Beyond the Grant

Our Roadmap for the XRONOS Radiocarbon Database

Martin Hinz, Joe Roe, IAW Bern, CAU Kiel, Kopenhagen University

Schweizerischer Nationalfonds

Why Chronology Databases Matter

- Chronological data = foundational interpretative layer
- Data must be preserved, updated, verified
- Many DBs are project deliverables: build fast, then stall
- The result: drifting standards, unclear provenance, brittle citability
- Sustainability requires community involvement

56 radiocarbon databases

39 **open** radiocarbon databases*

606000 radiocarbon dates**

* according to https://opendefinition.org/

** not distinct records

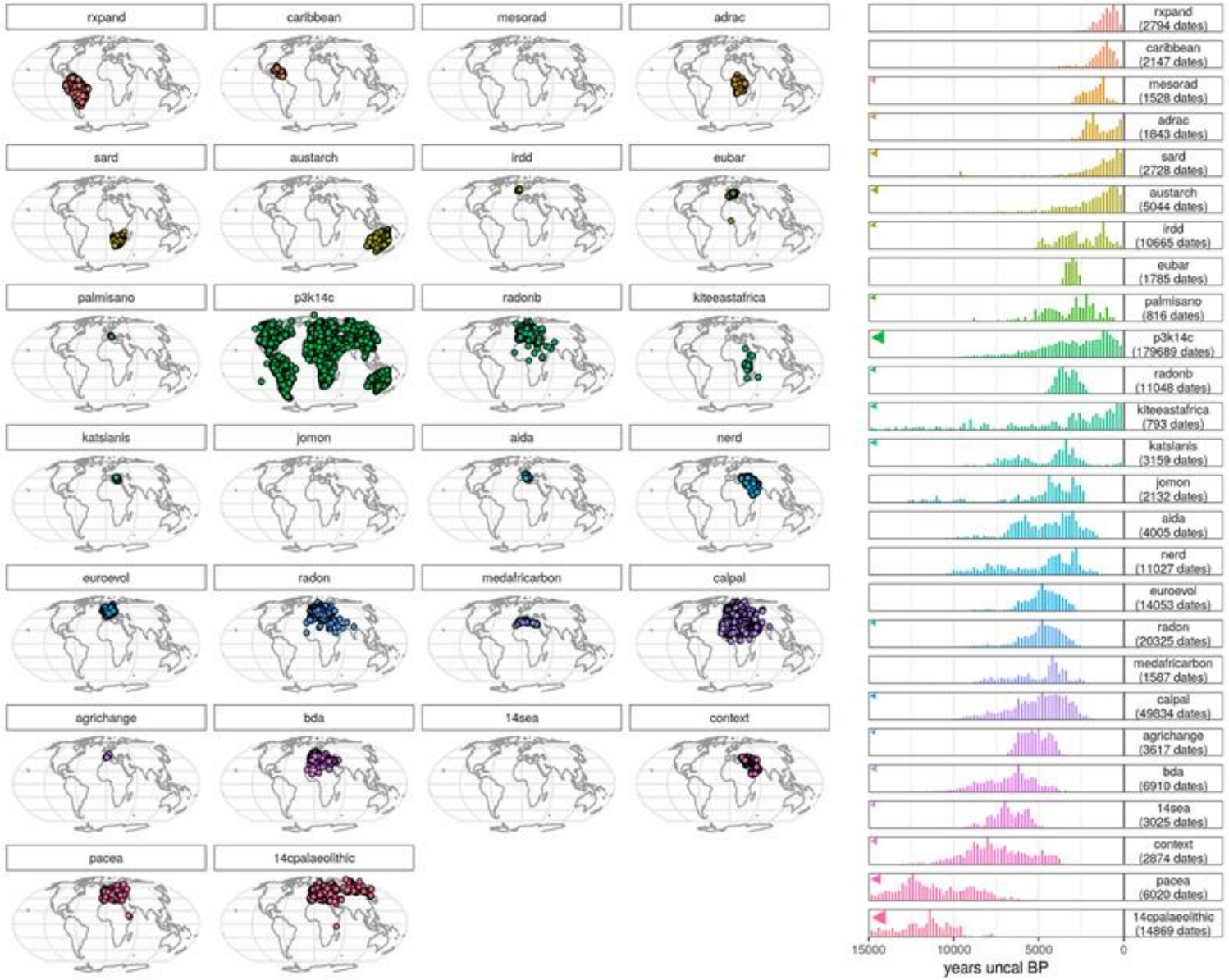
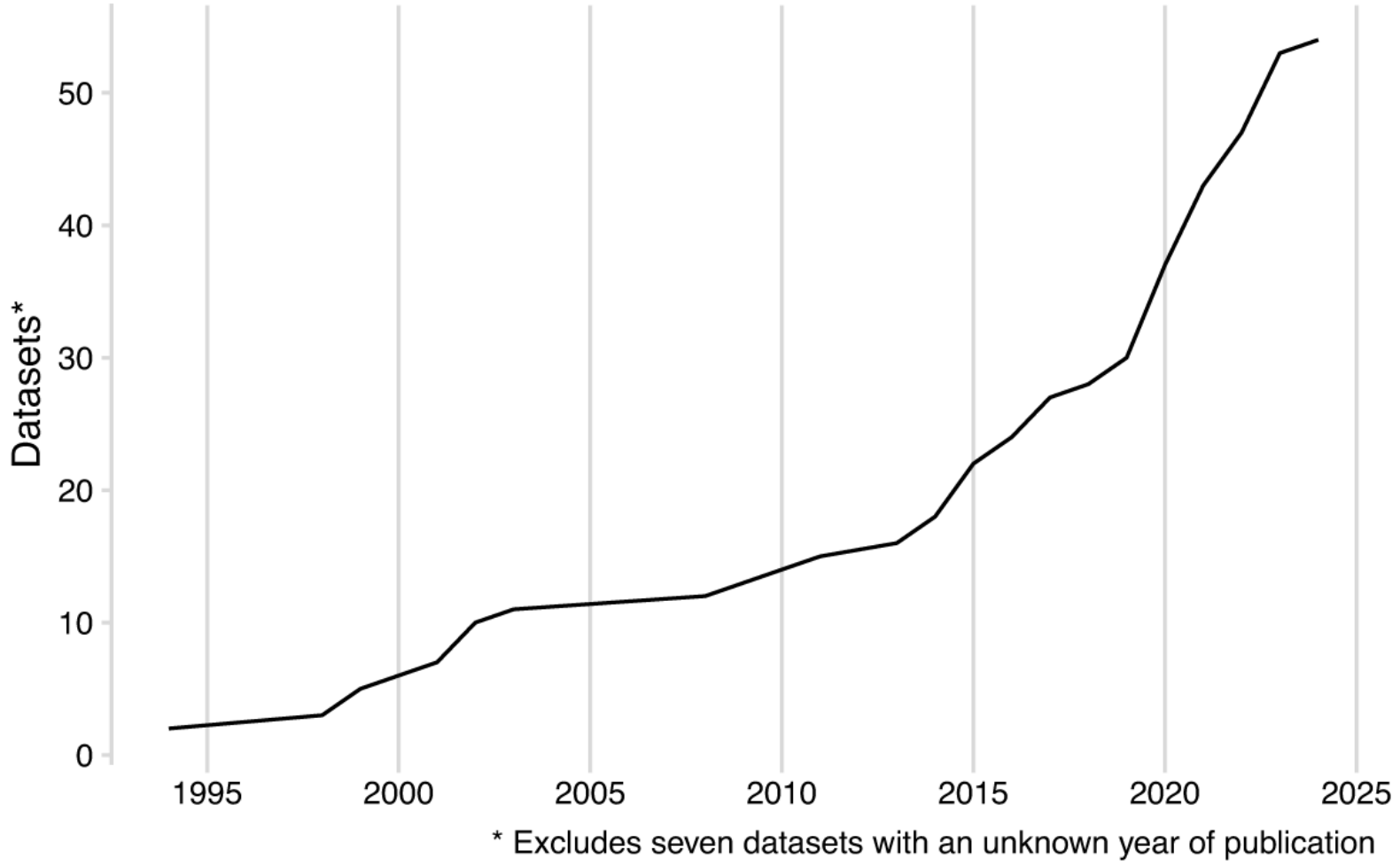
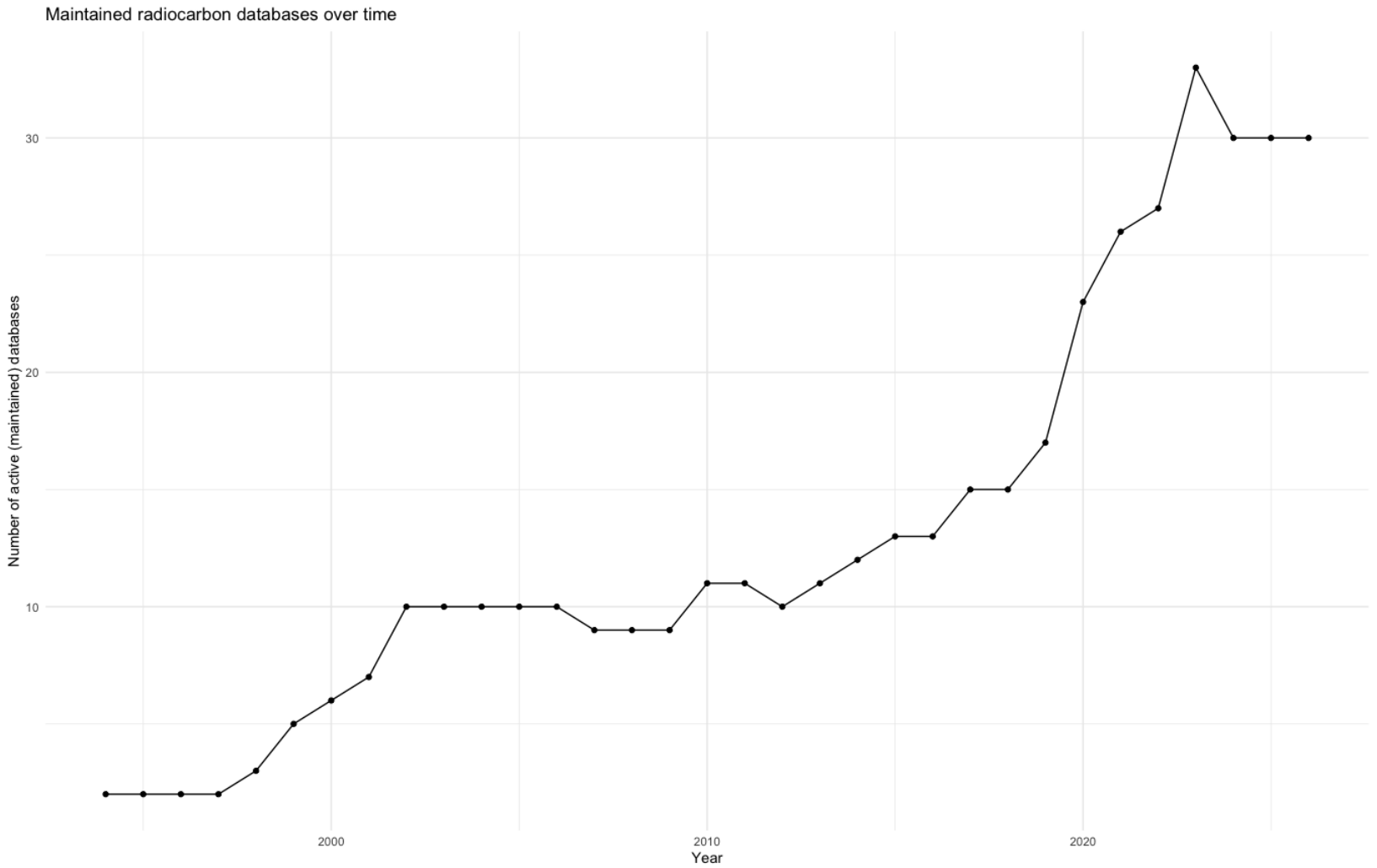


