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金川Cu-Ni-PGE硫化物矿床成矿过程稀有气体同位素组成示踪

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摘要:

稀有气体同位素在示踪成矿作用流体来源方面具有独特优势。本文应用熔融质谱法测定了金川Cu-Ni-PGE硫化物矿床23个硅酸盐矿物和金属硫化物单矿物的He、Ne和Ar丰度和同位素组成。结果表明,硅酸盐矿物的 $^3\text{He}/^4\text{He}$ 比值(0.239Ra)略低于硫化物(平均0.456Ra),且从橄榄石(平均0.291Ra)、斜方辉石(0.215Ra)到单斜辉石(0.174Ra)逐渐降低, $^{20}\text{Ne}/^{22}\text{Ne}$ - $^{21}\text{Ne}/^{22}\text{Ne}$ 分布于MORB与大陆地壳演化线之间,扣除放射性成因 $^4\text{He}^*$ 和 $^{40}\text{Ar}^*$ 后橄榄石和辉石中 $^3\text{He}/^4\text{He}$ 和 $^{40}\text{Ar}/^{36}\text{Ar}$ 接近岩石圈地幔组成。He、Ne和Ar同位素组成示踪表明成矿岩浆中存在岩石圈地幔(SCLM)、地壳(CC)和大气饱和流体(ASW)三种端元成分,硫化物熔体的分离发生在岩浆结晶分异的早期。岩石圈地幔部分熔融形成的成矿初始岩浆经历了两阶段的演化。在深部岩浆房高温成矿岩浆同化围岩引入地壳混染组分,促使硫饱和及硫化物熔体的熔离,同时形成具有壳幔混合特征的混合岩浆组分(MC),上升至上部岩浆房后混入较高比例的大气饱和流体,进一步促使硫饱和及浸染状硫化物就地熔离堆积。

英文摘要:

Noble gases are recognized as being exceptional tracers of volatile sources during mineralization. He, Ne and Ar abundances and isotopic compositions from 23 silicate and sulfide separates in the Jinchuan Cu-Ni-PGE sulfide deposit, West China, have been investigated by melting extraction MM5400 mass spectrometer. The results show that $^3\text{He}/^4\text{He}$ ratios in silicate minerals (av. 0.239Ra) are slightly lower than those in sulfide (av. 0.456Ra), and decrease from olivine (av. 0.291Ra), orthopyroxene (av. 0.215Ra) to clinopyroxene (av. 0.174Ra). $^{20}\text{Ne}/^{22}\text{Ne}$ and $^{21}\text{Ne}/^{22}\text{Ne}$ ratios are plotted into the ranges between MORB line and continental crust line. $^3\text{He}/^4\text{He}$ and $^{40}\text{Ar}/^{36}\text{Ar}$ of olivine (Olv) and orthopyroxene (Opx) deduced by radiogenic He^* and Ne^* are close to the He and Ar isotopic ranges of subcontinental lithosphere mantle (SCLM). He, Ne and Ar isotopic compositions suggested that SCLM, continental crust (CC) and air saturated water (ASW) three end-members were involved into ore-forming magma of the Jinchuan Cu-Ni-PGE sulfide deposit. The segregation of immiscible sulfide liquid from magma took place at the early stage of magma evolution. The primary ore-forming magma had been formed by partial melting of SCLM, and undergone two stages of evolution. It had been assimilated possibly with wall rock which resulted in the sulfur supersaturating in silicate magma and segregation of immiscible sulfide melt and formed a mixed component (MC) with SCLM and continental crust (CC) signatures. The mixed component (MC) emplaced into upper chamber and mixed with a high proportion of deep circulatory ASW which induced sulfur supersaturating of ore-forming magma and in-situ formed the disseminated ore in upper magma chamber.

关键词: [成矿过程示踪](#) [稀有气体同位素](#) [超镁铁质侵入体](#) [Cu-Ni-PGE硫化物矿床](#) [金川](#)

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