Data of leaf wax hydrogen isotope ratios and climatic variables along an aridity gradient in Chile and globally (https://doi.org/10.5880/GFZ.3.3.2023.001)

Nestor Gaviria-Lugo[1], Charlotte Läuchli[2], Hella Wittmann[1], Anne Bernhard[2], Patrick Frings[1], Mahyar Mohtadi[3], Oliver Rach[1], Dirk Sachse[1]

1. *GFZ German Research Centre for Geosciences, Potsdam, Germany*
2. *Institute of Geological Sciences, Freie Universität Berlin, Berlin, Germany*
3. *MARUM-Center for Marine Environmental Sciences, Bremen Universität, Bremen, Germany*

1. Licence

2. Citation

When using the data please cite:

Gaviria-Lugo, N., Läuchli, C., Wittmann, H., Bernhardt, A., Frings, P.J., Mohtadi, M., Rach, O., Sachse, D. (2023): Data of leaf wax hydrogen isotope ratios and climatic variables along an aridity gradient in Chile and globally. GFZ Data Services. http://doi.org/10.5880/GFZ.3.3.2023.001

The data are supplementary material to:

Gaviria-Lugo, Nestor; Läuchli, Charlotte; Wittmann, Hella; Bernhard, Anne; Frings, Patrick; Mohtadi, Mahyar; et al. (2023): Climatic controls on leaf wax hydrogen isotope ratios in terrestrial and marine sediments along a hyperarid-to-humid gradient. Biogeosciences. https://doi.org/10.5194/bg-20-4433-2023

Table of contents

3. Data Description

This data publication is supplementary to a study on the climatic controls on leaf wax hydrogen isotopes, by Gaviria-Lugo et al. (2023). The dataset contains hydrogen isotope ratios from leaf wax n-alkanes (δ^2H_{wax}) taken from soils, river sediments and marine surface sediments along a climatic gradient from hyperarid to humid in Chile. In addition, for each sampling site the hydrogen isotope ratios from precipitation (δ^2H_{pre}) from the grids produced by the Online Isotopes in Precipitation Calculator (OIPC) (Bowen and Revenaugh, 2003). Furthermore, for each sampling site we report mean annual data of precipitation, actual evapotranspiration, relative humidity, and soil moisture, all

derived from TerraClimate (Abatzoglou et al., 2018). Also provide data of mean annual temperature and the annual average of maximum daily temperature derived from WorldClim (Fick and Hijmans, 2017). As a final climatic parameter, we also derived data of aridity index from the Consultative Group of the International Agricultural Research Consortium for Spatial Information (CGIARCSI) (Trabucco and Zomer, 2022). In addition to climatic variables, for each site we include land cover fractions of trees, shrubs, grasses, crops, and barren land. These land cover fractions were obtained from Collection 2 of the Copernicus Global Land Cover layers (Buchhorn et al., 2020) via Google Earth Engine.

For further comparison here we provide δ^2H_{wax} compiled from 26 publications (see references) that reported both the *n*-C_{29} and *n*-C_{31} *n*-alkanes homologues from soils and lake sediments. For each sampling site of the global compilation, we provide δ^2H_{pre} and the same climatic and land cover parameters as for the Chilean data (i.e., precipitation, actual evapotranspiration, relative humidity, soil moisture, aridity index, temperature, fraction of trees, fraction of grasses, etc.), using the same sources.

The data is provided here as one single .xlsx file containing 9 data sheets, but also as 9 individual .csv files, to be accessed using the file format of preference. Additionally, 5 supplementary figures that accompany the publication Gaviria-Lugo et al. (2023) are provided in one single .pdf file. The samples taken for this study were assigned International Geo Sample Numbers (IGSNs), which are included in the provided tables S4, S5 and S6.

3.1. Sampling methods

We conducted fieldwork in Chile during March-April 2019. We sampled manually topsoils (upper 5 cm, n =12) and riverbed sediments (n=26) from catchments draining to the Pacific Ocean. Three small sub-catchments nested in three of the major catchments were also sampled. Marine core top sediments (1-2 cm core depth, 29 sites) were provided by the MARUM core repository. Marine samples used in this study were recovered during expeditions SO-102 and SO-156 of the RV SONNE using a multicorer (Hebbeln, 1995, 2001). The samples taken for this study in continental Chile were assigned International Geo Sample Numbers (IGSNs), which are included in the provided tables S4, S5 and S6. The marine sediment samples from the MARUM have assigned their own IGSNs.

3.2. Analytical methods

Detailed descriptions of the analytical methods followed to obtain the δ^2H_{wax} data for the Chilean samples can be found in Gaviria-Lugo et al. (2023).

3.3. Global δ^2H_{wax} data compilation criteria

We compiled δ^2H_{wax} values from 26 publications, using as starting point the compiled datasets of soils and lake sediments from Ladd et al. (2021) and Chen et al. (2022). We expanded these compilations with newer δ^2H_{wax} datasets of soils. For the compilation we exclusively used publications that reported δ^2H_{wax} values of both *n*-C_{29} and *n*-C_{31}. Data was asked directly from authors when one of the homologues was shown in the publication figures but was missing from published tables or supplements. In total, our compilation includes data from 26 peer-reviewed publications, with 750 and 663 δ^2H_{wax} values for *n*-C_{29} and *n*-C_{31}, respectively.

