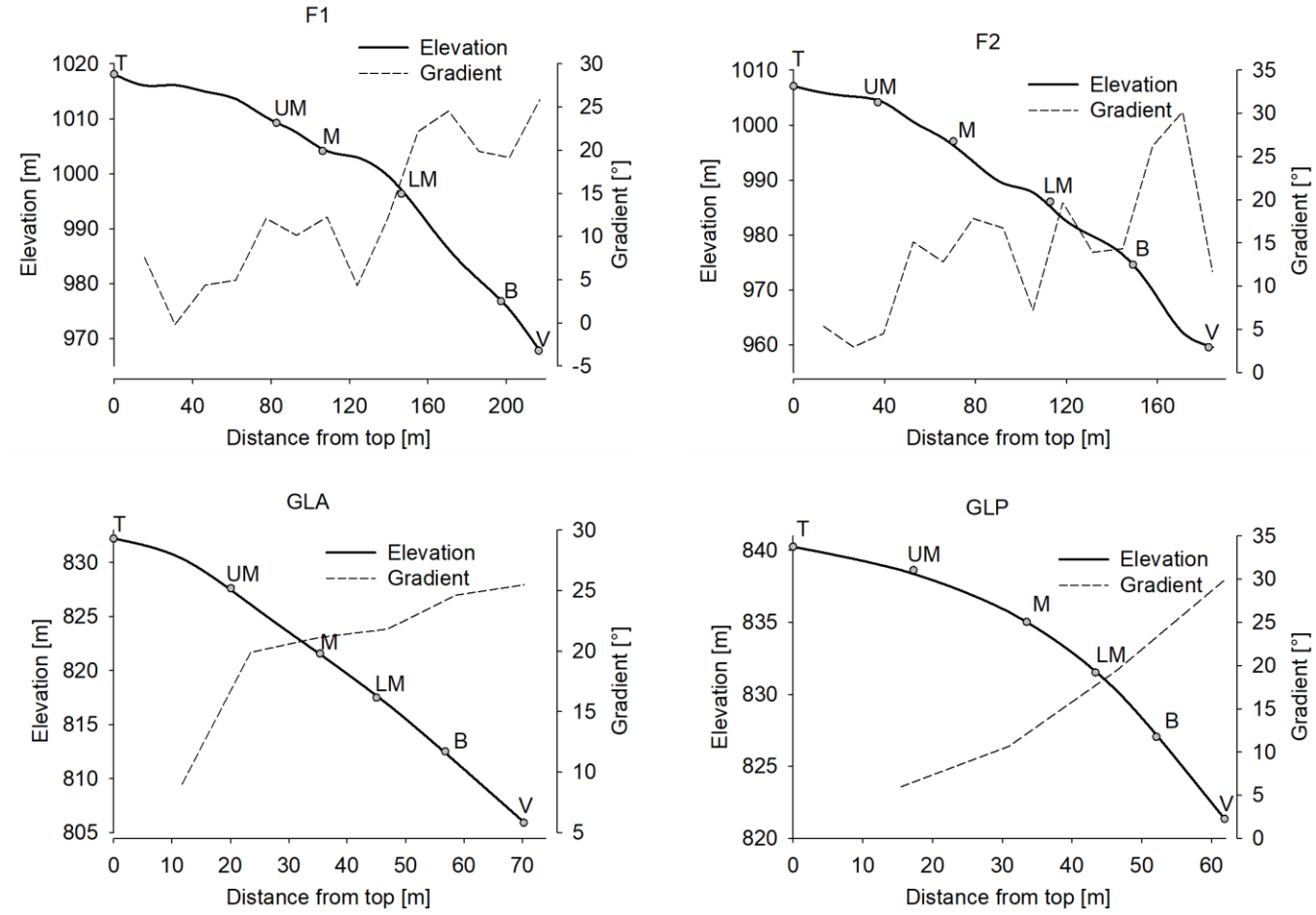
**Supplementary figures**

S1: Active inverse teardrop-shaped lavaka on a convex hillslope in the Lake Alaotra basin. The *Eucaluptus sp*. trees act as a reference for the scale (Photo taken in October 2019 by V.F. Razanamahandry)

S2: Current vegetation cover of grassland (left) and forest hillslope (right) where soil profiles were sampled. Photo taken in October 2019 by V.F. Razanamahandry.




S3: Sampling locations along the hillslope transect plotted together with elevation profiles (left vertical axis) and slope gradient (right vertical axis). T (Top), UM (Upper middle), M (Middle), LM (Lower Middle), B (Bottom) and V (Valley). Elevation data were extracted from the TanDEM-X DEM.