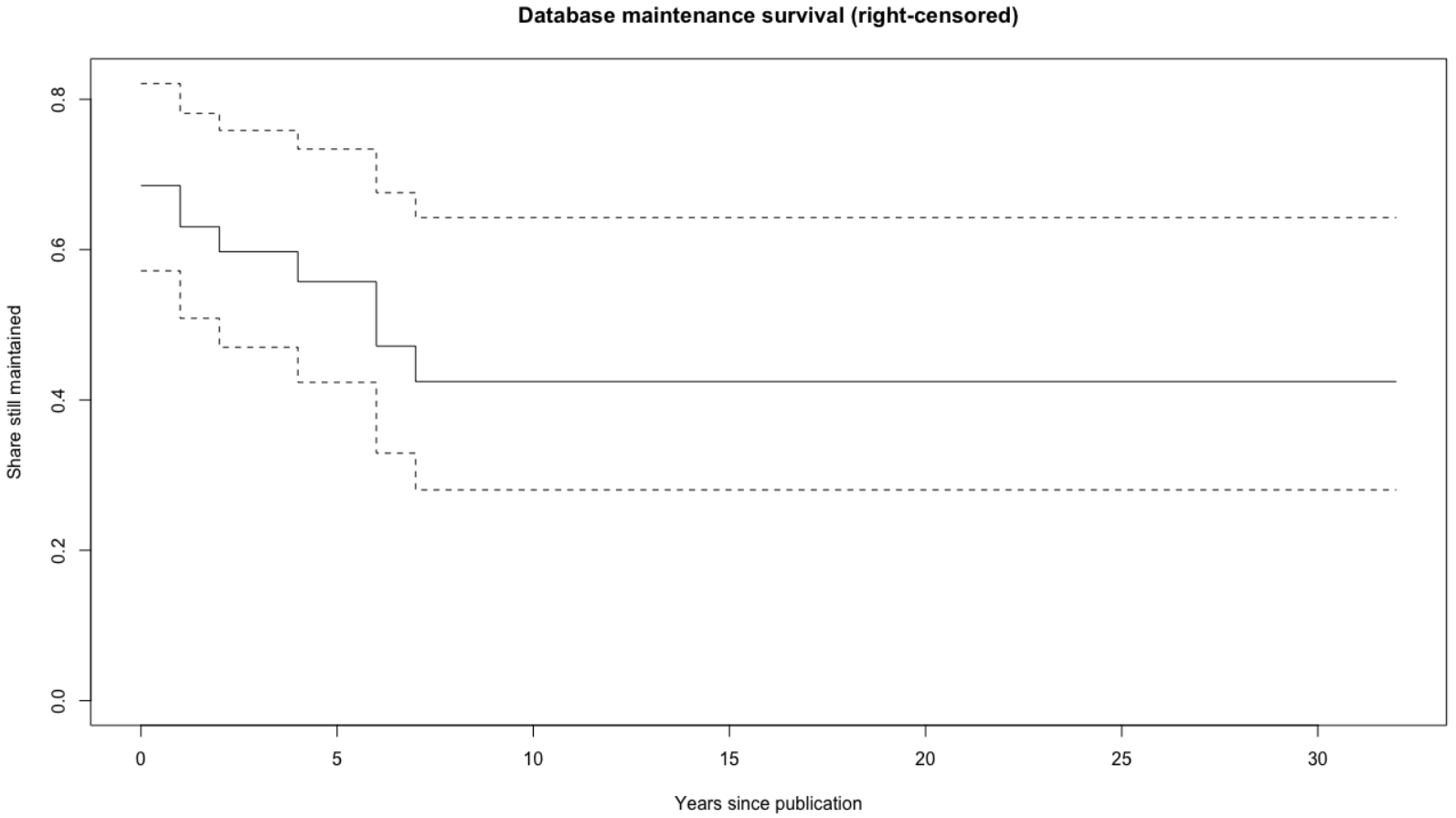
Image: Schmid et al.
https://github.com/ropensci/c14bazAAR



