Package 'spaAlign'

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Title Stratigraphic Plug Alignment for Integrating Plug-Based and XRF Data

Version 0.0.6

Description Implements the Stratigraphic Plug Alignment (SPA) procedure for integrating sparsely sampled plug-based measurements (e.g., total organic carbon, porosity, mineralogy) with high-resolution X-ray fluorescence (XRF) geochemical data. SPA uses linear interpolation via the base approx() function with constrained extrapolation (rule = 1) to preserve stratigraphic order and avoid estimation beyond observed depths. The method aligns all datasets to a common depth grid, enabling high-resolution multivariate analysis and stratigraphic interpretation of core-based datasets such as those from the Utica and Point Pleasant formations. See R Core Team (2025) <https://stat.ethz.ch/R-manual/R-devel/library/stats/html/stats-package.html> and Omodolor (2025) <http://rave.ohiolink.edu/etdc/view?acc_num=case175262671767524> for methodological background and geological context.

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Depends R (>= 4.0)

Imports stats

Suggests testthat (>= 3.0.0), knitr, rmarkdown

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`spa_align` *Stratigraphic Plug Alignment (SPA)*

Description

Linearly interpolates plug-based measurements (e.g., TOC, porosity, XRD) onto a high-resolution reference depth grid (e.g., XRF). The procedure uses base R's `approx()` with `rule = 1` (default) to prevent extrapolation beyond the observed depth range, ensuring stratigraphically consistent alignment of all datasets.

Usage

```
spa_align(
  ref,
  ...,
  depth_col = "Depth_m",
  rule = 1,
  add_suffix = TRUE,
  trim = FALSE
)
```

Arguments

`ref`	A data.frame containing the reference depth grid and (optionally) high-resolution variables (e.g., XRF). Must contain the depth column specified in `depth_col`.
`...`	One or more named data.frames containing plug-based measurements to be interpolated (e.g., `xrd = xrd_df`, `plugs = plug_df`).
`depth_col`	A character string giving the name of the depth column shared by all input datasets. Defaults to `"Depth_m"`. The depth column may use any unit (e.g., meters, feet, centimeters); `"Depth_m"` is only a column label and does not require depths to be in meters. However, all input datasets must use the same depth unit for interpolation to be meaningful.
`rule`	Integer passed to `approx()` (default 1). `rule = 1` prevents extrapolation outside the observed depth range. `rule = 2` performs constant extrapolation (end-point hold).
`add_suffix`	Logical; if `TRUE`, variable names are suffixed with the dataset name (e.g., `TOC_plugs`, `Quartz_xrd`).
`trim`	Logical; if `TRUE`, drops rows where any interpolated column is `NA`. Default `FALSE` (preserves all reference depths).

Details

SPA is intended for vertically ordered core or log data, where measurements are indexed by depth along a stratigraphic profile.

Value

A data.frame containing the reference depth grid and interpolated variables aligned to the same resolution.

Examples

```
ref <- data.frame(Depth_m = 0:10, Ca = runif(11, 100, 200))
xrd <- data.frame(Depth_m = c(2, 5, 7), Quartz = c(54, 60, 58))
plugs <- data.frame(Depth_m = c(3, 7, 9), TOC = c(3.0, 3.3, 3.5))

# Default: preserves reference depth grid
aligned <- spa_align(ref, xrd = xrd, plugs = plugs)
head(aligned)

# Overlap-only alignment
aligned_overlap <- spa_align(ref, xrd = xrd, plugs = plugs, trim = TRUE)
```

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