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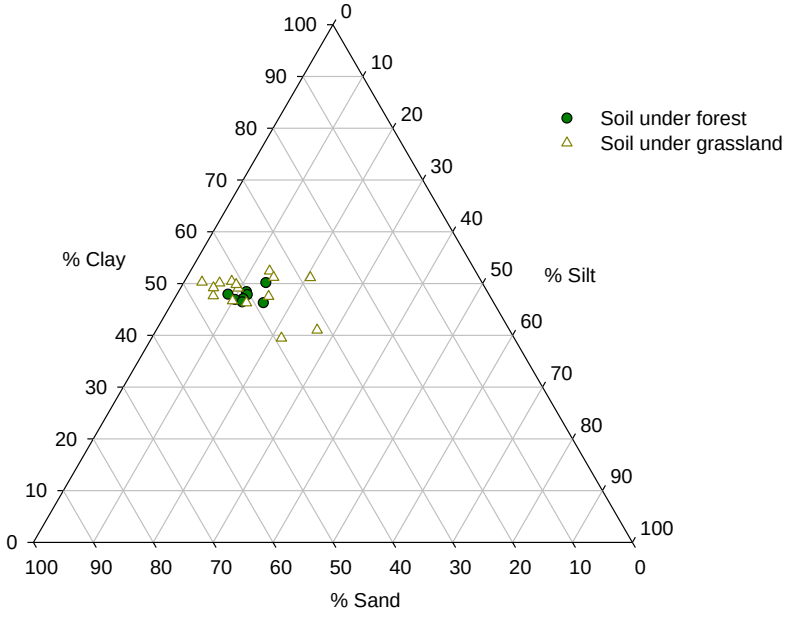
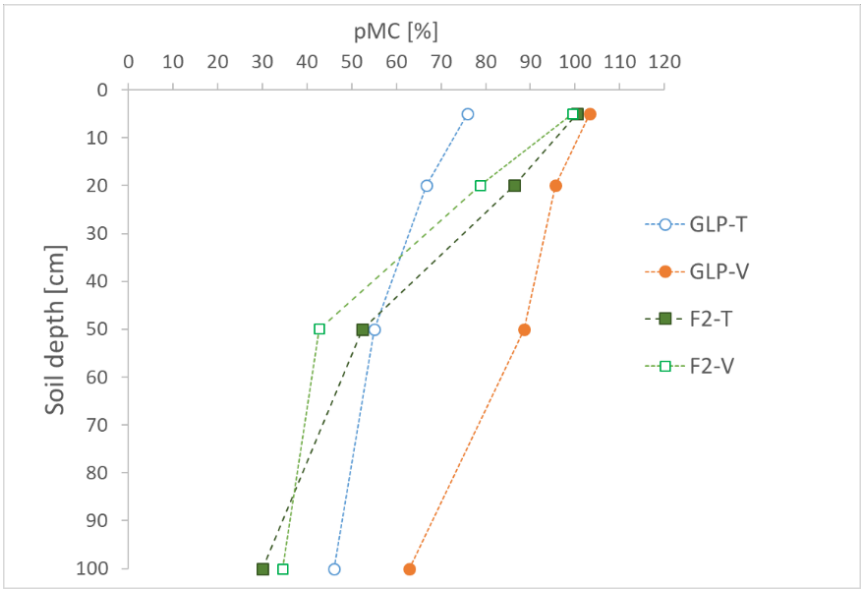
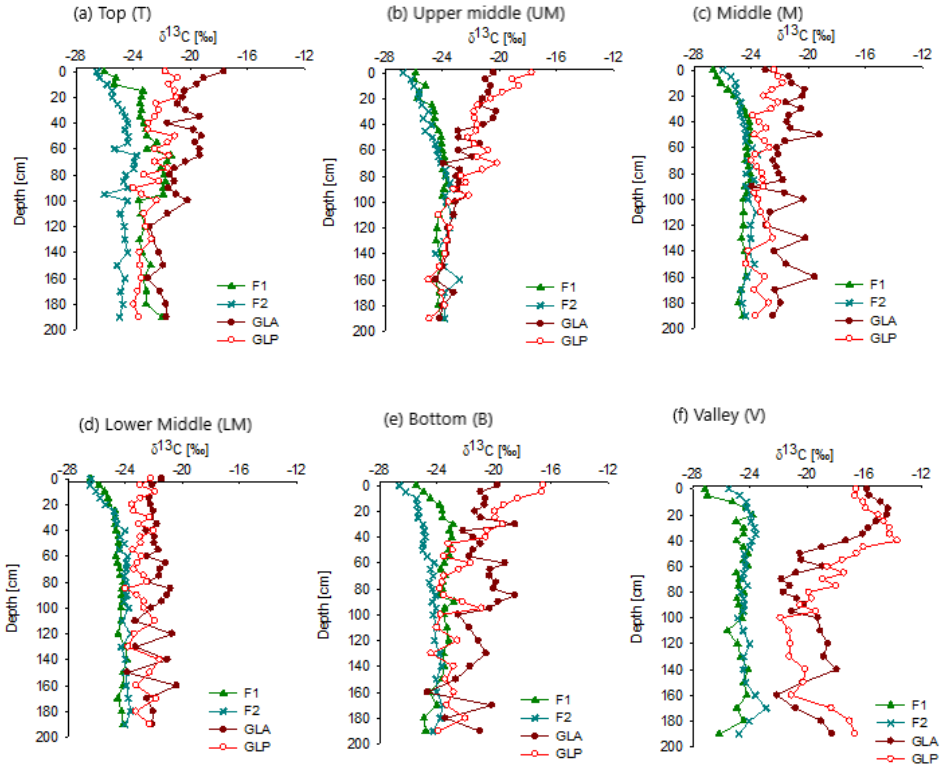
S4: Convex hillslope surrounding lake Alaotra, characterised by a relatively flat top with a slope which curves outwards and steepens toward their basis (Photo taken in January 2019 by V.F. Razanamahandry)




