

Air–snow transfer of nitrate on the East Antarctic plateau – Part 1 : Isotopic evidence for a photolytically driven dynamic equilibrium

J. Erbland¹, W. C. Vicars¹, J. Savarino¹, S. Morin², M.M. Frey³, D. Frosini⁴,
E. Vince⁵, and J.M.F. Martins⁵

¹UJF-Grenoble 1/CNRS, LGGE UMR 5183, Grenoble, France

²Météo-France – CNRS, CNRM – GAME URA 1357, CEN, Grenoble, France

³British Antarctic Survey, Natural Environment Research Council, Cambridge, UK

⁴Department of Chemistry, University of Florence, Sesto Fiorentino, Italy

⁵UJF-Grenoble 1/CNRS-INSU/G-INP/IRD, LTHE UMR 5564, Grenoble, France

Correspondence to: J. Erbland

(joseph.erbland@lgge.obs.ujf-grenoble.fr)

SUPPLEMENTARY INFORMATION

On Figures 1 to 23, we present a detailed view of nitrate mass fraction and isotopic composition profiles for each snow pit presented in this work together with the Blunier et al. and the Frey et al.'s snow pits. The black dashed lines represent the fit to the data used to derive the asymptotic values.

- 5 Values in the lower yellow panels represent the asymptotic values. The error bars represent the 1- σ uncertainty calculated for each asymptotic value.

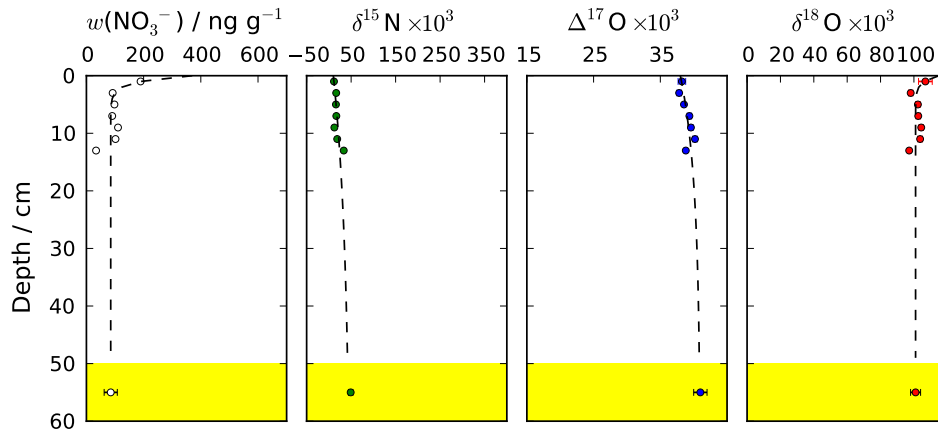


Fig. 1. Site 1 (D10), pit ID : D10 (this study).

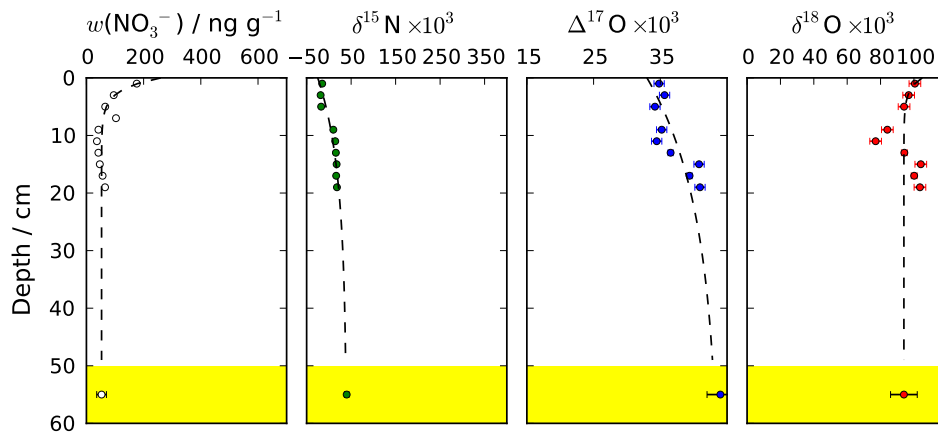


Fig. 2. Site 2, pit ID : II (this study).

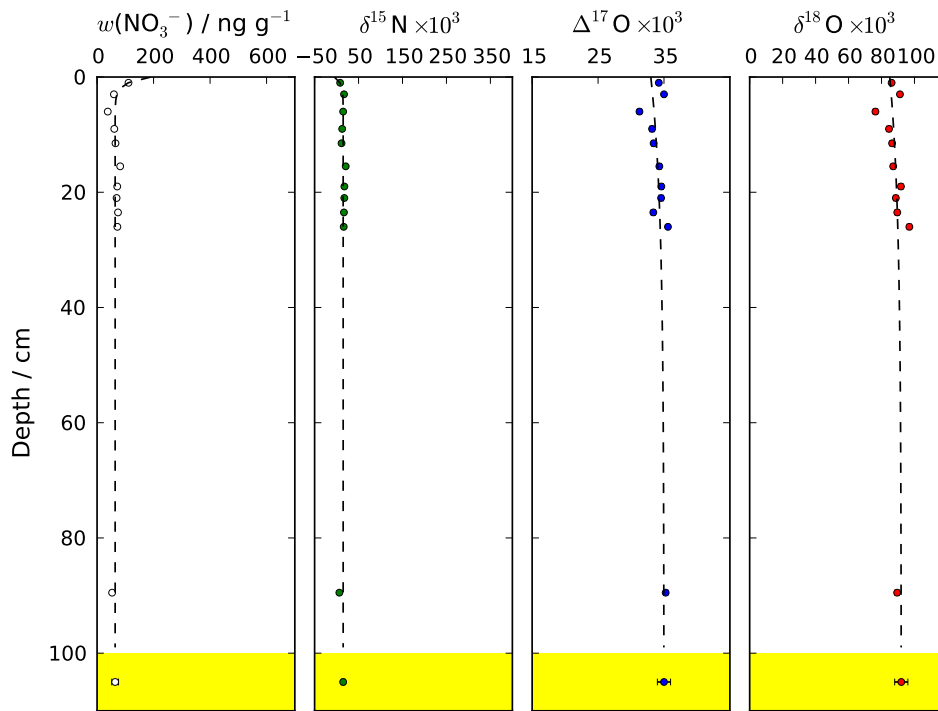


Fig. 3. Site 3, pit ID : IV (this study).

