Advancing CoreWall

Lessons learned from my own visualization experiences

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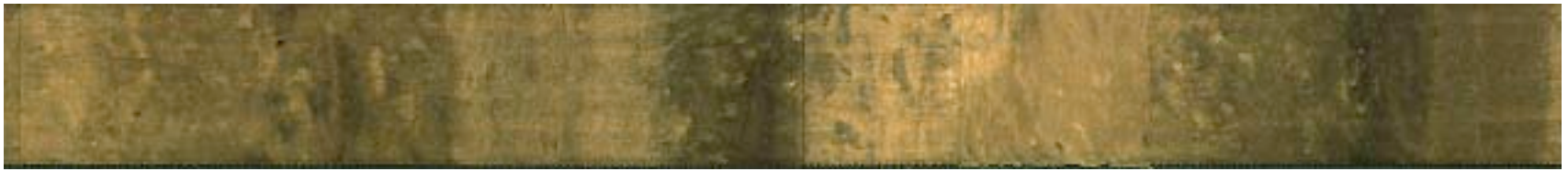
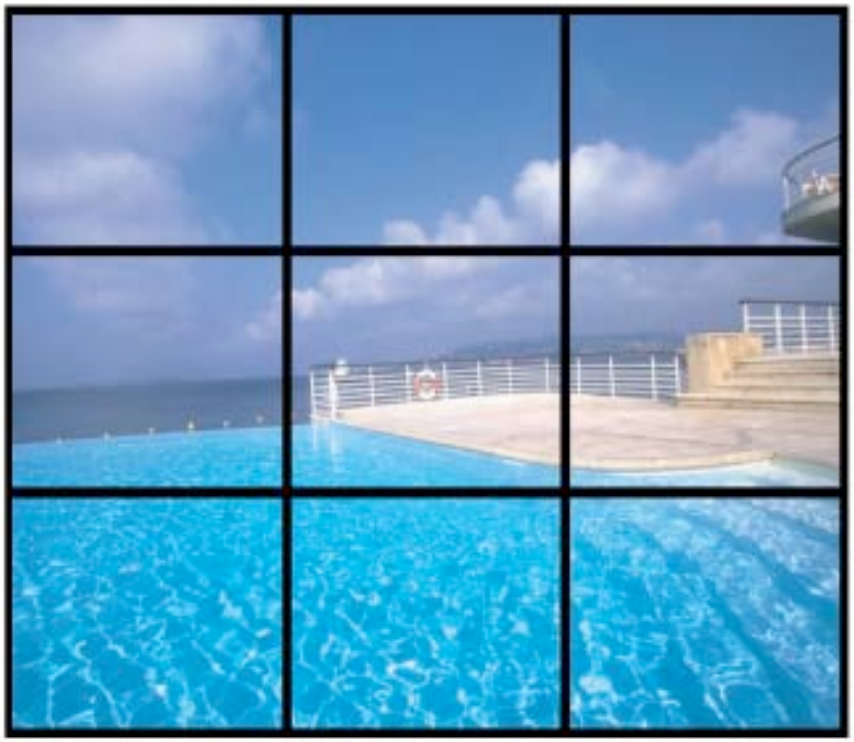
Paradigm

Visualization, data presentation, interaction and analysis



CoreWall at AGU 2004.



Multiple screens in arrays

Requires

Dedicated viewing facilities at selected sites: e.g., research labs, schools, university lecture halls, museums, aboard ships

Current use of such systems

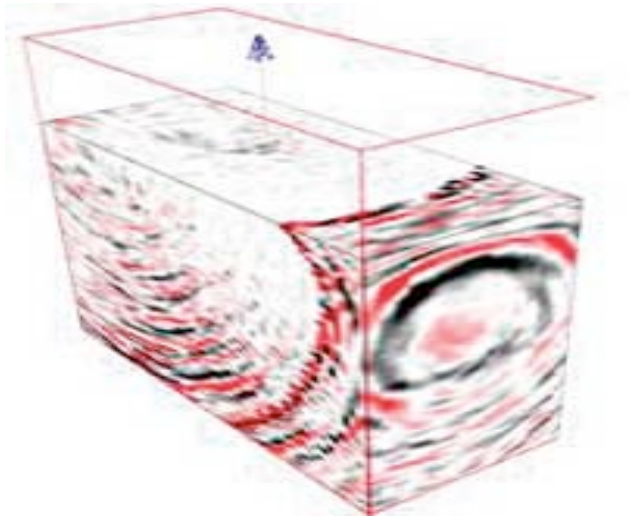
Command and control such as homeland security

