Package 'avstrat'

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Title Stratigraphic Data Processing and Section Plots

Version 0.1.1

Description Data processing and generating stratigraphic sections for volcanic deposits and tephrastratigraphy. Package was developed for studies on Alaska volcanoes (``av'') where stratigraphic (``strat'') figures are needed for interpreting eruptive histories, but the methods are applicable to any sediment stratigraphy project. Plotting styles inspired by ``SedLog'' (Zervas et al. 2009) <doi:10.1016/j.cageo.2009.02.009> but with more customizable outputs and flexible data input based on best practice recommendations for the tephra community (Wallace et al. 2022) <doi:10.1038/s41597-022-01515-y>.

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BugReports https://code.usgs.gov/vsc/tephra/tools/avstrat/-/issues

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Contents

`add_depths` *Add standardized depth information to stratigraphic layer data*

Description

`add_depths()` takes a data frame of stratigraphic layer information and calculates standardized thickness and depth values. It ensures required columns are present, converts thickness and depth units to centimeters, derives a plotting thickness, and computes top, bottom, and middle depths for each layer within a stratigraphic section. The function is designed to handle input where layers are defined either by order and thickness or with absolute start and stop depth values.

Usage

```
add_depths(df)
```

Arguments

`df` A data frame containing stratigraphic layer information. The following columns are required depending on the method:

Always required

- `stratsection_name`: Unique identity of the section (repeated for each layer).
- `stratlayer_name`: Unique identity of the layer.
- `stratmeasuremethod`: One of `"order and thickness"` or `"start and stop depth"`.

- `stratlayer_order_start_at_top`: Logical, does ordering start at the top (`TRUE`) or bottom (`FALSE`)? For "start and stop depth", this defines if the reference "depth" is the top or bottom of the section.

If `stratmeasuremethod == "order and thickness"`

- `stratlayer_order`: Integer order of layers within the section.
- `thickness_units`: One of `"meters"`, `"centimeters"`, `"millimeters"`.
- At least one of `thickness_typical`, `thickness_min`, or `thickness_max`.

If `stratmeasuremethod == "start and stop depth"`

- `depth_units`: One of `"meters"`, `"centimeters"`, `"millimeters"`.
- `depth_top`: Absolute depth of the top of the layer.
- `depth_bottom`: Absolute depth of the bottom of the layer.

Other columns are carried through unchanged. Missing expected columns are added automatically and filled with `NA`.

Details

The function groups data by `stratsection_name` and orders layers according to `stratlayer_order_start_at_top`. Depths are computed cumulatively if only thickness is provided, or taken directly from absolute depth columns if available.

Value

A tibble with the original data plus:

- `thickness_min_cm`, `thickness_max_cm`: thickness values converted to cm.
- `depth_top_cm`, `depth_bottom_cm`: depth values converted to cm.
- `thickness_plot`: representative thickness used for plotting.
- `thickness_plot_warning`: message if no thickness was available.
- `Depth_top`, `Depth_bottom`, `Depth_middle`: calculated depths (cm). Rows without sufficient information are dropped.

Examples

```
# Example data is included with the package
data("example_data_strat", package = "avstrat")

# Order + thickness method (section "fake1")
df1 <- subset(example_data_strat, stratsection_name == "fake1")
add_depths(df1)

# Start/stop depth method (section "fake3")
df2 <- subset(example_data_strat, stratsection_name == "fake3")
add_depths(df2)
```

add_layer_width *Reformat stratigraphic layer data for polygon plotting*

Description

add_layer_width() reshapes stratigraphic layer grainsize data into a "long" format suitable for plotting polygons in a stratigraphic section diagram. It constructs left/right grain size boundaries, gathers them into long format, assigns depth coordinates, and converts grain size text labels into numeric values for plotting with ggstrat().

Usage

```
add_layer_width(df, grainsize_direction = c("increasing", "decreasing"))
```

Arguments

df A data frame containing stratigraphic layer information. The following columns are required:

- stratsection_name: Unique identity of the section (repeated for each layer).
- stratlayer_name: Unique identity of the layer.
- Depth_top, Depth_bottom: Depths in centimeters, as returned by add_depths().
- grainsize_top: Grain size at the top of the layer.
- grainsize_bottom: Grain size at the bottom of the layer.

