# A Seismic Atlas Based upon AAPG Publications and Associated Search and Discovery Documents*

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## Introduction

Using AAPG digital sources, we have cataloged and reproduced over 5,800 seismic images located in and/or surrounding 200 nations, states, provinces, and regions (Table 1). In each case, latitudes and longitudes have been computed for the ends of track lines, or when that is not possible, a point.

The images and their associated references are displayed in a standardized format in a Google[tm]earth format (Figures 1 and 2). After zeroing in on a specific location, images are "called up" by clicking on tracks or points on the Google[tm]earth display.

The images and associated information found in the Google[tm]earth displays are generated from the AAPG Atlas of Seismic Images, which is an ongoing product of AAPG/Datapages.

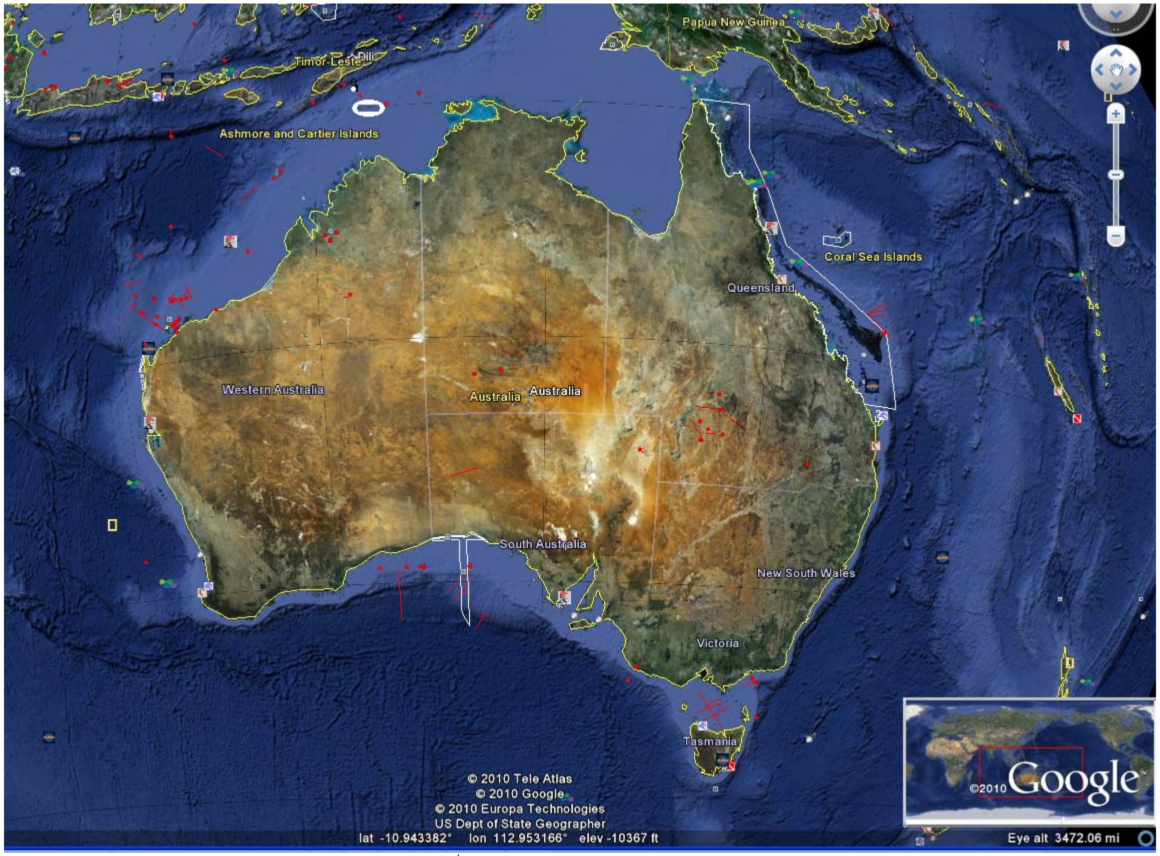



Figure 1. Australian image from Google^tm^earth, showing location of seismic image tracks and points. A white ellipse outlines the example shown in Figure 2.

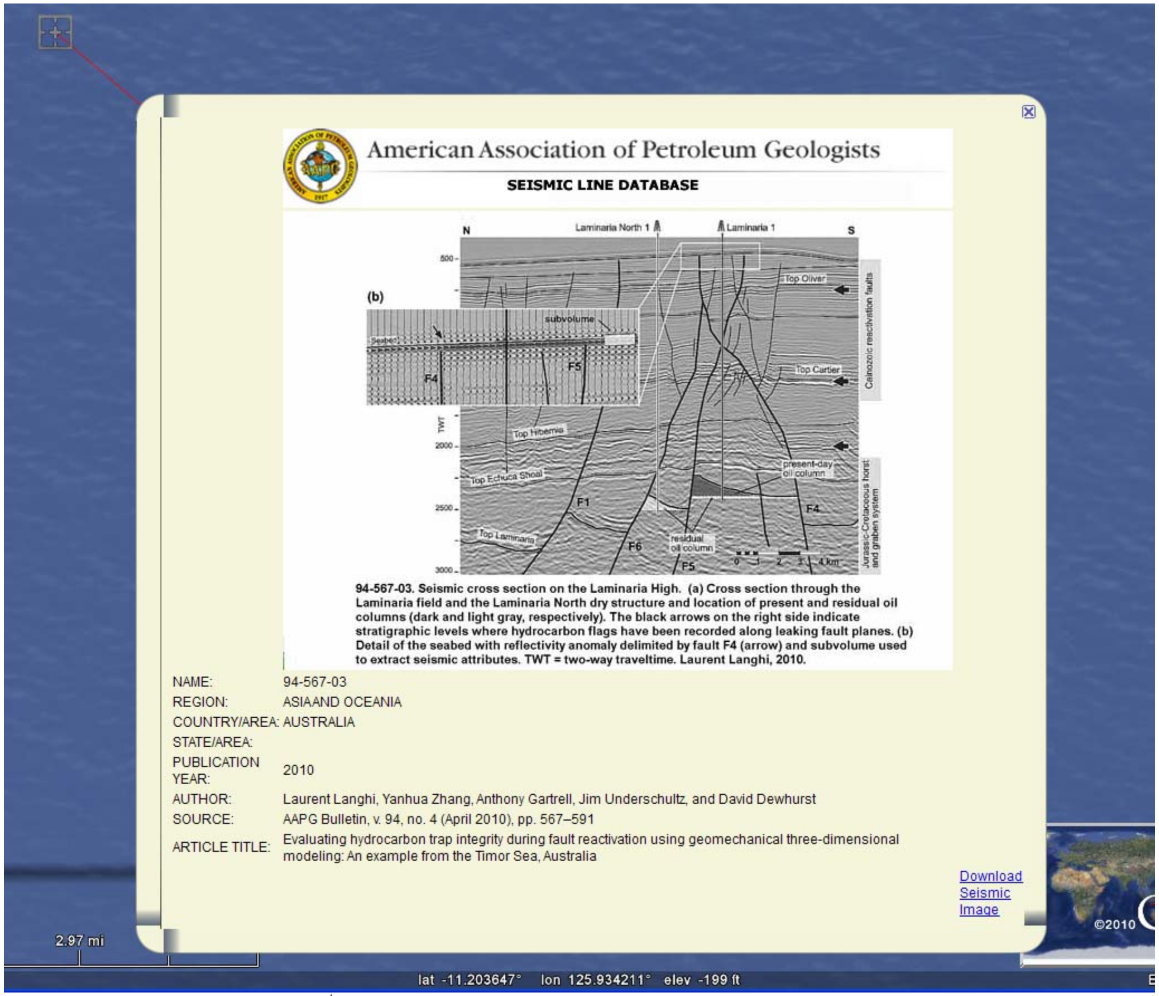


Figure 2. Example of Google™earth display of a seismic image. Location is shown in Figure 1.

## AAPG Atlas of Seismic Images

The AAPG Atlas of Seismic Images consists of:

a) Seismic tracks and points on a Google™earth base;
b) An Excel workbook called "Seismic Catalog" containing the basic *data* used to generate displays;
c) The Atlas' *seismic images* stored in nested files on a host computer, arranged by geographic region;
d) A copy of Atlas' seismic images stored in monthly folders starting with June, 2010, on a remote server (Microsoft Windows Live SkyDrive);
e) A Microsoft Windows MapPoint display system used to assist in location (latitude and longitude) determinations as well as providing an auxiliary mapping system;
f) An Excel workbook called "Seismic Statistics" containing a backup of 1) basic data, 2) an inventory based upon geographic distribution, and an image list arranged according to generation date, starting with June, 2010;
g) Java version using map data from ESRI, seismic layers on a Lynx Server and seismic imagery from an Amazon Cloud Server… based on ESRI GIS Server technology.

*a. Seismic tracks and points on a Google™earth base.* In order to create a Google™earth kmz file of the seismic data, the seismic catalog (Excel workbook, see b. below) was imported into an ERSI Personal Geodatabase, which preserved all the original entries in the spreadsheet. The data table was then imported into ESRI ArcMap. Location data for the various entries were classified as potential point location or line locations. Seismic locations represented as points were then built as point features in the geodatabase. For seismic tracks, longitude-latitude pairs for the start, bends and ends of the tracks were created initially as point features and then converted into polyline features using a point to line extension in ArcMap. All the original attributes of entries in the seismic catalog were appended to the point and polyline features. In addition, two url address columns were added to the attributes into which cloud server locations of seismic thumbnails and seismic images were shown for each entry. The point and line features were then given symbologies and output as KMZ files from ArcMap using the Arc2Earth extension. Final formatting of the KMZ files was done using a text editor.

The seismic images were batch processed in Photoshop™ and a 600x600 pixel thumbnail produced for each image. All images and thumbnails were then uploaded to an Amazon S3 Cloud Server.

In the current Google™earth version, seismic images in the Table of Content are listed according to the line name. In future versions they will be shown according to geographic area.

*b. Seismic Catalog.* The Seismic Catalog is an Excel workbook divided by tabs into worksheets titled A. North America; B. Central and South America; C. Western Europe; D. Eastern Europe and the former USSR; E. Middle East; F. Africa; G. Asia and Oceania; H. Atlantic Deep; and I. Arctic Ocean Basin. A portion of the Seismic Catalog worksheet (G. Asia and Oceania) is shown in Figure 3.

There are 15 columns (columns A to O) of data in Seismic Catalog. The following example uses image description 94-567-03 found in Figure 3.

Column A. NAME. A unique identifier. For example, 94-567-03. In this case code for AAPG Bulletin, volume 94, starting on page 567, Figure 3. Codes will change as a function of source.

Column B. DATE POSTED. For example, BEFORE 4/15/2010. All entries after 4/15/2010 contain the actual post date.

Column C. REGION FOLDER A. Major regional breakdown, using the nine regions listed above. For example, G. ASIA & OCEANIA.

Column D. REGION FOLDER B. Second geographic breakdown, usually a country. For example, AUSTRALIA.

Column E. REGION FOLDER C. Third geographic breakdown, used for USA states and Chinese basins (China is the only country that usually specifies a basin location in their technical articles). This column is left blank when not needed.

Column F. PUBLICATION YEAR. For example, 2010.

Columns G and H. LAT START and LONG START. Track line start in decimal format. For example, -11.1489 and 125.8684. The methods used to spatially locate the seismic images in a lat-long framework are discussed in the section "Methods Used to Spatially Locate the Seismic Images." Columns G and H are left blank when the image can only be located as a point. Columns I and J are left blank when the image can only be located as a point.

Columns I and J. LAT END and LONG END. Track line end in decimal format. For example, -11.2584 and 126.0000. The methods used to spatially locate the seismic images in a lat-long framework are discussed in the section "Methods Used to Spatially Locate the Seismic Images." Columns G and H are left blank when the image can only be located as a point.

Columns K and L. LAT POINT and LONG POINT. Point location of the seismic image in decimal format. The methods used to spatially locate the seismic images in a lat-long framework are discussed below. Columns K and L are left blank when the image can be located as a track.

Column M. AUTHOR(S). The author(s) of the article containing the image. For example, Laurent Langhi, Yanhua Zhang, Anthony Gartrell, Jim Underschultz, and David Dewhurst.

Column N. SOURCE. The reference designation where the image is located within Search and Discovery digital data bank. For example, AAPG Bulletin, v. 94, no. 4 (April 2010), pp. 567–591.

Column O. ARTICLE TITLE. For example, Evaluating hydrocarbon trap integrity during fault reactivation using geomechanical three-dimensional modeling: An example from the Timor Sea, Australia.

*c. The Atlas' seismic images stored in nested files on a host computer, arranged by geographic region.* The nested file uses the same geographic breakdown as that in Seismic Catalog. For example, the digital location of the image associated with above example (i.e., 94-567-03) is shown in Figures 4, 5, and 6.

The seismic images found in the Atlas have been retrieved from published articles originally located in AAPG Bulletins, Memoirs, and Search and Discovery articles. We believe that >95% of the seismic images residing in these publications have been found and displayed in the Atlas.

| | A | C | D | E | F | G | H | I | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | **NAME** | **REGION FOLDER A** | **REGION FOLDER B** | **REGION FOLDER C** | **PUBLICATION YEAR** | **LAT START** | **LONG START** | **LAT END** | **LON END** |
| 140 | **90-1921-07** | G. ASIA & OCEANIA | AUSTRALIA | | 2006 | -10.5114 | 125.9199 | -10.6667 | 12 |
| 141 | **90-1921-09A** | G. ASIA & OCEANIA | AUSTRALIA | | 2006 | -10.5317 | 125.9528 | -10.6441 | 12 |
| 142 | **90-1921-09B** | G. ASIA & OCEANIA | AUSTRALIA | | 2006 | -10.5174 | 126.0674 | -10.6602 | 12 |
| 143 | **90-1921-09C** | G. ASIA & OCEANIA | AUSTRALIA | | 2006 | -10.5058 | 125.9800 | -10.6607 | 12 |
| 144 | **90-1921-09D** | G. ASIA & OCEANIA | AUSTRALIA | | 2006 | -10.6172 | 126.0970 | -10.7583 | 12 |
| 145 | **2006S&D-10095-06** | G. ASIA & OCEANIA | AUSTRALIA | | 2006 | | | | |
| 146 | **2006S&D-10096-03** | G. ASIA & OCEANIA | AUSTRALIA | | 2006 | -28.4851 | 131.5146 | -28.8555 | 13 |
| 147 | **2006S&D-10119-10A** | G. ASIA & OCEANIA | AUSTRALIA | | 2006 | -19.5238 | 113.3691 | -20.8631 | 11 |
| 148 | **2006S&D-10119-10B** | G. ASIA & OCEANIA | AUSTRALIA | | 2006 | | | | |
| 149 | **2008S&D-40371-12** | G. ASIA & OCEANIA | AUSTRALIA | | 2008 | | | | |
| 150 | **2008S&D-40371-18** | G. ASIA & OCEANIA | AUSTRALIA | | 2008 | | | | |
| 151 | **2009S&D-20067-U1** | G. ASIA & OCEANIA | AUSTRALIA | | 2009 | | | | |
| 152 | **94-567-03** | G. ASIA & OCEANIA | AUSTRALIA | | 2010 | -11.1489 | 125.8684 | -11.2584 | 12 |
| 153 | **94-977-04** | G. ASIA & OCEANIA | AUSTRALIA | | 2010 | | | | |
| 154 | **94-977-06** | G. ASIA & OCEANIA | AUSTRALIA | | 2010 | -10.0278 | 126.4750 | -10.1852 | 12 |
| 155 | **94-977-07A** | G. ASIA & OCEANIA | AUSTRALIA | | 2010 | -10.0648 | 126.4364 | -10.0741 | 12 |
| 156 | **94-977-07B** | G. ASIA & OCEANIA | AUSTRALIA | | 2010 | -10.0926 | 126.4171 | -10.0926 | 12 |
| 157 | **94-977-12A** | G. ASIA & OCEANIA | AUSTRALIA | | 2010 | -10.0741 | 126.4557 | -10.1296 | 12 |
| 158 | **94-977-12B** | G. ASIA & OCEANIA | AUSTRALIA | | 2010 | -10.0741 | 126.4942 | -10.1111 | 12 |
| 159 | **94-977-14** | G. ASIA & OCEANIA | AUSTRALIA | | 2010 | -10.0661 | 126.5113 | -10.0973 | 12 |
| 160 | **75-1223-04** | G. ASIA & OCEANIA | BANGLADESH | | 1991 | 23.5500 | 89.4000 | 24.1000 | 8 |
| 161 | **75-1223-14** | G. ASIA & OCEANIA | BANGLADESH | | 1991 | 23.9500 | 89.5500 | 23.2500 | 8 |
| 162 | **75-1223-19** | G. ASIA & OCEANIA | BANGLADESH | | 1991 | | | | |
| 163 | **85-433-03** | G. ASIA & OCEANIA | BRUNEI | | 2001 | | | | |
| 164 | **85-433-05** | G. ASIA & OCEANIA | BRUNEI | | 2001 | | | | |
| 165 | **85-433-06** | G. ASIA & OCEANIA | BRUNEI | | 2001 | | | | |
| 166 | **85-433-09** | G. ASIA & OCEANIA | BRUNEI | | 2001 | | | | |
| 167 | **85-433-10** | G. ASIA & OCEANIA | BRUNEI | | 2001 | | | | |
| 168 | **85-433-11** | G. ASIA & OCEANIA | BRUNEI | | 2001 | | | | |
| 169 | **85-433-12** | G. ASIA & OCEANIA | BRUNEI | | 2001 | | | | |
| 170 | **85-433-13** | G. ASIA & OCEANIA | BRUNEI | | 2001 | | | | |
| 171 | **91-1449-05** | G. ASIA & OCEANIA | CHINA | BAISE | 2007 | | | | |
| 172 | **1980MEM90-471-07A** | G. ASIA & OCEANIA | CHINA | BOHAI | 1980 | | | | |
| 173 | **1980MEM90-471-07B** | G. ASIA & OCEANIA | CHINA | BOHAI | 1980 | | | | |

B. SOUTH AND CENTRAL AMERICA / C. WESTERN EUROPE / D. EASTERN EUROPE & FORMER USSR / E. MIDDLE EAST / F. AFRICA / **G. ASIA & OCEANIA** / H.

Figure 3. A portion of the Seismic Catalog worksheet (G. Asia and Oceania).
The example used below is line 152.

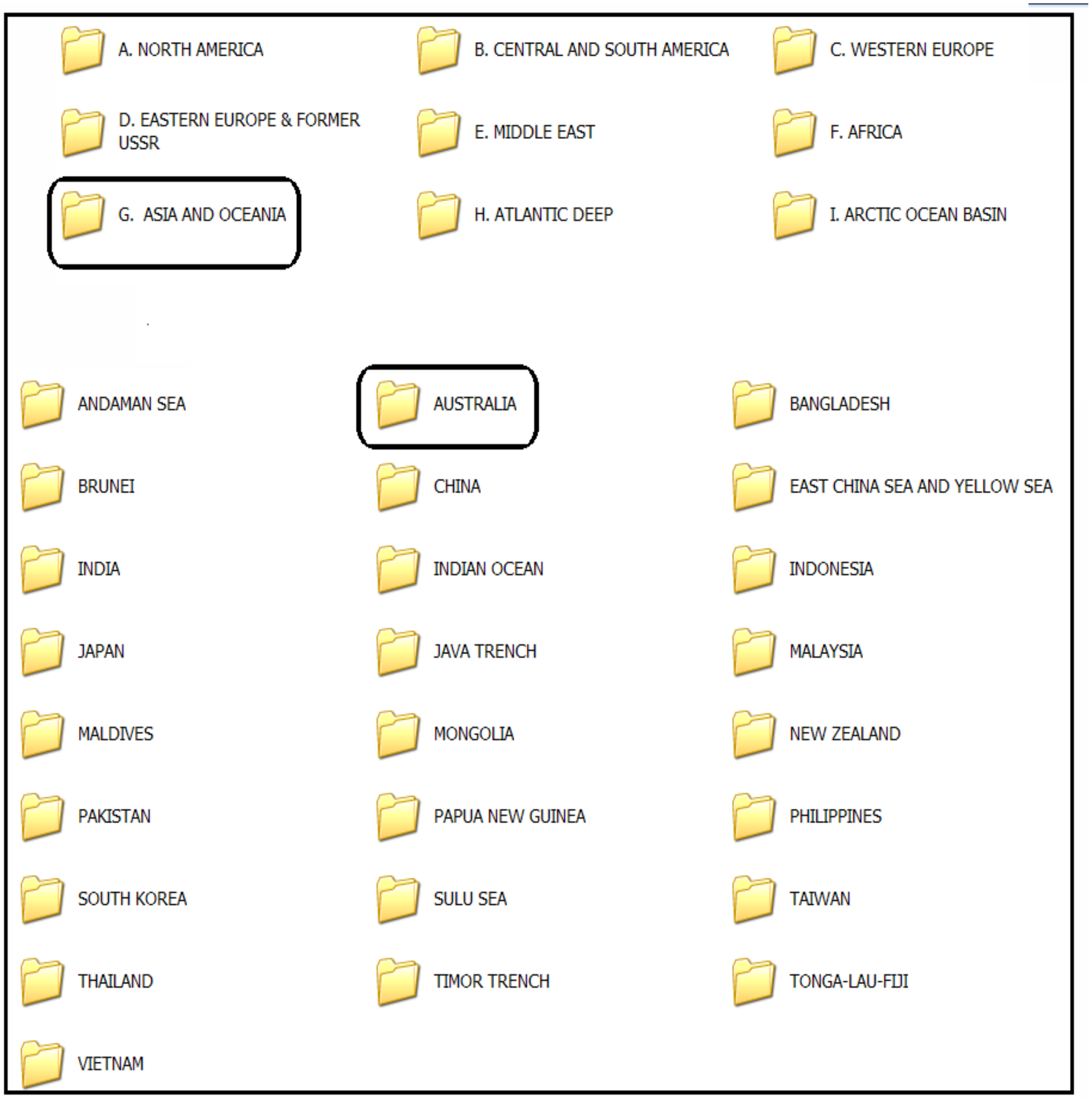



Figure 4. Top: Display of first order folder in the Seismic Image catalog. Bottom: Display of the folders within the *G. Asia and Oceania* first order folder. G. *Asia and Oceania* and *Australia* are outlined.

