



Paleo-pressure reconstruction of the deep carbonate formation and its coupling with the temperature in the Central Paleo-Uplift, Sichuan Basin (Southwest China)

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The deep Sinian and Cambrian carbonate formation in the Central Paleo-Uplift of the Sichuan Basin (Southwest China), is the major targets of exploration, where Weiyuan and Moxi large gas fields have been found. However, the pressure evolution and its relationship with the temperature, which have an important effect for the hydrocarbon generation and accumulation, are still ambiguous.

According to the analysis on the collected present-day pressure and temperature data, this study found that the present-day pressure coefficient of the Neo-Proterozoic Sinian Dengying Formation and Cambrian Longwangmiao Formation showed a significant positive correlation with the formation temperature. For example, from the Gaoshi-Moxi area to the Weiyuan area, temperature of Cambrian Longwangmiao Formation is reduced to about 90°C from 136°C, as with a reduction of pressure coefficient from 1.69 to 0.99.

Based on the measured fluid inclusion data includes homogenization temperature, freezing temperature, and salinity, PVT and basin modeling, we reconstructed the paleo-pressure evolution histories of some typical wells, which indicated that the Neo-Proterozoic Sinian Dengying Formation and Cambrian Longwangmiao Formation experienced four periods since the Jurassic: normal pressure (before 200Ma) - weak overpressure (200Ma ~ 170Ma) - strong overpressure (170 Ma ~ 90Ma) - pressure relief (90Ma up to now).

Moreover, 2D modeling of four sections indicated that the residual pressure of Cambrian Longwangmiao Formation and Neo-Proterozoic Sinian Dengying Formation in the Gaoshi-Moxi area gradually decreased since the late Cretaceous, and Neo-Proterozoic Sinian Dengying Formation reached normal pressure in the Neogene, while Cambrian Longwangmiao Formation remained overpressure up to now. However, Cambrian Longwangmiao Formation and Neo-Proterozoic Sinian Dengying Formation are now both normal pressure in the Weiyuan area. The differential distribution of overpressure in the Weiyuan area was probably caused by the rapid uplift and denudation during the Neogene. The overflow points of the Sinian Dengying Formation trap gradually rose to the west. The natural gas of the Gaoshi-Moxi area was transported for a long distance, and escaped in the Weiyuan area, resulting in the overpressure of Neo-Proterozoic Sinian Dengying Formation loss.

This study provides new insights for the paleo-pressure evolution of the Central Paleo-Uplift in the Sichuan Basin and its coupling with the temperature, which are very important for the further hydrocarbon exploration.