PETROLEUM EXPLORATION AND DEVELOPMENT
Volume 43, Issue 3, June 2016
Online English edition of the Chinese language journal

Available online at www.sciencedirect.com
ScienceDirect

Cite this article as: PETROL. EXPLOR. DEVELOP., 2016, 43(3): 395–403.

RESEARCH PAPER

Hydrothermal fluid activity and the quantitative evaluation of its impact on carbonate reservoirs: A case study of the Lower Paleozoic in the west of Dongying sag, Bohai Bay Basin

LI Jiyan[1,2,*], WANG Yongshi[1], LIU Chuanhu[3], DONG Dawei[4], GAO Zhiqiang[1]

1. Research Institute of Petroleum Exploration & Development, Shengli Oilfield Company, Dongying 257000, China;
2. Working Station for Postdoctors, Shengli Oilfield Company, Sinopec, Dongying 257000, China;
3. Shengli Oilfield Company, Sinopec, Dongying 257000, China;
4. Shengli College of China University of Petroleum, Dongying 257061, China

Abstract: By integrating the analyses of core samples, thin sections, homogenization temperature measurement of inclusions, stable isotopic compositions of carbon & oxygen, trace element composition, and conventional physical properties, this research identifies the evidence of Lower Paleozoic hydrothermal fluid activity in the western Dongying sag of Bohai Bay Basin, quantitatively evaluates the hydrothermal dissolution strength in various carbonate reservoirs, and analyzes the longitudinal distribution of effective fractures in reservoirs. The markers of hydrothermal dissolution in the study area include the typical hydrothermal mineral combinations such as fluorite-anhydrite-authigenic quartz combination, the homogenization temperature of inclusions in fracture fillings related to hydrothermal fluid of up to 150 °C–210 °C, and the high FeO, high SiO_2, high MnO and low Na_2O features of carbonate in hydrothermal fluid karst area. Dissolution of hydrothermal fluid can produce not only new fluorite mineral, but also many pores, micropores, small fractures and micro-fractures, which significantly improve the quality of carbonate reservoirs. During the process of hydrothermal fluid dissolution, calcite precipitated and filled structural fractures as the hydrothermal fluid dissolved host rock. As the hydrothermal fluid went up along faults, its velocity and temperature dropped gradually, the intensity of dissolution and calcite filling differ significantly in different formations of the Lower Paleozoic, for example, the Fengshan and Yeli-Liangjiashan Formations have low fracture filling degree and highly developed dissolved fractures and pores, whereas the Majiagou Formation has high fracture filling degree and poorly developed dissolved fractures and pores.

Key words: carbonate; reservoir; hydrothermal fluid; dissolution; Bohai Bay Basin; Dongying sag; Lower Paleozoic; quantitative eveluation

Introduction

In recent years, the domestic study of hydrothermal karstification mainly concentrated in the Tarim Basin and Ordos Basin, previous studies systematically summed up hydrothermal karstification characteristics, identification and development mode, and qualitatively described the reconstructing effects of hydrothermal fluid on carbonate reservoirs[1–2], but didnot do quantitative evaluation analysis. In addition, as hydrothermal fluid flows along faults upward, the velocity and temperature will change gradually, which will cause the formation of "dissolution belts and permeability belts", and thus forming the heterogeneity of effective structural fractures in Carbonate reservoirs, this has been seldom covered in previous studies.

Previous buried hill exploration in Jiyang depression of Bohai Bay Basin focused on karst reservoirs on "mountain top" and has discovered a big batch of buried hill reservoirs, including Renqiu, Qianmiqiao, and Gudao etc. But exploration in inner buried hill has not made any major breakthrough, scale exploration of buried hill has been stalled for years, and prediction of favorable reservoirs is one of the key factors restricting the exploration of inner buried hill. There develop large sets of magmatic intrusive rocks in the Lower Paleozoic of Bohai Bay Basin, in the process of magma intrusion, hydrothermal fluid could corrode carbonate reservoir to form effective inner buried hill reservoir, this has been paid little

Received date: 01 Sep. 2015; **Revised date:** 22 Mar. 2016.
*** Corresponding author.** E-mail: ljy19870817@163.com
Foundation item: Supported by the China National Oil and Gas Science and Technology Major Project (2011ZX05006-003).
Copyright © 2016, Research Institute of Petroleum Exploration and Development, PetroChina. Published by Elsevier BV. All rights reserved.

attention to and seldom covered in previous studies. Taking carbonate rock of Lower Paleozoic in western Dongying sag of Bohai Bay Basin as an example, features and identification marks of deep hydrothermal karstification have been examined from the perspective of mineralogy element, geochemistry and fluid inclusion, on this basis, observation of core and thin section, and results of conventional petrophysical analysis have been used to qualitatively evaluate the reconstruction degree of hydrothermal fluid on carbonate reservoir, and analyze the effect of thermal fluid velocity and temperature changes on the vertical heterogeneity of reservoir.

