Energy Metal Lithium Research: Based on the Weilasituo Lepidolite and the Dahongliutan Spodumene Deposits

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Abstract. Lithium has very active chemical properties and is widely used in various fields. It is known as “the energy metal of the 21st century”, so we paid more attention on it. Basic characteristics and exploration progress of the Weilasituo lepidolite deposit and the spodumene ore deposit in the Dahongliutan area are introduced in this paper, in order to have a deep research for lithium. The discovery of these special large lithium deposits have brought new attention to the research of granite pegmatite type lithium ore at north China. The group took the rare metal mining right of the Dahongliutan, which costs 2 billion yuan, so we need get more information for future exploration.

1. Introduction
Lithium has very active chemical properties and is widely used in various fields. It is known as “industrial monosodium glutamate”, “the energy metal of the 21st century” and “white oil”. In recent years, with the rapid development of the lithium industry market driven by the high-tech industry, the strategic position of lithium has gradually become prominent. Only in the past five years, the global investment in lithium exploration has increased by 50 times, and lithium has become the focus of global competition. Although China’s lithium resources are very rich, they are limited by lithium extraction technology and have a high dependence on foreign countries. Therefore, in addition to strengthening exploration in China, it is necessary to learn from the experience of foreign mining companies and provide certain reference for Chinese mining companies to “go global” in combination with the investment of Chinese enterprises in local areas. New discovered lithium deposits at northern China are the Weilasituo lepidolite and the Dahongliutan spodumene deposits.

2. Type of Lithium Deposit

2.1. Main Lithium Bearing Minerals
Lithium is a kind of silver white rare metal element. Among all the metal elements, the density of lithium is the smallest, only 0.534g/cm³, which is 1/5 of the density of so-called “light metal” aluminum. The abundance of lithium in nature is relatively large. At present, there are about 150 kinds of lithium minerals and lithium bearing minerals found in the world, mostly in the form of silicates and carbonates. The most exploited lithium ore resources are spodumene, spodumene, tremolite and lepidolite [1] (table 1). Among them, spodumene is the main ore for extracting lithium at present, which has a high grade and does not contain fluorine. About 30% of the lithium extracted from the ore
every year comes from spodumene, such as Sichuan Jiajika, Inner Mongolia Weilasituo, Xinjiang Dahongliutan deposits and other large-scale lithium deposits.

### Table 1. Main bearing lithium minerals.

| Minerals            | Chemical formula | Crystallography system | Li (%) | Proportion (g/cm^3) | Hardness | Colours                        |
|---------------------|------------------|------------------------|--------|---------------------|----------|--------------------------------|
| Spodumene           | LiAl(Si_2O_6)    | Monoclinic             | 3.7    | 3.2                 | 6.5-7    | White, grey, yellow, green, pink, colourless |
| Limonite (Li,Na)Al(PO_4)(F,OH) | Monoclinic triclinic | 4.7    | 3.0                | 5.5-6    | White, yellow, grey, colourless |
| Lithium permeable feldspar | LiAl(Si_4O_10) | Monoclinic             | 2.3    | 2.4-2.5             | 6-6.5g   | Grey, yellow, colourless        |
| Lepidolite          | K(Li,Al)_3(Si,Al)_4O_10(OH,F)_2 | Monoclinic | 3.6    | 2.8-2.9             | 1.55-1.59 | White, grey, pink, yellow, colourless |
| Lithium nepheline   | LiAlSiO_4        | Monoclinic             | 5.5    | 2.7                 | 6.5      | Brown, white, colourless        |
| Jadarite            | LiNaSiB_3O_7(OH) | Monoclinic             | 3.4    | 2.45                | 4-5      | White, porcelain                |

### 2.2. Main Types of Lithium Deposits

Due to the different classification standards of predecessors, there are some differences in the classification of lithium ores [2-7] (table 2). But generally speaking, the global lithium resources mainly come from pegmatite type and salt lake type lithium. The ore mineral is a new mineral containing lithium and boron at the same time, jadarite. The discovery of this special large lithium ore has brought new attention to the research of sedimentary lithium ore, and it also has the potential of independent mining. Therefore, based on previous studies, this paper divides lithium deposits into three types: granite pegmatite type, Salt Lake (brine) type and sedimentary type.

### Table 2. Summary of main classification types of lithium deposits.

| Date | Classification types | Reference |
|------|----------------------|-----------|
| 2009 | continental Salt Lake type, geothermal brine type, oilfield brine and lithium rich clay type, Pegmatite type, exogentic type (dolomite type, magmatic hydrothermal type, granite pegmatite type and granite type), endogenetic type (brine type and salt lake brine type) and endogenetic and exomorphic type (granite weathering crust type). | [2] |
| 2014 | brine type (salt lake brine type, underground brine type), hard rock type (granite pegmatite type, granite type) | [3] |
| 2017 | | [4] |

Lepidolite-type pegmatite usually produces tantalum-niobium (Ta-Nb) resources, however, the role of the hydrothermal fluid in the Ta-Nb mineralization remains controversial.