Grain size values must be chosen from the validated list (White & Houghton, 2006, *Geology* 34:677–680):

- "clay" (<1/256 mm)
- "silt" (1/256-1/16 mm)
- "very fine sand/ash" (1/16-1/8 mm)
- "fine sand/ash" (1/8-1/4 mm)
- "medium sand/ash" (1/4-1/2 mm)
- "coarse sand/ash" (1/2-1 mm)
- "very coarse sand/ash" (1-2 mm)
- "granule/fine lapilli" (2-4 mm)
- "pebble/medium lapilli" (4-16 mm)
- "cobble/coarse lapilli" (1.6-6.4 cm)
- "blocks/bombs/boulders" (>6.4 cm)
- NA (no data)

Several legacy abbreviations (e.g. "vca", "vcs") are currently accepted but may be deprecated in future versions.

grainsize_direction

Character string, one of "increasing" or "decreasing". Controls the numeric mapping of grain sizes:

- "increasing" (default): clay/silt = 1, ..., blocks/bombs/boulders = 10.
- "decreasing": clay/silt = 10, ..., blocks/bombs/boulders = 1.

Increasing will show coarser units as bigger polygons (more prominent) which is espeically useful for emphasizing more energentic volcanic deposits. Decreasing will show finer (typically more resistive) units as bigger which may better match observed erosional profiles.

Value

A tibble in long format with original data plus:

- size_loc: identifier for polygon vertex locations.
- size_text: original grain size text.
- depth: numeric depth coordinate.
- grainsize: numeric grain size code for plotting.

Examples

```
library(dplyr)
library(tidyr)
df <- tidyr::tibble(
stratlayer_order = c(1,2),
grainsize_top = c("clay", "coarse sand/ash"),
grainsize_bottom = c( "silt", "medium sand/ash"),
Depth_top = c(0, 10),
Depth_bottom = c(10, 20)
)
add_layer_width(df)
```

---

example_data_indiv *Example stratigraphic data from individual tables*

Description

A dataset created by loading example inputs with load_stratdata_indiv(). This demonstrates the structure of stratigraphic data when stations, sections, layers, and samples are provided as separate tables and then merged. It shares many column definitions with example_data_strat but contains a reduced set of fields.

Usage

```
example_data_indiv
```

Format

`example_data_indiv`**:**

A data frame with 244 rows and 23 columns:

stratsection_name Character. Name/identifier of the stratigraphic section.

stratlayer_name Character. Name/identifier of the stratigraphic layer.

stratlayer_desc Character. Free-text description of the layer.

stratlayer_order Integer. Order of the layer within the section.

thickness_units Character. Units for thickness (e.g., "millimeters", "centimeters", "meters").

thickness_typical Numeric. Typical thickness of the layer.

thickness_min Numeric. Minimum thickness of the layer.

thickness_max Numeric. Maximum thickness of the layer.

depth_units Character. Units for depth (see thickness_units).

depth_top Numeric. Absolute depth to the top of the layer.

depth_bottom Numeric. Absolute depth to the bottom of the layer.

layer_type Character/Factor. Lithology or depositional type of the layer (e.g., "tephra fall", "soil").

stratlayer_color Character. Color description.

grainsize_top Numeric/Character. Grain size at the top of the layer.

grainsize_bottom Numeric/Character. Grain size at the bottom of the layer.

volcano_name Character. Source volcano name. If multiple, separated by "|".

station_id Character. Station identifier (links back to station metadata).

stratmeasuremethod Character. Method used for stratigraphic measurement.

stratlayer_order_start_at_top Logical. Whether ordering starts at the top.

Latdd Numeric. Latitude in decimal degrees.

Longdd Numeric. Longitude in decimal degrees.

stratlayer_sample Character. Collapsed sample identifiers per layer, separated by "|".

SampleID List. Nested list column of sample IDs per layer.

