

Supplementary Information: The SISAL database: a global resource to document oxygen and carbon isotope records from speleothems

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Figure S1: The structure of the SISAL database, showing individual tables (and their contents) and the nature of the relationships between them (where “many to one linkages” indicate that it is possible to have several entries in one table linked to a single entry in another table).

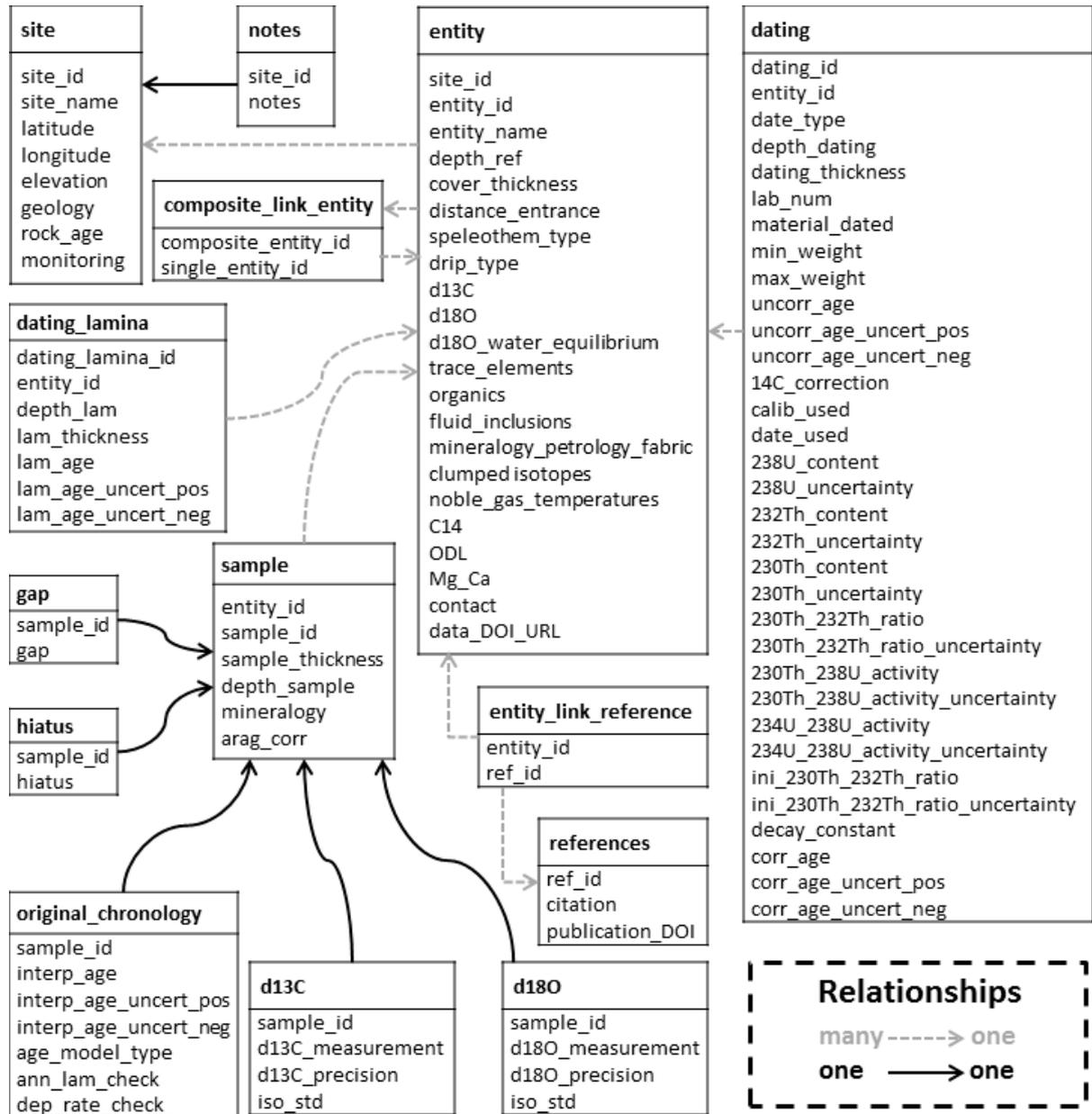


Table S1: Definition of pre-defined choice for all fields in the SISAL_v1 database

