



Prospective Seal Unit Spatial Extent Database for U.S. Sedimentary Basins ReadMe

Dataset Name: Prospective Seal Unit Spatial Extent Database for U.S. Sedimentary Basins **License:** Creative Commons Attribution Open

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Description:

The Prospective Seal Unit Spatial Extent Database for U.S. Sedimentary Basins contains a series of spatial datasets representing spatial extents of publicly available data for caprock and seal rock units within the Appalachian Basin, Denver-Julesburg Basin, Great Valley Basin (Sacramento and San Joaquin Basins), Illinois Basin, Michigan Basin, San Juan Basin, U.S. Gulf Coast Basin, and Williston Basin. The database is designed to support carbon storage feasibility and resources assessment for carbon transport and storage (CTS) projects (e.g. Class VI wells) while displaying the spatial extent of prospective seal units and provide a guide to the original data source. This database leverages publicly available data resources from authoritative sources (e.g. U.S. Geological Survey, State Geologic Surveys, and published reports), and aims to help guide users to understand the seal unit's spatial coverage and data gaps from the regional to sub-basin/field scale. The database is organized by seal unit/formation, including the spatial extent for data found to be available for the seal unit. The various datasets represented include spatial extents of the lithologic formation, depth to top structural contour maps, and thickness/isopach maps.

Disclaimer:

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Future Updates: There are no future updates planned for this dataset at this time.

Geographic coordinate system: WGS 1984 **Projected coordinate system:** WGS 1984 Web Mercator (auxiliary sphere).

Points of contact:

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Resources list for data release:

- 1. Geodatabase/Dataset: "prospective-seal-unit-extents.gdb"
- 2. ReadMe: "ReadMe Prospective Seal Unit Spatial Extent Dataset.pdf"
- 3. Data Catalog: "prospective-seal-unit-spatial-extents-data-catalog.xlsx"

Keywords:





United States, Onshore, Offshore, Sedimentary Basin, Basin, Prospective Seal, Prospective Caprock, Seal, Storage Complex, CO2 Storage, Carbon Dioxide Storage, Geologic Carbon Storage, GCS, Carbon Storage, Carbon Management, CO2 Sequestration, Sequestration, Confining System, Lithology, CO2-Caprock Interactions, Data Catalog, EDX4CTS; EDX4CCS, Saline Storage

Processing Steps and workflow:

Spatial extent data aggregated within the geodatabase has been extracted from publicly available literature and authoritative data resources. Much of the aggregated literature is associated with geologic carbon storage assessments, characterization projects, and project reports (e.g. regional carbon sequestration partnerships, initiatives, and CarbonSAFE projects). To maintain consistency, the data are contained within an ESRI ArcGIS Pro geodatabase as feature classes in a feature dataset with standardized attribute table headers as described in Table 1.

1. Existing Shapefiles:

Some spatial datasets were available in digital formats such as ESRI ArcGIS Pro Shapefiles. Collected Shapefiles representing prospective seal unit extents were converted to feature classes and utilized to visually represent the spatial extents of the associated formations. Data sources are referenced within the associated spatial extent, feature class metadata, and within the Data Catalog.

2. Georeferencing Figures:

When spatial data was not already available in digital formats, figures from published literature displaying spatial extent(s) associated with sealing rock units were extracted from source publications. Extracted images were imported into ArcGIS Pro and georeferenced using spatial contextual reference information and anchor points. After the images were anchored to the basemap, outline polygon feature classes were created to represent the spatial extents of the associated formations. Users are encouraged to review the original referenced literature publications for more information regarding georeferenced extents. Data sources are referenced within the associated spatial extent, feature class metadata, and within the Data Catalog.

3. Georeferencing Cross-Sections:

To utilize cross-section data, figures sourced from published literature with aerial view of crosssection traces paired with individual cross-section images were extracted from source publications. Extracted images of the aerial view of cross-section traces were imported into ArcGIS Pro and georeferenced using spatial contextual reference information and anchor points. After these images were anchored to the basemap, cross-sections were imported into ArcGIS Pro and georeferenced to superimpose the cross-sections upon the trace lines correlated to represented subsurface data. Extents of formations within the cross-sections were marked as points, mirrored along the cross-section trace, and the intersections of lines drawn between the mirrored points and cross-section lines were used to constrain generalized polygons within the study areas. Users are encouraged to review the original referenced literature publications for more information regarding georeferenced extents due to the generalized nature of the resource. Data sources are referenced within the associated spatial extent, feature class metadata, and within the Data Catalog.