See Also

`example_data_strat` for a more complete dataset including additional descriptive fields.

`example_data_strat` *Example GeoDIVA forms data*

Description

A dataset of forms loaded with `load_geodiva_forms()`. Useful for demonstrating plotting and analysis functions in this package.

Usage

```
example_data_strat
```

Format

`example_data_strat`:

A data frame with 244 rows and 39 columns:

stratsection_name Character. Name/identifier of the stratigraphic section.

stratlayer_name Character. Name/identifier of the stratigraphic layer.

date_described Date. Date the section was described.

date_described_timezone Character. Time zone of the description date.

stratlayer_desc Character. Free-text description of the layer.

stratlayer_order Integer. Order of the layer within the section.

thickness_units Character. Units for thickness (e.g., "millimeters", "centimeters", "meters").

thickness_typical Numeric. Typical thickness of the layer.

thickness_min Numeric. Minimum thickness of the layer.

thickness_max Numeric. Maximum thickness of the layer.

depth_units Character. Units for depth (see thickness_units).

depth_top Numeric. Absolute depth to the top of the layer.

depth_bottom Numeric. Absolute depth to the bottom of the layer.

depth_uncertainty_top Numeric. Uncertainty in top depth.

depth_uncertainty_bottom Numeric. Uncertainty in bottom depth.

layer_type Character/Factor. Lithology or depositional type of the layer (e.g., "tephra fall", "soil").

stratlayer_color Character. Color description.

grainsize_top Numeric/Character. Grain size at the top of the layer.

grainsize_bottom Numeric/Character. Grain size at the bottom of the layer.

stratlayer_grading Character. Grading description (e.g. normal, reverse).

contact_lower Character. Description of the lower contact.

contact_upper Character. Description of the upper contact.

stratlayer_sorting Character. Sorting description.

stratlayer_support Character. Support description (matrix or clast).

tephra_concentration Numeric/Character. Tephra concentration.

stratlayer_unit Character. Stratigraphic unit designation.

tephra_name Character. Formal tephra name.

tephra_guess Character. Tentative tephra identification.

volcano_name Character. Source volcano name. If multiple source volcanoes separated by "|".

eruption_name Character. Source eruption name.

stratlayer_sample Character. Sample identifier. If multiple samples separated by "|".

station_id Character. Station identifier.

stratmeasuremethod Character. Method used for stratigraphic measurement.

stratlayer_order_start_at_top Logical. Whether ordering starts at the top.

section_notes Character. Free-text notes about the section.

Latdd Numeric. Latitude in decimal degrees.

Longdd Numeric. Longitude in decimal degrees.

LocationDesc Character. Location description.

SampleID List. Nested list column of sample IDs per layer.

Source

<doi.org/10.14509/31084>

<doi.org/10.14509/31090>

`extract_sample_depths` *Extract unnested samples with stratigraphic depths*

Description

`extract_sample_depths()` takes a stratigraphic dataset that has already been merged (e.g. from `load_geodiva_forms()` or `load_stratdata_indiv()`) and applies `add_depths()` to compute absolute depths. It then expands a nested sample column (by default `"SampleID"`) so that each sample is represented as its own row, and drops rows where the chosen column is missing. Optionally, you can strip away all other layer metadata and return only the sample IDs and depth columns. Can be used on any nested or unested column.

Usage

```
extract_sample_depths(
  strat_data,
  sample_column = "SampleID",
  remove_layer_metadata = FALSE
)
```

Arguments

`strat_data`	A data frame ready for applying `add_depths()`, containing `"SampleID"` or another column you want to expand to sample-level rows.
`sample_column`	A string giving the name of the column to extract and unnest. Defaults to `"SampleID"`.
`remove_layer_metadata`	Logical. If `TRUE`, only the selected sample column and the depth columns (`Depth_top`, `Depth_middle`, `Depth_bottom`) are returned. Defaults to `FALSE`.

Value

A data frame with one row per sample, including the depth information and associated layer metadata (unless `remove_layer_metadata = TRUE`).

