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胶东焦家金矿床热液蚀变作用

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摘要:

胶东作为中国最重要的金矿集区, 区内大型-超大型金矿床集中产出, 已探明金矿资源量占全国近1/3。其中, 破碎带蚀变岩型金矿床是最重要的金矿床类型, 占胶东已探明金矿资源量的90%以上, 焦家金矿床是著名的“焦家式”破碎带蚀变岩型金矿的命名地, 内发育大规模的绢英岩化蚀变带(宽20~200m)和钾化蚀变带(50~300m), 蚀变岩型金矿体主要发育在焦家断裂带下盘的绢英岩化蚀变带中。本文通过详细的野外地质观测, 查清了焦家金矿床蚀变类型及矿物组合特征, 系统采集了不同蚀变类型的岩石样品, 进行了岩石元素地球化学分析, 运用质量平衡方法讨论了热液蚀变过程中元素迁移规律, 初步探讨了焦家金矿床热液蚀变机理。其中, 钾化蚀变是成矿前蚀变, 钾化花岗岩常以团块状或角砾状残留于黄铁绢英岩和绢英岩内; 黄铁绢英岩化和绢英岩化蚀变受焦家断裂及其下盘的次级断裂控制, 其规模大小受断裂的规模控制; 其中焦家主断裂下盘的绢英岩化蚀变带规模最大, 一般宽10~200m; 而次级断裂控制的绢英岩化蚀变带规模相对较小, 一般以0.1~1m宽的脉状发育在钾化花岗岩内, 指示绢英岩化蚀变晚于钾化蚀变。相对于黑云母花岗岩, 不同蚀变带岩石普遍表现出高K₂O、低Al₂O₃、CaO和Na₂O, 而不同蚀变岩石Si、Fe、Mg等元素各表现出不同特征。钾化带岩石表现为K₂O的富集, 而绢英岩带和黄铁绢英岩带岩石表现为MgO、Fe₂O₃增加的趋势。黑云母花岗岩发生钾化蚀变过程中, SiO₂、K₂O表现为明显的带入, 指示在钾长石化过程中, 流体为富硅的碱性氧化流体。在钾化花岗岩→黄铁绢英岩过程中, Fe₂O₃表现为明显的带入, 可能是由于黑云母等暗色矿物的分解造成的; 此外, 亲硫元素(Au、Ag、As、Pb、Zn)均表现为带入, 特别是成矿元素Au表现为明显的带入。结合本区金的来源可能部分为玲珑黑云母花岗岩, 本研究认为钾化过程中的富硅碱性氧化流体通过交代蚀变反应使金从围岩中释放、成为高价态离子活化进入成矿流体, 即分散还原态的金(Au⁰)被活化为氧化态(Au⁺、Au³⁺)以AuH₃SiO₄形式随热液迁移。在绢英岩化过程中, 热液中的SiO₂等组分损失, 引起热液中的AuH₃SiO₄稳定性降低, 造成AuH₃SiO₄分解, Fe²⁺、Fe³⁺被消耗形成黄铁矿, 导致金大量沉淀和聚集沉淀, 此时完成了金由活化→迁移→沉淀富集成矿。

英文摘要:

Jiaodong Peninsula, the most important gold province in China, is an area with concentration occurrence of large-superlarge gold deposits, the proved reserves in Jiaodong Peninsula account for nearly 1/3 of the country's. Fracture zone altered type gold deposit is the most important deposit type which accounts for more than 90% of the proved gold reserves in Jiaodong Peninsula. Jiaojia gold deposit is named after "Jiaojia-type" fracture zone altered rock type gold deposit, large-scale sericite-quartz alteration zone (with the width of 20~200m) and potassic alteration zone (with the width of 50~300m) occur in the gold deposit. Altered rock type gold orebody mainly develops in the sericite-quartz alteration zone which is in the footwall of Jiaojia fault zone. Based on the detailed geologic observations in the field, this paper found out the alteration type and mineral assemblage of the Jiaojia gold deposit, collected different types of alteration rock samples scientifically, and conducted rock geochemistry element analysis which uses the method of the mass balance to discuss the regularity of elements migration in the hydrothermal alteration process and mechanism. Thereinto, potassic alteration occurs in the premineralization, potassic granite is usually as lumpy and breccia residual in the pyrite-sericite-quartz and sericite-quartz altered rock which is controlled by the secondary faults in the footwall of the Jiaojia fault, and the scale is controlled by the faults. The scale of sericite-quartz altered rock is the largest in the footwall of the Jiaojia fault with the width of 10~200m, sericite-quartz altered zone controlled by secondary faults is relatively small, usually presenting as wide 0.1~1m veins in the potassic granite, which indicates sericite-quartz

z alteration is later than potassic alteration. Compared with biotite granite, rocks from various alteration zones show high contents of K_2O and low contents of Al_2O_3 , CaO and Na_2O , but elements like Si, Fe, and Mg have different characteristics. Potassic granite are rich in K_2O , while both sericite-quartz altered rock and pyrite-sericite-quartz altered rock are characterized with increases of MgO and Fe_2O_3 . During the process of potassic alteration, SiO_2 and K_2O were added, indicating that the forming fluid is silicon-rich, alkaline and oxidation. In the process of alteration from potassic granite to pyrite-sericite-quartz altered rock, the Fe_2O_3 increased obviously, which may be caused by the decomposition of biotite and other melanocratic minerals. Furthermore, sulfophilic elements like Au, Ag, As, Pb and Zn also increased significantly. Part of the gold may be derived from Linglong biotite granite. In the process of potassic alteration, the metasomatism between the wall rock and silicon-rich, alkaline and oxidation fluids, extracted gold in the form of high valence ion from wall rocks. To be specific, dispersed reduced gold (Au^0) was activated to be oxidized (Au^+ , Au^{3+}), and migrated with the fluids in the form of AuH_3SiO_4 . In the process of sericite-quartz alteration, the descent of the content of SiO_2 induced the decomposition of AuH_3SiO_4 . Fe^{2+} and Fe^{3+} were consumed to form the pyrites, which induced the deposition and enrichment of gold. Gold activate, migrate and deposit run through all these process.

关键词: [热液蚀变](#) [质量平衡](#) [焦家金矿床](#) [胶东](#)

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