Roe et al. 2025



Data: Roe et al. 2025



Data: Roe et al. 2025

c14bazAAR

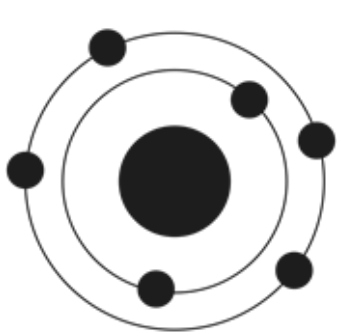
https://docs.ropensci.org/c14bazAAR/

IntChron

https://intchron.org/

p3kc14

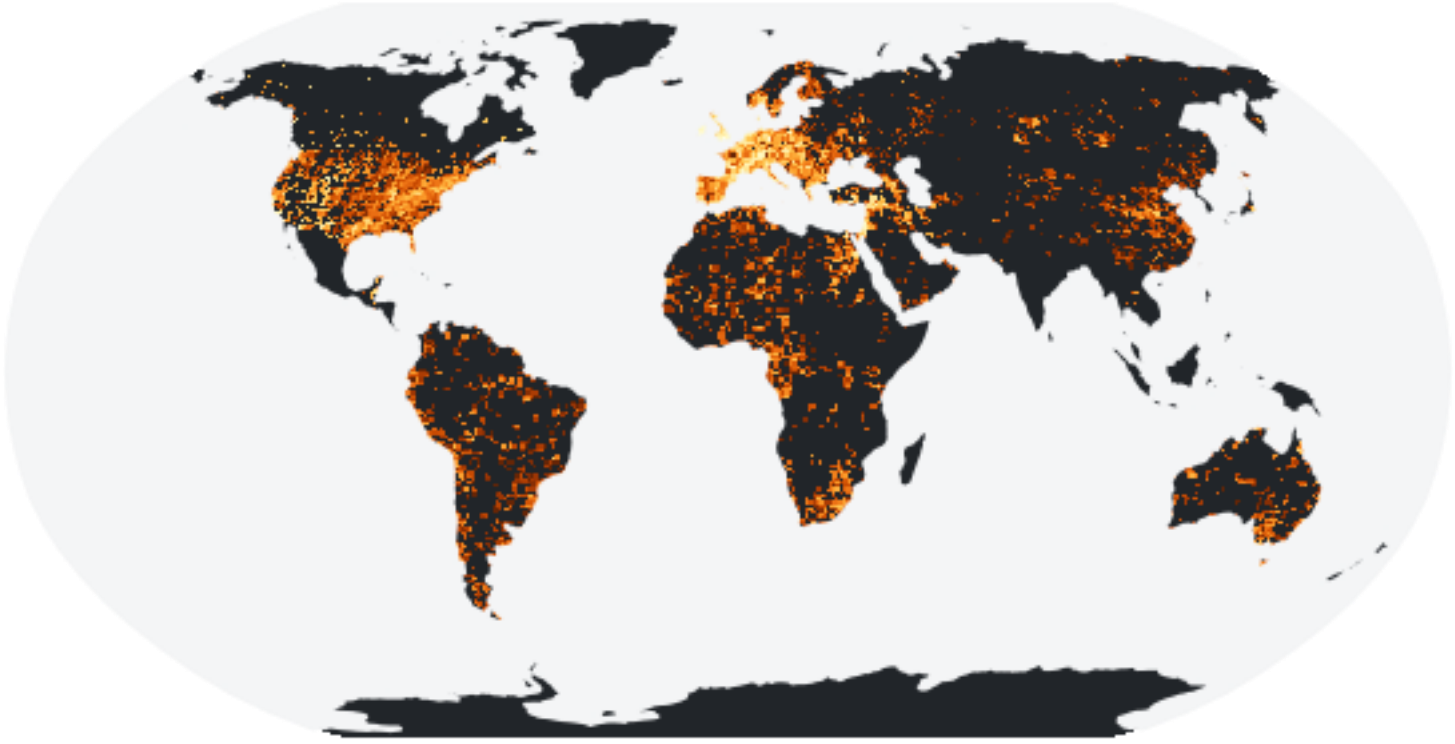
https://www.p3k14c.org/



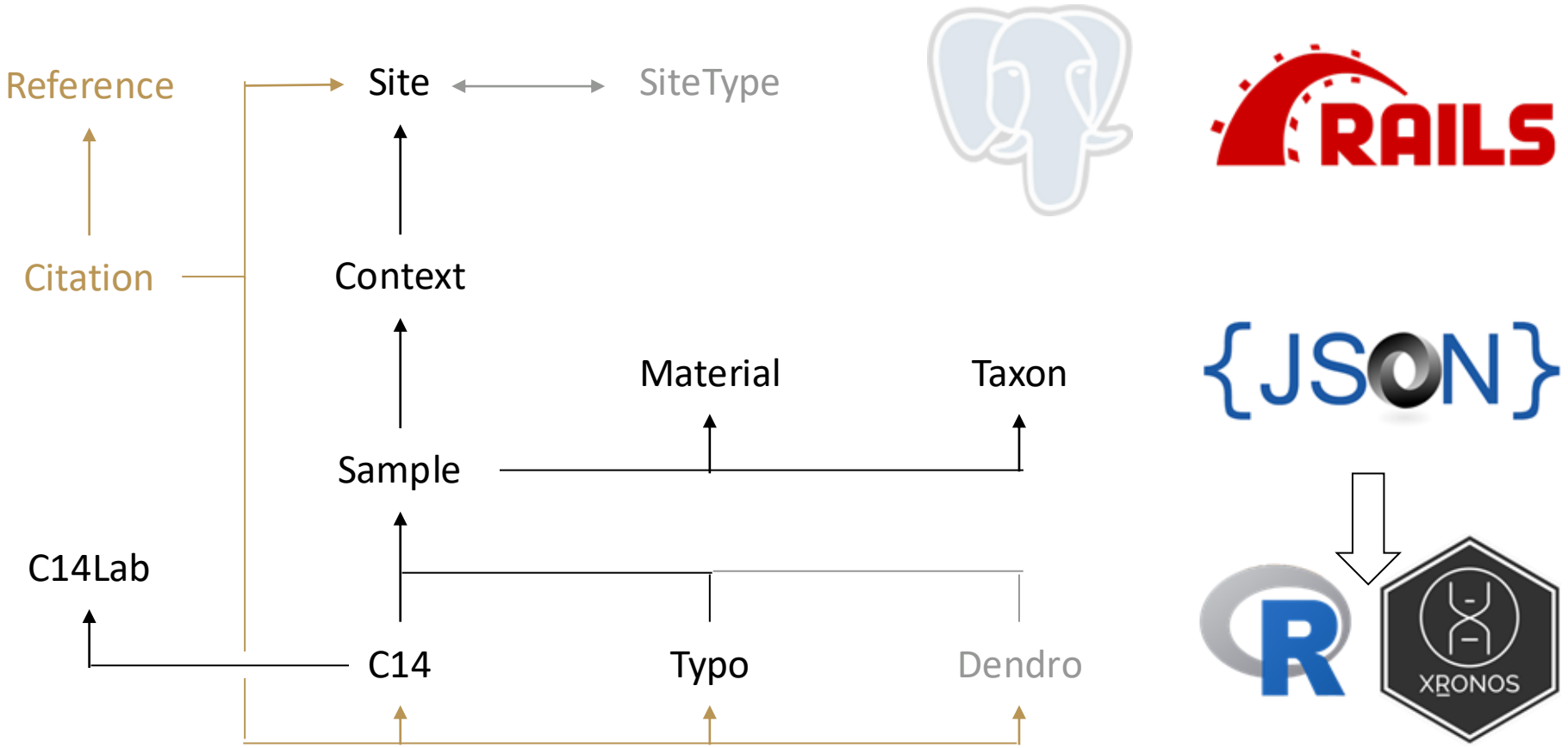

?

XRONOS

An open repository and curation platform for chronometric data from archaeological contexts worldwide.

