Supplement of Biogeosciences Discuss., 11, 7823–7852, 2014
http://www.biogeosciences-discuss.net/bgd-11-7823-2014/
doi:10.5194/bgd-11-7823-2014-supplement


Biogeosciences Discussions Open Access

*Supplement of*

# Revisiting Mt. Kilimanjaro: Do $n$-alkane biomarkers in soils reflect the $\delta^2\mathrm{H}$ isotopic composition of precipitation?

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**Biogeosciences Discussions**
**- Supplementary Material -**

# Revianjaro: Do n-alkane biomarkers in soils reflect the $\delta^2H$ isotopic composition of precipitation?

**Table S1: Elevation and vegetation zone of the soil samples and $\delta^2H$ values (‰, VSMOW) of *n*-alkanes**

| Sample name | Elevation a.s.l. (m) | Vegetation zone | *n*-$C_{27}$ | | | *n*-$C_{29}$ | | |
|---|---|---|---|---|---|---|---|---|
| | | | amplitude (mV) | mean δD (‰) | stdev (‰) | amplitude (mV) | mean δD (‰) | stdev (‰) |
| O-layer k2 | 1750 | submontane forest | 3095 | -162 | 2 | 1440 | -152 | 6 |
| O-layer k4 | 2030 | montane rainforest | 2795 | -154 | 2 | 1181 | -148 | 3 |
| O-layer k6 | 2140 | montane rainforest | 3593 | -145 | 1 | 2420 | -131 | 2 |
| O-layer k8 | 2250 | montane rainforest | 3987 | -159 | 1 | 2416 | -150 | 3 |
| O-layer k10 | 2350 | montane rainforest | 2378 | -148 | 5 | 799 | -135 | 7 |
| O-layer k12 | 2450 | montane rainforest | 3187 | -151 | 2 | 1141 | -143 | 3 |
| O-layer k14 | 2550 | montane rainforest | 3179 | -145 | 0 | 2368 | -153 | 1 |
| O-layer k16 | 2650 | montane rainforest | 1585 | -152 | 2 | 1487 | -144 | 3 |
| O-layer k18 | 2750 | montane rainforest | 886 | -126 | 2 | 2560 | -144 | 5 |
| O-layer k20 | 2780 | montane rainforest | 983 | -141 | 3 | 2444 | -147 | 1 |
| O-layer k22 | 2860 | montane rainforest | 1054 | -129 | 3 | 1837 | -137 | 2 |
| O-layer k24 | 2880 | montane rainforest | 1072 | -133 | 5 | 1584 | -139 | 6 |
| O-layer k26 | 2980 | montane rainforest | 2126 | -147 | 2 | 2276 | -151 | 3 |
| O-layer k28 | 3060 | montane rainforest | 1265 | -137 | 4 | 1405 | -132 | 4 |
| O-layer k30 | 3150 | subalpine zone | 1016 | -134 | 9 | 1142 | -143 | 3 |
| O-layer k32 | 3230 | subalpine zone | 3299 | -150 | 1 | 1544 | -149 | 1 |
| O-layer k34 | 3800 | subalpine zone | 306 | (-102) | 3 | 2070 | -138 | 1 |
| Ah-horizon k1 | 1430 | cultivated zone | 245 | (-127)[#] | 1 | 279 | (-106) | 3 |
| Ah-horizon k3 | 1750 | submontane forest | 382 | (-163) | 6 | 430 | (-108) | 5 |
| Ah-horizon k5 | 2030 | montane rainforest | 2780 | -153 | 3 | 1703 | -150 | 2 |
| Ah-horizon k7 | 2140 | montane rainforest | 1792 | -146 | 4 | 1121 | -140 | 8 |
| Ah-horizon k9 | 2250 | montane rainforest | 2829 | -152 | 1 | 1457 | -147 | 2 |
| Ah-horizon k11 | 2350 | montane rainforest | 1655 | -144 | 1 | 978 | -139 | 4 |
| Ah-horizon k13 | 2450 | montane rainforest | 1364 | -142 | 3 | 739 | (-123) | 1 |
| Ah-horizon k15 | 2550 | montane rainforest | 1585 | -144 | 5 | 1178 | -141 | 4 |
| Ah-horizon k17 | 2650 | montane rainforest | 409 | (-123) | 6 | 1140 | -146 | 1 |
| Ah-horizon k19 | 2750 | montane rainforest | 1058 | -138 | 5 | 1685 | -142 | 3 |
| Ah-horizon k21 | 2780 | montane rainforest | 740 | (-129) | 5 | 1285 | -140 | 3 |
| Ah-horizon k23 | 2860 | montane rainforest | 1208 | -138 | 5 | 1389 | -134 | 3 |
| Ah-horizon k25 | 2880 | montane rainforest | 1367 | -136 | 1 | 2097 | -138 | 2 |
| Ah-horizon k27 | 2980 | montane rainforest | 2170 | -141 | 2 | 2575 | -145 | 2 |
| Ah-horizon k29 | 3060 | montane rainforest | 1631 | -134 | 2 | 1787 | -140 | 1 |
| Ah-horizon k31 | 3150 | subalpine zone | 1246 | -137 | 4 | 1753 | -144 | 2 |
| Ah-horizon k33 | 3230 | subalpine zone | 896 | -125 | 5 | 675 | (-144) | 3 |
| Ah-horizon k35 | 3800 | subalpine zone | 1322 | -148 | 6 | 1842 | -148 | 4 |
| Ah-horizon k36 | 4000 | subalpine zone | 757 | -142 | 3 | 1693 | -135 | 2 |