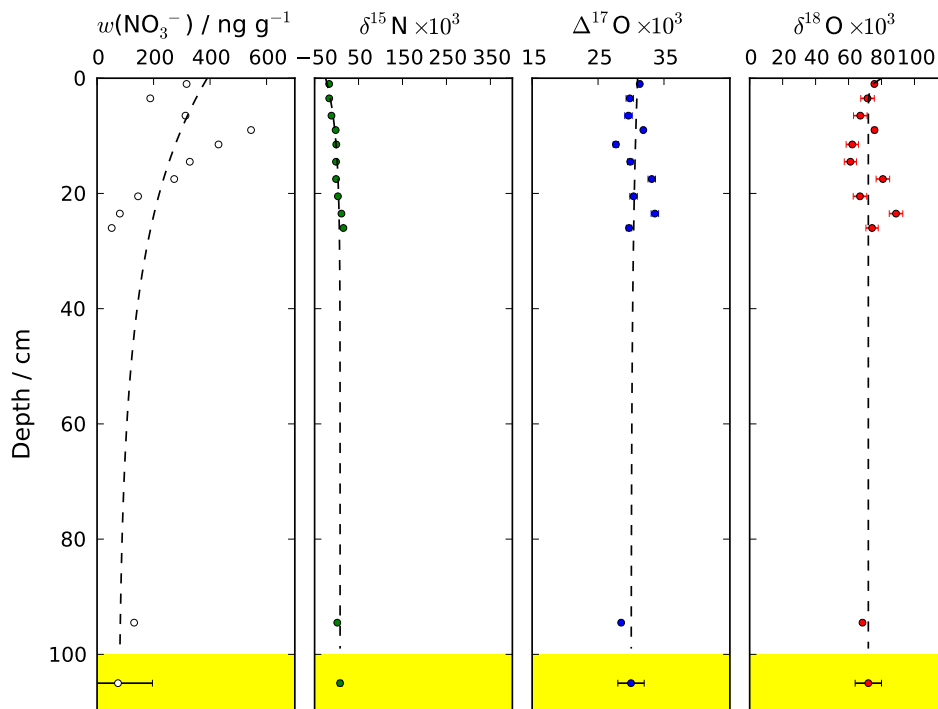


Fig. 4. Site 4, pit ID : VI (this study).

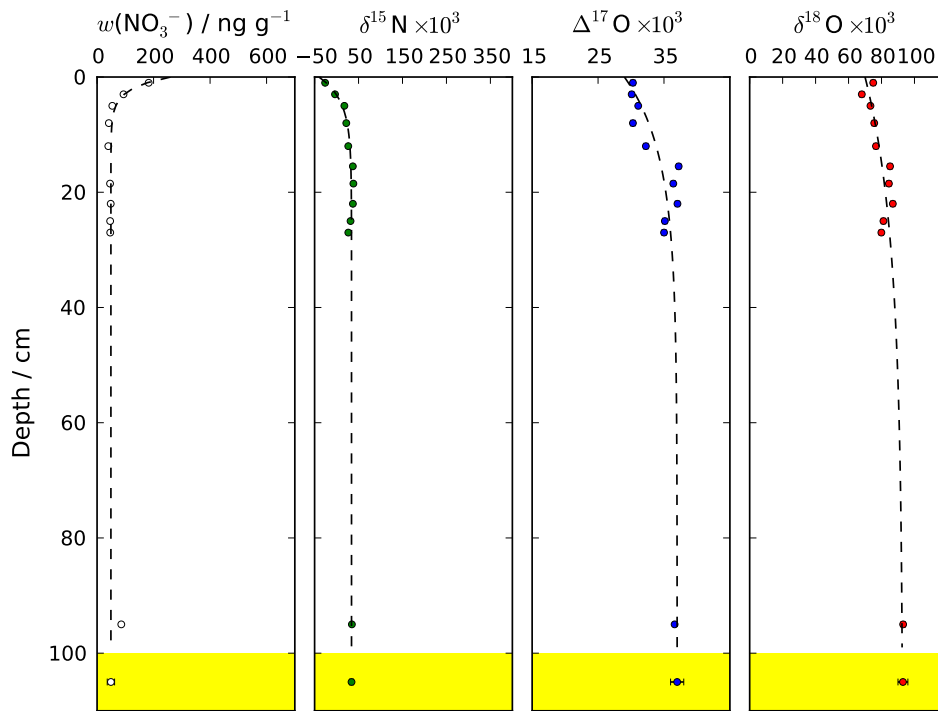


Fig. 5. Site 5, pit ID : VIII (this study).

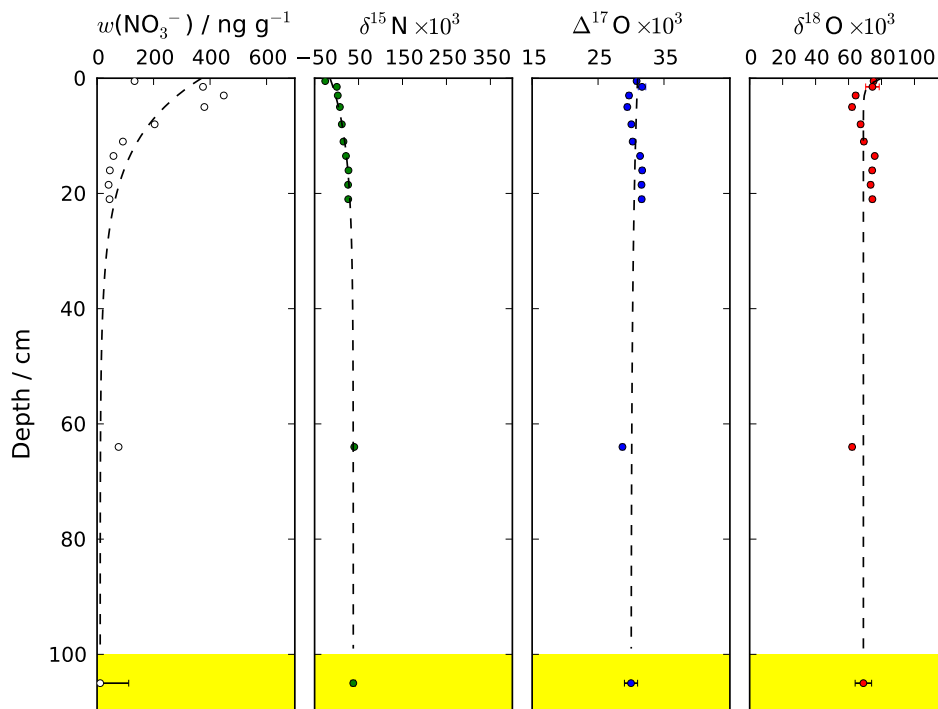


Fig. 6. Site 6, pit ID : X (this study).

