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Complementary Roles of Ontong Java and Kerguelen Large Igneous Provinces emplacement in Early Cretaceous Ocean-Atmosphere perturbations

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Ontong Java Plateau (OJP) and Kerguelen Plateau (KP) are the first and second most voluminous Large Igneous Provinces (LIP) in the world and could be the drivers of paleoenvironmental perturbations in Early Cretaceous. OJP, combined with Manihiki and Hikurangi plateaus, formed the Ontong Java Nui LIP between 125 to 86 Ma. On the other hand, the older KP formed from 120 to 90 Ma. More recently, discoveries of older volcanism on Naturaliste and Wallaby plateaus in the Indian Ocean are attributed to Kerguelen hotspot activity between 130 and 124 Ma. However, some age gaps exist and the spatiotemporal relationships among these volcanic events are unclear. Thus, the paleoenvironmental impacts attributed to Kerguelen LIP has been limited.

IODP Expedition 369 recovered a volcanic sequence at Site U1513, which is the first stratigraphically controlled representation of volcanism on Naturaliste Plateau. Of the 82 m recovered section, only the two 2.3-5.2 m thick uppermost flows appear to have been emplaced under water and the rest were subaerial. Combined with ^{40}Ar-^{39}Ar dating, the results suggest that volcanic activities may have started as continental flood basalt eruptions since 134 Ma and may have evolved to submarine emplacement as Greater India rifted away from Australia at around 128 Ma. Hydrothermal alteration and younger dike intrusions indicate that volcanism continued from 126-113 Ma on Naturaliste Plateau, during which the main KP was constructed. A previous study estimates that volcanism on Naturaliste Plateau and geochemically similar 136-124 Ma flood basalts in India, Australia, and Antarctica, indicate a minimum erupted volume of 1.2 million km^3. Together, these findings suggest that significant release of volcanic CO_2 during subaerial eruptions may have occurred and may have been responsible for the higher pCO_2, increased weathering, and increasing seawater Sr isotopic trends from 133-130 Ma, prior to OAE 1a event at 121 Ma. Largely submarine Ontong Java eruption events, combined with contemporaneous emplacement of the central and northern KP may have driven the decreasing seawater Sr isotope and a protracted excursion, followed by several switches, to mantle Os isotopic values at 125-115 Ma, accompanied by ocean warming and acidification.