Analysis on Ore-hosting Space of Sandstone-type Uranium Deposits in Mesozoic Era of Junggar Basin

GUO Qiang, LI Ziyin and QIN Mingkuan

CNNC Key Laboratory of Uranium Resources Exploration and Evaluation Technology, Beijing Research Institute of Uranium Geology, Beijing 100029

1 Introduction

Sandstone type-uranium deposit plays a very important role in the structure of global uranium resources and is one of the four traditional industry types of uranium in China. Since 1990s, China focus mainly on the leachable sandstone type uranium deposits. A number of medium to large-sized and even super-huge sized sandstone uranium deposits are found successively in Ili, Tuha, Ordos, Erlian, Songliao and Bayingebi basin (Li Ziyin et al., 2006; Qin Mingkuan et al., 1999; Quan Zhigao et al., 2012; Wang Guo, 2002; Chen Daisheng et al., 1997; Chen Zuyi et al., 2010). Currently, the total potential resources of sandstone type uranium resource potential has ranked forefront of China's four major industrial type uranium deposits. Xinjiang, as China’s earliest areas to achieve a breakthrough in the leachable sandstone type uranium deposits, has been built to the largest uranium mine production capacity base in north China.

Of the four major basins in Xinjiang, Yili and Tuha basin have become a base for exploration of uranium resources.

As the superimposed-type sedimentary basins, Saerbuqi and Bashibulake uranium deposits in the Tarim Basin (non-situ leaching type) and the Junggar Basin, which are made late in the whole sub-Paleozoic tectonic environment to the Mesozoic-Cenozoic, locate in the structure of an environment favorable to uranium mineralization with developmental volume to a, but still are the difficult Basins that with a long way to go.

2 Different Reductant Uranium Ore Body Volume

In this paper, with the geological field study of the Junggar Basin as well as combining the previous research, we believe that has the high reduction capacity of Mesozoic sandstone in the Junggar Basin can be divided into two categories (Table 1): a protogene reducer sand body and katagenesis reducer sand body.

Table 1 The sand body types with different reducing agent and its spatial position in Mesozoic Era of Junggar Basin

<table>
<thead>
<tr>
<th>Sand Body Types with Different Reducing Agent</th>
<th>Spatial Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protogene Reducer Sand Body</td>
<td>Syngenetic Deposit or Para-syndepositional Reductant (Organic Matter &amp; Pyrite)</td>
</tr>
<tr>
<td>Katagenesis Reducer Sand Body</td>
<td>Epigenetic Cryogenic Fluid Caused by Reducer (Oil &amp; Gas)</td>
</tr>
</tbody>
</table>

In addition, there is a reductant sand body combining the two above. This type is formed by the addition of the katagenesis reducer on basis of the protogene reducer sand body, so this type of sand should be spatially recognized consistently with reducer sand body, without making a single presentation.

Mesozoic sandstone of Junggar Basin with native reductant are mainly built by coal-bearing rocks (Figure 1), mainly distributed on the mid and Lower Jurassic, of which Badaowan, Xishanyao are major coal-rich coal producing layer, which contains a lot of sand planting pole
pieces and high content of reducing native, are potentially favorable uranium ore-space; Sangonghe, Toutunhe, which are not of coal-bearing clastic rock though in the actual field survey, in which sand organic matter content is higher, is still seen more planting pole pieces. Sangonghe and bottom of Toutunhe are associated with coal layer of underlying Badaowan, Xishanyao. The coal thermal evolution expulsion phase can provide a lot of organic matter to Sangonghe and bottom of Toutunhe, making it a high reducing capacity to become favorable uranium ore-space, such as Liuhuanggou uranium point which developed in the middle Jurassic Toutunhe under paragraph, fragments are found in its gray sand bar vegetation. Geological lithology indicate that it’s a higher reducing capacity of the original sedimentary sandstone layer, in addition, 20-30m lower of it are the thick coal seam of Xishanyao, of which thermal evolution of the department provides certain hydrocarbon sand deposition substances, which increase its capacity to become favorable uranium ore-hosting space.

Epigenetic reducing sand refers to the sandstone which are mainly related to oil and gas activities to improve their capacity. Space of Oil and gas activities (migration path) is often associated with unconformity, fracture, sand transporting layer (Li Pilong et al., 2010), these three sand bodies in and around will be affected by oil and gas in the hydrocarbon migration process, which can improve their own restore the capacity to become favorable uranium ore-space (Figure 1).

Unconformity has an important role in hydrocarbon migration and accumulation process (Zhang Chengjiang et al., 2007). Meanwhile unconformity is a channel for large ground water activity, oxygenated and uranium containing groundwater enriched in uranium activities under the sand to restore the capacity to be increased in the unconformity.

