

## SUPPLEMENTARY MATERIALS

Calculation steps of CO<sub>2</sub> and CH<sub>4</sub> concentrations. The concentration values are taken from Tables 2 and 3.

$$V_t = V_1 * \frac{T_0}{T_{\text{gas}}} * \frac{P_i - P_{\text{H}_2\text{O}}}{P_0} + V_{\text{H}_2\text{O}} * \frac{P_i - P_{\text{H}_2\text{O}}}{P_0} * (\% \text{CO}_2 * S_{\text{CO}_2} + \% \text{CH}_4 * S_{\text{CH}_4}) \quad (\text{S.1})$$

where the first term (S.1a) calculates the volume of the dissolved gas corrected for the water vapour pressure  $V$  and the second (S.1b) computes the volume of the remaining dissolved gas in separated water  $V_r$ :

$$V = V_1 * \frac{T_0}{T_{\text{gas}}} * \frac{P_i - P_{\text{H}_2\text{O}}}{P_0} \quad (\text{S.1a})$$

$$V_r = V_{\text{H}_2\text{O}} * \frac{P_i - P_{\text{H}_2\text{O}}}{P_0} * (\% \text{CO}_2 * S_{\text{CO}_2} + \% \text{CH}_4 * S_{\text{CH}_4}). \quad (\text{S.1b})$$

$P_{\text{H}_2\text{O}}$ ,  $S_{\text{CO}_2}$  and  $S_{\text{CH}_4}$  are obtained using the following equations:

$$P_{\text{H}_2\text{O}} = 9 * 10^{-4} T_{\text{H}_2\text{O}}^3 - 0.0107 T_{\text{H}_2\text{O}}^2 + 0.7316 T_{\text{H}_2\text{O}} + 6.11 \quad (\text{S.2})$$

$$S_{\text{CO}_2} = 6 * 10^{-4} T_{\text{H}_2\text{O}}^2 - 0.0493 T_{\text{H}_2\text{O}} + 1.6948 \quad (\text{S.3})$$

$$S_{\text{CH}_4} = 10^{-5} T_{\text{H}_2\text{O}}^2 - 0.0013 T_{\text{H}_2\text{O}} + 0.0568. \quad (\text{S.4})$$

Parameters used in (S.1) to (S.4) are as follow:

- $V_t$  is the total volume STP representing gas/water ratio at a given sampled depth (L);
- $V_{\text{H}_2\text{O}}$  is the volume of liquid phase collected in the separator (L);
- $V_1$  is the volume of gas obtained as difference between initial and final index readings of the gas flow-meter and volume  $V_{\text{H}_2\text{O}}$  of water in the separator ( $\Delta \text{index} - V_{\text{H}_2\text{O}}$ ) (L);
- $V$  is the volume STP obtained after correcting  $V_1$  (L);
- $V_r$  is the residual gas remaining in water in equilibrium with the internal pressure of the measuring line ( $P_i$ ) corrected for water vapour contribution (L);
- $T_0 = 273$  (K);
- $T_{\text{gas}}$  = gas temperature given by the gas meter inbuilt thermometer (K);
- $P_0$  = atmospheric pressure at sea level (1013 hPa);
- $P_i$  is the internal pressure of the measuring line calcu-

lated as:  $P_i = P_a + P_m$  (hPa) where,  $P_m$  is the pressure reading given by the manometer and  $P_a$  is the barometric pressure (~887.64 hPa) at the level of the lakes (ca. 1100 m asl.);

- $P_{\text{H}_2\text{O}}$  is the water vapour pressure in the system calculated following equation (2) (Wilhelm *et al.*, 1976). Temperature (°C) of water measured by a hand thermometer at the outlet of the FDP;

- $S_{\text{CO}_2}$  is carbon dioxide solubility calculated following equation (3) (Weiss, 1974; Wilhelm *et al.*, 1976); water temperatures (°C) was measured by a hand thermometer at the outlet of the FDP (cm<sup>3</sup>/cm<sup>3</sup>);

- $S_{\text{CH}_4}$  is methane solubility calculated following equation (4) (Wilhelm *et al.*, 1976); water temperatures (°C) was measured by a hand thermometer at the outlet of the FDP (cm<sup>3</sup>/cm<sup>3</sup>).

Once  $V_t$  is obtained, the concentrations of the dissolved CO<sub>2</sub> and CH<sub>4</sub> are calculated using (S.1) and (S.2) where %CO<sub>2</sub> and %CH<sub>4</sub> are their volume concentrations in mole %, assuming water density is 1 kg/L.

$$[\text{CO}_2] = \frac{1}{V_{\text{H}_2\text{O}}} \left[ V_t * \frac{\% \text{CO}_2}{22.4} \right] * 1000 \text{ (}\mu\text{mol / kg)} \quad (\text{S.5})$$

$$[\text{CO}_2] = \frac{1}{V_{\text{H}_2\text{O}}} \left[ V_t * \frac{\% \text{CH}_4}{22.4} \right] * 1000 \text{ (}\mu\text{mol / kg)}. \quad (\text{S.6})$$

Calculation of partial pressures using Henry law's constant

$$P_i = K_{Hi} * X_i. \quad (\text{S.7})$$

Where

$$K_H(\text{CH}_4) = 10^{(4.37103 + 0.01096t - 8.49689 * 10^{-5} t^2 + 2.09817 * 10^{-7} t^3 - 1.92689 * 10^{-10} t^4)} \quad (\text{S.7a})$$

$$K_H(\text{CO}_2) = 10^{(2.89612 + 0.01502t - 8.80542 * 10^{-5} t^2 + 2.07454 * 10^{-7} t^3 - 1.87966 * 10^{-10} t^4)} \quad (\text{S.7b})$$

in atm/mole fraction (Taran, 2005).

The mole fraction  $X$ :

$$X = C / 55.51 \quad (\text{S.7c})$$

where  $C$  is gas concentration in mol/kg.