3.4. Remote sensing data and GIS methods

For all the sites in Chile and for the sites of the global compilation, we employed remote sensing products to derive climatic variables, land cover fractions and δ^2H_{pre} values. Mean annual data of precipitation (MAP), actual evapotranspiration (AET), actual vapor pressure (VAP), vapor pressure deficit (VPD), relative humidity (RH), and soil moisture (SM), were derived from TerraClimate (Abatzoglou et al., 2018). Data of mean annual temperature (MAT) and the annual average of maximum daily temperature (MaxT) were derived from WorldClim (Fick and Hijmans, 2017). Data of aridity index (Aidx) was derived from (CGIARCSI) (Trabucco and Zomer, 2022). Data of land cover fractions of trees (FrTrees), shrubs (FrShrubs), grasses (FrGrasses), crops (FrCrops), and barren land (FrBarren) were obtained from Collection 2 of the Copernicus Global Land Cover layers (Buchhorn et al., 2020). Data of δ^2H_{pre} was obtained from the grids produced by OIPC (Bowen and Revenaugh, 2003). Detailed information about characteristics from the remote sensing products used can be found in Gaviria-Lugo et al. (2023).

Each value assigned of δ^2H_{pre}, the climatic parameters, and land cover fractions is a long term mean annual value. To derive the values over catchments areas in Chile we considered the average value of the pixels contained inside the catchment areas. For lake sediment samples we defined drainage basins for each lake and calculated the average value of the pixels contained inside the defined drainage basin. Soil samples were considered as points, in this case we extracted the values of δ^2H_{pre}, the climatic parameters, and land cover fractions from the pixel containing the sampling point.

3.5. δ^2H_{pre} data from stations in Chile

We obtained a dataset comprising 923 monthly δ^2H_{pre} values measured at 9 long-term monitoring stations located along the different aridity zones of continental Chile. This dataset was obtained from the International Atomic Energy Agency (IAEA/WMO, 2023), collected as part of the Global Network of Isotopes in Precipitation (GNIP) program.

3.6. Data processing

We used actual vapor pressure (VAP) and vapor pressure deficit (VPD) to derive relative humidity (RH) using equation 1:

$$RH(\%) = \frac{VAP}{VAP+VPD} \times 100 \quad (1)$$

We applied equation 2 to calculate the apparent fractionation $(\varepsilon_{wax/pre})$ between δ^2H_{wax} and δ^2H_{pre}:

$$\varepsilon_{wax/pre} = \frac{\delta\,^2H_{wax}+1}{\delta\,^2H_{pre}+1} - 1 \quad (2)$$

To derive the woody fraction of the land cover, we summed the values of FrTrees and FrShrubs and divided this sum by the sum of all the vegetation fractions (FrTrees, FrShrubs, FrGrasses, FrCrops). The values of the herbaceous fraction were derived summing the values of FrGrasses and FrCrops and dividing this sum by the sum of all the vegetation fractions (FrTrees, FrShrubs, FrGrasses, FrCrops). All other equations and statistical methods used in Gaviria-Lugo et al. (2023) are not essential for this data publication, but in case of interest can be consulted in the methods section of the manuscript Gaviria-Lugo et al. (2023).

4. File description

4.1.File inventory

The zip file provided (**2023-001_Gaviria-Lugo-et-al_Data.zip)** includes all data and contains the three following folders:

- **2023-001_Gaviria-Lugo-et-al_DataXLSX**: This folder contains one .xlsx file that includes 9 different sheets with all the data in table format, each sheet is one data table. The file included in this folder is next:
    - *2023*-001*_Gaviria-Lugo-et-al_Data.xlsx*

- **2023-XXX_Gaviria-Lugo-et-al_DataCSV**: This folder contains 9 .csv files, each CSV file is one data table that corresponds to one of the 8 sheets in the .xlsx file. The list of files included in this folder is next:
    - 2023-001_Gaviria-Lugo-et-al_Data_TableS1_GlobalCompilation.csv
    - 2023-001_Gaviria-Lugo-et-al_Data_TableS2_GlobalAridityGradients.csv
    - 2023-001_Gaviria-Lugo-et-al_Data_TableS3_d2HpreChileStations.csv
    - 2023-001_Gaviria-Lugo-et-al_Data_TableS4_ChileWaxConcentration.csv
    - 2023-001_Gaviria-Lugo-et-al_Data_TableS5_d2HwaxChile.csv
    - 2023-001_Gaviria-Lugo-et-al_Data_TableS6_AppFractionationChile.csv
    - 2023-001_Gaviria-Lugo-et-al_Data_TableS7_PowerMdlsFit.csv
    - 2023-001_Gaviria-Lugo-et-al_Data_TableS8_LeafEnrichmentMdls.csv
    - 2023-001_Gaviria-Lugo-et-al_Data_TableS9_KruskalWallis.csv

- **2023-001_Gaviria-Lugo-et-al_Figures**: Contains one .pdf file that includes 8 supplementary figures that accompany the paper Gaviria-Lugo et al. (2023). The file included in this folder is next:
    - 2023-001_Gaviria-Lugo-et-al_Figures.pdf

4.2.Description of data tables

As the data included in the .xlsx files and the data in the .csv files is the same, the tables presented below are equally valid for each sheet of the .xlsx file or each of the .csv files.

4.2.1. 2023-001_Gaviria-Lugo-et-al_Data_TableS1_GlobalCompilation

Global compilation of δ^2H_{wax} values including δ^2H_{pre}, climatic variables and land cover fractions for each sampling site.

