Tectonic Evolution And History Of The South China Sea: Clues From Re-Os Isotopes

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ABSTRACT

The South China Sea (SCS) is the largest marginal basin in the world, and is located in the confluence of three major tectonic plates (Pacific-Philippine Sea, Indo-Australia, Eurasia). Its tectonic history and evolution throughout the Cenozoic has been the subject of much discussion with regards to its mechanism, timing, and relationship to neighboring geological features. We conducted the first Re-Os isotope study of the SCS cores recovered from ocean drilling (ODP-Ocean Drilling Program and IODP-International Ocean Discovery Program) and from Philippine oil exploration wells in order to investigate whether or not the basin's tectonic evolution will be reflected in the seawater Os isotope record. These cores represent the northwest and southeast conjugate margins of the SCS, and should have complementary records of the tectonic events in the basin. We found three important negative excursions in the SCS seawater Os isotope record at ~33 Ma, ~23 Ma, and ~13-6 Ma, which are temporally related to tectono-magmatic events. At the northern margin, the record starts with the lowest $^{187}Os/^{188}Os$ values of 0.37 and 0.32 for the oldest samples, which then progress to more radiogenic values for younger sediments. The trend is consistent with the start of seafloor spreading at ~33 Ma that saw the peak in the flux of mantle-derived material, which later slowed down until the second peak at ~23 Ma. However, these unradiogenic values also mark the Eocene-Oligocene Transition and more likely implies SCS connectivity to global ocean circulation since pre-Oligocene. In both margins, slight to marked decrease in $^{187}Os/^{188}Os$ values deviate from the global trend and coincides with the ridge jump at ~23 Ma. In the southern conjugate margin, $^{187}Os/^{188}Os$ show a general decreasing tendency opposite to the global trend starting from Mid- to Late Miocene (~13-6 Ma). Mass balance modeling suggests that the two younger negative excursions may be accounted for by mantle and hydrothermal Os inputs of ~374 mol/my at ~23 Ma and post ~13 Ma. We suggest that the post ~13 Ma protracted decrease in $^{187}Os/^{188}Os$ values for the southern margin reflects localized input of mantle-derive lithogenic Os from the Luzon Arc combined with post-spreading magmatic intrusions, and possibly gradual changes in ocean circulation at the southern East Sub-basin.