Coastline geological parameters and beach motion image simulation based on particle swarm optimization

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Abstract
This paper uses the function of neural network-based nonlinear mapping and particle group optimization algorithm to optimize the system, and then uses the particle group optimization algorithm of inertia weight, so as to achieve the goal of optimizing the weight of neural network training. By choosing to encode the geological parameters of the coastline with mpeg-4 and obtain the relevant data, the relevant data of the beach motion image can be obtained, so that the simulation experiment can be carried out. This paper introduces the process of establishing a multi-modal pore size distribution fitting model based on probability density function, and conducts an experimental analysis on the geological parameters and pore structure of two typical shale storage layer samples in China. Finally, the multi-peak opening distribution fitting model and the pore size distribution are obtained through quantitative fitting curves, and the geological parameters of the marine continental shale that affect the pore size distribution are investigated, and the pore size distribution of the shale and the geology of the shale are investigated. In-depth parameter analysis is to explore the thermal maturity of organic matter, and the relationship between its content and mineral composition. In addition, the coastal image simulation is researched focusing on the characteristics of coastal beach recreational sports, the problems existing in the development process, and future development countermeasures. Finally, it is pointed out that the future development trend of coastal beach leisure sports, through the integration of local leisure sports-related characteristics and professional development, so as to achieve the implantation of culture in sports, and the organic combination of the two promotes the economic and ecological environment.

Keywords Particle algorithm · Coastline geology · Beach movement · Image simulation

Introduction
Particle swarm optimization (PSO) was promoted by Dr. Kennedy and Dr. Eberhart in 1995. His idea is to conduct in-depth research on the predation behavior of birds and find that when birds are pairing together foraging, when they find that there is food in a certain area, but the quantity is small, then the simplest and effective strategy is to find food closest to the bird area. The PSO algorithm is derived from this model and is used to solve optimization problems. Moreover, people often make decisions based on their own experience and the experience of others, which forms the basic concept of PSO (Barma et al. 2018). The same particle swarm algorithm has the same principles as other evolutionary algorithms, and some people think that it is an evolutionary algorithm, based on the environment suitable for individuals in the group to move to the appropriate field (Catcheside and Ralph 2002). However, there is still a difference between the two, that is, everyone has their own personal and collective flight experience, which is regarded as a small negligible particle, enters the search space at a specific speed, and determines their own speed through personal experience. Make adjustments to start the search (Chang et al. 2020).

This paper is based on the particle swarm optimization algorithm based on the geological parameters of the coastline and the beach motion image simulation (Chen et al. 2003). So far, many scholars at home and abroad have conducted many studies on the pore structure and geological parameters of...
shale storage layers in marine and terrestrial areas. In order to determine the pore size distribution of shale storage layers, various experimental methods have been used (Chen et al. 2017). Nowadays, many studies on the pore structure of shale are limited to specific shale blocks, and do not comprehensively summarize the commonalities of shale storage layers, but only analyze the characteristics of specific shale storage layers. Therefore, the research on the relationship between the pore size distribution of marine and terrestrial shale and geological parameters is not very extensive (Chen et al. 2019). Mathematical models are used to analyze the pore size distribution of marine and terrestrial shale. By integrating geological parameters, investigating the relationship between shale pore size distribution and geological parameters plays a very important role in the development of research (Ghosh et al. 2014).

In addition, with the development of economy and the increase of people’s spare time, spare time in people’s daily life has become an urgent necessity. Participating in outdoor fitness activities that are beneficial to the body and mind has gradually become an important choice for people’s entertainment and leisure (Gupta and Gupta 2014). Our country has abundant coastal resources and can provide people with tourism activities that integrate leisure, entertainment, and sporting goods (Haider et al. 2013). Therefore, leisure sports on the beaches along the coast began to become an important sightseeing and leisure activity. Generally speaking, coastal beach leisure sports are an extension of coastal tourism (Hamidi et al. 2014). The development of this series of sports requires the use of beach natural conditions and sporting goods to meet the leisure, fitness, and entertainment needs of holiday tourists (Hamidi et al. 2021). Therefore, in order to meet people’s leisure needs and the development of the city’s economy, it is very important to study beach leisure sports along the coast (Haq et al. 2018).