Column header	unit	Description
PublicationNumber	--	Number of the publication in the compilation
FirstAuthor	--	Last name from the first author of the publication
PublicationYear	yyyy	Year of publication of the study
Journal	--	Journal in which the study was published
Latitude	(°N)	Latitude in WGS84 in decimal degrees
Longitude	(°E)	Longitude in WGS84 in decimal degrees
SampleName	--	Name assigned to the sample in the publication
SpecificLocation	--	Specific name of the sampling location indicated
Country	--	Country where the sample was taken
Region	--	Subcontinental or country region where the sample was taken
Continent	--	Continent where the sample was taken
Elevation	m	Elevation of the sampling location
SedType	--	Type of sample (Lake sediment, soil)
d2H_C29	per mil (‰)	δ^2H_{wax} values in per mil for the n-C_{29} alkane homologue
d2H_C29Error	per mil (‰)	2σ error on the δ^2H_{wax} values in per mil for the n-C_{29} alkane homologue
d2H_C31	per mil (‰)	δ^2H_{wax} values in per mil for the n-C_{31} alkane homologue
d2H_C31Error	per mil (‰)	2σ error on δ^2H_{wax} values in per mil for the n-C_{31} alkane homologue
d2Hpre_OIPC	per mil (‰)	δ^2H_{pre} values in per mil derived from gridded data by Bowen and Revenaugh (2003)
d2Hpre_OIPC_error	per mil (‰)	Error of δ^2H_{pre} values in per mil, derived from gridded data by Bowen and Revenaugh (2003)
AppFracC29	per mil (‰)	$\varepsilon_{wax/pre}$ values in per mil for the n-C_{29} alkane homologue
AppFracC29error	per mil (‰)	2σ error of the $\varepsilon_{wax/pre}$ values in per mil for the n-C_{29} alkane homologue
AppFracC31	per mil (‰)	$\varepsilon_{wax/pre}$ values in per mil for the n-C_{31} alkane homologue
AppFracC31error	per mil (‰)	2σ error of the $\varepsilon_{wax/pre}$ values in per mil for the n-C_{31} alkane homologue

Column header	unit	Description
Aidx	--	Aridity index derived from Trabucco and Zomer (2022)
MAP	mm y^{-1}	Mean annual precipitation derived from Abatzoglou et al. (2018)
AET	mm y^{-1}	Mean annual actual evapotranspiration derived from Abatzoglou et al. (2018)
SM	mm y^{-1}	Mean annual soil moisture derived from Abatzoglou et al. (2018)
VAP	kPa	Mean annual actual vapor pressure derived from Abatzoglou et al. (2018)
VPD	kPa	Mean annual vapor pressure deficit derived from Abatzoglou et al. (2018)
RH	%	Mean annual relative humidity derived from Abatzoglou et al. (2018)
MAT	(°C)	Mean annual temperature derived from Fick and Hijmans (2017)
MaxT	(°C)	Annual average of the maximun daily temperature derived from Fick and Hijmans (2017)
FrTrees	--	Fraction of land covered by trees, derived from Buchhorn et al. (2020)
FrShrubs	--	Fraction of land covered by shrubs, derived from Buchhorn et al. (2020)
FrGrasses	--	Fraction of land covered by grasses, derived from Buchhorn et al. (2020)
FrCrops	--	Fraction of land covered by crops, derived from Buchhorn et al. (2020)
FrBarren	--	Fraction of land covered by barrenland, derived from Buchhorn et al. (2020)
FrWoodyVeg	--	Fraction of the total vegetation at each site that corresponds to woody vegetation. Sum of FrTrees and FrShrubs over the sum of all vegetation fractions.
FrHerbaceousVeg	--	Fraction of the total vegetation at each site that corresponds to herbaceous vegetation. Sum of FrGrasses and FrCrops over the sum of all vegetation fractions.

4.2.2. 2023-001_Gaviria-Lugo-et-al_Data_TableS2_GlobalAridityGradients

δ^2H_{wax} values from samples of the 4 strongest aridity gradients in the global compilation. Includes δ^2H_{pre}, climatic variables and land cover fractions for each sampling site.

Column header	unit	Description
PublicationNumber	--	Number of the publication in the compilation
FirstAuthor	--	Last name from the first author of the publication
PublicationYear	yyyy	Year of publication of the study
Journal	--	Journal in which the study was published
Latitude	(°N)	Latitude in WGS84 in decimal degrees
Longitude	(°E)	Longitude in WGS84 in decimal degrees
SampleName	--	Name assigned to the sample in the publication
SpecificLocation	--	Specific name of the sampling location indicated
Country	--	Country where the sample was taken
Region	--	Subcontinental or country region where the sample was taken
Continent	--	Continent where the sample was taken
Elevation	m	Elevation of the sampling location
SedType	--	Type of sample (Lake sediment, soil)
d2H_C29	per mil (‰)	δ^2H_{wax} values in per mil for the n-C_{29} alkane homologue
d2H_C29Error	per mil (‰)	2σ error on the δ^2H_{wax} values in per mil for the n-C_{29} alkane homologue
d2H_C31	per mil (‰)	δ^2H_{wax} values in per mil for the n-C_{31} alkane homologue
d2H_C31Error	per mil (‰)	2σ error on δ^2H_{wax} values in per mil for the n-C_{31} alkane homologue
d2Hpre_OIPC	per mil (‰)	δ^2H_{pre} values in per mil derived from gridded data by Bowen and Revenaugh (2003)
d2Hpre_OIPC_error	per mil (‰)	Error of δ^2H_{pre} values in per mil, derived from gridded data by Bowen and Revenaugh (2003)
AppFracC29	per mil (‰)	$\varepsilon_{wax/pre}$ values in per mil for the n-C_{29} alkane homologue
AppFracC29error	per mil (‰)	2σ error of the $\varepsilon_{wax/pre}$ values in per mil for the n-C_{29} alkane homologue
AppFracC31	per mil (‰)	$\varepsilon_{wax/pre}$ values in per mil for the n-C_{31} alkane homologue
AppFracC31error	per mil (‰)	2σ error of the $\varepsilon_{wax/pre}$ values in per mil for the n-C_{31} alkane homologue
Aidx	--	Aridity index derived from Trabucco and Zomer (2022)
MAP	mm y^{-1}	Mean annual precipitation derived from Abatzoglou et al. (2018)

