Supplementary Sample Analyses

Inclusion of Taxa. This decision tree was used to include or exclude taxa from the analysis:

1. Can the taxon be identified in both its adult and larval stage so that there is a clear match between planktonic and benthic samples?
   YES- Include in the analysis.
   NO- go to question 2.
2. For a taxon found only as an adult, does it have a generic larval morphotype?
   YES- Include in analysis, but pool with other benthic taxa with the same larval morphotype. For example, *Paralvinella* sp. larvae are likely to be nectochaetes; however, nectochaetes could also include polychaetes in other families such as ampharetids. Therefore, several groups in the benthos are grouped and matched with a single category in the plankton.
   NO- Go to question 3.
3. For a given unmatched larval morphotype or adult taxon, is a match based on morphology not possible? For example, a gastropod species that loses its protoconch after settlement and can be matched to a larval specimen only through genetics.
   YES- Exclude from the analysis.
   NO- Go to question 4.
4. Can the adult not be taxonomically assigned at higher resolution than Class (e.g., unidentified polychaete)?
   YES- exclude
   NO- This pathway does not occur.

Grouping of Taxa

The benthic, vent-endemic, metazoan species analysed in this study were limited to those likely to be sampled as adults using a slurp or colonization surface (i.e., no highly mobile fish or crustaceans). "Unknown" sub-categories were used for morphotypes that could be assigned reliably to vent taxa but did not belong to any of the "known" categories in either the plankton or the benthos. For groups of taxa in which taxonomic resolution differed between the plankton and benthos, the coarsest grouping was used for both. For instance, chaetosphaerids and nectochaetes are generic larval morphotypes containing multiple polychaete species. As chaetosphaerids and nectochaetes have no one-to-one match with species in the benthos, taxa that were likely to have these generic larval forms were pooled in the benthos and matched to these larval morphotypes. Genetic evidence supports some of these groupings but others are informed by morphology alone and remain speculative. For the Mariana Trough planktonic samples, multiple morphotypes were identified within these two generic forms. In the cases where these morphotypes were supported by genetic evidence, they were kept separate in the analysis. Grouping taxa at a higher taxonomic rank can lead to false positive matches between the plankton and benthos. To limit this problem, taxa with larvae that could not be morphologically identified to a taxonomic rank below class were excluded as described in the decision tree. This restricted the analysis primarily to gastropods and polychaetes.

Table S1. Component taxa of the two pooled larval groups (Chaetosphaerid and Nectochaete) that occurred across all vent fields but corresponded to different sets of benthic taxa in each. For Mariana Trough, the Chaetosphaerid plankton group included the morphotypes listed here, distinct from another morphotype (large, *Archinome*-like) listed in the Table S2; the Nectochaete plankton group included a classic nectochaete morphotype that matched with terebellids in the benthos, distinct from a more complex form that was identified genetically as Hesionidae and listed in Table S2. Details on genetic analysis provided in Genetic Identification.

Plankton Group	Pescadero Basin Benthos	EPR pre-eruption Benthos	EPR post-eruption Benthos	Mariana Trough Benthos	Mariana Trough Plankton
Chaetosphaerid	Spionidae,	*Prionospio sandersi*, *Laminatubus alvini*	*Prionospio sandersi*	Spionidae	Chaetosphaerid 'large, little punk', Chaetosphaerid, 'small'
Nectochaete	Ampharetidae, *Paralvinella* sp.	*Amphisamytha galapagensis*	*Amphisamytha galapagensis*, Hesionidae, *Paravinella grasslei*	Ampharetidae, *Paralvinella* sp., *Paralvinella* sp. (*hessleri* ?)	Nectochaete

Genetic Identification

Methods. Specimens from the benthos and plankton at Pescadero Basin were sent for sequencing to the Canadian Centre for DNA Barcoding; specimens from the plankton at Mariana Trough were sequenced by collaborators. For Pescadero Basin, they included 74 benthic and 18 planktonic individuals for the mitochondrial cytochrome oxidase subunit 1 (CO1) gene. For the Mariana Trough, they included 78 plankton: 36 gastropods for the histone 3 (H3) gene and 5 for the 28S gene; 17 polychaetes for CO1 gene and 19 for the 28S gene, and 1 bivalve for the 28S gene.

