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Theory of Extentional Fault-Related Folds and its Applications in Geology

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Abstract:-The theory of extensional fault-related folds has come into sight for a long time, having established relatively systematic achievement, and geologists have already realized that it has close relationship with the distribution of hydrocarbon. This paper briefly documents the types of folds associate with extensional fault and the application of extentional fault-related folds theory in geology. Extensional folds are divided into three principal types including longitudinal, transverse and oblique folds. Additional, geologists regard folds which are combained with more than one mechanisms as compound folds. Futher more, we can construct the normal fault geometry and predict the distribution of hydrocarbon using the theory of extensional fault-related folds.

Key words:- *normal fault, extensional fault-related fold, application*

I. INTRODUCTION

Having been recognized existing wildly by geologists in rencent several decades, extensional fault-related folds theory has received more and more attention and been used in exploration and development of hydrocarbon. Extensional fault-related folds were firstly described by Hamblin (1965), who found that the rollover folds had close relationship with nomal faults[1]. Extensional folds occur in most Extensional basins and regions, The classification scheme of the extensional fault-related folds proposed Schlische（1995）, which divided extensional folds into longitudinal and transverse folds based on the relationship between the axial trend of fold and the strike of associated normal fault[2], is acknowledged by most geologists.. As time going on, other geologists(eg. Janecke et. al.) improved the classification scheme, promoting the development of the theory of extensional fault-related folds[3].

After realizing the close relationship between extensional folds and the nomal faults, extensional fault-related folds theory is applied to solve many geological problems. For instance, geologists such as Verralla, Gibbs and so on construct a series of geometric models to rebuild the unkonw fault shape based on the given shape and heave or displacement of a deformed marker horizon in hanging wall.

II. CLASSIFICATION OF EXTENSIONAL FOLDS

Fault-related folds in extensional settings are generally divided into three categories referring to a summarize of domestic and abroad study, namely longitudinal folds, transverse folds and oblique folds. Further more, according to the origin mechanism, these tree kind of folds are divided into more detailed categories. (See detail classification in figure 1).

2.1 Longitudinal folds

Longitudinal folds, which incorporates fault-bend folds, fault propagation folds, normal drag folds, reverse drag folds and isostatic folds, are folds whose axial trend lie parallel or subparallel to the strike of associated normal fault, angle between the axial and the strike restrict within 22.5°[3].

2.2 Transverse folds

Contrast to longitudinal folds, axial trend of transverse folds are perpendicular to the strike of normal fault, angle between the axial and the strike range from 67.5º~90º. Transverse folds consist of displacement gradient folds, fault-line deflection folds, transverse constrictional folds and accommodation zones folds.

2.3 Oblique folds

The term oblique folds describe fold with a trend that is between 22.5º and 67.5º from the strike of the associated normal fault[3], including fault-bend folds, transtensional folds and accommodation zones folds.