Examples

```
# Default: expand the SampleID column
extract_sample_depths(example_data_strat)

# Expand a different column (here "stratlayer_sample")
extract_sample_depths(example_data_strat, sample_column = "stratlayer_sample")
```

```
# Return only SampleID and depth columns
extract_sample_depths(example_data_strat, remove_layer_metadata = TRUE)
```

`ggstrat` *Plot a grainsize-depth stratigraphic section*

Description

Uses ggplot2 to create a grainsize vs. depth stratigraphic section plot.

Usage

```
ggstrat(
  df,
  section_name,
  grainsize_direction = c("increasing", "decreasing"),
  grainsize_labs = gs_volc_abbr,
  use_theme = NULL,
  xlim = c(-1, 10),
  ylim = NULL,
  depth_units = c("cm", "m"),
  ybreaks = 7,
  layer_fill = "layer_type",
  layer_fill_color = "stratpal_rpg",
  layer_border_color = "black",
  layer_border_linewidth = 0.2
)
```

Arguments

`df` A data frame containing stratigraphic data. Must include columns `stratsection_name`, `stratlayer_order`, `grainsize`, `depth`, and `stratlayer_type`.

`section_name` Character string giving the section name to filter "stratsection_name".

`grainsize_direction`
Character string, one of `"increasing"` or `"decreasing"`. Controls the numeric mapping of grain sizes:

- `"increasing"` (default): clay/silt = 1, ..., blocks/bombs/boulders = 10.
- `"decreasing"`: clay/silt = 10, ..., blocks/bombs/boulders = 1.

Increasing will show coarser units as bigger polygons (more prominent) which is espeically useful for emphasizing more energentic volcanic deposits. Decreasing will show finer (typically more resistive) units as bigger which may better match observed erosional profiles.

`grainsize_labs` Character vector of labels for the x-axis. Several predefined options are available:

- `gs_volc_abbr`: Volcanic grainsize abbreviations (default).

- `gs_sed_abbr`: Sedimentary grainsize abbreviations.
- `gs_volc_names`: Volcanic grainsize full names.
- `gs_sed_names`: Sedimentary grainsize full names.
- `gs_numeric`: Numeric grainsize labels.

`use_theme` A ggplot2 theme object to apply to the plot, e.g., "theme_avstrat".

`xlim` Numeric vector of length 2 giving x-axis limits.

`ylim` Numeric vector of length 2 giving y-axis limits (optional).

`depth_units` Units to use for depth (y-axis) scale, either "cm" (default) or "m".

`ybreaks` Number of breaks on the y-axis.

`layer_fill` Character string naming the column to use for fill. If using anything other than "layer_type" from the template, will need to make a new palette.

`layer_fill_color` Palette object to use for fill colors.

`layer_border_color` Border color for polygons.

`layer_border_linewidth` Border line width for polygons.

Value

A ggplot object

Examples

```
example_data_strat |>
 add_depths() |>
 ggstrat(section_name = "21LSHD02")
```

---

ggstrat_bulk_save *Bulk save stratigraphic plots for all uploaded sections*

Description

Generate and save a series of stratigraphic plots, one per unique stratigraphic section in the input data frame. The user can supply any plotting function that returns a ggplot object (e.g. one of the package's plotting functions, or a custom function).

Usage

```
ggstrat_bulk_save(
  df,
  plotfunction = ggstrat,
  outdir = NULL,
  file_type = "png",
  dpi = 300,
```

```
  width = 4,
  height = 8,
  units = "in",
  ask = TRUE,
  ...
)
```

Arguments

df	A data frame containing stratigraphic data. Must include columns stratsection_name, and any other variables needed for the plotfunction, such as: stratlayer_order, grainsize, depth, and stratlayer_type.
plotfunction	A function that generates a plot for a single section. It should accept at least two arguments: the full data frame (df) and a section identifier (stratsection_name). Defaults to ggstrat().
outdir	Directory where plots will be saved. Suggest supplying a name such as "StratSectionsPlotted", will create directory if it does not exist.
file_type	File extension for saved plots (e.g. "png", "pdf"). Defaults to "png".
dpi	Plot resolution in dots per inch. Can be a numeric value (e.g. 300) or one of "screen", "print", or "retina". Defaults to 300.
width	Plot width passed to ggplot2::ggsave(). Defaults to 4.
height	Plot height passed to ggplot2::ggsave(). Defaults to 8.
units	Units for width and height. One of "in", "cm", or "mm". Defaults to "in".
ask	Logical. If TRUE (default) and running interactively, the function will prompt the user to confirm before generating and saving all plots.
...	Additional arguments passed on to plotfunction.