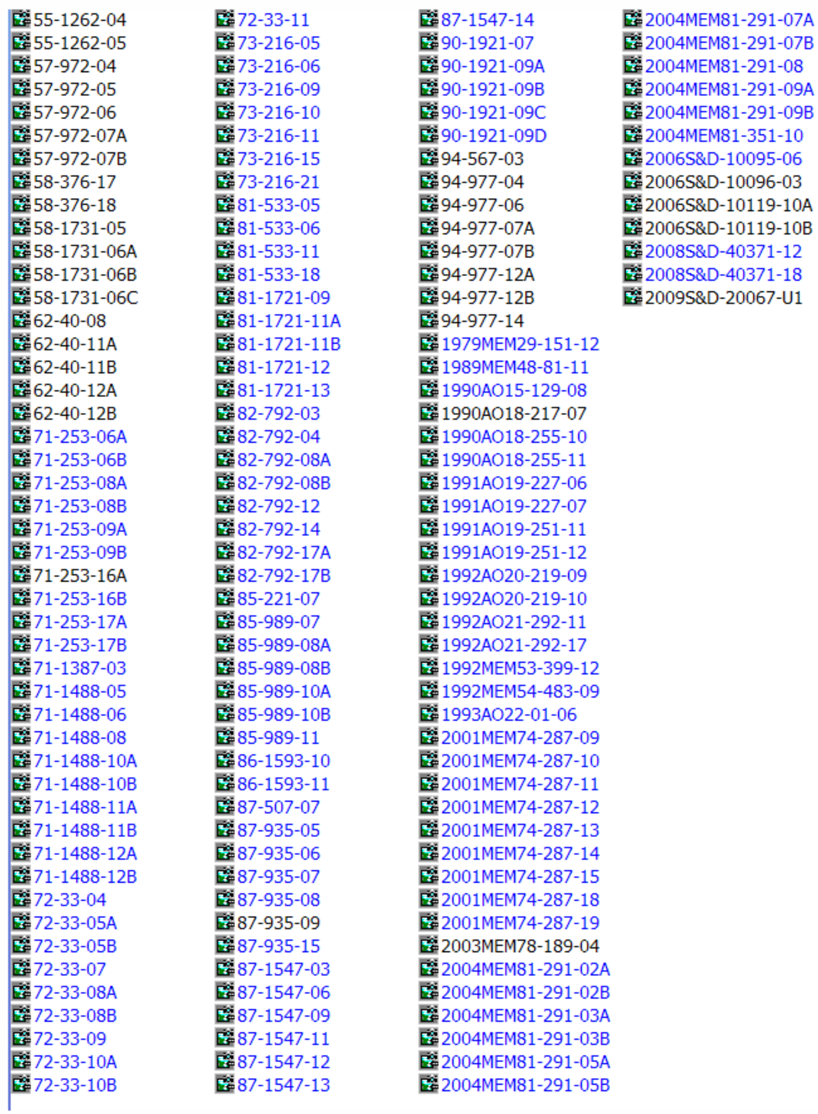



Figure 5. List of images in the *Australia* folder.

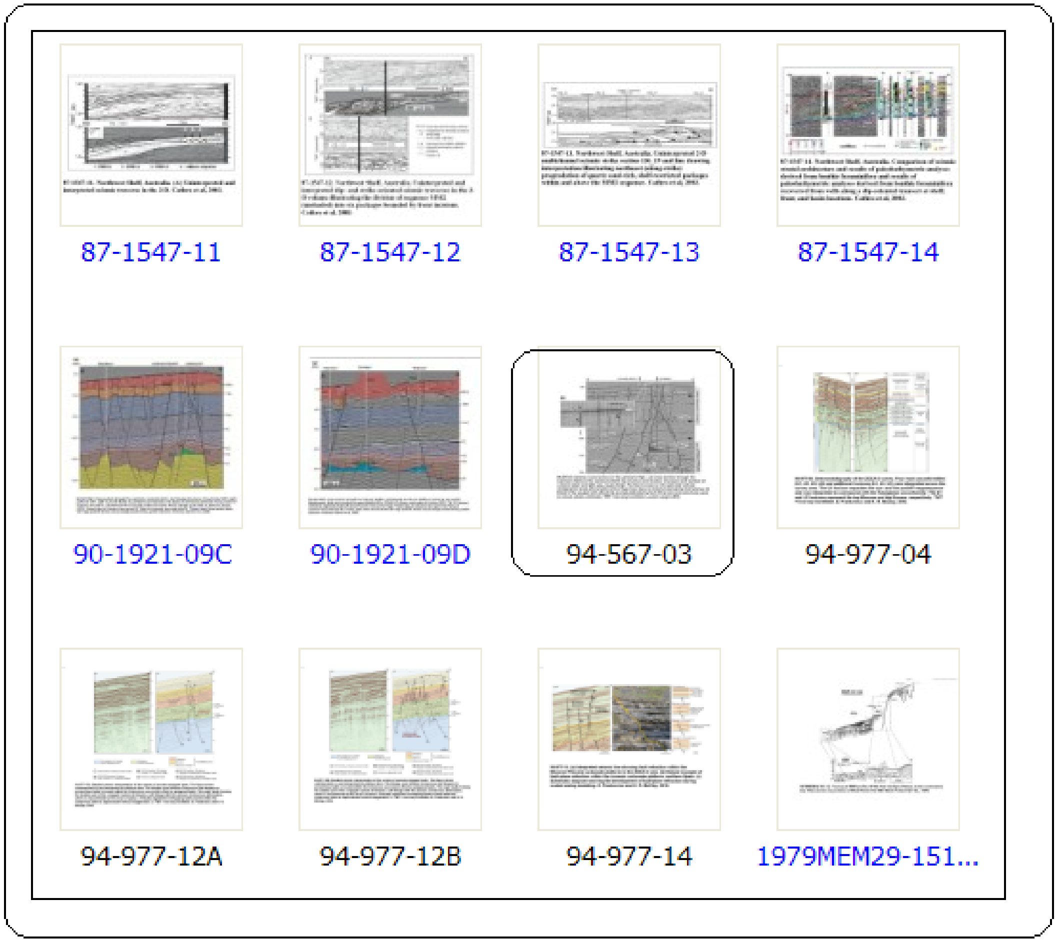



Figure 6. Partial view of the Australia folder, thumbnails display mode, showing the example 94-567-03.

*d. A copy of seismic images stored in monthly folders starting with June 2010, on a remote server (Microsoft Office Live Skydrive).* Approximately 50 images are added to the system every month. In order to facilitate the transfer of these images, copies are placed in skydrive remote server accessed by a sharing password. This feature was started in June 2010: no images generated before that date are found on the server. A view of a portion of the November 2010 folder is shown in Figure 7.

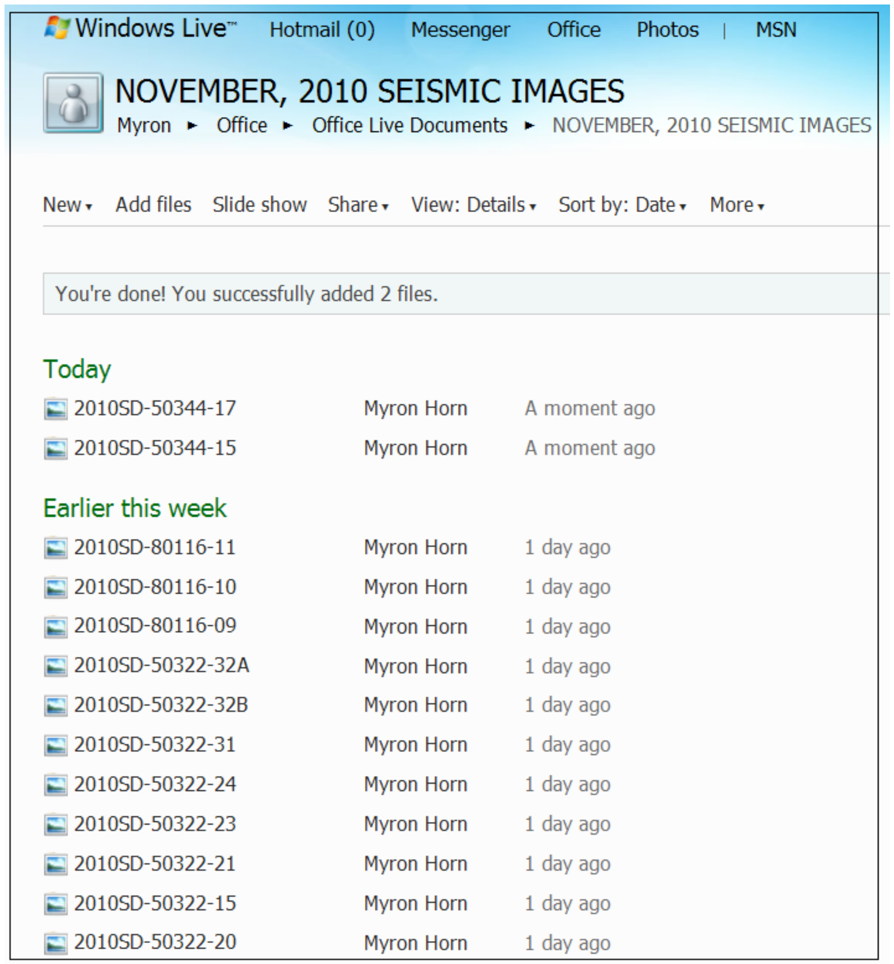



Figure 7. A view of a portion of the November 2010 *Microsoft Office Live SkyDrive* folder used to store offline images on a monthly and transferable basis.

*e. MapPoint display.* Because of its direct linkage with Microsoft Excel, MapPoint is used as a tool to aid in the determination of lat-longs of the retrieved seismic images, as well as an auxiliary mapping system. Examples of the MapPoint displays of image locations are shown in Figures 8 – 16 (8, 9, 10, 11, 12, 13, 14, 15, 16).

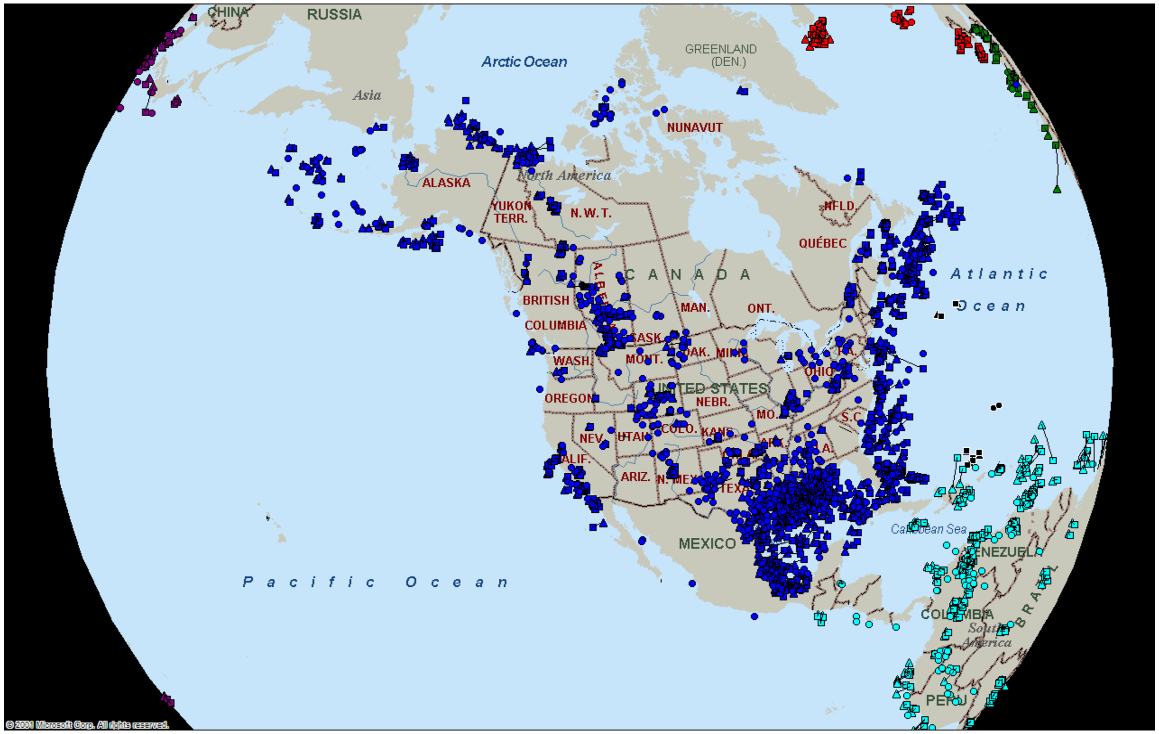


Figure 8. North American seismic image locations, shown in blue. 2,716 images are represented, consisting of 1,210 tracks and 1,506 points.

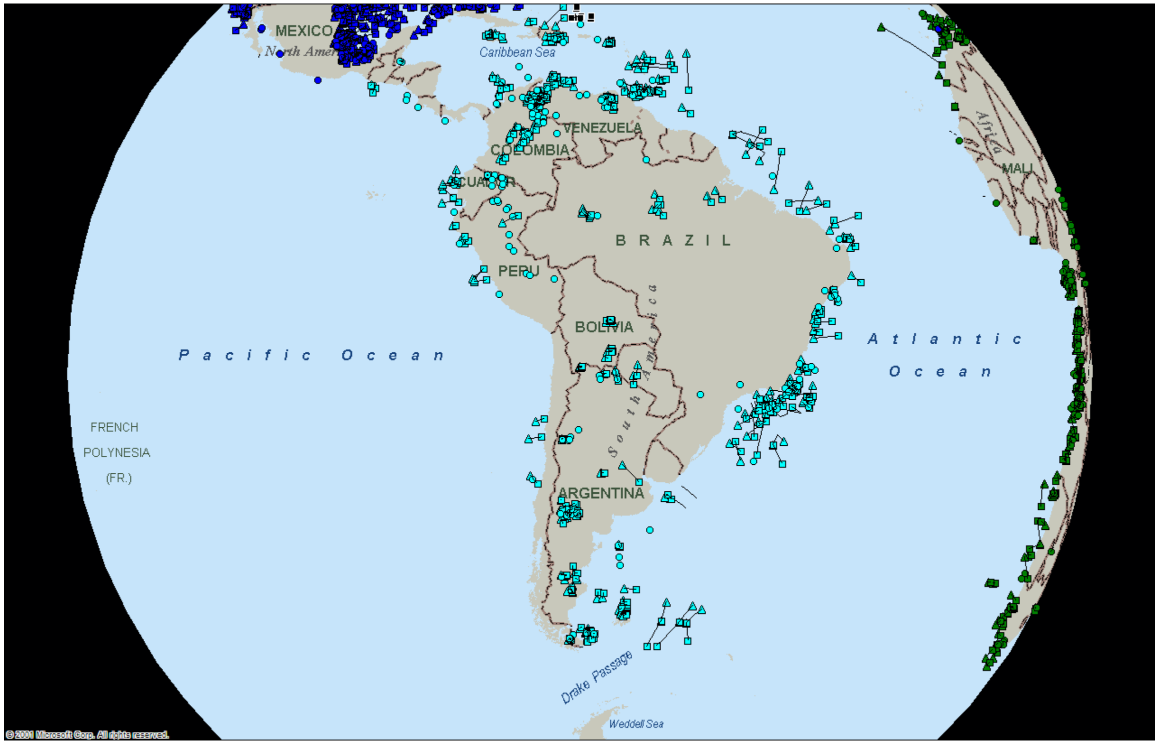



Figure 9. South American seismic image locations, shown in light blue. 666 images are represented, consisting of 392 tracks and 274 points.

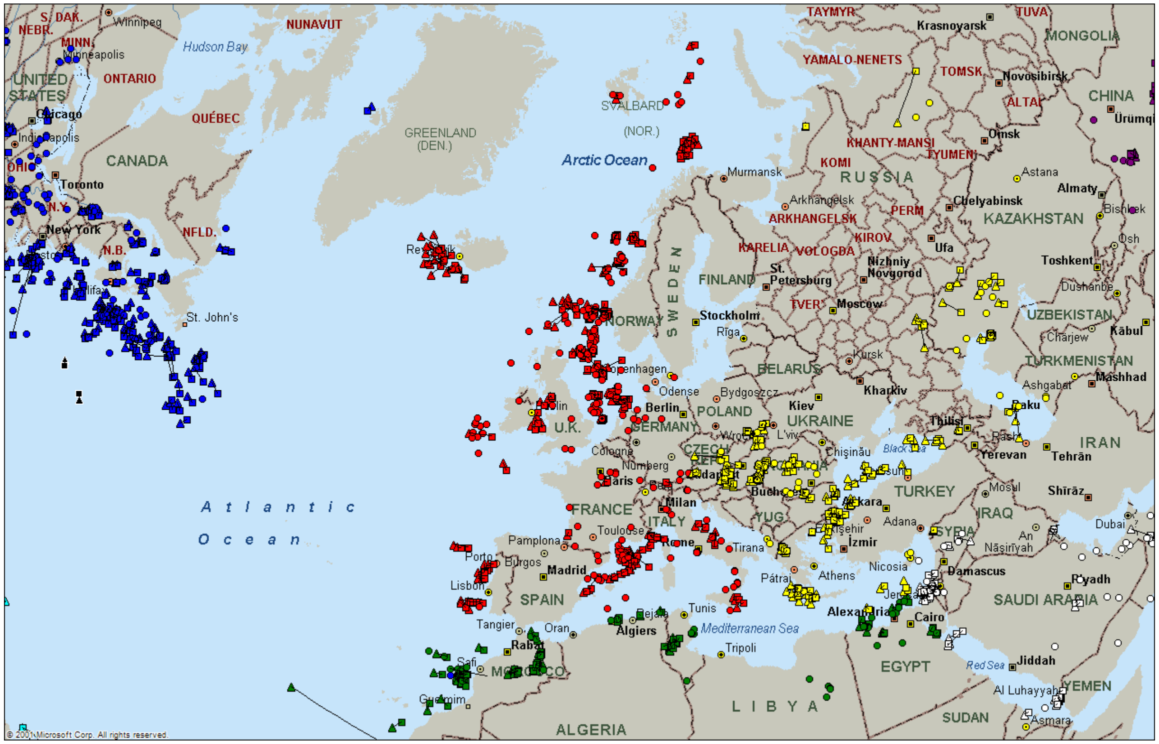



Figure 10. Western European seismic image locations, shown in red. 595 images are represented, consisting of 243 tracks and 352 points.