Main control parameters of coastline shale gas accumulation

Organic matter content

Organic matter content (TOC) is an important parameter that determines whether a shale storage layer can form a high-quality gas storage layer, and plays an important role in controlling the production capacity of shale gas (Huang et al. 2013). The organic matter contained in the shale storage layer can be divided into three types. The first is the resulting hydrocarbon products (Jian et al. 2019). The second is mechanical carbon that can be converted into hydrocarbons (Jones et al. 2010). The third type is carbon-containing organic residues. Because the hydrogen content is too low to form hydrocarbons, it is often referred to as “inactive carbon” or “dead carbon.” Organic matter can not only produce oil and gas, but also use its surface as an adsorption point for shale gas (Klein et al. 1997). The hydrocarbon generation capacity of shale is proportional to the content of organic matter, and the gas adsorption capacity also increases with the increase of organic matter. The porosity and water saturation of the shale storage layer are also related to the organic content (Li et al. 2019).

Types of organic matter

The oil and gas in the shale layer mainly come from the conversion of organic matter, and the organic matter mainly comes from the dead bodies of animals and plants and bacteria. These remains are preserved in the deposits (Li et al. 2021). If the old strata are covered by the new strata, the remains will gradually become deeper, and the heat and pressure at the bottom of the strata will form oil (Liu et al. 2016). In petroleum, kerogen content usually accounts for 80-90% of organic matter content, which is an important component of shale organic matter. Some studies have shown that kerogen is the source of more than 80% of the oil and natural gas in shale (Lupton et al. 2020). The content and composition of oil and natural gas in shale are affected by ketones. Different types of ketones have different hydrocarbon generating capabilities depending on their composition. Therefore, the analysis of ketones can provide clues to the depositional environment of shale (Machnikowska et al. 2002).

Due to the different ratios of carbon, hydrogen, and oxygen in ketones, ketones can be divided into three main categories. Type I kerogen has high hydrogen content and low oxygen content. This kerogen has a very high oil production capacity. Type II kerogen can be divided into two types: type II1 and type II2. The hydrogen content of this type of ketone element is lower than that of type I, but there are more hydrogen elements. The main component of this type of ketone is a polycyclic carbon skeleton with less branched chain structure and high saturation. Type III ketones are mainly derived from terrestrial plants, which are rich in oxygen, less hydrogen, more polycyclic aromatic hydrocarbons, and less straight-chain structure (Mullakaev et al. 2017). Compared with the other two, this ketone has a lower ability to produce oil, but has a strong growth ability and is the main source of shale gas (Nguyen et al. 2019). Most type I and type II ketones produce liquid hydrocarbons, but the liquid hydrocarbons produced will generate a lot of gas after decomposition. According to current data, marine shale organic matter in China and the USA is mainly of types I-II1 and mainland Chinese shale organic matter is mainly of types III-III.

Thermal maturity

The oil and natural gas in shale are produced by organic matter under the action of high temperature and high pressure. The thermal maturity of organic matter is an important factor in
determining whether shale has the ability to generate hydrocarbons. The organic matter in shale does not often produce oil and natural gas, but gradually produces oil and natural gas in the process of immature to mature, during which the reserves of shale oil and natural gas will also increase. The transfer of organic matter to oil and gas occurs at all stages when the thermal maturity of shale is rising. With a thermal maturity of more than 0.4%, organic matter is likely to produce oil and natural gas, and shale may form a storage layer for oil and natural gas. With the gradual increase in thermal maturity, the production of oil and natural gas increases, and the formation pressure rises, which may promote the formation of gas adsorption. When the formation pressure reaches a certain point, the formation will be forcibly opened, forming pores and cracks, and these are the places where oil and gas accumulate. Therefore, thermal maturity is the main reference factor for analyzing whether the shale storage layer has development value.

Mineral composition

The structure plays an important role in the control of shale, and the microporous structure controls the permeability and gas storage capacity of shale. Therefore, the study of shale mineral composition is an important part of shale gas exploration and development. Common minerals in shale can be divided into clay minerals and brittle minerals. There are various types of clay minerals, the most important of which is kaolin. Brittle minerals are also diverse and play a decisive role in the brittleness of rocks. The most important things are quartz, feldspar, and etc. For example, the Antlin shale in the Michigan Basin is a siliceous black shale that contains a lot of limestone and carbonate. The change in the mineral composition of shale not only changes the microporous structure of the shale, but also changes the mechanical properties and gas adsorption capacity of the rock disk. Compared with brittle minerals, clay minerals have finer particles and more micropores.