Value

Invisibly returns NULL. Called for its side effect of saving plot files to disk.

Examples

```
# Save plots for each section using the default ggstrat() function
td <- tempdir()
ggstrat_bulk_save(example_data_strat, outdir = td)

# Save plots using a different plotting function
ggstrat_bulk_save(example_data_strat,
                  plotfunction = ggstrat_column,
                  outdir = td)

# Save plots with higher resolution
ggstrat_bulk_save(example_data_strat,
                  outdir = td,
                  dpi = 600)

# Optional cleanup
```

```
unlink(list.files(td, full.names = TRUE))
```

`ggstrat_column` *Plot a simple stratigraphic column*

Description

Uses ggplot2 to create a simple depth-only stratigraphic section plot with no variable mapped to the x-axis. Each layer is drawn as a fixed-width rectangle.

Usage

```
ggstrat_column(
  df,
  section_name,
  use_theme = NULL,
  ylim = NULL,
  depth_units = c("cm", "m"),
  ybreaks = 7,
  layer_fill = "layer_type",
  layer_fill_color = "stratpal_rpg",
  layer_border_color = "black",
  layer_border_linewidth = 0.2
)
```

Arguments

`df`	A data frame containing stratigraphic data. Must include columns `stratsection_name`, `stratlayer_order`, `grainsize`, `depth`, and `stratlayer_type`.
`section_name`	Character string giving the section name to filter "stratsection_name".
`use_theme`	A ggplot2 theme object to apply to the plot, e.g., "theme_avstrat".
`ylim`	Numeric vector of length 2 giving y-axis limits (optional).
`depth_units`	Units to use for depth (y-axis) scale, either "cm" (default) or "m".
`ybreaks`	Number of breaks on the y-axis.
`layer_fill`	Character string naming the column to use for fill. If using anything other than "layer_type" from the template, will need to make a new palette.
`layer_fill_color`	Palette object to use for fill colors.
`layer_border_color`	Border color for polygons.
`layer_border_linewidth`	Border line width for polygons.

Value

A ggplot object showing a schematic stratigraphic column.

Examples

```
example_data_strat |>
  ggstrat_column(section_name = "21LSHD02")
```

`ggstrat_label` *Plots text lables alongside a stratigraphic section*

Description

Uses ggplot2 to plot any character column associated with stratigraphic data such as SampleID at the correct depths for their corresponding layers. Connecting lines extend to the left of the plot to point to plotted layers. It is designed to be combined with a stratigraphic section plot created by `ggstrat()` using the patchwork::patchwork framework for arranging multiple ggplot objects.

Usage

```
ggstrat_label(
  df,
  section_name,
  use_theme = NULL,
  label = "stratlayer_sample",
  ylim = NULL,
  ybreaks = 7
)
```

Arguments

`df`	A data frame containing stratigraphic data. Must include columns `stratsection_name`, `stratlayer_order`, `grainsize`, `depth`, and the column specified by `layer_fill`.
`section_name`	Character string giving the section name to filter "stratsection_name".
`use_theme`	A ggplot2 theme object to apply to the plot, e.g., "theme_avstrat".
`label`	Character strin gnaming the column to use for labels. Default is "SampleID".
`ylim`	Numeric vector of length 2 giving y-axis limits (optional).
`ybreaks`	Number of breaks on the y-axis.

Value

A ggplot object showing SampleIDs plotted by depth in section.

