IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 05, Issue 12 (December. 2015), ||V2|| PP 05-10

Langgu sag Sha 3 member and Sha4 membersedimentary environment analysis

Lu Jun[1], He Bo[2], Liu Shougang[3], Liu Jia[4]
(1,2,3,4. Earth Science of Northeast Petroleum University， Daqing 163318， P.R.China)

Abstract: In this paper, the samples' trace elements of Sha 3 member and Sha 4 member are tested. According to the characteristics of trace elements and the ratio of elements, the paper discusses the sedimentary environment, and expounds the significance of them. The results show that the value of the B element in Sha 3 member is lower, and the value of B/ Ga、Sr/Ba also shows that the main deposit environment is fresh water lake. The value of the B element in Es4 is strong enriching , shows that it belongs to the salt water sedimentary environment, the value of B/Ga、Sr/Ba also shows that the impact of the sea water or intermittent by sea water; the value of Sha 3 member and Sha4 member V/(V+Ni)、V/N、Ni shows that the sedimentary environment is a reducing environment, and in conclusion, the Sha 3 member in the studying district which environment is fresh water reducing, while the Sha4 member is sault water reducing environment.

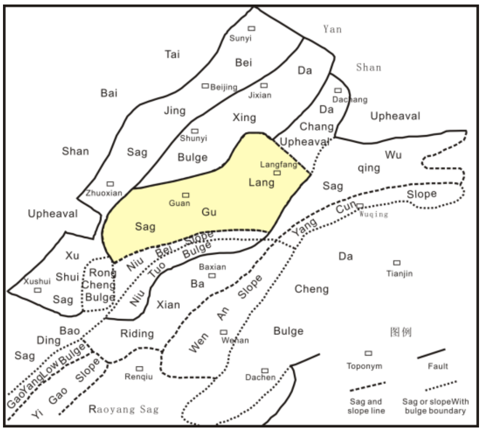
***Key words**: Langgu depression; Sha 3 member; Sha4 member; depositional environment*

I. INTRODUCTION

The evolution of the geochemical elements in sedimentary can reflect the paleoenvironment、the ancient climate[1、2]. Constantly, analysis of trace elements is more and more applied in the environmental research on paleoclimate[3, 4], but in view of the sha 3 member and sha4 member elements of the evolution and paleoenvironment there in Langgusag is few research reported. The overall exploration degree of the Langgusag is high, Liuquan、Hexiwu、Yongqing、Bieguzhuang and many other fields have been discovered. The fossils in the study area are abundant, the hydrocarbon source rocks are obviously controlled by the factors of paleoclimate and paleoenvironment. Tracing elements test samples, studying the ancient environmentoxidation of reducing and paleosalinity. To further clarify the Sha 3 member and Sha4 member oil and gas exploration and development direction has important guiding significance.

II. REGIONAL GEOLOGICAL BACKGROUND

Langgusag is located in the northern Hebei central sag of Bohaiwan bay basin[5],it's Fig.1Langgu sag structural diagram (according toCao Lanzhu 2012, modified)
one of the major oil and gas regions. In the west it nears Daxing bulge, southeast is niutuozhuang uplift, north is connected with Dachang sag, neighboring Wuqing sag in the east, north and south is about 90 km long(Pic.1). Due to the control of the northeast fracture, showing overall uneven decline characteristics of the half graben[6, 7]. During the Palaeogene sedimentary period, it has experienced a tectonic three evolution stages:faultbasin initialstage (KongdianShahejie four group),theformation of faulting in the east tectonic sedimentary
pattern; then basin strong tension, thick Shahejie group received three period of deposition, the east raised and the west fell; Es3 experienced Langgu movement at the end of the deposition, causing the same sag divided, the south raised and the north fell.



III. GEOLOGICAL BASIS FOR THE IDENTIFICATION OF SEDIMENTARY ENVIRONMENT IN SHA 3 MEMBER AND SHA 3 MEMBER

With great change of basin long geological history evolution, in different periods and different regions, different degree historical information has been saved, which the paleoenvironment of study provides strong evidence.

