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Functions of the Gypsum/Salt-Bearing Sequence in the Buildup and Storage of Hydrocarbons

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Abstract

Around the world, gypsum/salt beds have been extensively developed in petroliferous basins. It has been demonstrated that most basins with gypsum/salt beds contain a wealth of hydrocarbon resources. The strong sealing ability of gypsum/salt beds as cap rocks was the main focus of earlier investigations on the implications of these beds on hydrocarbon reserves. Gypsum/salt beds have the potential to encourage the creation of high-quality source rocks and hydrocarbon reservoirs, according to an increasing number of exploratory finds. Hydrocarbon production, preservation, and accumulation are influenced by gypsum/salt beds. The study discussed the control of gypsum/salt beds on play elements and examined the relationship between the development of gypsum/salt beds and global large- and medium-scale hydrocarbon reservoirs based on the systematic analysis of the generation of hydrocarbons in global gypsum/salt bearing sequences. Additionally, we looked examined the relationship between typical gypsum/salt bearing sequences and their potential for producing hydrocarbons in China. In terms of the geographical superimposition of gypsum/salt beds and source rocks, a thorough investigation reveals three patterns: the postal pattern, the inter-salt pattern, and the pre-salt pattern. The inter-salt pattern's source rocks, among others, are extensively developed in salt basins and have a lot of potential for oil development. Petroleum Exploration and Production Research Institute of Sinopec, 2022. Elsevier B.V. provides publishing services on KeAi Communications Co. Ltd. The CC BY-NC-ND licence governs this open access article.

Keywords: ***Hydrocarbon reservoir; Gypsum/ salt bed; Source rock; Play element***

Introduction

Gypsum/salt beds are important during the development of hydrocarbon resources in several petroliferous basins. More than half of the almost 200 petroliferous basins throughout the world have commercial oil and gas reserves discovered, according to statistics. About 89% and 80%, respectively, of the world's total oil and gas reserves are proved oil and gas reserves from the aforementioned basins. In these basins, gypsum- and salt-bearing sequences are developed in about 60% of the oil and gas fields. About 40% of China's total gas field reserves are confirmed gas reserves in basins with developed gypsum/salt-bearing sequence [1]. Therefore, thorough understanding of the origins and development of oil and gas depends on examining the relationship between the distribution of petroleum reserves and the gypsum/salt-bearing sequence. It is also commercially significant for directing exploration in basins that contain gypsum. Because they act as suitable cap rocks for oil and gas reservoirs and encourage the creation of pre-salt reservoirs, gypsum/salt-bearing sequences have been shown in prior studies to be significant in influencing the production and accumulation of hydrocarbons (Warren, 2016 There are, however, few research examining the mechanisms by which gypsum/salt-bearing sequences generate hydrocarbons and the link between gypsum/salt beds and source rocks. The study

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examined the function of gypsum/salt-bearing sequence as cap rocks, reservoirs, and source rocks in order to analyse the effects of gypsum/salt-bearing sequence on the formation of oil/gas pools systematically [2]. This analysis was based on the analysis of large and medium oil and gas reservoirs in gypsum/salt-bearing sequences throughout the world. The study further demonstrated the significance of the gypsum/salt-bearing sequence to the formation and accumulation of hydrocarbons by investigating the spatial superimpositions of gypsum/salt beds and source rocks [3].

Roles of salt and gypsum beds in the buildup of hydrocarbons

Acting as high-quality cap rock: Gypsum/salt beds are well known as the premium cap rocks of oil reservoirs and have exceptional sealing properties. Previous research revealed that the oil and gas fields with gypsum/salt beds as cap rocks make up 46% of all oil and gas fields, and their respective oil and gas reserves make up 65% and 43% of the global oil and gas reserves. The greatest gas fields in China, belonging to the marine and continental facies, respectively, Puguang and Kela-2, have gypsum/salt beds sealing the cap rocks [4]. Due to the following qualities, gypsum/salt cap rocks often play a significant role in the accumulation and preservation of hydrocarbons: very high injection pressure, good ductility and flow capacity; and low permeability and wide lateral distribution Gypsum/salt cap rock has high ductility in a context of deep burial, making it likely to flow without rupture with the possibility of sealing faults or fractures. This makes it desirable for efficiently stopping oil and gas from escaping [5].

Acting as potential reservoir and promoting pre-salt reservoir formation: The following explanations explain why the gypsum/salt-bearing sequence may serve as possible high-quality reservoirs and encourage the development of pre-salt reservoirs. Gypsum dehydrates to become anhydrite, which produces intercrystalline holes [6]. These pores are ideal for storing hydrocarbons before cementing; Gypsum/salt beds are stable in density and have high thermal conductivity, which effectively reduces the intensity of diagenesis and maintains primary pores in the underlying strata; and In a deep burial environment, gypsum has a tendency to lose a significant amount of crystal water containing organic acids and turn into anhydrite [7]. Under-compaction of the strata and abnormally high pressure produced by this process have the potential to fracture reservoirs. While this is happening, the organic acids created by the process have the potential to erode some minerals and increase the number of secondary pores; in marine facies carbonate strata, gypsum and dolomitization typically occur in conjunction with sulphate reduction during the diagenetic stage, improving the physical characteristics of reservoirs. The early microbial breakdown and the dissolution of late pyrolytic products give the microbial gypsum-bearing dolomite reservoirs, which are frequently formed in sequences with coexisting carbonates and gypsum/salt beds, superior storage capability [8].

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