Simple comparison of geological parameters of marine and terrestrial shale

According to the assessment of the shale gas resource potential carried out by the China Geological Survey in 2020, there are three types of shale developed in China: marine shale, terrestrial shale, and sea-land interaction, and the resources of the three are similar. At present, China’s marine shale research has made great progress, but the exploration and development of continental shale are relatively backward. The characteristics of marine shale and continental shale are the same as shale, but due to the great difference in sedimentary environment, the geological parameters of marine shale and continental shale are very different. To further analyze and compare the difference between marine shale and terrestrial shale, the two types of shale need to adopt different methods in shale gas exploration in China.

Ocean shale is widely distributed all over the world and is the main target of shale gas exploration and development. Marine shale is also widely developed in northern and southern China. Researchers have conducted various experimental studies on China’s marine and terrestrial shale storage layers. It is found that there are more than 50% brittle mineral components in China’s marine shale. Therefore, it has a strong compression resistance and can protect the pores in it. Most of the organic matter from plankton in seawater is marine shale, and the organic matter type is mainly I-II type 1. This organic matter hydrogen element can generate a large amount of oil and gas. The thermal maturity of the marine shale layer is relatively high, R0 is generally more than 2%, and the organic matter is in the stage of high over-maturity, which may produce a large amount of gas.

The shale storage layer in the land area is also the area where China’s shale gas is developed. The shale basins of China’s mainland are all sediments of the Great Lakes, and the continental shale was formed during the expansion period of lakes and marshes. Compared with marine shale, continental shale has a narrow accumulation range. After terrestrial shale is diluted by debris on the land, the proportion of clay minerals becomes larger. Unlike most marine shale in the continental shale of organic matter in land plants, the types of organic matter are more complex, mainly belonging to types II2-III organic matter. Type II2 and type III organics are rich in oxygen and low in hydrogen, which is not conducive to the production of oil and gas. The thermal maturity of continental shale is generally lower than that of marine shale, and R0 is mainly 0.6-1.2%. Organic matter is mainly in the early stage from low maturity to maturity. At this stage, the main product is liquid hydrocarbons, and only the thickest shale deposits can enter the gas production stage.

Materials and methods

Measurement method of pore size distribution of coastline shale

In the past decades, in order to study the pore size distribution, various methods such as MICP, low-pressure N2/CO2 gas adsorption, micro-nano CT technology, and nuclear magnetic resonance (NMR) have been used, as shown in Fig. 1.

Among these experimental methods, scanning electron microscopy is a microscopic morphological observation method between transmission electron microscopy and optical microscopy. Scanning electron microscope is usually used to qualitatively describe the pore structure of shale. The morphological characteristics of the microscopic pores of shale can be
directly observed from the images obtained by scanning electron microscope. If nothing is treated, the surface of the shale is rough, and it is difficult to clearly observe the pore structure of the shale with a scanning electron microscope. After the sample is polished with argon ion to make the surface smooth, as shown in Fig. 2, a clear image of the shale pore size can be obtained through a scanning electron microscope (SEM). Scanning electron microscope (SEM) studies the pore structure of shale, which makes it possible to further grasp the pore form of shale, the accumulation of shale gas in the pore, and the movement law of shale gas in the pore.

Nuclear magnetic resonance (NMR) is a relatively new method to study the behavior and characteristics of atomic nuclei in a magnetic field. The lateral relaxation time T2 (ms) of the fluid in the pores of the porous media can be expressed as follows:

\[ \frac{1}{T} = \frac{1}{T_{2\text{bulk}}} + \frac{1}{T_{2\text{surface}}} + \frac{1}{T_{2\text{diffusion}}} \]  

(1)

The volume relaxation and diffusion relaxation of shale interstitial water are much smaller than the surface relaxation when shale interstitial water is fully saturated. In this case, the experimentally determined T2 spectrum of lateral relaxation time is mainly determined by the rock surface relaxation, and the T2 value is proportional to the ratio of pore surface area to pore volume (S/V), which can be expressed as follows:

\[ \frac{1}{T_2} = \rho_2 \frac{s}{V} = F_s \frac{P_2}{r} \]  

(2)

Assuming that the shale pores are cylindrical and connected to the outside of the shale sample, the relationship between the pressure required to press mercury into the pores and the pore size can be expressed by the Washburn equation:

\[ D = 2r = -\frac{4\sigma \cos a}{\rho} \]  

