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铬在橄榄石中的赋存状态: 西藏罗布莎地幔橄榄岩和铬铁矿中的富铬橄榄石及对深部地幔成因的启示

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摘要:

西藏罗布莎蛇绿岩的地幔橄榄岩和铬铁矿中含有目前世界上已知最富铬的包裹体橄榄石(Cr_2O_3 含量最高达1.49%)和富含铬铁矿出溶体的变形残晶橄榄石。通过对富铬橄榄石产出特征和其中Cr与其他元素相关关系的分析,结合前人的研究,指出铬是以还原态的 Cr^{2+} 进入橄榄石晶格的, Cr^{2+} 可能以占据空位和部分替代 Fe^{2+} 的方式稳定于富铬橄榄石初始相的晶格中。鉴于前人在罗布莎地幔橄榄岩和铬铁矿中大量超高压强还原相矿物的发现,认为这些富铬橄榄石的初始相可能为形成于地幔过渡带或下地幔的瓦兹利石或林伍德石,富铬橄榄石的产出也反过来证明了罗布莎地幔橄榄岩和铬铁矿中部分物质的深部地幔来源。

英文摘要:

Chromium-rich included olivines and chromite exsolution rod-rich deformed porphyroclast olivines occur in the Luobusha mantle peridotite and chromitite in the Yarlung Zangbo ophiolite, Tibet. Included olivines are subhedral to euhedral with size up to 50 μm and occur in spinels or chromites in harzburgite, dunite, disseminated chromitite, nodular chromitite and massive chromitite. Deformed porphyroclast olivines are coarse-grained (up to 10mm), undulatory extincted, kink banded and recrystallized. Amounts of chromite exsolution rods arrange parallelly with light-white color and extremely narrow width of <3 μm . In each sample, no matter what lithology, included olivines contain obviously higher Cr_2O_3 and lower FeO than other olivines. Parts of those included olivines contain by far the highest Cr_2O_3 (up to 1.49%) in the world and much higher than those in lunar and chondrite olivines (~0.7%). Except for a weak negative correlation of Cr_2O_3 vs. FeO for those included olivines, no other correlation of Cr_2O_3 vs. MnO and of Cr_2O_3 vs. MgO was observed, distinguishing from those chromium-rich olivines in lunar basalts (Cr varies inversely with Fe) and from those in St. Mesmin chondrite (Cr varies positively with Fe). Aluminum is near background levels and minors of manganese (~0.1%) and nickel (0.3%~0.5%) were detected in included olivines. Combining with previous studies, we analyzed the valence state and substitution of chromium in Cr-rich olivine or its precursor phase. Cr^{2+} is believed to be the controlled valence in the octahedral site of olivine since an in-situ moissanite in one of samples studied here has been discovered. A possible vacancy substitution mechanism is proposed to explain the uncorrelated characteristic between Cr and other metal elements. According to lots of findings of ultra-high pressure and extremely reductive minerals reported by previous studies, that the chromium-rich olivines in the Luobusha mantle peridotite and chromitite might originate from mantle transition zone or lower mantle and their precursor phase might be wadsleyite or ringwoodite.

关键词: [富铬橄榄石](#) [地幔橄榄岩](#) [铬铁矿](#) [罗布莎蛇绿岩](#) [西藏](#)

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