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# The Reservoir Controlling Model of Antithetic Faults in Tamtsag basin, Mongolia

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***Abstract:*** **-** In recent years, with the constant breakthroughs of the exploration in TAMTSAG basin, its accumulational controlling factors and rules are more and more concerned by experts. Based on the analysing of reservoir's types and distributional rules,we divided the formation into three petroleum systems vertically.According to the analysing of lower petroleum system,,we can find the key factors which control the distribution of oil and gas by antithetic faults,and then establish a representative accumulational model.Finally,these works would guide the exploration effectively.

***Keywords:*** **-** *Tamtsag basin; Petroleum system; Antithetic Faults; Accumulational model*

## I. INTRODUCTION

Tamtsag basin which includes South Bell sag and South Tamtsag sag is located on Hulunbuir plateau and part of the central rift belt in Hailar-Tamtsag basin.South Bell sag is further divided into three tectonic units:East Sub-Sag,West Sub-Sag and South Buried-hill Structural Belt.South Tamtsag is also further divided into four tectonic units: East Sub-Sag,central Sub-Sag, South Buried-hill Structural Belt and West Sub-Sag[1](Fig.1).The formation of Tamtsag basin is vertically devided into Tongbomiao group,Nantun group,Damoguaihe group,Yinmin group and Qingyuangang group from bottom to top[2] (Fig 2).Through the exploring research for many years,we have got some ideas which reflect the rules of oil and gas accumulation.In this article, according to the analysing of reservior's types and distribution,we can find the key factors that control the distribution of oil and gas by antithetic faults,and then establish a representative accumulational model.Finally,these work would guide the exploration effectively.

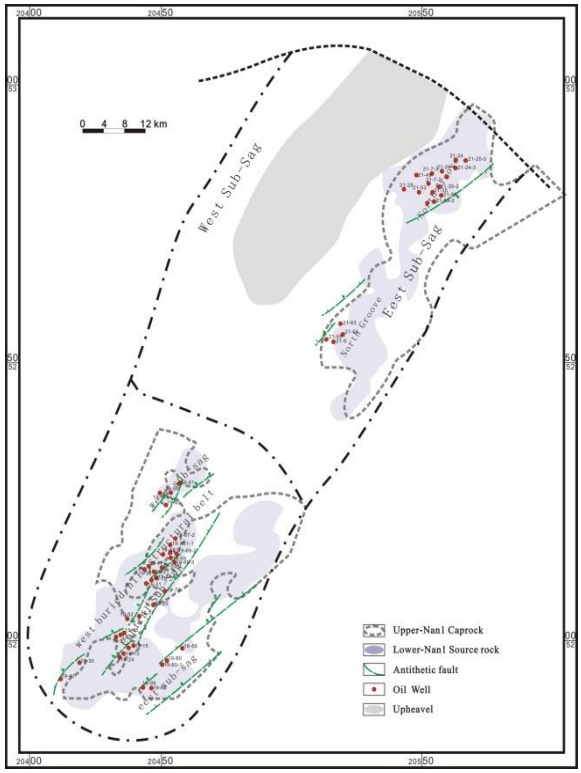


Fig.1 The key factors of hydrocarbon accumulation and structural units in Tamtsag basin

## II. REGIONAL GEOLOGIC SETTING

Tamtsag basin is a typical superimposed basin.Faults acted weekly during the Tongbomiao sedimentary period.The regional stress field induced passive rifting mechanism in Tamtasg basin from Lower-Nan1 to Mid-Nan1 sedimentary period.Active faults controled the formation of the sag locally and formed many synclastic faults which acted as the antithetic faults for the stratum inclination.With the continually tilting of the stratum,the footwalls generated tilted uplifts.From the Upper-Nan1 to Nan2 sedimentary period,the mantle plume arched up by the force of early passive rifting mechanism.From the Damoguaihe to Qingyuangang sedimentary period,the tectonic evolution phase gradually changed from rifting to depression.In the late Yimin sedimentary period,the basin underwent the structural inversion in the compressive stress field[3].