(3)

**Calculation method of shale pore size distribution**

The most common method to obtain the pore radius according to the nitrogen adsorption method is Kelvin’s formula. Assuming that the hole shape is cylindrical, Kelvin’s formula is as follows:

\[ r_k = \frac{-2\gamma V}{RT \ln(p/p_0)} \]  

(4)

The BJH method is generally used to calculate the distribution of mesopores and is calculated as follows:

\[ V_{pn} = \left( \frac{r_{pn}}{r_{kn} + \frac{\Delta \sigma}{2}} \right)^2 \left( \Delta V_n - \Delta r_n \sum_{j=1}^{n-1} A_{ij} \right) \]  

(5)

For micropores in shale, you can use Dubinin-Astakhov (D-A) method, and the calculation formula is as follows:

\[ W = W_0 \exp\left[-(A/E)^n\right] \]  

(6)

\[ A = RT \ln(p/p_0) \]  

(7)
By applying the curve to the adsorption isotherm, \( E \) and \( N \) can be calculated. If these two parameters are substituted into Formula 8, the distribution of micropore size can be obtained:

\[
\frac{d(w/w_0)}{dr} = 3n \left( \frac{K}{E} \right)^n r^{-(3n+1)} \exp \left[ -\left( \frac{K}{E} \right)^n r^{-3n} \right] \tag{8}
\]

The foundation and improvement of particle swarm algorithm

Among all the particles in the current group, through the position of \( Xi \), the \( i \)-th particle group has experienced the best position of pgbest, that is, the velocity \( Vi \) of particle \( i \), in each iteration, expresses the particle I moving in space according to the following formula:

\[
X_{id}^{k+1} = X_{id}^k + C1 \cdot Rand() \cdot (pgbest^k - X_{id}^k) + C2 \cdot Rand() \cdot (pbest^k - X_{id}^k)
\]

(9)

\[
V_{id}^{k+1} = V_{id}^k + C1 \cdot Rand() \cdot (pbest^k - X_{id}^k) + C2 \cdot Rand() \cdot (pgbest^k - X_{id}^k)
\]

(10)

If the problem is different, the algorithm has different requirements for the global search function or the local search function. Therefore, it is necessary to adjust the balance between the global search function and the local search function of the algorithm. Therefore, the following revised algorithm is proposed in the literature:

\[
X_{id}^{k+1} = X_{id}^k + C1 \cdot Rand() \cdot (pbest^k - X_{id}^k) + C2 \cdot Rand() \cdot (pgbest^k - X_{id}^k)
\]

(11)

Principle and structure of moving image simulation system

There are many factors that affect the display quality of color AC-POP images, such as the number of fields and coding mode. Therefore, in order for the animation simulation system to take the above elements into consideration, various elements need to be reasonably configured. The interface of the color AC-POP animation simulation system is mainly composed of two parts: the animation simulation part and the gamma characteristic simulation part.

In addition, the parameters of the video simulation system mainly include image selection, technical settings, number of subfields, subfield weights, and motion speed (pixels/fields). The simulation of the gamma function mainly includes the following options: GAM settings, MA curve index and subfield matching. This option is mainly used to investigate the display method of using CLEAR and other anti-gamma correction codes.

Results

Basic research results of coastline shale samples

Although the two experimental samples of the adsorption-desorption isotherm have different shapes, in general, the type IV isotherm is similar (Fig. 3). This isothermal characteristic forms an obvious hysteresis loop between the two curves. In P/P0, P/P 0 within the adsorption mass range of the shale pore surface means that a single layer of adsorption is formed in a small area, and the interval is basically a line length. After P/P0 >0.8, the nitrogen in the shale pores is formed by capillary condensation, which is characterized by a sharp rise in adsorption isotherms. Within the range of P/P0 >0.45, the two isotherms do not overlap, the position of the desorption isotherm is significantly higher than the adsorption isotherm, and the hysteresis loop between the two curves will cause serious hysteresis. This hysteresis of desorption is related to the pore structure of shale, and pore size and distribution information can be obtained by investigating adsorption-desorption isotherms (Fig. 4).

The BJH method and DFT method are generally used to calculate the pore size distribution. Previous studies have shown that the BJH method cannot accurately calculate the pore size distribution of micropores and mesopores, but the DFT method can more accurately calculate the pore size distribution of micropores and mesopores. Figures 5 and 6 show the experimental points of the pore size distribution of the shale samples of the A and B groups calculated by the nitrogen adsorption method.