4. Summarized Extent (Minimum Bound Geometry):

To consistently summarize the extent of spatial data points, X/Y or Latitude and Longitude location coordinates were extracted from published literature resources and visualized. Once individual points were plotted spatially in ArcGIS Pro and any appropriate coordinate system conversions were applied, the geoprocessing tool "Minimum Bounding Geometry" could be utilized with the geometry type setting "convex hull" to generate "the smallest convex polygon enclosing an input feature" (as described within ArcGIS Pro documentation) for all grouped spatial data points. Users are encouraged to review the original referenced literature publications for more information regarding summarized extents due to the generalized nature of the resource. Data sources are referenced within the associated spatial extent, feature class metadata, and within the Data Catalog.





5. Merge Process:

After each individual spatial extent layer containing formation extents derived from different published literature sources were created, they were then merged with other layers of the same geologic formation to give an aggregate representation of spatial knowledge while maintaining reference to their original source publications. To facilitate data consistency, a feature class attribute field schema was implemented and can be reviewed in Table 1 and within the "Header Glossary" of the "Prospective Seal Unit Spatial Extent Data Catalog".



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Feature Class Header	Definition	Field Data Type	Field Length
Formation	Name of formation represented spatially in dataset.	Text	255
Basin	Name of sedimentary basin wherein the named formation is primarily located.	Text	100
Sub_Basin	Name of sub-region within a larger sedimentary basin wherein the named formation is primarily located.	Text	100
SubsurfaceData	Based off the source material utilized to define spatial extent, if material is subsurface focused, field is populated with "Yes".	Text	3
Data_Type	Type of map or extent used to draw original representation of formation based off the source material utilized to define spatial extent.	Text	255
Spatial_Quality	Quality of data represented in dataset based on method of extraction from original source.	Text	255
Sources_Table	Data table containing source information including full-length citations and hyperlinks.	Text	100
GeoAge	Geologic age of named formation represented spatially in dataset.	Text	100
GeoAge_REF	Citation of source material utilized to define geologic age of named formation represented spatially in dataset.	Text	6
SpatialDataSource	Citation of source material utilized to define extent of named formation represented spatially in dataset.	Text	6
SpatialDataSource_ Date	Date (YEAR) associated with source material utilized to define extent of named formation represented spatially in dataset.	Date	8
Last_Updated	Updated Date (YEAR) associated with last update of spatial dataset.		8
Hyperlink Hyperlink to digital resource location as of last update of spatial dataset.		Text	255

Table 1. Feature Class Field Header Attributes

Geodatabase Structure:

The database is organized by formation name, with details regarding each referenced spatial extent source retained in the feature class attribute table and data catalog. The original source link and citation have been preserved to enable user accessibility of prospective sealing rock layer information as described within the cited resource. Users are encouraged to review the original referenced publications for more information regarding prospective seal formation extents. Data sources are referenced within the associated spatial extent, feature class metadata, and within the Data Catalog.

Source Data Characteristics and Types:

Datasets within the geodatabase are primarily focused on representing the spatial extent of prospective seal formations. Boundary definition of subsurface datasets varies based on published literature source and may include regions assessed in previous carbon management studies such as extent of prospective confinement zone (prospective seal unit confining fluid within a prospective reservoir formation), overall extent of the geologic formation containing the prospective seal unit, prospective seal formation depth-to-

top structural map, and prospective seal formation isopach maps, and more. Users are encouraged to review the original referenced literature publications for more information. Data sources are referenced within the associated spatial extent, feature class metadata, and within the data catalog.

Both subsurface and surface extent are included where available and are labelled within the attribute tables of the included feature classes. Surficial spatial extent of prospective seal formations is provided for regional context in data-scarce regions and for their utility in supporting modeling efforts through potential identification of outcrop-scale heterogeneity.