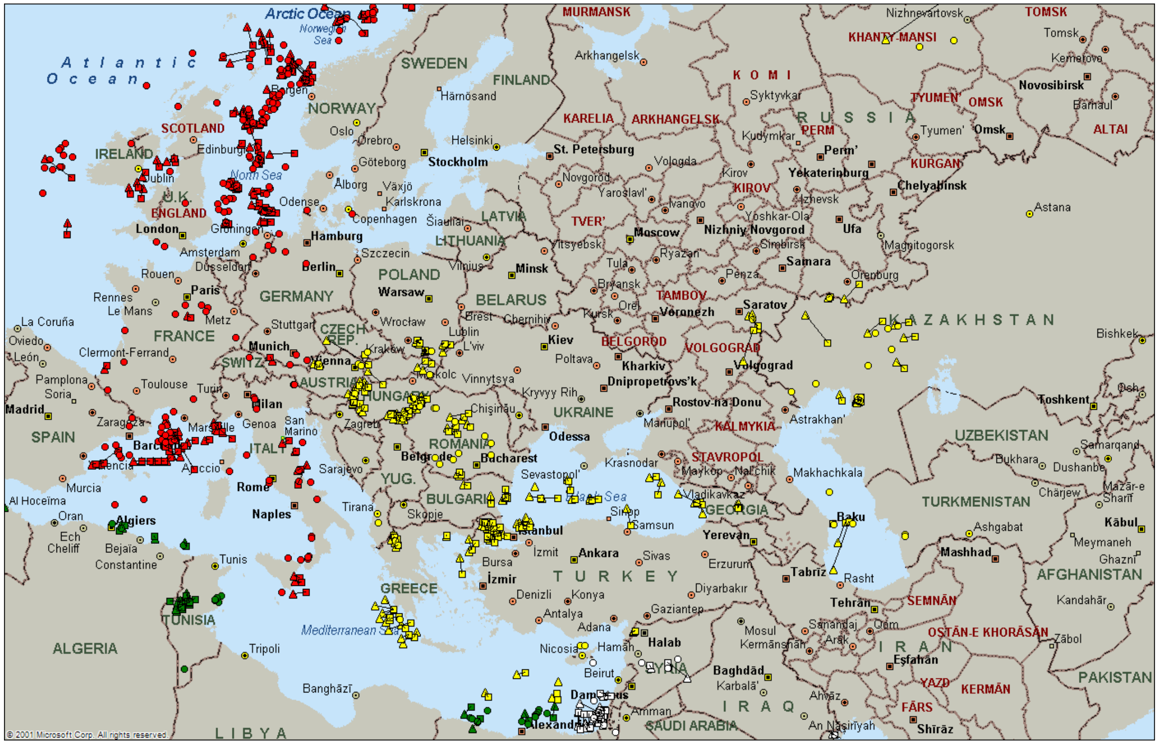



Figure 11. Eastern European and former USSR seismic image locations, shown in yellow. 249 images are represented, consisting of 161 tracks and 88 points.


Figure 12. Middle Eastern seismic image locations, shown in white. 149 images are represented, consisting of 57 tracks and 92 points.

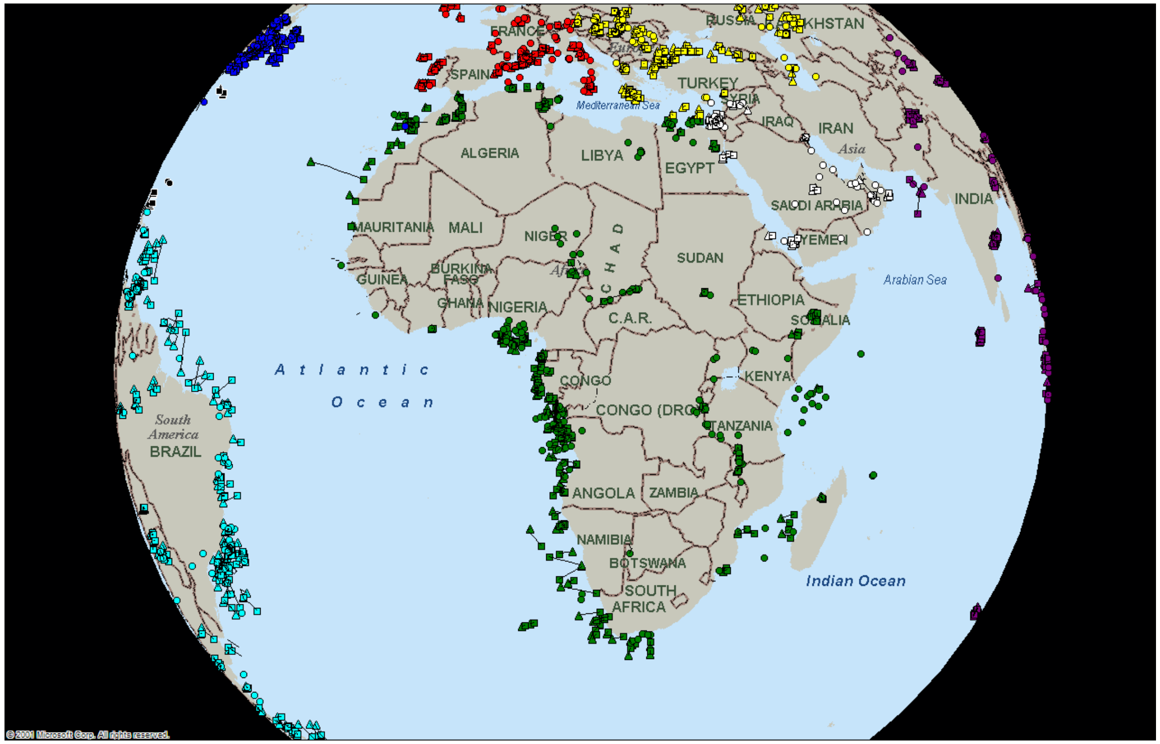



Figure 13. African seismic image locations, shown in green. 618 images are represented, consisting of 253 tracks and 365 points.

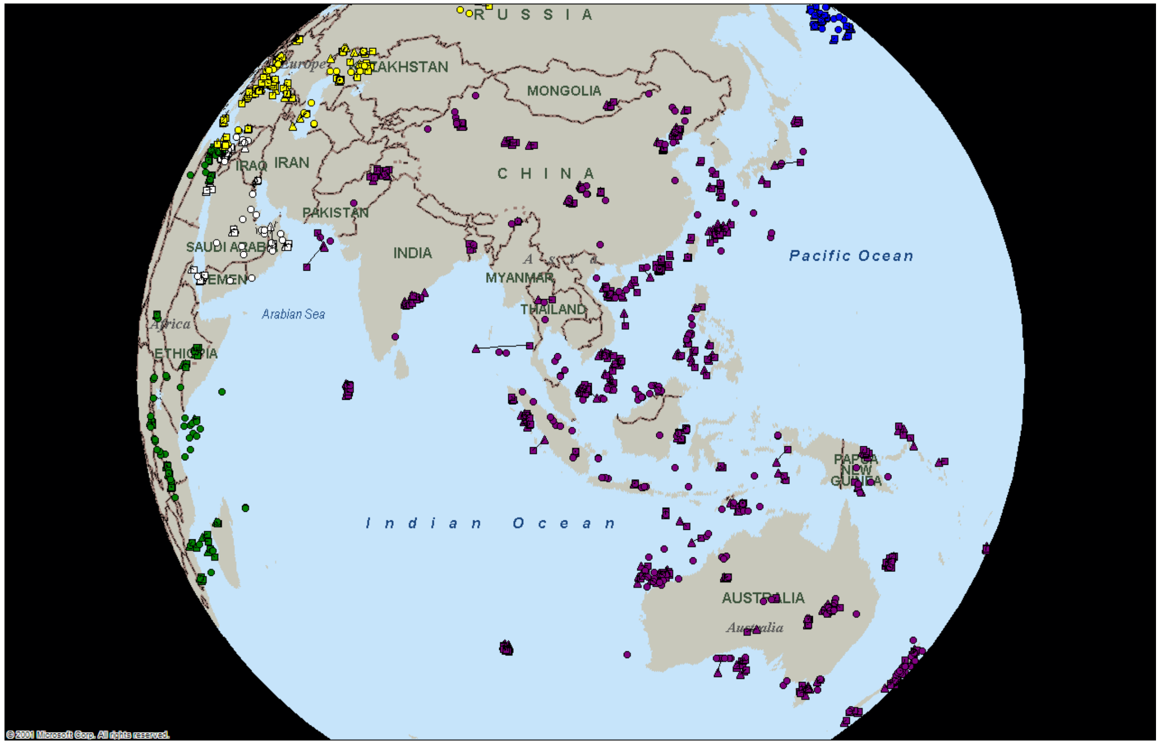



Figure 14. Asian seismic image locations, shown in purple. 809 images are represented, consisting of 392 tracks and 417 points.

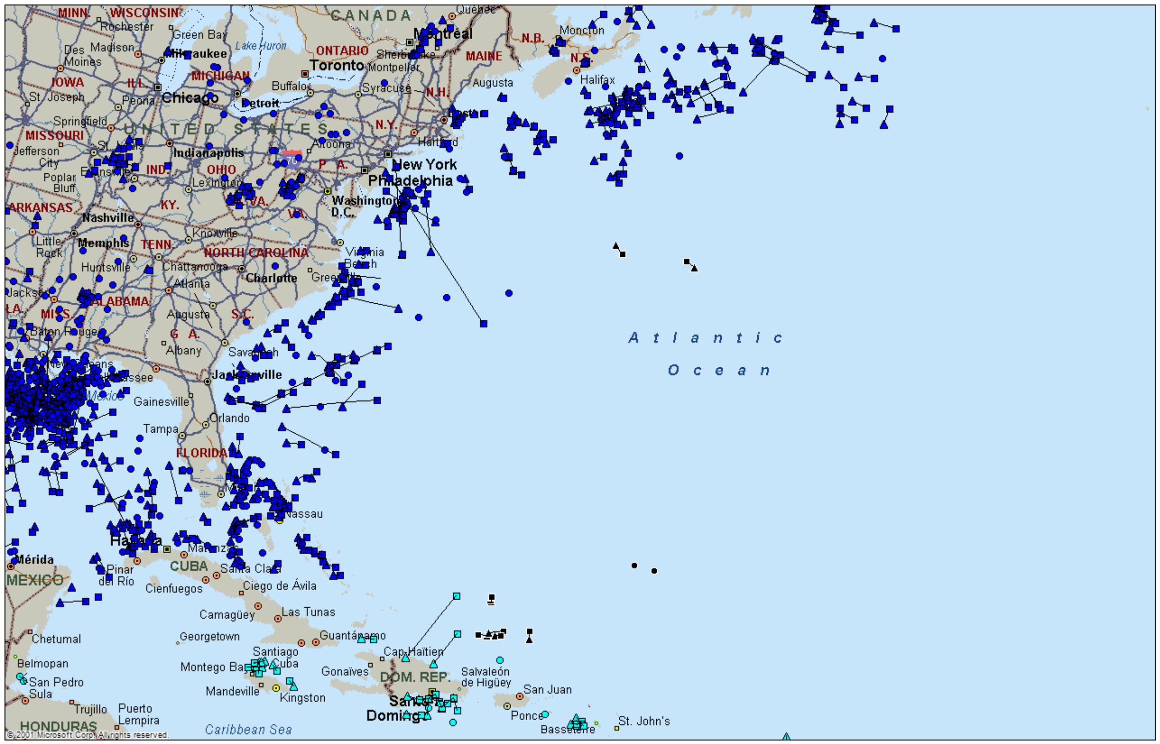



Figure 15. Atlantic Deep seismic image locations, shown in black. 16 images are represented, consisting of 12 tracks and 4 points.

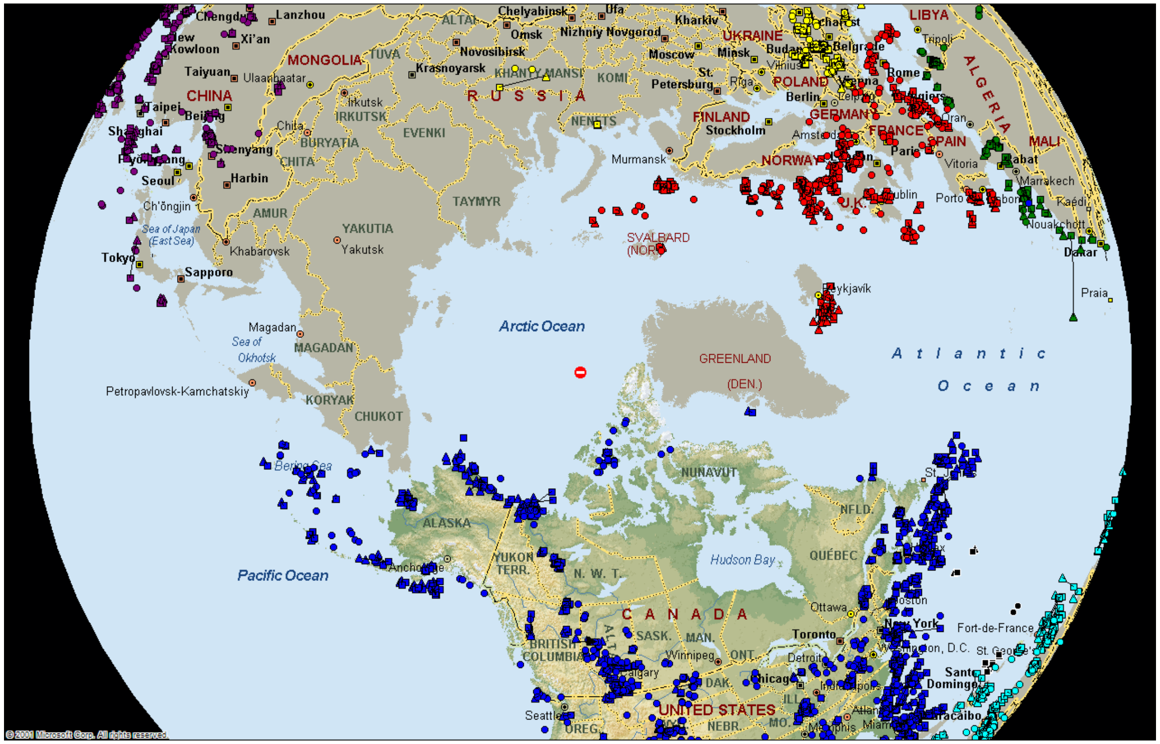



Figure 16. Arctic Ocean Basin seismic image location, shown in red and white.
1 image is represented, consisting of 1 point.

*f. An Excel workbook named “Seismic Statistics” containing a backup of a) above; a folder by folder (i.e., nation) inventory; and a list of images arranged by date of generation, starting with June, 2010.* This workbook is used in inventory control as well as providing a chronological history of image inputs. It is the source of Table 1 of this document.

*g Internet Browser Version*. An internet browser version of the project is currently being developed using Java Script. This version will be run under an ArcGIS Server which has recently been installed at AAPG and will be part of GIS-UDRIL. The browser version will use a variety of imagery provided by ESRI and an overlay of seismic atlas locations. Users will be able to query the locations and download images. The browser version will be available to GIS-UDRIL subscribers in 2011. An example of a similar browser can be found at the web-site of the UK Onshore Geophysical Library (http://maps.lynxinfo.co.uk/UKOGL_LIVE/map.html).

In this example users can select a variety of background imagery and map layers including seismic line locations, wells, licenses, etc. A number of navigation tools are available allowing panning and zooming, and an information icon can be used to view details of seismic and wells. Selection of a seismic line will list acquisition parameters, and users then have the option to view side labels and download grayscale or color images of the seismic sections. There are also a number of print options.

## Methods Used to Spatially Locate the Seismic Images

Latitudes and longitudes (lat-long’s) associated with the seismic images are determined from information supplied in the corresponding reference source, usually in the form of map figures in the reference, although in a few cases, the actual lat-longs are posted directly on the published image (Figure 17). The corresponding Google[tm]earth track line is shown in Figure 18.

However, the great majority of published seismic images do not carry the lat-longs as shown in Figures 16. Hence, using a variety of methods, the location of track lines must be determined from other sources of information contained within the reference. The methods include:

a) Lat-longs derived from map figures with posted lat-long tics.
b) Lat-longs derived from map figures without posted lat-long tics; or tics are not readable.
c) Lat-longs derived from map figures containing UTM tics.
d) Lat-longs derived from map figures containing Township – Range – Section information.
e) Lat-longs derived from map figures containing Gulf of Mexico blocks.

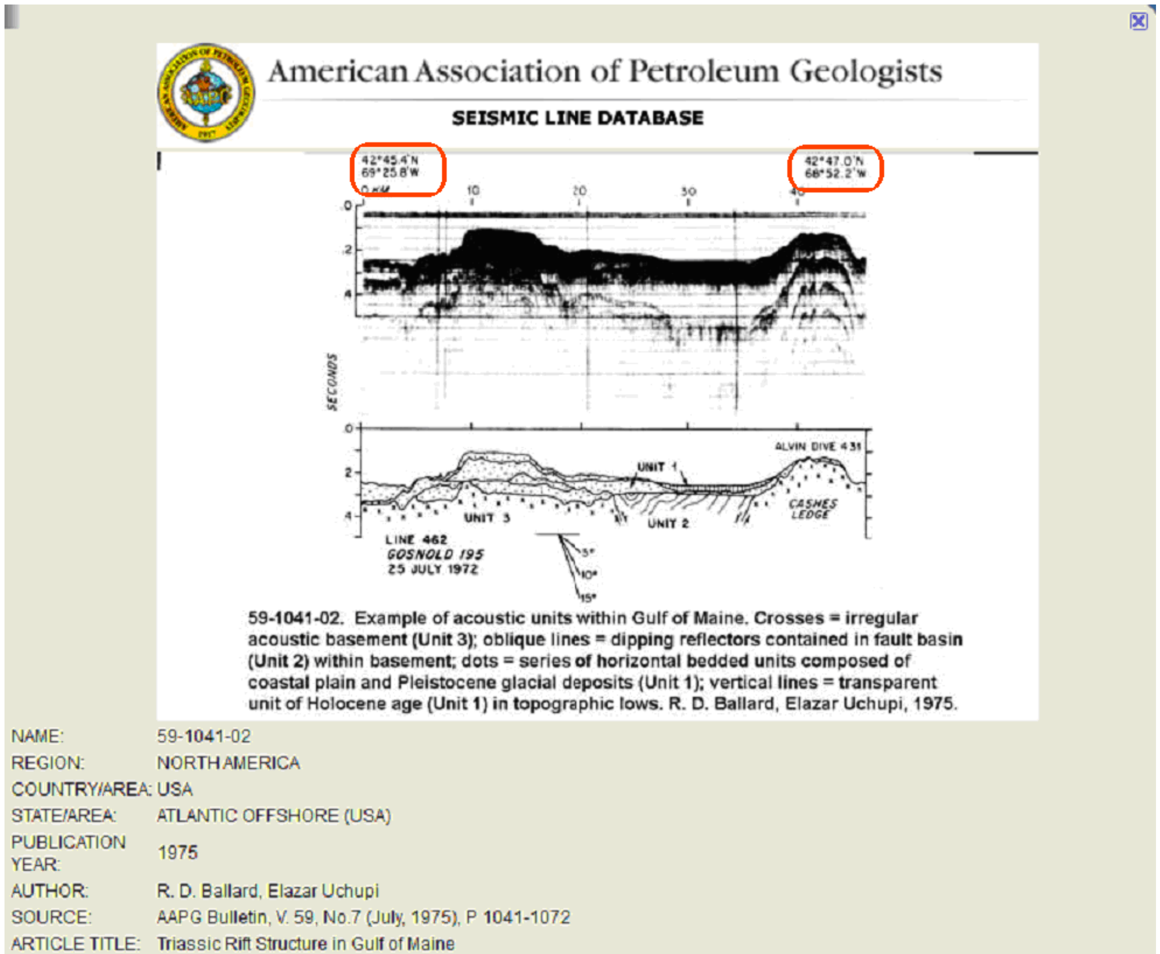



Figure 17. One of the entries in the Seismic Atlas, with lat-longs posted directly on the published image.

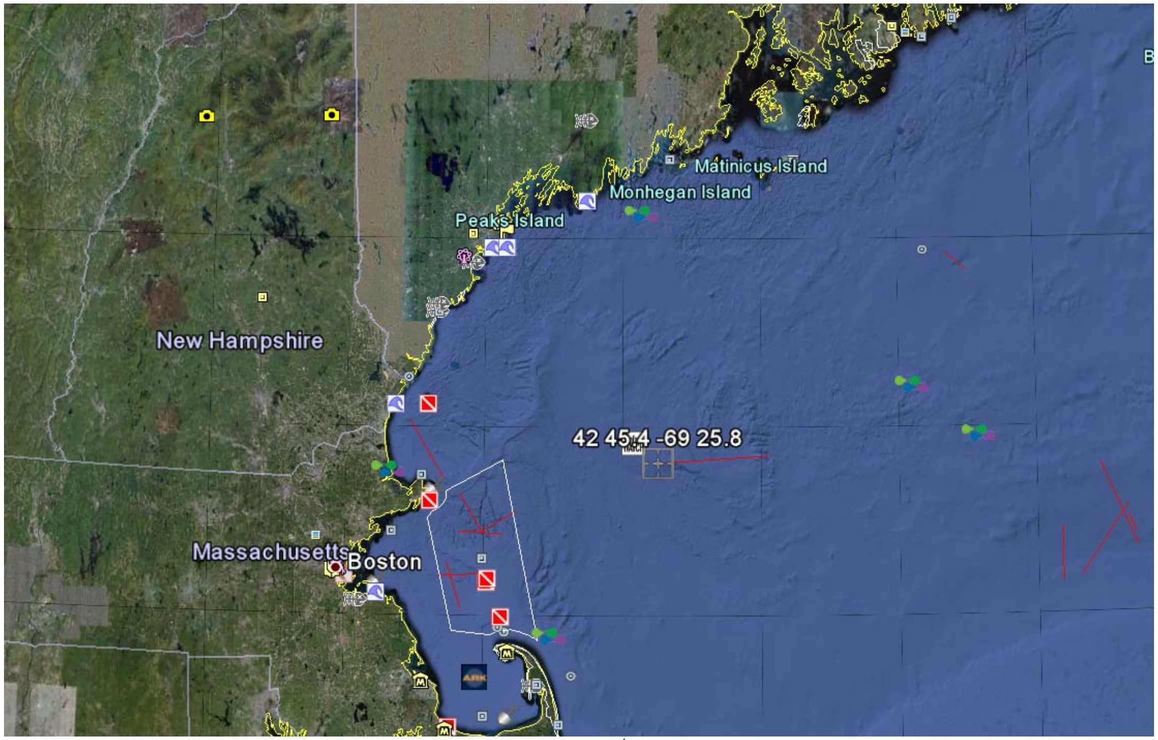



Figure 18. The corresponding Google[tm] earth track line of the image shown in Figure 17. The start location (42º 45.4' – 69º 25.8') is displayed.

