

Package: mlms (via r-universe)

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Title Multilevel Monitoring System Data for Wells in the USGS INL
Aquifer Monitoring Network

Version 1.0.2

Description Analysis-ready datasets detailing the Multilevel Monitoring System (MLMS) wells within the U.S. Geological Survey's (USGS) aquifer-monitoring network at the Idaho National Laboratory (INL) in Idaho, and the data collected within these wells. Supported by the U.S. Department of Energy (DOE), the USGS collected discrete measurements of hydraulic head at various depths from wells in the eastern Snake River Plain (ESRP) aquifer over several years. These measurements were derived from data on fluid pressure, fluid temperature, and atmospheric pressure. Each well was equipped with an MLMS, which included valved measurement ports, packer bladders, casing segments, and couplers. The MLMS facilitated monitoring at multiple hydraulically isolated depth intervals, reaching significant depths below the land surface. Additionally, groundwater samples were collected from these wells over multiple years and analyzed for various chemical and physical parameters.

Depends R (>= 4.1)

Imports checkmate, graphics, grDevices, jsonlite, plotrix, readxl, stats, sf, stringi, tools, utils

Suggests connectapi, covr, dm, DiagrammeR, DiagrammeRsvg, fontawesome, htmltools, htmlwidgets, inldata, knitr, pkgbuild, pkgdown, pkgload, rcmdcheck, reactable, renv, rmarkdown, roxygen2, tinytest, V8, webmap

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`calibrations`*Sensor Calibrations*

Description

Dataset of electronic sensor calibration measurements in the Multilevel Monitoring System (MLMS) wells of the U.S. Geological Survey (USGS) aquifer-monitoring network, Idaho National Laboratory (INL), Idaho.

Usage`calibrations`**Format**

A data frame with the following variables:

`sensor_id` Identifier for the integrated sensor, see [sensors](#) dataset for a description of each sensor.

`cal_dt` Calendar date of sensor calibration.

`cal_tp` Calibration type.

`ref_temp_va` Reference temperature, in degree Celsius.

`ts_dt` Date.

`lab_standard` Laboratory standard.

`r2` R-squared, coefficient of determination.

`p_value` p-value.

Source

The dataset originates from the USGS INL Project Office and underwent processing using the [read_sensors_json](#) function.

Examples

```
str(calibrations)
```

get_head_outliers *Detect Hydraulic Head Outliers*

Description

Detect outliers in the fluid pressure data by comparing parameter values against statistical metrics derived from the [heads](#) dataset. This function will employ both the standard score (z-score) and Interquartile Range (IQR) methods for outlier identification.

Usage

```
get_head_outliers(  
  data = mlms::heads,  
  vars = NULL,  
  method = c("z-score", "IQR"),  
  threshold = 3,  
  multiplier = 1.5,  
  min_n = 10L,  
  quiet = TRUE  
)
```

Arguments

data	'data.frame' table. Depth-discrete measurements of fluid pressure and temperature, hydraulic head values, and land-surface atmospheric pressure measurements. Defaults to the heads dataset.
vars	'character' vector. One or more variable names for which to compute summary statistics. Choices include: "total_head_va" is the hydraulic head in feet above the North American Vertical Datum of 1988, "temp_va" is the fluid temperature in degree Celsius, "baro_va" is the atmospheric pressure in pounds per square inch absolute (psi), and "press_va" is the absolute fluid pressure in psi. By default, all variables are included.
method	'character' string. Outlier detection method. Specify "z-score" (default) for the standard score method, best suited for normally distributed data, or "IQR" to use the IQR method, which is ideal for skewed distributions.
threshold	'numeric' number. Z-score value used to determine whether a parameter value is considered an outlier or significantly different from the historic mean value.
multiplier	'numeric' number. Multiplier used to determine the threshold for outliers in the IQR method.
min_n	'integer' number. Minimum sample size needed to detect outliers.
quiet	'logical' flag. Whether to suppress printing of outlier information.

Value

A data frame with the following variables:

var_ds Variable description.

var_nm Variable name as specified in the vars argument.

site_nm Local site name for a MLMS well.

port_nu Identifier for the valved measurement port, included only if the by_port argument is set to true (not the default).

press_dt Time at which measurements were measured outside the multiport casing.

var_va Parameter value.

z_score Z-score, a statistical measure that indicates how many standard deviations a parameter value is from the mean.

qu_1st First quartile (25th percentile) of historical parameter values.

qu_3rd Third quartile (75th percentile) of historical parameter values.

n Sample size.

