A Brief description on the classification and geological significance of sedimentary basins

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Abstract: The classification of sedimentary basins should focus not only on the principles of tectonic types but also on the evolution of basins. From different perspectives, the term “basin” has different meanings. After the sediment accumulation, the basin formed by the crustal movement transformation is called “structural basin”, also known as “post-deposition basin”, such as large syncline, mantle and so on. There are also several different versions of the definition of sedimentary basins, one is that the sedimentary basin is in a certain geological period and in an independent geographical area in a relatively uniform tectonic setting from one or more sediment sources, the sediment consists and is composed of sedimentary rock masses. Another definition is: a settlement system containing sediments more than km thick, which now retains its original shape more or less. The classification and geological significance of sedimentary basins need to be studied in detail.

1. Introduction

A basin is a unified subsidence unit with the same or similar developmental characteristics (including sedimentary characteristics, stress environment, development time, and process) on the earth's crust. When a considerable thickness of sediment is developed in the basin and the center is much thicker than the surrounding, it is called a sedimentary basin. In the world, the largest sedimentary basin is the great basin in northern South America, where Colombia and Venezuela are located. The basin has three basic attributes: one is that the basin is composed of certain materials, that is, it should contain at least 1km thick sedimentary rock layers; the second is that basins are all developed in a certain geological time, the basin can be modern, also can be geological history period; the basin has a certain spatial form, and it should retain its original basin shape more or less. According to relevant statistics, there are only 417 sedimentary basins in China. Up to now, there are about 200 oil and gas basins with large-scale exploration and development in the world, and 80 important oil and gas basins. It can be seen that the research on the classification and geological significance of sedimentary basins plays an important role [1].

2. Classification of sedimentary basins

The classification of sedimentary basins should not only take into account the geographical location of the basins, but also pay attention to the change process of the basins from the very beginning to the present stage, as well as the tectonic motion properties and strain fields. A clear boundary between the development and change of the basin should be identified, and then detailed examinations and studies should be carried out to determine the specific links between the boundaries. Finally, there is a comprehensive understanding of the overall development process of the basin. Therefore, the specific classification method is not only to find out from the surface of the sedimentary basin, the basin caused by the expansion, or the basin caused by the pressure, but also to analyze the basin from the specific geological structure of the sedimentary basin to know whether the basin is a unitary geological structure or a dualistic one, or even a more diversified one. The difference in geological structure of sedimentary basins is a key to classification, as it has an impact on the oil and gas resources contained in sedimentary basins, which is an important research aspect

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of sedimentary basins. There are obvious differences in the classification of sedimentary basins with different geological structures, and the conditions of oil and gas are also different.

Sedimentary basins have developed many theories in their understanding and development, and the classification criteria for sedimentary basins are not identical, different experts and scholars have different classification methods and classification basis. The famous classification includes antecedent basin, syngeneic basin and secondary basin; or discrete sedimentary basins, convergent sedimentary basins, conversion sedimentary basins and so on. The various classification names are mostly different, but in fact, the basis for these classifications is mostly the same, perhaps only slightly different in the subtle knowledge level, and the overall knowledge framework for the classification of sedimentary basins is the same. The knowledge exploration of sedimentary basins is still deepening. The future research on sedimentary basins will become more and more profound. It is believed that there will eventually be a classification method that all scholars and experts who study sedimentary basins agree with.

In general, the classification of sedimentary basins is only an auxiliary role. The most important significance of sedimentary basins lies in its oil and gas resources. The ultimate goal of the study of sedimentary basins is that oil and gas resources can be developed safely, scientifically, and rationally. This is one of the most important aspects of sedimentary basin research. Through the classification of sedimentary basins, data on oil and gas distribution, abundance, etc. of the basin can be obtained. In fact, for different geological features, there will be different oil and gas distributions, and the classification of sedimentary basins will be different. It is necessary to strengthen the research on sedimentary basins and continuously improve the classification of sedimentary basins, so that the classification of sedimentary basins is more accurate, so the development and utilization of oil and gas resources will be greatly helpful in the later stage.

3. The basic characteristics of sedimentary basins

Classification of convergent basins. According to the relative position of the volcanic arc, it is divided into trench, accretion basin, fore-arc basin, intra-arc basin, back-arc foreland basin, marginal sea basin and inter-arc basin.