*a. Lat-longs derived from map figures with posted lat-long tics*. An example of a published map (Likuan Zhang et al., 2010, fig. 3.) that contains lat-long tic marks is shown in Figure 19. The tic marks are used to determine the end points (start and end) of track line AA’, corresponding to the image shown in Figure 20.

In order to make the conversion, an Excel spreadsheet template and Microsoft Paint are used. The procedure is as follows:

1. The map (Figure 19) is pasted into Microsoft Paint (Figure 21).
2. Using a designed Excel template (contact m.horn@sbcglobal.net to obtain a copy), regression equations for the lat and long tic marks are obtained (step A, Figure 22).
3. The xy coordinates for the start point obtained on the Paint image is posted on the Excel template (cells B13 and C13 in Figure 21, step B). As an example the start (northwest) position of line AA’ is used.
4. The resultant latitude and longitude values (cells B16 and C16 of Figure 22, step C) are copied and pasted into the Seismic Catalog.
5. Steps 3 and 4 are repeated for the end point of the track line.

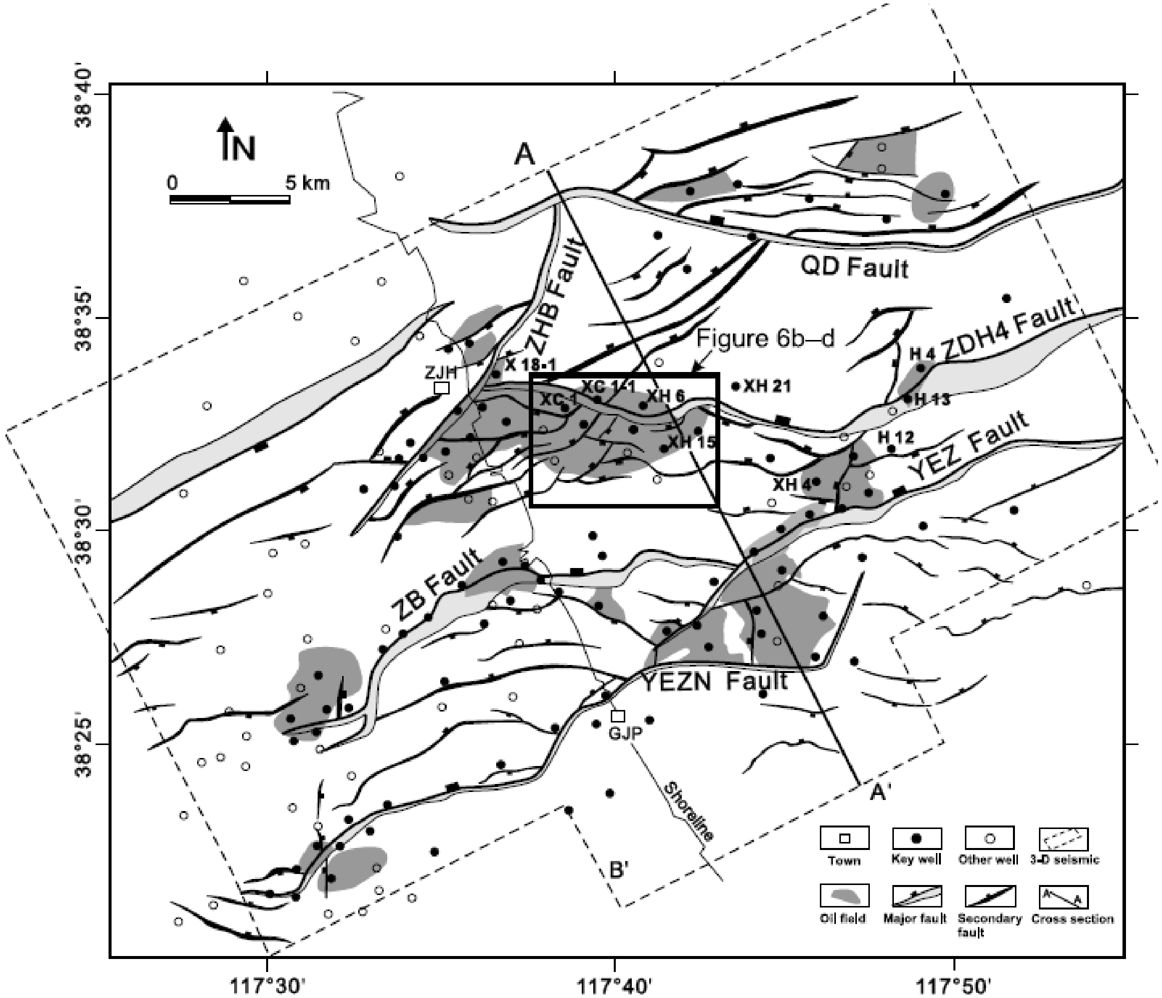
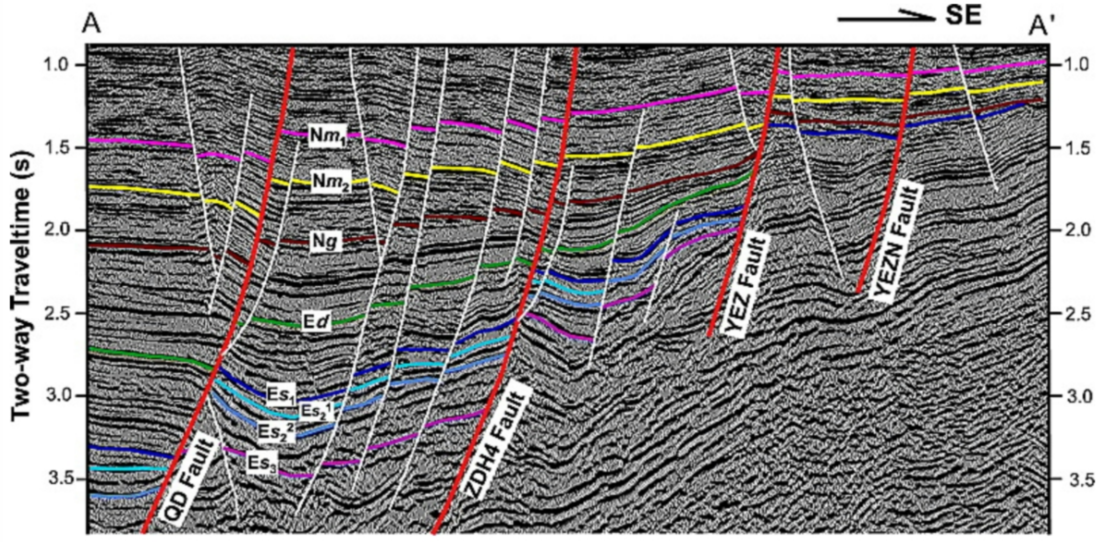



Figure 19. Illustration of a published map with lat-long tic marks, which are used to determine the position of a seismic track, in this case track line AA' (Likuan Zhang et al., 2010, fig. 3).




**94-1379-04. Slope between the Chengning uplift and Qikou depression in the Bohai Bay Basin. Interpreted seismic section AA' showing major faults and stratigraphic intervals. QD = Qidong; ZDH4 = Zhangdonghai 4; YEZ = Yangerzhuang; YEZN = Yangerzhuangnan. Likuan Zhang et al., 2010.**

Figure 20. The seismic image corresponding to track line AA' in Figure 18 (Likuan Zhang et al., 2010, fig. 4).

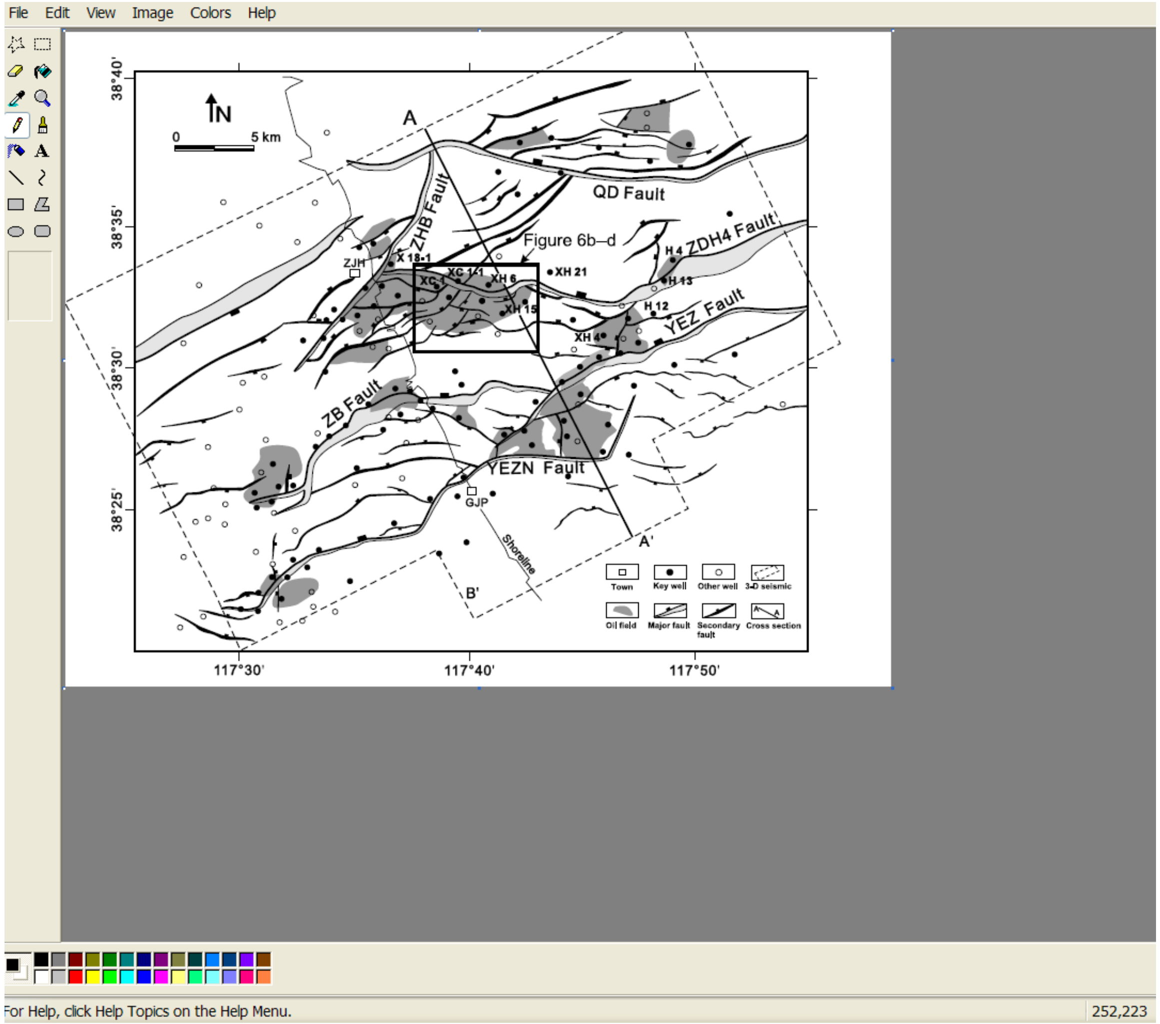



Figure 21. Figure 19 pasted into Microsoft Paint. Note the xy coordinates corresponding to cursor location is in the lower right hand corner.

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CONVERT XY TO LAT LONGS | | | | | | | | -1 | | | |
| 2 | | | | | | | | | | | | |
| 3 | | LAT | | CHECK | LONG | | CHECK | | | | | |
| 4 | | 38.4167 | 447 | 38.4174 | 117.5000 | 41 | 117.5002 | SUMMARY OUTPUT | | | | |
| 5 | **A** | 38.5000 | 314 | 38.4998 | 117.6667 | 205 | 117.6663 | | | | | |
| 6 | | 38.5833 | 182 | 38.5817 | 117.8333 | 370 | 117.8335 | *Regression Statistics* | | | | |
| 7 | | 38.6667 | 43 | 38.6678 | | | | Multiple R | 0.999932 | | | |
| 8 | | | | | | | | R Square | 0.999865 | | | |
| 9 | | | | | | | | Adjusted R | 0.999797 | | | |
| 10 | | | | | | | | Standard E | 0.001531 | | | |
| 11 | | | | | | | | Observatic | 4 | | | |
| 12 | | LONG | LAT | | | | | | | | | |
| 13 | **B** | 336 | 90 | | | | | ANOVA | | | | |
| 14 | | | | | | | | | *df* | *SS* | *MS* | *F* |
| 15 | **C** | LAT | LONG | | | | | Regressioi | 1 | 0.034717533 | 0.034717533 | 14806.03279 |
| 16 | | 38.6387 | 117.7991 | | | | | Residual | 2 | 4.68965E-06 | 2.34482E-06 | |
| 17 | | | | | | | | Total | 3 | 0.034722222 | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | *Coefficients* | *Standard Error* | *t Stat* | *P-value* |
| 20 | | | | | | | | Intercept | 38.69449 | 0.001470889 | 26306.86741 | 1.44498E-09 |
| 21 | | | | | | | | X Variable | -0.00062 | 5.09497E-06 | -121.6800427 | 6.75332E-05 |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | SUMMARY OUTPUT | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | *Regression Statistics* | | | | |
| 29 | | | | | | | | Multiple R | 0.999998 | | | |
| 30 | | | | | | | | R Square | 0.999997 | | | |
| 31 | | | | | | | | Adjusted R | 0.999994 | | | |
| 32 | | | | | | | | Standard E | 0.000414 | | | |
| 33 | | | | | | | | Observatic | 3 | | | |
| 34 | | | | | | | | | | | | |

Figure 22. Lat-long Conversion template. Step A. Obtain regression equations for tic marks. Use Tools/Data Analysis/Regression. Step B. Post x and y values from Microsoft Paint image of "start" position of track line. Step C. Copy resultant lat long to Seismic catalog.

*b. Lat-longs derived from map figures without posted lat-long tics, or tics are not readable.* If lat-long tic marks are not supplied on the published track map, or if the tic marcs on the map are not readable (Figure 23), then one must use geographic markers (towns, cities, state lines, coastline points, etc.) on the map in lieu of the tic marcs. The latitude and longitude of the geographic markers are obtained from an independent map source, such as Google$^{tm}$earth or MapPoint$^{tm}$. The method is defined in Figures 23, 24, and 25.

Figure 23 shows the published map. The objective is to determine the lat-longs of the end points of line AA' and BB'. Line AA' is used in this example. The associated seismic image is shown in Figure 24.

The method is as follows:

1. Copy-paste the map to Microsoft Paint.
2. Choose at least three geographic markers on the published map (Camamu, Itacare, Ilheus).
3. Determine the lat-longs of these geographic markers from the independent map.
4. Using the conversion template, combine the lat-longs of the individual geographic markers, derived from the independent map, with their associated xy coordinates derived from the Paint map.
5. Using the conversion template, enter the xy coordinates, from the Paint map, for the end points of line AA', and read out the associate lat-longs. The results are shown in Figure 25.

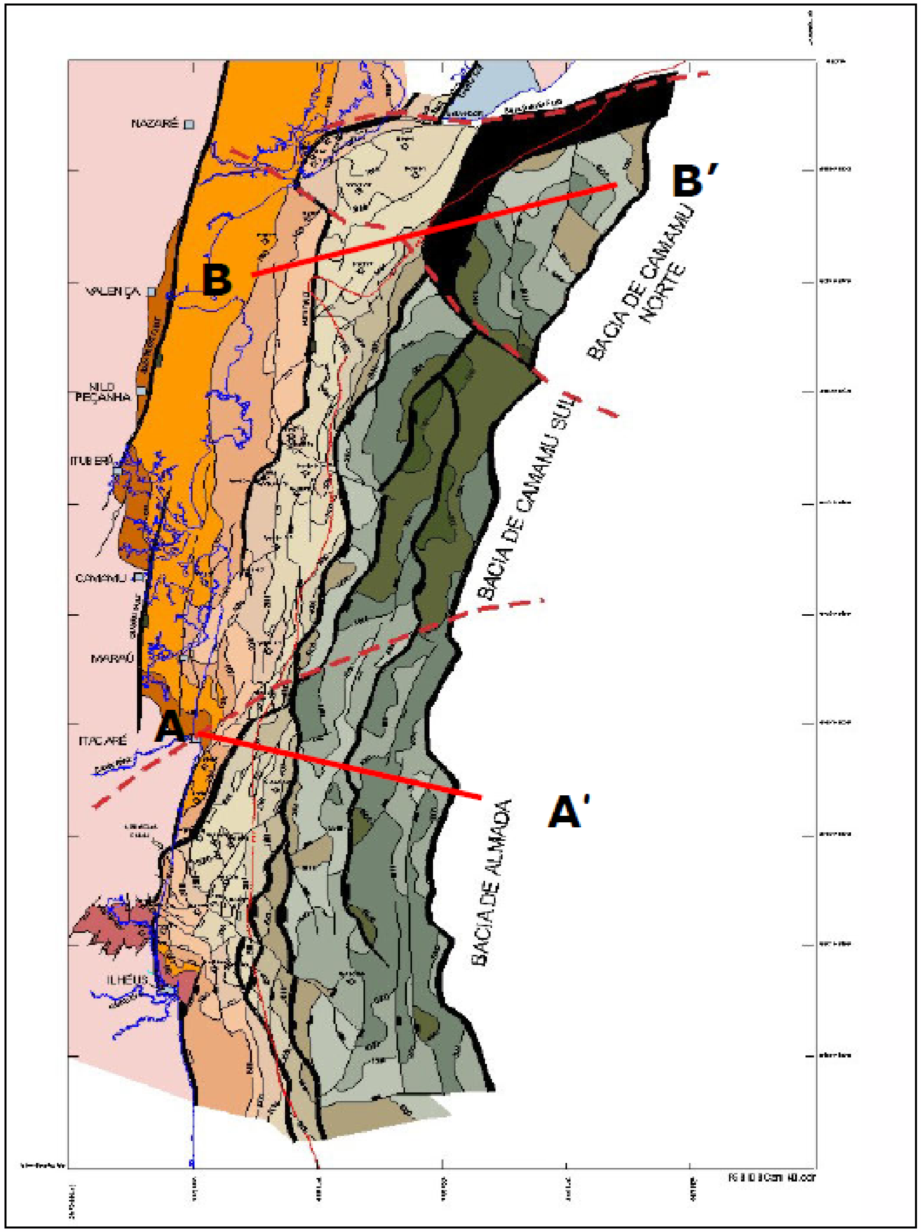



Figure 23. Example of map showing track lines, but the tic marks are illegible. Need to determine lat longs by using geographic markers.