Column header	unit	Description
AET	mm y^{-1}	Mean annual actual evapotranspiration derived from Abatzoglou et al. (2018)
SM	mm y^{-1}	Mean annual soil moisture derived from Abatzoglou et al. (2018)
VAP	kPa	Mean annual actual vapor pressure derived from Abatzoglou et al. (2018)
VPD	kPa	Mean annual vapor pressure deficit derived from Abatzoglou et al. (2018)
RH	%	Mean annual relative humidity derived from Abatzoglou et al. (2018)
MAT	(°C)	Mean annual temperature derived from Fick and Hijmans (2017)
MaxT	(°C)	Annual average of the maximun daily temperature derived from Fick and Hijmans (2017)
FrTrees	--	Fraction of land covered by trees, derived from Buchhorn et al. (2020)
FrShrubs	--	Fraction of land covered by shrubs, derived from Buchhorn et al. (2020)
FrGrasses	--	Fraction of land covered by grasses, derived from Buchhorn et al. (2020)
FrCrops	--	Fraction of land covered by crops, derived from Buchhorn et al. (2020)
FrBarren	--	Fraction of land covered by barrenland, derived from Buchhorn et al. (2020)
FrWoodyVeg	--	Fraction of the total vegetation at each site that corresponds to woody vegetation. Sum of FrTrees and FrShrubs over the sum of all vegetation fractions.
FrHerbaceousVeg	--	Fraction of the total vegetation at each site that corresponds to herbaceous vegetation. Sum of FrGrasses and FrCrops over the sum of all vegetation fractions.

4.2.3. 2023-001_Gaviria-Lugo-et-al_Data_TableS3_d2HpreChileStations

Monthly δ^2H_{pre} values from 9 long term stations in Chile. Data obtained by the International Atomic Energy Agency.

Column header	unit	Description
Site	--	Specific name of the sampling location indicated
Latitude	(°N)	Latitude in WGS84 in decimal degrees
Longitude	(°E)	Longitude in WGS84 in decimal degrees
Elevation	m	Elevation of the sampling location
Reference	--	Reference of the entity that collected the data
Date	yyyy-mm-dd	Date assigned to the sample. The sample is a monthly averaged but is assigned the 15 of each month as day.
Year	yyyy	Sampling year
MonthNumber	--	Number of the sampling month as part of a year from 1-12
Month	--	Name of the sampling month
Season	--	Name of the sampling season
d2Hpre_measured	per mil (‰)	Monthly average δ^2H_{pre} values in per mil measured at the station
Precipitation	mm m^{-1}	Monthly precipitation registered at the sampling station
AirTemperature	(°C)	Monthly average temperature registered at the sampling station
VapourPressure	kPa	Monthly average vapor pressure registered at the sampling station
Aidx	--	Aridity index derived from Trabucco and Zomer (2022)
d2Hpre_OIPC	per mil (‰)	δ^2H_{pre} values in per mil derived from gridded data by Bowen and Revenaugh (2003)
d2Hpre_OIPC_error	per mil (‰)	Error of δ^2H_{pre} values in per mil, derived from gridded data by Bowen and Revenaugh (2003)

4.2.4. 2023-001_Gaviria-Lugo-et-al_Data_TableS4_ChileWaxConcentration

Leaf wax n-alkanes concentration for the samples of the Chilean aridity gradient. Includes average chain length and carbon preference index values for each sample.

Column header	unit	Description
Sampling Site	--	Specific name of the sampling location.
Sediment Type	--	Type of sediment sample (Riverine, Soils, Marine)
IGSN	--	International Geo Sample Number. Metadata for each sample can be accessed here: http://igsn.org/[insert IGSN number here]
Aridity Zone	--	Aridity Zone of the sampling location. Defined following the classification proposed by UNEP (1997).
Latitude	(°N)	Latitude in WGS84 in decimal degrees
Longitude	(°E)	Longitude in WGS84 in decimal degrees
n-C25	[ug g^{-1} sediment dry weight]	Concentration of the n-C_{25} alkane homologue in the sample.
n-C26	[ug g^{-1} sediment dry weight]	Concentration of the n-C_{26} alkane homologue in the sample.
n-C27	[ug g^{-1} sediment dry weight]	Concentration of the n-C_{27} alkane homologue in the sample.
n-C28	[ug g^{-1} sediment dry weight]	Concentration of the n-C_{28} alkane homologue in the sample.
n-C29	[ug g^{-1} sediment dry weight]	Concentration of the n-C_{29} alkane homologue in the sample.
n-C30	[ug g^{-1} sediment dry weight]	Concentration of the n-C_{30} alkane homologue in the sample.
n-C31	[ug g^{-1} sediment dry weight]	Concentration of the n-C_{31} alkane homologue in the sample.
n-C32	[ug g^{-1} sediment dry weight]	Concentration of the n-C_{32} alkane homologue in the sample.
n-C33	[ug g^{-1} sediment dry weight]	Concentration of the n-C_{33} alkane homologue in the sample.
n-C34	[ug g^{-1} sediment dry weight]	Concentration of the n-C_{34} alkane homologue in the sample.
n-C35	[ug g^{-1} sediment dry weight]	Concentration of the n-C_{35} alkane homologue in the sample.
Concentration Total n-alkanes	[ug g^{-1} sediment dry weight]	Sum of the concentration of n-alkanes from n-C_{25} to n-C_{35} in the sample.

