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The Homogenization Temperature in the Fluid Inclusions of Ordovician Halite and Paleoclimatic Implication

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1 Introduction

The homogenization temperature of fluid inclusions reflects the temperatures of the brines from which halite crystals grew. Therefore, it is a powerful mean to reveal the paleoclimate. Northern Shaanxi Salt Basin is located in the central and eastern of Ordos Basin. We have detail petrographical research and the homogenization temperatures measurement to the samples which come from Zhenjia-1 core. We measure the homogenization temperatures of fluid inclusions by cooling nucleation method. According to the results of the research, we discuss the implication of the paleoclimate in mid-Ordovician from the homogenization temperature of fluid inclusions.

2 The survey of research region and samples

The Northern Shaanxi Salt Basin is located in the mid-eastern of the Ordos Basin. The geologic coordinate is between 36°10'-39°10'N and 108°30'-111°E. Zhenjia-1 core is in the western salt depression of Shaanxi Salt Basin. Our samples are from the Majiagou Deposition stage of mid-Ordovician. The depth of the samples are: 2738m (zjy-1), 2740m (zjy-2), 2744m (zjy-3), 2812.8m (zjy-4). And the lithology of the samples are: zjy-1, zjy-2, zjy-3 are light brown medium-crystalline salt rock. zjy-4 is light brown medium-crystalline salt rock with mud and sand in

Tab.1. Homogenization temperature (Th) data of primary fluid inclusions in halite

Samples	Th (°C)				
	Max	Mix	Rage	Average	Middle
zjy-1	27	18.5	8.5	23.5	23.3
zjy-2	29.9	14.9	15	23.9	23.9
zjy-3	36.9	24	12.9	30.5	30
zjy-4	31	14.7	16.3	23.1	23.3

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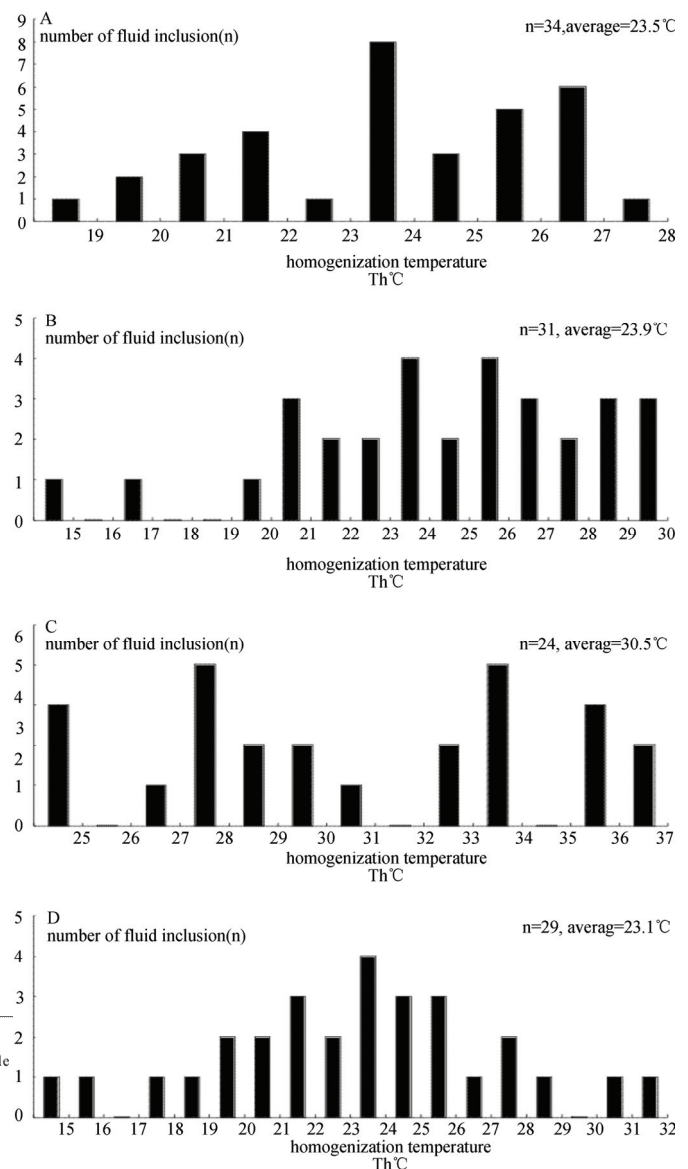


Fig.1. Histograms of homogenization temperatures(Th) of fluid inclusions

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3 Experimental method

Halite samples were prepared with careful attention paid to avoidance of water and heat. Samples are cut into thin section less than 0.5mm thickness .