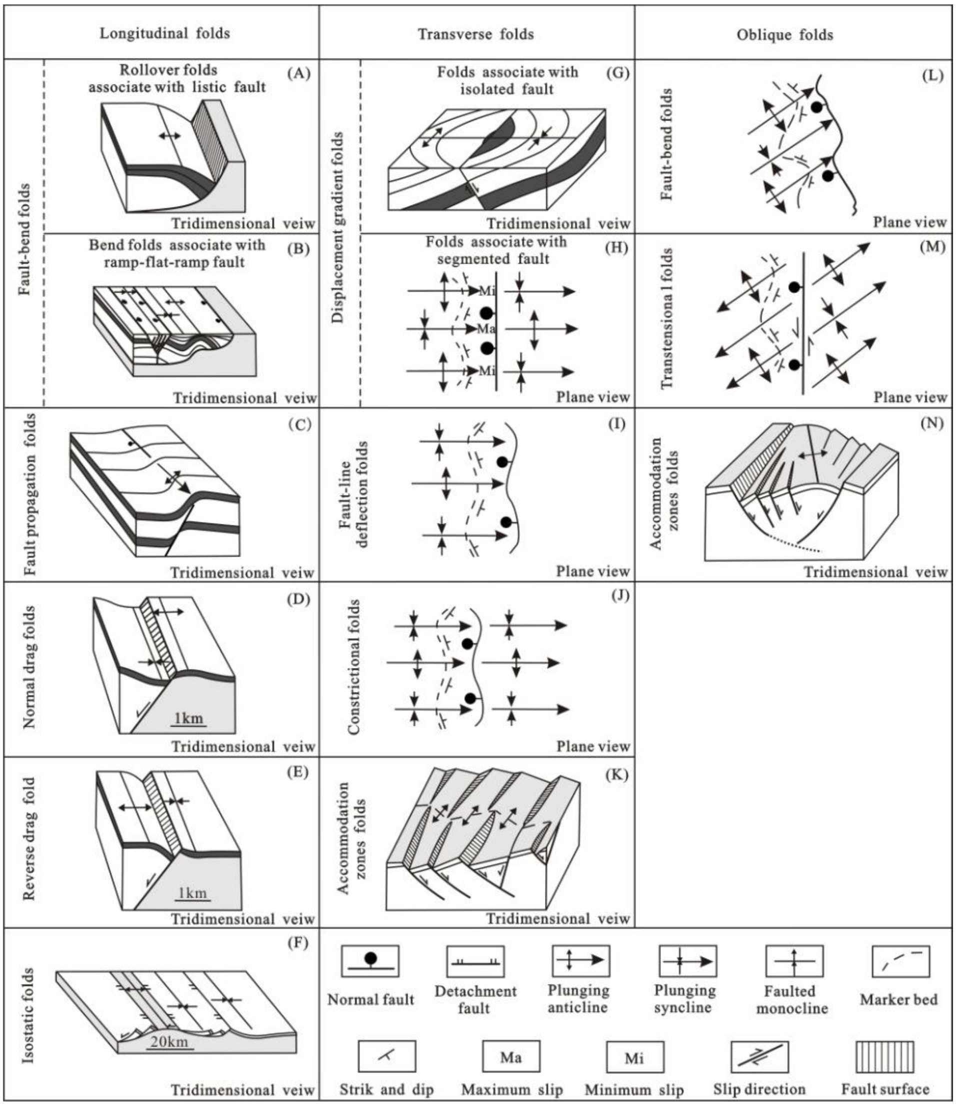


Fig.1 Diagram illustrating the common types of extensiona l folds
(Modified from Janecke et.al.,1998 and Xinwen Wang，1998)

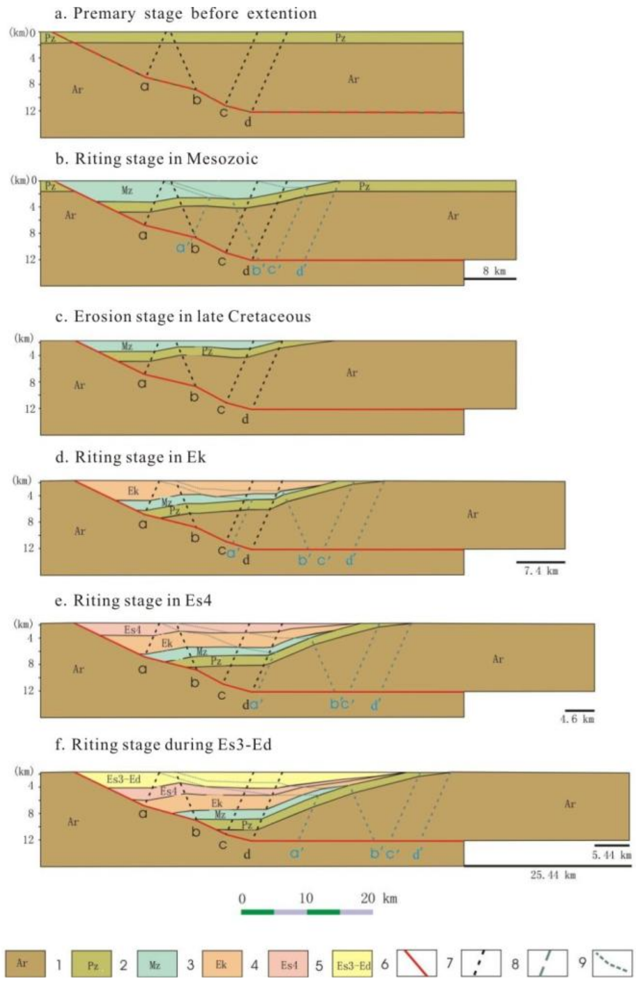
III. APPLICATIONS OF EXTENSIONAL FAULT-RELATED FOLDS THEORY

As the theory of the extensional fault-related folds becomeing well-rounded gradually, it has been applied to solve certain of geology problems. Here we document some examples of the applications of this theory.

3.1 Seismic forward modeling analysis of

When researching a region covered by high quality seismic data, on the basic of being aware of the geometry characteristics of a seismic cross section, we can analyze deformation and deposition history of the extensional fold according to the theory of fault related fold, thus explaining some geological phenomena.

