

Table 1

Locations and sulfur isotope compositions of fluids and sulfide minerals from black smoker systems, and of oceanic serpentinites and gabbros from various tectonic settings

Name	Location	Hydrothermal system	Temperature of fluids	Basement rocks	Mineral assemblages	$\delta^{34}\text{S}_{\text{sulfide}}$	$\delta^{34}\text{S}_{\text{sulfate}}$	References
<i>Black smoker basalt-hosted hydrothermal systems</i>								
EPR	21°N, Pacific	Black smoker	380 °C ± 30 °C	Basalts		+1.4‰ to +3.0‰		Arnold and Sheppard (1981)
EPR	21°N, Pacific	Black smoker	260–350 °C 350 °C	Basalts	wu, cpy, py, cu + anh Black smoker: sph, py, cpy Dead chimney: sph, cpy, py, S Basal mound: sph, cpy, py Sediment: po, sph, py Vent fluid	+1.3‰ to +4.1‰ +1.8‰ to +1.9‰ −0.4‰ to +3.0‰ +1.5‰ to +2.3‰ +0.7‰ to +1.3‰ +3.4‰ to +3.7‰	+19.6‰ to +20.8‰ anh: +18.9‰	Styrt et al. (1981) Kerridge et al. (1983)
Juan de Fuca	Pacific	Black smoker	220–284 °C	Basalts	Fluid Chimney sulfides: sph, cpy, isocu, po	+4‰ to +7.4‰ +1.6‰ to +5.7‰	+20.4‰ to +21.4‰	Shanks and Seyfried (1987)
Galapagos Rift	85° 55'W	Black smoker	Low <i>T</i> (17 °C)	Basalts	cpy, py /source of sulfur: sw cpy, py ± ma, sph, ga, ba	+5.4‰ to +6.3‰ +2.7‰ to +5.5‰		Skirrow and Coleman (1982) Knott et al. (1995)
TAG	26° 08'N, MAR		360–366 °C / 273–301 °C	Pillow lavas/ Basalts	py, cpy, anh py, cpy, sph, anh (stockwork zone) py, ma, sph, cpy, anh (vertical section through the mound)	+6.5‰ to +8.8‰ +0.3‰ to +10.2‰ +4.4‰ to +8.9‰	+21.4‰ to +22.8‰ +20.5‰ to +21.5‰ +19.2‰ to +20.9‰	Chiba et al. (1998) Gemmell and Sharpe (1998) Knott et al. (1998)
Broken Spur	29° 10'N, MAR	Black smoker	357–366 °C	Pillow lavas/ Basalts	ma, py, cpy, sph, wu, isocu, po, anh	−0.8‰ to +2.4‰	+ 19.3‰	Duckworth et al. (1995)
Mariana back arc	18° 13'N	Black smoker	287 °C	Basalts	ba, sph, ga, cpy, py Vent fluids	+2.1‰ to +3.1‰ +3.6‰ to +4.8‰	+21‰ to +22‰	Kusakabe et al. (1990)
Hole 504B	Eastern Pacific			Volcanic section and sheeted dikes	Pillow basalts Transition zone + dikes	−11‰ to +1.6‰	+18.5‰ to +36‰ ~Seawater	Alt et al. (1989)
Snake Pit	23° 22'N, MAR	Black smoker	350 °C	Basalts	isocu, py, ma, cpy, sph, po	+1.2‰ to +2.8‰		Kase et al. (1990)
Lucky Strike	37° 17'N, MAR	Black smoker	170–364 °C ^b	Basalts	cpy, py, ma, sph, co, ba, anh	−0.5‰ to +4.6‰	~Seawater	Rouxel et al. (2004)
Hole 735B	Indian Ocean, Atlantis II FZ			Gabbros	po, cpy, pn, tr, py	−3.2‰ to +6.9‰ py: −2.1‰ to +0.8‰	+3.2‰ to +23.5‰	Alt and Anderson (1991)
<i>Serpentinized abyssal peridotites and hydrothermal systems</i>								
Logatchev	14° 45'N, MAR	Black smoker	347–352 °C ^b	Ultramafic rocks	cpy, sph, py, ma, bo cpy, py, po + anh	+0.7‰ to +13.8‰ +2‰ to +9‰	+ 17.5‰ to +20‰	Bogdanov et al. (1997) Eickmann et al. (2005, 2006)

Hess Deep	EPR		Serpentinites (275-375 °C ^a)	aw, pn, hz, mi, ma, va	+1.5‰ to -23.7‰	-3.3‰ to +21.5 ‰	Alt and Shanks (1998)
Iberian Margin	41°N, Atlantic		Serpentinites (~20– 200 °C ^a)	py, mi, va, pn, cpy	-25‰ to -43.7‰	-19.5‰ to +25.1‰	Alt and Shanks (1998)
MARK area	MAR, Kane FZ, 23°N	335–350 °C ^b	Serpentinites + gabbros	pn, po, mi, cpy, ±hz ± aw	+3.7‰ to +12.7‰	+5‰ to +20.3‰	Alt and Shanks (2003)
Mariana and Izu- Bonin arcs	Western Pacific	3 °C	Serpentinites		-6.7‰ to +9.8‰	-20‰ to +30.9‰	Alt and Shanks (2006)
15° 20'N (ODP Leg 209)	MAR		Serpentines + gabbros (<150–350 °C)	pn, cpy, bo, aw, hz, va, py, mi, po, vio	-32.1‰ to +10.8‰	-4.5‰ to +15.3‰	Alt et al. (2007)
IODP Site U1309	Atlantis Massif, 30°N		Gabbros + minor serpentinites	pn, mac, po, mi, py, cpy, hz, vio	-1.5‰ to +13.9‰	+7.3‰ to +22.8‰	Delacour et al. (this issue)
Lost City		40–91 °C ^b	Serpentinites + minor gabbros	py, pn, po, cpy	-22.9‰ to +19.4‰	+3.6‰ to +22‰	This study

Mineral abbreviations: po: pyrrhotite, cpy: chalcopyrite, py: pyrite, pn: pentlandite, hz: heazlewoodite, aw: awaruite, bo: bornite, vio: violarite, mac: mackinawite, mi: millerite, va: valleriite, sph: sphalerite, ma: marcasite, anh: anhydrite, tr: troilite, cu: cubanite, isocu: isocubanite, wu: wurtzite, ga: galena, ba: barite, co: covellite, sw: seawater; S: elemental sulfur.

^a Temperature range of serpentinization; references Hess Deep (Agrinier et al., 1995), Iberian Margin (Agrinier et al., 1996), 15° 20'N (Alt et al., 2007).

^b References of hydrothermal fluid temperatures: Logatchev, Lucky Strike and MARK (Charlou et al., 2002), Lost City (Kelley et al., 2001, 2005). References for fluid temperatures of other sites are given in the table.