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

See Also

[get_head_stats](#) function is used to calculate the fluid pressure statistics.

Examples

```
d <- get_head_outliers()
str(d)
```

```
d <- get_head_outliers(method = "IQR")
str(d)
```

get_head_stats

Calculate Hydraulic Head Statistics

Description

Calculate summary statistics for multi-level hydraulic head data, categorized by site and port, and summarized over time.

Usage

```
get_head_stats(vars = NULL, by_port = FALSE)
```

Arguments

vars	'character' vector. One or more variable names for which to compute summary statistics. Choices include: "total_head_va" is the hydraulic head in feet above the North American Vertical Datum of 1988, "temp_va" is the fluid temperature in degree Celsius, "baro_va" is the atmospheric pressure in pounds per square inch absolute (psi), and "press_va" is the absolute fluid pressure in psi. By default, all variables are included.
by_port	'logical' flag. Whether to compute statistics according to a sites monitoring port. Defaults to grouping by site only.

Value

A data frame with the following variables:

var_ds	Variable description.
var_nm	Variable name as specified in the vars argument.
site_nm	Local site name for a MLMS well.
port_nu	Identifier for the valved measurement port, included only if the by_port argument is set to true (not the default).
n	Sample size, which is the number of records in a given sample that contain finite values.
nna	Number of missing values that were stripped before the statistic was computed.
start_dt	Start date for the period of record.
end_dt	End date for the period of record.
duration	Duration of the record period, measured in years.
mean	Arithmetic mean of the variable values.
sd	Standard deviation of the variable values.
min	Minimum of the variable values.
qu_1st	First quartile of the variable values.
median	Median of the variable values.
qu_3rd	Third quartile of the variable values.
max	Maximum of the variable values.

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

See Also

[get_head_outliers](#) function may be used to identify fluid pressure outliers.

Examples

```
d <- get_head_stats()
str(d)

d <- get_head_stats(vars = "press_va", by_port = TRUE)
str(d)
```

get_profile	<i>Retrieve Profile Data</i>
-------------	------------------------------

Description

Retrieve pressure, temperature, and water-quality data for site visits.

Usage

```
get_profile(  
  site_nm = NULL,  
  stime_dt = NULL,  
  poi = NULL,  
  time_dt = NULL,  
  pcode = NULL,  
  strings_as_factors = TRUE  
)
```

Arguments

site_nm	'character' vector. Local site name for a MLMS well.
stime_dt	'POSIXct' or 'character' vector. Start time for field visit.
poi	'POSIXct' or 'character' vector of length 2. Start and end limits on the period of interest.
time_dt	'POSIXct' or 'character' string. Estimated field visit time, the closest time in the vector of field visit start times.
pcode	'character' string. USGS 5-digit parameter code. For example, the parameter code for Tritium is "07000".
strings_as_factors	'logical' flag. Whether character vectors should be converted to factor class.

Value

A data frame.

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

See Also

[plot_profile](#) function to plot multilevel data for a site visit.

Examples

```
d <- get_profile(site_nm = "USGS 133", pcode = "07000")
str(d)

d <- get_profile(poi = c("2023-01-01", NA), strings_as_factors = FALSE)
str(d)
```

<code>get_samples</code>	<i>Retrieve Discrete Sample Data</i>
--------------------------	--------------------------------------

Description

Retrieve discrete sample water-quality data from the **inldata** package. See `inldata::samples` for a description of the source dataset. Requires that the **inldata** package is available.

Usage

```
get_samples(
  site_no = NULL,
  pcode = NULL,
  ports = mlms::ports,
  visits = mlms::visits
)
```

Arguments

<code>site_no</code>	'character' vector. USGS site identification number. The site numbers of measurement ports in the Multilevel Monitoring System (MLMS) wells by default.
<code>pcode</code>	'character' vector. USGS 5-digit parameter code. For a list of the parameter codes used by default, refer to the Details section.
<code>ports</code>	'data.frame' table. MLMS measurement port data, see <code>ports</code> dataset for data structure.
<code>visits</code>	'data.frame' table. Field visits, see <code>visits</code> dataset for data structure.

Details

The default parameters included are:

- 00930 Sodium, water, filtered, in milligrams per liter (mg/L).
- 00940 Chloride, water, filtered, in mg/L.
- 00945 Sulfate, water, filtered, in mg/L.
- 00950 Fluoride, water, filtered, in mg/L.
- 01030 Chromium, water, filtered, in micrograms per liter.
- 00618 Nitrate, water, filtered, in mg/L as nitrogen.
- 07000 Tritium, water, unfiltered, in picocuries per liter (pCi/L).

