

PS The Study on How to Divide System Tracts Using Variety of Geological Data at Different Scales*

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Abstract

Relative to marine strata, the division of the continental sequence system tracts is difficult because of their complexity. Different scholars advocate different division schemes, and it is difficult to be certain of the interface position of system tracts. Combined with the division of the system tracts of the second member of the Dongying Formation in the Bozhong sag of the Bohai area, we discuss the method of using a variety of geological data at different scales to distinguish between lowstand, transgressive system, and highstand system tracts.

Our research focuses on large-scale paleontological information in wells. In lowstand system tracts, the relative content of sporopollen of coastal swamps is dominant. In transgressive system tracts, the sporopollen of pinaceae is dominant, due to the ability of sporopollen of pinaceae to fly to the well areas. In highstand system tracts, algae is dominant in the upper part of the well, while in the lower part, the sporopollen of coastal swamps is dominant. Therefore, based on paleontological evidence, we can determine the approximate depth range of different system tracts.

Next, using seismic data, we make relative lake-level change curves and analyze seismic response characteristics. In lowstand system tracts, a steady upward trend is obvious in the lake-level changes as seismic shows the reflection characteristics of wedge progradation. In transgressive system tracts, the lake-level rises quickly to the maximum flooding surface illustrated by imbricate progradation in the seismic data. In highstand system tracts, a steady downward trend is obvious in the lake-level changes as seismic shows the reflection characteristics of “S” or skew progradation. Therefore, we have additional indicators to the location of the interface position of different system tracts.

Finally, in conjunction with the results described above, we analyze lithology, well log properties and changes of TOC in wells to accurately divide system tracts in small scale. The results of actual sand distribution of different system tracts validates this method, which is also effective in other areas in Bohai and plays an important role in petroleum exploration, particularly for the exploration of subtle traps.

The study on how to divide system tracts using variety of geological data at different scales

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1、The reason of writing this paper and the research thought of the paper

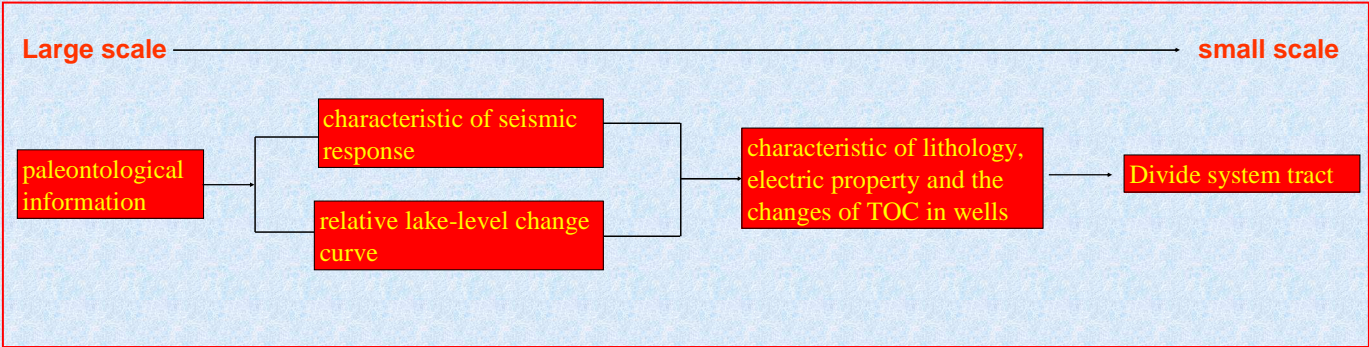


Fig1.the research thought

Fig.1 Relative to the marine strata, the division of the continental sequence system tracts is difficult because of its complexity. Different scholars advocate different division schemes, and we are difficult to certain the interface position of system tracts. Combined with the division of the system tracts of the second Member of Dongying Formation in Bozhong sag of Bohai area, this paper puts forward the method using variety of geological data at different scales to distinguish between lowstand system tracts, transgressive system tracts and highstand system tracts.