During the Sha4 member depositional period, the braided river delta sedimentary sand body of the depression widelydistributes in the southern part, mainly deposited in the Hexiwu area[9]; the Sha 3 member begin to strongly sink, the landscape background of high mountains、deep water is formed; the climate was humid, water depth increased, accommodation space increased rapidly, with the feature of large area continuous transgressive[10], the center of the lake basin sedimentary thickness is more than 2000 m (Fig. 2).

The vegetation visages of sha4 member are mainly AnacardiaceaeEuphorbiaceaeMeliaceaelinden such angiosperms pants and thermophilic oak branch;thermophilic drought tolerant ephedra powder (Ephedripites) is a common development, it is a typical sign of hot climates[10]; Verrutetraspora Schizaeois porites Pteris is porites and some other plants which like hot grow prosperous in the slopes and river valley. When sha 3 member layer deposits, the climate became moist, QuercoiditesJuglanspollenitesMomipites which like lukewarm continuous appear, typical and subtropical components significantly decline[11], ephedra powder content dropped significantly.

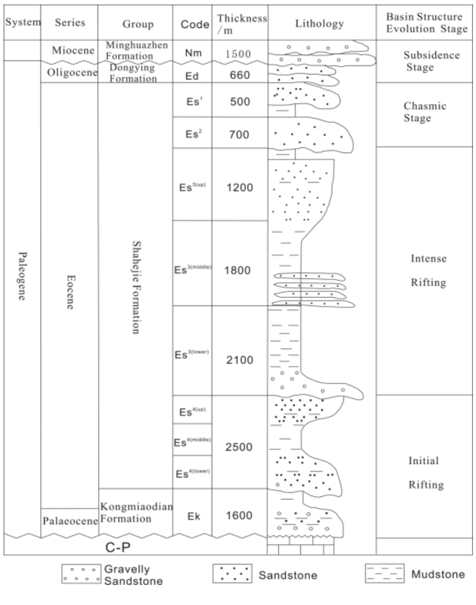


Fig. 2 Langgu sag comprehensive strata histogram (accordingto Diao Fan 2014, modified)

IV. SEDIMENTARY ENVIRONMENTAL ANALYSIS OF SHA3 MEMBER AND SHA4 MEMBER

In the process of deposition, there is a complex geochemical balance between sediment and water medium, such as elements exchange and sediment adsorption of certain elements,etc[12]. This kind of exchangeand adsorption in addition to be related to the nature of the element itself, also is affected by the physical and chemical conditions of sedimentary medium, and water in different sedimentary environments have different physical and chemical conditions, thus it provides a theoretical basis thatusing trace element contentto analyze paleoenvironment[13,14].

4. 1 paleosalinity

Boron (B) and gallium (Ga) are two obviously different elements in chemical properties. The boric acid salt' solubility is very big, can move far away, and deposited only when the water evaporation.While gallium is low active, easy to precipitate[12] when migration. Couch[15] think, there is a linear relationship between B content and salinity in water, namely the higher of the salinity, the greater of the content of B. Boron element has a clear instruction significance to sedimentary environment and various geological effects,commonly used to indicate that the paleosalinity[16].In salt-water environment, the boron content usually is 80-125, boron content < 60 in fresh water environment. The boron content of most specimensis inferior to60 in Sha3 member, with a mean of 45.10. Outliers may be affected by climate change. The B/Ga ratio may be increased along with the increase of salinity, the use of the B/Ga ratio can effectively indicate the paleosalinity[17, 18]. ChengFengli[19] think that B/Ga ratio is less than 1.5 in fresh water; is between 1.5-3 in brackish water; is greater than 4-5 in salt water. According to the analysis results (figure 3), theSha4 member has a highest ratio, an average of 4.18,individual value can reach 6.23, the Sha-3 member has a minimum ratio,an average of 2.03, most is between 0.85 to 2.27.

