An overview on the characteristics and origin of iron-oxide copper gold (IOCG) deposits in China

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Distributions of IOCG or IOCG-like deposits in China

- Kangdian metallogenic province
- Northern margin metallogenic belt of East Junggar
- East Tianshan metallogenic belt
- Middle-lower Yangtze metallogenic belt
- Baiyunbo deposit in Inner Mongolia province
- Shilu deposit in Hainan province

(Chen et al., 2019)
Kangdian metallogenic province

- Located in the southwest margin of the Yangtze Craton, from Yuanyang in the south to Huili in the north, and across southern Sichuan and northern Yunnan.

- Meso-proterozoic strata: Kunyang Group; Huili Group; Julin Group.

- Paleo-proterozoic strata: Dongchuan Group; Dahongshan Group; Hekou Group.

- Neoproterozoic intrusion: Granite; Diorite; Gabbro.

- Regional tectonics: Luzijiang fault belt; Ailaoshan-Red River fault belt

- Typical deposits: Lala deposit; Yinachang deposit; Dahongshan deposit.

- Feature:

  The ore bodies of each deposit are obviously controlled by tectonics, and most of them are lenticular and stratiform.

  The ore bodies in many deposits are closely related to hydrothermal breccia in space.

  Most of the deposits have no obvious spatial symbiosis with contemporaneous intrusive rock.

  The ore minerals are iron oxides (magnetite/hematite) and copper sulfides (chalcopyrite, bornite)

  The early regional sodiumization, Fe-Na-(Ca) alteration in the Fe mineralization stage, and potassium and carbonation in the Cu mineralization stage.

(Zhou et al., 2014)
Lala deposit

Geological Feature | Feature Description
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Ore-controlling tectonics | The deposit is controlled by Hongnipo syncline-the secondary tectonics of Hekou duplex anticline, basement faults and volcanic edifice, distributed in the contact zone between sodium volcanic rock and gabbro body.

Wall rock | Luodang Formation (second section), Hekou Group in Paleoproterozoic. The lithology is imandrite, mica quartz schist, garnet biotite quartz schist and banded iron formation.

Magmatic rock | Gabbro, granite porphyry and small amount of diorite dikes and lamprophyre dikes.

Metamorphic degree | High green schist facies, up to epidote amphibolite facies

Size and shape of the ore body | Main ore body is about 1,000 m long, thicker than 20 m, middle and small ore body is 100-1,000 m long and 7-20 m thick. In stratiform, stratiform-like and lenticular structure.

Ore minerals | Chalcopyrite, pyrite, magnetite, bornite, chalcocite, cobaltite

(Zhou et al., 2014)
Yinachang deposit

<table>
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<tr>
<th>Geological Feature</th>
<th>Feature Description</th>
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<tr>
<td>Ore-controlling tectonics</td>
<td>The regional tectonics is north-south Luzijiang fault zone, the deposit is located in the combination of north-south tectonics and east-west tectonics.</td>
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<td>Wall rock</td>
<td>Middle upper part of Yinmin Formation (Pty), Dongchuan Group. The lithology is garnet biotite schist, biotite schist. The protolith is mainly alkaline trachyandesite.</td>
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<td>Magmatic rock</td>
<td>The intrusive rock in the mining area is relatively complex. It can be divided into 3 phases: 1, Proterozoic porphyry, subvolcanic rock; 2, Jingningian gabbro and diabase which are vein and bedrock, intrude into Yinmin Formation and Etouchang Formation, 3 Yanshanian diabase dyke.</td>
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<tr>
<td>Size and shape of the ore body</td>
<td>The deposit is divided into 8 ore sections and all of them are located in the middle-upper part of Yinmin Formation. The ore body is layered and lenticular. Generally, it is 400-700m long, with a maximum length of over 1,000 m, 3.93~4.31m thick and 200m wide.</td>
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<td>Texture and structure of ore</td>
<td>There are two types of ores, including iron and copper ores (block-shaped, stratiform-like, stripped and disseminated) as well as single copper ores (copper-bearing dolomite, copper-bearing schist ore). The ore structure is mainly heteromorphic and idiomorphic grain structure, with metasomatic and variegated structure.</td>
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<td>Ore minerals</td>
<td>Magnetite, siderite, chalcopyrite, pyrite and a small amount of chalcocite, cobaltite, arsenopyrite, galena, chromite and bornite.</td>
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<td>Gangue minerals</td>
<td>Quartz, fluorite, apatite, tremolite, diopside, dolomite, biotite, albite and almandine, as well as rare earth minerals include bastnasite, monazite, erium apatite and allanite.</td>
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</table>

(Hou et al., 2013)
### Dahongshan deposit

**Geological Feature** | **Feature Description**
---|---
Ore-controlling factors | The regional tectonics is Ailao Shan-Red River fault and luzijiang fault. The mining area is mainly controlled by east-west tectonics. The ore body is controlled by volcanic cycle and volcanic mechanism.

