Molybdenum isotope behavior and its implication during weathering of basalt from intensive to extreme profile in Hainan Island

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We investigate Molybdenum isotopic compositions of two basalt weathering profiles developed on Neogene in Hainan Island, South China. The two profiles (Penglai and Nanyang) differing in the weathering intensity for their intensive to extreme are compared, where with a similar conclusion that light Mo isotope was in general retained into residual minerals, while the heavy isotope of Mo was leached into the fluid out of the weathering profile.

Narrow variable compositions of $\delta^{98/95}$Mo (-0.64‰~0.15‰) are observed, compared to parent rock (-0.11±0.05‰, 2sd) in Penglai intensive profile which displays a discontinuity at 1.3 m. A successively decreasing tendency of $\delta^{98/95}$Mo is occurred above 1.3 m as the function of depth, accompanying by the identical descending of TOC content, which illustrates that organic matter is preference to absorb the heavier Mo isotope, by a positive correlation (r=0.99) is observed between $\delta^{98/95}$Mo and TOC (>0.1%); whereas with a weak correlation (r=0.57) with depth below 1.3 m due to the low content of TOC (<0.1%), which couldn't take up sufficient Mo selectively, where Mo concentration varies narrowly from 2 to 4 ppm almost from top to bottom of profile.

In contrast, two abnormal areas are found in Nanyang extreme profile, where large variations of $\delta^{98/95}$Mo are observed according to the positive abnormity of Ce. Meanwhile, $\delta^{98/95}$Mo composition revealed the significant fractionation mechanism. The $\delta^{98/95}$Mo ratios approximating to -0.15‰ with the measurement uncertainties at the first abnormal area in the upper unit, are controlled by the antagonistic action of both TOC and oxidation environment. However, the second abnormal area, where with negative composition of Mo isotope (about -1.1‰), was happened of the simultaneous concentration of Mo and Ce, with the low content of TOC making no difference. The Ce abnormity here not just indicated oxidation conditions, but the existence of hydrothermal fluid because of positive Eu*. Therefore, $\delta^{98/95}$Mo here may be fractionated by oxidation condition and hydrothermal fluid. Overall, Fe_2O_3 negatively correlates with $\delta^{98/95}$Mo (r=0.67) and positively correlates with Mo concentration (r=0.86) throughout the whole weathering profile.