| Table name | Field | Lists |
|---------------------|-----------------------------|---|
| d13C | iso_std | 'PDB', 'Vienna-PDB' |
| d18O | iso_std | 'PDB', 'Vienna-PDB' |
| dating | date_type | 'C14', 'MC-ICP-MS U/Th', 'ICP-MS U/Th Other', 'Alpha U/Th', 'TIMS', 'U/Th unspecified', 'Cross-dating', 'Multiple methods', 'Event; hiatus', 'Event; actively forming', 'Event; start of laminations', 'Event; end of laminations', 'unknown' |
| dating | material_dated | 'calcite', 'aragonite', 'organic', 'other', 'unknown' |
| dating | calib_used | 'INTCAL13 NH', 'INTCAL13 SH', 'INTCAL13 marine', 'INTCAL09', 'INTCAL09 marine', 'INTCAL04 NH', 'INTCAL04 SH', 'INTCAL98', 'FAIRBANKS09', 'not calibrated' |
| dating | date_used | 'yes', 'no', 'unknown' |
| dating | decay_constant | 'Cheng et al. 2000', 'Cheng et al. 2013', 'Edwards et al. 1987', 'Ivanovich & Harmon 1992', 'others', 'unknown' |
| entity | depth_ref | 'from top', 'from base', 'not applicable' |
| entity | speleothem_type | 'stalagmite', 'composite', 'stalactite', 'flowstone', 'unknown', 'other' |
| entity | drip_type | 'seepage flow', 'seasonal drip', 'fast flow', 'mixture', 'unknown' |
| entity | d13C | 'yes', 'no', 'unknown' |
| entity | d18O | 'yes', 'no', 'unknown' |
| entity | d18O_water_equilibrium | 'yes', 'no', 'unknown' |
| entity | trace_elements | 'yes', 'no', 'unknown' |
| entity | organics | 'yes', 'no', 'unknown' |
| entity | fluid_inclusions | 'yes', 'no', 'unknown' |
| entity | mineralogy_petrology_fabric | 'yes', 'no', 'unknown' |
| entity | clumped_isotopes | 'yes', 'no', 'unknown' |
| entity | noble_gas_temperatures | 'yes', 'no', 'unknown' |
| entity | C14 | 'yes', 'no', 'unknown' |
| entity | ODL | 'yes', 'no', 'unknown' |
| entity | Mg_Ca | 'yes', 'no', 'unknown' |
| gap | gap | 'G' |
| hiatus | hiatus | 'H' |
| original_chronology | age_model_type | 'linear', 'linear between dates', 'polynomial fit', 'polynomial fit omitting outliers', 'Bayesian', 'Bayesian Bacon', 'Bayesian Bchron', 'StalAge', 'StalAge and other', 'Clam', 'COPRA', 'OxCal', 'combination of methods', 'unknown', 'other' |
| original_chronology | ann_lam_check | '14C peak', '14C slope', 'U/Th cycle', 'trace element cycle', 'assumed', 'not applicable', 'unknown' |
| original_chronology | dep_rate_check | 'yes', 'no', 'assumed', 'not applicable', 'unknown' |
| sample | mineralogy | 'calcite', 'secondary calcite', 'aragonite', 'vaterite', 'mixed', 'unknown' |
| sample | composite | 'yes', 'no', 'unknown' |

| | | |
|--------|------------|---|
| sample | arag_corr | 'yes', 'no', 'not applicable', 'unknown' |
| site | geology | 'limestone', 'dolomite', 'gypsum', 'magmatic', 'marble', 'granite', 'mixed', 'other', 'unknown' |
| site | rock_age | 'Holocene', 'Pleistocene', 'Pliocene', 'Miocene', 'Oligocene', 'Eocene', 'Palaeocene', 'Cretaceous', 'Jurassic', 'Triassic', 'Permian', 'Carboniferous', 'Devonian', 'Silurian', 'Ordovician', 'Cambrian', 'Precambrian', 'unknown' |
| site | monitoring | 'yes', 'no', 'unknown' |

