

湖南辰溪特高有机硫煤的稀土元素特征及其成因

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Characteristics of the rare earth elements in a high organic sulfur coal from Chenxi, Hunan province

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摘要 采用高分辨率电感耦合等离子质谱(HR-ICP-MS)技术测定辰溪晚二叠世高有机硫(7.75%)煤中的稀土元素(REEs)。辰溪煤中 Σ REE变化较大,从38.84 $\mu\text{g/g}$ 至305.85 $\mu\text{g/g}$,加权平均值为104.57 $\mu\text{g/g}$,高于世界煤均值,与中国煤相近。辰溪煤中有明显的Ce异常($\delta\text{Ce}=0.74\sim 0.84$)和Eu的负异常($\delta\text{Eu}=0.55\sim 0.69$)。煤层剖面上稀土元素含量和分布模式的变化反映了成煤环境的波动,从底板到顶板陆源物质的影响减弱,而海水的影响增强。沉积环境的阶段性变化是导致剖面上下有机硫与黄铁矿硫比值相差悬殊的原因。辰溪煤中稀土元素与铁呈现了显著的正相关性($n=11, r=0.95$),说明其物质来源和富集条件有一定相似性,即陆源物质和海水共同影响的结果。稀土元素的分布模式以及 Σ REE与灰分、Si、Al的相关性说明了其主要来源于陆源物质;辰溪煤中 δCe 与 δEu 在剖面上变化很小,说明海水对煤中的稀土元素存在重新改造的作用。

关键词: 高硫煤 稀土元素 赋存形态

Abstract: The contents of rare earth elements (REEs) in high sulfur coal of Late Permian from Chenxi coalfield, with the organic sulfur content of 7.75%, have been analyzed by HR-ICP-MS. The Σ REE varies from 38.84 to 305.85 $\mu\text{g/g}$, with the weighted average of 104.57 $\mu\text{g/g}$ which is higher than that of the world coal and similar to that of Chinese coal. The negative anomalies of Ce and Eu in Chenxi coal, with the δCe from 0.74 to 0.84 and the δEu from 0.55 to 0.69, indicate the influence by marine and by terrigenous materials, respectively. The two-stage change of REE content and distribution patterns in the profile suggested the fluctuations in coal-forming environment, with the terrigenous influence decreasing and the marine impact increasing from the floor to the roof of coalseam. This results in the significant difference of the proportion of organic and pyrite sulfur. The pyritic sulfur and the Σ REE in Chenxi coal present a good positive correlation ($n=11, r=0.95$), which indicates the common source and similar enrichment conditions involving both terrigenous material and marine influence. The distribution pattern of the REEs, the correlation between the Σ REE and ash yield, Si, Al illustrate that the REEs mainly derive from terrigenous materials. The narrow range of δCe and δEu in the profile can be explained by the seawater rebuilding of the rare earth elements in the coal.

Key words: high-sulfur coal rare earth element mode of occurrence

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