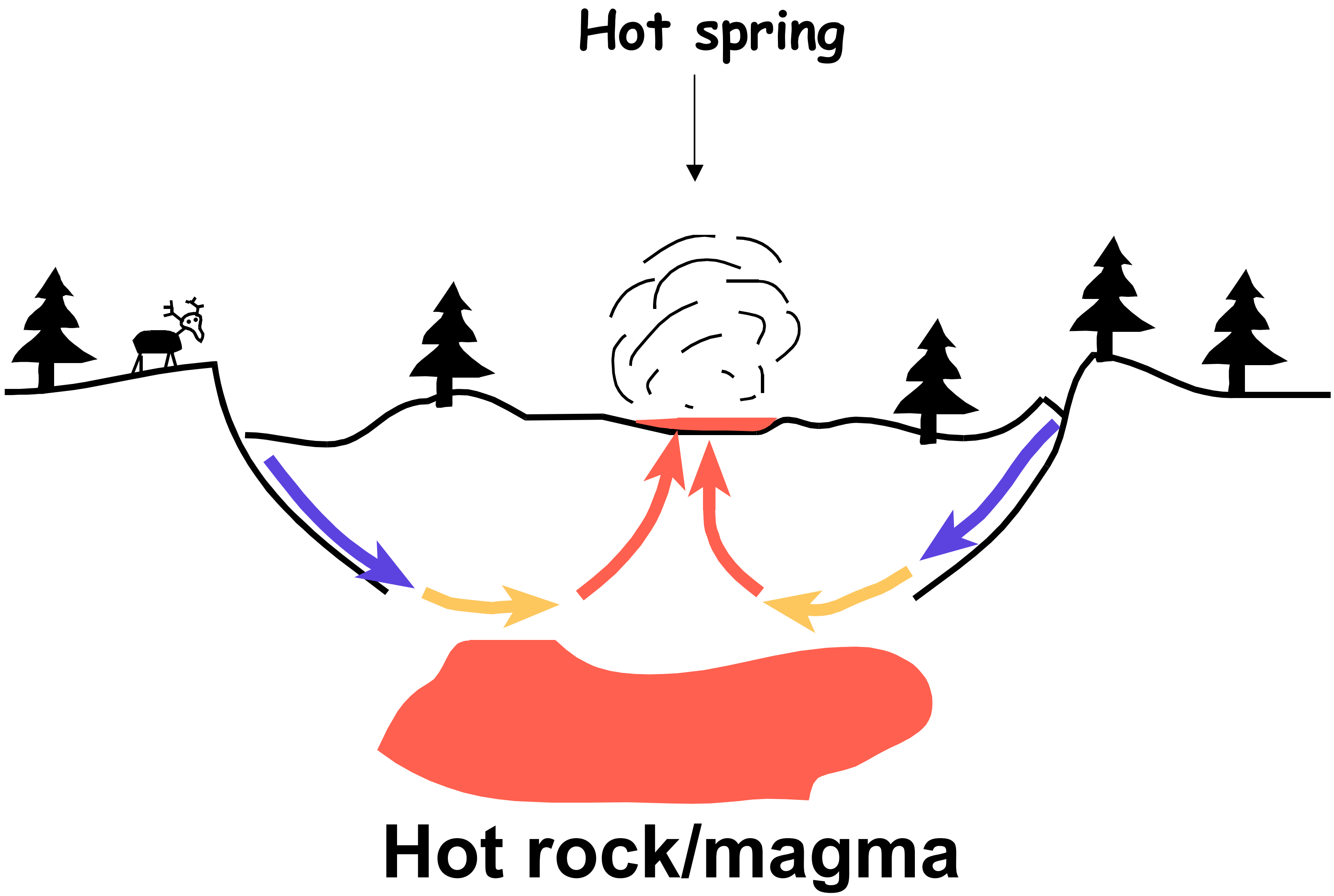
- Unique hot spring microbial communities largely a product of chemistry (*NOT* heat)
- Hot spring chemistry results from reaction of groundwater with volcanic rocks in the subsurface

Basalt:

- -an igneous (volcanic) rock
- -relatively rich in iron (Fe), magnesium (Mg), and silicon (Si)
- -mineral composition: glass, plagioclase, pyroxene, olivine, amphiboles

Rhyolite:

- -similar to basalt, but slightly more enriched in Si


Hot spring
Hot rock/magma

Basalt-groundwater reactions produce reduced compounds (electron donors):

e.g.:

$$2FeO_{(rock)} + H_2O \Rightarrow Fe_2O_{3(rock)} + H_2$$

$$FeS_{(rock)} + H_2O \Rightarrow FeO_{(rock)} + H_2S$$

$$FeO_{(rock)} + 2H^+ \Rightarrow Fe^{2+} + H_2O$$

As a result of fluid-rock interactions, hot springs fluids emerge:

- warm (to ~93°C in Yellowstone; to 402°C on seafloor)
- enriched in reduced compounds (i.e., *electron donors*) (H_2, H_2S, aresenite, methane, etc.)
- enriched in metals (Fe, Mn, etc.)

Exposure to atmosphere provides electron acceptors (i.e., oxidants) (primarily O_2, but also sulfate, nitrate, etc.)

Table 1 Concentrations of selected chemical constituents measured in *Succession Spring* source water on day 103 (October 29, 2001)

Cations and Anions	Concentration (µM)	Weak Acids/ Bases	Concentration (µM)
Na^+	12 532	Si	4819
K^+	954	DIC[†] **[CO_2]**	1763
Ca	116.7	B	651
Al	108.7	As	70.1
Fe	86.1	NH_4^+	44.9
Mg	9.4	DOC[‡]	41.0
Zn	2.1	S(–II) **[H_2S]**	7.4
Mn	0.65	P	0.9
Cl^-	13 342	H_2(aq)[§]	0.036 (0.028)
SO_4^{2-}	1331	O_2(aq)[§]	<0.08 (0.00)
F^-	174.9	Charge Difference[¶]	3.0%
NO_3^-	24.4	Ionic Strength[¶]	0.0165 M

pH = 3.1

(from Macur et al., Geobiology, 2004)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