In the high-pressure mercury injection experiment using an automatic mercury injection device, the pore size test range is 3 nm~1000 \( \mu \)m, and the accuracy of mercury recovery reaches 0.1 \( \mu \)L. Figures 7 and 8 show the experimental point injection method for the pore size distribution of the two sets of shale samples calculated by mercury.

According to the fitting results of the pore size distribution \( f(r) \), the pore sizes of the two groups of experimental shale samples are shown in Figs. 9 and 10. Table 1 shows the fitting parameters \( a_i, \mu_i, \text{ and } \sigma_i \) of the pore size distribution of two shale samples L1 and Y1. The table interval with a matching parameter of 0 corresponds to the case where \( f(r) \) is 0.

Research on the relationship between pore size distribution of coastline shale and geological parameters

The fitting results of the pore size distribution of the obtained shale samples are shown in Figs 11, 12, 13, and 14.

According to the cumulative pore volume curve, the pore volume distribution of micropores \( (r <1\text{nm}) \) and intermediate
pores (1-25 nm) can be obtained. Table 2 shows the pore volume distribution of all survey samples.

For comparison, as shown in Fig. 15, the data in the table has been converted into a histogram of pore volume distribution. The pore volume distribution of various shades can be clearly seen from the histogram. The pore volumes of shale samples from different shale storage layers are quite different, and the pore volumes of different samples from the same storage layer are quite different. In all samples, mesopores accounted for the largest volume and accounted for a large proportion. The volume of micropores and macropores is much smaller than that of mesopores.

According to the data in Table 3 (N/A means there is no such data), the two groups of experimental samples L1-L4 and Y1-Y4 were collected for analysis. According to existing research, the R0 of continental shale ranges from 0.56 to 1.40%, with an average value of 0.96%.

According to Table 4, shale minerals are very diverse and there are many clay minerals. The content of clay minerals in the samples in the table is in the range of 15.7-69.3%, with an average of 48.54%. In addition to clay minerals, shale also contains many brittle minerals such as quartz and feldspar, but the content is relatively small.

Simulation results of beach motion images and their comparison

Figure 16 shows the convergence curve of the particle swarm optimization algorithm in each experimental scenario. The convergence and convergence speed of the optimization algorithm directly affect the quality of the optimization scheme and the length of the calculation time, so this paper analyzes the performance of the particle swarm optimization algorithm. The essence of particle swarm optimization is random optimization, and the convergence performance varies according to the problem of the target. Therefore, after repeated tests, the number of iteration steps is set to 200. As shown in Fig. 16, each optimization calculation process achieves good convergence within 200 steps, and the convergence rate is satisfactory. In the case of \( C = 1 \) Mbs, the output capacity of the multiplexer is large enough, so if a higher token generation rate is selected, the data stream can be smoothly output to the network through the multiplexer, so the system can be the cost which is kept to a minimum. Therefore, the convergence speed of the optimization algorithm is very fast, almost a straight line.
The color AC-PPDP moving image simulation system can simulate the abovementioned gray image and other color images, so you can understand the difference between the detailed content of the color image displayed by the color AC-PPDP and the gray image display.

Taking the usual 8-subfield ADS technology in Fig. 16 as an example, the dynamic image simulation system is applied to realize the dynamic image simulation of the color image. The conventional video signal is a gamma-corrected nonlinear signal from a color CRT.
display. However, according to the operating principle of the color AC-PPDP, the color AC-PPDP system does not have a nonlinear problem. Therefore, in order to use color AC-PPDP to display ordinary video signals, it is necessary to perform inverse gamma correction on the input signal, or use inverse gamma correction-related coding for correction. Therefore, the gamma characteristic of the video signal must have a great influence on the display quality of the color AC-PPDP. Gamma characteristics have also been studied in detail in the color ACPDP animation simulation system, which simulates the exponential characteristics of the gamma correction curve and the inverse gamma approximation of the inverse gamma correction-related code.

