is supported by Huang and Xie's work
- ❑ What kind works contributed to the discovery in 1950s?
  - ❑ Li as the minister of MOG was in charge of all geological survey plan and activities
  - ❑ Huang as the chief engineer designed exploration surveys and responsible for reports
  - ❑ Xie as a leader of petroleum reconnaissance was involved in exploration survey activities

# Conclusion



李四光 (1889-1971)  
Li Siguang

黃汲清 (1904-1995)  
Huang Jiqing

謝家榮 (1898-1966)  
Xie Jiarong

## Political influence

- Li Siguang was the first minister of MOG and maintained a close tie to Chinese leaders, specially to Chairman Mao; his work Geo-mechanics was excessively appreciated in China before Mao's death
- After the discovery of Daqing oilfield, Huang and Xie were labeled as rightists and left the MOG; Xie committed a suicide in 1966 at the beginning of Culture Revolution
- Huang Jiqing was a native fellow of late Chinese leader Deng Xiaoping; He declared Geo-mechanics has nothing to do with the discovery of Daqing after Deng re-seized the power

## Academic bias

- The followers of Li's geo-mechanics believe Li's theory lay the foundation of tectonic-stratigraphic framework for the discovery of Daqing
- Huang Jiqing claimed the discovery of Daqing is resulted from his theory of terrestrial oil generation and his China tectonic setting

## Historic view of Daqing Oilfield Discovery

*"Who discovered Daqing oilfield" may still be an ongoing argument in Chinese academia, but Li-Huang-Xie unarguably played very important roles in the discovery. Although their theorem may not be completely correct, it had more or less guided and directed the geological investigation and eventually led to the discovery of Daqing. This is not uncommon in a course of oil exploration.*

# A Quote from a Chinese Historian

以故事说历史，  
以历史说人物，  
以人物说文化，  
以文化说人性。

- To tell the story of history,
- to history of that people's character,
- to people's character of that culture,
- to culture, speaking of human nature.

*In 2017 AAPG Convention, Houston, author ran into Mr. Li Desheng (李德生), one of 23 distinguished geoscientists like Li Shiguang, Huang Jiqing, and Xie Jiarong who received the National Achievement Award (1982), the highest possible recognition for the discovery of Daqing Oilfield*