Pescadero Basin. Of the Pescadero Basin specimens sent for sequencing, 43 benthic individuals (58%) and 10 planktonic individuals (55%) were successfully sequenced. These sequences, and those that clustered into BINs (Barcode Index Number), are publicly available in the BOLD Systems database under projects PESBE and PESPL, respectively. Two bivalve specimens from the plankton slurps matched to *Calyptogena* sp. As these results were from a limited number of D-stage (early life stage) specimens, *Calyptogena* sp. was not included in the overall analysis. For the gastropod neomphalid-like morphotype that clustered to BOLD:ADP4603, the sequences had no match to sequences in the NCBI database; this potentially could be a new species. Genetic sequences of gastropods collected in grab samples on the same cruise suggest that Neolepetopsidae, *Phymorhynchus* sp. and Provannidae were also present in the benthos, but we only included slurp samples in the analyses.

Mariana Trough. Of the Mariana Trough planktonic specimens, 60 were sequenced successfully: 24 gastropods for the H3 gene (67%) and 3 for the 28S gene (60%), 17 polychaetes for the CO1 gene (100%) and 17 for the 28S gene (89%), and the 1 bivalve for the 28S gene (100%). Multiple morphotypes had been distinguished for both the Nectochaete and Chaetosphaerid groups, and the sequences supported splitting each of them into two separate subgroups. The sequences of one set of Nectochaete morphotypes, including the 'classic' form, matched with terebellids in the benthos, including *Paralvinella* sp., and Ampharetidae, and were listed as Nectochaete group. Sequences of a second set of 'complex' nectochaete morphotypes matched with Hesionidae in the benthos, kept separate as Complex nectochaete group (Table S2). Sequences of two of the chaetosphaerid morphotypes ('small' and 'large, little punk')

matched with Spionidae and were listed as Chaetosphaerid group, whereas the sequence of a third morphotype did not and was kept separate as Chaetosphaerid, large *Archinome*-like. Sequences of a few specimens that had siboglinid-like larval morphotypes appeared instead to be from the infraclass Scolecida (Families Capitellidae and Maldanidae); however, as very few individuals were successfully sequenced, we did not feel sufficiently confident of this grouping to include it in the analyses.

Table S2. Counts of vent taxa included in analyses for: A) Pescadero Basin; B) northern East Pacific Rise; and C) southern Mariana Trough. P = presence in Mariana Trough. Component taxa of the chaetosphaerid and nectochaete groups are in Supplementary Sample Analyses. Taxa that were collected or observed outside of the dedicated sampling scheme (e.g., in benthic grab samples or video) are not included.

A) Pescadero Basin Taxa	Group	Benthos	Plankton
Gastropod, unk., *Cyathermia*-like	Gastropoda	2	1
Gastropod, unk., neomphalid-like	Gastropoda	626	52
Lepetodrilus spp.	Gastropoda	0	2
Peltospirid.	Gastropoda	168	15
Amphinomid	Polychaeta	5	0
Chaetosphaerid group	Polychaeta	4	110
Nectochaete group	Polychaeta	18	8
Nereid	Polychaeta	1	0
Ophryotrocha sp.	Polychaeta	8301	207
Polynoid	Polychaeta	26	4

