Supplementary Material

1. Fe(II) oxidation half lives

Fe(II) oxidation process is shown to be pseudo-first-order with respect to Fe(II) concentration as shown in Eq. (1) (King, 1998; Millero et al., 1987) and the Fe(II) half-life depends on pH and dissolved oxygen concentrations [O_2].

$$-\frac{d[Fe(II)]}{dt} = k_1[Fe(II)] \quad (1)$$

where k_1=k [OH-]2 [O2], log k = 21.56 – 1546/T−3.29 I1/2+1.52 I, I = 0.0199 S, and $[OH^-]=10^{-pKw+pH}$, where T is the temperature in Kelvin, I is the ionic strength, and S is the salinity. The half-life of Fe(II) is: $t_{1/2}$ = ln2/k_1. [O2] is ~ 140 μmol/l (https://www.nodc.noaa.gov/OC5/woa13/). The samples from Mata Ua and West Mata have pH (SWS, seawater scale) values between 7.62 and 7.76 and between 7.72 and 7.74. pKw is calculated using the program of Lewis and Wallace (1998). Thus, the calculated Fe(II) half-life for Mata Ua and West Mata plumes was computed to be 3.2 ±0.7 h and 2.7 ±0.2 h (average ±SD). For Mata Ua samples, a delay of ~ 4 h between sampling and filtration corresponds to about 1.3$t_{1/2}$. V13 station was about 5 km away from the summit of West Mata. Previously, Speer and Thurnherr (2012) found the western flow rate of 10 cm s^{-1} in Lau Basin near the study area from 1700 to 1800 m. It should be noted the current rate and direction are variable and is greatly influenced by the hydrothermal venting and the local topography. The mean current rates of 20 ~ 40 cm/s have been observed from 1700 to 2100 m on the Endeavour segment of Juan de Fuca Ridge in the northeast Pacific Ocean (Thomas et al., 1989). We assume a mean current rate of 10 cm s^{-1} for West Mata samples, then the time for plume dispersal is about 13.8 h. By adding ~ 4 h of sampling and filtration, the delay time of these samples corresponds to roughly 6.6 $t_{1/2}$.

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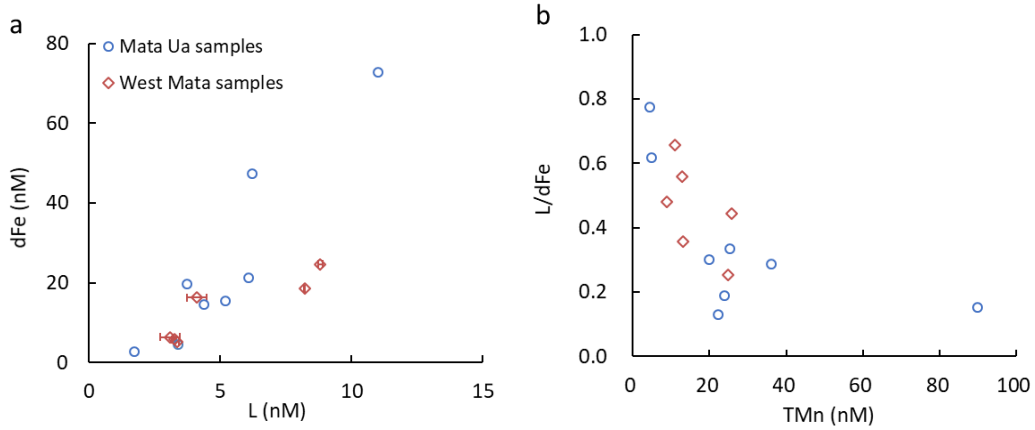

Fig. S1. The correlations between dFe and [L] (a), dFe and [L]/dFe (b) for Mata Ua and West Mata samples

Table S1

Fe and H_2S concentrations and Fe isotope compositions in hydrothermal vent fluids.

Vent site	Lat	Long	Depth (m)	Temperature (°C)	pH	δ^{56}vFe (‰)	2SD	Fe (mM)	H_2S (mM)	Fe/ H_2S
Mata Ua (V9)	-15.0168	-173.78764	2356	330	3.76	-0.54	0.05	1.00	3-9	0.1-0.3
West Mata (V13)	-15.09441	-173.74909	1294	22	3.78	0.13	0.04	0.73	0.1	7.28