[#]) brackets indicate that datapoints were excluded from further data evaluation (compare with Fig. 5)

**Table S2: Changes of $\delta^2H$ and $\delta^{18}O$ of precipitation along the southern slopes of Mt. Kilimanjaro.**

| Elevation a.s.l. (m) | MAP (mm)[1] | $\delta^2H_{prec}$ (‰) | $\delta^{18}O_{prec}$ (‰) | d-excess (‰) |
|---|---|---|---|---|
| 1430 | 1800 | -11.3 | -2.9 | 12.0 |
| 1800 | 2271 | -12.6 | -3.3 | 13.5 |
| 1900 | 2414 | -9.5 | -3.0 | 14.5 |
| 2130 | 2691 | -10.0 | -3.3 | 15.3 |
| 2200 | 2645 | -9.3 | -3.3 | 17.1 |
| 2250 | 2600 | -10.5 | -2.9 | 12.5 |
| 2350 | 2300 | -13.1 | -3.7 | 16.5 |
| 2400 | 2225 | -14.2 | -3.7 | 15.2 |
| 2450 | 2150 | -14.4 | -3.8 | 15.6 |
| 2560 | 1945 | -15.0 | -3.8 | 15.7 |
| 2700 | 1875 | -15.8 | -3.9 | 15.7 |
| 2900 | 1470 | -21.6 | -4.5 | 14.5 |
| 3300 | 969 | -25.1 | -4.8 | 13.5 |
| 3700 | 794 | -30.6 | -5.5 | 13.2 |

1) interpolated from Hemp, 2006

**Table S3: Model-data comparison of $\Delta\delta^2H$ ($^2H$ enrichment of leaf water) along the altitudinal gradient on the southern slopes of Mt Kilimanjaro.**

| Altitude (m a.s.l.) | $T_S$ [a)] (°C) | $h_N$ [b)] (%) | $\delta^2H_{prec}$ (‰) | $\delta^2H_{C27/C29}$ [c)] (‰) | $\Delta\delta^2H_{measured}$ [d)] (‰) | $\Delta\delta^2H_{modelled}$ [e)] (‰) |
|---|---|---|---|---|---|---|
| 2030 | 13,6 | 77,6 | -10,3 | -152,1 | 18,2 | 24,6 |
| 2140 | 12,9 | 75,9 | -10,9 | -144,0 | 26,9 | 26,7 |
| 2250 | 12,2 | 74,6 | -10,5 | -150,2 | 20,3 | 28,4 |
| 2350 | 11,5 | 73,7 | -13,1 | -142,0 | 31,1 | 29,6 |
| 2450 | 10,9 | 72,8 | -14,4 | -141,6 | 32,8 | 30,7 |
| 2550 | 10,3 | 71,8 | -14,8 | -142,4 | 32,4 | 32,1 |
| 2650 | 9,7 | 71,4 | -15,5 | -146,3 | 29,2 | 32,7 |
| 2750 | 9,2 | 70,4 | -17,3 | -140,4 | 36,9 | 34,0 |
| 2850 | 8,9 | 68,4 | -20,2 | -135,8 | 44,4 | 36,5 |
| 2860 | 8,9 | 68,4 | -20,5 | -136,1 | 44,4 | 36,5 |
| 2880 | 8,8 | 68,0 | -21,0 | -137,5 | 43,5 | 37,0 |
| 2980 | 8,6 | 67,1 | -22,3 | -143,5 | 38,8 | 38,1 |
| 3060 | 8,4 | 66,2 | -23,0 | -137,5 | 45,5 | 39,2 |
| 3150 | 8,1 | 64,8 | -23,8 | -141,2 | 42,6 | 40,9 |
| 3230 | 7,7 | 64,7 | -24,5 | -133,2 | 51,3 | 41,2 |
| 3800 | 5,2 | 54,2 | -31,7 | -147,9 | 43,8 | 54,8 |
| 4000 | 4,1 | 51,3 | -34,0 | -137,0 | 57,0 | 59,0 |

a) surface air temperatures obtained by interpolating the mean temperatures for the period 2004-2012 (N. Pepin - unpublished data), representing nine stations situated on southwestern slopes of Mt. Kilimanjaro covering the altitude range from 1890 to 5470 m a.s.l.

b) relative humidity calculated using free-air vapor pressures at sampling elevations derived from the data reported by Pepin et al., (2010).

c) weighted means of *n*C27 and *n*C29 $\delta^2H$ values obtained for $A_h$-horizons

d) $\Delta\delta^2H = \delta^2H_{leaf\ water} - \delta^2H_{prec}$ where $\delta^2H_{leaf\ water}$ is represented by $\delta^2H_{C27/C29}$ corrected for biosynthetic fractionation

e) calculated using Eqn. (1)