Column header	unit	Description
CPI	--	Carbon Preference Index. Calculated as in the equation 1 presented in Gaviria-Lugo et al. (2023).
ACL	--	Average Chain length of the n-alkanes in the sample. Calculated using equation 2 presented in Gaviria-Lugo et al. (2023).
C29/(C29+C31)	---	Ratio of the concentration of n-C_{29} and n-C_{31}.
$\delta^2H_{precipitation}$	per mil (‰)	δ^2H_{pre} values in per mil derived from gridded data by Bowen and Revenaugh (2003).
δ^2H n-C_{29}	per mil (‰)	δ^2H_{wax} values of the n-C_{29} homologue in per mil.
δ^2H n-C_{31}	per mil (‰)	δ^2H_{wax} values of the n-C_{31} homologue in per mil.

4.2.5. 2023-001_Gaviria-Lugo-et-al_Data_TableS5_d2HwaxChile

δ^2H_{wax} values for the chilean samples. Includes δ^2H_{pre}, predicted δ^2H_{wax} values, and residuals of the predicted values.

Column header	unit	Description
Sampling Site	--	Specific name of the sampling location.
Sediment Type	--	Type of sediment sample (Riverine, Soils)
IGSN	--	International Geo Sample Number. Metadata for each sample can be accessed here: http://igsn.org/[insert IGSN number here]
Aridity Zone	--	Aridity Zone of the sampling location. Defined following the classification proposed by UNEP (1997).
Latitude	(°N)	Latitude in WGS84 in decimal degrees
Longitude	(°E)	Longitude in WGS84 in decimal degrees
$\delta^2H_{precipitation}$	per mil (‰)	δ^2H_{pre} values in per mil derived from gridded data by Bowen and Revenaugh (2003).
δ^2H n-C_{29}	per mil (‰)	δ^2H_{wax} values of the n-C_{29} homologue in per mil.
δ^2H n-C_{31}	per mil (‰)	δ^2H_{wax} values of the n-C_{31} homologue in per mil.
Predicted δ^2H n-C_{29}	per mil (‰)	δ^2H_{wax} values of the n-C_{29} homologue in per mil. Values are predicted using the δ^2H_{pre} of each site and the regression parameters presented in Table 2 of Gaviria-Lugo et al. (2023).
Predicted δ^2H n-C_{31}	per mil (‰)	δ^2H_{wax} values of the n-C_{31} homologue in per mil. Values are predicted using the δ^2H_{pre} of each site and the regression parameters presented in Table 2 of Gaviria-Lugo et al. (2023).
Residuals δ^2H n-C_{29}	per mil (‰)	Values were obtained substracting predicted values to the measured values of each sample.
Residuals δ^2H n-C_{31}	per mil (‰)	Values were obtained substracting predicted values to the measured values of each sample.

4.2.6. 2023-001_Gaviria-Lugo-et-al_Data_TableS6_AppFractionationChile

$\varepsilon_{wax/pre}$ values for the chilean samples. Includes climatic variables and land cover fractions for each sampling site.

Column header	unit	Description
Sampling Site	--	Specific name of the sampling location.
Sediment Type	--	Type of sediment sample (Riverine, Soils)
IGSN	--	International Geo Sample Number. Metadata for each sample can be accessed here: http://igsn.org/[insert IGSN number here]
Aridity Zone	--	Aridity Zone of the sampling location. Defined following the classification proposed by UNEP (1997).
Latitude	(°N)	Latitude in WGS84 in decimal degrees
Longitude	(°E)	Longitude in WGS84 in decimal degrees
$\delta^2H_{precipitation}$	per mil (‰)	δ^2H_{pre} values in per mil derived from gridded data by Bowen and Revenaugh (2003).
$\varepsilon_{pre/wax}$ n-C_{29}	per mil (‰)	Values of apparent fractionation between δ^2H_{pre} and δ^2H_{wax} for the n-C_{29} homologue in per mil.
$\varepsilon_{pre/wax}$ n-C_{31}	per mil (‰)	Values of apparent fractionation between δ^2H_{pre} and δ^2H_{wax} for the n-C_{31} homologue in per mil.
Predicted δ^2H n-C_{29}	per mil (‰)	δ^2H_{wax} values of the n-C_{29} homologue in per mil. Values are predicted using the δ^2H_{pre} of each site and the regression parameters presented in Table 2 of Gaviria-Lugo et al. (2023).
MAP	mm y^{-1}	Mean annual precipitation derived from Abatzoglou et al. (2018)
AET	mm y^{-1}	Mean annual actual evapotranspiration derived from Abatzoglou et al. (2018)
Aidx	--	Aridity index derived from Trabucco and Zomer (2022)
VAP	kPa	Mean annual actual vapor pressure derived from Abatzoglou et al. (2018)
VPD	kPa	Mean annual vapor pressure deficit derived from Abatzoglou et al. (2018)
RH	%	Mean annual relative humidity derived from Abatzoglou et al. (2018)
SM	mm y^{-1}	Mean annual soil moisture derived from Abatzoglou et al. (2018)
MAT	(°C)	Mean annual temperature derived from Fick and Hijmans (2017)
MaxT	(°C)	Annual average of the maximun daily temperature derived from Fick and Hijmans (2017)
FrTrees	--	Fraction of land covered by trees, derived from Buchhorn et al. (2020)
FrShrubs	--	Fraction of land covered by shrubs, derived from Buchhorn et al. (2020)

Column header	unit	Description
FrGrasses	--	Fraction of land covered by grasses, derived from Buchhorn et al. (2020)
FrCrops	--	Fraction of land covered by crops, derived from Buchhorn et al. (2020)
FrBarren	--	Fraction of land covered by barrenland, derived from Buchhorn et al. (2020)
FrWoodyVeg	--	Fraction of the total vegetation at each site that corresponds to woody vegetation. Sum of FrTrees and FrShrubs over the sum of all vegetation fractions.
FrHerbaceousVeg	--	Fraction of the total vegetation at each site that corresponds to herbaceous vegetation. Sum of FrGrasses and FrCrops over the sum of all vegetation fractions.

