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华北克拉通前寒武纪BIF铁矿研究:进展与问题

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摘要：

研究表明,BIF铁矿在华北克拉通的分布具有一定规律性。大规模BIF铁矿主要发育在绿岩带分布区的鞍山-本溪、冀东、霍邱-舞阳、五台、鲁西和固阳等地;华北克拉通时代最古老的BIF形成于古太古代,最年轻BIF形成于古元古代早期,但BIF铁矿的峰期为新太古代晚期(2.52~2.56Ga);BIF铁矿类型可划分为阿尔戈马型和苏比利尔湖型两类,但华北以晚太古代绿岩带中的阿尔戈马型为主,仅吕梁的古元古代袁家村铁矿具典型苏比利尔湖型铁矿特征。根据BIF在绿岩带序列中的产出部位和岩石组合关系,可将华北BIF划分为:1)斜长角闪岩(夹角闪斜长片麻岩)-磁铁石英岩组合;2)斜长角闪岩-黑云变粒岩-云母石英片岩-磁铁石英岩组合;3)黑云变粒岩(夹黑云石英片岩)-磁铁石英岩组合;4)黑云变粒岩-绢云绿泥片岩-黑云石英片岩-磁铁石英岩组合;5)斜长角闪岩(片麻岩)-大理岩-磁铁石英岩组合等5种类型。华北克拉通BIF形成时代与早前寒武纪岩浆活动的时间基本一致(2.5~2.6Ga),但与华北克拉通陆壳增生的峰期(2.7~2.9Ga)有一定偏差,其原因可能与新太古代晚期华北克拉通构造-热事件十分强烈有关。华北克拉通新太古代BIF大多形成于岛弧环境,但局部地区(如固阳)BIF铁矿可能形成于深部有地幔柱叠加的岛弧环境。华北克拉通BIF富矿主要有三种类型:原始沉积、受后期构造-热液叠加改造和古风化壳等,但总体不发育富铁矿,国外发育的风化壳型富铁在我国甚为少见。本文认为在探讨BIF铁矿类型时,需要从绿岩带发育序列进行综合判别。阿尔戈马型铁矿一般产于克拉通基底(绿岩带)环境,苏比利尔湖型铁矿一般形成于稳定克拉通上的海相沉积盆地或被动大陆边缘。华北克拉通BIF铁矿地球化学研究结果表明,BIF铁矿无Ce负异常且Fe同位素为正值,从而暗示铁矿沉淀的环境为低氧或缺氧环境,而铕正异常可能指示BIFs为热水沉积成因,其机制可能为海水对流循环从新生镁铁质-超镁铁质洋壳中淋滤出Fe和Si等元素,在海底排泄沉淀成矿,而条带状构造的形成可能归咎于成矿流体的脉动式喷溢。但对于BIF铁矿的物质来源、成矿条件和机制、富铁矿成因、华北克拉通不发育苏比利尔湖型铁矿的原因等方面,仍需深入研究。

英文摘要：

It is shown that regular patterns can be established for the distribution of BIF-iron deposits in the North China Craton (NCC). Large scale BIF-iron deposits mainly exist in some greenstone-belts areas such as Anshan-Benxi, eastern Hebei, Huoqiu-Wuyang, Wutai, western Shandong and Guyang etc; formation ages of BIF in the NCC cover a wide range from Paleoarchean to Early Paleoproterozoic, among which Late Neoarchean is the peak period (2.52~2.56Ga); BIF can be divided into two types, Algoma and Superior Lake. Most BIFs occurring in Neoarchean greenstone belts in the NCC belong to the former while only the Paleoproterozoic Yuanjiacun iron deposit in the Lvliang area has typical characteristics similar to Superior-type BIF. Five specific types for BIFs in the NCC can be divided on the basis of their occurrences in greenstone belts successions and their relations with rock assembly: 1) amphibolites (or hornblende plagioclase gneiss) and magnetite quartzite association; 2) amphibolites, biotite leptynite, mica quartz schist, and magnetite quartzite association; 3) biotite leptynite (or biotite quartz schist) and magnetite quartzite association; 4) biotite leptynite, sericite chlorite schist, biotite quartz schist and magnetite quartzite association; and 5) amphibolites (gneiss), marble and magnetite quartzite association. The formation era of BIFs in the NCC is in accordance with magmatic activity in Early Precambrian, but there is some deviation from the peak period of crustal growth of the NCC, due to Neoarchean intense tectono-thermal events in the NCC. Most Neoarchean BIFs in the NCC formed in island arc setting while BIFs in other areas (like Guyang) might form in deep mantle plume superimposed on island arc setting. There are mainly three types for BIF-hosted high-grade iron ore, primary-deposit type, later structure-hydrothermal superimposed type and ancient weathering crust type, but overall, only a small quantity of high-grade iron ore exist in the NCC and the third type, widespread in foreign countries, is rare in China. This article argues that comprehensive discriminant should take the greenstone belt development sequences into consideration when discussing the types of BIF iron d

eposits. Algoma-type BIFs often originate in the craton basement setting (greenstone belts) while Superior-type BIFs often form in marine sedimentary basins in the stable craton or in the passive continental margin. Large amount of ge ochemistry research results of BIFs in the NCC indicate that BIF iron ores lack Ce negative anomaly and their iron isot ope characteristics are positive, which suggest that iron deposits formed in low-oxygen or anoxia environments, and the Eu positive anomaly may indicate that BIFs are hot water deposits. The possible mechanism may be that some el ements such as Fe and Si are leached out from newly-formed mafic-ultramafic oceanic crust because of the convective circulation of seawater, and then they precipitate in the ocean floor due to changes of physicochemical conditions. Th e fluctuating eruption of ore-forming fluids may lead to the formation of banded structure of BIFs. However there are some problems needed to be further studied in detail such as material source, minerogenetic condition and mechanis m of BIF iron deposits, causes of high-grade ore, reasons for lack of Superior-type BIF iron deposits in the NCC.

关键词：前寒武纪 条带状铁矿 绿岩带 陆壳增生 成矿机制 华北克拉通

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