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基性和超基性岩蛇纹石化的机理及成矿潜力

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摘要:

蛇纹石化是指基性岩(例如玄武岩)和超基性岩(橄榄岩、科马提岩等)在中、低温条件下产生的含蛇纹石的水热蚀变。蛇纹石化可以出现在不同的地质构造环境中,例如大洋底、扩张洋脊和俯冲带。蛇纹石化的特别之处在于:蛇纹石化过程中产生氢气,这可能解释地球早期生命起源的问题;蛇纹石化生成磁铁矿;蛇纹石富水(可达13%);蛇纹石富Cl、Li、Sr、As等元素。蛇纹石在高温下(>700°C)脱水形成橄榄石, Li、Sr、As等元素富集在流体中,流体交代地幔楔可改变地幔的微量元素组成。此外,铁矿、金矿和银矿等可赋存于蛇纹岩中,矿床的形成可能和基性或超基性岩的蛇纹石化相关。本文从以下4个方面探讨蛇纹石化的机理:(1)蛇纹石化的产物,主要介绍和蛇纹石化相关的热液流体的组成,蛇纹石化过程中产生氢气的量,利蛇纹石、纤蛇纹石和叶蛇纹石的形成条件,水镁石的形成条件,以及磁铁矿的形成;(2)蛇纹石化的反应速率;(3)蛇纹石化过程中元素的迁移;(4)蛇纹石化的成矿潜力。

英文摘要:

Serpentinization is the hydrothermal alteration of ultramafic rocks (e.g., peridotite, komatiite) and mafic rocks (e.g., basalt). Serpentinization occurs at different types of geological settings, e.g., oceanic basins, spreading ocean ridges, and convergent margins. One specialty of serpentinization that gained wide interests is: hydrogen gas is generated, which may help to explain the origin of life during the early history of the Earth; magnetite usually forms; serpentine is rich in H<sub>2</sub>O, up to 13%. Some water-soluble elements, e.g. lithium, strontium and arsenic, are concentrated in serpentine. Serpentine dehydrates at temperatures above 700°C, releasing water and these water-soluble elements, which is significant for subduction processes. Such fluid metasomatizes the mantle wedge, resulting in composition changes of the mantle. Moreover, serpentinization may have some effect for the formation of different deposits, e.g., iron deposit, gold deposit and silver deposit. In this study, four aspects were discussed in order to understand the mechanism of serpentinization: (1) the alteration products. This part includes five sections, hydrothermal fluid composition, hydrogen generated during serpentinization, formation of lizardite, chrysotile and antigorite, brucite formation and magnetite formation. The fluid composition is dependent on temperature and rock type. At high temperature (>300°C), e.g., Logachev hydrothermal field at 353°C, the fluid is acidic (pH around 2.8) and is rich in Fe (2500µmol/kg); At low temperature, e.g., Lost City hydrothermal field at 40~75°C, fluid is alkaline (pH around 8.0) and contains almost no Fe (below detection limit). Serpentinization of ultramafic rocks generates larger amounts of hydrogen gas than that of basalt. Logachev hydrothermal field is hosted by peridotite, which contains 12.0mmol/kg H<sub>2</sub>. By contrast, the host rock of TAG hydrothermal field is basalt and the concentration of H<sub>2</sub> is only 0.18~0.23mmol/kg. In the following section, we discuss the formation of lizardite, chrysotile and antigorite. Lots of factors affect which type of serpentine forms, e.g., temperature, pressure, the amount of water, and MgO/SiO<sub>2</sub> ratio. The following section is about brucite formation. Brucite usually contains some Fe and its Fe content decreases with increasing temperature. The next section is about magnetite formation. The formation of magnetite depends on reaction progress, temperature and activity of SiO<sub>2</sub>. (2) Kinetic studies of serpentinization. The speed of serpentinization is dependent on temperature, grain size and fluid type, etc. (3) Element migration during serpentinization. Mg, Ca, Fe and Si could be leached into fluid. Al and Cr are also mobile. (4) The potential of mineralization. Some Fe, Au, Ag deposits are associated with serpentinites, which may be the source for these ore elements.

关键词: [蛇纹石化](#) [磁铁矿](#) [利蛇纹石](#) [叶蛇纹石](#) [成矿](#)

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