Marine Geoscience Data System

Investigators, affiliations

Anna Titova, Bureau of Economic Geology, The University of Texas at Austin, Austin, U.S.A.
Andrey Bakulin, Bureau of Economic Geology, The University of Texas at Austin, Austin, U.S.A.

Data Types

Inverted shear-wave velocity of shallow-water marine sediments

Data Details

This data set was generated as part of the Texas Consortium for Computational Seismology Gulf Coast Offshore Monitoring Study that uses 65 km of shallow-water telecommunications distributed acoustic sensing (DAS). This data set presents a seismic shear-wave velocity model that extends horizontally from the shore to 51 km offshore across the Texas shelf and vertically from the near-seafloor to approximately 2.7 km depth, with broad shallow low-velocity intervals interpreted as softer incised-valley fill within stiffer Pleistocene deposits. The velocity model is in GMT-compatible netCDF grid format. The study area polygon is included as "study_area_polygon" and represents a generalized study-area outline sufficient to place the model geographically. The distance coordinate is profile distance in m (grid interval 127.6 m), the depth coordinate is depth in m below seafloor (variable grid interval), and the values of the shear-wave velocities are in m/s. The passive seismic data used for Scholte-wave imaging and shear-wave velocity inversion were acquired using a seabed telecommunication fiber-optic cable that begins onshore near the modern Brazos River delta and extends seaward into the deeper Gulf basin. The dataset analyzed for this model spans one day, October 1, 2025. DAS acquisition used a gauge length of 23.93 m and a channel spacing of 12.76 m, providing 5,091 channels along approximately 65 km of cable.

Device Type, Make, Model

Stationary submarine telecommunications fiber-optic cable interrogated using Distributed Acoustic Sensing (DAS)

License type

Cruise ID or Field Program Name

Texas Consortium for Computational Seismology Gulf Coast Offshore Monitoring Study

Related References

Scholte-wave imaging workflow: Submitted for peer review to The Seismic Record (Seismological Society of America) on July 14, 2026, manuscript number: TSR-D-26-00031. A preprint version is available at https://arxiv.org/abs/2607.16157
Bathymetry source: https://www.nauticalcharts.noaa.gov/data/bluetopo.html

In [1]:
```
import xarray as xr
import numpy as np
import matplotlib as mpl
import matplotlib.pyplot as plt
from matplotlib.colors import SymLogNorm
from matplotlib.ticker import MultipleLocator
from mpl_toolkits.axes_grid1 import make_axes_locatable
```

In [2]:
```
dst = xr.open_dataset("GulfDAS_VShearModel_ver01.grd")
print(dst)
```

```
<xarray.Dataset> Size: 177kB
Dimensions:            (lat: 2, lon: 2, depth: 106, distance: 400)
Coordinates:
  * lat                (lat) float64 16B 28.0 29.0
  * lon                (lon) float64 16B -96.0 -94.6
  * depth              (depth) float64 848B 0.1 0.2 0.3 ... 2.501e+03 2.716e+03
  * distance           (distance) float64 3kB 6.635e+03 6.763e+03 ... 5.755e+04
Data variables:
    study_area_polygon (lat, lon) float32 16B ...
    vshear             (depth, distance) float32 170kB ...
    bathym             (distance) float32 2kB ...
    chanls             (distance) float32 2kB ...
Attributes: (12/15)
    title:                    GulfDAS BEG UT Data Product
    institution:              Bureau of Economic Geology, Jackson School of...
    product_author_names:     Anna Titova and Andrey Bakulin
    file_creator_name:        Anna Titova
    file_creator_email:       anna.titova at beg.utexas.edu
    horizontal_datum:         WGS84
    ...                       ...
    summary:                  Shear-wave velocity
    history:                  On 2026-08-24, data was prepared for review p...
    comment:                  Passive DAS records were processed and invert...
    references:               ['Scholte-wave imaging workflow: https://arxi...
    keywords:                 Texas, Distributed Acoustic Sensing, seabed p...
    license:                  CC BY 4.0
```

