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西太平洋海山富钴结壳稀土元素(REE)组成原位LA-ICPMS测定

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摘要:

利用激光剥蚀电感耦合等离子体质谱(LA-ICPMS)微区原位分析方法,对采自西太平洋海山具完整三层结构的富钴结壳样品进行了稀土元素(REE)含量测定,结果表明,虽然均产于西太平洋海山且均具有明显的三层结构,富钴结壳化学组成受地理位置和沉积环境影响很大。绝大多数西太平洋富钴结壳具有高 $\Sigma$ REE、高LREE/HREE、 $\delta$ Ce正异常和 $\delta$ Eu基本无异常或微弱正异常的特点,显示它们主要由正常海水沉积形成。结壳不同层圈之间REE组成有较大的区别,其原因主要在于其形成环境和矿物组成不同。样品O327稀土元素总量( $\Sigma$ REE)由亮煤层到疏松层到外层逐渐升高,且亮煤层 $\delta$ Ce和Y/Ho变化非常大,最大值分别为38.61和105.5,显示该层生长环境较为氧化且相对动荡,而样品O346中三层结构的 $\Sigma$ REE都非常高,且变化趋势与O327正好相反,从亮煤层到致密层 $\Sigma$ REE有降低的趋势。亮煤层形成时海水相对较氧化的环境有利于铁锰氧化物的形成和 $Ce^{4+}$ 等稀土元素的吸附,导致其中 $\Sigma$ REE较疏松层和外层为高,而后期磷酸盐化导致REE元素的迁移和亏损。在结壳生长剖面上,由最外层到疏松层和亮煤层, $\delta$ Ce呈明显上升趋势,且变化范围趋大,说明该结壳所处的海水环境在由老至新的生长过程中由相对动荡和氧化变为相对平静和还原。

英文摘要:

Rare earth elements (REEs) and trace elements compositions of ferromanganese crusts collected from North-West Pacific seamounts were analyzed by using an in-situ laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS). The results show that records of elements composition of ferromanganese crusts differ significantly between localities even though they have similar oceanographic settings and three-layered structures. Most of these samples show high total REE concentrations ( $\Sigma$ REE), high LREE/HREE, marked positive Ce anomaly ( $\delta$ Ce) and non- or weakly positive Eu anomaly ( $\delta$ Eu), suggesting that most of them were of hydrogenetic origin. The REE compositions are quite different among various layers in the crusts, which probably results from their different growth environments and different mineral assemblages. In sample O327, the  $\Sigma$ REE vary widely over three layers and increasing from inner to outer layers. The values of  $\delta$ Ce and Y/Ho in inner layer of sample O327 are quite high and varies dramatically, with maximums of 38.61 and 105.3 respectively. This shows that growth environment of inner layer of sample O327 was much more turbulent and oxidized than the ones of other two layers. On the contrary, the  $\Sigma$ REE in sample O346 are quite high in all three layers and decline slightly from the inner to outer layers. The relatively oxidized environment of the seawater during growth of the inner layers might favor formation of ferromanganese oxyhydroxides and absorption of  $Ce^{4+}$ , resulting in a higher Ce content and  $\Sigma$ REE in the inner layers. On the other hand, phosphatization events caused strong depletion of REE in the crusts. In the growth profile of the crusts,  $\delta$ Ce increasing and varying more greatly from outer to inner layers, suggesting that the growth environments of these crusts varied from relatively turbulent and oxidized to peaceful and reduced during growth.

关键词: [富钴结壳](#) [稀土元素\(REE\)](#) [原位分析](#) [激光剥蚀电感耦合等离子体质谱\(LA-ICPMS\)](#)

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