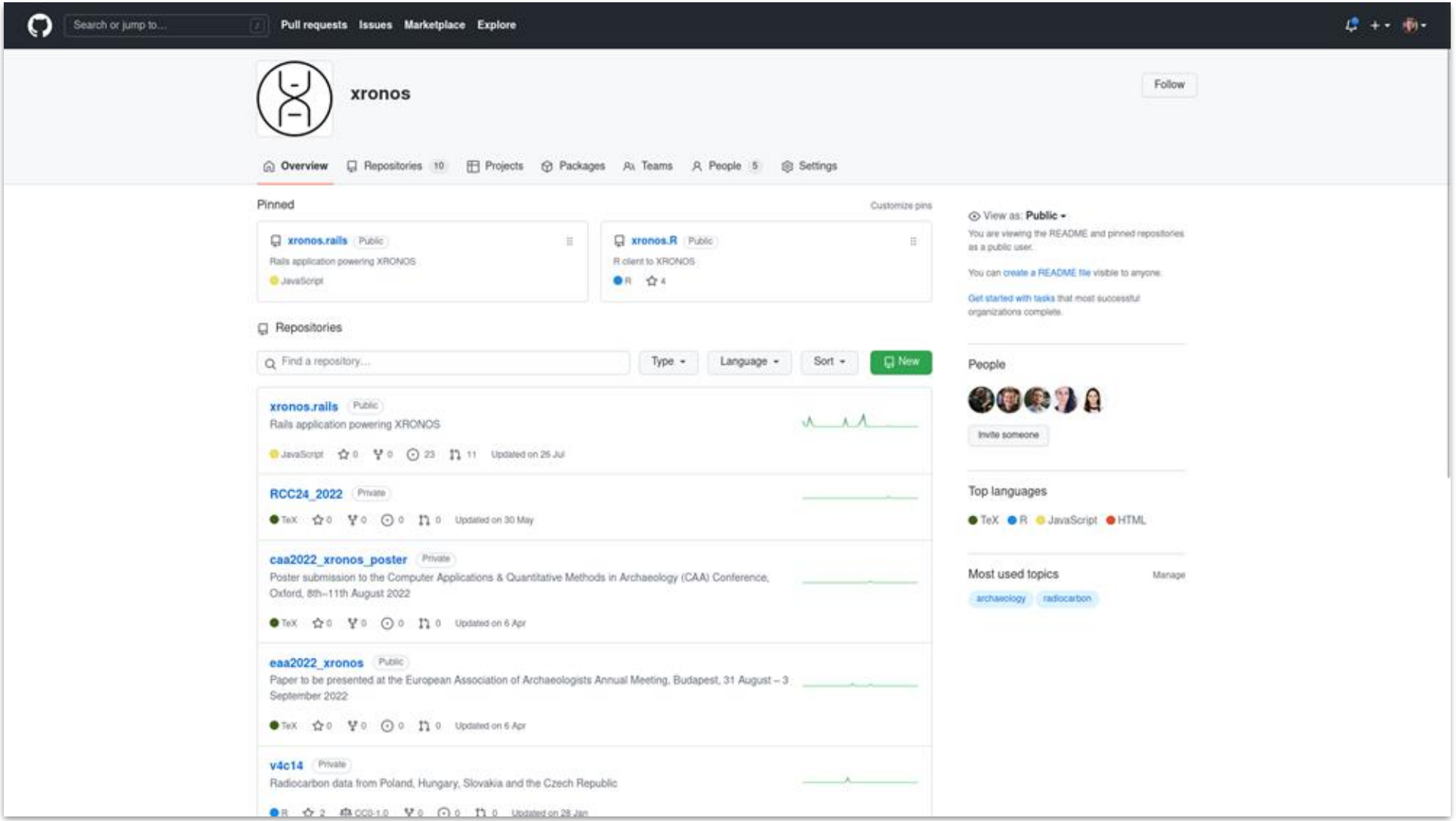


https://xronos.ch


Reference
Site
SiteType
Citation
Context
Material
Taxon
Sample
C14Lab
C14
Typo
Dendro
RAILS
{JSON}
R
XRONOS

Typical Pitfalls in Research Databases

- Overly narrow data model
- No documented curation workflow
- No versioning or provenance
- Hidden assumptions, inconsistent taxonomies
- No exit strategy (“dead projects” problem)



https://github.com/xronos-ch

xronos 0.1.1.9000 Get started Reference Changelog

xronos

An R client to XRONOS, a worldwide database of chronological information from archaeological contexts, including radiocarbon and dendrochronological data.

Installation

You can install the development version of xronos using the remotes package:

```
remotes::install_github("xronos-ch/xronos.R")
```

Usage

Use `chron_data()` to get chronological data, using any of the search parameters supported by the XRONOS API:

```
chron_data(country = "Switzerland", material = c("charcoal", "bone"))
```

For further usage, see the introductory vignette (`vignette("xronos")`).

Links

Browse source code

Report a bug

License

Full license

MIT + file LICENSE

Citation

Citing xronos

Developers

Martin Hinz
Author

Joe Roe
Author, maintainer

Funder

More about authors...

Dev status

repo status Active

CRAN not published

R-CMD-check passing

codecov 100%

DOI 10.5281/zenodo.7467875

https://r.xronos.ch

API

The data in this application can also be accessed in JSON format with direct requests to an API. Use the following URL to access all (public) dates.

```
https://xronos.ch/api/v1/data
```

You can also filter the data with this interface to only access the subsets relevant for you. With the following URL you get - for example - only one date with the Lab Number **AAR-1847**.

```
https://xronos.ch/api/v1/data?query_labnr=AAR-1847
```

The **|** ("pipe") operator allows you to combine multiple filter keys. **|** represents a logical **OR**. That means the following URL will give you both dates **AAR-1847** and **KN-2506**.

```
https://xronos.ch/api/v1/data?query_labnr=AAR-1847|KN-2506
```

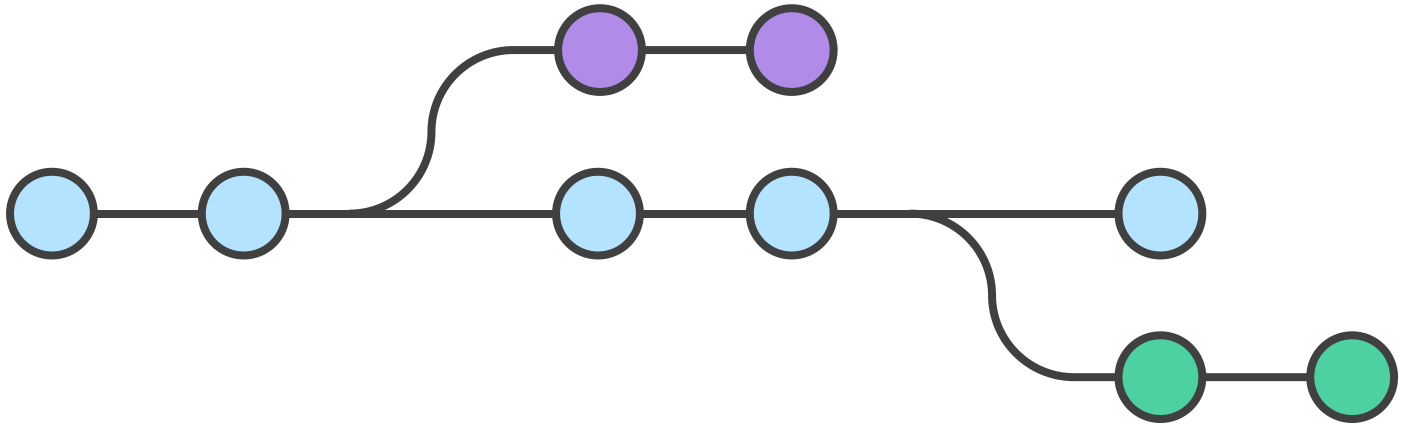

```
[{"measurement":{"id":21924,"labnr":"AAR-1847","bp":4780,"std":100,"cal_bp":null,"cal_std":null,"delta_c13":-27.3,"source_database":"","lab_name":"","material":"food
residue","species":null,"feature":null,"feature_type":"","site":"Øgårde 4","country":"DK","lat":"55.5937","lng":"11.543","site_type":"hoard","periods":[{"period":"Neolithic"},
{"period":"Trichterbecher-North Group"}],"typochronological_units":[{"typochronological_unit":"Neolithic"},{"typochronological_unit":"Trichterbecher-North Group"}],"ecochronological_units":
[],"reference":[{"reference":"Koch 1998, 307."},{"reference":"CalPal"}]}},{"measurement":{"id":85745,"labnr":"AAR-
1847","bp":4780,"std":100,"cal_bp":null,"cal_std":null,"delta_c13":null,"source_database":"","lab_name":"","material":"food
residue","species":null,"feature":null,"feature_type":"","site":"Øgårde 4","country":"DK","lat":"55.5937","lng":"11.543","site_type":"hoard","periods":[{"period":"MN"},
{"period":"Bernburg"}],"typochronological_units":[{"typochronological_unit":"MN"},{"typochronological_unit":"Bernburg"}],"ecochronological_units":[],"reference":[{"reference":"EUROEVOL"}]}},
{"measurement":{"id":88925,"labnr":"AAR-1847","bp":4780,"std":100,"cal_bp":null,"cal_std":null,"delta_c13":-27.3,"source_database":"","lab_name":"","material":"food remains","species":"\"food
crust\".","feature":"Moorfund; \"food crust on funnel beaker Type III\".","feature_type":"","site":"Øgårde 4","country":"DK","lat":"55.5937","lng":"11.543","site_type":"hoard","periods":
[{"period":"Bernburg"}],"typochronological_units":[{"typochronological_unit":"Bernburg"}],"ecochronological_units":[],"reference":[{"reference":"Koch 1998, 307; Aud 1995, 319"},
{"reference":"RADON"}]}},{"measurement":{"id":177143,"labnr":"AAR-
1847","bp":4780,"std":100,"cal_bp":null,"cal_std":null,"delta_c13":-27.3,"source_database":"","lab_name":"","material":"charcoal","species":null,"feature":null,"feature_type":"","site":"Øgård
e 4","country":"DK","lat":"55.5937","lng":"11.543","site_type":"hoard","periods":[],"typochronological_units":[],"ecochronological_units":[],"reference":[{"reference":"Koch 1998 307."},
{"reference":"p3k14c"}]}}]
```