Examples

```
# Example 1: Basic usage
example_data_strat |>
  ggstrat_label(section_name = "21LSHD02",
              label = "SampleID")

# Example 2: Combine with a stratigraphic section plot using patchwork
if (requireNamespace("patchwork", quietly = TRUE)) {
  stratsection <- example_data_strat |>
    ggstrat(section_name = "21LSHD02")

  samples <- example_data_strat |>
    ggstrat_label(section_name = "21LSHD02",
              label = "SampleID")

  stratsection + samples
}
```

`ggstrat_samples` *A combined grainsize-depth and sample label stratigraphic plot*

Description

Combines a grainsize–depth plot and sample label plot into a single composite figure using the patchwork::patchwork framework. The two plots are aligned and legends are collected at the bottom.

Usage

```
ggstrat_samples(
  df,
  section_name,
  label = "stratlayer_sample",
  use_theme = NULL,
  ylim = NULL,
  depth_units = c("cm", "m"),
  ybreaks = 7
)
```

Arguments

`df`	A data frame containing stratigraphic data. Must include columns `stratsection_name`, `stratlayer_order`, `grainsize`, `depth`, `stratlayer_type`, and `SampleID`.
`section_name`	Character string giving the section name to filter "stratsection_name".
`label`	Character strin gnaming the column to use for labels. Default is "SampleID".
`use_theme`	A ggplot2 theme object to apply to the plot, e.g., "theme_avstrat".

ylim	Numeric vector of length 2 giving y-axis limits (optional).
depth_units	Units to use for depth (y-axis) scale, either "cm" (default) or "m".
ybreaks	Number of breaks on the y-axis.

Value

A patchwork/ggplot object combining the stratigraphic plot and sample labels. This object can be further modified with ggplot2::theme() or additional patchwork operators.

Examples

```
example_data_strat |>
  ggstrat_samples(section_name = "21LSHD02")
```

---

load_geodiva_forms *Load stratigraphic data from GeoDIVA upload forms*

Description

load_geodiva_forms() processes and cleans stratigraphic data from GeoDIVA upload forms, specifically a form that includes Station and Sample data and another form that includes the Layer data. It merges these datasets, resolves any conflicts in key fields, and prepares a consolidated dataset for further analysis. The function also extracts and, optionally, prints a list of unique stratigraphic sections.

Usage

```
load_geodiva_forms(station_sample_upload, layer_upload, verbose = TRUE)
```

Arguments

station_sample_upload	data frame created from uploaded GeoDIVA format Station/Sample upload sheet, usually uploaded with readxl::read_xlsx() linked to filepath.
layer_upload	data frame created from uploaded GeoDIVA format Layers upload sheet, usually uploaded with readxl::read_xlsx() linked to filepath.
verbose	Logical. If TRUE (default), prints a message listing the imported stratigraphic sections. Set to FALSE to suppress console output.

Value

A data frame containing the merged and cleaned stratigraphic data, ready for further analysis.

Examples

```
# Locate the example Excel files shipped with the package
path_samples <- system.file("extdata", "example_samples_stations_upload_2024.xlsx",
  package = "avstrat"
)
path_layers <- system.file("extdata", "example_layers_upload_2024.xlsx",
  package = "avstrat"
)

# Read them with readxl
library(readxl)
  station_sample_upload <- readxl::read_xlsx(path_samples, sheet = "Data")
  layer_upload <- readxl::read_xlsx(path_layers, sheet = "Data")

  result <- load_geodiva_forms(station_sample_upload, layer_upload)
  head(result)  # result is a data frame
```

---

load_stratdata_indiv *Load stratigraphic data from individual tables*

Description

`load_stratdata_indiv()` loads necessary data for `avstrat` from separate station (location), section (section metadata), stratlayer, and sample data. Allows upload of smaller number of tables if data are already joined together (e.g., stations-sections combined, or layers-samples combined). The function also extracts and, optionally, prints a list of unique stratigraphic sections.