According to the matching of accumulational elements and geological mechanism,the formation was divided into three petroleum systems[4]: passive rifting lower petroleum system,active rifting middle petroleum system and rifting-depression transformation upper petroleum system(Fig.2). The lower petroleum system consists of Mid-Nan1 mudstone regarded as the source rock, Upper-Nan1 mudstone which is the regional caps and superior reservoirs of secondary porosity in the footwall of the antithetic faults.When affected by the early tectonic activity,Nan1 stratum tilted and uplifted,covered by Nan1 sand and mudstone interbedding,and structural traps which mainly were the type of antithetic fault blocking were eventually formed.In the late Yinmin sedimentary period,the source rock gradually entered into the peak of hydrocarbon-generating and basicly covered the whole region,and then hydrocarbon transfered into traps through the unconformity and sands.These traps which mainly were the type of antithetic fault blocking became oil and gas reservoirs.The lower petroleum system has the feature of once hydrocarbon-generating and once reservoir forming.

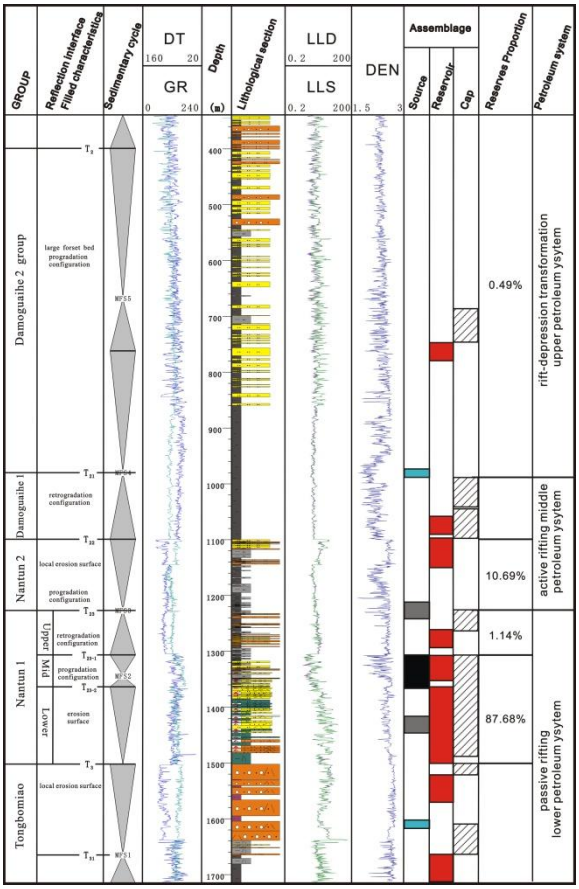


Fig.2 Generalized geological section

## III. RESERVOIR TYPE AND DISTRIBUTION

Hydrocarbon of 70% of the total output vertically and mainly distributes in the lower petroleum system in Tamtsag basin and flatly distributes in structural unit especially accumulating in north groove of east sub-sag in South bell sag and central sub-sag in South Tamtsag sag.Viewed from the structural position,hydrocarbon distribution in lower petroleum system shows a strip-type near the antithetic fault[5].

Reservoir types are mainly antithetic fault blocking reservoirs and followed by fault-lithological and lithological reservoirs(Fig.3).There are a series of antithetic faults that lean to eastern developed in Mid-Nan1and Lower-Nan1 in notrth groove in east sub-sag,South bell sag.Reservoirs at the western of the fault were well sealed by the upper-Nan1 and Nan2 mudstone,and they had basicly unified oil-water interface and were mainly antithetic fault blocking reservoirs which were also the main type of north groove in central sub-sag of South Tamtsag.Central sub-sag of South Tamtsag was a haft-graben fault basin.There were a a series of antithetic faults in Mid-Nan1 and Lower-Nan1 that form multistep fault zone.Hydrocarbon transferred from central sag to updip position and was blocked by the antithetic fault to accumulate[6,7].