Data Source Reference Formatting:

To support reference of source publications, a reference code is utilized within the attribute table of feature classes. This code is based on the Geologic Map Schema (GeMS) nonspatial table "DataSources" which provides a concise feature-level reference format that is highly compatible with field length limitations associated with ESRI ArcGIS Pro Feature Classes (Table 2). The full list of citations within this dataset are included in the table "Data_Sources.csv" within the ESRI ArcGIS Pro Geodatabase.

The components of the code utilized within this dataset include the following:

- Data Attribute Source = "DAS"
- Data Source Number = Represented as a positive integer.

Table 2. Example source reference following the Geologic Map Schema (GeMs)

DataSource_ID	Source	Citation	Year	Hyperlink
DAS1	Geology of the Northern Sacramento Valley	McManus, D.; Staton, K.; Spangler, D.; Pearson, G.; Ehorn, B.; Mulder, J.; Hightower, N.; Dickens, Z.; Andreasen, C.; Moody, J.; Murray, C.; Calo, D. Geology of the Northern Sacramento Valley, California. Cornelius, P.; Keeley, F.; Olivares, C.; Rains, C.; Sol, S.; Talley, M.; Woled, J. Eds. Report for the California Department of Water Resources Northern Region Office Groundwater and Geologic Investigations Section 2014, 5, 1-213.	2014	https://h8b186.p3cdn2 .secureserver.net/wp- content/uploads/2017/ 05/Geology-of-the- Northern-Sacramento- Valley.pdf

Note: Although some elements of this geodatabase are based on Geologic Map Schema (GeMS) elements, this dataset should not be considered a fully GeMS-compliant database. For more information see:

U.S. Geological Survey National Cooperative Geologic Mapping Program, 2020, GeMS (Geologic Map Schema)—A standard format for the digital publication of geologic maps: U.S. Geological Survey Techniques and Methods, book 11, chap. B10, 74 p., https://doi.org/10.3133/tm11B10.









Data Catalog:

All spatial data contained within the Prospective Seal Unit Spatial Dataset has been listed within the data catalog included with the geodatabase. Additional details are provided in Table 3.

Sheet Name	Column Name	Description
Data Catalog	Unique ID	Unique identification number for reference and tracking purposes.
	Prospective Seal Name	Human readable name of prospective sealing formation represented by spatial dataset.
	Prospective Seal File Name	Name of spatial data file within geodatabase.
	Associated Potential Reservoir(s)	Name of prospective storage formation associated with prospective sealing formation(s).
	Basin(s) Covered	Sedimentary basin associated with the visualized extent of prospective sealing formation(s).
	Sub Basin Coverage	Sedimentary sub-basin associated with the visualized extent of prospective sealing formation(s).
	Data Category	Type of visualization method used to spatially represent the visualized extent of prospective sealing formation(s).
	Data Type	Type of data source spatially represented within the visualized extent of prospective sealing formation such as spatial extent, structural top, depth to base, or thickness (isopach or isochron).
	Maximum Scale Range	Maximum recommended "zoomed in" viewable extent.
	Minimum Scale Range	Minimum recommended "zoomed out" viewable extent.
	Tags/Keywords	Tags or keywords associated with dataset.
	Summary	Summary or purpose of dataset.
	Description	Description of source data and/or description of processing steps involved in visualizing spatial extent of prospective sealing formation(s).
	Source Citation	Source data citations for spatial data involved in visualizing spatial extent of prospective sealing formation(s).
	GCS/PCS	Geographic Coordinate System or Projected Coordinate System associated with the visualized spatial extent of prospective sealing formation(s).
	Last Updated	Date of last update to spatial data file within geodatabase.
	Notes	Any processor notes regarding the data represented in the catalog.
Header Glossary	Field Name	Name of header used in attribute tables
	Alias	Alias name of header used in attribute tables
	Field Data Type	Ex. Short, Long, Double, Text, etc.
	Field Length	Character limit of field
	Special Characters	Any special characters used in text field data types
	Null Value	Any syntax used to denote lack of data in text field data types
	Units Detail (optional)	Additional details regarding units of measure and data collection information associated with attributes under header.
	Description	Description of information included in attribute table under the associated header.

Table 3. Data catalog contents and header descriptions.

Feature Class Metadata:





Metadata information is provided for all feature class layers in the database using the metadata format described in ArcGIS Pro (Version 3.4.2) as: "ISO 19115-3 XML Schema Implementation"