S5: Texture triangle diagram (clay, silt and sand fractions) of soils under forest and grassland.




S6: Depth profile of pMC for the GLP-T, GLP-V, F2-T and F2-V profiles.




S7: $\delta^{13}C$ profiles of hillslopes F1, F2, GLA and GLP plotted together for each sampling location: (a) Top, (b) Upper Middle, (c) Middle, (d) Lower Middle, (e) Bottom and (f) Valley.

**Supplementary tables**

Table 1: P-values from statistical analysis of profiles under forest and grassland with respect to OC%, $\delta^{13}C$ and SOC stocks in the upper 50 cm depth.

| Comparison | OC% | $\delta^{13}C$ | SOC stock |
|---|---|---|---|
| GLA-V vs GLP-V | 0.183 | 0.933 | 0.270 |
| GLA-B vs GLP-B | 0.966 | 0.836 | 0.467 |
| GLA-LM vs GLP-LM | 0.486 | 0.659 | 0.601 |
| GLA-M vs GLP-M | 0.071 | 0.186 | 0.128 |
| GLA-UM vs GLP-UM | 0.204 | 0.931 | 0.553 |
| GLA-T vs GLP-T | 0.929 | 0.228 | 0.837 |
| F1-V vs F2-V | 0.469 | 0.459 | 0.6597 |
| F1-B vs F2-B | 0.128 | 0.063 | 0.138 |
| F1-LM vs F2-LM | 0.760 | 0.990 | 0.833 |
| F1-M vs F2-M | 0.116 | 0.982 | 0.154 |
| F1-UM vs F2-UM | 0.746 | 0.599 | 0.689 |
| F1-T vs F2-T | 0.968 | 0.190 | 0.966 |

Table 2: P-values from statistical comparison of valley to each other position ( T, UM, M and B) (i) in the forest (F) and (i) grassland in the upper 0-50 cm depth.

| | | OC% | $\delta^{13}C$ | SOC stock |
|---|---|---|---|---|
| Soil under Grassland | G-V vs. G-B | 0.001 | <0.001 | <0.001 |
| | G-V vs. G-LM | <0.001 | <0.001 | <0.001 |
| | G-V vs. G-M | <0.001 | <0.001 | <0.001 |
| | G-V vs. G-UM | 0.020 | <0.001 | 0.004 |
| | G-V vs. G-T | 0.013 | <0.001 | 0.013 |
| Soil under Forest | V-F vs. F-B | 0.010 | 0.890 | 0.002 |
| | V-F vs. F-LM | 0.002 | 0.066 | 0.002 |
| | V-F vs. F-M | 0.264 | 0.092 | 0.166 |
| | V-F vs. F-UM | <0.001 | 0.120 | <0.001 |
| | V-F vs. F-T | 0.704 | 0.991 | 0.092 |

Table 3: Average values (means ± standard deviation) for cumulative SOC stocks (Mg C $ha^{-1}$) of grassland soil profiles and forest profiles for 30 cm, 100 cm and 200 cm soil profiles.

| | **FOREST SOILS** | | **GRASSLAND SOILS** | |
|---|---|---|---|---|
| **SOIL DEPTH** | F1 | F2 | GLA | GLP |
| **0-30 CM** | 70 ± 30 | 74 ±20 | 33 ± 9 | 30 ± 11 |
| **0-100 CM** | 137 ± 55 | 139 ± 36 | 76 ± 23 | 65 ± 16 |
| **0-200 CM** | 197 ± 83 | 171 ± 38 | 100 ± 31 | 91 ± 20 |