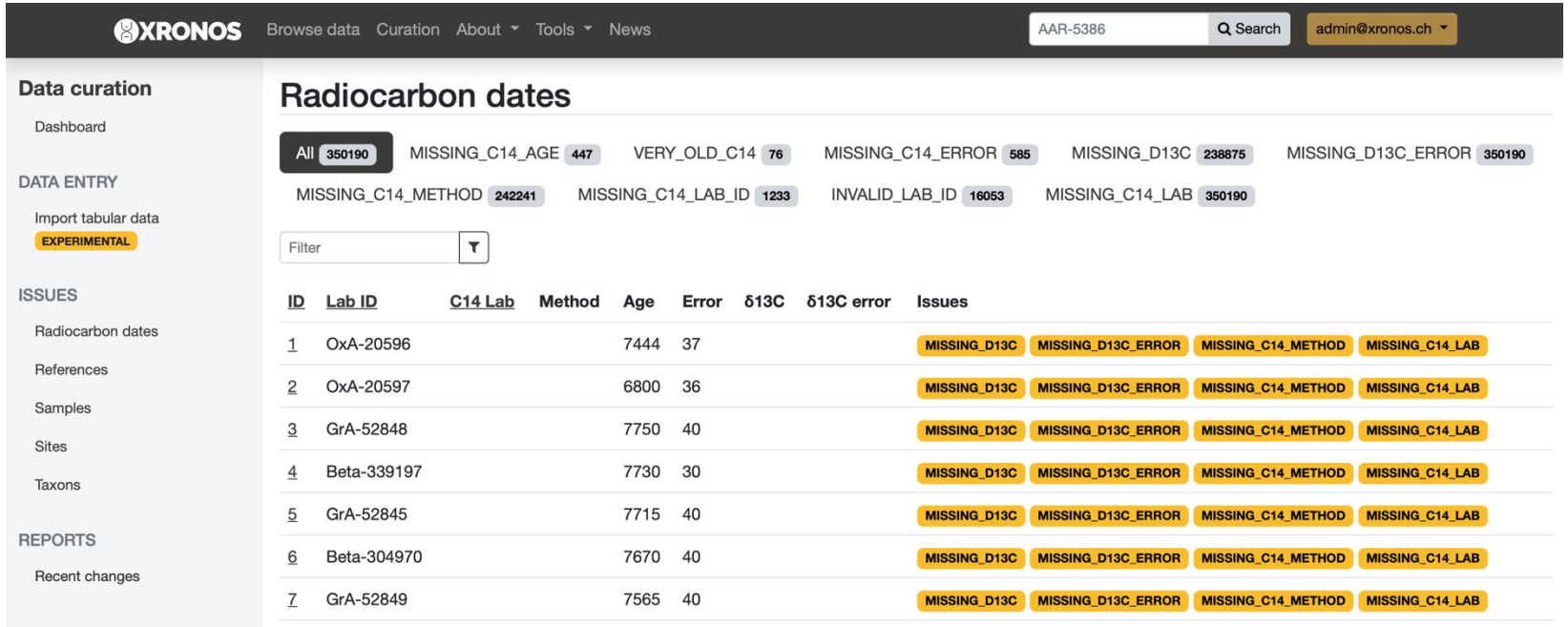
```r
library(c14bazAAR)
library(cleanc14) # remotes::install_github("joeroe/cleanc14")
library(tidyverse)

c14 <- get_c14data("all")

c14 |>
  mutate(
    labnr = c14_control_lab_id(labnr, quiet = TRUE, warn_unmatched = FALSE),
    material = c14_control_material(material, quiet = TRUE, warn_unmatched =
FALSE)
  ) |>
  distinct(site, labnr, c14age, c14std, material, species)
#>  Radiocarbon date list
#>  dates: 288471
#>  sites: 50139
#>  uncalBP: 80000 – -3800
#>
#> # A data frame: 288,471 × 6
#>    labnr c14age c14std site         material      species
#>    <chr>  <int>  <int> <chr>        <chr>         <chr>
#>  1 OxA-    7444     37 Aktopraklık  bone          <NA>
#>  2 OxA-    6800     36 Aktopraklık  bone          <NA>
#>  3 GrA-    7750     40 Barcın Höyük charcoal      <NA>
#>  4 Beta-   7730     30 Barcın Höyük charcoal      <NA>
#>  5 GrA-    7715     40 Barcın Höyük charcoal      <NA>
#>  6 Beta-   7670     40 Barcın Höyük charcoal      <NA>
#>  7 GrA-    7565     40 Barcın Höyük charcoal      <NA>
#>  8 Beta-   7530     40 Barcın Höyük plant remains <NA>
#>  9 Beta-   7480     40 Barcın Höyük plant remains <NA>
#> 10 GrA-    7470     60 Barcın Höyük charcoal      <NA>
  #> # … with 288,461 more rows
```

u^b




XRONOS
Browse data
Curation
About
Tools
News
AAR-5386
Search
admin@xronos.ch
Data curation
Dashboard
DATA ENTRY
Import tabular data
EXPERIMENTAL
ISSUES
Radiocarbon dates
References
Samples
Sites
Taxons
REPORTS
Recent changes
Radiocarbon dates
All 350190
MISSING_C14_AGE 447
VERY_OLD_C14 76
MISSING_C14_ERROR 585
MISSING_D13C 238875
MISSING_D13C_ERROR 350190
MISSING_C14_METHOD 242241
MISSING_C14_LAB_ID 1233
INVALID_LAB_ID 16053
MISSING_C14_LAB 350190
Filter
ID Lab ID C14 Lab Method Age Error δ13C δ13C error Issues
1 OxA-20596 7444 37 MISSING_D13C MISSING_D13C_ERROR MISSING_C14_METHOD MISSING_C14_LAB
2 OxA-20597 6800 36 MISSING_D13C MISSING_D13C_ERROR MISSING_C14_METHOD MISSING_C14_LAB
3 GrA-52848 7750 40 MISSING_D13C MISSING_D13C_ERROR MISSING_C14_METHOD MISSING_C14_LAB
4 Beta-339197 7730 30 MISSING_D13C MISSING_D13C_ERROR MISSING_C14_METHOD MISSING_C14_LAB
5 GrA-52845 7715 40 MISSING_D13C MISSING_D13C_ERROR MISSING_C14_METHOD MISSING_C14_LAB
6 Beta-304970 7670 40 MISSING_D13C MISSING_D13C_ERROR MISSING_C14_METHOD MISSING_C14_LAB
7 GrA-52849 7565 40 MISSING_D13C MISSING_D13C_ERROR MISSING_C14_METHOD MISSING_C14_LAB

