

Geochemical characteristics of Limahe intrusion in Pan-Xi district (SW China): Relation to Emeishan basalts and constraint on ore genesis

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The Limahe mafic-ultramafic intrusion, is one of a number of Cu-Ni sulfide deposits in Pan-Xi district (SW China). The Limahe body is also temporally and spatially associated with Emeishan basalts and is composed of periodite and gabbro-diorite, in which periodites occur in veins intruding gabbro-diorite, and all Cu-Ni sulfide ores are hosted in peridotites, suggesting Cu-Ni ores and peridotites were formed later than gabbro-diorite. Major element, trace element and Sr-Nd isotopic geochemical characteristics are reported. Age-corrected ($^{87}\text{Sr}/^{86}\text{Sr}$) and $\epsilon_{\text{Nd}}(t)$ isotope values, ranging from 0.687062 to 0.709298 and from -0.6 to -4.13 respectively, are partly overlap the field of Emeishan basalt and OIB, but all lie between upper crust and OIB generally having trend towards upper crust. The extremely low ($^{87}\text{Sr}/^{86}\text{Sr}$) can be attributed to strong alteration effects. The similar chondrite-normalized REE patterns and primitive mantle-normalized trace element patterns to ELIP imply the genetic relation with Emeishan basalt. However, remarkably negative Nb, Ta and Ti anomalies exist on the primitive mantle-normalized patterns, characterizing crustal contamination. The lower Nb/U (<30), $(\text{La}/\text{Nb})_{\text{PM}}$ and $(\text{Th}/\text{Ta})_{\text{PM}}$ ratios (<1) indicate the contamination of the upper crust material. Moreover, the diagram of $\log(\text{Th}/\text{Yb})_{\text{PM}}$ vs. $\log(\text{Ta}/\text{Th})_{\text{PM}}$, in which the Limahe intrusion exhibits relatively high $(\text{Th}/\text{Yb})_{\text{PM}}$ and low $(\text{Ta}/\text{Th})_{\text{PM}}$ values, also supports the same conclusion. The extent of crustal contamination of the Limahe rocks estimated by Nd isotope data was estimated to be within 8.2 to 15.0%. Good correlations between MgO and major element oxides suggest the fractional crystallization of olivine, clinopyroxene and minor plagioclase in the deep-seated chamber. Therefore, upper crustal contamination would increase SiO_2 contents or lower FeO contents, which was the trigger for formation of the immiscible sulfide melts. The denser sulfide melts drop down the bottom of magma chamber. Thus, the immiscible sulfide melt was forced out of the deep-seated chamber, and then flowed along the structural fracture, intruded gabbro-diorites.

This research was supported by Program for New Century Excellent Talents in University (Grant No. NCET-04-0728), Programme of Excellent Young Scientist Project of the Ministry of Land and Resources, and 111 Project (B07011).

An ecological explanation for high resolution stable carbon isotope stratigraphy approaching the Permian/Triassic boundary in Meishan area, South China

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High resolution carbon isotope stratigraphy has been generated from marine carbonate and organic carbon during the Changhsingian at the end of Permian and earliest Triassic from Meishan in south China. The result reproduces a gradual decline in $\delta^{13}\text{C}_{\text{carb}}$ during the Changhsingian, but this decrease trends is superimposed by three large positive excursions in $\delta^{13}\text{C}_{\text{carb}}$ at lower, middle and upper interval. This observation maybe reflect changes in the rate of organic matter burial during the late Permian. The large positive positive $\delta^{13}\text{C}_{\text{carb}}$ excursions would present the enhanced organic carbon burial, presumably in response to episodic transgression-associated anoxia.

The $\delta^{13}\text{C}_{\text{org}}$ values indicate much more variable compared to the $\delta^{13}\text{C}_{\text{carb}}$, however the values of $\Delta^{13}\text{C}$ ($\delta^{13}\text{C}_{\text{carb}} - \delta^{13}\text{C}_{\text{org}}$) have fallen in only two groups: (1) between 28~ 30.3‰ and indicative of maximal fractionation of carbon isotopes by phytoplanktonic producers; (2) greater than 30.5‰ (< 33.3‰), and apparently indicative of significant input from bacterial biomass in bottom water. The $\delta^{13}\text{C}_{\text{org}}$ of each of these groups parallels (separately) the more detailed profile of $\delta^{13}\text{C}_{\text{carb}}$, strongly suggesting that differences in $\delta^{13}\text{C}$ of both inorganic and organic carbon related to difference in $\delta^{13}\text{C}$ of $\text{CO}_2(\text{aq})$ in photic zone. The multiple coeval negative excursions in $\delta^{13}\text{C}$ of both carbonate and organic carbon occurred before extinction intervals, suggesting that isotopically CO_2 was recycled into the photic zone from stagnant water below. The pattern and magnitude of change in both $\delta^{13}\text{C}_{\text{carb}}$ and $\delta^{13}\text{C}_{\text{org}}$ are easy to reconcile with the gas hydrate hypothesis as the explanation for abrupt negative $\delta^{13}\text{C}$ anomalies at extinction interval. The methane-consuming associations of sulfate-reducing bacteria may have contributed to this dramatic negative shift.

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