AdeGang mines of southern edge Junggar Basin located at the top surface Qigu which are below Jurassic and Cretaceous unconformity, contact with the conglomerate of Qingshuihe bottom overlying Cretaceous. Qigu itself is a red clastic rocks lack of organic matter with lower reduction capacity. Field observations find that color of the top main ore body of Adelaide Qigu is gray, of which the sand is loose and largely contains clay and black bands.

Around the of gray sand, brown striped yellow oxide develop, asphalt could be found at the chalk contact Qingshuihe basal conglomerate cracks, presumably that this mine is a sand which is lack of reducing agent at the original deposit, latter, due to the presence of oil and gas transport at the unconformity surface, the light hydrocarbon group of diffuses into the unconformity sandstone body under, result in increasing the capacity reduction in the sand, then the latter activities of groundwater uranium mineralization happened.

In the active period of faults and afterwards a large-scale migration of oil and gas can occur along faults, and on both sides of the fault oil immersion occurred in these good permeability sandstone body. The reason of Urho bitumen mine at northwest margin of the Junggar Basin is due to fracture the formation of the late Yanshan movement and communication Permian reservoirs deep fracture in the rise of oil and gas migration pathways become shallow, the viscous heavy oil left in the break, after long exposed oxide formed. Among them, the light oil components go into sandstone porosity at both sides of the fracture to form the area invaded by oil and gas. The actual spectrum measurement proves the area with a

---

**Table 1: Classification diagram of the sand body types with different reducing agent in Mesozoic Era of Junggar Basin.**

<table>
<thead>
<tr>
<th>Sand Body Types with Different Reducing Agent</th>
<th>Sand Body Model with Different Reducing Agent</th>
<th>Typical Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Proterogene Reducing Sand Body</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal-bearing Limestone Formation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Katagenene Reducing Sand Body</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand Body Above and Below the Unconformity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand Body on Two Sides of the Fault</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destroyed Oil and Gas Reservoir</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand Transporting Layer of Oil and Gas</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig.1. Classification diagram of the sand body types with different reducing agent in Mesozoic Era of Junggar Basin.
uranium content of the dip up to $140 \times 10^{-6}$, which could be defined as uranium abnormal area. Presumably, as the oil and gas migration pathways, the invaded sand body of faults could become favorable uranium ore space on the basis of improving the capacity reduction capacity, uranium carried by the same or a hydrocarbon fluid surface water could be mineralized at this place.

Reservoir layer is the storage space for the oil and gas, which itself has a high reduction of capacity, a large number of oil and gas reservoirs are dissipated after the reservoir destroyed, but there is still a lot of heavy viscous oil remaining in the pores between the sand, the capacity reduction is still high, which become favorable uranium ore-space; Due to the large oil and gas through, as sand transporting layer of oil and gas, body heavy portion of oil and gas can be remained in the sands, thus greatly improve the capacity to restore sand to become favorable uranium ore-space, such as Cretaceous Urho Youshashan at the northwestern margin of the Junggar Basin, is formed in sand for hydrocarbon migration process after losing light components and heavy components residual porosity. It has high reduction capacity, the actual field measured gamma shows no abnormalities, which may be related to insufficient or late tectonic hydro geological conditions, however it is still in a favorable position in the uranium ore-space prediction.

3 Holding Ore Space Evaluation

As mentioned before, from the perspective of capacity reduction, this article divided the Junggar Basin in Mesozoic sandstone-type uranium ore-space into two major categories and 4 subcategories, taking the prediction accuracy, size and other factors into account, the favorable sandstone uranium ore-space above can be evaluated as a classification.

This article divided the beneficial sandstone uranium ore-space into three categories:

Uranium ore-space Class I: is the kind that have native reductant coal-bearing clastic sand body, this is the main target layer as the sandstone-type uranium miners for uranium, such as Yili, the Tarim Basin which are discovered in the Jurassic as large types of coal-bearing clastic sandstone-type uranium deposits (Chen Zuyi et al., 2010). Currently there has not been a big breakthrough of sandstone uranium in Junggar Basin, but due to the construction of coal-bearing rocks of the coal output, it is easier to identify and to form a certain size, nor it is lack of a reducing agent, therefore it could be the first choice as uranium exploration.

Uranium ore-space Class II: is the kind that lays under the unconformity surface and the transformation, which are destroyed to be the oil and gas sandstone reservoirs and channel sandstones. The former are formed due to the unconformity output, relatively easy to identify on the geology, but is on a relatively small scale; The latter two are often large-scale sand, because of the heavily involved in oil and gas, sand reduction capacity was greatly improved, making it a larger volume of uranium ore favorable horizons of space, but it’s difficult to identify such ore-space with a large degree. II type uranium ore-space is easier to identify the preferred unconformity type of exploration, followed by hydrocarbon accumulation mode can take advantage of the Junggar Basin, the latter two different regions of the analysis, thus reducing the difficulty of exploration.

Uranium ore-space Class III: is the kind that at the transformation of oil sand on both sides of the fault, this type is less common with small scale and are difficult to identify, thus it should be the last goal of exploration.

References