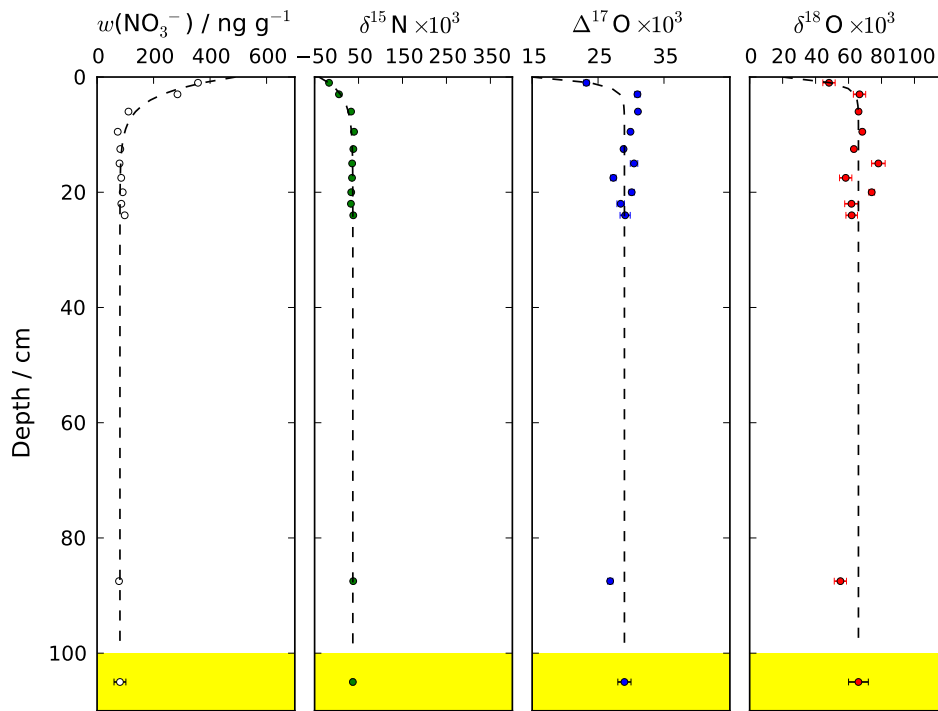


Fig. 7. Site 7, pit ID : XII (this study).

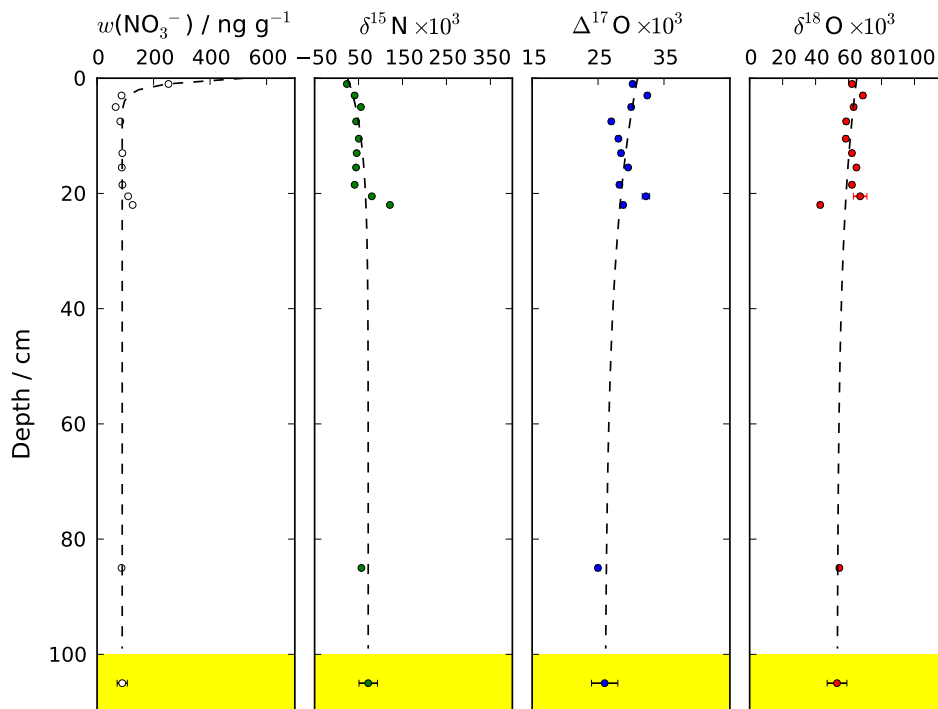


Fig. 8. Site 8, pit ID : XIV (this study).