4.2.7. 2023-001_Gaviria-Lugo-et-al_Data_TableS7_PowerMdlsFit

Parameters of the regression models fitted between $\varepsilon_{wax/pre}$ and the climatic variables.

Column header	unit	Description
X	--	The independent variable considered for the regression model.
Y	--	The dependent variable considered for the regression model.
Dataset	--	The dataset that was used for the regression. The Chilean dataset or the selection of the 4 aridity gradients from the global compilation.
Sediment Type	--	Type of sediment sample that the dataset used for the regression is based on (Rivers, Soils)
a	--	Slope of the model fit of the form Y =aX^k
k	--	Exponent of the model fit of the form Y =aX^k
CV	--	Coefficient of variation of the regression model.
df	--	Degrees of freedom of the regression model.
R2	--	R squared value of the regression model.
F	--	F statistic of the regression model.
P value	--	P value of the regression model.

4.2.8. 2023-001_Gaviria-Lugo-et-al_Data_TableS8_LeafEnrichmentMdls

Results from the ^2H enrichment models. Includes the relative enrichment predicted and empirically measured for the studied rivers in the hyperarid zone of Chile.

Column header	unit	Description
Site	--	Specific name of the sampling location.
Δ^2H_{SW}	per mil (‰)	Soil water ^2H enrichment calculated using equation 9 presented in Gaviria-Lugo et al. (2023).
Relative soil water ^2H enrichment	per mil (‰)	Standardized Δ^2H_{SW} value of each catchment relative to the Δ^2H_{SW} value of the Los Choros catchment.
Δ^2H_{LWP}	per mil (‰)	Leaf water ^2H enrichment corrected for the peclét effect. Calculated using equation 20 presented in Gaviria-Lugo et al. (2023).
Relative leaf water ^2H enrichment	per mil (‰)	Standardized Δ^2H_{LWP} value of each catchment relative to the Δ^2H_{LWP} value of the Los Choros catchment.
Δ^2H_{RMd}	per mil (‰)	Modeled relative ^2H enrichment for each catchment. Calculated as the sum of the relative leaf water and soil water enrichment.
$\varepsilon_{pre/wax}$ n-C_{29}	per mil (‰)	Values of apparent fractionation between δ^2H_{pre} and δ^2H_{wax} for the n-C_{29} homologue in per mil.
$\varepsilon_{pre/wax}$ n-C_{31}	per mil (‰)	Values of apparent fractionation between δ^2H_{pre} and δ^2H_{wax} for the n-C_{31} homologue in per mil.
Δ^2H_{REm} n-C_{29}	per mil (‰)	Empirical net ^2H enrichment for the n-C_{29} homologue, calculated relative to the $\varepsilon_{wax/pre}$ n-C_{29} of the Los Choros catchment.
Δ^2H_{REm} n-C_{31}	per mil (‰)	Empirical net ^2H enrichment for the n-C_{31} homologue, calculated relative to the $\varepsilon_{wax/pre}$ n-C_{31} of the Los Choros catchment.

4.2.9. 2023-001_Gaviria-Lugo-et-al_Data_TableS9_KruskalWallis

Results from the statistical test of the medians. The results presented here were obtained after testing if there are differences in median δ^2H_{wax} values across soils, river sediments and marine sediments from different aridity zones.

Column header	unit	Description
Homologue	--	Specific name of n-alkane homologue that was being compared.
p-value	-	p-value of the Kruskal-Wallis statistical test.
Chi-squared	-	Chi-squared of the Kruskal-Wallis statistical test.
df	-	Degrees of freedom of the Kruskal-Wallis statistical test.
Aridity Zone	-	Aridity zone of the sediments used for the statistical test.

5. References

Abatzoglou, J. T., Dobrowski, S. Z., Parks, S. A., and Hegewisch, K. C.: TerraClimate, a high-resolution global dataset of monthly climate and climatic water balance from 1958–2015, Sci Data, 5, 170191, https://doi.org/10.1038/sdata.2017.191, 2018.

Aichner, B., Rajabov, N., Shodmonov, M., Mętrak, M., Suska-Malawska, M., Strecker, M., & Sachse, D. (2021). Local effects on soil leaf wax hydrogen isotopes along a west to east transect through the Pamirs, Tajikistan. Organic Geochemistry, 160, 104272. https://doi.org/10.1016/j.orggeochem.2021.104272

Bai, Y., Fang, X., Jia, G., Sun, J., Wen, R., & Ye, Y. (2015). Different altitude effect of leaf wax n-alkane δD values in surface soils along two vapor transport pathways, southeastern Tibetan Plateau. Geochimica et Cosmochimica Acta, 170, 94-107. https://doi.org/10.1016/j.gca.2015.08.016

Bertassoli, D. J., Häggi, C., Chiessi, C. M., Schefuß, E., Hefter, J., Akabane, T. K., & Sawakuchi, A. O. (2022). Controls on the distributions of GDGTs and n-alkane isotopic compositions in sediments of the Amazon River Basin. Chemical Geology, 594, 120777. https://doi.org/10.1016/j.chemgeo.2022.120777

The Online Isotopes in Precipitation Calculator, version 3.1: http://www.waterisotopes.org

Bowen, G. J. and Revenaugh, J.: Interpolating the isotopic composition of modern meteoric precipitation, Water Resources Research, 39, https://doi.org/10.1029/2003WR002086, 2003.