13501 Strontium-90, water, unfiltered, in pCi/L.
 22012 Plutonium-238, water, unfiltered, in pCi/L.
 28401 Cesium-137, water, unfiltered, in pCi/L.
 63018 Gross alpha radioactivity, water, unfiltered, Th-230 curve, in pCi/L.
 80049 Gross beta radioactivity, water, unfiltered, Sr-90/Y-90 curve, in pCi/L.
 00095 Specific conductance, water, unfiltered, in microsiemens per centimeter at 25 degrees Celsius.

Value

A data frame, see [samples](#) dataset for table structure.

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

Examples

```
d <- get_samples(site_no = "433409112570503", pcode = "07000")
```

heads

Hydraulic Heads

Description

Dataset of depth-discrete measurements of fluid pressure, fluid temperature, atmospheric pressure, and calculated hydraulic head in the Multilevel Monitoring System (MLMS) wells in the U.S. Geological Survey (USGS) aquifer-monitoring network, Idaho National Laboratory (INL), Idaho.

Usage

heads

Format

A data frame with the following variables:

site_nm Local site name for an MLMS well.

port_nu Identifier for the valved measurement port.

site_no USGS site identification number.

stime_dt Start time for field visit.

press_dt Time at which measurements were measured outside the multiport casing.

temp_va Fluid temperature measured inside the multiport casing from the bridge of the pressure transducer, in degree Celsius.

baro_va Atmospheric pressure measured at the time of the port measurement, in pounds per square inch absolute (psi).
 press_va Absolute pressure of fluid measured outside the multiport casing, in psi.
 press_head_va Pressure head outside the multiport casing, in feet.
 total_head_va Hydraulic head outside the multiport casing, in feet above the North American Vertical Datum of 1988 (NAVD 88).
 press_in_1_va Fluid pressure measured inside the multiport casing before the outside pressure measurement was taken, in psi.
 press_in_2_va Fluid pressure measured inside the multiport casing after the outside pressure measurement was taken, in psi.
 press_in_diff_va Difference in the fluid pressure measurements taken inside the multiport casing, in psi.
 replicate_fl Whether the measurement is a replicate for quality-control purposes.
 comment_tx Comments.

Source

The dataset originates from the USGS INL Project Office and underwent processing using the [read_field_json](#) function.

Examples

```
str(heads)
```

plot_profile	<i>Plot Profile Data</i>
--------------	--------------------------

Description

Plot pressure, temperature, or water-quality data for a site visit.

Usage

```

plot_profile(
  site_nm,
  time_dt,
  type = "head",
  replicates = FALSE,
  position = NULL,
  file = NULL,
  ...
)

```

Arguments

site_nm	'character' string. Local site name for a MLMS well.
time_dt	'POSIXct' or 'character' string. Estimated field visit time, the closest time in the vector of field visit start times. Note that water-quality samples may be collected up to one week after the site visit for pressure profiling.
type	'character' string. Plot type, choose "head" for hydraulic head, "temp" for fluid temperature, or a USGS 5-digit parameter code (pcode in the samples dataset). Hydraulic head is plotted by default.
replicates	'logical' flag. Whether to include replicate pressure measurements.
position	'character' string. Location used to position the legend. Choose a single keyword from the list "bottomright", "bottom", "bottomleft", "left", "topleft", "top", "topright", "right" and "center".
file	'character' string. PDF file to send plot graphics. Defaults to the active graphics window.
...	Additional arguments to be passed to the pdf function. Only relevant if the file argument is specified.

Value

Invisibly NULL

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

See Also

[get_profile](#) function is used to retrieve profile data.

Examples

```
site_nm <- "USGS 133"
time_dt <- "2008-08-27"
plot_profile(site_nm, time_dt, position = "topleft")

plot_profile(site_nm, time_dt, type = "temp")

plot_profile(site_nm, time_dt, type = "07000", position = "bottomright")

site_nm <- "USGS 131A"
time_dt <- "2012-10-24"
plot_profile(site_nm, time_dt)

plot_profile(site_nm, time_dt, type = "temp")

plot_profile(site_nm, time_dt, type = "07000")

file <- tempfile("test-profile-", fileext = ".pdf")
```

```
plot_profile(site_nm, time_dt, file = file, pointsize = 10)

unlink(file)
```

ports

Measurement Ports

Description

Dataset describing the locations of measurement ports within the multilevel completions of wells in the U.S. Geological Survey (USGS) aquifer-monitoring network, Idaho National Laboratory (INL), Idaho. These valved measurement ports enable monitor groundwater outside the multiport casing and within a monitoring zone.