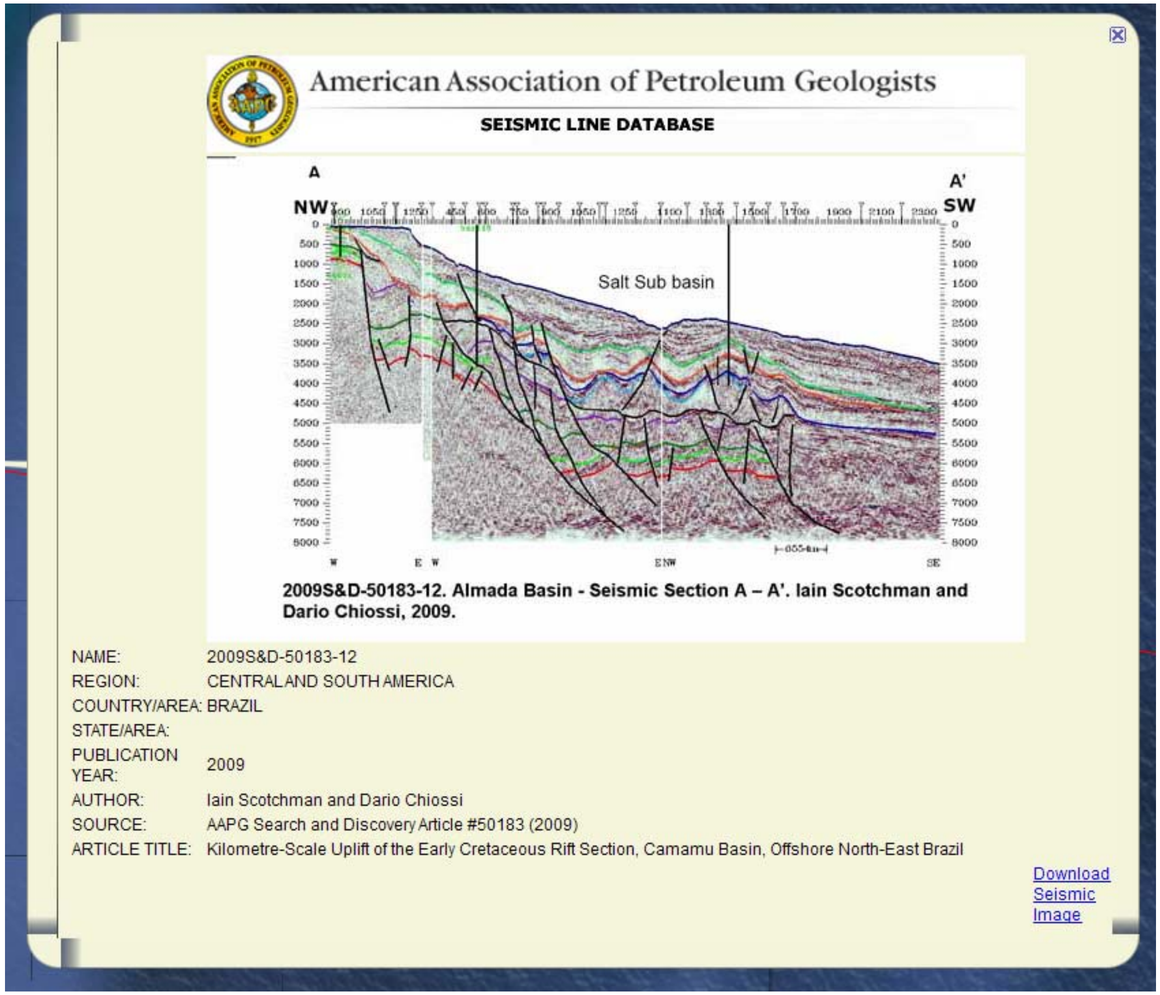



Figure 24. The seismic section associated with line AA’ of Figure 23.

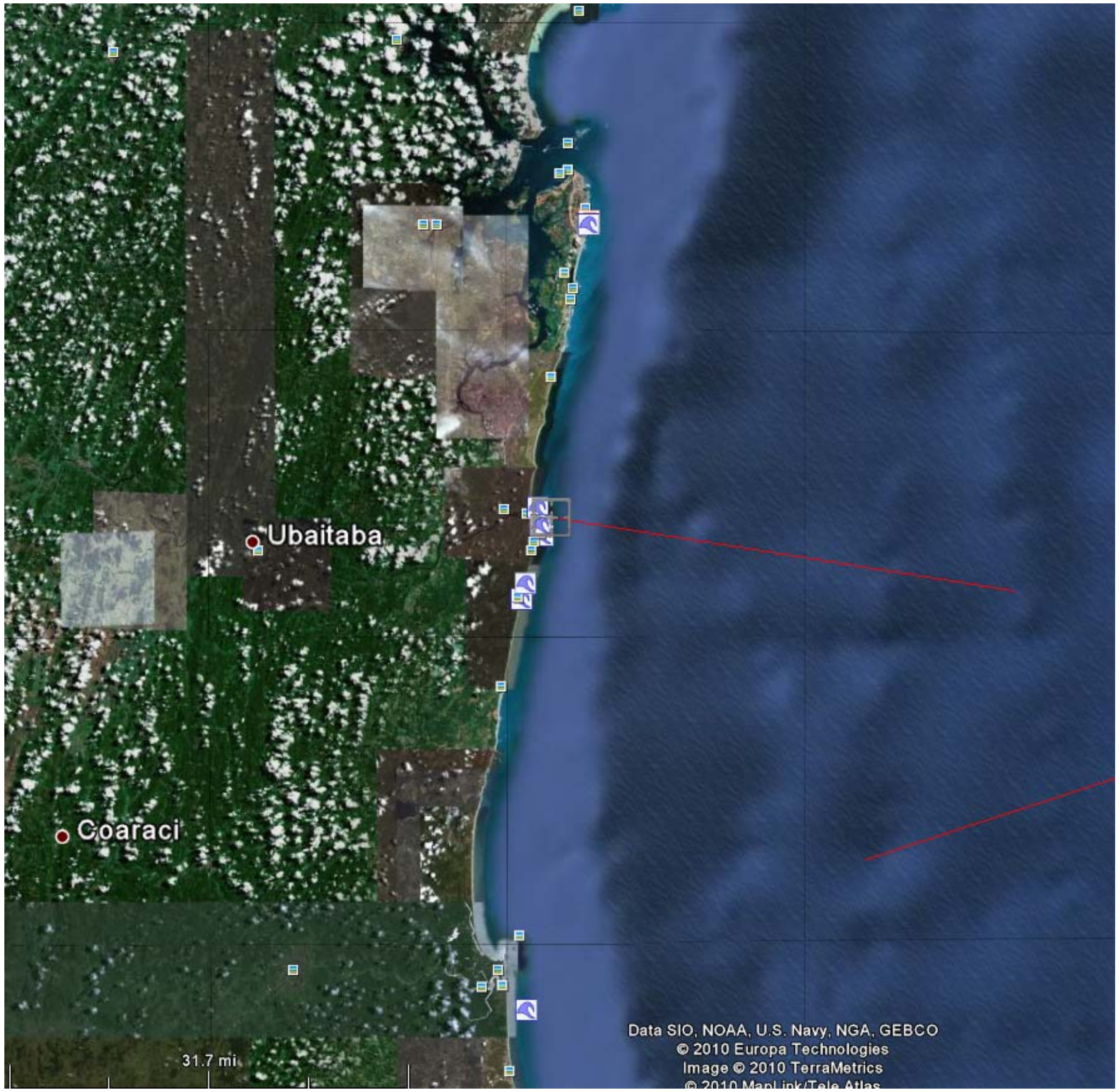



Figure 25. Location of line2009S&D-50183-12.The more southerly line shown partially is 60-186-08C.

c. Lat-longs derived from map with figures containing UTM tics. *Figure 26 is an example of a map containing seismic track lines that uses the Universal Transverse Mercator System (UTM). In order to determine the lat-long values for the beginning and end of the seismic track line with a map containing UTM coordinates, the following procedure is used ("Figure 3" track line in Figure 27 will be used as an example):*

1. Copy-paste the map to Microsoft Paint (Figure 26).

2. Open UTM CONVERSION STEP 1 program. (contact m.horn@sbcglobal.net or the AAPG library to obtain a copy). See Figure 28.

3. From the PAINT image, record the easting UTM values in column B and their corresponding y values in column C; and the northing UTM values in columns E and their corresponding x values in column F.

4. Use *Tools/Data Analysis/Regression* for the northing data. The results of the regression are shown in H3..B21. Repeat for the easting data. The results are shown H28..P43. If the R squared values are <0.999, recheck the input data.

5. The xy coordinates for the start and end points obtained from the Paint image are posted in cells B13 and C13 (the beginning start (northwest) xy values of line "Figure 3" is shown in Figure 27). The resultant UTM values for that point are displayed in cells B18 and C18.

6. Open UTM CONVERSION STEP 2 program. (contact m.horn@sbcglobal.net or the AAPG library to obtain a copy). See Figure 29.

7. "There is no way to get latitude and longitude from UTM coordinates if you do not know your longitude zone and hemisphere. There are four places on earth that have the same latitude and longitude if you omit N/S and E/W. There are 120 places that have the same northing and easting." Therefore, it is necessary to post an approximate lat and long for the conversion. Fortunately, there is usually enough information in the published references using UTM coordinates to obtain these approximate values. The approximations are posted in cells E7..E9 of the UTM CONVERSION STEP 2 program. In the example, we post 10S and 125E. Ignore the northing and easting values and simply read off the zone; in this case 51. Post that value in cell E19 and post N or S (in this case, S) in cell H18.

8. Copy the resultant latitude and longitude found in cells E22 and E23 and paste in the Seismic Catalog.

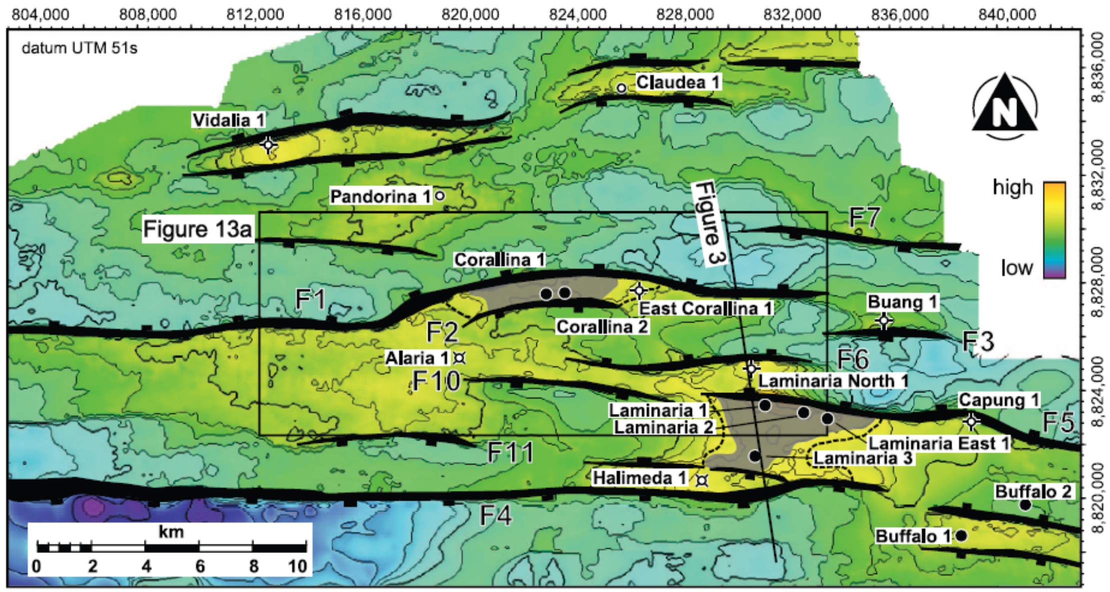



Figure 26. Map that utilizes UTM coordinates. The "Figure 3" track line is used in this example (Langhi et al., 2008, Figure 2).

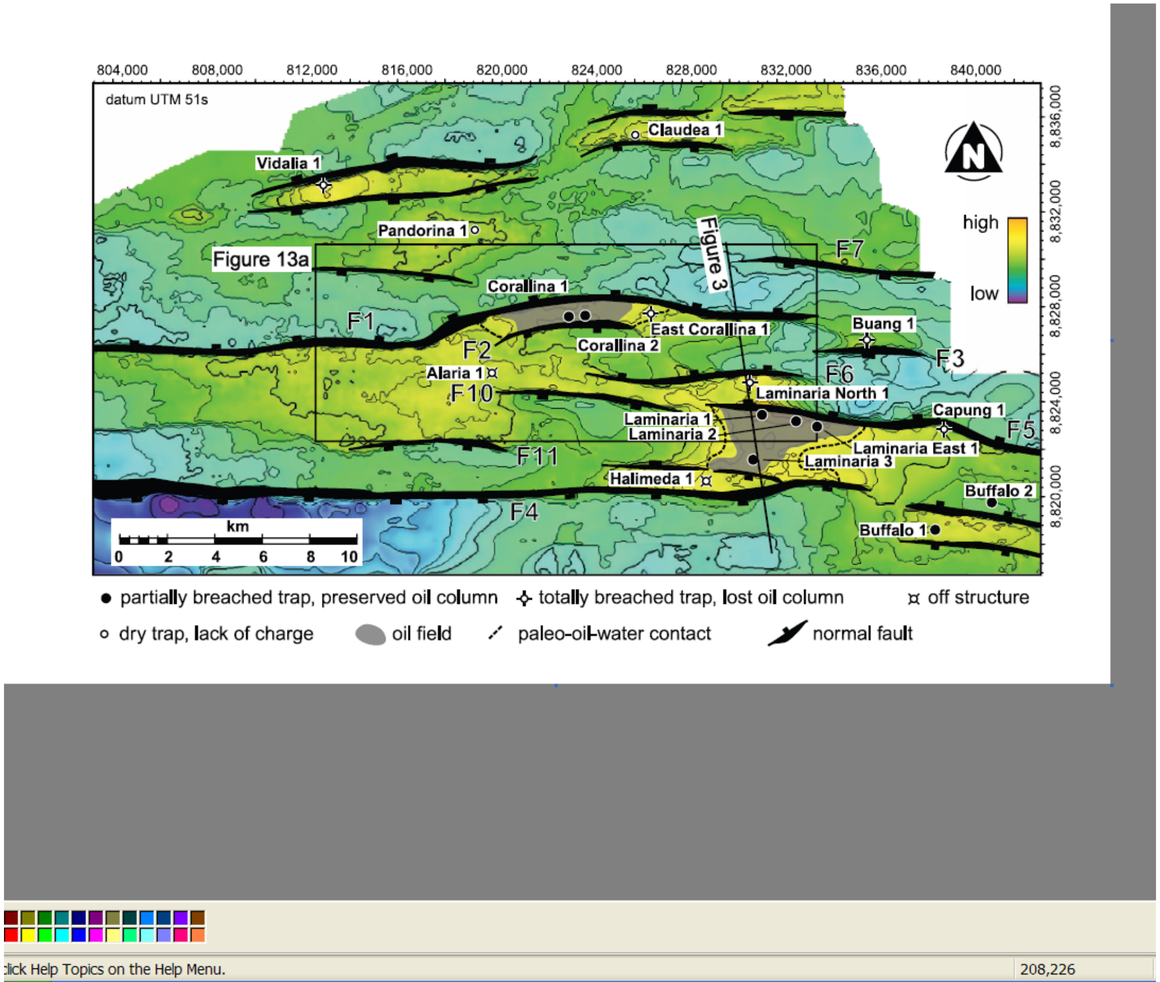



Figure 27. Microsoft Paint copy of Figure 26. Note the x and y coordinate values in the lower right hand corner representing the cursor location.

| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | UTM CONVERSION STEP 1 | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | |
| 3 | | Northing | | CHECK | Easting | | CHECK | Northing | | | | | |
| 4 | | 8.836E+06 | 113 | 8.836E+06 | 8.120E+05 | 284 | 8.120E+05 | SUMMARY OUTPUT | | | | | |
| 5 | | 8.832E+06 | 203 | 8.832E+06 | 8.200E+05 | 463 | 8.200E+05 | | | | | | |
| 6 | | 8.828E+06 | 292 | 8.828E+06 | 8.280E+05 | 641 | 8.280E+05 | *Regression Statistics* | | | | | |
| 7 | | 8.824E+06 | 381 | 8.824E+06 | 8.360E+05 | 821 | 8.360E+05 | Multiple R | 0.999997 | | | | |
| 8 | | 8.820E+06 | 471 | 8.820E+06 | | | | R Square | 0.999995 | | | | |
| 9 | | | | | | | | Adjusted R | 0.999993 | | | | |
| 10 | | | | | | | | Standard E | 16.33769 | | | | |
| 11 | | x,y coordinates from PAINT | | | | | | Observatio | 5 | | | | |
| 12 | | Easting | Northing | | | | | | | | | | |
| 13 | | 683 | 231 | | | | | ANOVA | | | | | |
| 14 | | | | | | | | | *df* | *SS* | *MS* | *F* | *Significan* |
| 15 | | | | | | | | Regressioi | 1 | 159999199.2 | 159999199.2 | 599427 | 4.75186E |
| 16 | | Computed: | | | | | | Residual | 3 | 800.7607227 | 266.9202409 | | |
| 17 | | Easting | Northing | | | | | Total | 4 | 160000000 | | | |
| 18 | | 8.298E+05 | 8.831E+06 | | | | | | | | | | |
| 19 | | | | | | | | | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95* |
| 20 | | PROCEED TO UTM CONVERSION STEP 2 | | | | | | Intercept | 8841065 | 18.38853331 | 480792.2776 | 1.98426E-17 | 8841006 |
| 21 | | | | | | | | X Variable | -44.7425 | 0.057789927 | -774.226711 | 4.75186E-09 | -44.926 |
| 22 | | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | | |
| 25 | | | | | | | | Easting | | | | | |
| 26 | | | | | | | | SUMMARY OUTPUT | | | | | |
| 27 | | | | | | | | | | | | | |
| 28 | | | | | | | | *Regression Statistics* | | | | | |
| 29 | | | | | | | | Multiple R | 0.999998 | | | | |
| 30 | | | | | | | | R Square | 0.999996 | | | | |
| 31 | | | | | | | | Adjusted R | 0.999993 | | | | |
| 32 | | | | | | | | Standard E | 26.4553 | | | | |
| 33 | | | | | | | | Observatio | 4 | | | | |
| 34 | | | | | | | | | | | | | |
| 35 | | | | | | | | ANOVA | | | | | |
| 36 | | | | | | | | | *df* | *SS* | *MS* | *F* | *Significan* |
| 37 | | | | | | | | Regressioi | 1 | 319998600.2 | 319998600.2 | 457217.2857 | 2.18714E |

Figure 28. UTM CONVERSION STEP 1 program.

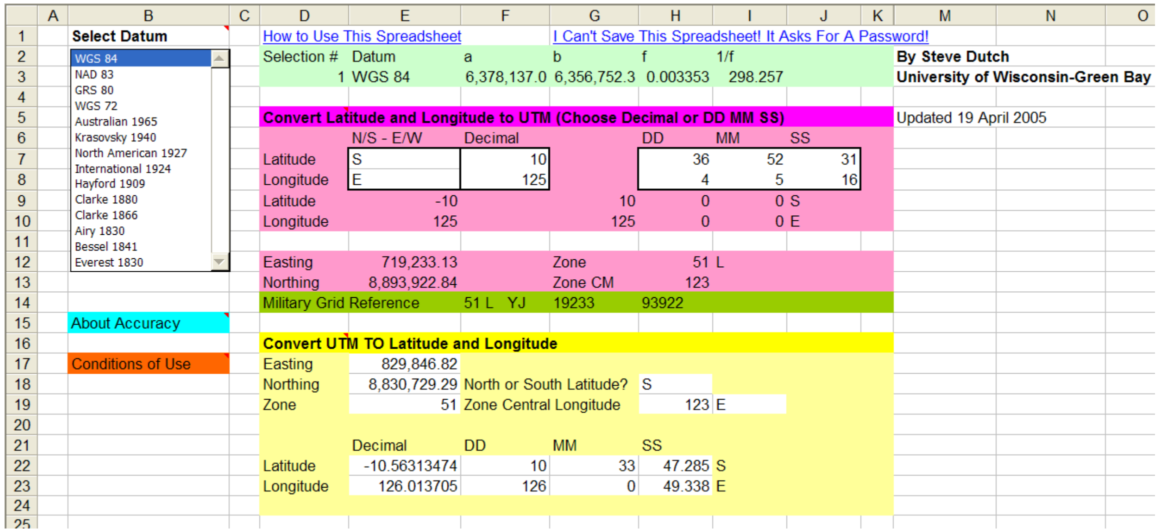



Figure 29. The UTM CONVERSION STEP 2 program.

*d. Lat-longs derived from map figures containing Township – Range – Section information.* Figure 30 is a map from containing township, range and section information. The objective is to determine the lat-longs of the six seismic lines shown in the figure. In order to do this, a template available on WWW is used: http://wefald.com/. Click on the TRS2LL program, followed by the instruction to convert township/range/section to latitude/longitude. Enter the state and meridian, followed by the township range and section. The program does not determine lat-longs below the section level, therefore the centers of the individual sections are used as points. The results showing the locations of the six seismic line-points are shown in the MapPoint display of Figure 31.

A Canadian township and range to latitude and longitude coverter can be downloaded from http://www.maptown.com/ (Figure 32).