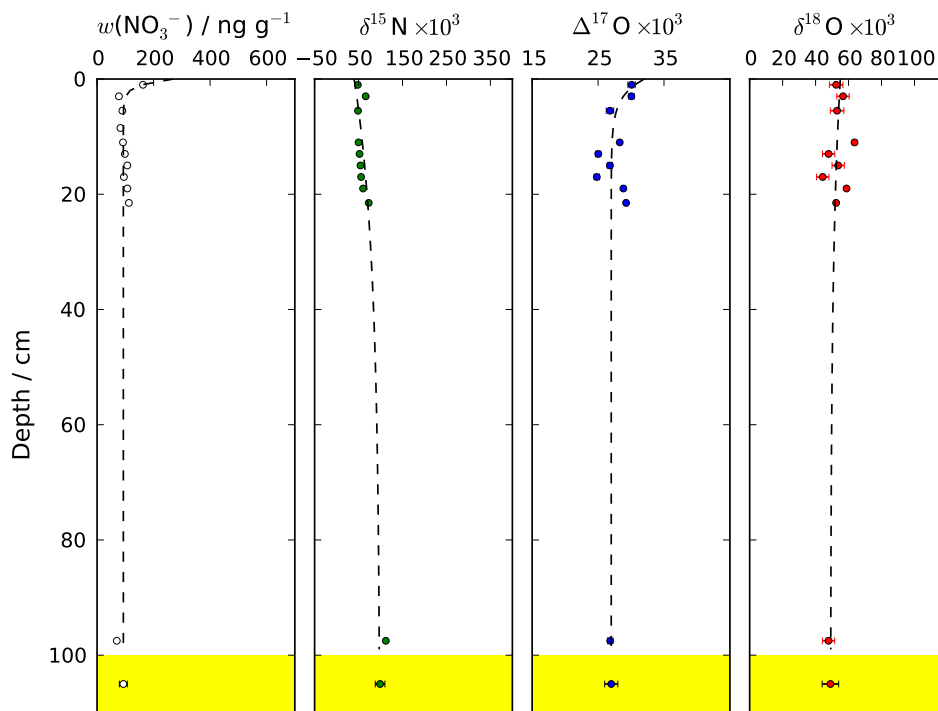


Fig. 9. Site 9, pit ID : XVI (this study).

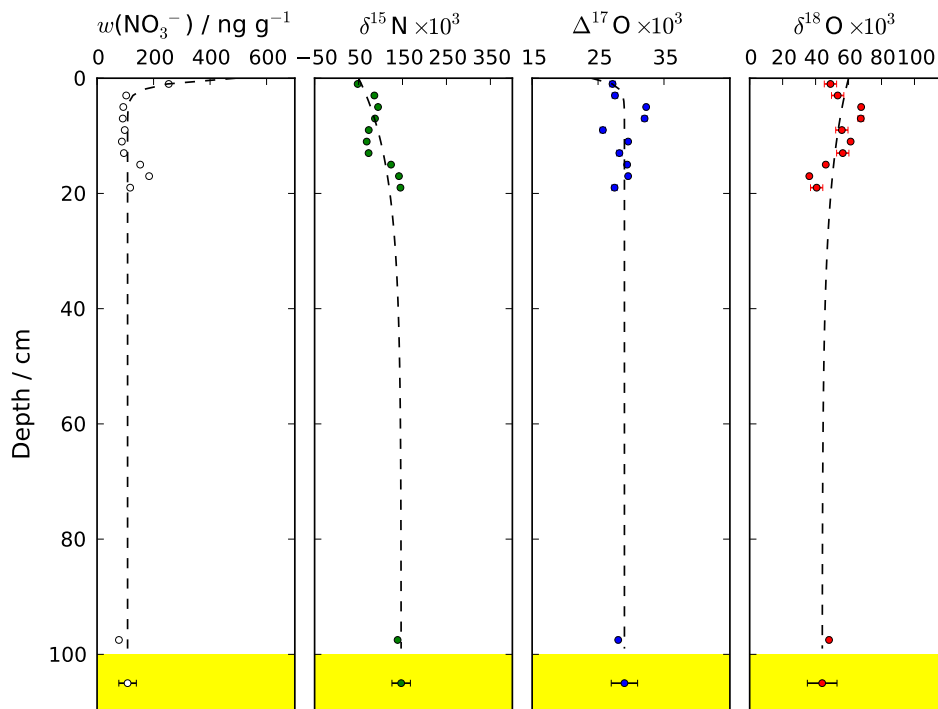


Fig. 10. Site 10, pit ID : XVIII (this study).

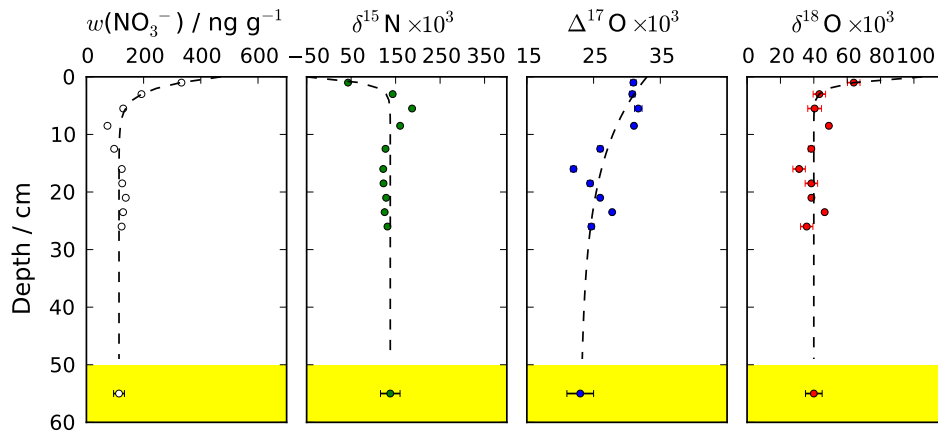


Fig. 11. Site 11, pit ID : XX (this study).

