Duolong ore concentrated area, located in the west of the famous Bangong Lake-Nujiang River metallogenic belt, was discovered in 2000, and attracted extensive concern both in home and abroad for its special structural setting, metallogenic geological conditions and advantaged ore resource superiority.

Numerous scholars have made studies the ore-bearing intrusion on lithogeochemistry, isotope geology and deposit geology. This paper mainly focus on study of fluid inclusions and ore-forming fluid from the ore deposit, aims to provide concrete data for analysis of thermodynamic conditions of mineralization and genesis of ore deposit.

1 Ore Deposit Geology

Duobuza and Bolong porphyry copper deposits were typical example occurred in the Duolong ore concentrated area. Marine deposition of the Quse Formation of Lower Jurassic and the epimetamorphic Sega Formation of Middle Jurassic are ore-host strata widely distributed in the ore concentrated area. Well developed faults of east-west direction, northeast direction and northwest direction controlled the distribution of rock bodies and ore bodies and obviously possessed multi-stage deformation activity.

Ore bodies occurred in porphyry and the main types of ore-bearing rock bodies were monzonitic granite (γπη), granite porphyry (γπ), granodiorite-porphyry (όδπιγι), shaped as lentiform, nervation, vesiculate and other irregular forms. Wall rock alteration of potassic alteration, sericitization, chloritization, silicification and carbonatation were widespread near ore bodies. Mineralization was characterized by veinlet disseminated copper with copper pyrites, pyrite, magnetite as primary metallic minerals and bornite, molybdenite, galena, blende, hematite as subordinate metallic minerals. Zircon U-Pb dating from ore-bearing porphyry of Duobuza copper deposit and Bolong copper deposit yielded ages of 120.9~121.6±1.9Ma (Li JingXiang et.al, 2008) and 119.4±1.3Ma (Zhu Xiangping et.al, 2011) respectively, and the Re-Os isochron age of molybdenite was 118.0±1.5Ma (Yu Hongquan et.al, 2009).

2 Fluid Inclusion

The fluid inclusions in ore-bearing quartz vein were isolated or clustered and the size of inclusions was uneven, changing from 5 to 25μm. Most of the inclusions were spherical shaped, and some of them were irregular, reflecting the characteristics of hydrothermal solution mineralization. Based on the vapor liquid ratio and homogeneous mode, the fluid inclusions can be divided into gaseous phase inclusion, gas-liquid two phase inclusion, multiphase inclusion contained daughter minerals. Of the fluid inclusions, gas-liquid two phase inclusion, multiphase inclusion contained daughter minerals. Of the fluid inclusions, gas-liquid two phase inclusions with large gas-liquid ratio of 10-35% were the major inclusion type, accounts for over 60% of the total, indicating hypabyssal mineralization condition of the porphyry. Multiphase inclusions containing daughter minerals, such as saline minerals and hematite, account for nearly 50% of total, revealing high salinity of ore-forming fluid.

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Homogenization temperature and salinity were measured from the inclusions by Linkam THNSG600 freezing and heating stage. 4 samples from the Bolong ore deposit were tested and 26 homogenization temperature data and 7 salinity data were obtained. In fact, the homogenization temperature of mineralization ranged from 212°C to 551°C, with an average temperature of 372°C, the salinity of ore-bearing fluid changed from 12.42 to 79.61 wt%NaCl, with an average salinity of 40.47 wt%NaCl, and the density was 1.068 ~ 1.227 g/cm³. 3 samples from the Duobuza ore deposit were tested, 24 homogenization temperature data and 6 salinity data were acquired. It was showed that the homogenization temperature of mineralization changed from 211.6 to 510.7°C, with an average temperature of 372°C, the salinity of ore-bearing fluid ranged from 9.34 to 61.88 wt%NaCl, with an average salinity of 35.49 wt%NaCl, the density was 1.073 ~ 1.227g/cm³.

The data from the fluid inclusions revealed that the metallogenic environment of Duolong porphyry copper deposit was a relative open system. The value of pressure from inclusion belonged to hydrostatic pressure, corresponding to hypabyssal genesis with the lowest metallogenic depth of 1200m ~ 2200m (Yu HunQuan, 2006).

### 3 Ore-forming Fluid

The compositions of liquid phase from ore-forming fluid (tested by Central South Mineral Resource Supervision Test Centre, Ministry of Land and resources, 2014) were mainly Na⁺, K⁺ and Ca²⁺, Mg²⁺ took the second place (Table 1). K⁺/ Na⁺ was 0.378~1.869, Ca/K was 0.019~0.57. Ore-forming fluids belonged to NaCl-KCl-CaSO₄-H₂O system, a hydrothermal solution rich in halogen and alkalis. The compositions from inclusions were in accordance with wall rock alteration. Ore-forming fluid was rich in alkalis which were extremely favourable for mineralization. Compositions of ore forming fluid of the Duolong ore concentrated area were similar to those of Yulong copper deposit, rich in Cl⁻, SO₄²⁻, Na⁺, K⁺, H₂O etc., migrated in the form of Cl complex.

Ore-forming fluid was characteristic of magmatic hydrothermal solution with high temperature, high salinity and high density. Its hydrothermal system was supposed to be NaCl+KCl±CaSO₄+H₂O one, likely rich in ore-forming elements of Mo, Fe, Cu, Ti etc.

### Table 1 Compositions of fluid inclusions, Duolong ore concentrated area

<table>
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<th>Sample No.</th>
<th>DB15</th>
<th>DB11</th>
<th>BB7</th>
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<tr>
<td>Homogenization temperature (℃)</td>
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<td>244~416</td>
<td>246~341</td>
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<tr>
<td>Gas composition (10⁻⁶)</td>
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<td>Mg²⁺</td>
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<td>Ca²⁺</td>
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<td>K⁺</td>
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<tr>
<td>F⁻</td>
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</tr>
</tbody>
</table>

### 4 Discussion Conclusion

The fluid inclusions of Duolong ore concentrated showed typical porphyry characters. The great disparity of vapour liquid ratio from gas-liquid inclusion coexisting with daughter mineral indicated that rapid depressurization in ore-forming fluid occurred for a time and the fluid inclusion was in multiple pressure status, characteristic of two kinds of minerogenetic conditions, relative closed and relative open system.

Contribution of underground water to ore-forming fluid was limited because of rarely developed liquid phase inclusion, middle-low temperature and low salinity inclusions. Meanwhile, the existence of high temperature, high salinity, high density, high vapour liquid ratio, and daughter mineral containing inclusions suggested that the ore-forming fluid was originated from magmatic hydrothermal solution.

The composition of ore-forming fluid was characteristic of middle-high salinity hydrothermal solution, rich in halogen and alkalis, typical of porphyry copper deposit.

High concentration of K⁺ in fluid was favourable for mineralization of porphyry copper deposit, resulted in wall alteration of alkalis and molybdenite mineralization. Testing results of homogenization temperature from the
inclusions indicated that formation temperature of the deposit was middle to low one; and the deposit belonged to porphyry copper deposit.

References