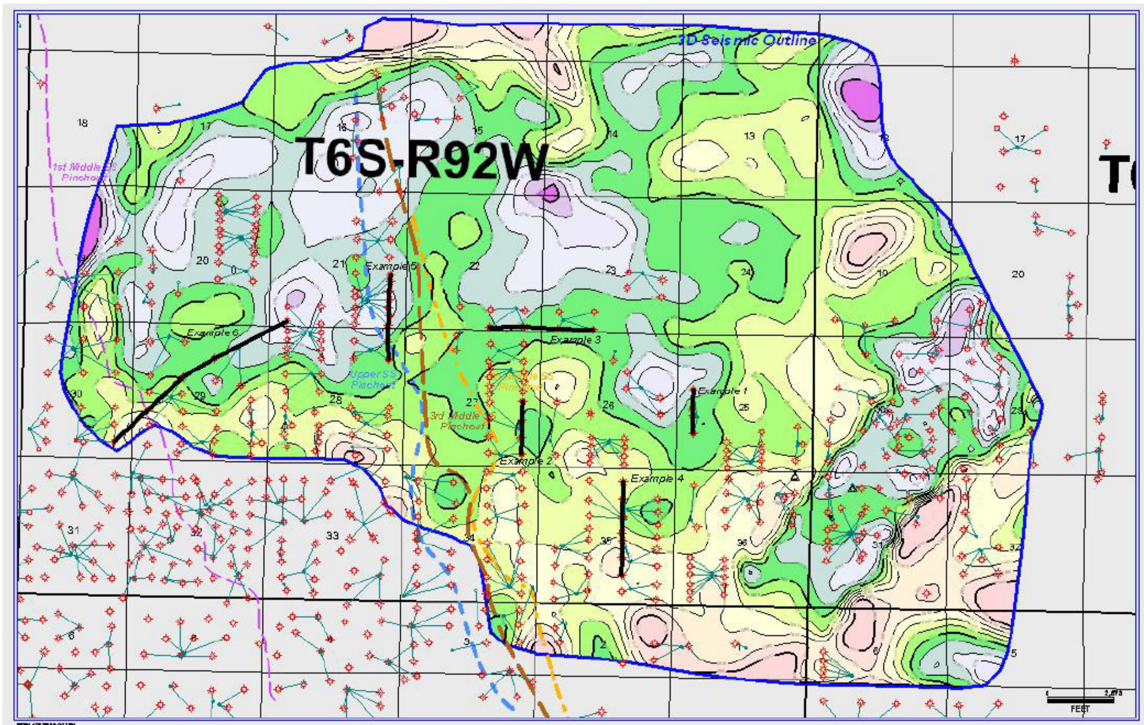



Figure 30. An example of a map from northwest Colorado containing township, range and section information. The objective is to determine the lat-longs of the six seismic lines shown in the figure (from Scheevel and Cumella, 2010).

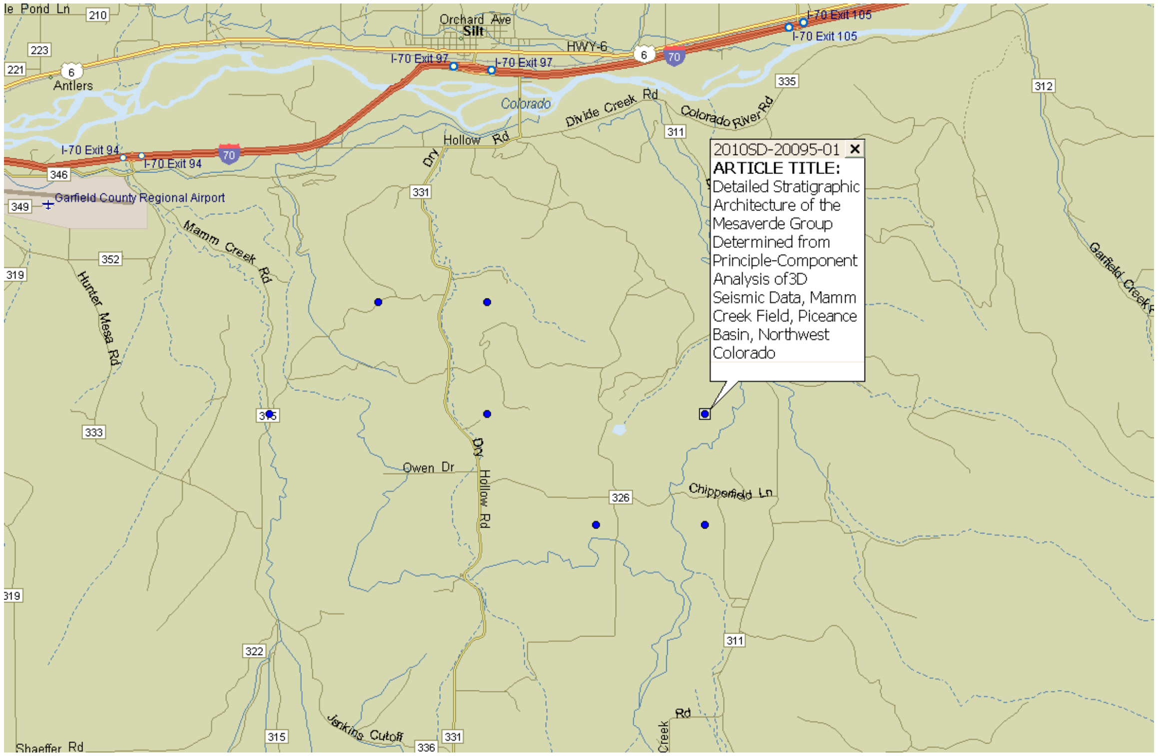



Figure 31. Using : http://wefald.com/, township, ranges and sections of the seismic lines of Figure 30 have been converted to latitude and longitude points in this MapPoint display. Note “Mamm Creek” map annotation.

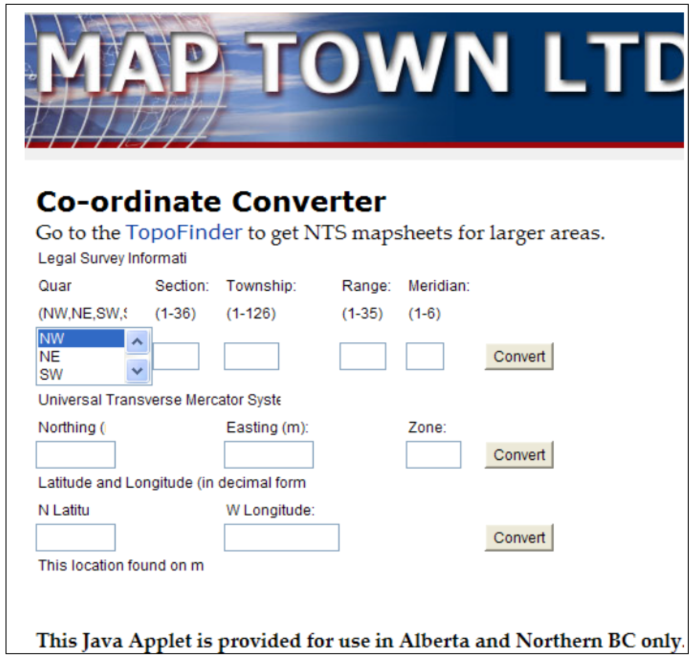


Figure 32. Township-range to lat-long converter for Alberta and northern BC.

*e. Lat-longs derived from map figures containing Gulf of Mexico blocks.* Approximately 15% of the images in the Seismic Atlas are located in the Gulf of Mexico (Figure 33).

The determination of lat-longs in the GOM is difficult, especially when located in U.S. federal and state waters, where most of the referenced maps used in the study do not contain lat-long coordinates.

Fortunately, a set of federal and state GOM block maps exist on the web (for example, http://www.gomr.boemre.gov/homepg/lsesale/pdf/tx1.pdf). See Figure 34. This allows one to link block identification with latitude and longitude. These maps have been used in several of the Atlas GOM images.

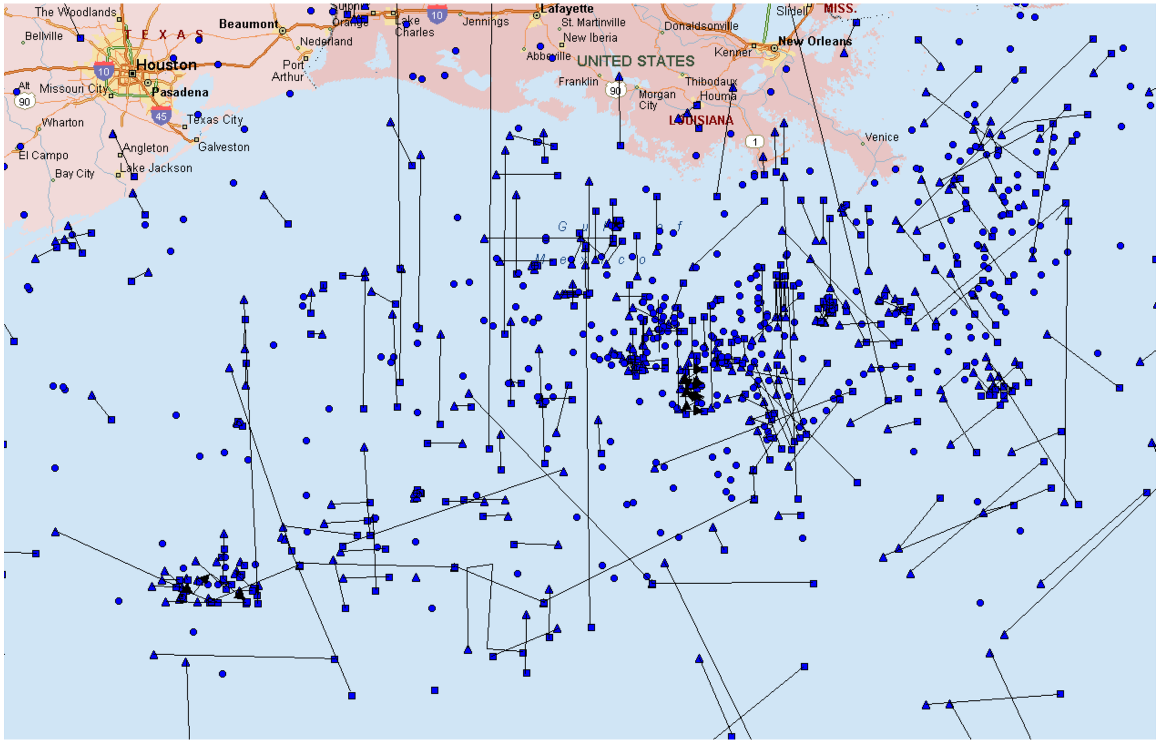



Figure 33. A portion of the Gulf of Mexico showing the density of seismic image locations in this region.

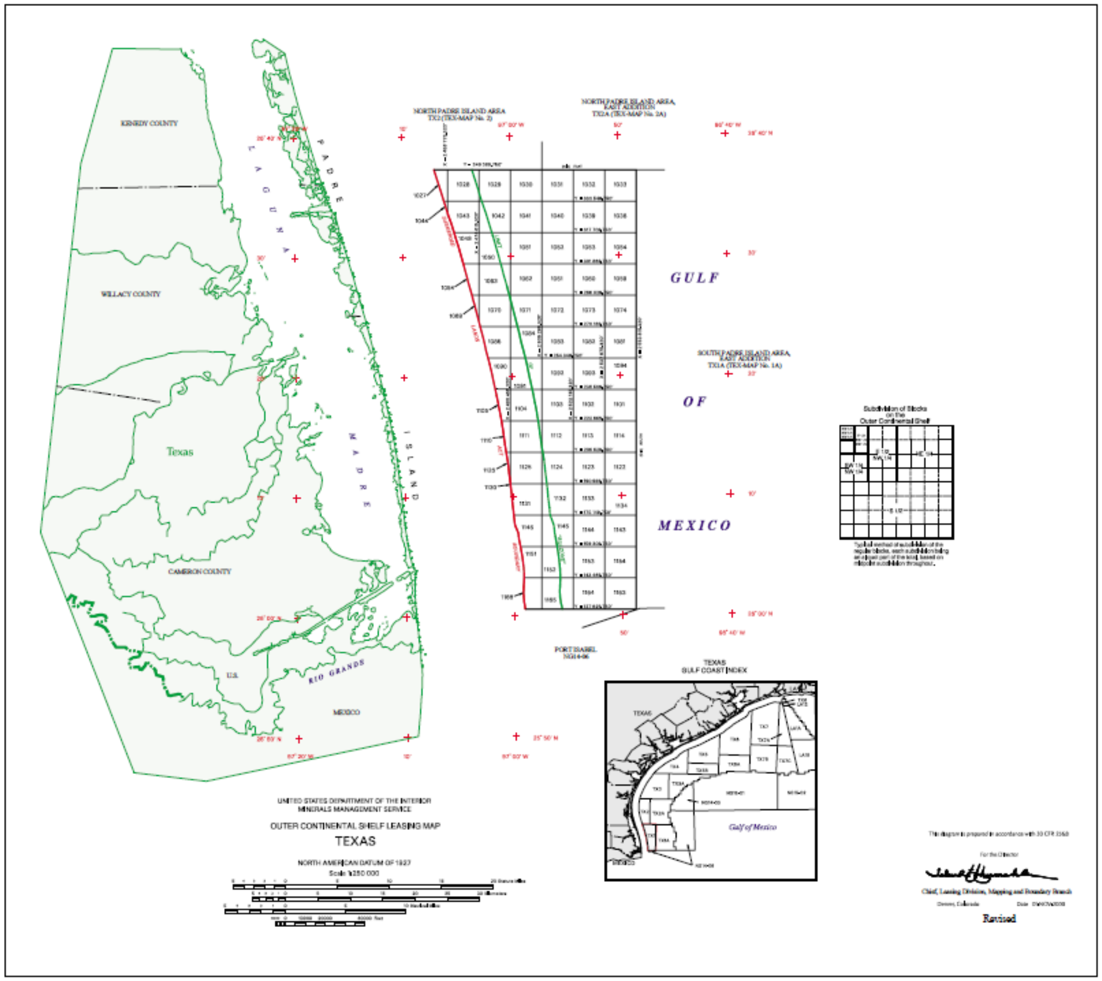



Figure 34. Example of MMS (BOEMRE) map: South Padre Island Area, which can be used to link block identification to latitude and longitude.

**Selected Examples**
(Figures 35, 36, 37, 38, 39, 40, 41, 42, 43, 44)

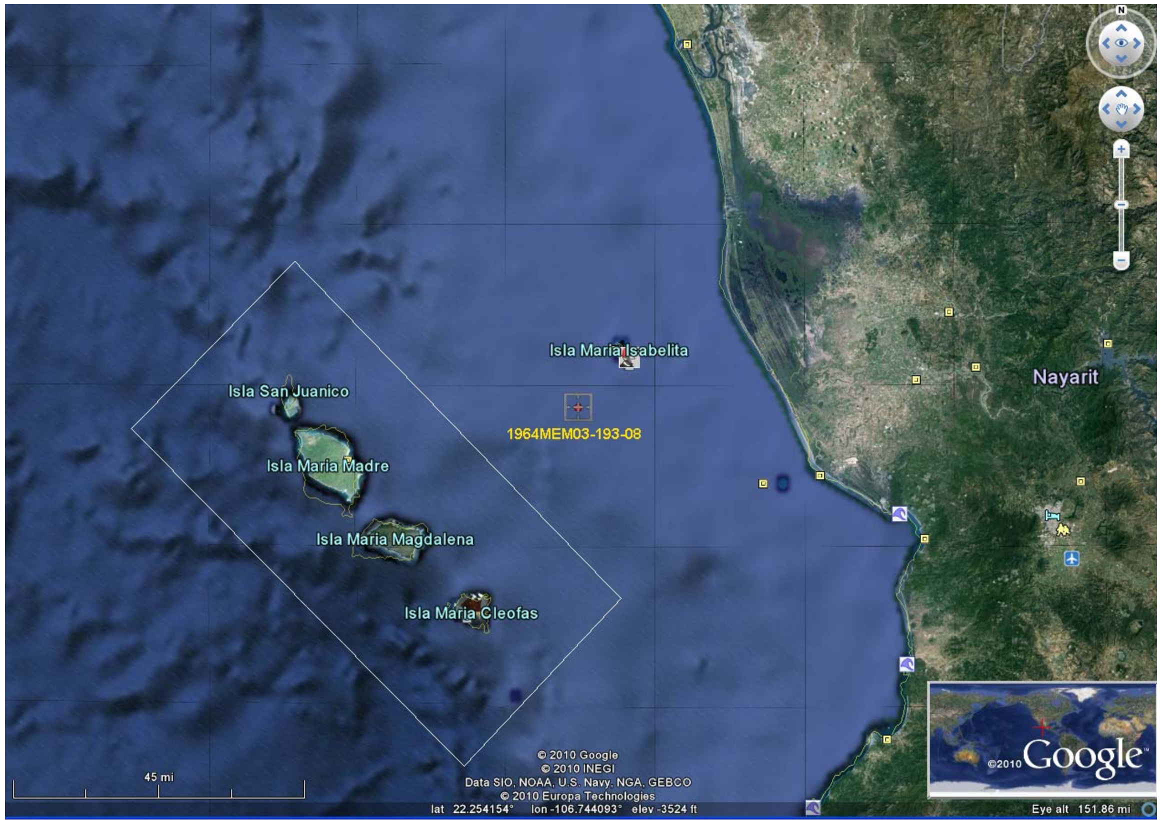
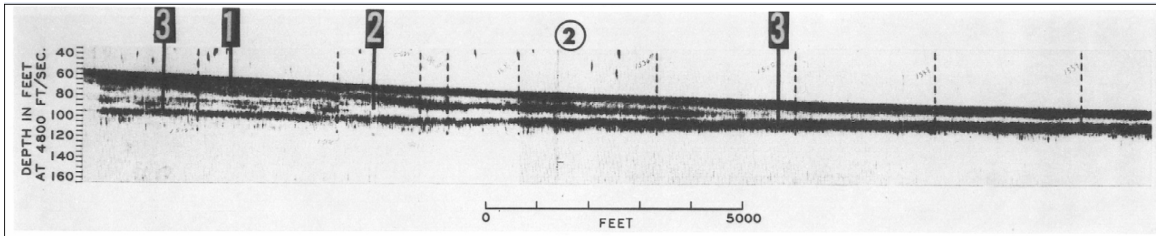



Figure 35. Google[tm]earth location of image 1964MEM03-193-07, Baja California, Costa de Nayarit, Mexico.




**1964MEM03-193-08. Baja California Costa De Nayarit sonoprobe record. (1) Surface layer of Holocene shelf-facies silty clays. (2) Holocene basal transgressive sands, locally interbedded with shelf muds. (3) Subaerial pre-transgressive alluvial surface. This surface is covered with basal sands under the shelf muds and where it crops out seaward from this record. Joseph R. Curray, David G. Moore, 1964.**

Figure 36. Atlas image 1964MEM03-193-07. An example of a 1960's vintage seismic image. The oldest image in the Atlas, possibly the first published by the AAPG.

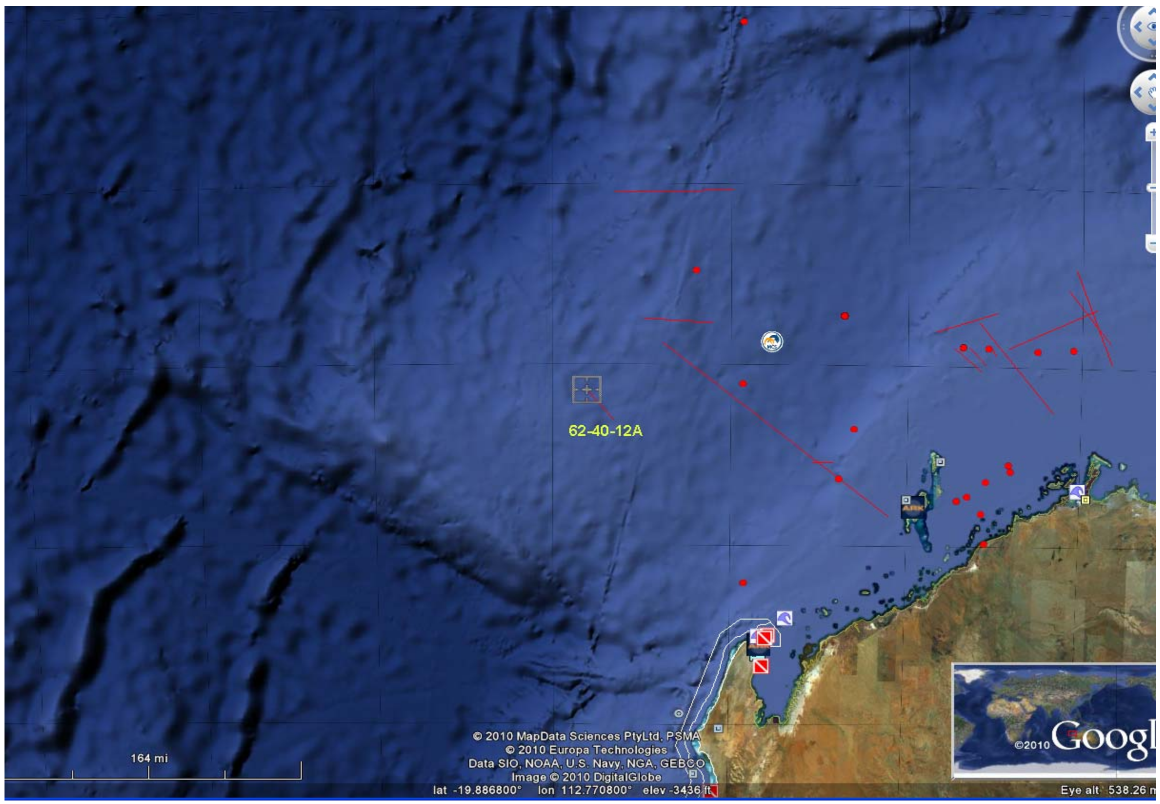
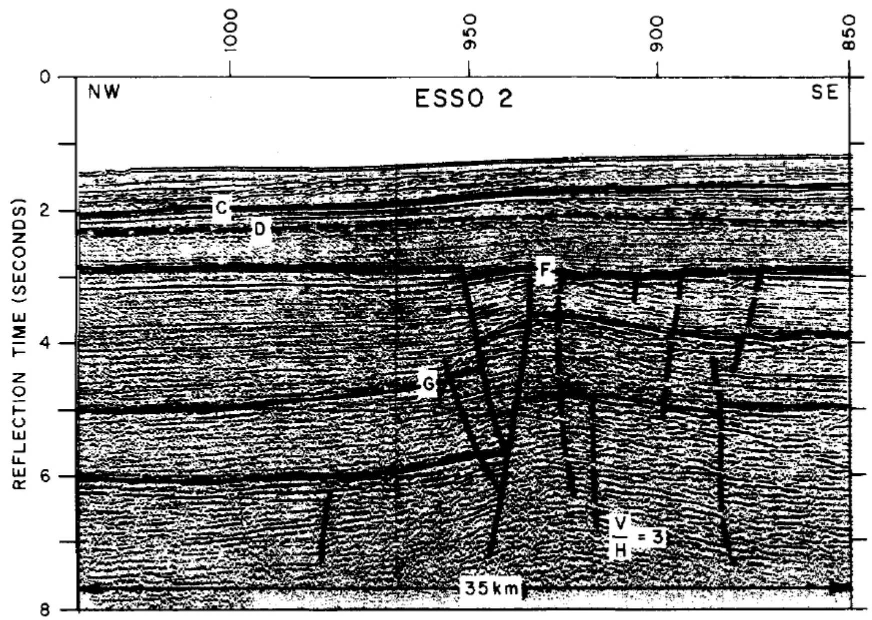



Figure 37. Google$^{tm}$earth location of image 62-40-12A, northwest shelf of Australia.