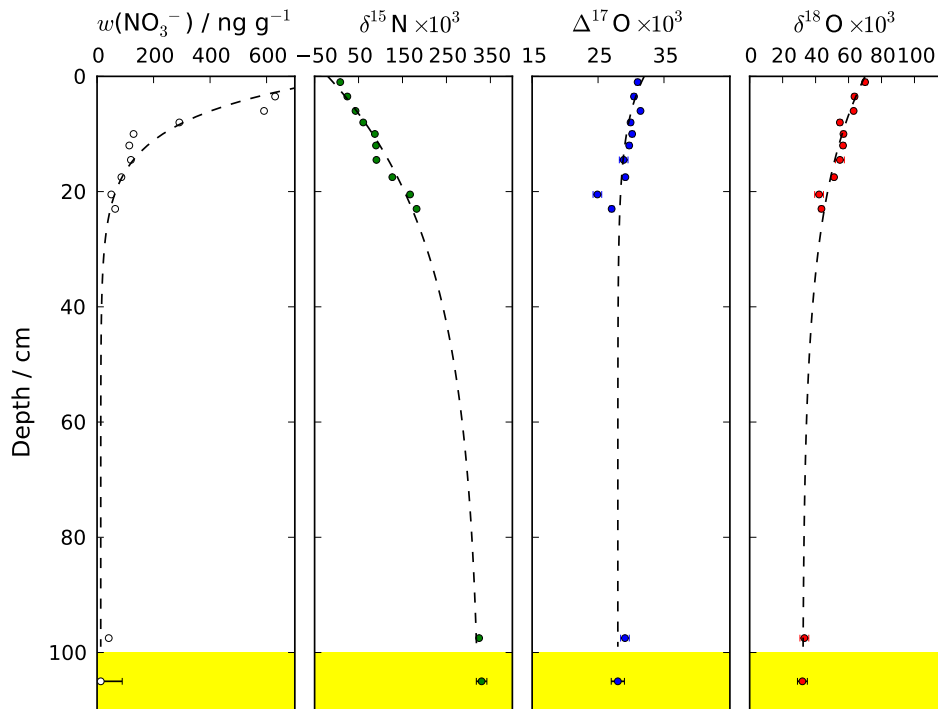


Fig. 12. Site 12, pit ID : XXII (this study).

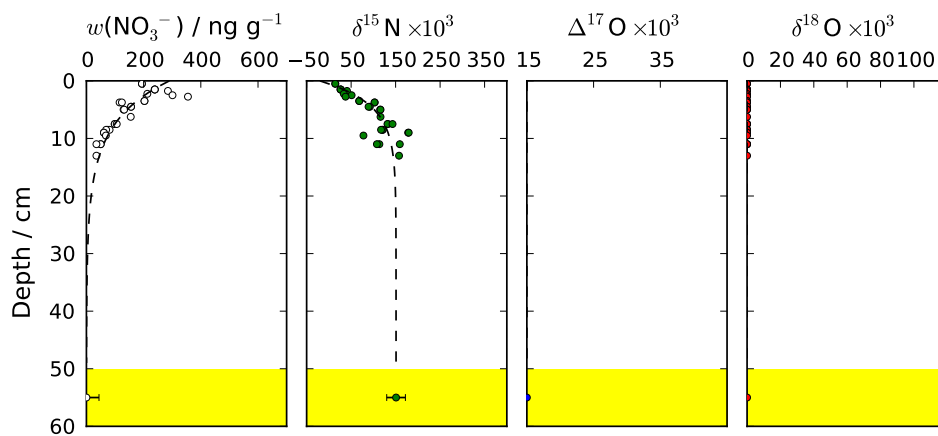


Fig. 13. Site 13 (Dome C), pit ID : DC03 (Blunier et al., 2005).

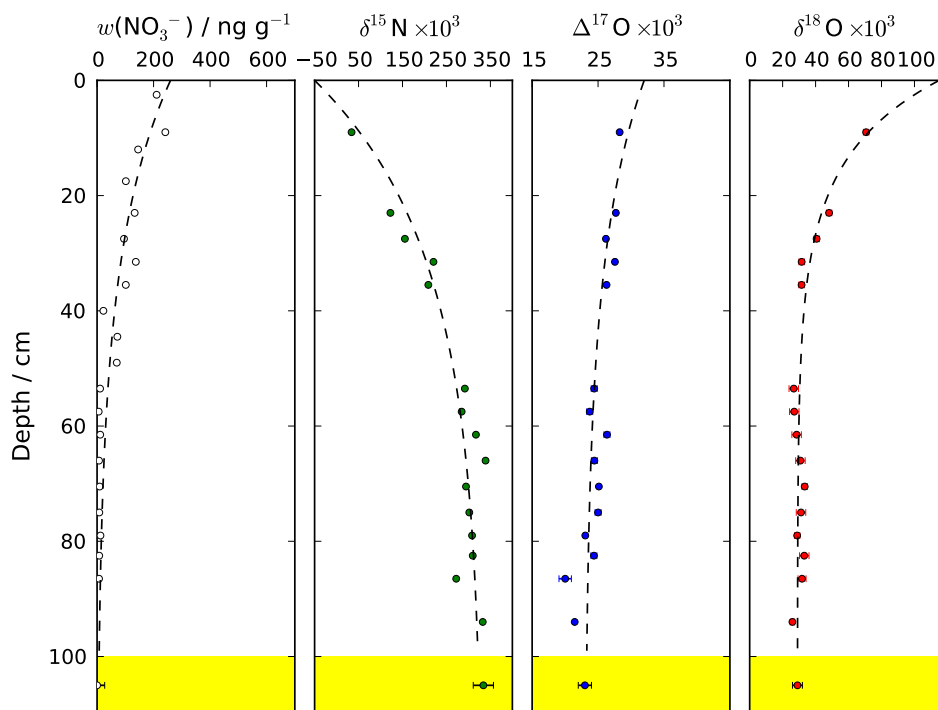


Fig. 14. Site 13 (Dome C), pit ID : DC04 (Frey et al., 2009).

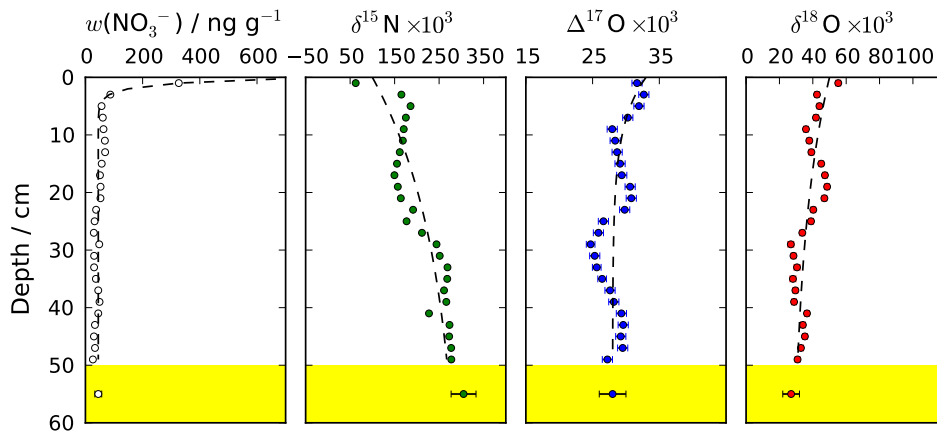


Fig. 15. Site 13 (Dome C), pit ID : DC07-1 (Frey et al., 2009).