Table S2: Characteristics of the site table

| Field label | Definition | Format | Constraints |
|--------------------|--|---------------|--------------------------------|
| site_id | Unique identifier for each site, where a site is defined as a cave or cave system | Numeric | Positive integer |
| site_name | Site name as given by original authors or as defined by us where there was no unique name given to the site | Text | None |
| latitude | Latitude of the cave site, given in decimal degrees, where N is positive and S is negative | Numeric | None |
| longitude | Longitude of the cave site, given in decimal degrees, E is positive and W is negative | Numeric | None |
| elevation | Elevation of the cave, in meters above sea level (where negative values indicate elevations below sea level) | Numeric | None |
| geology | Description of the rock type | Text | selected from pre-defined list |
| rock_age | Description of age of the rock | Text | selected from pre-defined list |
| monitoring | Indication of whether long-term monitoring of cave conditions have been carried out | Text | selected from pre-defined list |

Table S3: Characteristics of the entity table

| Field | Definition | Format | Constraints |
|-----------------------------|--|---------------|--------------------------------|
| site_id | Refers to the unique identifier for each site (as given in site table) | Numeric | Positive integer |
| entity_id | Unique identifier for each entity, where an entity is defined as a speleothem or a speleothem composite | Numeric | Positive integer |
| entity_name | Entity (speleothem) name as given by the author | Text | None |
| depth_ref | Indication of whether the reference point is the top or base of the speleothem | Text | selected from pre-defined list |
| cover_thickness | Thickness of overlying bedrock above the speleothem (m) | Numeric | Positive decimal |
| distance_entrance | Distance of the speleothem from the cave entrance (m) | Numeric | Positive decimal |
| speleothem_type | Description of the speleothem type | Text | selected from pre-defined list |
| drip_type | Description of the drip type | Text | selected from pre-defined list |
| d13C | Indication of whether $\delta^{13}\text{C}$ measurements have been made of the speleothem | Text | selected from pre-defined list |
| d18O | Indication of whether $\delta^{18}\text{O}$ measurements have been measured | Text | selected from pre-defined list |
| d18O_water_equilibrium | Indication of whether studies assessing if the speleothem is precipitating in equilibrium with dripwaters have been done | Text | selected from pre-defined list |
| trace_elements | Indication of whether trace elements have been measured | Text | selected from pre-defined list |
| organics | Indication of whether organics have been measured | Text | selected from pre-defined list |
| fluid_inclusions | Indication of whether fluid inclusions have been measured | Text | selected from pre-defined list |
| mineralogy_petrology_fabric | Indication of whether fabric measurements have been made | Text | selected from pre-defined list |
| clumped_isotopes | Indication of whether clumped isotopes have been measured | Text | selected from pre-defined list |
| noble_gas_temperatures | Indication of whether noble gases have been measured | Text | selected from pre-defined list |
| C14 | Indication of whether ^{14}C measurements have been made | Text | selected from pre-defined list |
| ODL | Indication of whether the optical density of luminosity measurements have been made | Text | selected from pre-defined list |
| Mg_Ca | Indication of whether the Mg/Ca ratio measurements have been made | Text | selected from pre-defined list |
| contact | Name of the person who entered | Text | None |

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| | the data into the workbook | | |
| data_doi_url | Digital Object Identifier (DOI) of the data or URL of the webpage from which the data can be obtained. | Text | None |

Table S4: Characteristics of the sample table

| Field | Description | Format | Constraints |
|------------------|---|---------------|--------------------------------|
| entity_id | Refers to the unique identifier for each entity (as given in entity table) | Numeric | Positive integer |
| <u>sample_id</u> | Unique identifier for the sample | Numeric | Positive integer |
| sample_thickness | Thickness of the sample analysed (mm) | Numeric | Positive decimal |
| depth_sample | Distance in mm from a reference point | Numeric | Positive decimal |
| mineralogy | Description of the mineralogy of the sample | Text | selected from pre-defined list |
| arag_corr | Indication of whether the isotope measurements have been corrected in aragonite samples | Text | selected from pre-defined list |