Usage

```
ports
```

Format

A data frame with the following variables:

site_nm Local site name for a MLMS well.

port_nu Identifier for the valved measurement port.

site_no USGS site identification number.

mp_a_va Distance between the transducer plane and the bottom of the adjacent upper packer (top of the monitoring zone), in feet, as documented in the system log. A value of not applicable (NA) indicates a optional lower port coupling within the monitoring zone.

wl_depth_va Depth to water inside the multiport casing measured using an electric tape (e-tape), in feet below the top of the well casing.

baro_compl_va Atmospheric pressure measured at land surface, in pounds per square inch (psi).

temp_compl_va Fluid temperature measured inside the multiport casing at the pressure transducer bridge, in degrees Celsius (°C).

press_compl_va Absolute pressure of fluid inside the multiport casing, in psi.

tp_depth_va Depth to the transducer plane in the measurement port coupling, in feet below land surface.

port_depth_va Depth to the measurement port inlet valve of a port coupling, in ft bls.

port_alt_va Altitude of the measurement port inlet valve of a port coupling, in feet above the North American Vertical Datum of 1988 (NAVD 88).

zone_nu Identifier for the depth-discrete monitoring zone, where groundwater in this zone is vertically isolated between upper and lower packers.

npress Number of pressure and temperature measurements collected at the port.

nsamples Number of water-quality samples collected at the port.

Source

The dataset originates from the USGS INL Project Office and underwent processing using the [read_mlms_json](#) function.

Examples

```
str(ports)
```

read_field_json	<i>Read Field Data in JSON Format</i>
-----------------	---------------------------------------

Description

Read Multilevel Monitoring System (MLMS) field data in JSON format.

Usage

```
read_field_json(  
  paths,  
  wells = mlms::wells,  
  ports = mlms::ports,  
  tz = "America/Denver"  
)
```

Arguments

paths	'character' vector. Paths to the JSON files to read.
wells	'data.frame' table. MLMS well data, see wells dataset for data structure.
ports	'data.frame' table. MLMS measurement port data, see ports dataset for data structure.
tz	'character' string. Time zone specification. Defaults to America/Denver.

Value

A list of data frame components. See [visits](#) and [heads](#) datasets for example output.

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

See Also

[write_field_json](#) function for writing field data to file in JSON format.

Examples

```
l <- system.file("extdata/ex-field.json", package = "mlms") |>  
  read_field_json()  
str(l, max.level = 1)
```

read_field_xlsx	<i>Read Field Data in an Excel Workbook</i>
-----------------	---

Description

Read worksheet(s) of Multilevel Monitoring System (MLMS) field data in an Excel workbook.

Usage

```
read_field_xlsx(  
  path,  
  sheet = NULL,  
  pattern = "[0-9]{1,2}-[0-9]{1,2}-[0-9]{2,4}$"  
)
```

Arguments

path	'character' string. Path to the Excel workbook (xlsx) to read.
sheet	'character' vector. Name of the Excel worksheet(s) to read. Sheet names may also be specified via the pattern argument. If neither argument specifies the sheet, defaults to the first sheet in the workbook.
pattern	'character' string. A pattern (regular expression) used to identify worksheet names in the workbook.

Value

A list with data frame components.

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

Examples

```
path <- system.file("extdata/ex-field.xlsx", package = "mlms")  
l <- read_field_xlsx(path, sheet = "06-30-2022")  
str(l, max.level = 1)
```

read_mlms_json	<i>Read MLMS Data in JSON Format</i>
----------------	--------------------------------------

Description

Read Multilevel Monitoring System (MLMS) data in JSON format. Requires that the **inldata** package is available.

Usage

```
read_mlms_json(path)
```

Arguments

path 'character' string. Path to the JSON file to read.

Value

A list of data frame components. See [wells](#), [zones](#), and [ports](#) datasets for example output.

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

Examples

```
l <- system.file("extdata/ex-mlms.json", package = "mlms") |>
  read_mlms_json()
str(l, max.level = 1)
```

read_sensors_json	<i>Read Sensor Data in JSON Format</i>
-------------------	--

Description

Read electronic sensor data in a JSON format.

