Additional file 2: Speed of sound

The speed of sound c is defined by

$$c = \sqrt{\frac{\gamma RT}{M}} , \qquad \text{(A1)}$$

where γ is the adiabatic index, R is the universal molar gas constant (~ 8.3145 J/mol/K), T is absolute temperature (K) and M is the molar mass of gas.

From equation (A1), the speed of sound in dry air (γ=1.402, M=28.966$\times 10^{-3}$ kg/mol) is approximated as

$$c = 331.5 + 0.6t , \qquad \text{(A2)}$$

where t is temperature in degrees Celsius (℃).

The speed of sound for gas-gas mixture is defined by

$$c_{mix} = \sqrt{\gamma_{mix} R_{mix} T} . \qquad \text{(A3)}$$

The definitions of γ_{mix} and R_{mix} are as below when gas A and gas B are mixed.

$$\gamma_{mix} = x_A \gamma_A + x_B \gamma_B , \qquad \text{(A4)}$$

$$R_{mix} = x_A R_A + x_B R_B = x_A \frac{R}{M_A} + x_B \frac{R}{M_B} , \qquad \text{(A5)}$$

where x is the mass fraction, γ_{A} and γ_{B} are the adiabatic indexes for each gas and R_{A} and R_{B} are molar gas constants for each gas.

[Reference]

Pierce A. D. (1989) Acoustics: An Introduction to Its Physical Principles and Applications. The Acoustical Society of America, New York, pp 28-29.

Morrissey M. M. & Chouet B. A. (2001) Trends in long-period seismicity related to magmatic fluid compositions. Journal of Volcanology and Geothermal Research, 108(1-4):265-281.