Discussion

The background of the rise of coastal beach leisure sports

Leisure demand provides power support for the development of coastal beach leisure sports

After 2008, China adjusted its daily holidays, and the legal rest days increased to 115 days per year. The increase in spare time provided the possibility of entertainment and leisure. At the same time, with the development of the economy, after satisfying low-level needs for food, clothing, housing, and transportation,
development needs for leisure, entertainment, and fitness are also increasing. Coastal sports were only developed in the 1980s to meet people’s needs. According to a survey conducted by China.com.cn on February 10, 2019, the coastal area’s comprehensive tourism revenue exceeded 8 billion yuan in 2018, and the number of tourists exceeded 50 million for the first time. According to incomplete statistics, the number of sports tourists in Binhai maintains a steady growth rate every year. Beach leisure sports along the coast have improved people’s physical fitness, met their spiritual needs, and improved their health, making them more and more popular with tourists.

Urban development and construction have become an effective catalyst for the development of coastal beach leisure sports

At present, most of the domestic coastal leisure sports are located on the coast, which has the advantages of natural sandy beaches. Most of these natural attractions are brands and business cards for external promotion, and they are also an important manifestation of the overall economic strength of the city. Therefore, the development of beach sports and leisure has become a necessary condition for urban development and construction. At present, all coastal areas rely on local coastal natural resources to accelerate the development of
coastal tourism, strive to build related coastal sports and cultural festivals, and open up new economic growth points. On the other hand, it also helps to promote the maturity of coastal leisure sports.

The development of China’s competitive sports creates a good environment for the development of coastal beach leisure sports

In the past 20 years, China has developed from a second-rate sports country to a great sports country that has attracted worldwide attention, and competitive sports have developed rapidly. This situation has stimulated the enthusiasm of sports workers, increased sports workers, and created a good atmosphere for the development of coastal beach leisure sports.

China’s coastal natural conditions lay a natural foundation for the development of coastal beach leisure sports

The development of beach leisure sports along the coast of China has obvious natural advantages. China is close to the west coast of the Pacific Ocean, with a continental coastline of 18,000 km and an island coastline of 14,000 km, spanning three temperate zones, subtropical, and tropical zones. There are various hydrological characteristics and sea scenery, and various sightseeing resources. In addition, many coastal areas have natural ports, which provide plenty of space for beach leisure activities. In addition, the coastal area of southern China is located in the south-central subtropical monsoon climate zone with subtropical maritime monsoon characteristics, and the range of temperature changes is small. Good climatic conditions provide favorable conditions for the development of coastal sports. Especially in exciting marine activities such as surfing and sailing, good hydrological and meteorological conditions can increase the charm of attracting leisure sports enthusiasts on the beach.

The development status of coastal beach leisure sports

The characteristics of coastal beach leisure sports

First, the tourism market has gradually matured. With the emergence of economic growth points for coastal beach leisure sports, the development of the beach leisure tourism market has become increasingly mature. This is

Table 1 Fitting parameter list of two shale experimental samples

| Sample serial number | Fitting parameters | Fitting interval number |
|----------------------|-------------------|------------------------|
|                      |                  | 1          | 2           | 3           | 4           | 5           | 6           | 7           |
| L1                   | a_i              | 5.98E-06   | 0.00017    | 7.92E-05    | 0.00029    | 0.0018     | 0           | 0.0029     |
|                      | mu_i             | 3.23       | 2.34       | 1.86        | 1.39       | 0.741      | 0           | -0.32      |
|                      | sig_i            | 0.12       | 0.26       | 0.076       | 0.16       | 0.10       | 0           | 0.11       |
|                      | a_i              | 0.00014    | 0.0012     | 0.00724     | 0.00332    |            |             |             |
| Y1                   | mu_i             | 2.43       | 1.51       | 0.63        |            |             |             |             |
|                      | sig_i            | 0.24       | 0.23       | 0.24        |            |             |             |             |
mainly manifested in the increase in external investment, the gradual improvement of tourism, leisure, and sports projects, and the continuous improvement of corresponding support means and service systems. In order to adapt to the various sports needs of participants, the capacity of coastal scenic areas is continuously improved. At the same time, the overall management of the coastal leisure sports market has become more standardized. Relevant departments have introduced a series of rectification measures and standardized measures, including regular inspections of the qualification certificates of Binhai sporting goods, regular investigations and punishments for unauthorized operations, and promotion of training and management of operating institutions. Second, the government’s planning has been strengthened. The development of coastal beach recreational sports is mainly promoted by the support of the government. In recent years, local governments have proposed the development of coastal beach recreational sports as an important part of the urban development plan. At the same time, the Municipal Sports Development Office also hosted beach football matches and beach volleyball matches, which were popularized in the city’s primary and secondary schools, and contributed to the development of beach entertainment. Finally, emphasize the degree of internationalization. With the progress of economic globalization, the relationship between China and the world has been strengthened, and the development of beach leisure sports along the coast of China has gradually become internationalized. In order to meet the needs of participants, there should be an introduction of mature foreign coastal beach leisure sports competitions, etc., in the development of the specific performance of foreign coastal beach leisure sports models. Focus on holding international beach sports events to increase the popularity of beach leisure sports in China. In 2010, such as the “First Asian...
Student Beach Volleyball Championship” held in a province, the relevant departments invited Thailand to participate in the observation and learning experience of some game events. In the end, 12 countries and regions including Nepal and Sri Lanka participated in the coastal beach recreational games in China. Lastly, the awareness of leisure sports on China’s coastal beaches has been effectively improved.

