WEI Zhao, DENG Xiaolin, ZHAO Yuhai and WANG Jian, 2014. Discovery of Potassium-Bearing Cuttings from the Well Yangta 4 in the Kuqa Depression and Seam Division. *Acta Geologica Sinica* (English Edition), 88(supp. 1): 265–266.

Discovery of Potassium-Bearing Cuttings from the Well Yangta 4 in the Kuqa Depression and Seam Division

WEI Zhao, DENG Xiaolin, ZHAO Yuhai and WANG Jian

Geological Institute of China Chemical Geology and Mine Bureau, Zhuozhou 072754

The world petroleum exploration suggests that, about 70% of the world's potash resources were discovered during oil and gas exploration (Zheng et al., 2007). The Kuqa depression in the Tarim basin is abundant with petroleum exploration data, and a lot of drill cutting data are available by drilling. This study detected potassium-bearing anomalies through systematic sampling of drill cuttings, and determined potash minerals through observations under microscopes, potassium tests and X-ray diffraction analysis, and then divided mineralization sections and industrial seams based on chemical analysis. It is believed that, a full use of the petroleum exploration data to carry out secondary development in the Kuqa depression is the most economic and rapid way to prospecting deep-seated potash resources.

The well Yangta 4 is located in the south Baicheng sag of the Kuqa depression, and is a wildcat well of the Tarim oilfield Company. It penetrated the Paleogene Kumugeliemu group gypsum salt rock at a depth interval of 5104~5233 m, and this gypsum salt rock has a thickness of 129 m.

This study conducted systematic sampling of drill cuttings from major salt layers in the well Yangta 4, and carried out chemical analysis to determine its potassium-bearing properties. The tested items include K, Na, Ca, Mg, Cl, SO_4, water-insoluble matter and Br, and the result shows that, it has K content ranging from 1% to 4%, with a maximum value of 7.83%.

Primary cuttings were selected to do potassium reagent test (Qu et al., 2010). As shown in Figs. 1 and 2, we obtained black copper-lead-potassium nitrate cubics in the test, which act as sufficient evidence for the presence of potassium minerals in cutting from the well Yangta 4.

X-ray powder diffraction analysis on some primary cuttings shows that (Table 1), it contains 85%~90% halite and 5%~10% sylvite, with little anhydrite and quartz. It also indicates that, the primary cuttings contain potassium salt minerals.

Microscopic observations and chemical analysis of cuttings were used to determine potassium-bearing properties of salt strata, and further to divide potassium mineralization and seams. The tested samples were from cuttings, and thus the chemical analysis was not equal to that of drill cores because the primary potassium salt may

Fig. 1. Primary cutting YT4-XH93.
The cuttings are fleshpink-maroon, angular-subangular, with a bright and clean surface.

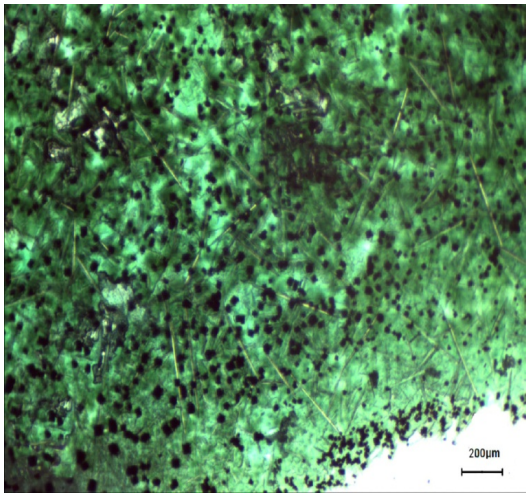

Fig. 2. Potassium reagent test of the primary cutting YT4-XH93. The black cubics are copper-lead-potassium nitrate.