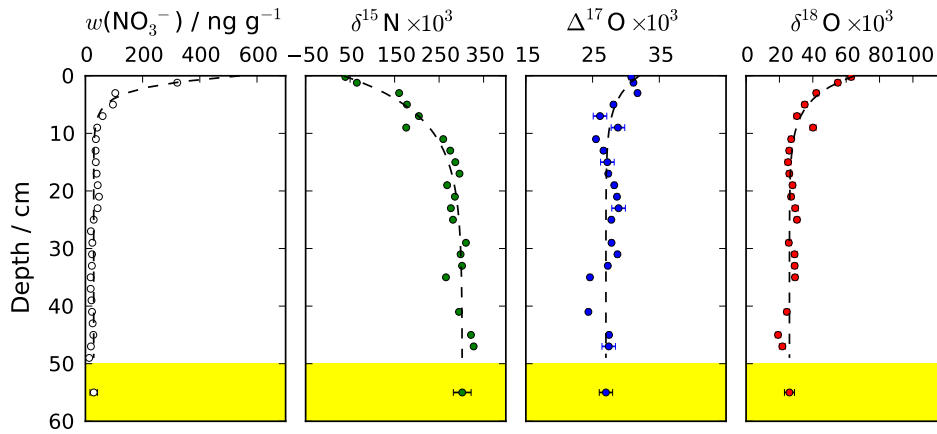


Fig. 16. Site 13 (Dome C), pit ID : DC07-2 (this study).

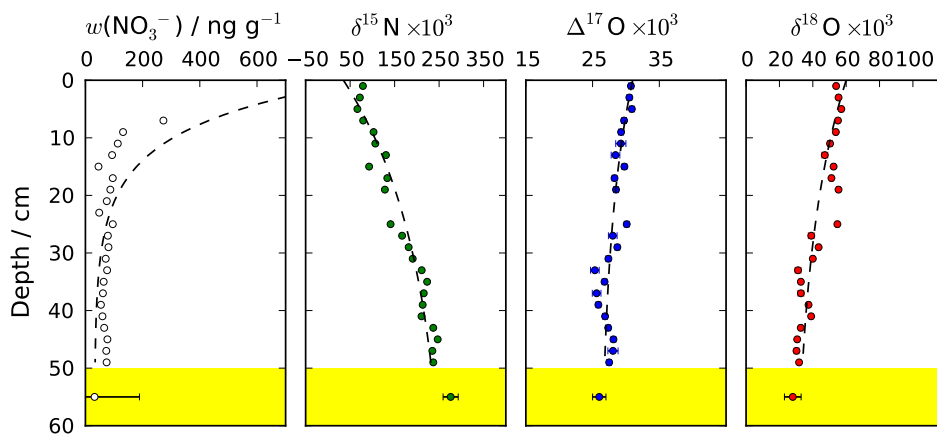


Fig. 17. Site 13 (Dome C), pit ID : DC07-3 (this study).

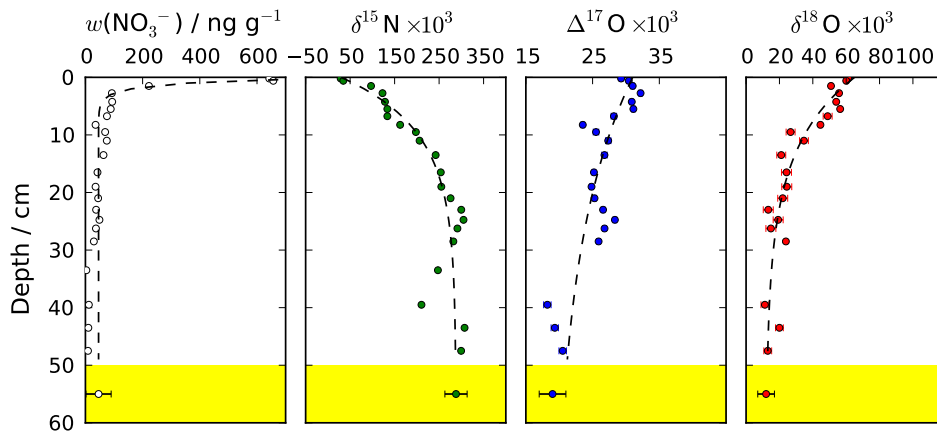


Fig. 18. Site 14, pit ID : S1 (this study).

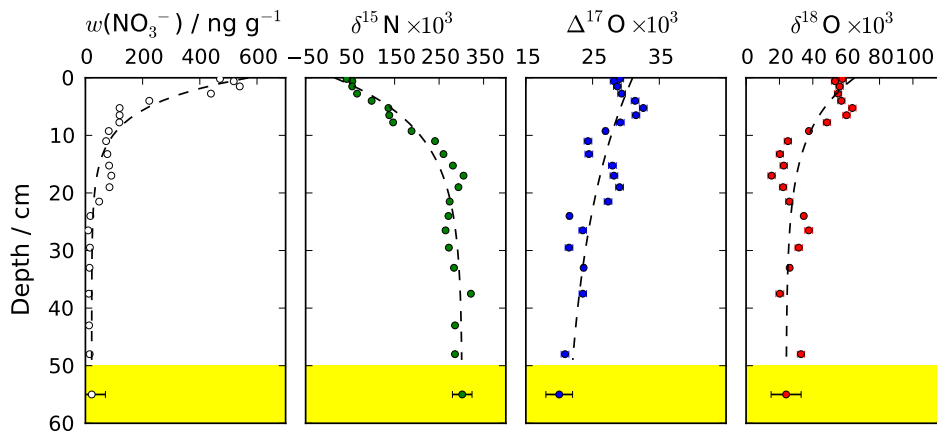


Fig. 19. Site 15, pit ID : S2 (this study).