In [3]:
```
for attr in dst.attrs:
    print(f"\nAttribute: {attr}");print(dst.attrs[attr])
for var in dst.data_vars:
    print(f"\nVariable: {var}")
    print(dst[var].attrs);print(dst[var].coords);print(dst[var].data[:10])
for coord in dst.coords:
    print(f"\nCoordinate: {coord}");print(dst[coord].attrs);print(dst[coord].data[:
```

```
Attribute: title
GulfDAS BEG UT Data Product

Attribute: institution
Bureau of Economic Geology, Jackson School of Geosciences, University of Texas at Au
stin

Attribute: product_author_names
Anna Titova and Andrey Bakulin

Attribute: file_creator_name
Anna Titova

Attribute: file_creator_email
anna.titova at beg.utexas.edu

Attribute: horizontal_datum
WGS84

Attribute: vertical_datum_bathym
NAVD88

Attribute: vertical_reference_vshear
depth below seafloor

Attribute: model_version
1.1.0

Attribute: summary
Shear-wave velocity

Attribute: history
On 2026-08-24, data was prepared for review prior to release to MGDS

Attribute: comment
Passive DAS records were processed and inverted between 2026-04-01 - 2026-07-08; Pas
sive DAS data were acquired on 2025-09-30 - 2025-10-02

Attribute: references
['Scholte-wave imaging workflow: https://arxiv.org/html/2607.16157v1', 'Bathymetry s
ource: https://www.nauticalcharts.noaa.gov/data/bluetopo.html ']

Attribute: keywords
Texas, Distributed Acoustic Sensing, seabed properties, shear-wave velocity model, c
oastal, shallow water, marine, sediments

Attribute: license
CC BY 4.0

Variable: study_area_polygon
{'standard_name': 'generalized_study_area_polygon', 'long_name': 'a generalized stud
y-area bounding box; this box contains the fiber-optic cable but does not correspond
to the actual cable footprint'}
Coordinates:
  * lat      (lat) float64 16B 28.0 29.0
  * lon      (lon) float64 16B -96.0 -94.6
```

```
[[1. 1.]
 [1. 1.]]

Variable: vshear
{'standard_name': 'shear_wave_velocity', 'long_name': 'shear wave velocity', 'unit
s': 'meters per second', 'content_type': 'inversionResult', 'type': 'data'}
Coordinates:
  * depth     (depth) float64 848B 0.1 0.2 0.3 ... 2.303e+03 2.501e+03 2.716e+03
  * distance  (distance) float64 3kB 6.635e+03 6.763e+03 ... 5.742e+04 5.755e+04
[[41.8 42.2 42.9 ... 63.1 62.2 61.2]
 [46.7 47.5 48.1 ... 68.  67.1 66.3]
 [50.5 51.6 52.5 ... 71.8 70.9 70. ]
 ...
 [66.7 67.7 69.  ... 84.5 84.1 82.5]
 [69.9 70.5 71.7 ... 86.9 86.1 84.6]
 [72.6 74.  75.  ... 88.7 87.9 86.8]]

Variable: bathym
{'standard_name': 'sea_floor_height_above_mean_sea_level', 'long_name': 'elevation v
alues are increasingly negative with increasing water depth', 'units': 'meters', 'po
sitive': 'up', 'content_type': 'extracted from BlueTopo and interpolated onto the re
leased profile', 'type': 'data'}
Coordinates:
  * distance  (distance) float64 3kB 6.635e+03 6.763e+03 ... 5.742e+04 5.755e+04
[-12.98 -12.93 -12.91 -12.95 -12.99 -12.95 -12.96 -12.96 -12.92 -12.95]

Variable: chanls
{'standard_name': 'DAS_channel', 'long_name': 'central DAS channel identifying the l
ocation of the ensemble of DAS traces used for retrieving Scholte-wave dispersion',
'units': 'index_start_1', 'content_type': 'DAS acquisition settings', 'type': 'dat
a'}
Coordinates:
  * distance  (distance) float64 3kB 6.635e+03 6.763e+03 ... 5.742e+04 5.755e+04
[520. 530. 540. 550. 560. 570. 580. 590. 600. 610.]

Coordinate: depth
{'standard_name': 'depth_in_meters_below_seafloor', 'long_name': 'depth at the base
of each layer in meters below seafloor', 'units': 'meters', 'coverage_content_type':
'coordinate', 'axis': 'Z'}
[0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1. ]

Coordinate: distance
{'standard_name': 'distance_in_meters', 'long_name': 'distance in meters as measured
along the fiber-optic cable from the DAS interrogator connection point; this distanc
e is not the geographic distance from shore or the projected offshore distance', 'un
its': 'meters', 'coverage_content_type': 'coordinate', 'axis': 'C'}
[6635.2 6762.8 6890.4 7018.  7145.6 7273.2 7400.8 7528.4 7656.  7783.6]

Coordinate: lat
{'standard_name': 'latitude', 'long_name': 'study area latitude in degrees north',
'units': 'degrees_north'}
[28. 29.]

Coordinate: lon
{'standard_name': 'longitude', 'long_name': 'study area longitude in degrees east',
```

```
'units': 'degrees_east'}
[-96.  -94.6]
```

In [4]:
```
plt.rcParams.update({
    'font.size': 24,          # base font size
    'axes.titlesize': 24,     # axes title
    'axes.labelsize': 24,     # x and y labels
    'xtick.labelsize': 24,    # x tick labels
    'ytick.labelsize': 24,    # y tick labels
    'legend.fontsize': 24,    # legend
    'figure.titlesize': 24    # figure title
})

DX = 12.76
Water_Column = -dst['bathym'].data
VS = dst['vshear'].data
dist = dst['distance'].data
depth = dst['depth'].data

Z = np.repeat(depth.reshape(-1, 1), len(dist), axis=1)
C = np.transpose(np.repeat(dist.reshape(-1, 1), len(depth), axis=1))
```

