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Application of Fischer plot based on wavelet analysis in sequence stratigraphy

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Wavelet Multi-resolution analysis is one of the representative computer technologies which is applied to both seismic stratigraphy and well stratigraphy successfully on abroad. In this paper the research technique of sequence stratigraphy is improved based on previous studies. Combining with multiple well logging curves decomposed by wavelet decomposition, kinds of curves fused by the method of wavelet multi-resolution analysis is applied to identify the interfaces of sequence and analyze the characteristics of system tracts of Dengying formation in south of Sichuan basin. It shows that this method is feasible in carbonate sequence stratigraphy.

Dengying Formation (Sinian) has been taken attention by many scholars for a long time. Because of the experience of multiple tectonic movement, the top is seriously corroded, and the sequence division standard is different, and there is no unified sequence division at present. Nowadays, most of scholars think that there are 3-7 III sequences (Wang Xingzhi etc., 1996; Zhou Guangfu etc., 2001; Chen Hongde etc., 2007; Mei Mingxiang, 2007; Ma Yongsheng etc., 2009; Wang Zhiqiang, 2009).The lithology of Dingshan 1 well(South of Sichuan basin) is single dolomite, the sedimentary environment is stable, the logging curves reflect the changes of shale content and native structure, and the natural gamma GR and resistivity logging RD curve is most prominent. Dingshan 1 well plays a role of typical Wells in South of Sichuan on behalf of sedimentary characteristics. Therefore, Taking Dingshan 1 well as the research object, this article explored the application of Fischer plot in carbonate sequence division.

According the research, the prosesses of the method is summarized as follows: Excessive abnormally high value does not reflect the deposit characteristics, so, it is necessary to eliminate the abnormal high value on GR and SP curve of Dingshan 1 well, and it is necessary to take logarithm before standardization; Then take wavelet transform to the logging data after standardization in previous step respectively, eliminate coefficient d1, d2 which is the carrier of interference information, then do weighted fusion processing;

The fusion curve in step 3 is decomposed by wavelet analysis. The analysis result shows that some wavelet (d10, d9, d8, d7, d6) decomposition curves has good corresponding to lithology. Take the example of D10 decomposition curve, the decomposition curve has 5 cycles, combined with previous research, its average age of cycle is less than 9 Ma. It is near to professor Wang HongZheng who defined the duration of Ⅲ level sequence as 2～5Ma(1989) and most of foreign scholars who defined the duration of Ⅲ level sequence as 1～10Ma (Vail, 1991).In the results of step 3, db6 wavelet can be divided into 34 cycles, it's average cycle age is less than 1.32 Ma, belong to the category of high frequency cycle, the corresponding Fischer plot also shows 5 cycles, the cycle line is still relatively clear, and have a good correspondence with lithology Ⅲ sequence.

Therefore, it could be concluded that The wavelet fusion curves of well Dingshan 1 (located in South of Sichuan basin) shows that the cyclicity of d10 wavelet decomposition curve is obvious, the corresponding relationship to the predecessors' division of 5 level-III sequences is clear, the 34 cycle's time in d6 wavelet decomposition curve also has good consistency with milankovitch cycles. At the same time, the unconformity at the top and the thrust at the bottom have a significant impact on the corresponding cycle form in Fischer plot.

In the mean while, it also suggest that sequence interface have different response on different logging curves. Wavelet weighted fusion of all kinds of well logging curve can suppress interference of formation interface, enhance the effective information of sequence interfaces;

The difference in the result of sequence division between kinds of wavelet fusion curves is no significant. This confirmed the validity and stability of the method in carbonate sequence division, and filled the gap of Calculating of accommodation space automatically.

Key words: wavelet analysis, frequency division fusion, pedigree chart; fischer plot

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