Usage

```
read_sensors_json(path)
```

Arguments

path 'character' string. Path to the JSON file to read.

Value

A list of data frame components. See [sensors](#) and [calibrations](#) datasets for example output.

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

Examples

```
l <- system.file("extdata/ex-sensors.json", package = "mlms") |>
  read_sensors_json()
str(l, max.level = 1)
```

samples

Water-Quality Samples

Description

Depth-discrete chemical and physical data for groundwater collected from Multilevel Monitoring System (MLMS) wells in the U.S. Geological Survey (USGS) aquifer-monitoring network, Idaho National Laboratory (INL), Idaho.

Usage

samples

Format

A data frame with the following variables:

site_nm Local site name for a MLMS well.

port_nu Identifier for the valved measurement port.

site_no USGS site identification number for a MLMS measurement port.

stime_dt Start time for the pressure profiling event.

sample_dt Date and time the water-quality sample was collected, in "America/Denver" time zone. Missing values of time were substituted with "12:00".

parm_short_nm Parameter short name assigned by the USGS, such as "pH"; followed by 'wu' water, unfiltered or 'wf' water, filtered.

unit_cd Units of measurement.

pcode USGS 5-digit parameter code. For example, the parameter code for Tritium is "07000".

remark_cd Remark code (result level) used to qualify the parameter value. The codes and their meanings are as follows: NA (missing value) is a quantified value; "<" is where the actual value is known to be less than the value reported, that is, the measured concentration is below the reporting limit (RL) and represented as a censored (or nondetection) value. For censored values, the value reported is the RL; and "E" is an estimated value, that is, the actual value is greater than the minimum detection limit (MDL) and less than the laboratory reporting level (LRL).

result_va Parameter value.

lab_li_va Lower confidence interval of the result value based on laboratory analysis.

lab_ui_va Upper confidence interval of the result value based on laboratory analysis.

dqi_cd Data quality indicator code that indicates the review status of a result. The codes and their meanings are as follows: "R" reviewed and accepted, and "S" provisional (presumed satisfactory).

sample_type_cd Sample type code that identifies the quality-assurance (QA) type of a sample. The codes and their meanings are as follows: "2" is a blank sample; "7" is a replicate sample taken from the environment; and "9" is a regular sample taken from the environment.

Source

Sample data retrieved from the **inldata** package using the [get_samples](#) function.

Examples

```
str(samples)
```

sensors

Sensors

Description

Dataset of sensors used to make measurements at port couplings in the Multilevel Monitoring System (MLMS) wells of the U.S. Geological Survey (USGS) aquifer-monitoring network, Idaho National Laboratory (INL), Idaho. Sensor calibration measurements are stored in the [calibrations](#) dataset.

Usage

```
sensors
```

Format

A data frame with the following variables:

sensor_id Identifier for the integrated sensor.

sensor_nu Serial number for the sensor.

sensor_brand_nm Brand name.

sensor_model_cd Model code.

press_unit_cd Pressure unit code.

temp_unit_cd Temperature unit code.

sensor_tp Integrated sensor types.

temp_lower_va Lower temperature range, in degree Celsius.

temp_upper_va Upper temperature range, in degree Celsius.
 press_lower_va Lower fluid pressure range, in pounds per square inch (psi).
 press_upper_va Upper fluid pressure range, in psi.
 press_res_va Pressure resolution, in psi.
 press_acc_va Pressure accuracy, in psi.
 press_repeat_acc_va Repeated pressure accuracy, in psi.
 press_hyster_acc_va Hysteresis error of the pressure sensor, in psi.
 response_time_tx Response time description.

Source

The dataset originates from the USGS INL Project Office and underwent processing using the [read_sensors_json](#) function.

Examples

```
str(sensors)
```

visits

Field Visits

Description

This dataset provides detailed information about the context and specifics of field visits. It documents field visits to Multilevel Monitoring System (MLMS) wells in the U.S. Geological Survey (USGS) aquifer-monitoring network, Idaho National Laboratory (INL), Idaho. These visits involve measuring fluid pressure at various depths within an MLMS well, typically completed within a few hours.