Strontium and barium have a similar chemical properties in alkaline earth metal, but itsseparate due to the differences of the geochemical properties in different sedimentary environments.Thus the Sr/Ba ratio can be use as a symbol of paleosalinity discriminant, and have a obvious positive correlation with paleosalinity[20]. When freshwater and salinization of lake water mixed, Ba^{2+} in freshwater and SO_2^{-4}in salinization of lake water integrate,combining $BaSO_4$ precipitation ,while the solubility of $SrSO_4$is big, it can continue to migrate to the central of saline and settle through biological function. Because the Sr/Ba value is gradually increased away from the lake shore, so the Sr/Ba can qualitatively reflect thepaleosalinity of medium[12]. In general, the Sr/Ba value is less than 1 in freshwater sediments, is greater than 1 in the salt lake sediments. The Sr/Ba value in Sha3 memberis between 0.27 and 0.27, an average of 0.57. The Sr/Ba value in Sha4 member is between 0.37 and 2.6, an average of 1.18. Generally,the Sr/Ba value in Sha4 member is bigger than Sha3 member,this shows higher salinity of Sha4 member. The ratio changes stable in Sha3 member,the exceptional high ratio in early Sha4 member may be due to the lake level is reduce, water strong evaporation caused salinity increases, and the abnormal low valueat end of the Sha4 membermay be caused by water rapidly deepening (figure 3).

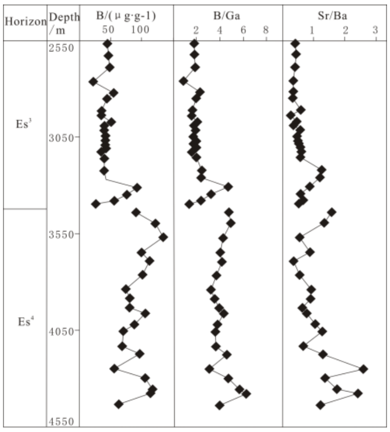


Fig.3 Langgu sag Wugu 4 Wells redox paleosalinity change characteristics between Sha4 member and Sha3 member

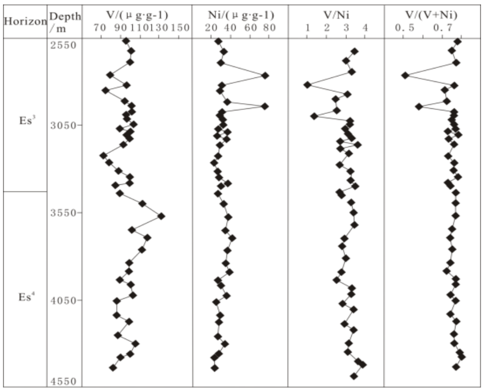


Fig.4 Langgu sag Wugu 4 Wells redox conditions change characteristics between Sha4 member and Sha3 member

Comprehensive above studies show that the samples of Sha3 member have lower B, B/Ga and Sr/Ba ratio, indicating the paleosalinity is low in depositional period of Sha3 member, for fresh water deposits; The samples of Sha4 member have obvious higher B, B/Ga and Sr/Ba ratio, indicating the paleosalinity is higher in the period of Sha4 member, for salt deposits.

4.2 paleoclimate

Paleogene in Bohai bay basin is locatedin the temperate zone to subtropical zone in the climatic paleozone, the total trend of climate change is form warm to cold.The sedimentary period of Sha-3 memberwas humid subtropical climate, Sha4 member was dry subtropical climate [21]. Different climate background controlled different water environment and biological develop outlook in Sha3 member and Sha4 member. In the sedimentary period of Sha3 member in Langgu sag,the climate is humid, rainfall is abundant, higher plants is flourish in the basin, water condition is given priority to with fresh water; While in the sedimentary period of Sha4 member,the climate is dry, higher plants in the basin is not development, water condition is given priority to with salt water [10].