Usage

```
load_stratdata_indiv(
  stations_upload,
  sections_upload,
  layers_upload,
  samples_upload = NULL,
  verbose = TRUE
)
```

Arguments

`stations_upload`

A data frame with "station" metadata. The following columns are required in order to work with `avstrat` functions:

- `station_id`: UniqueID for the station.
- `latdd`: Location in decimal degrees, in WGS84 datum.
- `longdd`: Longitude in decimal degrees, in WGS84 datum.

sections_upload

A data frame with "section" metadata (point to same file as station_upload if already joined). The following columns are required in order to work with avstrat functions:

- station_id: UniqueID for the station, must match an existing value in station_upload.
- stratsection_name: Unique identity of the section.
- stratmeasuremethod: One of "order and thickness" or "start and stop depth".
- stratlayer_order_start_at_top: Logical, does ordering start at the top (TRUE) or bottom (FALSE)? For "start and stop depth", this defines if the reference "depth" is the top or bottom of the section.

layers_upload

A data frame with "layer" metadata. The following columns are required in order to work with avstrat functions:

- stratsection_name: Unique identity of the section, must match an existing value in section_upload.
- stratlayer_name: Unique identifier for the layer.
- layer_type: A character value from a list for plotting default layer symbols (color). If not provided, plotting functions will need to override default layer_fill mapping. Must be chosen from a validated list:
  - volcanic
  - tephra fall
  - lava
  - intrusion
  - tuff
  - sediment
  - soil
  - peat
  - lacustrine
  - fluvial
  - eolian
  - diamict
  - clay
  - pyroclastic density current
  - pyroclastic surge
  - pyroclastic flow
  - mass wasting
  - debris flow
  - lahar
  - landslide
  - hyperconcentrated flow
  - debris avalanche
  - frozen water

  - ice
  - snow
  - dirty snow
  - plant
  - rock
  - other
  - undifferentiated/undescribed
- grainsize_top: Grain size at the top of the layer.
- grainsize_bottom: Grain size at the bottom of the layer.

Grain size values must be chosen from the validated list (White & Houghton, 2006, *Geology* 34:677–680):

- "clay" (<1/256 mm)
- "silt" (1/256-1/16 mm)
- "very fine sand/ash" (1/16-1/8 mm)
- "fine sand/ash" (1/8-1/4 mm)
- "medium sand/ash" (1/4-1/2 mm)
- "coarse sand/ash" (1/2-1 mm)
- "very coarse sand/ash" (1-2 mm)
- "granule/fine lapilli" (2-4 mm)
- "pebble/medium lapilli" (4-16 mm)
- "cobble/coarse lapilli" (1.6-6.4 cm)
- "blocks/bombs/boulders" (>6.4 cm)
- NA (no data)

If stratmeasuremethod == "order and thickness"

- stratlayer_order: Integer order of layers within the section.
- thickness_units: One of "meters", "centimeters", "millimeters".
- thickness_typical: Numeric value of the typical thickness of a layer.
- thickness_min: Numeric value of the minimum thickness of a layer.
- thickness_max: Numeric value of the maximum thickness of a layer. **If** stratmeasuremethod == "start and stop depth"
- depth_units: One of "meters", "centimeters", "millimeters".
- depth_top: Absolute depth of the top of the layer.
- depth_bottom: Absolute depth of the bottom of the layer.

samples_upload A data frame with "sample" metadata.

- stratlayer_name: Unique identifier for the layer, must match an existing value in layer_upload.
- SampleID: Unique identifier for the sample.

verbose Logical. If TRUE (default), prints a message listing the imported stratigraphic sections. Set to FALSE to suppress console output.

Value

A data frame of layers joined with section and station metadata, plus collapsed sample information:

- `stratlayer_sample`: concatenated `SampleID`s per layer (separated by `"|"`).
- `SampleID`: list column of `SampleID`s per layer.

Examples

```
# Locate the example Excel files shipped with the package
path <- system.file("extdata", "example_inputs.xlsx",
  package = "avstrat"
)

# Read them with readxl
library(readxl)
  stations <- readxl::read_xlsx(path, sheet = "stations")
  sections <- readxl::read_xlsx(path, sheet = "sections")
  layers <- readxl::read_xlsx(path, sheet = "layers")
  samples <- readxl::read_xlsx(path, sheet = "samples_layer")

  load_stratdata_indiv(stations_upload = stations,
                       sections_upload = sections,
                       layers_upload = layers,
                       samples_upload = samples)
```

`run_ggstrat_app` *Launch the interactive map with stratigraphy plots*

Description

This function launches a Shiny app that displays an interactive map locations with stratigraphic data. If you click on a station it will generate a stratigraphic plot with the plotting function of your choice (default is `ggstrat_samples()`). You can also adjust the height of the plot using the slider below the map.