In [5]:
```
fig=plt.figure(figsize=(32,32))
mosaic=[["WaterColumn"],["Section1"],["Section2"],["Section4"]]

axd = fig.subplot_mosaic(mosaic,gridspec_kw={"wspace":0.2,"hspace":0.4,"height_rati

key = "WaterColumn"
axd[key].plot(C[0,:]/1000,Water_Column,'royalblue',linewidth=10.0,label='Bathymetry
ax = axd[key]

ax.xaxis.tick_top()
ax.xaxis.set_label_position('top')
ax.legend()
ax.set_xlabel("Distance (km)");ax.set_xlim([C[0,0]/1000,C[0,-1]/1000]);ax.set_ylim(
ax.minorticks_on()
ax.grid(which="major", linewidth=0.5, alpha=1.0)
ax.grid(which="minor", linestyle=":", linewidth=0.25, alpha=0.5)
ax.set_ylabel("Water\nDepth (m)")

ax.xaxis.set_major_locator(MultipleLocator(2.0))
ax.xaxis.set_minor_locator(MultipleLocator(0.4))
ax.tick_params(axis='y', which='both', right=True, labelright=True)

divider = make_axes_locatable(ax)
cax = divider.append_axes("right", size="2%", pad=0.15, sharey=ax)
cax.set_axis_off()
ax.text(0.02, 1.35,'NW',transform=ax.transAxes,ha='right',va='top',fontsize=28)
ax.text(0.98, 1.35,'SE',transform=ax.transAxes,ha='left',va='top',fontsize=28)
ax.text(-0.035, 1.35,'a)',transform=ax.transAxes,ha='right',va='top',fontsize=28,we

#cax.set_ylabel("Water\nDepth [m]", fontsize=22)
cax.text(
    1.5, 0.5,              # increase from 1.0 to move right
    "Water\nDepth (m)",
    rotation=270,
```

```
    va="center",
    ha="center",
    transform=cax.transAxes,
    fontsize=22,
)


for key in ["Section1","Section2","Section4"]:
    ax = axd[key]
    ax.set_xlabel("DAS Channels")
    def chan_to_km(x):
        return (x)*(12.76/1000)
    def km_to_chan(x):
        return x/(12.76*1000)

    secax=ax.secondary_xaxis('top',functions=(chan_to_km,km_to_chan))
    secax.set_xlabel("Distance (km)")
    secax.xaxis.set_major_locator(MultipleLocator(2.0))
    secax.xaxis.set_minor_locator(MultipleLocator(0.4))

    if key=="Section1":
        a_min = 2; a_max = 242; a_inc = int((a_max-a_min)/20)+1;y_max=20
    if key=="Section2":
        a_min = 2; a_max = 1142; a_inc = int((a_max-a_min)/50)+1;y_max=800
    if key=="Section4":
        a_min = 2; a_max = 1342; a_inc = int((a_max-a_min)/80)+1;y_max=2050

    im=axd[key].contourf(C/DX,Z,VS,levels=np.linspace(a_min,a_max,a_inc),vmin=a_min
    contours = axd[key].contour(C/DX, Z, VS,levels=np.linspace(a_min,a_max,a_inc),l
    axd[key].clabel(contours, inline=True, fontsize=16,colors='k')
    axd[key].set_ylim([y_max,0]);axd[key].set_ylabel("Depth (mbsf)");axd[key].set_x
    axd[key].tick_params(top=True, right=True)
    axd[key].minorticks_on()
    axd[key].grid(which="major", linewidth=0.25, alpha=0.5)
    axd[key].grid(which="minor", linestyle=":", linewidth=0.25, alpha=0.5)
    axd[key].xaxis.set_major_locator(MultipleLocator(400))
    axd[key].xaxis.set_minor_locator(MultipleLocator(100))
    #cbar = plt.colorbar(im,ax=ax,orientation="vertical",pad=0.03,fraction=0.06)

    divider = make_axes_locatable(ax)
    cax = divider.append_axes("right", size="2%", pad=0.15)
    cbar = fig.colorbar(im, cax=cax)
    if key=="Section1":
        cbar.set_label('Shear-wave\nvelocity (m/s)',  fontsize=22)
    else:
        cbar.set_label('Shear-wave velocity (m/s)',  fontsize=22)

    if key=="Section1":
        ax.text(-0.035, 1.3,'b)',transform=ax.transAxes,ha='right',va='top',fontsiz
        ax.text(0.020, 1.3,'NW',transform=ax.transAxes,ha='right',va='top',fontsize
        ax.text(0.980, 1.3,'SE',transform=ax.transAxes,ha='left',va='top',fontsize=
    if key=="Section2":
        ax.text(-0.035, 1.12,'c)',transform=ax.transAxes,ha='right',va='top',fontsi
        ax.text(0.02, 1.12,'NW',transform=ax.transAxes,ha='right',va='top',fontsize
        ax.text(0.98, 1.12,'SE',transform=ax.transAxes,ha='left',va='top',fontsize=
    if key=="Section4":
```

```
        ax.text(-0.035, 1.12,'d)',transform=ax.transAxes,ha='right',va='top',fontsi
        ax.text(0.02, 1.12,'NW',transform=ax.transAxes,ha='right',va='top',fontsize
        ax.text(0.98, 1.12,'SE',transform=ax.transAxes,ha='left',va='top',fontsize=

#fig.savefig('./inversion_result_part01.png',dpi=100,bbox_inches="tight")
#plt.close(fig)
```