Quantifying Dispersal from Hydrothermal Vent Fields in the Western Pacific Ocean

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Larval dispersal due to deep-ocean circulations is one of the major factors influencing gene flow, diversity, and distributions of vent animals. Some vent larvae may disperse higher in the water column, where their dispersal patterns are less constrained by bottom topography. They can be transported over greater distances by shallower, directional ocean currents (e.g., deep penetration of western boundary currents). Given quantitative information about larval development and behavior, ocean circulation models should be able to assess species-specific connectivity patterns, both on intra- and inter-regional scales. By combining a biophysical model and deep-profiling float experiments, we quantify potential larval dispersal of vent species via ocean circulation in the western Pacific Ocean. We demonstrate that vent fields within back-arc basins could be well connected without particular directionality, while basin-to-basin dispersal is expected to occur infrequently, once in tens to hundreds of thousands of years, with clear dispersal barriers and directionality associated with ocean currents. The southwest Pacific vent complex, spanning over 4,000 km, may be connected by the South Equatorial Current for species with a longer than average larval development time. Depending on larval dispersal depth, a strong western boundary current, the Kuroshio Current, could bridge vent fields from the Okinawa Trough to the Izu-Bonin Arc, 1,200 km apart. Outcomes of this study should help marine ecologists to estimate gene flow among vent populations and to design optimal marine conservation plans to protect one of the most unusual ecosystems on earth.