Controls on barium and radium-226 distributions along GEOTRACES GP15

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Radium-226 (226Ra; t1/2= 1,602 yr) and Ba are strongly correlated to one another in the ocean. However, the extent to which this correlation reflects an active biogeochemical coupling versus a passive sharing of the same circulation is unclear. The GEOTRACES GP15 section provides an ideal dataset with which to test these hypotheses. Radium-226 activities and Ba concentrations were determined in the Pacific along 152°W from 55°N to 20°S on samples collected between September–November 2018. We isolated the circulation component of the distribution by performing an optimum multiparameter analysis of the encountered water masses and modeled the distributions of 226Ra and Ba based solely on physical transport of these water masses. The difference between the modeled and observed 226Ra and Ba distributions reflects three significant non-conservative processes that influence 226Ra and Ba distributions in the Pacific. First, in the north Pacific, intermediate waters (0–1,500 m) exhibit substantial deficits in 226Ra and Ba that are likely caused by their incorporation into barite. Second, significant positive 226Ra and Ba anomalies are found in deep waters (below 3,000 m) along the entire GP15 section, reflecting accumulation of 226Ra and Ba from sediment diffusion and particle dissolution, respectively. Third, there are persistent positive 226Ra anomalies between 5°N and 20°S around 2,500 m. Importantly, there are no corresponding Ba anomalies, suggesting a solute source unique to 226Ra, such as from hydrothermalism. We augmented this statistical analysis with measurement of particulate 226Ra, Ba, and Ba isotopes, which bring additional insight into the sources of particulate material to the deep ocean.