2、The method to divide system tracts

(1) Research on the paleontological information to determine the approximate depth range of different system tracts.

Fig.2 According to the principle of pollen sedimentation.In the offshore area, the sporopollen is more enrichment of the coastal swamp. In the district of shallow lake to the half a deep lake, algae is more enrichment. And in the the middle of lake, only the sporopollen of pinaceae which has wings can fly here, so the sporopollen of pinaceae is more enrichment in the middle of lake. So the coastal swamp, algae and pinaceae are important plant that can show the environment, and they can indicate the change of lake level.

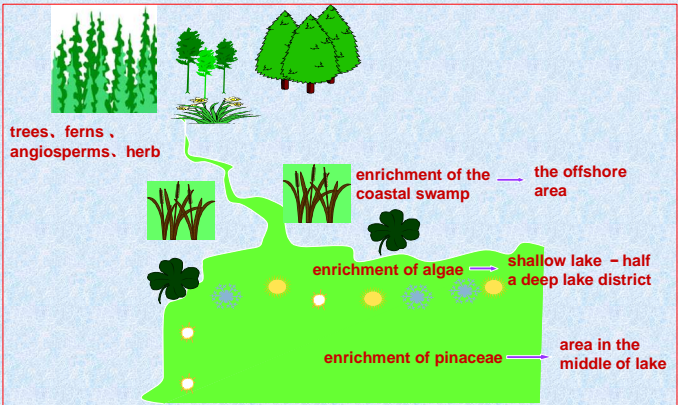


Fig2.the principle of pollen sedimentation

Fig.3 We carry out analysis on BZ19-2-1 well containing abundant paleontological information. In the 4200-3900 meters depth, the relative content of sporopollen of coastal swamp is dominant, and in the uper of this depth section appear an algae relative enrichment zone.So this depth section show an transgressive period of lowstand system tracts. In the 3900-3600 meters depth, the sporopollen of pinaceae is dominant, while the coastal swamp is little. So this depth section represents the transgressive systems tracts. The well is far from of the land, only the sporopollen of pinaceae with air sac could fly to the well areas.The 3600-3220meters depth section represents the highstand systems tracts. We can see the algae is dominant in the lower of the well, while in the uper the sporopollen of coastal swamp is dominant.

So, through the analysis of these three types of paleontology, we could determine the approximate depth range of different system tracts.

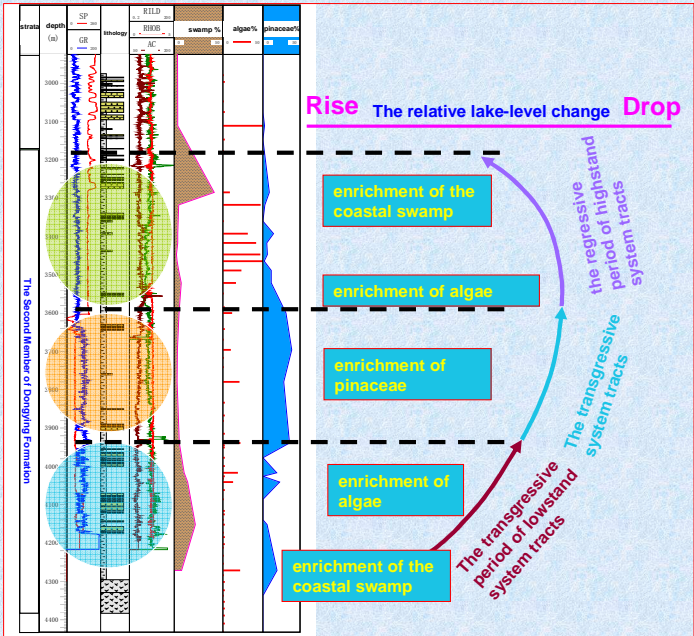


Fig3.the paleontological information of well BZ19-2-1

(2) Analysis on seismic response characteristics and make relative lake-level change curve to further identify the location of the interface position of different system tracts.