The basic characteristics of a convergent basin. There are two types of trenches and proliferating basins, one is the trench: the ocean floor in the submarine trench is composed of hydrothermal sedimentation and oceanic crust basalt and its oceanic sediments and volcanic ash. Most of them have no accumulation of terrigenous sediments; Seismic profiles show that most of the trench deposits have little deformation; The trench is a long sedimentary basin with sediments mainly from the basin side and mainly carried along the lateral direction; There are 4 types of sedimentary facies in the trench: trench fan, axial channel, non-channelized flake flow, hungry trench. The second is the subduction hyperplasia basin: the most developed site of the subduction hyperplasia basin is where there is sufficient land-source deposition supply in the undercut plate or trench; The sediment is characterized by the formation tending to the magma arc, while the structural orientation is opposite; The formation is several tens of kilometers thick [4]; The subduction hyperplasia is both a tectonic activity site and an important deposition site; The sediments are mainly semi-offshore silt and mud, and turbidity deposition is also important; The combination of sediments can be divided into submarine canyon combinations, slope combinations and slope basin combinations.

Fore-arc basin: According to the nature of the basement of the basin, the fore-arc basin can be divided into three types: residual basin, accumulation basin and composite basin; the modern fore-arc basin is generally 50-100 km wide and thousands of kilometers long, and sediments can be 10km thick and covers the accretionary complex. It can be contact with the stratum or fault contact. There are three sources of sediments in the fore-arc basin: subduction hyperplasia, volcanic (magma) arcs, and in some cases, vertical recharge of adjacent continents.

Intra-arc basin and back-arc basin: The intra-arc basin is distributed in the interior of the volcanic arc or in the transition zone between the volcanic arc and the pre-arc basin, and the sediment is overlaid on the arc rock. In the continental marginal arc and some oceanic arcs with symbiotic broad basins, the island volcanic activity is characterized by its explosive nature. It has two bursts,

the form of a high convection eruption column, which forms a wide range of volcanic ash and volcanic debris flows; The other is the material handling method, which is the process of volcanic ash cloud, underwater volcanic debris flow and volcanic debris debris flow during the eruption period, or river, coastal and ocean processes after the eruption period, especially the formation of sediment block flow. The arc back basin develops in the foreland area of the arc back fold thrust belt. It generally begins in the middle and late stages of plate subduction, often referred to as the arc-back foreland basin, and together with the frontal basin of the collisional suture zone, the foreland basin constitutes the two most important types of foreland basins. During the plate convergence process, the formation and evolution of the pre-arc basin is mainly controlled by the arc back fold thrust belt, which becomes the main source area of the arc back basin, but the arc back basin can also accept the source of vertical water flow.

Arc back margin basin and inter-arc basin: The modern arc back-edge basin and inter-arc basin are mainly distributed in the western Pacific Ocean, also in the western Atlantic and the Mediterranean; the back-arc basins of the arc generally have a large amount of sediments, and their stratum thickness is close to that of the continental crust. Some of the back-arc basins are tensile basins, which are caused by the post-arc expansion of the oceanic crust associated with the reduction; The key factor controlling the post-arc characteristics and the distribution of the back-arc basin is likely to be the lateral movement of the subduction zone relative to the overlying plate; Sediments in the inter-arc basin include volcanic debris from volcanic island chains and smectite clay, bio-sludge, and continental dust from the wind, and lack of injecting of terrestrial material. Although most basins are symmetrically open, the type of sedimentation is rarely symmetrical; the back-arc basin of the arc has a large number of different types of terrigenous material injections, and its sedimentation type is as complex as that of the ocean. The new sea basin crust is covered with pelagic sediments, there are several thousand meters thick turbidity current deposits in the abyssal plain, and there are continental sedimentary basins on the continental shelf.

4. Summary

In general, the scientific research and exploration of sedimentary basins has made great progress. Sedimentary basins are also associated with the formation of oil and gas and other energy resources. As a systematic subject, sedimentary basins should be further studied. More attention should be paid to the subject of sedimentary basin, which is of great help to the discovery and utilization of energy.

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