For example, Dong Jia(2005) contruct the balanced cross section of Dongying depression according to the theory of extensional fault-bend folds combained with the technique of balanced cross section[4]. He interpreted the fault in deep zone as kink fault, and restored the process of the development of extensional structure in Dongying depression(Fig.2). Meanwhile, the unconformity overlapped on the shahejie group was interpreted as angle disconformity result from sedimentation during extensional fault-bend folding,which could form angle disconformity without erosion or depositional break.



1-Precambrian metamorphic basement; 2-Palaeozoic; 3-Mesozoic; 4-Kongdian group; 5-Shasan group; 6-Shasan group-Dongying group; 7-fault plane; 8-active axial; 9-inactive axial; 10-growth axial

Fig.2 Forward modeling of balanced cross-section of extensional fault-bend fold in the Dongying depression(From Dong Jia et.al.,2008)

3.2 Reconstruct the geometry of fault in deep formation

We couldn't image the geometry of fault at depth when seismic quality at depth is poor. Since the geometry of extensional fault-bend folds largely depends on the geometry of the associate normal fault, we could reconstruct the possible fault geometry on base of the attainable strata of hanging wall and the fault geometry at shallow. Some geologists constructed some geometric models to rebuild the unkonw fault shape. Once the fault was determined, geometries of folds and potential reservoirs at depth could be predicted.

Geometric models constructed by geologists followed areas balance or bed length balance. Dula(1991) summarized the key constructions of these geometric models(Fig.3) [5]. However, it is unclear which model is the best to predict thr actual relation between rollover and fault geometry. We should choose the appropriate model according to the genetic mechanism of folds.

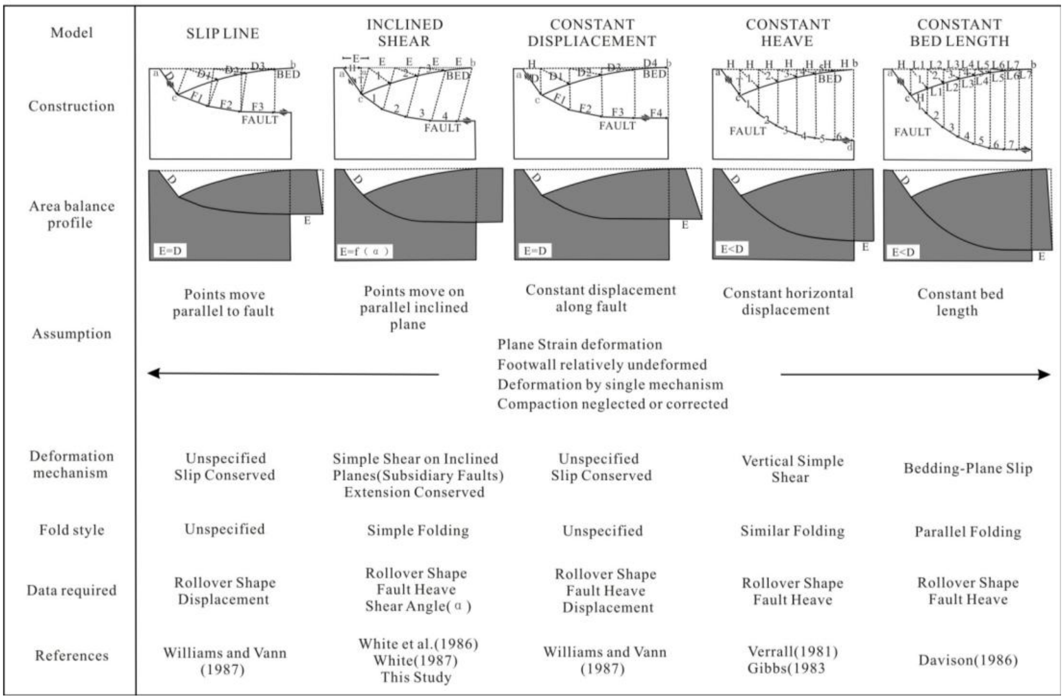


Fig.3 Summary of geometric models for determining fault shapes from rollover shapes(From Dula,1991)

3.3 Predict the distribution of hydrocarbon

Extensional fault related fold is a kind of important traps in extensional basin, and it is an important place for hydrocarbon occurrence. Different types and different directions of the extensional folds along with associated normal faults and secondary faults can form a variety of types of anticlinal traps and anticline-fault blocks traps[3]. In addition, transverse folds around normal faults are important component of positive micro amplitude structures, they are of great significance to predict the distribution of remaining oil.

IV. CONCLUSIONS

The theory of the extensional fault-related folds has acquired relatively systematic achievement, while extensional folds include longitudinal, transverse and oblique folds. The theory has been applied to analyze deformation and deposition history of the extensional fold, construct the geometry of normal fault associate with rollover fold ,predict the distribution of hydrocarbon and solve many other geology problems.

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