岩石学报
ACTA PETROLOGICA SINICA

刘磊,杨晓勇. 2013. 安徽霍邱BIF铁矿地球化学特征及其成矿意义：以班台子和周油坊矿床为例. 岩石学报, 29(7): 2551-2566

安徽霍邱BIF铁矿地球化学特征及其成矿意义：以班台子和周油坊矿床为例

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基金项目：本文受国家重点基础研究发展计划项目(2012CB416602);安徽省国土资源厅公益性地质科技项目和国家自然科学基金项目(41090372、40921002)联合资助.

摘要：

安徽霍邱铁矿田位于华北克拉通南缘,是一个大型BIF铁矿田。本文对霍邱矿田班台子矿区和周油坊矿区的铁矿石及其赋存的岩石共28件样品进行了详细的主微量元素地球化学分析。分析结果表明,班台子矿区的片麻岩和角闪岩的原岩属于一套亚碱性系列的岩石,具有大离子亲石元素(LILE)富集,高场强元素(HFSE)明显亏损的火山弧岩石的特征。班台子角闪岩具有低的K_2O含量和Ti/V值,Ti/V=22.7~25.9,平均24.5,与岛弧拉斑玄武岩一致。弧后盆地玄武岩化学组成具有类似岛弧拉斑玄武岩的特征。BIFs的形成往往需要构造稳定的半深水-深水盆地,弧后盆地能够为BIFs韵律条带的产生提供稳定的沉积环境,因此霍邱BIFs铁矿的大量出现说明班台子矿区角闪岩形成于弧后盆地,代表了霍邱铁矿形成的构造环境。班台子矿区铁矿石的$(Eu/Eu^*)_{SN}$=1.57~1.82,与Superior型(简称S型)BIFs特征一致;而周油坊矿区假象镜铁矿的$(Eu/Eu^*)_{SN}$=1.93~3.41,与Algoma型(简称A型)BIFs特征比较吻合。正Eu异常的强弱反应了成矿位置距离海底火山热液喷气口的远近。因此,我们推断霍邱地区BIFs型铁矿形成位置与海底火山热液喷气口的距离比较特别,处于A型向S型过渡的位置。角闪岩和片麻岩及其赋存的铁矿石的Al_2O_3和TiO_2良好的线性相关性说明铁矿石铁质部分来源于侵蚀的弧后盆地玄武岩。Y/Ho比值=31.05~56.67,平均为46.65,说明霍邱铁矿继承了海水与热液的混合特征,其中,海水的贡献更大一些。周油坊矿区的大理岩主要化学组成CaO为28.49%~29.10%,MgO为20.25%~21.22%以及少量的SiO_2(2.45%~6.10%). 与平均显生宙石灰岩相比,周油坊大理岩亏损LILE和HFSE;与后太古代平均澳大利亚页岩(PAAS)相比,周油坊假象镜铁矿稀土元素总量低,明显正Eu异常,Ce无明显异常,Y/Ho比值介于35.00~56.67,平均48.81。这些特征显示大理岩及其赋存的假象镜铁矿形成于缺氧的海洋环境,海水中的氧能使亚铁离子氧化成三价铁离子沉淀出$Fe(OH)_3$,但不足以使Ce^{3+}氧化成Ce^{4+}。

英文摘要：

As a large BIF iron ore field, the Huoqiu iron ore filed in Anhui Province is located in the North China craton. Twenty eight samples from both Bantaizi and Zhouyoufang deposits within Huoqiu banded iron formations (BIFs) ore field were analyzed for major and trace element compositions. The results have demonstrated that the protolithes of Bantaizi gneiss and amphibolite belong to a series of subalkaline rocks, which have the volcanic arc rock characteristics of large ion lithophile elements (LILE) enrichment and high field strength elements (HFSE) depletion. The Bantaizi amphibolites have the low K_2O concentrations with low Ti/V (Ti/V=22.7~25.9 with an average of 24.5), which is consistent with those of island arc tholeiite. Back-arc basin basalts are similar in chemical compositions to island arc tholeiite. The formation of BIFs frequently require tectonically stable half deep-deep basin, back-arc basin can provide the stable depositional environment for generation of the BIFs rhythm strip. Therefore, BIFs occurrences illustrate the Bantaizi amphibolites are formed in back-arc basin, which imply the tectonic environment of the Huoqiu iron ore filed. The bulk compositions of Bantaizi deposit have slightly Eu positive anomalies with $(Eu/Eu^*)_{SN}$=1.57~1.82, which is consistent with Superior-type BIFs (Abbre. S-type). However, the Zhouyoufang deposit mainly occurred as pseudomorph specularite with significantly Eu positive anomalies ($(Eu/Eu^*)_{SN}$=1.93~3.41), which is resemble with Algoma-type BIFs (Abbre. A-type). The degree of Eu positive anomalies reflects the distance between BIFs deposition position and submarine exhalative hydrothermal vent. Therefore, the depositional environment of the Huoqiu BIFs was medium away from submarine exhalative hydrothermal vent, thus we suggest that the formation type of Huoqiu BIFs iron ore filed should belong to the transition from A-Type to S-Type. The good linear correlations between Al_2O_3 and TiO_2 are present in amphibolites, gneiss and enclave iron deposit, demonstrating that some of the material provenances of iron ores are sourced from erosion of the back-arc basin basalt. The Y/Ho ratios range from 31.05 to 56.67 with the average of 46.65, demonstrating the Huoqiu iron ore field inherited the mixtures between hydrothermal and sea water and the later contribute more. Compared with average Phanerozoic limestones, marbles in the Zhouyoufang deposit contain 28.49%~29.10% CaO, 20.25%~21.22% MgO and minor SiO_2 (2.45%~6.10%), relatively depleted in LILE and HFSE. In contrast, compared with Post Archean Australia Shales (PAAS), the Zhouyoufang deposit displayed lower total REE, with considerably Eu positive anomalies, no Ce anomalies, Y/Ho ratios range from 35.00 to 56.67 with an average of 48.81. These features demonstrate that the marble and iron ores hosted within are formed in an anoxic marine environment, the oxygen in sea water can oxidize Fe^{2+} to Fe^{3+} and lead to precipitation into $Fe(OH)_3$, but can not oxidize Ce^{3+} to Ce^{4+}.

关键词：霍邱铁矿田 BIF建造 主微量元素 地球化学 形成环境

投稿时间： 2013-02-01 最后修改时间： 2013-04-27

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