Contribution ID: **31** Type: **ORAL**

VOLCANIC TYPE URANIUM DEPOSITS IN NORTH CHINA

Tuesday, June 26, 2018 9:20 AM (20 minutes)

INTRODUCTION

Volcanic type uranium deposit is one of the four largest kind of uranium deposits in China (volcanic type, granite type, sandstone-hosted type and Carbonaceous-Siliceous-Argillaceous Rock Type), and is play an important role in uranium resources. In 90s of last century, before the large-scale application of In-situ Leaching technology (ISL) in sandstone-hosted type uranium deposits, volcanic type uranium deposit was one of the main targets for exploration and exploitation in China. Uranium reserves in volcanic and granite type deposits account for 61% of China's total reserves[1]. As far as 2015, the volcanic type uranium still occupied 35.48% of the annual output[2]. It is different from granite type uranium deposits are mainly developed in southern China and sandstone type uranium deposits are mainly developed in northern China, volcanic type uranium deposits have been found in both southern and northern China. Southern China represented by Gan-hang uranium metallogenic belt, Northern Chinese represented by Guyuan-Hongshanzi uranium metallogenic belt and Qinglong-Xingcheng uranium metallogenic belt. In the two metallogenic belts of northern, there are 17 volcanic type uranium deposits and more than 100 mineralized points have been found, which are the important uranium-mining and production area in China.

TYPICAL URANIUM DEPOSITES

Guyuan-Hongshanzi uranium metallogenic belt and Qinglong-Xingcheng uranium metallogenic belt are located in northern margin of the North China Craton (NCC) uranium polymetallic metallogenic province of the circum-Pacific metallogenic zone[3]. The former is located in the middle section of northern margin of NCC, and the latter is located in the eastern section of the northern margin of NCC. According to the characteristics of ore-bearing rock and ore-controlling structures, volcanic type uranium deposits can be divided into 5 subtype[4], namely volcanic breccia subtype, sub volcanic subtype, dense fracture zone subtype, interlayer fracture zone subtype and pyroclastic rocks subtype. The volcanic type uranium deposit in north China is mainly composed of sub volcanic subtype and pyroclastic rocks subtype, Zhangmajing deposit, Daguanchang deposit and Hongshanzi deposit in Guyuan - Hongshanzi uranium metallogenic belt as the representative for sub volcanic subtype, and Gangou deposit and Dayingchang deposit in Qinglong- Xingcheng uranium metallogenic belt as the representative for pyroclastic rocks subtype. The geological characteristics of the typical uranium deposits are briefly introduced as follows:

Zhangmajing uranium deposit is located in the north edge of Zhangmajing volcanic collapse depression in Guyuan volcanic basin, the southern part of Zhangmajing - Hongshanzi uranium metallogenic belt, and controlled by Sub volcanic type crater. The ore bearing rock is potassium rhyolite, the fifth layer in the third lithology of Zhangjiakou group upper Jurassic and rhyolitic porphyry (main ore host rock). Zhangmajing uranium deposit is a typical sub rhyolite porphyry uranium-molybdenum deposit. It is the product of multiphases of volcanic magmatic hydrothermal geological events that happened in late Jurassic, early Cretaceous and Paleogene-Neogene, the mineralization age are 122Ma, 89Ma and 23.7Ma.

Daguanchang uranium deposit is located in the south edge of Daguangchang volcanic collapse depression in Guyuan volcanic basin, the southern part of Zhangmajing - Hongshanzi uranium metallogenic belt, and controlled by Subvolcanic type crater. The ore bearing rock is potassium rhyolite of volcanic effusive facies (main ore host rock), Zhangjiakou group upper Jurassic and rhyolitic porphyry of volcanic intrusive facies.

Daguanchang uranium deposit is a typical cryptoexplosion potassic rhyolite type uranium-molybdenum deposit. It is a product from multi-phase of volcanic magmatic hydrothermal geological events happened in early Cretaceous and Paleogene, and the mineralization age is 67Ma and 30Ma.

Hongshanzi uranium deposit is located in the west and east edge of Hongshanzi volcanic collapse depression where rhyolitic porphyry and granite porphyry distribution as ring, the northern part of Zhangmajing - Hongshanzi uranium metallogenic belt, controlled by the contact zone of Subvolcanic type crater. The ore bearing rock is trachyte in middle Manketouebo group upper Jurassic and rhyolite porphyry. Hongshanzi uranium deposit is a typical contact zone of subvolcano controlled - volcanic hydrothermal type uranium deposit. It is the product of multi-phases of Volcanic magmatic hydrothermal geological events that happened in late Jurassic, and early Cretaceous, and the main metallogenic age is 156Ma, 120 ˜ 130Ma.