Buchhorn, M., Lesiv, M., Tsendbazar, N.-E., Herold, M., Bertels, L., & Smets, B. (2020). Copernicus global land cover layers—Collection 2. Remote Sensing, 12(6), 1044. https://doi.org/10.3390/rs12061044

Chen, G., Li, X., Tang, X., Qin, W., Liu, H., Zech, M., & Auerswald, K. (2022). Variability in pattern and hydrogen isotope composition (δ2H) of long-chain n-alkanes of surface soils and its relations to climate and vegetation characteristics: A meta-analysis. Pedosphere, 32(3), 369–380. https://doi.org/10.1016/S1002-0160(21)60080-2

Daniels, W., Huang, Y., Longo, W., Giblin, A., & Russell, J. (2020). Lake Surface Sediment Transect from northern Alaska—Leaf wax biomarker (n-alkane and n-acid) indices and hydrogen isotope ratios, 2011-2015. Artic Data Center. https://doi.org/10.18739/A2183435S.

Douglas, P. M. J., Pagani, M., Brenner, M., Hodell, D. A., & Curtis, J. H. (2012). Aridity and vegetation composition are important determinants of leaf-wax δD values in southeastern Mexico and Central America. Geochimica et Cosmochimica Acta, 97, 24– 45. https://doi.org/10.1016/j.gca.2012.09.005

Feakins, S. J., Wu, M. S., Ponton, C., Galy, V., & West, A. J. (2018). Dual isotope evidence for sedimentary integration of plant wax biomarkers across an Andes-Amazon elevation transect. Geochimica et Cosmochimica Acta, 242, 64–81. https://doi.org/10.1016/j.gca.2018.09.007

Fick, S. E. and Hijmans, R. J.: WorldClim 2: new 1-km spatial resolution climate surfaces for global land areas, International Journal of Climatology, 37, 4302–4315, https://doi.org/10.1002/joc.5086, 2017.

Garcin, Y., Schwab, V. F., Gleixner, G., Kahmen, A., Todou, G., Séné, O., Onana, J.-M., Achoundong, G., & Sachse, D. (2012). Hydrogen isotope ratios of lacustrine sedimentary n-alkanes as proxies of tropical African hydrology: Insights from a calibration transect across Cameroon. Geochimica et Cosmochimica Acta, 79, 106–126. https://doi.org/10.1016/j.gca.2011.11.039

Gaviria-Lugo, Nestor; Läuchli, Charlotte; Wittmann, Hella; Bernhard, Anne; Frings, Patrick; Mohtadi, Mahyar; et al. (2023): Climatic controls on leaf wax hydrogen isotope ratios in terrestrial and marine sediments along a hyperarid-to-humid gradient. Biogeosciences. https://doi.org/10.5194/bg-20-4433-2023

Goldsmith, Y., Polissar, P. J., deMenocal, P. B., & Broecker, W. S. (2019). Leaf wax δD and δ13C in soils record hydrological and environmental information across a climatic gradient in Israel. Journal of Geophysical Research: Biogeosciences, 124, 2898– 2916. https://doi.org/10.1029/2019JG005149

Hebbeln, D. (1995). Cruise Report of R/V Sonne Cruise 102 Valparaiso—Valparaiso, 9.5.-28.6.1995. https://media.suub.uni-bremen.de/handle/elib/3752

Hebbeln, D. (2001). PUCK: Report and preliminary results of R/V Sonne Cruise SO156, Valparaiso (Chile) - Talcahuano (Chile). March 29 - May 14, 2001. https://media.suub.uni-bremen.de/handle/elib/3847

Hepp, J., Schäfer, I. K., Lanny, V., Franke, J., Bliedtner, M., Rozanski, K., Glaser, B., Zech, M., Eglinton, T. I., & Zech, R. (2020). Evaluation of bacterial glycerol dialkyl glycerol tetraether and 2H-18O biomarker proxies along a central European topsoil transect. Biogeosciences, 17(3), 741–756. https://doi.org/10.5194/bg-17-741-2020

Herrmann, N., Boom, A., Carr, A. S., Chase, B. M., West, A. G., Zabel, M., & Schefuss, E. (2017). Hydrogen isotope fractionation of leaf wax n-alkanes in southern African soils. Organic Geochemistry, 109, 1-13. https://doi.org/10.1016/j.orggeochem.2017.03.008

Hou, J., Tian, Q., & Wang, M. (2018). Variable apparent hydrogen isotopic fractionation between sedimentary n-alkanes and precipitation on the Tibetan Plateau. Organic Geochemistry, 122, 78–86. https://doi.org/10.1016/j.orggeochem.2018.05.011

IAEA, W. (2023). IAEA/WMO, Global Network of Isotopes in Precipitation. The GNIP Database. https://nucleus.iaea.org/wiser

Ladd, S. N., Maloney, A. E., Nelson, D. B., Prebble, M., Camperio, G., Sear, D. A., Hassall, J. D., Langdon, P. G., Sachs, J. P., & Dubois, N. (2021). Leaf wax hydrogen isotopes as a hydroclimate proxy in the tropical Pacific. Journal of Geophysical Research: Biogeosciences, 126(3), e2020JG005891. https://doi.org/10.1029/2020JG005891