B) East Pacific Rise Taxa	Group	Pre-eruption		Post-eruption	
		Benthos	Plankton	Benthos	Plankton
Bathymodiolus thermophilus	Bivalvia	140	0	315	1
Catillopecten vulcani	Bivalvia	0	0	2	0
Bathymargarites symplector	Gastropoda	17	1	0	1
Clypeosectus delectus	Gastropoda	57	4	82	0
Ctenopelta porifera	Gastropoda	0	0	16	2
Cyathermia naticoides	Gastropoda	1	99	1367	13
Echinopelta fistulosa	Gastropoda	0	0	0	2
Eulepetopsis vitrea	Gastropoda	70	4	45	0
Gastropod, unk. A	Gastropoda	0	27	4	5
Gastropod, unk. W	Gastropoda	0	4	0	0
Gastropod, unk. 5	Gastropoda	0	2	0	23
Gastropod, unk. 9	Gastropoda	0	0	0	1
Gorgoleptis emarginatus	Gastropoda	1	1	10	55
Gorgoleptis sp.	Gastropoda	0	5	0	0
Gorgoleptis sp. 3	Gastropoda	0	0	0	1
Gorgoleptis spiralis	Gastropoda	0	3	96	6
Laeviphitus sp.	Gastropoda	0	9	0	10
Lepetodrilus spp.	Gastropoda	210	222	28787	665
Lirapex granularis	Gastropoda	0	1	0	5
Melanodrymia aurantiaca	Gastropoda	0	8	0	0
Melanodrymia galeronae	Gastropoda	0	0	0	1
Neomphalus fretterae	Gastropoda	0	5	0	1
Pachydermia laevis	Gastropoda	0	2	45	5
Peltospira sp.	Gastropoda	0	49	0	20
Peltospirid	Gastropoda	0	3	0	2
Planorbidella planispira	Gastropoda	0	0	0	3
Provanna sp.	Gastropoda	3	0	0	0
Rhynchopelta concentrica	Gastropoda	1	3	5	0
Sutilizona theca	Gastropoda	0	12	1	12
Archinome rosacea	Polychaeta	105	1	7	3

Chaetosphaerid group	Polychaeta	276	8	39	71
Galapagomystides aristata	Polychaeta	1	0	0	0
Glycerid	Polychaeta	2	0	1	4
Nectochaete group	Polychaeta	1091	14	617	35
Nereis sp.	Polychaeta	20	0	5	1
Nicomache sp.	Polychaeta	18	0	0	0
Ophryotrocha sp.	Polychaeta	47	0	1451	22
Polynoid	Polychaeta	12	0	16	8
Siboglinid	Polychaeta	154	0	1588	0
Thermiphione risensis	Polychaeta	4	0	0	0
Helicoradomenia acredema	Solenogastres	8	0	1	0

C) Mariana Trough Taxa	Group	Benthos	Plankton
Alviniconcha sp.	Gastropoda	P	P
Anatoma sp.	Gastropoda	P	P
Desbruyeresia sp.	Gastropoda	P	P
Gastropod, unk., cf. *Gorgoleptis emarginatus*	Gastropoda	0	P
Gastropod unk., cf. *Laeviphitus japonicus*	Gastropoda	0	P
Gastropod, unk., protoconch 460-470µm	Gastropoda	0	P
Lepetodrilid	Gastropoda	0	P
Lepetodrilus spp.	Gastropoda	P	P
Lirapex sp.	Gastropoda	P	0
Peltospirid.	Gastropoda	0	P
Phymorhynchus sp.	Gastropoda	P	P
Provanna sp.	Gastropoda	P	0
Pseudorimula sp.	Gastropoda	0	P
Shinkailepas sp.	Gastropoda	P	0
Symmetromphalus sp.	Gastropoda	0	P
Ventsia sp. cf. *tricarinata*	Gastropoda	0	P
Chaetosphaerid group	Polychaeta	P	P
Chaetosphaerid, large, *Archinome*-like	Polychaeta	0	P
Chrysopetalidae	Polychaeta	P	0
Complex nectochaete group	Polychaeta	P	P
Glycerid	Polychaeta	0	P
Nectochaete group	Polychaeta	P	P
Polynoid and iphionid	Polychaeta	P	P

Full taxonomic lists have been submitted to, or are in the process of submission to, the online repository BCO-DMO under PIs Beaulieu (https://www.bco-dmo.org/person/665150) and Mullineaux (https://www.bco-dmo.org/person/472886)