* Corresponding author. E-mail: wzh_52@hotmail.com

Table 1 X-ray powder diffraction analysis of primary cuttings from the well Yangta 4

Sample number	Mineral composition and content			
YT4-XH65-a	Halite (Hal) 85-90%	Sylvine (Syl) 5-10%	Anhydrite (Anh) <5%	
YT4-XH96-a	Halite (Hal) 85%	Sylvine (Syl) 5%	Anhydrite (Anh) <5%	Quartz (Q) 5%

Note: The analysis was done by the X-ray diffraction laboratory, China University of Geosciences, and the contents are semiquantitative.

tend to lose during drilling. Therefore, we put the potassium mineralization indicators to be lower, and those having K content greater than or equal to 1.05% (i.e., KCl≥2%) and continuous thickness larger than or equal to 2 m are defined as potassium mineralization sections. Industrial grade is still in accordance with the general industrial indexes [3], i.e., those with K content greater than or equal to 2.62% (i.e., KCl≥5%) are potassium salt seams.

The potassium-bearing salt rocks from the well Yangta 4 are divided into 3 mineralization sections and 4 potassium salt. The accumulative thickness of the 3 potassium salt mineralization sections is 50 m, with an average K content of 3.05%. The upper potassium mineralization section has the greatest thickness; the middle potassium mineralization section has the highest K content, while the lower mineralization section has the lowest K content. The 4 seams have an accumulative thickness of 39 m, with an average K content of 4.20%. From the bottom to the top, the grade increases, and the fourth seam has the greatest thickness, the second seam has the highest grade.

This study conducted drill cutting analysis for the well Yangta 4, and first discovered ancient potassium seams through chemical analysis, microscopic observation, potassium reagent tests, immersion tests and X-ray powder diffraction. These results validate each other, and show a good reliability. The divided mineralization sections and seams display obvious regularity, and the main mineralization layers have a continuous thickness, with a certain scale. An in-depth investigation of potassium seams from the well Yangta 4 was further carried out, and potassium-forming regularities were explored, looking forward to provide a direction for prospecting potash resources.

Acknowledgements

This study is financially supported by the project of investigation and evaluation of potash deposits in the Cretaceous-Tertiary salt basin of the Tarim basin from potash investigation project of China Geological Survey (1212011220790). We give our heartfelt thanks to the Exploration and Development Research Institute of Tarim Oilfield Company for their help during data collection and cutting sampling. Thanks are given to academician Zheng Mianping and professor Qu Yihua for their kind help.

References

Geological and Mineral Industry Standard of the People's Republic of China, 2003. *DZ/T 0212—2002，Specification for saline lake and salt mine exploration*. Beijing: Geological Publishing House, (in Chinese).

Qu Yihua, Qian Ziqiang, Han Weitian, 2010. *Identification manual of salt minerals*. Beijing: Geological Publishing House, 9–17 (in Chinese).

Zheng Mianping, 2007. *The East China: A main target area for prospecting potash deposits*. Geological Exploration Herald, 2007-01-25(004) (in Chinese).

Table 2 Division of potash seams in gypsum sections of the well Yangta 4 (Unit: $\omega_{(B)}/10^{-2}$)

Layer	Salt rock name	Depth bottom (m)	Thickness (m)	Mineralization section K≥1.05			Depth bottom (m)	Thickness (m)	Cutoff grade K≥2.62	
				K^+	Mineralization sub-section				K^+	Seam
14	Gypsum mudstone	5141								
13	Mainly potassium salt, with gypsum mudstone	5171	30	3.71	Upper mineralization section		5157	16	3.34	4th seam
							5171	12	4.58	3rd seam
12	Mainly salt gypsum mudstone	5181								
11	Mainly potassium rock salt	5192	11	4.89	Middle mineralization section		5189	8	6.15	2nd seam
10	halite	5196								
9	Potassium salt rock	5200	4	2.41	Upper mineralization section	③				
8	halite	5204								
7	Potassium salt rock	5207	3	2.74		②	5207	3	2.74	1st seam
6	halite	5210								
5	Salt-bearing mudstone	5214								
4	halite	5216								
3	Potassium salt rock	5218	2	1.51		①				
2	Muddy salt rock	5231								
1	mudstone	5243								
Accumulative thickness			50					39		

Note: ① sampling is continuous in according with original cutting logging, and the sample length is 1 m; ② Chemical analysis was carried out in the central laboratory of Geological Institute of China Chemical Geology and Mine Bureau.