Advantages of Video Walls

- Can view lots of information: e.g., list of flights at an airport
- Multiple camera shots for a security guard

Limitations

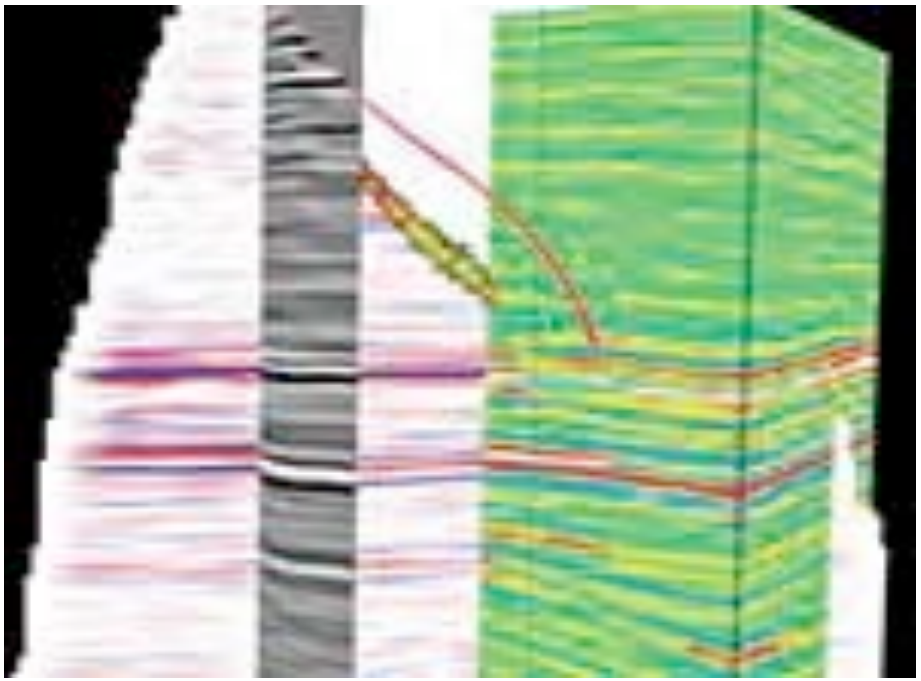
- Human peripheral vision
- Peripheral vision is weak especially at distinguishing color and shape because the density of receptor cells on the retina is greatest at the center and much lower at the edges



Useful Applications

In vaults to visually explore 3-D datasets such as:

- reflection profiles
- borehole imagery
- model computations



Old paradigm: (Video Walls)

- Large viewing real estate needed for study of large datasets at high-resolution. This requires an array of LCD screens.

New paradigm: (Google Earth)

- PC video-game technology makes it possible to fly and zoom through huge data sets instantly and interactively on a single screen.

Old paradigm: (Video Walls)

- Limited audience of expert users

New paradigm: (Google Earth)

- Global audience of novice to expert

My own experience

Started in the late 1988 with “MapMaker” application:

- Involved multibeam sonars that broadcast data on the shipboard internet

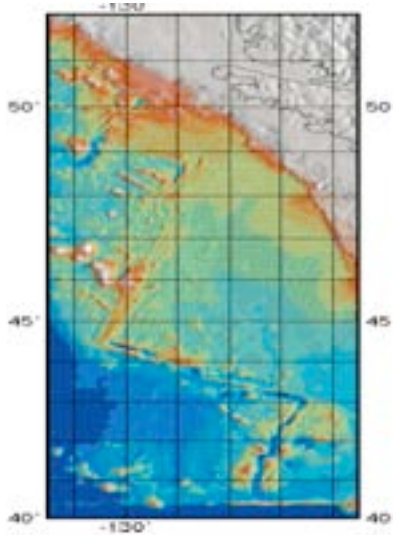
- Workstations at any location (lab, stateroom, bridge) could view bathymetric maps as they we created ping-by-ping