Usage

```
run_ggstrat_app(df, plot_fun = ggstrat_samples)
```

Arguments

`df`	A data frame containing stratigraphic data.
`plot_fun`	A function that generates a stratigraphic plot. Defaults to `ggstrat_samples()`.

Value

A Shiny app object.

Examples

```
if (interactive()) {
# Use your default plotting function
run_ggstrat_app(example_data_strat)

# Or swap in a custom plotting function
run_ggstrat_app(example_data_strat, plot_fun = ggstrat_column)
}
```

`scale_fill_stratpal` *Stratigraphic fill scale*

Description

A ggplot2 fill scale that uses one of the built-in stratigraphic palettes.

Usage

```
scale_fill_stratpal(
  palette = c("stratpal_rpg", "stratpal_grays"),
  overrides = NULL,
  allow_na = FALSE,
  na_color = "gray90",
  ...
)
```

Arguments

`palette`	Character string naming which palette to use. Options are names of palettes in `.stratpalettes`.
`overrides`	Optional named character vector of colors to override entries in the chosen palette.
`allow_na`	Logical. If TRUE, missing categories are filled with `na_color` instead of erroring.
`na_color`	Color to use for missing categories when `allow_na = TRUE`.
`...`	Additional arguments passed to `ggplot2::scale_fill_manual()`.

Value

A ggplot2 scale object.

Examples

```
library(ggplot2)
ggplot(mtcars, aes(factor(cyl), fill = factor(cyl))) +
  geom_bar() +
  scale_fill_stratpal("stratpal_rpg")

# Override one color
scale_fill_stratpal("stratpal_rpg", overrides = c("volcanic" = "orange"))

# Allow missing categories to be filled with gray
scale_fill_stratpal("stratpal_grays", allow_na = TRUE)
```

---

stratpalettes *Stratigraphic palettes*

Description

Named character vectors of hex colors for stratigraphic plotting. These palettes can be passed to `scale_fill_stratpal()`.

Usage

```
stratpal_rpg

stratpal_grays
```

Format

Named character vectors

An object of class `character` of length 30.

An object of class `character` of length 30.

Examples

```
stratpal_rpg["volcanic"]
stratpal_grays["soil"]
```

theme_avstrat *Custom theme for stratigraphic plots*

Description

A ggplot2 theme designed to work well with typical plot ouput from avstrat, and matching the author's preferred aesthetics.

Usage

```
theme_avstrat(base_size = 11, base_family = "arial")
```

Arguments

base_size	Base font size. Defaults to 11.
base_family	Base font famil. Defaults to Arial.

Value

A ggplot2::theme() object.

Examples

```
# Apply a custom theme to one plot
ggstrat(df = example_data_strat, section_name = "21LSHD02") +
  theme_avstrat()

# Set the custom theme as default for all plots
ggplot2::theme_set(theme_avstrat())
ggstrat(df = example_data_strat, section_name = "21LSHD02")
```

validate_stratpal *Validate a stratigraphic palette*

Description

Ensures that a palette covers all required categories. By default, missing categories trigger an error. If allow_na = TRUE, missing categories are filled with a default color instead.

Usage

```
validate_stratpal(pal, allow_na = FALSE, na_color = "gray90")
```

Arguments

pal	Named character vector of colors.
allow_na	Logical. If TRUE, missing categories are filled with na_color instead of erroring.
na_color	Color to use for missing categories when allow_na = TRUE.

Value

A complete palette (named character vector) ordered to match the required categories.

Examples

```
# A complete palette passes validation
validate_stratpal(stratpal_rpg)

# Allow missing categories to be filled with gray
validate_stratpal(stratpal_grays, allow_na = TRUE)
```

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