Usage

```
visits
```

Format

A data frame with the following variables:

site_nm Local site name for a MLMS well.
 stime_dt Start time for the field visit.
 etime_dt End time for the field visit.
 baro_id Identifier for the barometer used to measure atmospheric pressure.
 baro_start_va Atmospheric pressure measured at the beginning of the field visit, in pounds per square inch (psi).
 baro_end_va Atmospheric pressure measured at the visits end, in psi.

sensor_id Identifier for the pressure sensor.
 press_start_va Absolute pressure of fluid measured at the beginning of the field visit, in psi.
 press_end_va Absolute pressure of fluid measured at the visits end, in psi.
 temp_start_va Temperature of fluid measured at the beginning of the field visit, in degree Celsius.
 temp_end_va Temperature of fluid measured at the visits end, in degree Celsius.
 operators Initials of field operators.
 sheet_version_tx Version of field sheet.
 weather Weather conditions during the field visit.
 comment_tx Comments.

Source

The dataset originates from the USGS INL Project Office and underwent processing using the [read_field_json](#) function.

Examples

```
str(visits)
```

wells

MLMS Wells

Description

A spatial dataset describing the location of wells equipped with a Multilevel Monitoring System (MLMS) in the U.S. Geological Survey (USGS) aquifer-monitoring network, Idaho National Laboratory (INL), Idaho.

Usage

```
wells
```

Format

A spatial feature data frame with the following variables:

site_nm Local site name for a MLMS well.
 coord_acy_va Accuracy of latitude/longitude value, in seconds.
 alt_va Altitude of the land surface reference point (also known as the brass cap), in feet above the North American Vertical Datum of 1988 (NAVD 88).
 alt_acy_va Accuracy of the altitude value, in feet.
 etape_cf_va E-tape correction factor determined through calibration, in feet.
 deviation_cf_va Borehole deviation correction factor, in feet.

stickup_va Stick-up distance, the height of the well casing that extends above the land surface measurement point, in feet.

mp_b_va Distance between the top and bottom of an inflated packer seal, in feet.

mp_c_va Distance between the transducer plane and the measurement port inlet valve, in feet.

hole_depth_va Total depth to which the hole is drilled, measured as the distance below the land surface reference point, in feet below land surface (ft bls).

well_depth_va Depth of the finished well, in ft bls.

construction_dt Date the well was completed.

install_dt Date the MLMS was installed.

system_tp Multiport monitoring system type. Two versions of the Westbay System were utilized in this study: the "MP55" and the "MP38".

nzones Number of depth-discrete monitoring zones.

nports Number of measurement ports.

nvisits Count of field visits for pressure profiling.

geometry Zero-dimensional geometry containing a single point.

Source

The dataset originates from the USGS INL Project Office and underwent processing using the [read_mlms_json](#) function.

Examples

```
str(wells)
```

xlsx2json

Convert Field Data from XLSX to JSON

Description

Convert the file format of field data from XLSX to JSON.

Usage

```
xlsx2json(path, destdir)
```

Arguments

path 'character' string. Either the path to the Excel workbook file (XLSX) to read, or the directory containing XLSX files.

destdir 'character' string. Destination directory to write JSON file(s). Defaults to the path directory.

Value

File path(s) of the JSON formatted data.

Author(s)

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See Also

[read_field_xlsx](#) function for reading field data from a XLSX file.

[write_field_json](#) function for writing field data to a JSON file.

Examples

```
path <- system.file("extdata/ex-field.xlsx", package = "mlms") |>
  xlsx2json(destdir = tempdir())

unlink(path)
```

zones

Monitoring Zones

Description

A dataset describing the locations of depth-discrete monitoring zones within the multilevel completions of wells in the U.S. Geological Survey (USGS) aquifer-monitoring network, Idaho National Laboratory (INL), Idaho. These zones enable precise measurements at various depths, where groundwater is vertically isolated between upper and lower packers within each well.

Usage

zones

Format

A data frame with the following variables:

`site_nm` Local site name for a MLMS well.

`zone_nu` Identifier for the depth-discrete monitoring zone, where groundwater in this zone is vertically isolated between upper and lower packers.

`zone_top_va` Depth to the bottom of the uppermost adjacent packer, in feet below land surface (ft bls).

`zone_bot_va` Depth to the top of the lowermost adjacent packer, in ft bls.

`zone_top_alt_va` Altitude of the bottom of the uppermost adjacent packer, in feet above the North American Vertical Datum of 1988 (NAVD 88).

zone_bot_alt_va Altitude of the top of the lowermost adjacent packer, in feet above the NAVD 88.

zone_len_va Distance between packer seals or zone, length in feet.

nports Number of measurement ports within monitoring zone.

Source

The dataset originates from the USGS INL Project Office and underwent processing using the [read_mlms_json](#) function.

Examples

```
str(zones)
```

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