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西藏驱龙超大型斑岩铜矿床:地质、蚀变与成矿

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中文摘要:驱龙超大型矿床是一个产于后碰撞伸展环境下、与大洋俯冲无关的新型斑岩铜矿.文章通过对驱龙铜矿床地质、蚀变与矿化的详细研究,建立了驱龙中新世岩浆演化序列,初步查明了岩浆浅成侵位的构造控制要素,厘定了主要的围岩蚀变类型及空间展布规律,查明了引起各期蚀变事件的地质记录及矿化的空间分布规律,并探讨了成矿物质沉淀的机制,初步建立了该矿床的成矿模型.研究表明,驱龙铜矿中新世斑岩是闪长质深部岩浆房不断演化的产物,花岗闪长岩中新发现的、结晶时间为22.2 Ma左右的闪长质包体可近似代表深部岩浆房组分,依次产出的花岗闪长岩、呈岩株或岩枝产出的P斑岩、X斑岩及最晚期的闪长玢岩[(15.7±0.2)Ma],均为深部岩浆房连续演化的产物,岩浆持续6 Ma左右.岩浆演化过程中角闪石、斜长石不断的结晶分异,导致了岩石常量元素、稀土元素及微量元素组成的规律性变化,斑岩埃达克质的特征也因岩浆演化过程中角闪石等矿物的不断结晶分异而引起.X斑岩中锆石的Hf同位素特征表明,岩石可能形成于新生下地壳的部分熔融.大面积产出的花岗闪长岩为驱龙铜矿最主要的含矿围岩,容纳了驱龙矿床70%以上的矿体,主要由斜长石、钾长石和石英组成,具花岗结构-似斑状结构.近EW向产出,其浅成就位可能受背斜控制,其后的各期斑岩均沿该侵位中心上侵,而冈底斯地壳中新世的快速抬升与剥蚀是导致含矿斑岩浅成侵位的根本原因;矿区内的SN向裂隙带既不控岩,也不控矿.浅成侵位的斑岩及深部岩浆房均发生了流体出溶.发生了大量流体出溶的深部岩浆房,是矿区早期蚀变流体的主要来源,显微晶洞构造及单向固结结构(UST)是流体出溶的地质记录.蚀变主要有3种类型,分别为早期的钾硅酸盐化、青磐岩化以及晚期的长石分解.钾硅酸盐化可分为2个阶段,即蚀变矿物以次生钾长石为主的早期钾硅酸盐化和以次生黑云母为主的晚期钾硅酸盐化.青磐岩化因产出的岩石类型不同,蚀变矿物组合具有明显差异性:产于叶巴组地层中的青磐岩化相对较强,蚀变矿物以绿帘石为主;产于花岗闪长岩中的青磐岩化相对较弱,蚀变矿物以绿泥石为主.晚期长石分解蚀变以破坏长石类矿物为特征,蚀变矿物主要为绢云母-绿泥石-粘土等.石英和硬石膏贯穿于上述各种蚀变中.空间上,钾硅酸盐化位于斑岩体及其周围地区,青磐岩化位于钾硅酸岩化外侧.后期形成的长石分解蚀变强烈叠加了早期钾硅酸盐化,介于钾硅酸盐化带与青磐岩化带之间.与早期钾长石化有关的脉体主英-钾长石脉,与晚期黑云母化有关的脉体主要为不规则至板状的石英.硬石膏脉、黑云母脉,与青磐岩化有关的脉体主要为板状的绿帘石-石英脉,与晚期长石分解蚀变有关的脉体主要为板状黄铜矿-黄铁矿脉及黄铁矿脉;在早期钾硅酸盐蚀变与晚期长石分解蚀变转换阶段,发育一组板状的石英.硫化物脉.早期不规则的脉体形成于斑岩结晶早期、矿区裂隙小规模发育阶段;晚期的板状脉体形成于斑岩弱固结或固结之后、矿区大规模连通裂隙发育阶段.驱龙矿区的铜矿化分布较为均一,主体产于花岗闪长岩中,其中,铜矿化主体形成于黑云母化蚀变阶段,转变阶段及长石分解阶段也有大量铜的形成;钼主要形成于转换阶段,长石分解蚀变阶段也有产出.黑云母化阶段,铜的沉淀与角闪石黑云母化、斜长石钾长石化过程中Ca^{2+} 的大量释放有关;转换阶段,铜钼矿化可能与压力和(或)温度骤降有关;晚期铜矿化与长石矿化蚀变阶段,斜长石绿泥石化、黑云母绿帘石化过程中Ca^{2+} 及Fe^{2+} 的释放有关.

中文关键词:地质学 围岩蚀变 矿化 成矿模型 斑岩铜矿 驱龙 冈底斯 西藏

Qulong superlarge porphyry Cu deposit in Tibet: Geology, alteration and mineralization

Abstract: Although some porphyry deposits are seen in post-collisional extensional settings and seemingly have no relationship to subduction, such deposits commonly occur in arc settings in association with subduction-related calcalkaline magmas, and their characteristics remain poorly understood. In this paper, the authors describe igneous geology, alteration mineralogy and mineralization history of Qulong deposit, a newly-discovered post-collisional type porphyry Cu deposit in southern Tibet. It is associated with Miocene monzogranite_granodiorite intrusions and hosted partly in Jurassic andesitic-dacitic volcanics. A 19.5 Ma granodiorite pluton with diorite enclaves seem to be the earliest Miocene intrusive unit, into which a regularly-shaped stock (P porphyry) and then a thin dike (X Porphyry) of monzogranite intruded about 17.7 Ma ago.The main copper-molybdenum mineralization is associated with the P porphyry. A barren diorite porphyry intruded into the P and X porphyries around 15.7 Ma. Petrologic trends of the intrusions suggest that the Miocene intrusions had similar origin and were probably formed by fractionation of a rather deep magma chamber. Emplacement of Miocene porphyries, controlled by Qulong anticline, was a direct response to the rapid uplift/erosion of Gangdese arc batholiths in southern Tibet. Miarolitic cavities and unidirectional solidification textures, the key evidence for volatile separation, were recognized in the P and X porphyries, respectively.Early potassic alteration, characterized by quartz-K feldspar (±anhydrite), pervades the P porphyry and granodiorite. Laterally, this alteration grades into quartz-biotite-anhydrite (±K feldspar), which has affected all Miocene intrusions except the latest dioritic porphyry. Wall rocks of granodiorite and Jurassic andesitic-dacitic volcanics within 1～15 kilometers from the porphyries are dominated by potassic alteration. An outer halo of propylitic alteration (epidote-chlorite ± calcite) extends up to 2 km. Feldspar-destructive alteration (sericite-chlorite ± clay minerals) has overprinted most of the potassic and part of the propylitic alteration. The alteration is strongly pervasive in the interior of the porphyries and occurs as vein halos away from the porphyries.The earliest quartz-K feldspar alteration and veins are barren, whereas approximately 60 percent of the 7 million tons of copper they contain have to do with slightly later quartz-biotite-anhydrite alteration. Barren assemblages are related to irregular quartz (-K feldspar ± anhydrite) veins, which are truncated by the X porphyry. Cu sulfide-bearing assemblages are associated with discontinuous chalcopyrite (±biotite) and continuous quartz-anhydrite-chalcopyrite (± molybdenum) veins. Deposition of Cu-Mo with abundant anhydrite occurred during or between emplacements of closely related porphyries from high temperature magmatically-derived fluids, and was probably caused by hydrolysis of SO_2.

keywords:geology alteration mineralization metallogenetic model porphyry copper deposit Qulong Gangdese Tib