Table S5: Characteristics of the dating information table

| Field | Description | Format | Constraints |
|---------------------------------|---|---------|--------------------------------|
| dating_id | Unique identifier for each date | Numeric | Positive integer |
| entity_id | Refers to the unique identifier for each entity (as given in entity table) | Numeric | Positive integer |
| date_type | Description of the dating method used | Text | selected from pre-defined list |
| depth_dating | Distance in mm from a reference point | Numeric | Positive decimal |
| dating_thickness | Thickness of dated sample in mm | Numeric | Positive decimal |
| lab_num | The laboratory number of the dated sample | Text | None |
| material_dated | Mineralogy of the dated sample | Text | selected from pre-defined list |
| min_weight | Minimum weight of the dated sample in mg | Numeric | Positive decimal |
| max_weight | Maximum weight of the dated sample in mg | Numeric | Positive decimal |
| uncorr_age | Uncorrected age of the dated sample in years | Numeric | None |
| uncorr_age_uncert_pos | Positive uncertainty of the uncorrected age of the dated sample in years | Numeric | Positive decimal |
| uncorr_age_uncert_neg | Negative uncertainty of the uncorrected age of the dated sample in years | Numeric | Positive decimal |
| 14C_correction | Percentage dead carbon present in dated sample | Numeric | Positive decimal |
| calib_used | Calibration method used to convert C ¹⁴ dates to calendar years | Text | selected from pre-defined list |
| date_used | Indication of whether the date is used in the original age model | Text | selected from pre-defined list |
| 238U_content | ²³⁸ U content of the dated sample in ppb | Numeric | None |
| 238U_uncertainty | ²³⁸ U 2-sigma uncertainty of dated sample in ppb | Numeric | None |
| 232Th_content | ²³² Th content of the dated sample in ppt | Numeric | None |
| 232Th_uncertainty | ²³² Th 2-sigma uncertainty of the dated sample in ppt | Numeric | None |
| 230Th_content | ²³⁰ Th content of the dated sample in ppt | Numeric | None |
| 230Th_uncertainty | ²³⁰ Th 2-sigma uncertainty of the dated sample in ppt | Numeric | None |
| 230Th_232Th_ratio | ²³⁰ Th/ ²³² Th activity ratio of the dated sample | Numeric | None |
| 230Th_232Th_ratio_uncertainty | ²³⁰ Th/ ²³² Th activity ratio 2-sigma uncertainty of the dated sample | Numeric | None |
| 230Th_238U_activity | ²³⁰ Th/ ²³⁸ U activity ratio of the dated sample | Numeric | None |
| 230Th_238U_activity_uncertainty | ²³⁰ Th/ ²³⁸ U activity ratio 2-sigma uncertainty of the dated sample | Numeric | None |
| 234U_238U_activity | ²³⁴ U/ ²³⁸ U activity ratio of the dated sample | Numeric | None |
| 234U_238U_activity_u | ²³⁴ U/ ²³⁸ U activity ratio 2-sigma | Numeric | None |

| | | | |
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| ncertainty | uncertainty of the dated sample | | |
| ini_230Th_232Th_ratio | Initial $^{230}\text{Th}/^{232}\text{Th}$ activity ratio for the detrital correction | Numeric | None |
| ini_230Th_232Th_ratio_uncertainty | Initial $^{230}\text{Th}/^{232}\text{Th}$ activity ratio uncertainty for the detrital correction | Numeric | None |
| decay_constant | Description of the half-life used for ^{230}Th and ^{234}U for U/Th samples | Text | selected from pre-defined list |
| corr_age | Corrected age of the dated sample in years | Numeric | None |
| corr_age_uncert_pos | Positive uncertainty of corrected age of the dated sample in years | Numeric | Positive decimal |
| corr_age_uncert_neg | Negative uncertainty of corrected age of the dated sample in years | Numeric | Positive decimal |

Table S6: Characteristics of the lamina dating table

| Field | Description | Format | Constraints |
|--------------------|--|---------|------------------|
| dating_lamina_id | Unique identifier for each lamina | Numeric | Positive integer |
| entity_id | Refers to the unique identifier for each entity (as given in entity table) | Numeric | Positive integer |
| depth_lam | Depth of the midpoint of the lamina in mm from a reference point | Numeric | Positive integer |
| lam_thickness | Thickness in mm of the sample dated | Numeric | Positive decimal |
| lam_age | Age in years of individual lamina | Numeric | None |
| lam_age_uncert_pos | Positive counting uncertainty of individual lamina in years | Numeric | Positive decimal |
| lam_age_uncert_neg | Negative counting uncertainty of individual lamina in years | Numeric | Positive decimal |