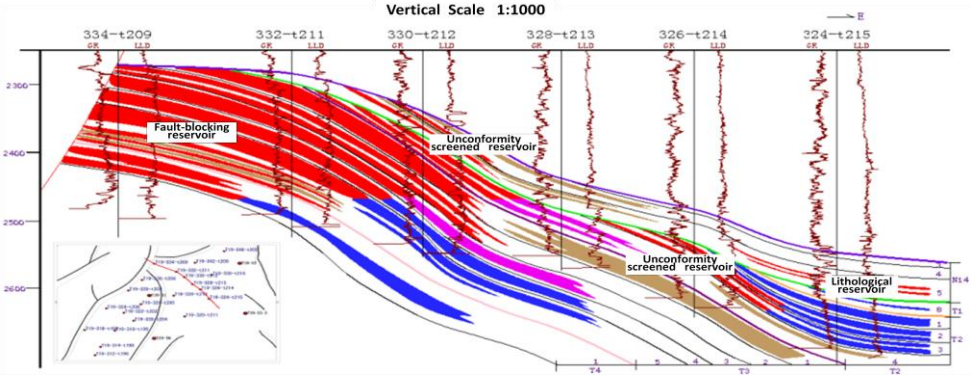


Fig.3 Well 334-t209 — Well 324-t215 reservoirs profile

## IV. THE ROLES OF ANTITHETIC FAULTS IN RESERVOIR FORMING

### 4.1 The Reservoir Forming Control of Antithetic Faults

The type of reservoirs in lower petroleum system of Tamtsag basin based on secondary porous superior reservoir.During the Tongbomiao and Nantun sedimentary period,a lot of antithetic faults were formed by twice week tectonic deformation,whose footwalls tilted up,partly exposed to the surface,and suffered leaching of meteoric water and denudation.The porosity and permeability of reservoirs were improved obviously,so a lot of the secondary porous superior reservoirs formed.In the smooth and stable sedimentary context, these reservoirs were covered by the subsequent Mid-Nan1 source rock[8],forming an idiomatical type which was controlled together by antithetic fault blocking and unconformity.Distributing along the trend of antithetic faults,these reservoirs had many supported conglomerate and often appeared at the footwall of antithetic faults,whose log had distinct abnormal porosity and the feature of truncation unconformity[9].The older the stratum is,the larger the proportion of secondary porosity is.

4.2 The Blocking Control for Migration of Antithetic Faults

Tilting deformation of the antithetic fault provides the structural environment for the forming of superior reservoirs and causes the footwall to form the upheaval.At the same time,the tilting upheaval was located in structure high part,so it was also the oriented accumulational region of hydrocarbon[5].Through the analysis of pool-forming history,the early stretch fault formed before Nantun sedimentary period,belong to three-level or four-level faults which associated with two-level faults forming in rifting period,and had no activities at critical moment of accumulation.By comparing the shaliness under Mid-Nan1 group,the sequence of Tamtsag basin was typical sand-shale interstratifications,whose sand-shale ratio was generally larger than 40%.The fault cores of clay swearing were built by fault deformating,forming the sealing condition at the same time,and their sealing capacity gradually increased with the buried depth increasing.Due to the better sealing condition of antithetic faults at the accumulational critical moment,it can block the hydrocarbon migrating both vertical and long-distance lateral,to be the blocking function for the accumulation.

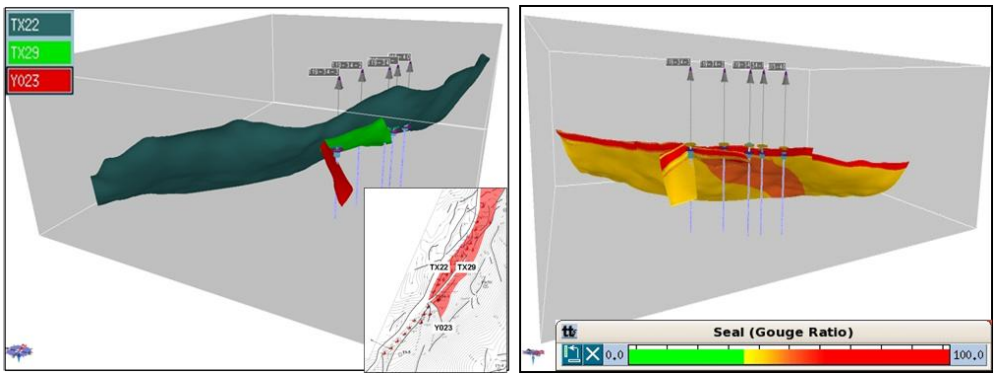


Fig.4 Structural modeling and sealing evaluation of Ta19-34 block

Ta19-34 block locates in the western of Tamtsag sag.There were three faults in Tongbomiao layer: TX22、TX29 and Y023,and they arrayed around to form the fault trap whose structural culmination was -970m. Using the well and sesmic data,we established the 3D structural frame model for Ta19-34 block and calculated sealing attribute value of the three fault planes(Fig.4).And then we predicted the hydrocarbon column height that every fault can seal and converted the height to the corresponding number of oil-water interface.The calculations of three faults respectively were -1217.5m,-1184.5m and -1202m，and sealing capability of the trap adopted the maximum number,-1184.5m.This result agreed well with oil-water interface number -1184m determined by well correlation(Fig.5).It is definitely that the sealing capability of antithetic faults decides the actual ability of the hydrocarbon accumulation in the trap.