Metadata

Site ID
36072

Created at
2022-12-02 00:50:45 UTC

Last updated at
2022-12-20 10:51:46 UTC

Changelog

Updated.
admin@xronos.ch, 2022-12-20 10:51:46 UTC

Name: Ayn Qasiyah → ʿAyn Qasiyya

Imported from source database via c14bazAAR
admin@xronos.ch, 2022-12-02 00:50:45 UTC

Metadata

radiocarbon date ID
163725

Created at
2022-12-02 00:50:45 UTC

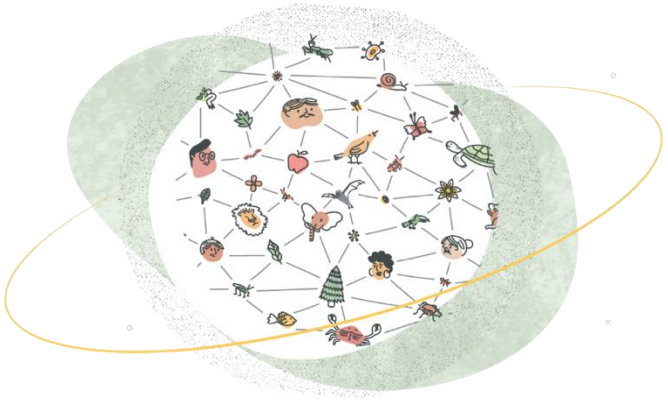
Last updated at
2023-03-09 15:36:25 UTC

Changelog

Updated.
admin@xronos.ch, 2023-03-09 15:36:25 UTC

Lab identifier: ?????? → NA

Imported from BDA via c14bazAAR
admin@xronos.ch, 2022-12-02 00:50:45 UTC



WIKIDATA

Period

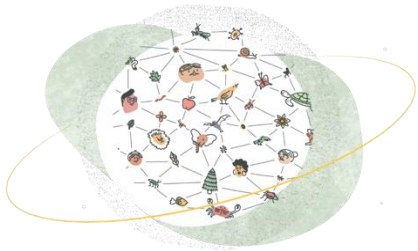
Radiocarbon dates (202)

Lab ID	Context	Material	Taxon	Method	Uncalibrated age
BM-1164		antler	*Cervus elaphus*	14C	3678±68 BP
BM-1582			NA	14C	3715±70 BP
BM-1583		bone	*Cervus elaphus*	14C	4410±60 BP
BM-1617		bone	*Cervus elaphus*	14C	4390±60 BP
BM-46		antler	NA	14C	3670±150 BP
C-602		charcoal	NA	14C	3798±275 BP
GU-5109		charcoal	*Pinus*	14C	8880±120 BP
HAR-2013		antler	NA	14C	3720±70 BP
HAR-455		charcoal	*Pinus*	14C	9130±180 BP
HAR-456		charcoal	*Pinus*	14C	8090±140 BP
HAR-4878		charcoal	NA	14C	3400±150 BP
OxA-17957		bone	*Homo sapiens*	14C	4271±29 BP

Radiocarbon dates (1)

Taxon not matched to backbone taxonomy

Lab ID	Context	Material	Taxon	Method	Uncalibrated age
A-195		BONE	Mammoth	RADIOMETRIC	8980±270 BP



Radiocarbon dates (1)

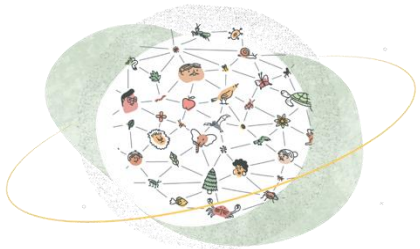
Lab ID	Context	Material	Taxon	Method	Uncalibrated age
A-195		BONE	Mammoth ⚠	RADIOMETRIC	8980±270 BP

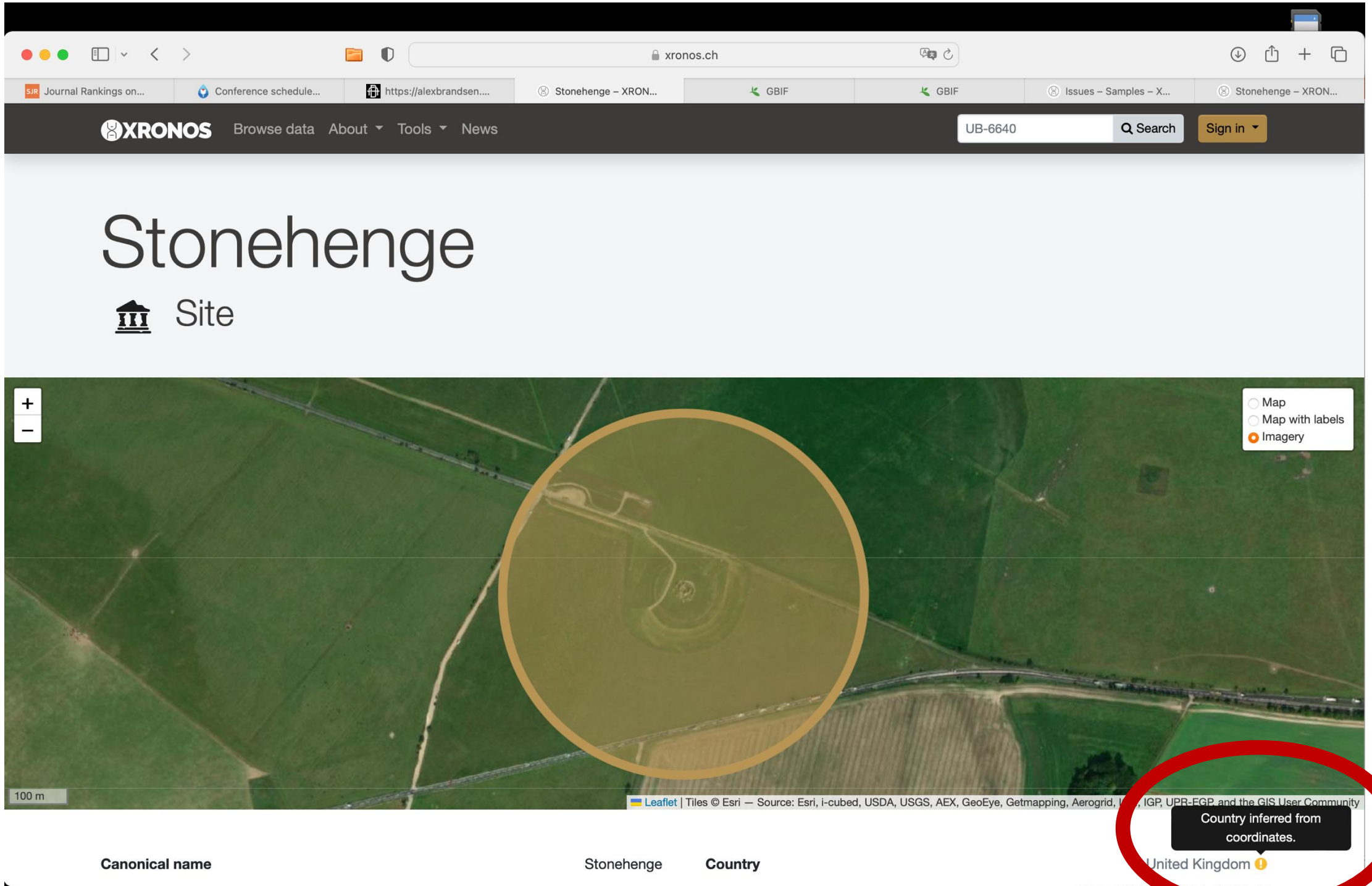
Taxon not matched to backbone taxonomy

Taxons

All 11806 | UNKNOWN_TAXON 11801

ID	Name	Suggested GBIF match	Match type	Samples
1		No name given	NONE	272144
1603	charcoal	None	NONE	2424
7012		No name given	NONE	2324
104	Quercus	GENUS *Quercus* L.	EXACT	1499
6821	indéterminé	None	NONE	1448
133	Corylus	GENUS *Corylus* L.	EXACT	1305
7052	Zea mays	SPECIES *Zea mays* L.	EXACT	1014
97	Homo Sapiens	No match because of too little confidence	NONE	949
119	animal	None	NONE	865
1013	bone	None	NONE	774
21	Quercus sp.	GENUS *Quercus* L.	HIGHERRANK	708




xronos.ch
Journal Rankings on...
Conference schedule...
https://alexbrandsen....
Stonehenge – XRON...
GBIF
GBIF
Issues – Samples – X...
Stonehenge – XRON...
XRONOS
Browse data
About
Tools
News
UB-6640
Search
Sign in
Stonehenge
Site
Map
Map with labels
Imagery
100 m
Leaflet | Tiles © Esri — Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGP, UPR-EGP, and the GIS User Community
Country inferred from coordinates.
Canonical name
Stonehenge
Country
United Kingdom