The development of coastal beach recreational sports

First, there is a shortage of operating managers. On the one hand, the development of sports tourism relies on external support. On the other hand, in order to improve service quality, the industry itself must improve service quality, and talent is the key. However, in the development of China’s coastal beach leisure sports, the lack of professional talents has become the main factor restricting development. In the development of coastal tourism projects, most of the staff are government staff, and the professional knowledge related to tourism is relatively insufficient. Professional knowledge in the management of the development process of sports tourism is also insufficient. In the management process, managers lack experience and cannot use professional knowledge, so the perfect combination of urban brand building and coastal sports tourism cannot be realized. Second is the lack of professional social sports coaches. With the improvement of people’s living standards, when participating in coastal sports, in addition to on-site equipment, the requirements for the surrounding environment will also increase, but they need to receive scientific guidance during the exercise. Professional social sports coaches can not only provide tourists with scientific guidance, but also improve the overall service quality of coastal sports tourism resorts.

Fig. 13 Fitting curve of cumulative pore volume of samples from Yanchang Formation in C area

Fig. 14 Fitting curve of cumulative pore volume of shale samples in group D
Second, there is a lack of supporting infrastructure. Compared with some famous foreign coastal sports resorts, the beach leisure and sports areas along the coast of China have no infrastructure at all. Due to the lack of progress in the marketization of resource development and product development, the items that tourists can choose are general ATVs and motor boats, which cannot meet the various needs of tourists. Moreover, most of the coastal beaches far away from the prosperous street are beach resorts along the coast. In order to adjust the surrounding traffic conditions, due to the development of the coastal leisure market, it is still in its infancy and the facilities are not yet complete. To a certain extent, coastal beach recreational sports affect the market and restrict the development of coastal beach recreational sports.

Among the beach resources along the coast of China, the brand is not very competitive. Each part of the beaches along the coast has its own characteristics. However, the development of coastal leisure sports is the same. There is neither planned development nor rational exploitation of its own resources. According to the characteristics of the core brand, the brand competitiveness of coastal beach leisure sports products is not obvious. At the same time, in the overall promotion and planning of the brand, the needs of the participants of the beach entertainment on the coast cannot be captured, and the needs of those participating in the product development movement cannot be aroused. In terms of service provision, due to the lack of perfect management and the inability of self-employed to provide high-quality services, the inability to form obvious brand characteristics has hindered the development of coastal sports and leisure activities.

The development trend of coastal beach recreational sports

Combination of localization and specialization

With the improvement of China’s international status and the strengthening of the call for the inheritance of Chinese traditional culture, the development trend of coastal beach leisure sports is getting lower and lower. Under the lessons of the mature model, the national characteristics and national brand characteristics are emphasized. Sports in other countries...
advocate “nature and mankind,” and advocate Chinese traditional culture of harmonious coexistence between man and nature, and coastal beach leisure sports based on coastal natural resources, combining coastal resources with sports. Therefore, leisure is the main trend in the development of leisure sports on coastal beaches. As a specific development direction, it is possible to combine sports that play a role in maintaining health in traditional Chinese culture with beach sports, and establish a seashore beach recovery leisure club that combines traditional Chinese medicine health care and sports health care. On the basis of the original traditional sports with Chinese national characteristics such as diving, sailing, and jet skiing, such as beach Tai Chi and Qigong, it can make coastal beach sports interesting. It not only satisfies the pursuit and stimulation of the younger generation, but also satisfies the health needs of the elderly. Such a desire can effectively improve the charm of beach entertainment along the coast.

