

Organic matter cycling along geochemical, geomorphic and disturbance gradients in vegetation and soils of African tropical forests and cropland - Project TropSOC DATABASE_v1.0

2.6. Forest – Parent Material

When using these data, please cite the original publication:

Doetterl S., Asifiwe R.K., Baert G., Bamba F., Bauters M., Boeckx P., Bukombe B., Cadisch G., Cizungu L.N., Cooper M., Hoyt A., Kabaseke C., Kalbitz K., Kidinda L., Maier A., Mainka M., Mayrock J., Muhindo D., Mujinya B.B., Mukotanyi, S.M., Nabahungu L., Reichenbach M., Rewald B., Six J., Stegmann A., Summerauer L., Unseld R., Vanlauwe B., Van Oost K., Verheyen K. Vogel C., Wilken F., Fiener P. Organic matter cycling along geochemical, geomorphic and disturbance gradients in forests and cropland of the African Tropics - Project TropSOC Database Version 1.0. *Earth System Science Data* XXX, DOI XXX, 2021.

Introduction

The dataset comprises a unique sample identifier, a comment regarding rock type, 62 variables measured to quantify elemental concentrations in unweathered rock samples of TropSOC's soil parent material using total combustion, ICPOES and XRF. Missing values are indicated by -9999.

Data structure

No.	Variable	Explanation	Unit
1	sampleID	unique identifier of any soil or vegetation sample taken in the field	-
2	rock_type_comment	first classification based on field samples; information partly missing when unclear; partly a "?" indicates somewhat unclear / uncertain classification estimates	-
3	N	nitrogen content in mass percent (total combustion)	%
4	C	organic carbon content in mass percent (total combustion)	%
5	Ca_ICPOES	mass percent of Ca in the bulk soil	%
6	Cu_ICPOES	mass percent of Cu in the bulk soil	%
7	K_ICPOES	mass percent of K in the bulk soil	%
8	Mg_ICPOES	mass percent of Mg in the bulk soil	%
9	Na_ICPOES	mass percent of Na in the bulk soil	%
10	P_ICPOES	mass percent of P in the bulk soil	%
11	Ti_ICPOES	mass percent of Ti in the bulk soil	%
12	Zn_ICPOES	mass percent of Zn in the bulk soil	%
13	Al_ICPOES	mass percent of Al in the bulk soil	%
14	Fe_ICPOES	mass percent of Fe in the bulk soil	%
15	Mn_ICPOES	mass percent of Mn in the bulk soil	%
16	Na_XRF	mass percent of Na in the bulk soil	%
17	Mg_XRF	mass percent of Mg in the bulk soil	%
18	Al_XRF	mass percent of Al in the bulk soil	%
19	Si_XRF	mass percent of Si in the bulk soil	%
20	P_XRF	mass percent of P in the bulk soil	%
21	S_XRF	mass percent of S in the bulk soil	%
22	Cl_XRF	mass percent of Cl in the bulk soil	%

23	K_XRF	mass percent of K in the bulk soil	%
24	Ca_XRF	mass percent of Ca in the bulk soil	%
25	Sc_XRF	mass percent of Sc in the bulk soil	%
26	Ti_XRF	mass percent of Ti in the bulk soil	%
27	Cr_XRF	mass percent of Cr in the bulk soil	%
28	Mn_XRF	mass percent of Mn in the bulk soil	%
29	Fe_XRF	mass percent of Fe in the bulk soil	%
30	Co_XRF	mass percent of Co in the bulk soil	%
31	Ni_XRF	mass percent of Ni in the bulk soil	%
32	Cu_XRF	mass percent of Cu in the bulk soil	%
33	Zn_XRF	mass percent of Zn in the bulk soil	%
34	As_XRF	mass percent of As in the bulk soil	%
35	Se_XRF	mass percent of Se in the bulk soil	%
36	Br_XRF	mass percent of Br in the bulk soil	%
37	Rb_XRF	mass percent of Rb in the bulk soil	%
38	Sr_XRF	mass percent of Sr in the bulk soil	%
39	Y_XRF	mass percent of Y in the bulk soil	%
40	Zr_XRF	mass percent of Zr in the bulk soil	%
41	Mo_XRF	mass percent of Mo in the bulk soil	%
42	Ag_XRF	mass percent of Ag in the bulk soil	%
43	Cd_XRF	mass percent of Cd in the bulk soil	%
44	In_XRF	mass percent of In in the bulk soil	%
45	Sn_XRF	mass percent of Sn in the bulk soil	%
46	Sb_XRF	mass percent of Sb in the bulk soil	%
47	Te_XRF	mass percent of Te in the bulk soil	%
48	I_XRF	mass percent of I in the bulk soil	%
49	Cs_XRF	mass percent of Cs in the bulk soil	%
50	Ba_XRF	mass percent of Ba in the bulk soil	%
51	La_XRF	mass percent of La in the bulk soil	%
52	Ce_XRF	mass percent of Ce in the bulk soil	%
53	Pr_XRF	mass percent of Pr in the bulk soil	%
54	Nd_XRF	mass percent of Nd in the bulk soil	%
55	Hf_XRF	mass percent of Hf in the bulk soil	%
56	Ta_XRF	mass percent of Ta in the bulk soil	%
57	W_XRF	mass percent of W in the bulk soil	%
58	Au_XRF	mass percent of Au in the bulk soil	%
59	Hg_XRF	mass percent of Hg in the bulk soil	%
60	Tl_XRF	mass percent of Tl in the bulk soil	%
61	Pb_XRF	mass percent of Pb in the bulk soil	%
62	Bi_XRF	mass percent of Bi in the bulk soil	%
63	Th_XRF	mass percent of Th in the bulk soil	%
64	U_XRF	mass percent of U in the bulk soil	%