4.3 Redox environment

There a close relationship between geochemical behavior of Delay elements V, Ni andredox environment in sedimentary and diageneticprocess. In the reducing environment, lowvalence V easy to enrichment. V/Ni commonly used as a marker for continentalfacies ormarine facies, also can be used as an indicator of oxidation-reduction, along with the reduction degree of enhancing. High value of V/Ni may the reaction of high salinity and strong reduction degree at the same time [24]. Research shows that the average of V/Ni of Sha4 memberis bigger than Sha3 member , Sha4 member is 3.20, Sha3member is 2.90. Formation of V/(V + Ni) value is often used as index of sedimentary environment[4],in oxygen-enriched environment is less than 0. 45, in lean oxygen environment is fall in between 0.45~0.60, and under the anoxic environment is greater than 0.60[25]. The value of V/(V + Ni) in Sha3 member is between 0.51~0.78, an average of 0.73 ,V/Ni value is between 1.03~3.62, on average2.90,shows that Sha3 member is anoxic environment. V/(V + Ni) value in Sha4member is between 0.72 and 0.8, an average of 0.76, V/Ni value is between 2.56 and 3.90, an average of 3.20, shows that Sha4 member is anoxic environment.

V is a sensitive element on the condition of redox, defected in the oxidation environment of sediments, and enriched in reducing environment[26]. V element and V/(V + Ni) ratio have a similar changing characteristic curve. V value in Sha3 member is between 104 and 72.7, an average of 34.73, shows anoxic environment. V value in Sha3 member is between 132 and 81.9, an average of 99.66, shows anoxic environment. The changing trend is stable in Sha3 member, low value appearing occasionally may be due to the lake level dropped or climate change. V value has a tendency to increase from Early to late in Sha4 member, suggests that basin expansion, water body and reductive degree increase.

The content of Ni related to biological enrichment[26], Ni values in Sha3 member is between 24 and 76.4, an average of 34.73. Ni value in Sha4 member is between 23.1 and41.9,an average of Ni value changed little between in Sha3 member and in Sha4member, showed that the biological enrichment regularity is stable. The high value appeared unusually inSha3 member, combining with the front research of characteristics of V paleosalinity, I think it is because reductive environment suddenly transformed into oxidation environment,the biology which can not adapt to environment eliminated and began to mass mortality.

V. CONCLUSION

(1) Through the analysis of trace element in Sha-4 member and Sha-3 member in Langgu sag, revealing the water salinity along sedimentary and redox conditions between Sha4 member and Sha3 member .

(2) In the period of Sha4 member, dry climate,and strong evaporation caused water salinity increasing, developed halocline, thus forming anoxicreducingenvironment.

(3) In the period of Sha3 member is saline sedimentary environment, climate turnedmoist, water and sediment supplied adequately, the water relatively deep and formed reductive environment.

REFERENCES

[1]. Chang Huajin，Chu Xuelei，FengLianjun，et al. Redox sensitive trace elements as PaleoenvironmentsProxies[J]. Geological Review, 2009;55(1):91～99.

[2]. Wang Kaiming，LuoShunshe. Geochemical characters of carbonates and indicative significance of sedimentary environment——an example from the Gaoyuzhuang Formation of the Changcheng System in the Northern Hebei Depression. Oil and Gas Geology,2009;30(3):343～349.

[3]. ZouJianjun，Shi Xuefa，Li Shuanglin. Distributions of minor elements in near surface sediments in north Yellow Sea and the early diagenesis. Marine Geology and Quaternary Geology,2007;27(3):43～50.

[4]. XieShangke，Wang Zhengjiang，Wang Jian, et al. Trace element geochemistry of the Middle and Upper Ordovician strata in he Guanyinqiao section，Qijiang，Chongqing . Sedimentary Geology and Tethyan Geology, 2010;30(4):60～65.

[5]. Cao Lanzhu, Mo Wuling,WangJianrui, et al. See Langgusag form the great break of Baxianindentation[J]. Oil Geology, 2012,005(6):28～34.

[6]. Hui.Daxing. Depositional characteristic and origin of DaxingGravelly stone in Paleogene of Langgusag [J], China

University of Geosciences,2011:57～109.

[7]. Huang Tingting,Zhou Wen, Fu heng, et al.Formation condition and reserve regulation of shelteroil and gas pool in Paleogene of Langgu sag[J].China Petroleum Exploration, 2007,26(6):51～56.

[8]. Zhang Wencchao, Cui Zhouqi,Han Cunyuan,et al. Lacustrine basin evolution and oil-gas in Jizhongsag in early Tertiary[J]. Journal of Palaeogeography, 2001,3(1):45～54.