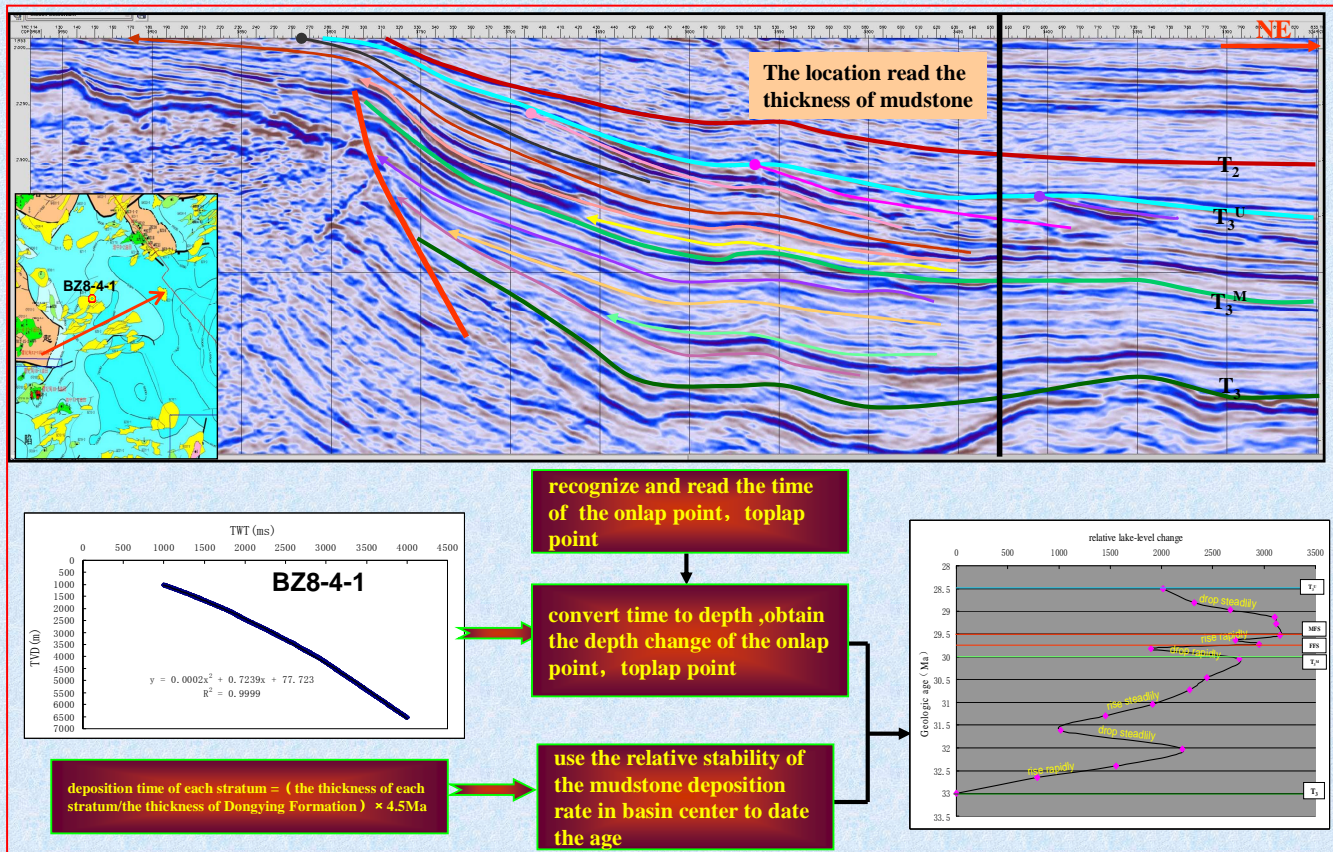


Fig.4 the step of making relative lake-level change curve

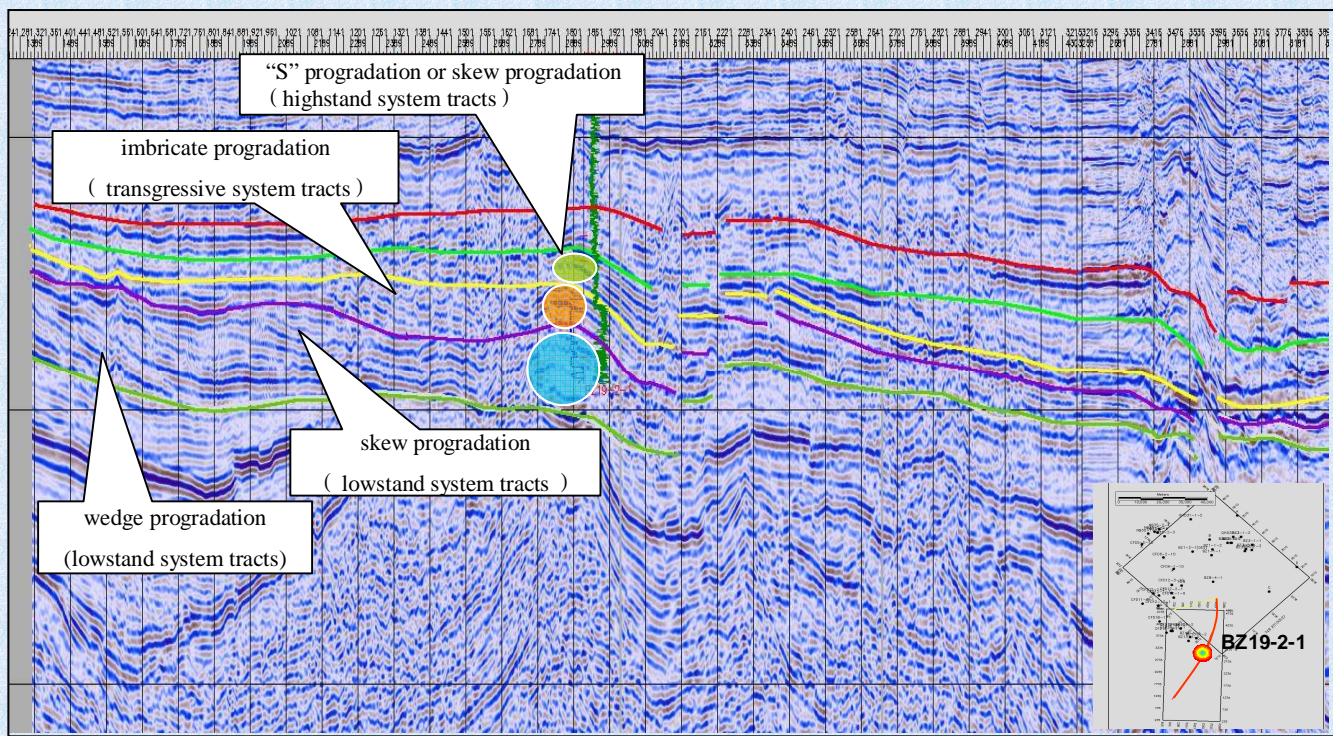


Fig.5 the seismic response characteristics in different system tracts

Fig.4/5 Using the seismic data, we make relative lake-level change curve and do analysis on seismic response characteristics: In the lowstand system tracts, an upward trend is obvious in the lake-level changes, seismic shows the reflection characteristics of wedge progradation; In the transgressive system tracts, the lake-level rises quickly to the maximum flooding surface, and imbricate progradation in seismic; In the highstand system tracts, a steady downward trend is obvious in the lake-level changes, seismic shows the reflection characteristics of "S" progradation or skew progradation. Therefore, we can further identify the location of the interface position of different system tracts.