Methods

Nitrogen and Carbon [Variable 3 and 4]: Bulk C and N content of rock samples was measured using 1 g of ground subsamples with a dry combustion analyzer (Variomax CN, Elementar GmbH, Hanau, Germany) and a measuring range of 0.2 - 400 mg g⁻¹ soil (to determine the absolute C or N mass in a sample) and a reproducibility of < 0.5 % (relative deviation). Recovery rates exceeding 97 % and 91 % were obtained across all samples for the rock masses as well as C and N concentrations. None of the soil samples showed any reaction when treated with 10 % HCl and are therefore considered free of carbonates. Consequently, total soil CN content is interpreted as fossile organic carbon (FOC) and fossile organic nitrogen (FON) content. This interpretation is also applied to samples showing geogenic C residues from sediment sources.

Total element composition based on ICP-OES measurements [variables 5 to 15 of the Data structure table]: Total elemental composition was determined using inductively coupled plasma optical emission spectrometry (ICP-OES) (5100 ICP-OES Agilent Technologies, USA) for the determination of calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), phosphorous (P), aluminium (Al), iron (Fe) and manganese (Mn). 1 g of powdered sample material was placed in a digestion tube and was boiled for 90 minutes at 120 °C in aqua regia (2 ml bi-distilled water, 2 ml 70 % nitric acid (HNO₃), 6 ml 37 % hydrochloric acid (HCl)) using a DigiPREP digestion system (DigiPREP MS SCP Science, Canada). All extracts including calibration standards were then filtered through a 41 grade Whatman filter and diluted with a dilution ratio of 1:2 for Ca, Mg, Na, K, P, and 1:1000 for Al, Fe, Mn using a diluting system (Hamilton 100, USA) before ICP-OES measurements. All extracts, including calibration standards, were then transferred into 50 ml PE-Tubes and digestion tubes rinsed three times bi-distilled water to remove potential residues before measurement of the extract.

Total element composition based on XRF measurements [variables 16 to 64]: Total elemental composition of unweathered rock samples of TropSOC's soil parent material was conducted using X-ray fluorescence (XRF) for Silica (Si), Titanium (Ti) and Zirkonium (Zr) following the procedure of Karathanasis & Hajek (1996). 4 g of powdered sample material and 1 g of CEROX wax were mixed for approximately 2 minutes using a vibrating mill (Mixer Mill MM 200 Retsch, Germany) before producing a pellet by applying pressure of 25 tons per cm² on the samples using a manual hydraulic press (Specac, USA). The stable and mixed pellet is then subsequently analysed using a XEPOS SEP03 XRF (Spectro Analytical Instruments GmbH).

Acknowledgment

TropSOC was funded via the Emmy-Noether-Program of the German Research Foundation (project ID 387472333).

References

- American Society for Testing Materials - ASTM. ASTM-D 5298-03. Standard test method for measurement of soil potential (suction) using filter paper. West Conshohocken, PA, 2003.
- Black, C. A. (ed.): Method of Soil Analysis, Part 2, Chemical and Microbiological Properties, American Society of Agronomy, Inc, Publisher, Madison, Wisconsin USA, 1965.
- Bouyoucos, G.J.: Hydrometer method improved for making particle Size analysis of soils. In: Agronomy Journal 53, 464-465, 1962
- Karathanasis, A. D. & B. F. Hajek: Elemental Analysis by X-Ray Fluorescence Spectroscopy - In: Soil Science Society of America Inc (1996): Methods of Soil Analysis. Part 3. Chemical Methods. SSA Book, USA, 1996.

Okalebo J.R., Gathua K.W. & P.L. Woomer: Laboratory Methods of Soil and Plant Analysis: A Working Manual. Second Edition. TSBF-CIAT and SACRED Africa, Kenya. Nairobi, 2002.

Pauwels, J. M, Eric Van Ranst, and Marc Verloo. Manuel De Laboratoire De Pédologie : Méthodes D'analyse De Sols Et De Plantes, équipement, Gestion De Stocks De Verrerie Et De Produits Chimiques. Yaoundé: Centre universitaire de Dschang. Département des sciences du sol, 1992.