Detailed fluid inclusion petrography, including photography of halite samples, was performed in order to document all-liquid primary fluid inclusions before the homogenization temperature measurement.

We use cooling nucleation method to measure the homogenization temperature of the fluid inclusion in halite (Lowenstein et al., 1998).

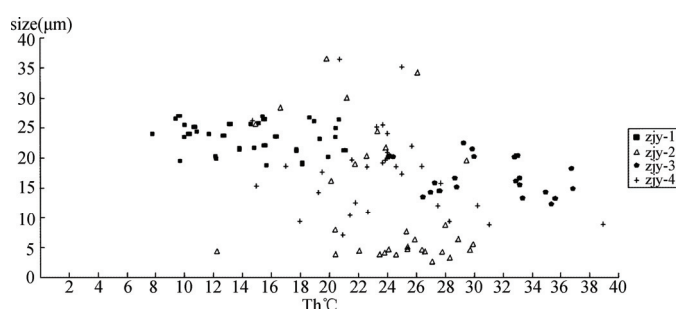


Fig. 2. Histogram of homogenization temperatures plotted against size of inclusions

4 Results and analysis

Fluid inclusions under the microscope show three shapes: cube, circle and irregular. The petrography of the fluid inclusion from samples are divided into different types: one-phase liquid inclusion, two-phase liquid-gas inclusion and three-phase liquid-gas -crystal inclusion.

A- Histograms of homogenization temperatures(Th) of primary fluid inclusions in zjy-1 , B- Histograms of homogenization temperatures(Th) of primary fluid inclusions in zjy-2, C- Histograms of homogenization temperatures(Th) of primary fluid inclusions in zjy-3, D- Histograms of homogenization temperatures(Th) of primary fluid inclusions in zjy-4

We have got 118 homogenization temperature data from the primary fluid inclusions in sample zjy-1, zjy-2, zjy-3, zjy-4(Tab.1.and Fig.1.).

5 Discussion

According to Roberts et al.(1995): halite is formed in the higher temperature and larger evaporation of a year. Therefore, the homogenization temperatures include the highest temperature of the brine. Compared with the air temperature, the maximum homogenization temperature of fluid inclusions is 5°C~10°C lower. We want to evaluate the paleotemperature ofShaanxi Salt Basin in mid-Ordovic

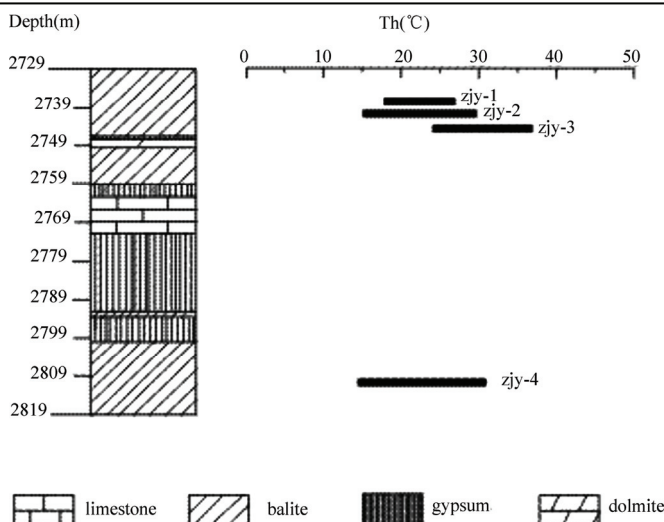


Fig. 3. Ranges of fluid inclusion homogenization temperatures plotted next to location of samples

ian by using the homogenization temperature we got.

The relationship between the homogenization temperature and the size of fluid inclusions is an important indicator of distinguishing the primary fluid inclusion in halite. After dissolution and recrystallization, the larger fluid inclusion is , the higher homogenization temperature shows. We compare the the homogenization temperature and the size of fluid inclusions in this research and find that there is no positive correlation relationship(Fig.2.).

The paleotemperature from the homogenization temperature of fluid inclusions is 18.5°C~27°C (zjy-1), 14.9°C~29.9°C (zjy-2), 24°C~36.9°C (zjy-3), 14.7°C~31°C (zjy-4)(Fig.3.). These data are corresponding to the paleotemperature from previous $\delta^{18}\text{O}$ data(Trotte et al., 2008; Giles et al., 2012; Sheields et al., 2003).

Comparing the previous research about the location of North China plate from paleomagnetism data, we recognize that Northern Shaanxi Salt Basin in mid-Ordovician is in low altitude with hot, drought paleoclimate, and the paleotemperature is 27~36.9°C.

Key words: Fluid inclusions in halite; homogenization temperature; cooling nucleation method ; halite of Northern Shaanxi Basin in Ordovician; paleoclimate.

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