

柴凤梅, 杨富全, 李强, 藏梅, 耿新霞, 孟庆鹏. 2014. 新疆阿尔泰阿巴宫富磷灰石磁铁矿床成矿机制: 来自包裹体和稳定同位素证据. 岩石学报, 30(5): 1397-1414

新疆阿尔泰阿巴宫富磷灰石磁铁矿床成矿机制: 来自包裹体和稳定同位素证据

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基金项目: 本文受国家重点基础研究发展计划973项目(2012CB416803)和国土资源部公益性行业科研专项经费项目(201211073-01)联合资助。

摘要:

阿巴宫富磷灰石磁铁矿床位于新疆阿尔泰南缘地区克朗盆地, 具有Kiruna型铁矿典型特征。本文对矿床中磷灰石和石英中的包裹体进行了详细的岩相学观察、对流体包裹体进行了显微测温 and 激光拉曼成分研究, 并测定了磷灰石和石英的氢、氧同位素以及硫化物的硫同位素组成。结果表明, 不同成矿阶段磷灰石中的包裹体具有明显不同的特征, 代表了不同的熔体和流体系统, 且流体由早阶段到晚阶段具有一定的演化规律。第一和第二成矿阶段磷灰石中主要为熔融包裹体、流体包裹体和单矿物包裹体, 成矿流体分别是高温(主要为290~460℃)中盐度(10.36%~17.79% NaCleqv)和中温(主要为230~290℃)中盐度(16.99%~22.4% NaCleqv)的富Ca²⁺的H₂O-NaCl体系, 是富挥发分的Fe-P熔体在结晶过程中捕获熔体和流体的结果。第三成矿阶段的磷灰石和石英中的包裹体特征相似, 主要为熔体-流体包裹体、液相包裹体、含液体CO₂三相包裹体、含子矿物H₂O-NaCl型多相包裹体和含子矿物H₂O-CO₂-NaCl型多相包裹体。成矿流体温度变化于160~320℃, 中低盐度(1.06%~23.1% NaCleqv), 少量高盐度变化于33.5%~42% NaCleqv, 属H₂O-CO₂-NaCl体系, 是岩浆-热液阶段出溶的流体发生沸腾作用的结果。磷灰石和石英的δD较为接近, 分别为-139‰~-118‰和-145‰~-104‰。成矿流体的δ¹⁸O_{H₂O}值显示以岩浆水为主, 从早阶段(4.9‰~9.1‰)向晚阶段(1.5‰~6.0‰)有降低的趋势。硫化物的δ³⁴S(0.4‰~5.2‰)表明硫来自深部岩浆。结合阿巴宫富磷灰石磁铁矿床的地质特征, 认为矿床的形成与不混溶作用的发生有关, 早阶段成矿是碳酸盐围岩的加入导致富挥发分Fe-P熔体与富Si熔体发生不混溶, 由富Fe-P熔体发生分离结晶和堆晶作用形成; 晚阶段成矿是富Fe-P熔体演化晚期, 由于减压降温导致流体出溶并发生大规模的不混溶(沸腾), 即在岩浆-热液过渡阶段由熔体结晶形成。

英文摘要:

The Abagong apatite-rich iron deposit is located in the Kelang volcano-sedimentary basin in the southern margin of the Chinese Altay Orogenic Belt (AOB), showing the typical characteristics of a Kiruna-type deposit in its mineral assemblages, ore texture and structure, and apatite and magnetite geochemistry. Apatite and quartz in this deposit host primary fluid inclusions and silicate melt inclusions. Microthermometry, Laser Raman Microprobe Analysis (LRM) and H and O isotopes were performed to fluid inclusions in apatite and quartz. In addition, the S isotope of sulphides had been analysed. Types of inclusions and bulk composition of primary fluid inclusions were different in different ore-stages. The inclusions in early-stage apatite (I and II stage) include silicate melt inclusions, liquid phase inclusions, daughter mineral-bearing H₂O-NaCl type multiple phase inclusions and crystal and metal-bearing inclusions. The inclusions in late-stage apatite and quartz (III stage) include liquid phase inclusions, liquid phase CO₂-bearing three-phase inclusions, pure CO₂ inclusions and daughter mineral-bearing CO₂-NaCl-H₂O type multiple phases inclusions. The ore-forming fluid evolved from earlier stage characterized by high temperature (290~460℃) and medium salinity (10.36%~17.79% NaCleqv) Ca-rich H₂O-NaCl system to later stage by medium-low temperature (160~320℃) and medium-low salinity (1.06%~23.1% NaCleqv) H₂O-CO₂-NaCl system. The δ¹⁸O_{H₂O} yields value of 4.9‰~9.1‰ with δD value of -139‰~-118‰ in earlier stage to 1.5‰~6.0‰ with δD value of -145‰~-104‰ in late-stage, suggesting that mineralizing fluids originated mainly from magmatic water. The δ³⁴S values of 0.4‰~5.2‰ suggest a mantle origin. We interpret the coexistence of melt inclusions and primary fluid inclusions in early-stage as a product entrapped from heterogeneous Fe-P-rich melt system. The various types of inclusions in late-stage were considered as a product entrapped from melt-fluid system due to aqueous fluid exsolution from Fe-P-rich melt during magmatic-hydrothermal transition stage. Thus, we propose that immiscibility is important mechanism in the formation of the Abagong apatite-rich iron deposit. The segregation between immiscible Fe-P-rich melt and Si-rich melt due to addition of carbonate rocks and early crystallization and cumulation of Fe-oxide and apatite from Fe-P-rich melt resulted to the formation of early-stage ore. The cr

ystallization of Fe-P-rich melt exsolved fluid by decrease of temperature and pressure during the magmatic-hydrothermal transition stage resulted to the formation of late-stage ore.

关键词: [包裹体](#) [流体H,O同位素](#) [阿巴宫铁矿床](#) [阿尔泰](#)

投稿时间: 2013-09-20 最后修改时间: 2014-01-05

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