Gangou uranium deposit is located in the south edge of Gangou middle Jurassic volcanic fault basin, eastern of Qinglong-Xingcheng uranium metallogenic belt. The ore bearing rock is Sedimentary pyroclastic rock formation of Middle Jurassic Haifanggou group, there were strong mafic and alkaline volcanic magmatic activities in the stage of mineralization. Gangou deposit is a typical volcanic hydrothermal fluid and meteoric water mixed type uranium deposit, it is the product of of multiple geological evolution with syndepositional pre enrichment and multi-stage volcanic hydrothermal fluid superimposed meteoric water mineralization, main metallogenic age is 121Ma and 76Ma.

Dayingchang uranium deposit is located in the magmatic active belt of the intersection area of the NE-trending Hongluoshan-Wuzhishan regioanl fault and EW-trending Qinglong-Jinxi regional fault, in the western part of Qinglong-Xingcheng uranium metallogenic belt. The ore bearing rock is medium-coarse grained quartzite in Middle Proterozoic Changzhougou group, Jurassic acid granitic and basic magmatic activities are the main causes of mineralization. Dayingchang uranium deposit is a typical multiple volcanic magmatic hydrothermal superimposed uranium deposit. The uranium mineralization is characterized by contemporaneous sedimentary preconcentration and volcanic magmatic hydrothermal overlap. The main metallogenic epoch is late Jurassic to early Cretaceous (142Ma ˜ 123Ma).

DISCUSSION AND CONCLUSION

Through comprehensive study of geological and mineralized characteristics of several typical uranium deposits, the volcanic type uranium deposits in North China are characterized by the following:

(1) Metallogenic geological background: in general, the volcanic uranium deposits occur on the paleo-landmass, especially on the edge of the paleo-landmass. The continental volcanic eruption belt dominated by acidic (or partial alkaline) volcanic rocks is the main production environment. Volcanic type uranium deposits often occur in the composite parts of regional faults and volcanic basins formed by multi-stage volcanic activities.

(2) Metallogenic epoch: all uranium deposits have the characteristics of multistage superposition and mineralization. Paleoproterozoic, large-scale potassic migmatization in north margin of NCC caused preliminary enrichment of uranium, formed the mainly uranium source layer in North China. Multi stage volcanic hydrothermal activity in late Jurassic to early Cretaceous is the main heat source and power for activation and migration of uranium mineralization. The intermediate-mafic volcanic magmatic activity in Paleogene Neogene is important to superposition activities for mineralization. The age of main ore mineralization is concentrated in 156˜120Ma, 89˜67Ma, 30˜23.7Ma.

(3) Mineralizing characteristics: Coexisting and associated minerals is commonly existed in volcanic uranium deposits in North China. Guyuan - Hongshanzi Uranium metallogenic belt is mainly characterized by uranium - molybdenum mineralization, even the intensity and range of molybdenum mineralization were greater than uranium, such as Zhangmajing deposit, the reserves of molybdenum are more than 100 000 tons, far greater than uranium reserves (8000 tU). From the southern section of Zhangmajing uranium deposit, Daguanchang uranium deposit to the northern section of the Hongshanzi uranium deposit, Guangxingyuan uranium deposits, uranium minerals are mainly pitchblende and coffinite, but molybdenum-bearing mineral changed from jordisite into molybdenite. The temperature from fluid inclusions show that the main metallogenic temperature of Guyuan area concentrated in the 137.7 ˜ 217.7℃, and metallogenic temperature of Hongshanzi area concentrated in 218 ˜ 275℃, Ore forming temperature increased obviously from south to north. Qinglong - Xingcheng uranium metallogenic belt is mainly single uranium mineralization type, but it is also associated with a small amount of Mo, Pb, Zn, Cu, Ag and other metallic minerals[5]. Uranium is dominated by dispersed as adsorption states, uranium bearing minerals are secondary, are mainly pitchblende, with a small amount of uraninite and secondary uranium minerals.