1. Regional geological setting

Dongying sag is a combination Mesozoic and Cenozoic fault depression in the southeast of Bohai Bay Basin, trending NEE, with Archaeozoic and Paleozoic strata as basement. Multi-phase magmatic intrusions and eruption events have happened in the evolution process of the basin, mainly in middle-late Mesozoic and the depositional stage of Cenozoic Shahejie Formation[3]. Moreover, a large number of CO_2 gas reservoirs of mantle-derived origin have been found in the Lower Paleozoic of the western Dongying sag, as typical abiogenic gas reservoirs in Bohai Bay Basin, the precipitation of mantle-derived CO_2 gas is closely related to magmatic activity[4]. The magma intrusion is strongly controlled by faults in the study area, this can be seen from the fact that the main distribution area of intrusive rock is on both sides of the Gaoqing-Pingnan fault which cut through the basement (Fig. 1). Massive hydrothermal fluid carried by magma activity could corrode carbonate reservoir of Lower Paleozoic, causing the formation of large amount of pore and fracture reservoir space in the inner carbonate buried hill. To study systematically the corrosion characteristics of hydrothermal fluid, identification marks and its transformation degree to reservoir in this area, the core samples related to hydrothermal fluid action have been collected from Well Bg26, Bg15, Bg11, and Bg22 etc. In order to understand the association characteristics of hydrothermal minerals, the mineralogical features of these samples were observed under electronic microscope. On this basis, homogenization temperature measurement of inclusions and microelement analysis were carried out on the samples. The samples in this research were taken from Majiagou Formation of Lower Ordovician, Fengshan Formation of Upper Cambrian, and Yeli-Liangjiashan Formation of Lower Ordovician, to eliminate the interference of atmospheric fresh water leaching karstification in Badou Formation of Middle Ordovician to the results of the study.

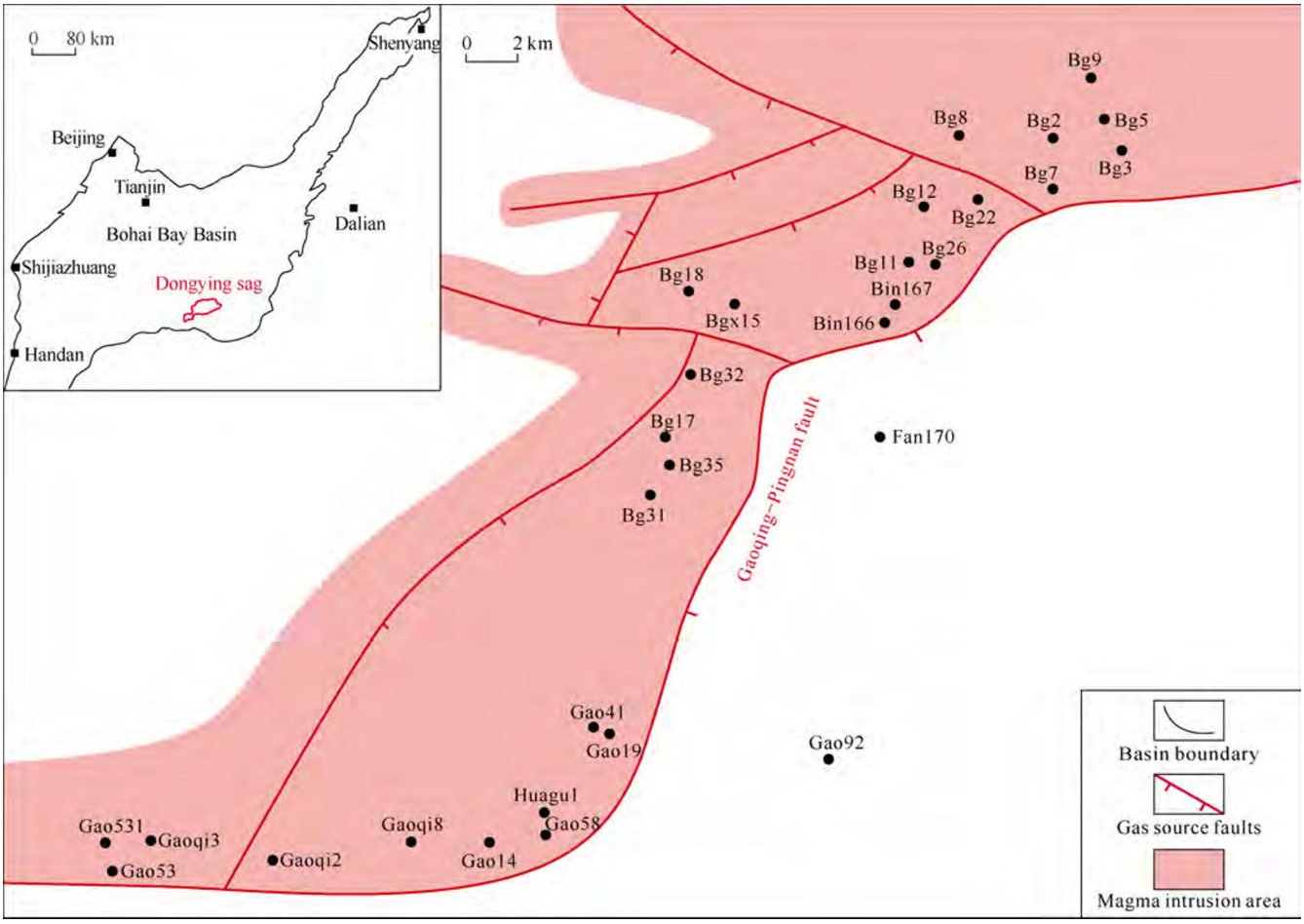

Fig. 1. Location and magma intrusion range of the study area.

Download English Version:

https://daneshyari.com/en/article/4719923

Download Persian Version:

https://daneshyari.com/article/4719923

Daneshyari.com