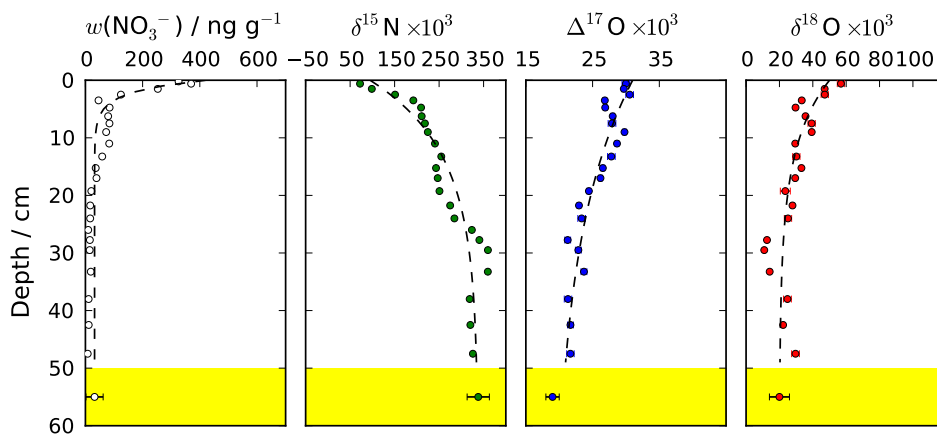


Fig. 20. Site 16, pit ID : S3 (this study).

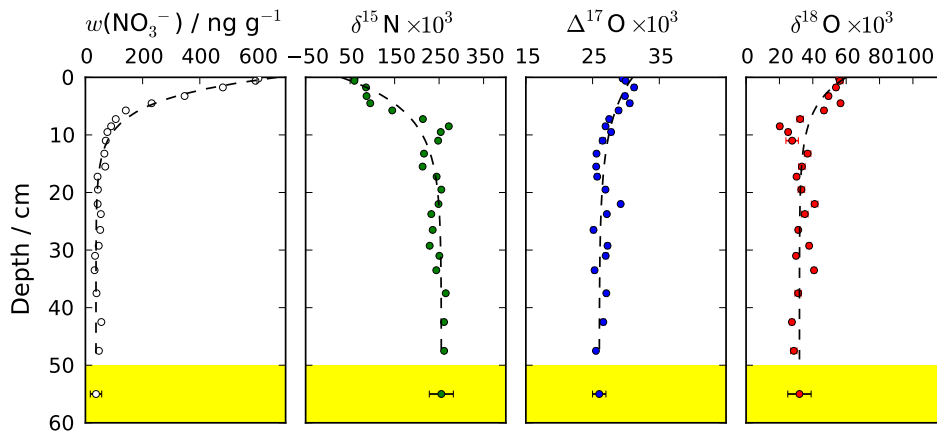


Fig. 21. Site 17 (Vostok), pit ID : S4 (this study).

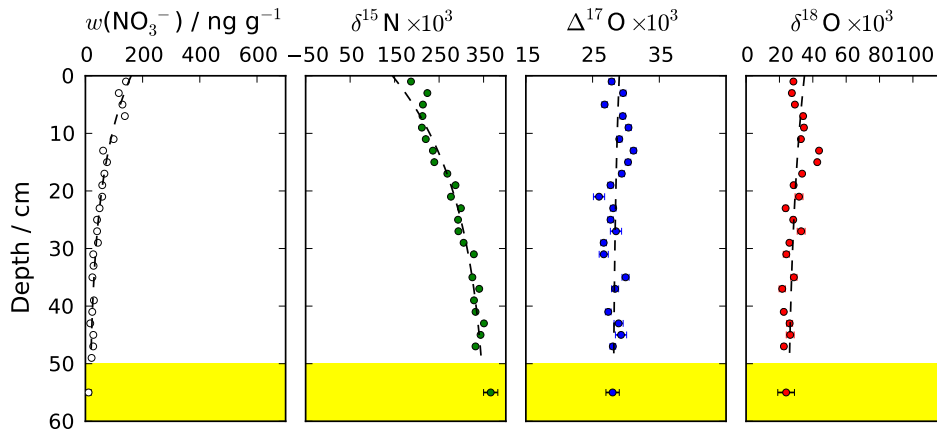


Fig. 22. Site 17 (Vostok), pit ID : V09-1 (this study).

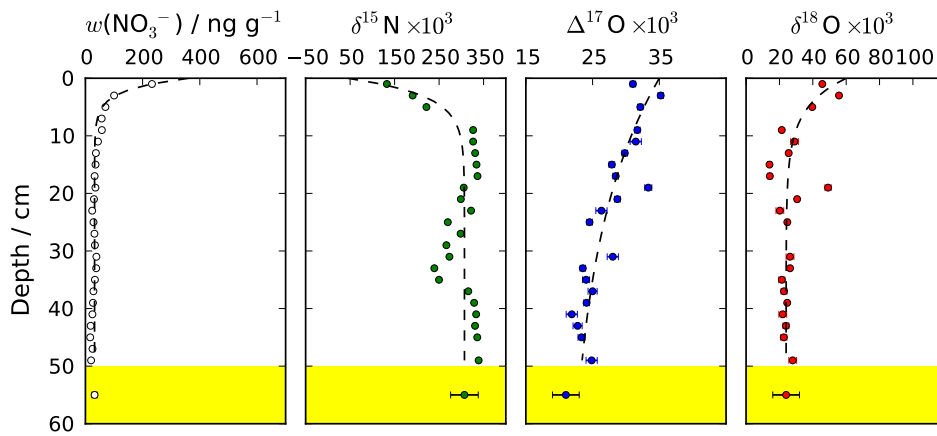


Fig. 23. Site 17 (Vostok), pit ID : V09-2 (this study).

Table 1. Decay parameter, η / cm, obtained for the measured quantity X ($= w(\text{NO}_3^-)$, $\delta^{15}\text{N}$, $\Delta^{17}\text{O}$ and $\delta^{18}\text{O}$).