(4) Ore controlling factor: Neoproterozoic - paleoproterozoic potassic migmatitic granite basement; Mesozoic uranium rich volcanoclastic rock, volcanic rock and sub volcanic rock; late Jurassic volcanic-sedimentary basin, volcanic collapse basin and volcanic apparatus, such as caldera structure, volcanic dome structure, volcanic collapse. This entire three are the major controlling factors of volcanic type uranium deposits in North China, and with regional faults together to control the location and scale of uranium deposits. The uranium deposits in Qinglong-Xingcheng uranium metallogenic belt is controlled by layer in general and the uranium ore bodies are stratified and lenticular, the occurrence of ore bodies is in accordance with the formation of the

strata. The uranium deposits in Guyuan-Hongshanzi uranium metallogenic belt are controlled by volcanic or sub volcanic rock and tectonic obviously, the ore bodies mainly as disseminated or veins. The host rock in both of two belts, is not given but is diversify, such as volcanoclastic rock, rhyolites, trachyte and rhyolite porphyry.

(5) The ore-forming fluid mainly originated from mantle: Isotope research indicate that the ore-forming fluid of Guyuan - Hongshanzi uranium metallogenic belt consists of little change of Pb isotope, 206Pb/204Pb = 16.857 ˜ 19.934, 207Pb/204Pb = 15.413 ˜ 15.726, 208Pb/204Pb = 37.596 ˜ 38.904, it is mainly between the mantle and lower crust or orogenic belt, more closely to mantle. Sr isotopic ratios (87Sr/86Sr)i = 0.707 ˜ 0.727, Between the depleted mantle (0.7022 ˜ 0.7035) and the upper crust of North China (0.7120 ˜ 0.7200), it has a very low Sr content (14.7×10-6 ˜ 19.8×10-6), which is close to the content of Sr in depleted mantle, indicating that ore-forming fluid has the characteristics of mantle source. δ34S of pyrite in Gangou deposit varied from 1.2% to 5.7%, close to the sulfur isotopic composition of meteorite. La/Yb - ∑REE diagram shown the lithology belong to continental alkali basalt series, suggesting that the sulfide (also metallogenic material) mainly derived from the upper mantle.

(6) Metallogenic regularity: Since Mesozoic, volcanic activity was frequent in North China, and as a regularity of basic ˜ intermediate acid ˜ basis, intrusion ˜ eruption and multi cycle activities in general. Uranium polymetallic deposits are mostly produced in transition zone of gravity high field and low field. The deposits are characterized by structure (include faults and volcanic structures) and sub volcanic rock controlled, reducing ore-forming fluids with high temperature and high pressure derived from mantle, superimposed alteration are development and associated with Mo, Pb, Zn, Ag and other elements. Uranium is enriched in late melts or fluids, and the age of mineralization is later than the intrusive age of the related rock masses[6]. All of above reflect the typical characteristics of hotspot uranium metallogenesis[7], the uranium mineralization may be related to the mantle plume activities in North China.

In conclusion, the volcanic type uranium deposits in North China have similar metallogenic epoch, metallogenic regularities, genesis and characteristics, which may be related to the same tectonic settings, indicating that the northern margin of NCC has undergone concerted and relatively large-scale volcanic uranium mineralization activities since Mesozoic era.

REFERENCES

[1] Shen Feng. Characteristics of Uranium Resources and Prospecting Direction in China. Uranium Geology, 3(1989):129-133 (in Chinese)
[2] NUCLEAR ENERGY AGENCY and INTERNATIONAL ATOMIC ENERGY AGENCY, 2016. Uranium 2016: Resources, Production and Demand.
[3] Huang ZX, Li ZY and Cai YQ, Metallogenic model of the Uranium deposits in Guyuan area, China. 1146. Abstract 35th International Geological Congress, Cape Town, South Africa (2016).
[4] BEIJING RESEARCH INSTITUTE OF URANIUM GEOLOGY. Evaluation of the potential for volcanic uranium deposits in China. 2011.
[5] Li Haidong, Zhong Fujun, Zhang Zhiyong, et al. Characteristics and significance of uranium polymetallic combination in volcanic uranium deposits in China. Mineral Resources and Geology 293 (2015):283-289. (in Chinese)
[6] Zhixin Huang, Ziying Li and Zhaoqiang Wang. Hotspot uranium metallogenesis in North Heibei province, China. Acta Geologica Sinica, 88 S2 (2014):1360-1361.
[7] Li Ziying. Hostspot uranium metallogenesis in South China. Uranium Geology, 222 (2006): 65-69. (in Chinese)

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Session Classification: Applied Geology and Geometallurgy of Uranium and Associated Metals

Track Classification: Track 3. Applied geology and geometallurgy of uranium and associated metals