Strontium isotopic change during alteration of oceanic plateau basalt and its impact for the mid-Cretaceous ocean chemistry

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It is commonly accepted that submarine volcanic activity was much greater during the mid-Cretaceous than at present. Larson (1991) demonstrated that the production rate of new oceanic crust at the mid-ocean ridges was drastically increased and most of large oceanic plateaus were formed between 120-80 Ma. In this period, Sr isotope ratio of seawater is known to have shifted to lower $^{87}Sr/^{86}Sr$ value (negative excursion; Jones et al., 1994). Seawater $^{87}Sr/^{86}Sr$ ratio is primarily controlled by the balance between radiogenic Sr (high $^{87}Sr/^{86}Sr$) derived from continental crust via river runoff and nonradiogenic Sr delivered from oceanic crust via seafloor hydrothermal circulation. Thus, the temporary decrease in seawater $^{87}Sr/^{86}Sr$ is generally considered to have been caused by the drastic increase of hydrothermal activity during the mid-Cretaceous. However, it is still unclear that whether excess hydrothermal flux was generated by increased rates of ocean-crust production or oceanic plateau formation.

In this study we present new geochemical and isotopic data of basement basalts drilled at the Ontong Java Plateau during Ocean Drilling Program Leg 130. The Ontong Java Plateau is well known as the largest oceanic plateau in the world and thus is considered to be the best example to assess the role of hydrothermal alteration of oceanic plateau in generation of negative Sr isotope excursion in seawater. Sr concentrations for fresh samples are positively correlated with concentrations of high field strength elements (HFSE) such as Zr, Nb, Hf, and Ta. On the other hand, Sr concentrations for altered samples are significantly departure from the Sr-HFSE regression lines toward the elevated Sr values, which indicates significant enrichment of Sr in altered samples. The Sr-enrichments are positively correlated with $^{87}Sr/^{86}Sr$ values, suggesting that $^{87}Sr/^{86}Sr$ values are also elevated during alteration. Simple mass balance calculation shows that the enrichment of Sr and elevation of $^{87}Sr/^{86}Sr$ can be explained by simple addition of Sr from seawater to the rocks. This implies that alteration of oceanic plateau basalts were not the main source of basaltic Sr causing the strong negative excursion at the mid-Cretaceous.