Table S7: Characteristics of the hiatus place mark information table

| Field | Description | Format | Constraints |
|-----------|--|---------|--------------------------------|
| sample_id | Refers to the unique identifier for each sample (as given in sample table) | Numeric | Positive integer |
| hiatus | Indication of an hiatus | Text | selected from pre-defined list |

Table S8: Characteristics of the gap place mark information table

| Field | Description | Format | Constraints |
|-----------|---|---------|--------------------------------|
| sample_id | Refers to the unique identifier for the sample (as given in sample table) | Numeric | Positive integer |
| gap | Indication of a gap | Text | selected from pre-defined list |

Table S9: Characteristics of the original chronology information table

| Field | Description | Format | Constraints |
|-----------------------|---|---------|--------------------------------|
| sample_id | Refers to the unique identifier for the sample (as given in sample table) | Numeric | Positive integer |
| interp_age | Calendar age of the sample in years | Numeric | Positive decimal |
| interp_age_uncert_pos | Positive uncertainty on the age of the sample in years | Numeric | Positive decimal |
| interp_age_uncert_neg | Negative uncertainty on the age of the sample in years | Numeric | Positive decimal |
| age_model_type | Description of the age model used in the original publication | Text | selected from pre-defined list |
| ann_lam_check | Indication that verification that laminae are annual, in cases where lamina counting is used to construct the age model | Text | selected from pre-defined list |
| dep_rate_check | Indication that verification of the deposition rate has been made | Text | selected from pre-defined list |

Table S10: Characteristics of the carbon isotope data table

| Field | Description | Format | Constraints |
|------------------|---|---------|--------------------------------|
| sample_id | Refers to the unique identifier for the sample (as given in sample table) | Numeric | Positive integer |
| d13C_measurement | Original $\delta^{13}\text{C}$ measurement | Numeric | None |
| d13C_precision | Laboratory precision on the $\delta^{13}\text{C}$ measurement | Numeric | None |
| iso_std | Description of isotopic standard used | Text | selected from pre-defined list |

Table S11: Characteristics of the oxygen isotope data table

| Field | Description | Format | Constraints |
|------------------|---|---------|--------------------------------|
| sample_id | Refers to the unique identifier for the sample (as given in sample table) | Numeric | Positive integer |
| d18O_measurement | Original $\delta^{18}\text{O}$ measurement | Numeric | None |
| d18O_precision | Laboratory precision on the $\delta^{18}\text{O}$ measurement | Numeric | None |
| iso_std | Description of isotopic standard used | Text | selected from pre-defined list |

Table S12: Characteristics of the publication information table

| Field | Description | Type | Constraints |
|-----------------|--|---------|------------------|
| ref_id | Unique identifier for the reference | Numeric | Positive integer |
| Citation | Full citation for the original publication | Text | None |
| publication_DOI | Digital Object Identifier (DOI) of publication | Text | None |

Table S13: Characteristics of the link entity and publication information table

| Field | Description | Format | Constraints |
|-----------|---|---------|------------------|
| entity_id | Refers to the unique identifier for the entity (as given in entity table) | Numeric | Positive integer |
| ref_id | Refers to the unique identifier for the publication (as given in the publication information table) | Numeric | Positive integer |

Table S14: Characteristics of the link composite and entity table

| Field | Description | Format | Constraints |
|---------------------|--|---------|------------------|
| composite_entity_id | Refers to the unique identifier for a composite entity (as given in entity table) | Numeric | Positive integer |
| single_entity_id | Refers to the unique identifier for each single entity in the composite (as given in entity table) | Numeric | Positive integer |

Table 15: Characteristics of the notes table

| Field | Description | Format | Constraints |
|---------|--|---------|------------------|
| site_id | Refers to the unique identifier for each site (as given in site table) | Numeric | Positive integer |
| Notes | Notes and additional information about the site | Text | None |