As a strategic key metal mineral, lithium exploration and research has become a hot spot in mineral exploration and geoscience. The newly discovered lithium deposit in the Weilasituo, Chifeng, Inner Mongolia, has its unique ore-forming element assemblage and its close spatial-temporal distribution.
relationship with Precambrian metamorphic rocks and Phanerozoic high-resolution and different granites, indicating that it is probably the product of the interaction between the reconstruction of deep-seated magma and the activation of ancient continental blocks. The structural trace activation of ancient continental blocks provides space conditions for the emplacement of diagenetic (ore) materials, the material reconstruction of deep crust lays the material foundation for the formation of the rock (ore) bodies, and the superimposition and transformation of Phanerozoic high-resolution and different granites on the ancient continental blocks is the key factor leading to the formation of multi-element deposits such as lithium tin copper. Therefore, the highly differentiated granite is the necessary condition for mineralization, and the superimposition of alteration and metasomatism is the sufficient condition for mineralization. It is an important scientific way to reveal the metallogenic regularity of lithium deposits in Great Xing’an area by identifying and searching for highly differentiated granites, finding out the favorable deformation position of the ore belt, revealing the time-space coupling, restriction and interaction of metamorphism deformation magma deep melting mineralization, reconstructing the law of lithium resource enrichment and preservation in the process of orogeny and establishing the metallogenic dynamic model. Although it is believed that the Xilinhot block is an important concentration area of metal mineralization, and the deposits are closely related to Precambrian metamorphic rocks and Phanerozoic granites in time and space, it is difficult to explain the occurrence environment, geological characteristics and formation mechanism of these deposits, especially their unique lithium tin ore-forming elements combination, by applying the traditional metallogenic theory. The key scientific problems in the study of metallogenic theory focus on the following aspects: (1) why a series of lithium tin bearing metallic deposits occur in Xilinhot block? (2) the activation of early crustal structural belt is Does the formation of Phanerozoic intrusive rocks and related deposits provide spatial or dynamic sources? (3) what is the relationship between metamorphic blocks, highly differentiated granites and these deposits? Is it inheritance and evolution, or superimposition and transformation? (4) is lithosphere reworking rock The formation of ore bodies and related deposits provides material sources. How do they enter the crust? (5) what are the constraints of the activation of preexisting structures in the crust and the reconstruction of the lower crust and mantle on the metallization? (6) high differentiation does not necessarily mean high water content. Where does a large amount of water beneficial to mineralization come from? This study will answer the above questions and objectively explain the origin of lithium deposits in this area.

3. The Weilasitu Lepidolite and the Dahongliutan Spodumene Deposits
As a strategic key metal mineral, lithium exploration and research has become a hot spot in mineral exploration and geoscience. Lithium belongs to “energy metal” and “high energy metal”. The research on the metallogenic law and lithium isotope of lithium energy metal is an important development trend of deep exploration of lithium energy metal mineral resource base. In 2017, a large-scale dolomite type lithium polymetallic deposit was found in the cryptoexplosive breccia tube of the Weilasitu mining area, the Keshiketeng, Chifeng, Inner Mongolia. Cain explosive breccia tube is generally a fine and thick column with an extension of 247 m, an extension of 640 m and a vertical height of 480 m. It is inclined to the northwest and faces to the South with a sideward angle of about 76 °. The cross section is an ellipse with a long axis strike of nearly 30 ° and a diameter of 140-300 M. The edge of the cryptoexplosive breccia tube is developed with fracture zone, and the inner part is developed with crushed breccia zone and blasted breccia zone. The whole rock of the crushed and blasted breccia zone is mineralized, and the main ore-forming elements are lithium and rubidium, and the associated beneficial components are niobium, tantalum, beryl, lithium, cesium, tin, tungsten, molybdenum, copper, zinc, etc. The Li2O grade is between 0.8% and 3.6%, the average grade is 1.25%, the Rb2O grade is between 0.1% and 0.58%, and the average grade is 0.35%. It is the first large-scale greisen type lithium deposit discovered in Inner Mongolia, with the amount of Li2O metal 600000 tons. This exploration breakthrough has important guiding significance for the exploration of lithium deposits in Daxinganling area [8]. The large vein tin tungsten zinc molybdenum orebody in the Weilasitu is distributed in the north-east direction, occurrence is 115 ° ∠ 30 °, controlled by the C structural plane.
of the S-C fabric in the high strain zone. The ore-forming parent rock is the concealed albitization Tianhe Petrochemical fine-grained porphyritic alkali feldspar granite body in the deep part of the mining area.

The Dahongliutan lithium lies at Xinjiang. The exposed strata of the mining area are Triassic Bayan Karashan group (TB) and a small amount of Quaternary System, which are distributed from northwest to Southeast. The exposed rocks are mainly biotite quartz schist, mica quartz schist and mica schist. The southwest is intruded by Permian mica monzogranite, and the northwest is intruded by Jurassic biotite granite. The south of Dahongliutan lithium beryllium deposit is located in the pegmatite vein of the internal and external contact zone of the mica monzogranite. The main ore body trend is NW trending, with a dip angle of 53°-77°. The ore body is 930-1300 m long, with an average thickness of 1.53-8.67 m. The average Li2O grade of the ore body is 0.485. The biggest highlight of the project of the West Gold Ltd Co. is to define a 600 km long MUJI Dahongliutan rare metal metallogenic belt, and propose that the potential of Xinjiang Kunlun Karakorum rare metal resources can completely match the Western Sichuan rare metal metallogenic area. In future, with the rapid development of the lithium industry market driven by the high-tech industry, the strategic position of lithium will gradually become prominent [9, 10].

4. Conclusions
Lithium has been widely used in various fields. It is known as “the energy metal of the 21st century”, so we paid more attention on this mental. We study the characteristics and exploration progress of the Weilasituo lepidolite deposit and the spodumene ore deposit in the Dahongliutan, think that they are important style a among three types. The cryptexplosive breccia tube is main target for exploration lithium at Weilashituo district. The discovery of these special large lithium deposits has brought new attention to the research of granite pegmatite type lithium ore at north China. The Dahongliutan deposit is first choice from its economic geology for our Group Company.

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