At the same time, the leisure development direction of coastal beach leisure sports is to integrate various ethnic sports, such as aerobics, with coastal leisure sports as the stage, and continue to integrate into the traditional Chinese sports culture. The development of professional competence is the focus of the thorough development of coastal beach recreational sports. According to the current demand and the characteristics of the development of coastal beach leisure sports, it is the key to cultivating and developing professional talents in coastal beach leisure sports. The specific route is mainly to formulate relevant talent training strategies, strengthen the training of existing local sports management talents, and use universities, university-related leisure experts, and local resources of professional sports to carry out training and practice in coastal beach sports sightseeing spots. In order to conduct regular internships for students in sports and leisure activities, a relevant practical basis is set up. Through cooperation with local universities, a team of experts with knowledge of TCM health maintenance and sports health can be cultivated.

### Combination of leisure sports development and sports culture construction

Coastal beach recreational sports centers have gradually become a new economic growth point for coastal cities. The government has also incorporated coastal beach recreational sports into the urban construction plan, focusing on exploring its brand effects and cultural characteristics. Therefore, on the basis of responding to people’s leisure needs, the development of coastal beach leisure sports gradually focuses on the construction and combination of sports culture, and strives to create its own coastal sports brands for coastal cities. On the one hand, take advantage of the opportunities of major beach sports activities to further develop local coastal beach recreational sports, increase the promotion of coastal beach recreational sports, and promote the knowledge of coastal beach recreational sports. On the other hand, the coastal sports art festival, the main beach sports festival, and the coastal beach sports season are important links in the development of coastal beach leisure sports. Through beach sports and art festivals, the coastal sports with traditional national characteristics are
displayed, and brand activities with national cultural characteristics are created. Organize influential beach football international invitation conferences, beach rock climbing conferences, and other sports activities, and create a strong leisure cultural atmosphere through publicity activities. The corresponding series of coastal beach sports and cultural activities can effectively increase the popularity of coastal areas and create unique sports and leisure brands.

Combination of economic benefits and ecological benefits

Beach sports along the coast will be an important way for people to welcome leisure life and an important growth point to promote regional economic development. Therefore, the development of coastal beach sports and leisure sports, through investment in the construction of a convenient transportation environment, strives to improve people’s enthusiasm for participating in coastal beach sports, and completes the purpose of improving the software of coastal beach sports. In order to achieve the purpose of attracting more passengers, develop hardware equipment, more interesting entertainment, and coastal sports, maintain health, and create greater benefits. At the same time, focusing on ecological benefits is also an important development direction for coastal beach recreational sports to promote the sustainable development of coastal beach recreational sports. On the one hand, it is necessary to strengthen development cooperation between coastal areas, effectively allocate various coastal resources, and promote the concentrated development of coastal beach sports. On the other hand, it is necessary to strengthen the protection of coastal resources, take ecological environmental protection as the first concept of coastal leisure sports development, and build the environmental awareness of coastal sports workers. Secretary Hu Jintao once emphasized the need to increase awareness of the oceans, do a good job in ocean planning, improve systems and mechanisms, strengthen basic work, and support the development of the ocean economy in terms of policies and finances. Therefore, the overall tendency of beach leisure sports development along the coast will definitely be guided by sustainable development.

Fig. 16 Convergence curve of particle swarm algorithm
Conclusion

This paper analyzes the pore structure and geological parameters of two shale storage layers based on the probability density function of the multi-mode opening distribution fitting model of shale samples in the Southern Ocean Basin, so as to make the characteristic evaluation and correspondence of shale samples suitable for the pore size distribution model. The acquisition of physical parameters and the model are proposed as an application model for shale gas permeation. Use the particle swarm optimization algorithm optimization system based on probability optimization to investigate the relationship between shale pore development rules and geological parameters, and understand the geological parameters of the coastline and the experimental data of beach motion images.

In addition, the current domestic coastal leisure sports are analyzed and understood, and the characteristics of coastal beach sports, existing problems, and how to better develop coastal beach sports are discussed. Most of the domestic beach sports use the natural conditions of the coast. These natural tourist attractions are almost all brands of these cities. In order to show the image to the outside world, the development of coastal leisure sports in these cities also includes their comprehensive economic influence. Therefore, studying leisure sports on coastal beaches to meet people’s leisure needs is also very important for studying urban economic development.

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Declarations

Conflict of interest

The author declares no competing interests.

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