Wall rock | Manganghe Formation and Hongshan Formation, Dahongshan Group. The lithology is mainly albite breccia-clastic rock, metasandstone-marble and garnet mica schist

Magmatic rock | Gabbro, Quartz albitite

Metamorphic degree | High green schist facies-low amphibolite facies, up to epidote amphibolite facies

Size and shape of the ore body | Main ore body is longer than 7,000 m, 200-1,500 m wide with the average thickness of 8.65~11.42 m, in stratiform and stratiform-like structure.

Ore minerals | Include large amount of chalcopyrite and magnetite, some pyrite, hematite, siderite and bornite as well as bare molybdenite and cobaltite.

Gangue minerals | Gangue mineral is mainly composed of albite, quartz, biotite, chlorite and dolomite as well as very few apatite, tourmalinite and rutile.

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(Chou et al., 2014)
# A brief comparison of Kangdian IOCG deposits

<table>
<thead>
<tr>
<th>deposit name</th>
<th>deposit scale</th>
<th>Wall rock</th>
<th>Main metallogenic stages and alteration types</th>
<th>Main element combinati on</th>
<th>Ore-forming fluid</th>
<th>Source of ore-forming metals</th>
<th>Tectonic background</th>
<th>reference</th>
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<tr>
<td>La la</td>
<td>200 million tons of ore，13% Fe，0.92% Cu，0.031% Mo，0.022% Co，0.016g/t Au，1.8g/t Ag</td>
<td>Metavolcanic sedimentary rock series</td>
<td>Premetallogenic alteration: albitization，scapolitization；Magnetite stage: actinolitization，Chloritization；Copper polymetallic stage: carbonatization，potash feldspathization，micasization</td>
<td>Fe+Cu+Mo+Au+Co+REE</td>
<td>magmatic hydrothermal fluids + Atmospheric precipitation</td>
<td>Fe，Cu，Mo may be mainly derived from magma，while REE may be derived from surrounding rock</td>
<td>Intracontinental rift environment</td>
<td>Chen and Zhou,2012,2014;Chen et al.,2014b,2018b;Zhu and Sun,2013;Zhu et al.,2018</td>
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<td>Yina chang</td>
<td>20 million tons of Fe ore，~45%；15 million tons of Cu ore，~0.9%</td>
<td>Metavolcanic sedimentary rock series</td>
<td>Early sodium-iron alteration stage: albitization，hematitization/Magnetization；Iron-(rare earth) mineralization stage: potash feldspathization，biotitization，garnetization，chloritization et al. Copper-(rare earth) stage: biotitization，fluoritization et al.</td>
<td>Fe+Cu+Au+REE+U+Nb</td>
<td>magmatic hydrothermal fluids + Atmospheric precipitation</td>
<td>Metallogenic metals (REE) may be mainly derived from mantle-derived magma，and some are derived from surrounding rock (water-rock reaction)</td>
<td>Intracontinental rift environment</td>
<td>Li and Zhou,2015;Li et al.,2015b,Zhao et al.,2013,2015;Hou et al.,2015;Hou Lin et al.,2013；Wen Ligang,2018</td>
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<td>Da hong shan</td>
<td>458 million tons of iron ore，41% Fe；1.35 million tons of Cu，16 tons of Au，141 tons of Ag，18156 tons of Co，2.1 tons of Pt&amp;Pd</td>
<td>Metavolcanic sedimentary rock series</td>
<td>Premetallogenic alteration: albitization，scapolitization；Iron mineralization stage: actinolitization，garnetization，tourmalinization；Copper polymetallic mineralization stage: potash feldspathization，chloritization，biotitization，Sericitization</td>
<td>Fe+Cu+Au+Ag+Co+PGE+REE</td>
<td>magmatic hydrothermal fluids +Basin brine</td>
<td>Metallogenic metals may be mainly derived from basic magma，and some are derived from water-rock reactions between fluids and surrounding rocks.</td>
<td>Intracontinental rift environment</td>
<td>Su et al., 2016；Zhao et al.,2017b</td>
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Main metallogenic periods:

~1.66Ga: Dahongshan and Yinachang gabbro and diabase formed in the within-plate environment
continental rift valley environment

~1.0Ga: Lala mafic-acid rock and related volcanic rock
continental rift valley environment

830~760Ma hydrothermal reformation events related to the magmatic rock in the Neoproterozoic Era in this region

(Chen et al., 2019)
Main References