Stonehenge

Site

Canonical name	Stonehenge	**Country**	United Kingdom
Other names	NA	**Coordinates**	051.179° N, 001.826° W
Site types	Henges and		
References			

Edit site details

Linked data

Wikidata	Q39671 (Stonehenge)
Wikipedia	en Stonehenge
Wikimedia Commons	Stonehenge

Stonehenge is a prehistoric monument on Salisbury Plain in Wiltshire, England, two miles (3 km) west of Amesbury. It consists of an outer ring of vertical sarsen standing stones, each around 13 feet (4.0 m) high, seven feet (2.1 m) wide, and weighing around 25 tons, topped by connecting horizontal lintel stones. Inside is a ring of smaller bluestones. Inside these are free-standing trilithons, two bulkier vertical sarsens joined by one lintel. The whole monument, now

WIKIDATA

Designing a Database Requires Early Decisions

Our guiding principles (before choosing any technology):

- **Longevity over novelty:**
  We favour tools with stable communities and long maintenance histories.
- **Transparency & reproducibility.**
  Every computational step should be inspectable, versioned, and citable.
- **Interoperability by default:**
  Data must be usable **outside** the platform: APIs, open formats, LOD links.
- **Modularity over monoliths:**
  Database, API, and analytical tools should not depend on each other's release cycles.

→ **These principles shaped our final stack: Rails (backend), REST API, R ecosystem.**

Checklist for „Planning Your Own Database“

1. What problem does it solve?
2. Who curates it over time?
3. How are updates made transparent?
4. Is the data model extensible?
5. Does it follow FAIR principles?
6. How are communities engaged?
7. How is long-term sustainability ensured?

What we did not finish

- Governance design didn’t mature by project end
- Roles/decision rights were implicit (and therefore fragile)
- Long-term stewardship was still “owned” by the project team

SUSTAINABILITY?

Buying time ≠ solving sustainability

- XRONOS stays alive through ESTER integration
- That creates runway (capacity + resourcing)
- But it also creates risk: dependence on one grant / one PI
- Therefore: we must design the handover now