**62-40-12A. Seismic profile showing structural and stratigraphic features on Exmouth Plateau arch and northeastern Kangaroo syncline. Esso 2; N. F. Exon, J. B. Willcox, 1978.**

Figure 38. Image 62-40-12A. An example of a 1970's vintage seismic image.

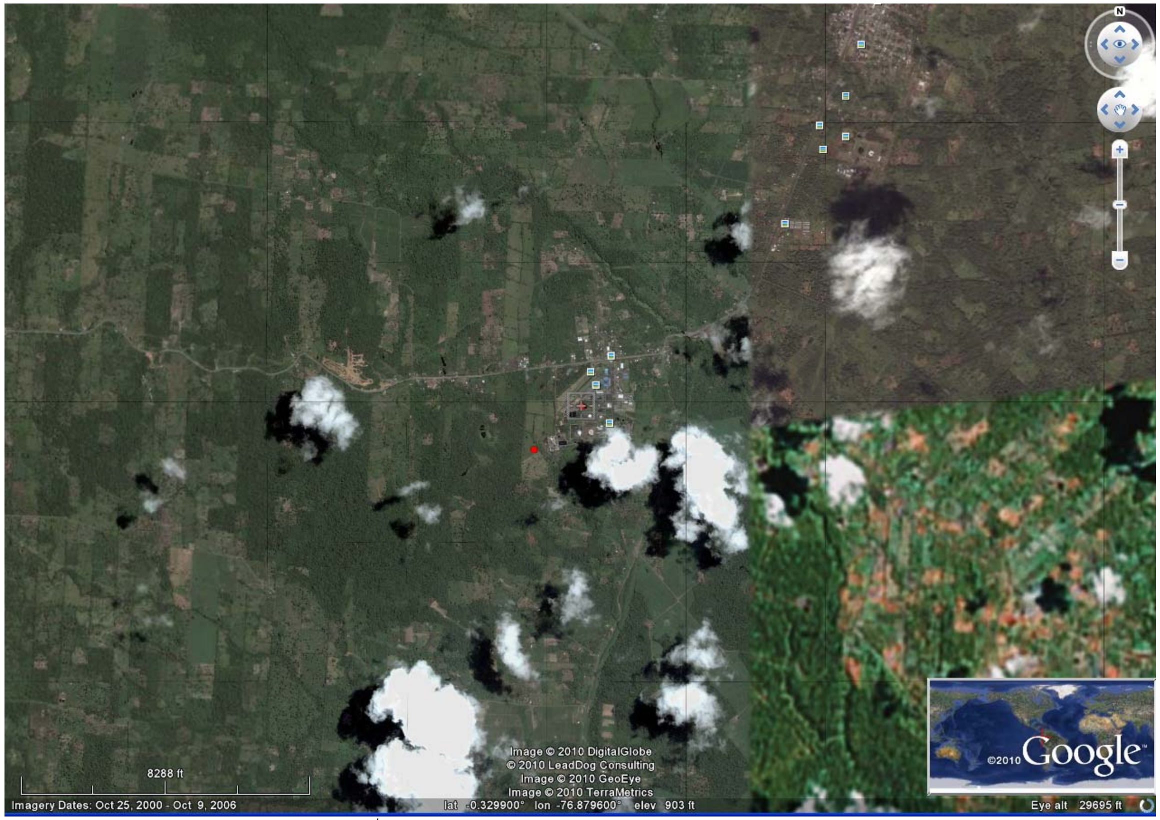
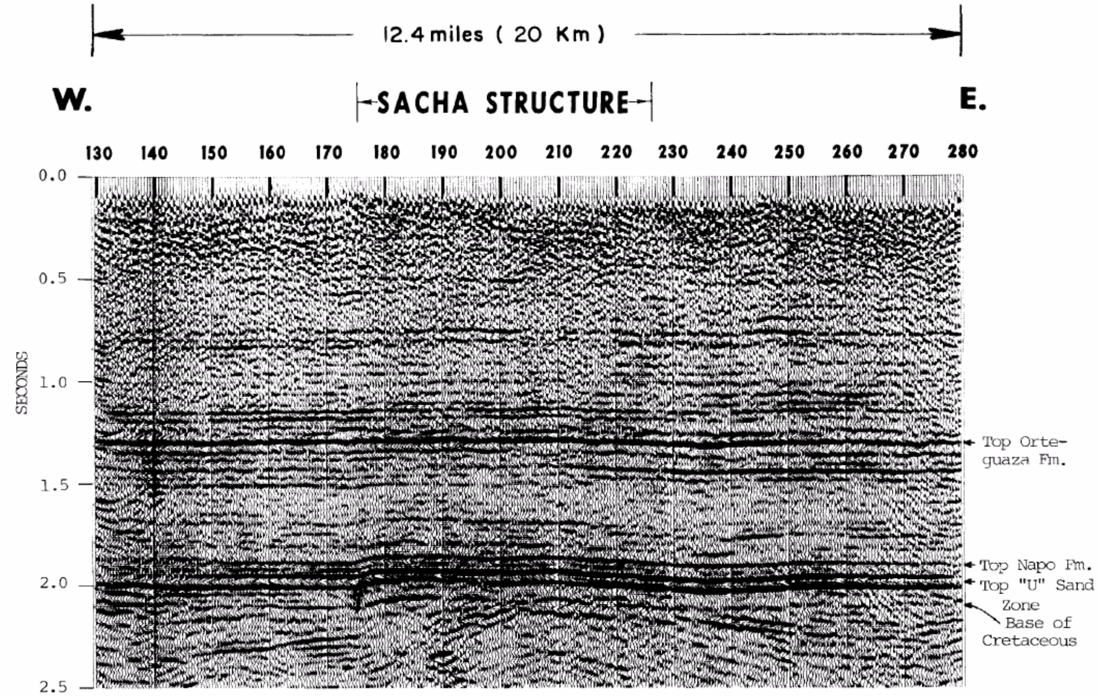



Figure 39. Google[tm]earth location of 66-1076-06 in Ecuador.




**66-1076-09. East-west digital seismic line 298 across Sacha structure showing (1) top of Orteguaza Formation, (2) top of Napo Formation, (3) top of "U" sand zone, and (4) base of Cretaceous. Robert W. Canfield et al., 1982.**

Figure 40. Image 66-1076-09. An example of a 1980's vintage seismic image from Ecuador.

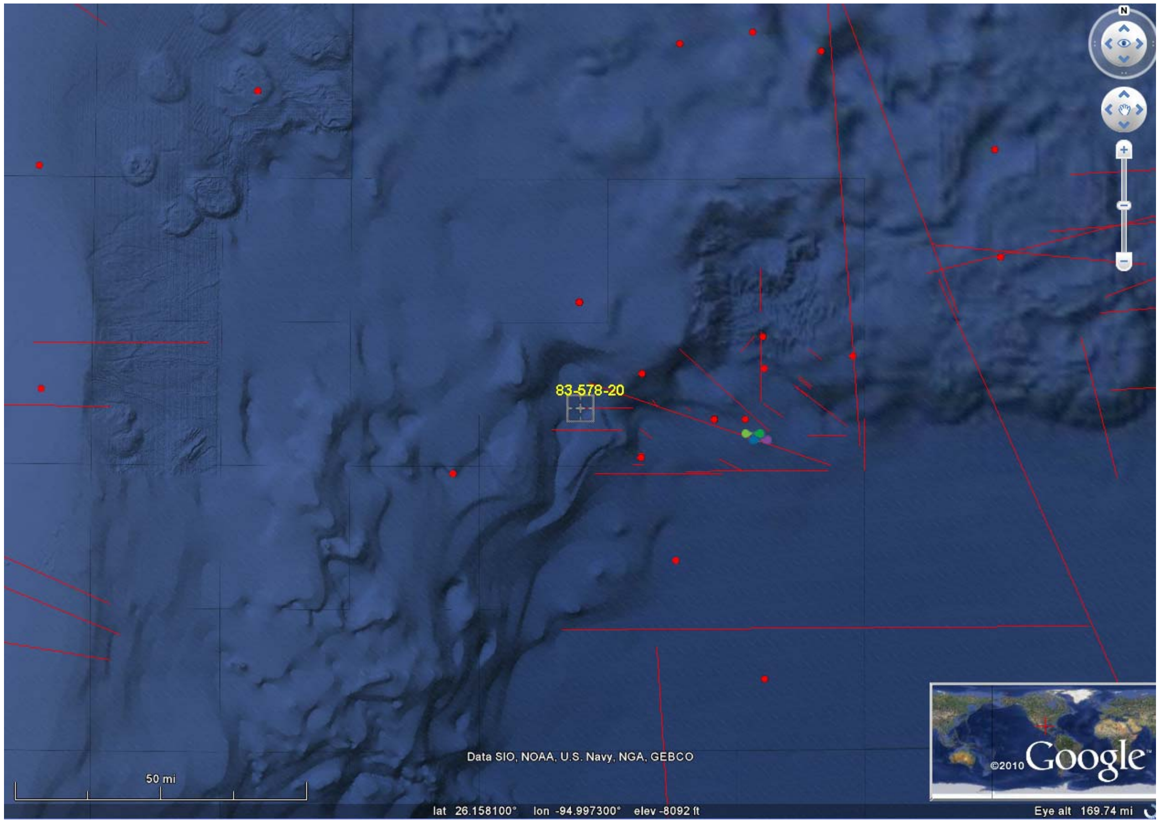
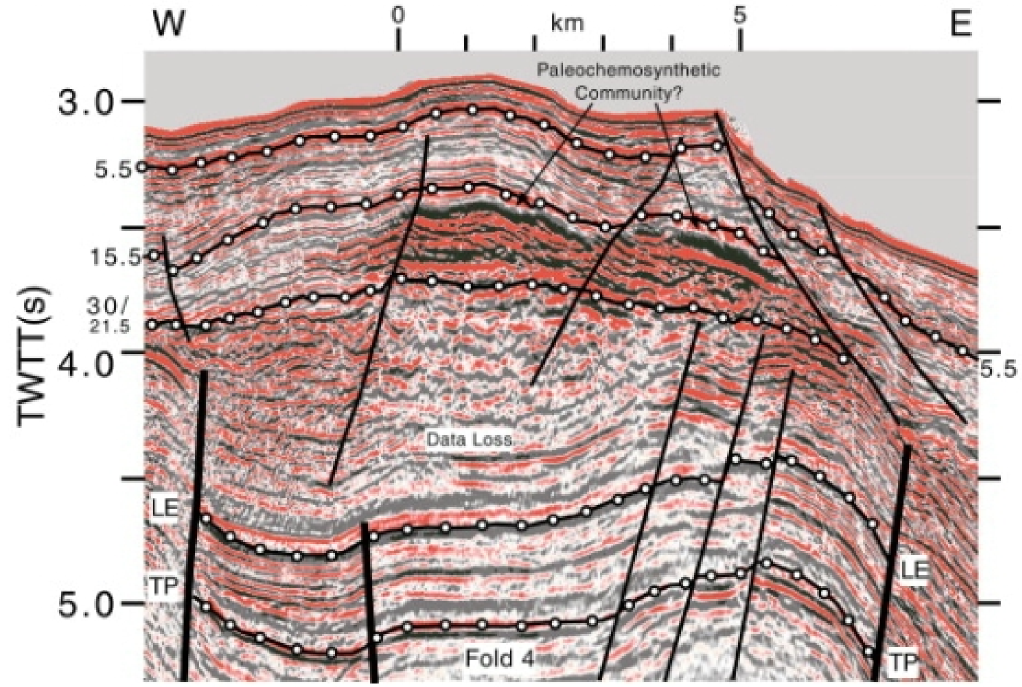



Figure 41. Google$^{tm}$earth location of 83-578-20 in the northwestern deep Gulf of Mexico.




**83-578-20. The Perdido Fold Belt, Northwestern Deep Gulf of Mexico. Seismic profile showing a possible paleochemosynthetic community on Fold 4. Fiduk et al, 1999.**

Figure 42. Image 83-578-20. An example of a 1990's vintage seismic image in the northwestern deep Gulf of Mexico.

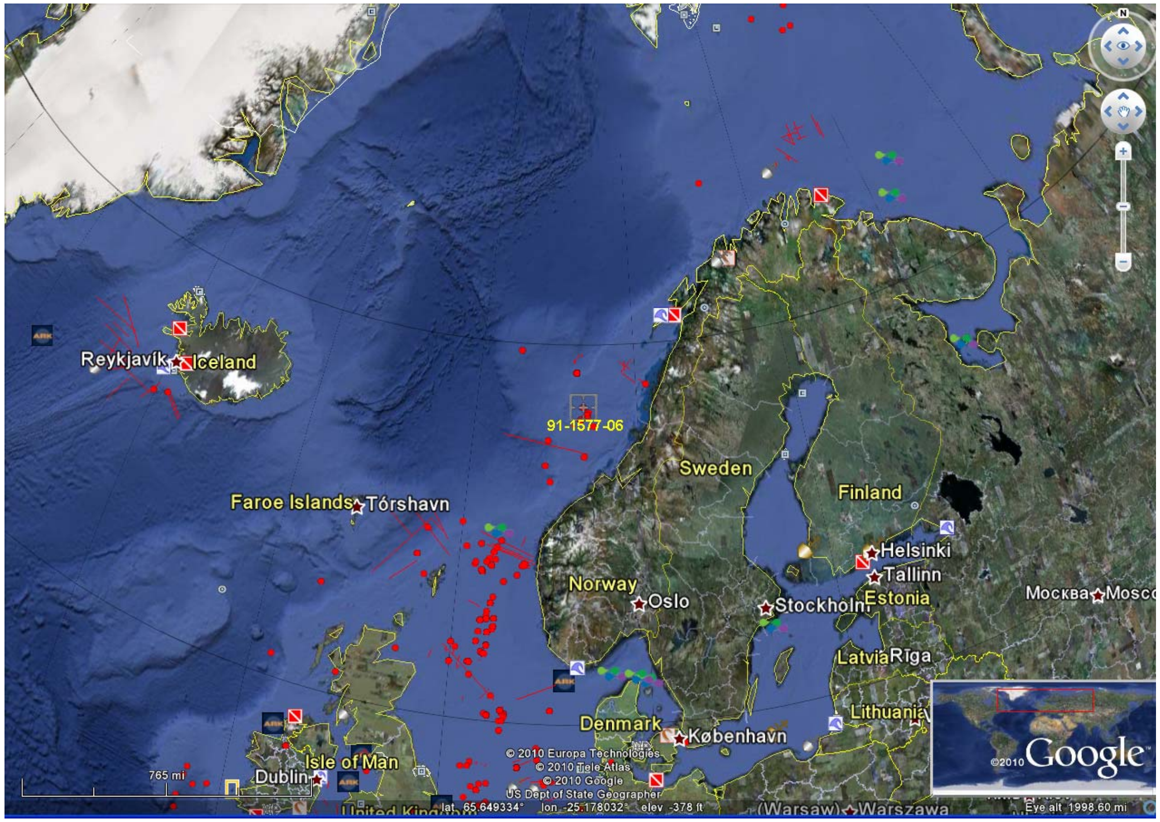
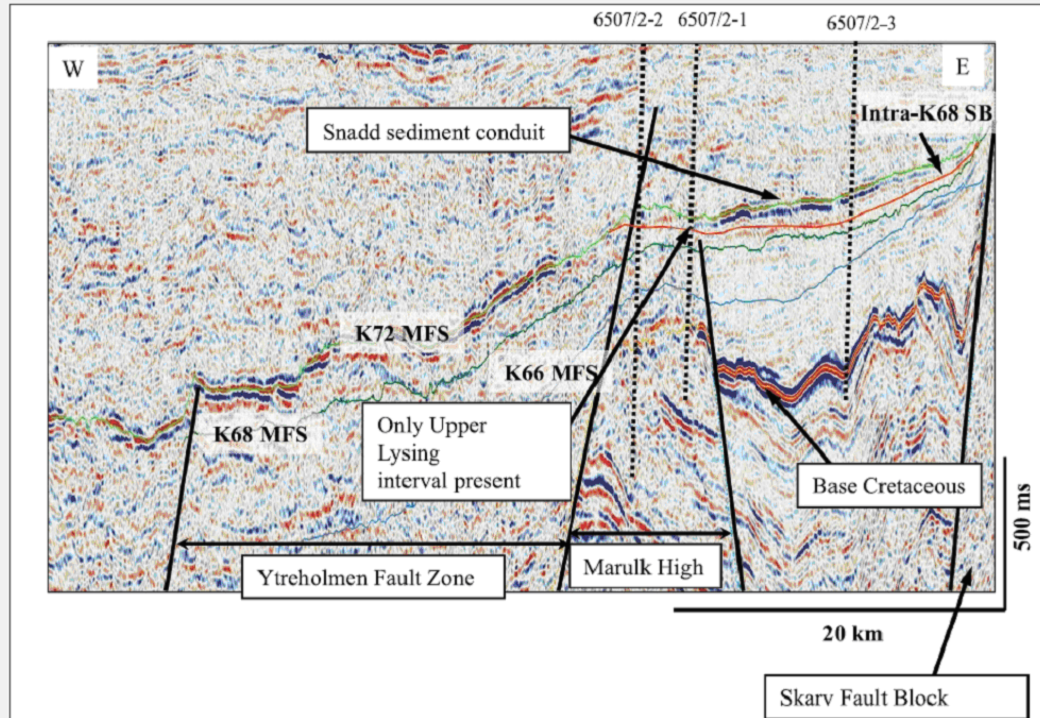



Figure 43. Google$^{tm}$earth location of North Sea. Note location of 91-1577-06.




**91-1577-05. Seismic cross section I. Edith M. G. Fugelli and Tina R. Olsen, 2007**

Figure 44. Image 91-1577-05. An example of a decade 2000 vintage seismic image from the North Sea.

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Exon, N.F., and J.B. Willcox, 1978, Geology and petroleum potential of Exmouth Plateau area off Western Australia: AAPG Bulletin, v. 62/1, p. 40-72.

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Zhang, L., X. Luo, Q. Liao, W. Yang, G. Vasseur, C. Yu, J. Su, S. Yuan, D. Xiao, and Z. Wang, 2010, Quantitative evaluation of synsedimentary fault opening and sealing properties using hydrocarbon connection probability assessment: AAPG Bulletin, v. 94/9, p. 1379-1399.