(3) In the front of the frame structures based on above , study the characteristics of lithology、electric property and the changes of TOC to accurately divide systems tract in small scale.

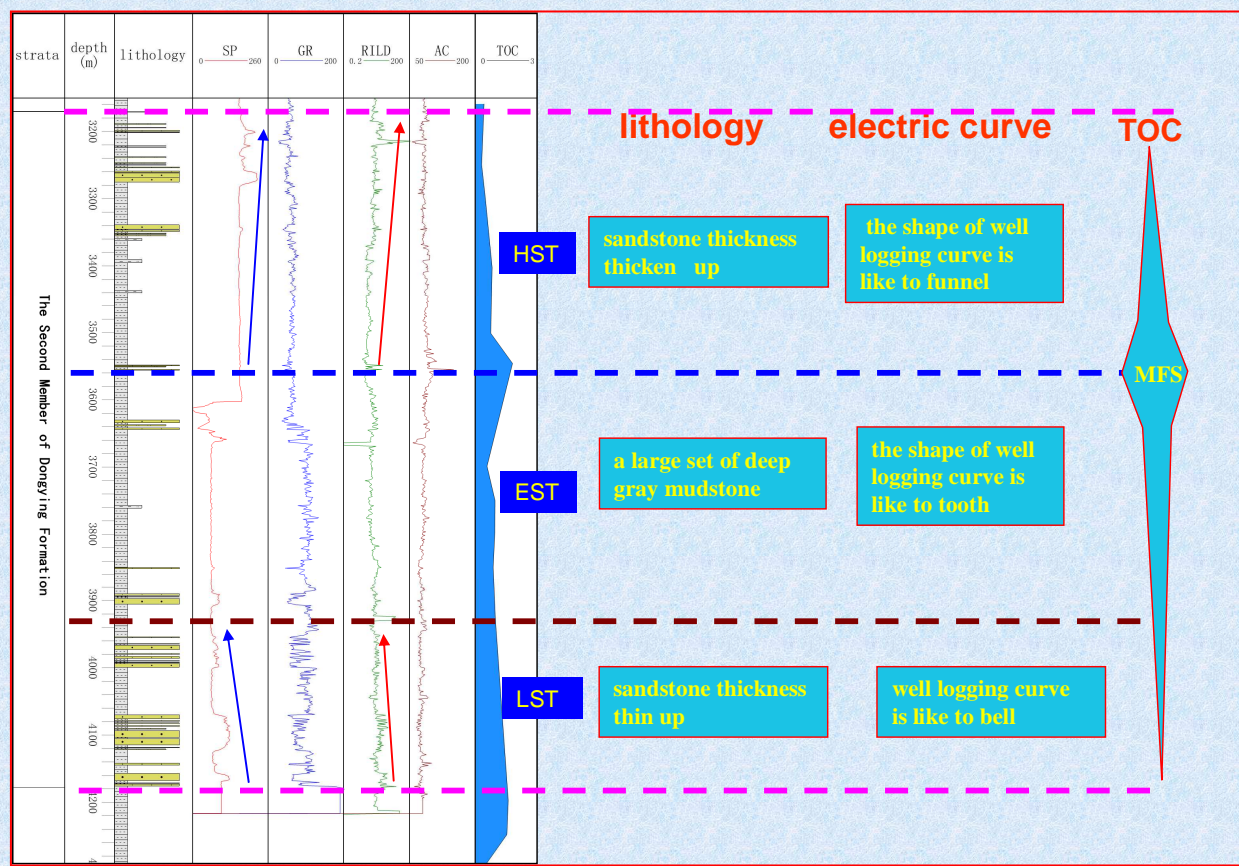


Fig.6 the characteristics of lithology、electric property and the changes of TOC in different system tracts

Fig.6 In the lowstand systems tracts, the Lithology shows the thickness of sandstone is gradually thinning, the shape of well logging curve is like to bell. The transgressive systems tract is mainly a large set of mudstone, the characteristics of the maximum flooding surface.is high value of AC、low value of resistance and the largest value of TOC. In the highstand systems tracts, The Lithology shows the thickness of sandstone is gradually thickening, the shape of well logging curve is like to funnel, the contents of TOC gradually decreased.