Leider, A., Hinrichs, K.-U., Schefuss, E., & Versteegh, G. J. M. (2013). Distribution and stable isotopes of plant wax derived n-alkanes in lacustrine, fluvial and marine surface sediments along an Eastern Italian transect and their potential to reconstruct the hydrological cycle. Geochimica et Cosmochimica Acta, 117, 16– 32. https://doi.org/10.1016/j.gca.2013.04.018

Li, Y., Yang, S., Luo, P., & Xiong, S. (2019). Aridity-controlled hydrogen isotope fractionation between soil n-alkanes and precipitation in China. Organic Geochemistry, 133, 53– 64. https://doi.org/10.1016/j.orggeochem.2019.04.009

Liu, W.,ladd Wang, H., Leng, Q., Liu, H., Zhang, H., Xing, M., Cao, Y., & Yang, H. (2019). Hydrogen isotopic compositions along a precipitation gradient of Chinese Loess Plateau: Critical roles of precipitation/evaporation and vegetation change as controls for leaf wax delta D. Chemical Geology, 528. https://doi.org/10.1016/j.chemgeo.2019.119278

Lu, J., Zang, J., Meyers, P., Huang, X., Qiu, P., Yu, X., Yang, H., & Xie, S. (2020). Surface soil n-alkane molecular and δD distributions along a precipitation transect in northeastern China. Organic Geochemistry, 144, 104015. https://doi.org/10.1016/j.orggeochem.2020.104015

Nieto-Moreno, V., Rohrmann, A., van der Meer, M. T. J., Damste, J. S. S., Sachse, D., Tofelde, S., Niedermeyer, E. M., Strecker, M. R., & Mulch, A. (2016). Elevation-dependent changes in n-alkane delta D and soil GDGTs across the South Central Andes. Earth and Planetary Science Letters, 453, 234-242. https://doi.org/10.1016/j.epsl.2016.07.049

Pérez-Angel, L. C., Sepúlveda, J., Montes, C., Smith, J. J., Molnar, P., González-Arango, C., Snell, K. E., & Dildar, N. (2022). Mixed Signals from the Stable Isotope Composition of Precipitation and Plant Waxes in the Northern Tropical Andes. Journal of Geophysical Research: Biogeosciences, e2022JG006932. https://doi.org/10.1029/2022JG006932

Polissar, P. J., & Freeman, K. H. (2010). Effects of aridity and vegetation on plant-wax δD in modern lake sediments. Geochimica et Cosmochimica Acta, 74(20), 5785– 5797. https://doi.org/10.1016/j.gca.2010.06.018

Rao, Z., Zhu, Z., Jia, G., Henderson, A. C. G., Xue, Q., & Wang, S. (2009). Compound specific δD values of long chain n-alkanes derived from terrestrial higher plants are indicative of the δD of meteoric waters: Evidence from surface soils in eastern China. *Organic Geochemistry, 40*(8), 922-930. https://doi.org/10.1016/j.orggeochem.2009.04.011

Sachse, D., Radke, J., & Gleixner, G. (2004). Hydrogen isotope ratios of recent lacustrine sedimentary n-alkanes record modern climate variability. Geochimica et Cosmochimica Acta, 68(23), 4877– 4889. https://doi.org/10.1016/j.gca.2004.06.004

Schwab, V. F., Garcin, Y., Sachse, D., Todou, G., Séné, O., Onana, J.-M., Achoundong, G., & Gleixner, G. (2015). Effect of aridity on δ13C and δD values of C3 plant- and C4 graminoid-derived leaf wax lipids from soils along an environmental gradient in Cameroon (Western Central Africa). Organic Geochemistry, 78, 99–109. https://doi.org/10.1016/j.orggeochem.2014.09.007

Strobel, P., Haberzettl, T., Bliedtner, M., Struck, J., Glaser, B., Zech, M., & Zech, R. (2020). The potential of δ2H-alkanes and δ18O sugar for paleoclimate reconstruction – A regional calibration study for South Africa. Science of The Total Environment, 716, 137045. https://doi.org/10.1016/j.scitotenv.2020.137045

Struck, J., Bliedtner, M., Strobel, P., Bittner, L., Bazarradnaa, E., Andreeva, D., Zech, W., Glaser, B., Zech, M., & Zech, R. (2020). Leaf Waxes and Hemicelluloses in Topsoils Reflect the δ2H and δ18O Isotopic Composition of Precipitation in Mongolia. Frontiers in Earth Science, 8, 343. https://doi.org/10.3389/feart.2020.00343

Trabucco, A. and Zomer, R.: Global Aridity Index and Potential Evapotranspiration (ET0) Climate Database v3, https://doi.org/10.6084/m9.figshare.7504448.v4, 2022.

Tuthorn, M., Zech, R., Ruppenthal, M., Oelmann, Y., Kahmen, A., del Valle, H. F., Eglinton, T., Rozanski, K., & Zech, M. (2015). Coupling δ2H and δ18O biomarker results yields information on relative humidity and isotopic composition of precipitation – a climate transect validation study. Biogeosciences, 12(12), 3913–3924. https://doi.org/10.5194/bg-12-3913-2015

van der Veen, I., Peterse, F., Davenport, J., Meese, B., Bookhagen, B., France-Lanord, C., Kahmen, A., Hassenruck–Gudipati, H. J., Gajurel, A., Strecker, M. R., & Sachse, D. (2020). Validation and calibration of soil δ2H and brGDGTs along (E-W) and strike (N-S) of the Himalayan climatic gradient. Geochimica et Cosmochimica Acta, 290, 408–423. https://doi.org/10.1016/j.gca.2020.09.014