XRONOS →

*

* collaborative innovation networks

Data curation

- Dashboard

DATA ENTRY

- Import tabular data EXPERIMENTAL

ISSUES

- Radiocarbon dates
- References
- Samples
- Sites
- Taxons

REPORTS

- Recent changes

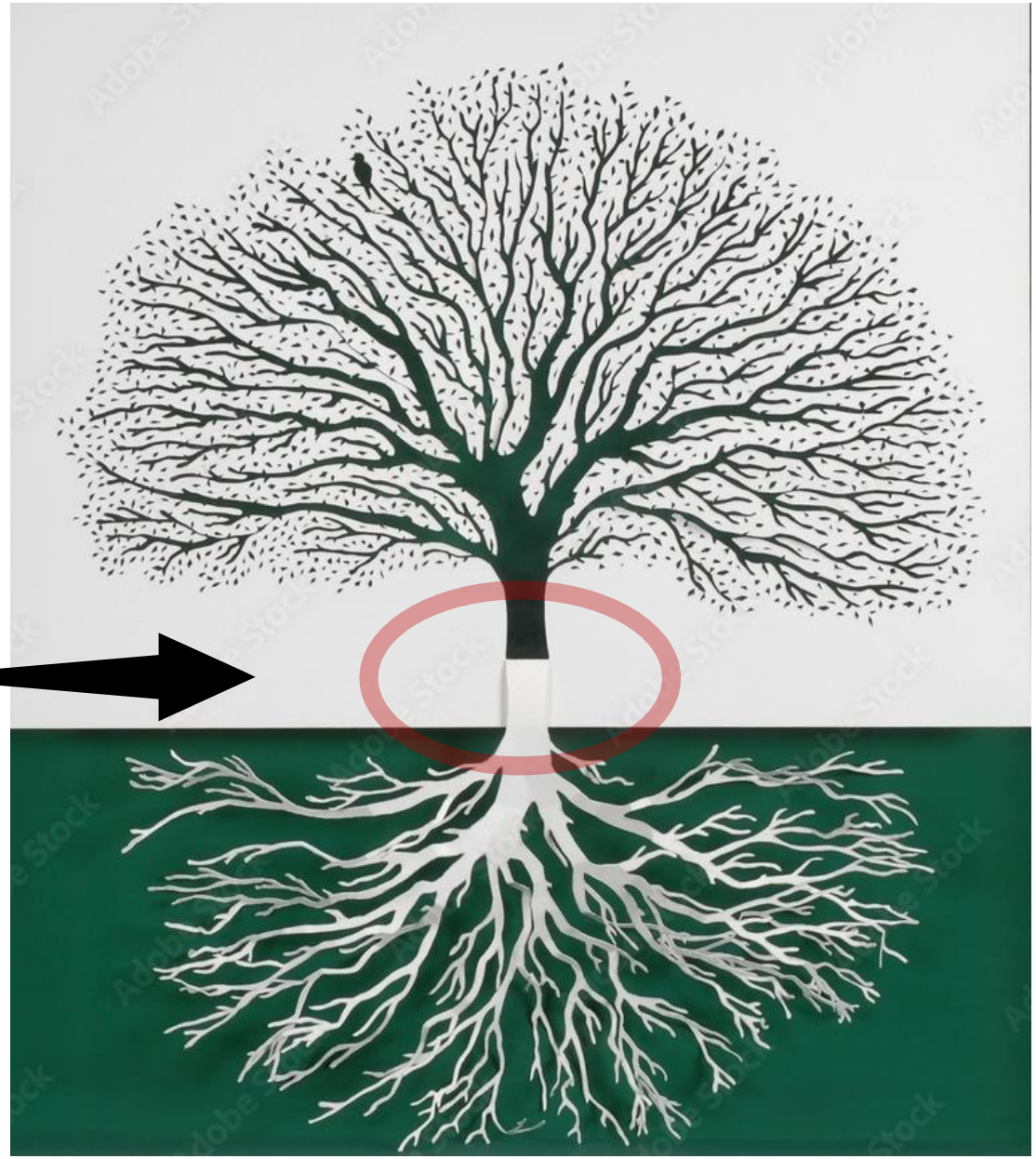
Sites

All 73429 | MISSING_COORDINATES 4450 | INVALID_COORDINATES 0 | MISSING_COUNTRY_CODE 7196

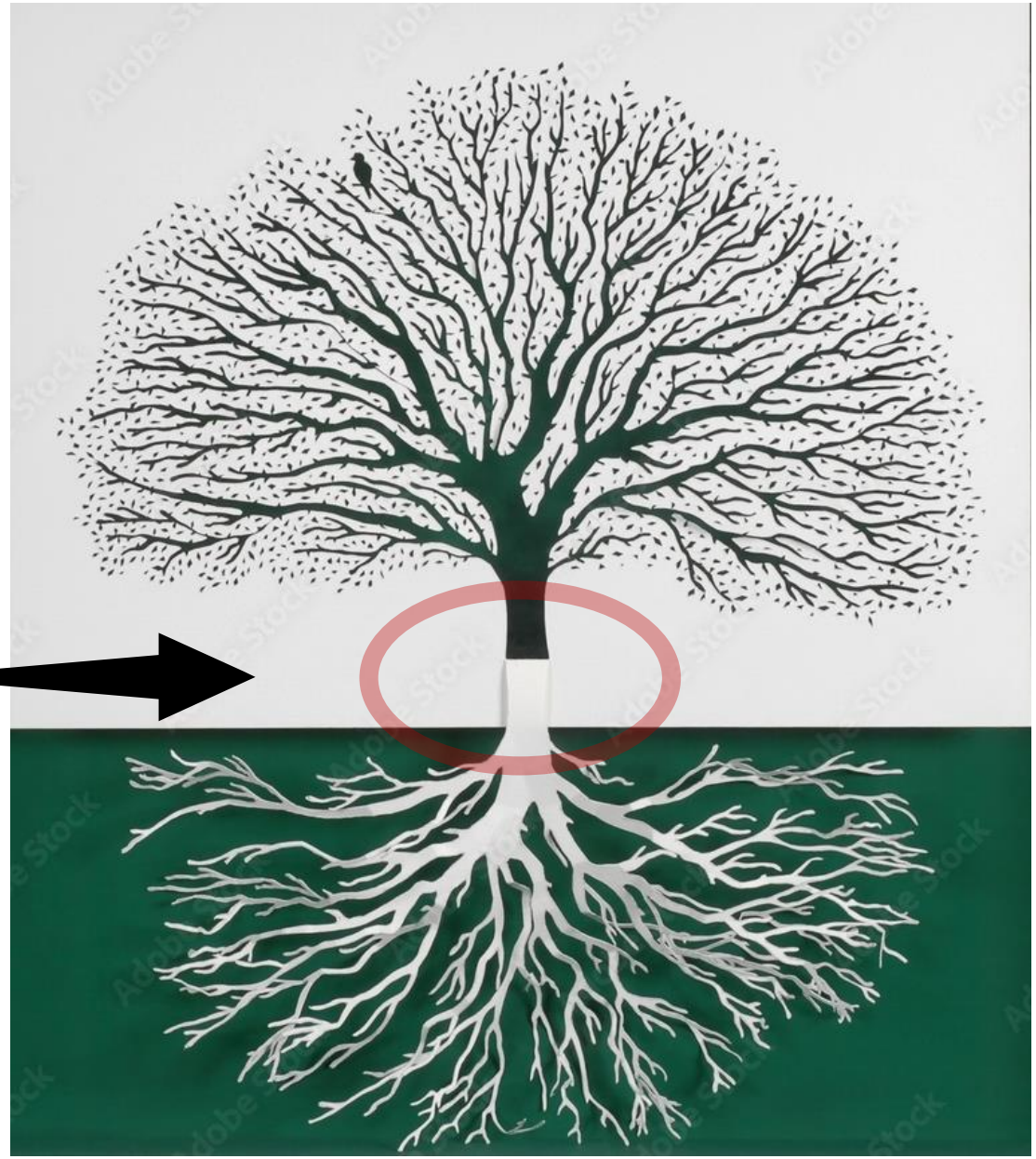
Filter

ID	Name	Country code	Coordinates	C14s	Typos	Issues
1	Aktopraklık	TR	NA	2	2	MISSING_COORDINATES
2	Barcın Höyük	TR	NA	17	17	MISSING_COORDINATES
3	Ilıpınar	TR	NA	68	68	MISSING_COORDINATES
4	Menteşe	TR	NA	11	11	MISSING_COORDINATES
5	Yarımburgaz	TR	NA	8	8	MISSING_COORDINATES
6	Yenikapı	TR	NA	12	9	MISSING_COORDINATES
7	İkiztepe I	TR	NA	7	3	MISSING_COORDINATES
8	İkiztepe II	TR	NA	6	0	MISSING_COORDINATES

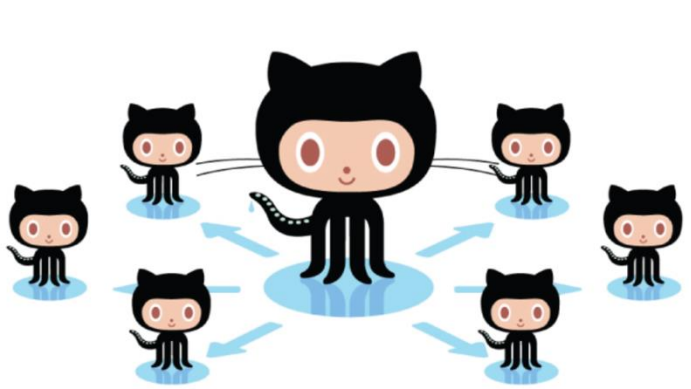
XRONOS
Curators



single
point of
failure




TRUST



Metadata

radiocarbon date ID
163725

Created at
2022-12-02 00:50:45 UTC

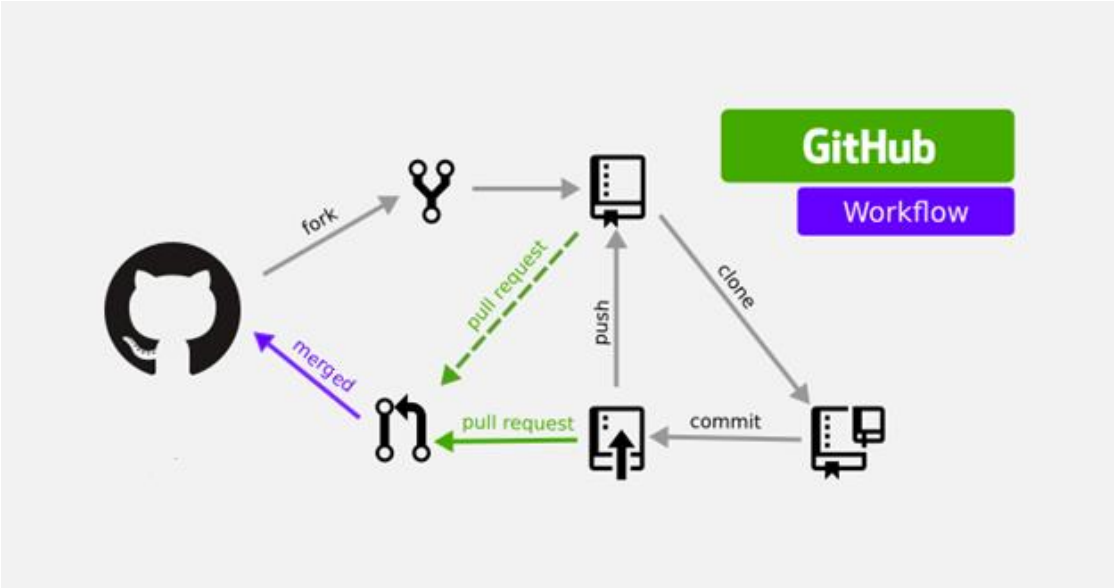
Last updated at
2023-03-09 15:36:25 UTC

Changelog

Updated.
admin@xronos.ch, 2023-03-09 15:36:25 UTC

Lab identifier: ?????? → NA

Imported from BDA via c14bazAAR
admin@xronos.ch, 2022-12-02 00:50:45 UTC



STEWARDSHIP?

Project database → infrastructure = “code + rules + people”

- Technical layer: open code, open interfaces, reproducible access
- Stewardship layer: shared norms for provenance, change, and citation
- Social layer: distributed ownership so continuity doesn’t depend on one person
- 3 roles?:
  - Maintainers (ops/releases)
  - Data stewards (QA)
  - Community (issues/PRs)
- Change control: PRs for routine work | RFC for schema/API

Database > Open Collaboration > Open Platform

community based quality control!

Trust is built through process, not authority

- Graduated responsibility: participation → contribution → review → stewardship
- Visible change: decisions and edits are inspectable and attributable
- Predictable rhythm: regular, small updates that keep the system legible to users
- On-ramps: many low-risk ways to help; recognition makes help repeatable

Intension > Engagement > ??? > PROFIT

Lessons Learned from Building XRONOS

- Invest early in data modelling
- Build tools *for* curation, not only for display
- Plan for multiple users and multiple curators
- Build everything *modular*
- Use open standards and linked data
- Make technical processes transparent
- In doubt: Hire an IT person for technical stuff:
  - We are scientist in the end…

People change roles, infrastructure should survive that

- Joe and I no longer work on XRONOS as our main job
- Progress will be shaped by available time — and by the community around it
- Our focus is to reduce single-person dependency and improve long-term trust

Contact

Martin Hinz, Joe Roe

Institute of Archaeological Sciences, University of Bern

Find us at https://xronos.ch