3、The significance of dividing system tracts

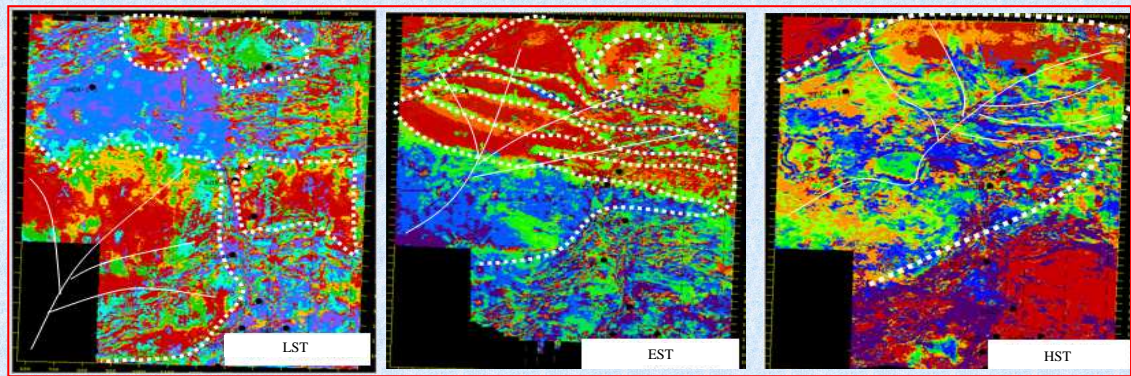


Fig.7 the seismic facies in different system tracts

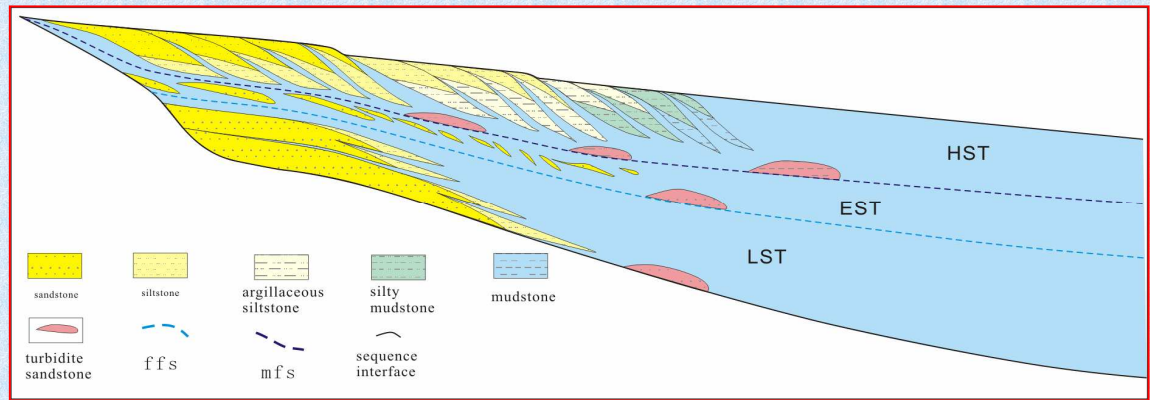


Fig.8 the lithology characteristics in different system tracts

Fig.7/8 Dividing system tracts correctly can help us to distinguish sandstone or mudstone and judge the possibility of reservoir. Lowstand system tracts is advantageous position in the oil and gas accumulation. The sandbody concentrated distribution and near the source rock, and the reservoir-seal associations is very well; The sand body is isolated distribution in the transgressive system tracts, So the hydrocarbon potential of transgressive system tracts is a little. In the highstand system tracts, the sand body distribution area is very large, but lack the cover layer, So the probability of accumulation is small.