README

Title dataset: Data underlying the publication: Assessment of the enhanced weathering potential of different silicate minerals to improve soil quality and sequester CO2

Authors: Emily E. E. M. te Pas, Mathilde Hagens, Rob N. J. Comans
Soil Chemistry and Chemical Soil Quality, Wageningen University & Research

Contact information: Emily.tepas@wur.nl or Mathilde.hagens@wur.nl

Wageningen University & Research – Environmental Science Group
P.O. Box 47
6700 AA Wageningen
The Netherlands

General introduction:

This data was collected during and after a down-flow soil column experiment conducted in the Soil Chemistry Laboratory (CBLB) at Wageningen University during 2019 and 2020. The results of this study were published in Frontiers in Climate in 2023 (open access): https://doi.org/10.3389/fclim.2022.954064. Two types of measurements were conducted: on the soils that were in the columns and on the leachate flowing out of the columns (see description of the experimental set-up below). For each group of measurements a file was created and uploaded.

Methodological information:

The aim of the experiment was to quantify and compare the enhanced weathering potential, including both the effects on soil quality and soil CO_2 sequestration, of different types of silicate minerals and rocks, namely olivine, basalt, wollastonite, anorthite, and albite. Details of the experimental set-up and chemical analyses can be found in the publication. Briefly, a down-flow soil column experiment was conducted for 64 days in a conditioned room of 20°C ± 2°C. Soil columns contained 150 g of soil (a low pH sandy soil collected in Wageningen, the Netherlands), had a diameter of 5 cm and a total volume of 180 mL. The columns were connected via a funnel to a closed container in which the leachate was collected. On the first day of the experiment, 18.75 g of one of the five silicate minerals was applied as a layer on top of the soil. This was done in duplicate and there was one control column, resulting in 11 columns in total. 40 mL de-mineralized water was added to the columns after which leachate was collected and analysed on the following days of the experiment: 1, 3, 5, 8, 10, 12, 15, 17, 19, 22, 24, 26, 29, 31, 33, 36, 40, 43, 47, 50, 53, 57, and 64. Upon termination of the experiment, the mineral layer was removed from the soil based on visual observation. The soil samples were dried at 40°C, sieved over 2 mm, and homogenised.

Data specific information:

Description of abbreviations:

- O1: olivine, first replicate
- O2: olivine, second replicate
- Ba1: basalt, first replicate
- Ba2: basalt, second replicate
- Wo1: wollastonite, first replicate
- Wo2: wollastonite, second replicate
- An1: anorthite, first replicate
- An2: anorthite, second replicate
- Al1: albite, first replicate
- Al2: albite, second replicate
- Control: there was one control that received the same treatment as the other columns but without silicate mineral application on top

File: te Pas et al. 2023 – Data leachate:

- ICP-OES and ICP-MS: Leachate samples were analysed with ICP-OES and ICP-MS on the following days: 1, 3, 5, 8, 12, 17, 24, 33, 64. Concentrations of Ca, Mg, K, and Na were measured with ICP-OES and Ni concentrations were measured with ICP-MS. Data sheet shows the cumulative concentrations in mg/kg soil or µg/kg soil.
- SFA: Leachate samples were analysed with Segmented Flow Analysis (SFA) on the following days: 1, 3, 5, 8, 12, 17, 24, 33, 64. Data sheet shows the cumulative concentrations of Dissolved Inorganic Carbon (DIC) and Total Carbon (TC) in mg/kg soil. Dissolved Organic Carbon (DOC) can be calculated by difference.
- Alkalinity: Leachate samples were analysed for alkalinity on the following days: 1, 3, 5, 8, 10, 12, 15, 17, 22, 24, 29, 33, 43, 53, 64. Total alkalinity was measured by titrating a 7.5 mL sub-sample with 0.02 M HCl to pH = 4.50 (±0.05). Data sheet shows the cumulative concentration in mmol.
- pH: pH was measured in the leachate samples on the following days: 1, 3, 5, 8, 10, 12, 15, 17, 19, 22, 24, 26, 29, 31, 33, 36, 43, 50, 53, 57, 64.

Data sheets only show measured data points. Concentrations for the days on which samples were not analysed were calculated by linear interpolation.

File: te Pas et al. 2023 – Data soils:

- 0.43 M HNO3: Results from the 0.43 M HNO_3 extraction of soils followed by ICP-OES measurements at the end of the experiment in mg/kg soil (Groenenberg et al., 2017).

- CEC: Results from the 0.1 M $BaCl_2$ extraction followed by ICP-OES measurements to determine Cation Exchange Capacity (CEC) of soils at the end of the experiment in mmol+/kg soil (ISO, 2018).
- 0.1 M BaCl2: Results from the 0.1 M $BaCl_2$ extraction followed by ICP-OES measurements of soils at the end of the experiment in meq/100 g soil. The measured cations and CEC data were used to calculate the base saturation (ISO, 2018).
- LECO TC: Results from the LECO CN analyzer for the total carbon content of soils at the end of the experiment in g/kg soil.
- Scheibler IC: Results for the inorganic carbon content of soils at the end of the experiment determined with the Scheibler method in g $CaCO_3$/kg soil (Allison, 1960; ISO, 1995).

There are no missing data.

References:

Allison, L. (1960). Wet-combustion apparatus and procedure for organic and inorganic carbon in soil. Soil Sci. Soc. Am. J. 24, 36–40. doi: 10.2136/sssaj1960.03615995002400010018x

Groenenberg, J. E., Römkens, P. F., Zomeren, A. V., Rodrigues, S. M., and Comans, R. N. J. (2017). Evaluation of the single dilute (0.43M) nitric acid extraction to determine geochemically reactive elements in soil. Environ. Sci. Technol. 51, 2246–2253. doi: 10.1021/acs.est.6b05151

ISO-10693. (1995). Soil Quality - Determination of Carbonate Content - Volumetric Method. International Organization for Standardization.

ISO-11260. (2018). Soil Quality - Determination of Effective Cation Exchange Capacity and Base Saturation Level Using Barium Chloride Solution. International Organization for Standardization.