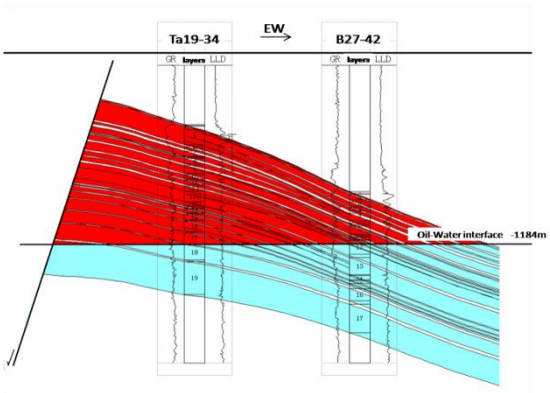


Fig.5 Well Ta19-34 — Well B27-42 reservoirs profile

## V. THE ACCUMULATIONAL MODEL OF THE ANTITHETIC FAULTS BACKING ON THE UPHEAVELS

There were many antithetic faults forming in passive rifting stage in Tamtsag basin,and they were built by the tilting of trunk boundary fault activities.In terms of the tectonic background,tilting was a process of“sunken settling and gentle slope lifting”,and it was the same time that antithetic faults formed and the footwalls uplifted.The tectonic model can be concluded that antithetic faults back the upheavels.The accumulational model can be summarized as “three-phases synchronous” reservoir building, “three-sides combinational” accumulation and “three-classes compound”hydrocarbon controlling(Fig.6). “Three-phases synchronous”reservoir building means the tilting phase with the fault deformating,lifting denudation phase and leaching phase of meteoric water.All the three phases controlled the forming of reservoirs importantly. “Three-sides combination”accumulation means the lateral blocking for traps by antithetic faults,the uncomformity to be the migrating passage and the regional cap of overlying stratas[7].“Three-classes compound”hydrocarbon controlling means that there were three types of reservoirs:structural reservoirs,lithologic reservoirs and composite reservoirs,but structural reservoirs were obviously dominant[10].

The reservoirs located in or near the hydrocarbon-generating depression,where the hydrocarbon need only short distance to migrate,so the forming of traps was primarily controlled by the antithetic faults.The structural reservoir was the most important,in which there were both edge water and bottom water,and had the unified oil-water interface which depends on the lateral sealing capacity of antithetic faults.The closer to the faults,the higher the well productivity was.These wells mostly distributed on the gentle slope and tilting position which had the most favorable exploration prospect.

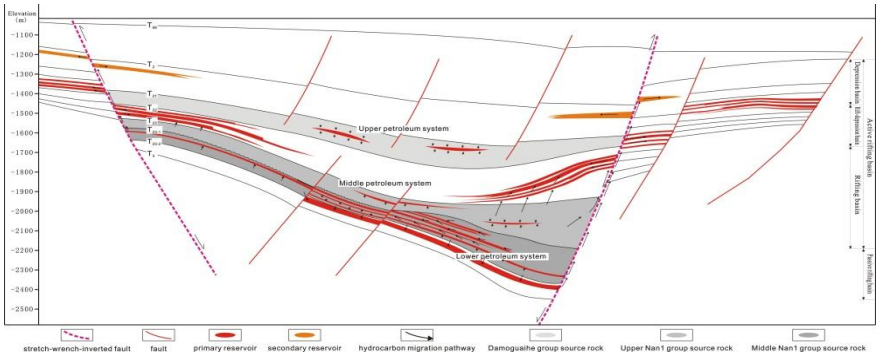


Fig.6 Accumulation pattern of Tamtsag basin

## VI. CONCLUSION

(1)The effection on accumulation of antithetic faults mainly reflected in the control of reservoir forming and the blocking of hydrocarbon migration;

(2) The accumulational model of the antithetic faults backing on the upheavels was the most important model in lower petroleum system in Tamtsag basin,and its feature can be summarized as "three-phases synchronous" reservoir building, "three-sides combinational" accumulation and "three-classes compound" hydrocarbon controlling.

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