[9]. Li Xianping, LiXiaodong,TianJianzhang, et al.Reserve condition exploration potential in territory of lithology sequence in Langguindentation[J]. China Petroleum Exploration,2013,18(6):1～6.

[10]. Diao Fan, Jin Fengming, Hao Fang,et al.The environment of Paleolacustrineand enriched mechanism of organic matter in PaleogeneShahejie Formation of Langgusag[J]. Experimental Petroleum Geology, 2014,63(4):479～486.

[11]. Wei Ping, Zhang Ling, ZhaiZhongxi, et al. Forecasting methods of SEC reserves replacement rate ［J］. Experimental Petroleum Geology，2013(6):702～706.

[12]. LiuGang, Zhou Dongsheng. Application of minor elements as distinguishing depositional environment——an example from the Qianjiang Formation in Jianghan basin, Experimental Petroleum Geology, 2007,29(3):307-314.

[13]. Miller E K, Blum J D, Friedland A J. Determination of soil exchanheablecation loss and weathering rates using Srisotope[J]. Nature,1993,362:438～44.

[14]. Reinhardt E G, Blenkinsop J, Patrerson R T. Assessment of a Sr isotope (87Sr/86Sr) vital effect in marine taxa from Lee Stocking Island, Bahamas [J]. GeoMarine Letters, 1998,18(3):241～246.

[15]. Couch E L.Calculation of paleosalinities from boron and clay mineral data[J]. AAPG Bull, 1971,55(10):1829～1837.

[16]. Li Fulai,QuXiyu,Liu Li,et al.Depositional environment in the Northern NeiMonggol in Linxi Formation of Upper Permian[J].ActaSedimentologicaSinica, 2009,27(2):265～272.

[17]. Chen Zhongyuan,Chen Zhenglou,Zhang Weigou. Quaternary stratigraphy and trace element indices of the Yangtze Delta, Eastern China, with special reference to marine transressions[J].Quaternary Research,1997,47(2):181～191.

[18]. Deng Hongwen,Qian Kai.Sedimentary Geochemistry and Environmental Analysis[M].Lanzhou:Gansu Science and Technology Press,1993.

[19]. Li Chengfeng, Xiao Jifeng. Use trace element studying paleosalinity in Dongying basin of Shengli oil field in ShahejieFormation[J]. Sedimentation Journal, 1988,6(4):100～107.

[20]. ZhengRongcai, Liu Meiqing. Paleosalinity study of Chang 6 reservoir set in Erdosbasin[J], Oil and Gas Geology,1993,20(1):20～25.

[21]. CaiZhiguo,ZhengGuoguang,CuiZhantang.Tertiary stratigraphy and micropalaeontology of the central Hebei petroliferous area[M].Beijing:SciencePress,1998.

[22]. Pi Daohui,Jiang Shaoyong,Luo Li,et al.Depositional environments for stratiformwitherite deposits in the Lower Cambrianblack shale sequence of the Yangtze Platform,southernQinlingregion,SWChina:Evidence from redox-sensitive trace element geochemistry[J].Palaeogeography,Palaeoclimatology,Palaeoecology,2014,398:125～131.

[23]. Adegoke A K,Abdullah W H,Hakimi M H,et al.Geochemicalcharacterisation of Fika Formation in the Chad(Bornu)Basin,northeasternNigeria:Implications for depositional environment and tectonic setting[J].Applied Geochemistry,2014,43:1～12.

[24]. Wang Zhengming.Geochemical indicators for diagnosing anoxic sedimentary environment[J].ActaGeologica Gansu,2003,12(2):55-58.

[25]. KIMURA H，WATANABE Y. Ocean anoxia at the PrecambrianCambrian boundary［J］. Geology，2001,29: 995～998.

[26]. Shi Zhongsheng, Chen Kaiyuan, Shi Jun,et al. feasibility analysis of applying Sr/Ba judging depositional environment[J]. Fault-Block Oil & Gas Field,2003,10(2):12～16.