Site	$w(\text{NO}_3^-)$	$\delta^{18}\text{O}$	$\Delta^{17}\text{O}$	$\delta^{15}\text{N}$
1 (D10)	1	1	17	28
2	2	2	22	15
3	1	22	21	1
4	26	1	28	9
5	2	26	13	4
6	11	1	28	11
7	3	1	1	3
8	1	26	28	10
9	1	28	3	28
10	1	18	1	15
11	2	1	14	1
12	7	22	9	28
13 (DC)	7	1	1	4
13 (DC)	28	13	28	28
13 (DC)	1	28	8	28
13 (DC)	2	4	4	7
13 (DC)	8	28	27	28
14	1	12	28	9
15	5	9	28	9
16	2	11	27	12
17 (Vk)	4	5	8	6
17 (Vk)	17	28	28	21
17 (Vk)	2	5	28	3
$m \pm 1-\sigma$	6 ± 8	13 ± 11	18 ± 11	14 ± 10

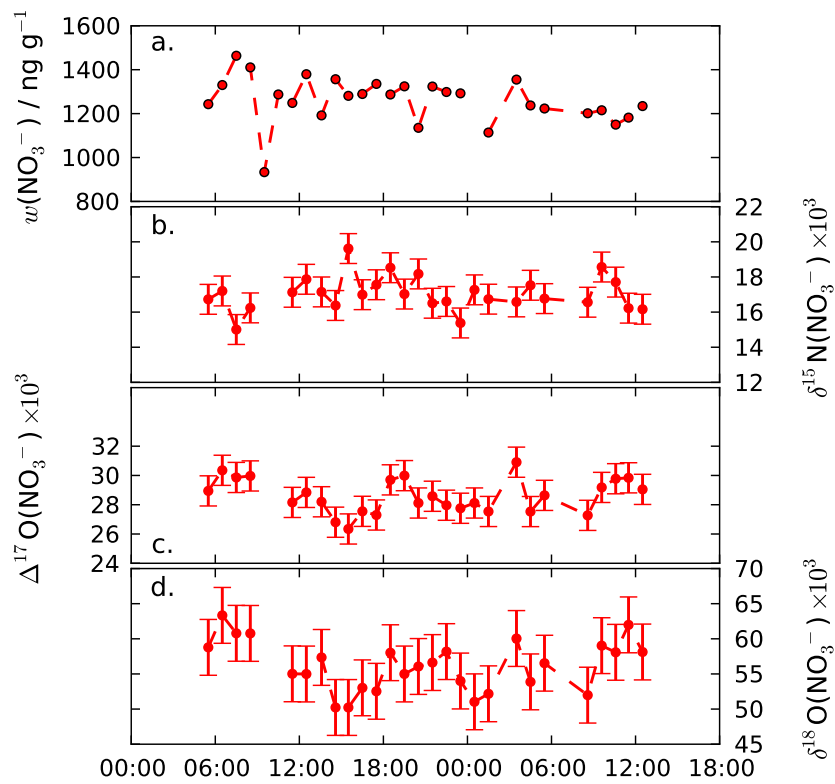


Fig. 24. Hourly variations of skin layer nitrate at DC on 28 and 29 December 2009: **(a)** NO_3^- mass fractions, **(b)** $\delta^{15}\text{N}(\text{NO}_3^-)$, **(c)** $\Delta^{17}\text{O}(\text{NO}_3^-)$ and **(d)** $\delta^{18}\text{O}(\text{NO}_3^-)$.

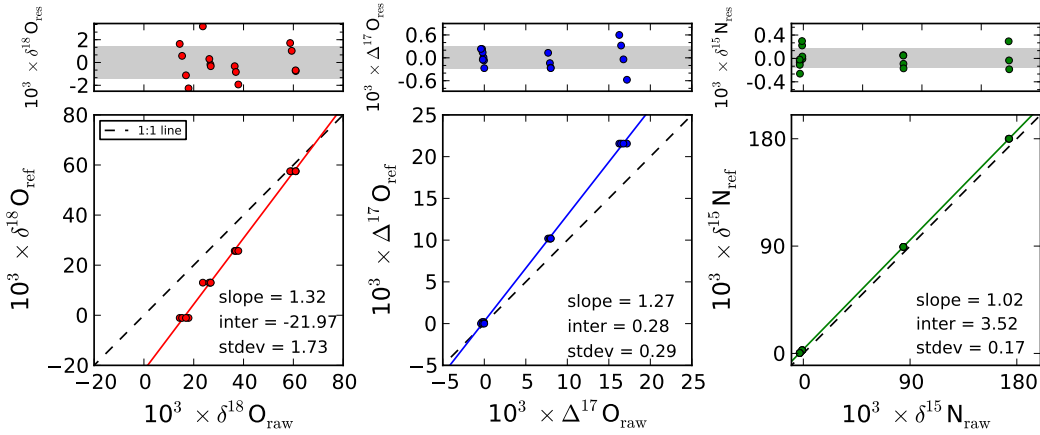


Fig. 25. Normal calibration obtained for a set of nitrate isotopic standards at 100 nmol in a NaCl 1M matrix using the bacterial method. The grey rectangles represent the interval $[-1\sigma, +1\sigma]$ in the residuals.

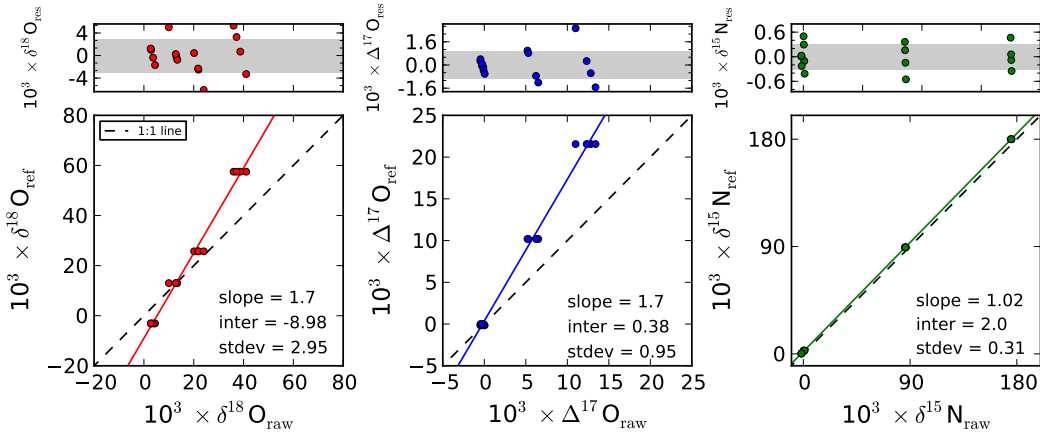


Fig. 26. Calibration obtained for a set of nitrate isotopic standards used for the analysis of the “physical release” experiment samples (100 nmol in a NaCl 1M matrix) using the bacterial method. The grey rectangles represent the interval $[-1\sigma, +1\sigma]$ in the residuals.