Table 1. Seismic Atlas Image Inventory

| REGION FOLDER A | REGION SUB FOLDER B | REGION SUB FOLDER C | TRACKS | POINTS | TOTAL | TOTAL | REGION SUM | TRACK SUM | POINT SUM |
|---|---|---|---|---|---|---|---|---|---|
| A. NORTH AMERICA | BAHAMAS | | 33 | 23 | 56 | | | | |
| A. NORTH AMERICA | BERING SEA - ALEUTIANS | | 15 | 30 | 45 | | | | |
| A. NORTH AMERICA | CANADA | ALBERTA | 60 | 83 | 143 | | | | |
| A. NORTH AMERICA | CANADA | ARCTIC ISLANDS | 3 | 20 | 23 | | | | |
| A. NORTH AMERICA | CANADA | BEAUFORT-MACKENZIE AREA | 16 | 26 | 42 | | | | |
| A. NORTH AMERICA | CANADA | BRITISH COLUMBIA | 11 | 21 | 32 | | | | |
| A. NORTH AMERICA | CANADA | CANADIAN ATLANTIC AND GULF OF ST, LAWRENCE | 89 | 65 | 154 | | | | |
| A. NORTH AMERICA | CANADA | MANITOBA | 0 | 1 | 1 | | | | |
| A. NORTH AMERICA | CANADA | NEW BRUNSWICK | 2 | 0 | 2 | | | | |
| A. NORTH AMERICA | CANADA | NEWFOUNDLAND | 12 | 2 | 14 | | | | |
| A. NORTH AMERICA | CANADA | NORTHWEST TERRITORIES | 26 | 2 | 28 | | | | |
| A. NORTH AMERICA | CANADA | NOVA SCOTIA | 4 | 1 | 5 | | | | |
| A. NORTH AMERICA | CANADA | ONTARIO | 5 | 1 | 6 | | | | |
| A. NORTH AMERICA | CANADA | QUEBEC | 15 | 9 | 24 | | | | |
| A. NORTH AMERICA | CANADA | SASKATCHEWAN | 1 | 18 | 19 | | | | |
| A. NORTH AMERICA | CUBA | | 14 | 11 | 25 | | | | |
| A. NORTH AMERICA | GREENLAND | | 4 | 0 | 4 | | | | |
| A. NORTH AMERICA | GULF OF CALIFORNIA | | 0 | 5 | 5 | | | | |
| A. NORTH AMERICA | GULF OF MEXICO | | 408 | 478 | 886 | | | | |
| A. NORTH AMERICA | MEXICO | | 104 | 90 | 194 | | | | |
| A. NORTH AMERICA | USA | ALABAMA | 1 | 25 | 26 | | | | |
| A. NORTH AMERICA | USA | ALASKA | 60 | 32 | 92 | | | | |
| A. NORTH AMERICA | USA | ARKANSAS | 14 | 12 | 26 | | | | |
| A. NORTH AMERICA | USA | ATLANTIC OFFSHORE (USA) | 124 | 36 | 160 | | | | |
| A. NORTH AMERICA | USA | CALIFORNIA OFFSHORE | 22 | 24 | 46 | | | | |
| A. NORTH AMERICA | USA | CALIFORNIA ONSHORE | 7 | 36 | 43 | | | | |
| A. NORTH AMERICA | USA | COLORADO | 4 | 28 | 32 | | | | |
| A. NORTH AMERICA | USA | FLORIDA | 2 | 2 | 4 | | | | |
| A. NORTH AMERICA | USA | IDAHO | 3 | 0 | 3 | | | | |
| A. NORTH AMERICA | USA | ILLINOIS | 9 | 3 | 12 | | | | |
| A. NORTH AMERICA | USA | INDIANA | 1 | 0 | 1 | | | | |
| A. NORTH AMERICA | USA | KANSAS | 2 | 8 | 10 | | | | |
| A. NORTH AMERICA | USA | KENTUCKY | 0 | 5 | 5 | | | | |
| A. NORTH AMERICA | USA | LAKE MICHIGAN | 2 | 0 | 2 | | | | |
| A. NORTH AMERICA | USA | LOUISIANA | 18 | 27 | 45 | | | | |
| A. NORTH AMERICA | USA | MICHIGAN | 0 | 6 | 6 | | | | |
| A. NORTH AMERICA | USA | MINNESOTA | 0 | 4 | 4 | | | | |
| A. NORTH AMERICA | USA | MISSISSIPPI | 5 | 14 | 19 | | | | |
| A. NORTH AMERICA | USA | MISSOURI | 1 | 0 | 1 | | | | |
| A. NORTH AMERICA | USA | MONTANA | 7 | 8 | 15 | | | | |
| A. NORTH AMERICA | USA | NEVADA | 2 | 5 | 7 | | | | |
| A. NORTH AMERICA | USA | NEW MEXICO | 7 | 23 | 30 | | | | |
| A. NORTH AMERICA | USA | NEW YORK | 0 | 4 | 4 | | | | |
| A. NORTH AMERICA | USA | NORTH CAROLINA | 3 | 2 | 5 | | | | |
| A. NORTH AMERICA | USA | NORTH DAKOTA | 1 | 14 | 15 | | | | |
| A. NORTH AMERICA | USA | OHIO | 0 | 10 | 10 | | | | |
| A. NORTH AMERICA | USA | OREGON | 0 | 6 | 6 | | | | |
| A. NORTH AMERICA | USA | OKLAHOMA | 25 | 21 | 46 | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| A. NORTH AMERICA | USA | PENNSYLVANIA | 0 | 11 | 11 | | | | |
| A. NORTH AMERICA | USA | SOUTH CAROLINA | 0 | 2 | 2 | | | | |
| A. NORTH AMERICA | USA | TEXAS | 34 | 174 | 208 | | | | |
| A. NORTH AMERICA | USA | UTAH | 0 | 7 | 7 | | | | |
| A. NORTH AMERICA | USA | VIRGINIA | 0 | 2 | 2 | | | | |
| A. NORTH AMERICA | USA | WASHINGTON | 3 | 3 | 6 | | | | |
| A. NORTH AMERICA | USA | WEST VIRGINIA | 15 | 7 | 22 | | | | |
| A. NORTH AMERICA | USA | WYOMING | 16 | 59 | 75 | 2716 | 2716 | 1210 | 1506 |
| B. CENTRAL AND SOUTH AMERICA | ARGENTINA | | 73 | 47 | 120 | | | | |
| B. CENTRAL AND SOUTH AMERICA | BARBADOS RIDGE | | 14 | 1 | 15 | | | | |
| B. CENTRAL AND SOUTH AMERICA | BELIZE | | 0 | 2 | 2 | | | | |
| B. CENTRAL AND SOUTH AMERICA | BOLIVIA | | 16 | 5 | 21 | | | | |
| B. CENTRAL AND SOUTH AMERICA | BRAZIL | | 101 | 63 | 164 | | | | |
| B. CENTRAL AND SOUTH AMERICA | CARIBBEAN SEA | | 14 | 4 | 18 | | | | |
| B. CENTRAL AND SOUTH AMERICA | CHILE | | 6 | 4 | 10 | | | | |
| B. CENTRAL AND SOUTH AMERICA | COLOMBIA | | 11 | 33 | 44 | | | | |
| B. CENTRAL AND SOUTH AMERICA | COSTA RICA | | 0 | 1 | 1 | | | | |
| B. CENTRAL AND SOUTH AMERICA | DOMINICAN REPUBLIC | | 15 | 2 | 17 | | | | |
| B. CENTRAL AND SOUTH AMERICA | ECUADOR | | 11 | 23 | 34 | | | | |
| B. CENTRAL AND SOUTH AMERICA | GUATEMALA | | 4 | 0 | 4 | | | | |
| B. CENTRAL AND SOUTH AMERICA | GUYANA | | 0 | 1 | 1 | | | | |
| B. CENTRAL AND SOUTH AMERICA | HAITI | | 1 | 0 | 1 | | | | |
| B. CENTRAL AND SOUTH AMERICA | JAMAICA OFFSHORE | | 7 | 0 | 7 | | | | |
| B. CENTRAL AND SOUTH AMERICA | NETHERLANDS ANTILLES | | 12 | 0 | 12 | | | | |
| B. CENTRAL AND SOUTH AMERICA | NICARAGUA | | 0 | 2 | 2 | | | | |
| B. CENTRAL AND SOUTH AMERICA | PANAMA | | 0 | 1 | 1 | | | | |
| B. CENTRAL AND SOUTH AMERICA | PARAGUAY | | 2 | 0 | 2 | | | | |
| B. CENTRAL AND SOUTH AMERICA | PERU | | 11 | 20 | 31 | | | | |
| B. CENTRAL AND SOUTH AMERICA | SURINAME | | 2 | 0 | 2 | | | | |
| B. CENTRAL AND SOUTH AMERICA | TRINIDAD AND TOBAGO | | 23 | 11 | 34 | | | | |
| B. CENTRAL AND SOUTH AMERICA | U.S. VIRGIN ISLANDS OFFSHORE | | 0 | 1 | 1 | | | | |
| B. CENTRAL AND SOUTH AMERICA | URUGUAY | | 5 | 3 | 8 | | | | |
| B. CENTRAL AND SOUTH AMERICA | VENEZUELA | | 64 | 50 | 114 | 3382 | 666 | | |
| C. WESTERN EUROPE | BARENTS SEA | | 14 | 4 | 18 | | | | |
| C. WESTERN EUROPE | DENMARK | | 0 | 8 | 8 | | | | |
| C. WESTERN EUROPE | FRANCE | | 2 | 12 | 14 | | | | |
| C. WESTERN EUROPE | GERMANY | | 11 | 14 | 25 | | | | |
| C. WESTERN EUROPE | IBERIAN MARGIN | | 7 | 0 | 7 | | | | |
| C. WESTERN EUROPE | ICELAND ATLANTIC | | 30 | -14 | 16 | | | | |
| C. WESTERN EUROPE | IRELAND | | 0 | 3 | 3 | | | | |
| C. WESTERN EUROPE | IRELAND ATLANTIC | | 2 | 13 | 15 | | | | |
| C. WESTERN EUROPE | IRISH SEA | | 6 | 0 | 6 | | | | |
| C. WESTERN EUROPE | ITALY | | 13 | 72 | 85 | | | | |
| C. WESTERN EUROPE | NETHERLANDS | | 5 | 4 | 9 | | | | |
| C. WESTERN EUROPE | NORTHWESTERN MEDITERRANEAN | | 26 | 31 | 57 | | | | |
| C. WESTERN EUROPE | NORWAY | | 71 | 111 | 182 | | | | |
| C. WESTERN EUROPE | PORTUGAL | | 6 | 1 | 7 | | | | |
| C. WESTERN EUROPE | SPAIN | | 2 | 6 | 8 | | | | |
| C. WESTERN EUROPE | SPITSBERGEN, SVALBARD | | 4 | 2 | 6 | | | | |
| C. WESTERN EUROPE | SWEDEN | | 0 | 1 | 1 | | | | |
| C. WESTERN EUROPE | SWITZERLAND | | 0 | 1 | 1 | | | | |
| C. WESTERN EUROPE | UNITED KINGDOM | | 44 | 83 | 127 | 3977 | 595 | | |

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|---|---|---|---|---|---|---|---|---|---|
| D. EASTERN EUROPE & FORMER USSR | ALBANIA | | 0 | 1 | 1 | | | | |
| D. EASTERN EUROPE & FORMER USSR | AUSTRIA | | 2 | 4 | 6 | | | | |
| D. EASTERN EUROPE & FORMER USSR | AZERBAIJAN | | 2 | 9 | 11 | | | | |
| D. EASTERN EUROPE & FORMER USSR | BLACK SEA | | 22 | 0 | 22 | | | | |
| D. EASTERN EUROPE & FORMER USSR | BULGARIA | | 2 | 0 | 2 | | | | |
| D. EASTERN EUROPE & FORMER USSR | CZECH REPUBLIC | | 1 | 5 | 6 | | | | |
| D. EASTERN EUROPE & FORMER USSR | GREECE | | 17 | 6 | 23 | | | | |
| D. EASTERN EUROPE & FORMER USSR | HUNGARY | | 36 | 7 | 43 | | | | |
| D. EASTERN EUROPE & FORMER USSR | KAZAKHSTAN | | 20 | 34 | 54 | | | | |
| D. EASTERN EUROPE & FORMER USSR | MEDITERRANEAN (EASTERN SECTOR) | | 4 | 2 | 6 | | | | |
| D. EASTERN EUROPE & FORMER USSR | POLAND | | 10 | 2 | 12 | | | | |
| D. EASTERN EUROPE & FORMER USSR | REPUBLIC OF GEORGIA | | 2 | 0 | 2 | | | | |
| D. EASTERN EUROPE & FORMER USSR | ROMANIA | | 8 | 12 | 20 | | | | |
| D. EASTERN EUROPE & FORMER USSR | RUSSIA | | 6 | 3 | 9 | | | | |
| D. EASTERN EUROPE & FORMER USSR | SLOVAKIA | | 3 | 1 | 4 | | | | |
| D. EASTERN EUROPE & FORMER USSR | TURKEY | | 25 | 0 | 25 | | | | |
| D. EASTERN EUROPE & FORMER USSR | TURKMENISTAN | | 0 | 2 | 2 | 4225 | 248 | | |
| D. EASTERN EUROPE & FORMER USSR | UKRAINE | | 1 | 0 | 1 | | | | |
| E. MIDDLE EAST | ABU DHABI, UAE | | 0 | 20 | 20 | | | | |
| E. MIDDLE EAST | CYPRUS | | 0 | 5 | 5 | | | | |
| E. MIDDLE EAST | IRAQ | | 0 | 2 | 2 | | | | |
| E. MIDDLE EAST | ISRAEL | | 29 | 15 | 44 | | | | |
| E. MIDDLE EAST | KUWAIT | | 5 | 1 | 6 | | | | |
| E. MIDDLE EAST | LEBANON | | 0 | 3 | 3 | | | | |
| E. MIDDLE EAST | OMAN | | 7 | 25 | 32 | | | | |
| E. MIDDLE EAST | QATAR | | 0 | 1 | 1 | | | | |
| E. MIDDLE EAST | RED SEA | | 9 | 1 | 10 | | | | |
| E. MIDDLE EAST | SAUDI ARABIA | | 3 | 11 | 14 | | | | |
| E. MIDDLE EAST | SYRIA | | 3 | 7 | 10 | | | | |
| E. MIDDLE EAST | YEMEN | | 1 | 1 | 2 | 4375 | 149 | | |
| F. AFRICA | ALGERIA | | 4 | 5 | 9 | | | | |
| F. AFRICA | ANGOLA | | 31 | 55 | 86 | | | | |
| F. AFRICA | ATLANTIC (AFRICAN) DEEP | | 1 | 6 | 7 | | | | |
| F. AFRICA | BOTSWANA | | 2 | 0 | 2 | | | | |
| F. AFRICA | CAMEROON | | 0 | 9 | 9 | | | | |
| F. AFRICA | CHAD | | 1 | 11 | 12 | | | | |
| F. AFRICA | CONGO (DRC) | | 0 | 8 | 8 | | | | |
| F. AFRICA | EAST AFRICAN CONTINENTAL MARGIN | | 1 | 12 | 13 | | | | |
| F. AFRICA | EAST AFRICAN RIFT SYSTEM | | 13 | 25 | 38 | | | | |
| F. AFRICA | EGYPT | | 19 | 36 | 55 | | | | |
| F. AFRICA | EQUATORIAL GUINEA | | 12 | 6 | 18 | | | | |
| F. AFRICA | ETHIOPIA | | 7 | 0 | 7 | | | | |
| F. AFRICA | GABON | | 29 | 6 | 35 | | | | |
| F. AFRICA | IVORY COAST | | 1 | 1 | 2 | | | | |
| F. AFRICA | KENYA | | 0 | 6 | 6 | | | | |
| F. AFRICA | LIBYA | | 0 | 17 | 17 | | | | |
| F. AFRICA | MADAGASCAR | | 2 | 2 | 4 | | | | |
| F. AFRICA | MAURITANIA | | 2 | 0 | 2 | | | | |
| F. AFRICA | MOROCCO | | 46 | 22 | 68 | | | | |
| F. AFRICA | MOZAMBIQUE CHANNEL | | 8 | 5 | 13 | | | | |
| F. AFRICA | NAMIBIA | | 11 | 2 | 13 | | | | |
| F. AFRICA | NIGER | | 0 | 7 | 7 | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| F. AFRICA | NIGERIA | | 27 | 75 | 102 | | | | |
| F. AFRICA | SENEGAL | | 0 | 1 | 1 | | | | |
| F. AFRICA | SIERRA LEONE - LIBERIA | | 0 | 4 | 4 | | | | |
| F. AFRICA | SOMALIA | | 0 | 1 | 1 | | | | |
| F. AFRICA | SOUTH AFRICA | | 24 | 19 | 43 | | | | |
| F. AFRICA | SUDAN | | 2 | 7 | 9 | | | | |
| F. AFRICA | TANZANIA | | 0 | 5 | 5 | | | | |
| F. AFRICA | TUNISIA | | 10 | 12 | 22 | 4993 | 618 | | |
| G. ASIA & OCEANIA | ANDAMAN SEA | | 1 | 3 | 4 | | | | |
| G. ASIA & OCEANIA | AUSTRALIA | | 75 | 79 | 154 | | | | |
| G. ASIA & OCEANIA | BANGLADESH | | 2 | 1 | 3 | | | | |
| G. ASIA & OCEANIA | BRUNEI | | 0 | 8 | 8 | | | | |
| G. ASIA & OCEANIA | CHINA | BAISE | 0 | 1 | 1 | | | | |
| G. ASIA & OCEANIA | CHINA | BOHAI | 18 | 8 | 26 | | | | |
| G. ASIA & OCEANIA | CHINA | ERLIAN BASIN | 0 | 5 | 5 | | | | |
| G. ASIA & OCEANIA | CHINA | HUBEI AND SICHUAN PROVINCES | 0 | 2 | 2 | | | | |
| G. ASIA & OCEANIA | CHINA | LIAONING PROVINCE | 1 | 0 | 1 | | | | |
| G. ASIA & OCEANIA | CHINA | PHILIPPINE SEA | 0 | 1 | 1 | | | | |
| G. ASIA & OCEANIA | CHINA | QAIDAM BASIN | 5 | 0 | 5 | | | | |
| G. ASIA & OCEANIA | CHINA | SICHUAN BASIN | 6 | 10 | 16 | | | | |
| G. ASIA & OCEANIA | CHINA | SONGLIAO BASIN | 1 | 3 | 4 | | | | |
| G. ASIA & OCEANIA | CHINA | SOUTH CHINA SEA | 44 | 14 | 58 | | | | |
| G. ASIA & OCEANIA | CHINA | SUBEI BASIN | 0 | 1 | 1 | | | | |
| G. ASIA & OCEANIA | CHINA | TARIM BASIN | 5 | 6 | 11 | | | | |
| G. ASIA & OCEANIA | CHINA | TIAN SHAN (FOOTHILLS) | 0 | 3 | 3 | | | | |
| G. ASIA & OCEANIA | CHINA | YINGGEHAI BASIN | 11 | 4 | 15 | | | | |
| G. ASIA & OCEANIA | CHINA | ZHEJIANG PROVINCE | 0 | 1 | 1 | | | | |
| G. ASIA & OCEANIA | CHINA | ZHUNGEER BASIN | 0 | 1 | 1 | | | | |
| G. ASIA & OCEANIA | EAST CHINA SEA AND YELLOW SEA | | 7 | 3 | 10 | | | | |
| G. ASIA & OCEANIA | INDIA | | 18 | 20 | 38 | | | | |
| G. ASIA & OCEANIA | INDIAN OCEAN | | 11 | 0 | 11 | | | | |
| G. ASIA & OCEANIA | INDONESIA | | 37 | 102 | 139 | | | | |
| G. ASIA & OCEANIA | JAPAN | | 15 | 12 | 27 | | | | |
| G. ASIA & OCEANIA | JAVA TRENCH | | 3 | 4 | 7 | | | | |
| G. ASIA & OCEANIA | MALAYSIA | | 11 | 36 | 47 | | | | |
| G. ASIA & OCEANIA | MALDIVES | | 11 | 4 | 15 | | | | |
| G. ASIA & OCEANIA | MONGOLIA | | 6 | 0 | 6 | | | | |
| G. ASIA & OCEANIA | NEW ZEALAND | | 28 | 30 | 58 | | | | |
| G. ASIA & OCEANIA | PAKISTAN | | 23 | 4 | 27 | | | | |
| G. ASIA & OCEANIA | PAPUA NEW GUINEA | | 13 | 13 | 26 | | | | |
| G. ASIA & OCEANIA | PHILIPPINES | | 10 | 17 | 27 | | | | |
| G. ASIA & OCEANIA | SOUTH KOREA | | 1 | 0 | 1 | | | | |
| G. ASIA & OCEANIA | SULU SEA | | 5 | 0 | 5 | | | | |
| G. ASIA & OCEANIA | TAIWAN | | 5 | 0 | 5 | | | | |
| G. ASIA & OCEANIA | THAILAND | | 1 | 13 | 14 | | | | |
| G. ASIA & OCEANIA | TIMOR TRENCH | | 0 | 3 | 3 | | | | |
| G. ASIA & OCEANIA | TONGA-LAU-FIJI | | 4 | 0 | 4 | | | | |
| G. ASIA & OCEANIA | VIETNAM | | 14 | 5 | 19 | 5802 | | | |
| H. ATLANTIC DEEP | | | 12 | 4 | 16 | 5818 | | | |
| I. ARCTIC OCEAN BASIN | | | 0 | 1 | 1 | 5819 | | | |
| | | | | | | | | | |
| | | | 2720 | 3099 | | **5819** | | | |