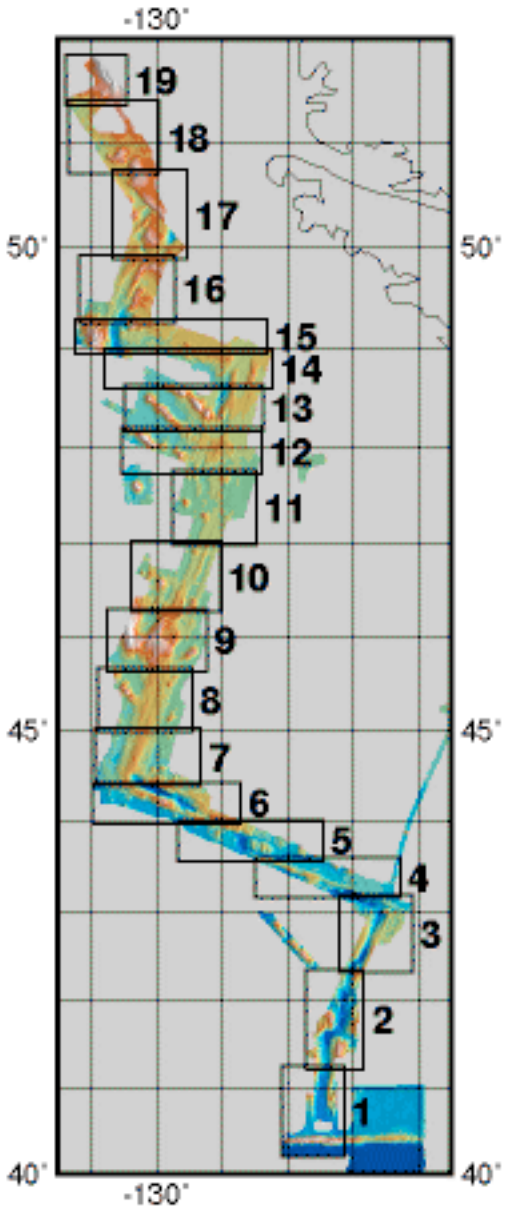
- Coded in “C” with X11 Window system on UNIX.

Evolved into

RIDGE Multibeam Synthesis Project

- Sun-shaded bathymetric maps delivered by a few clicks from WEB pages



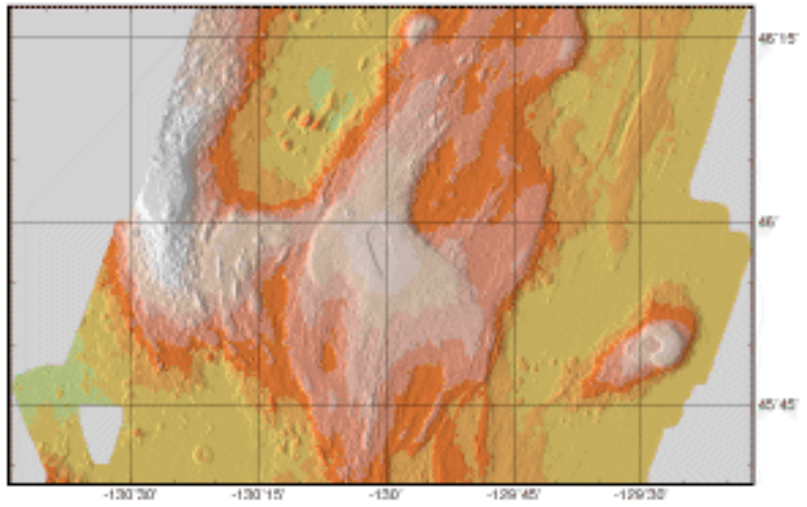


- Maps created, stored and retrieved as pre-created "tiles" at successive resolutions

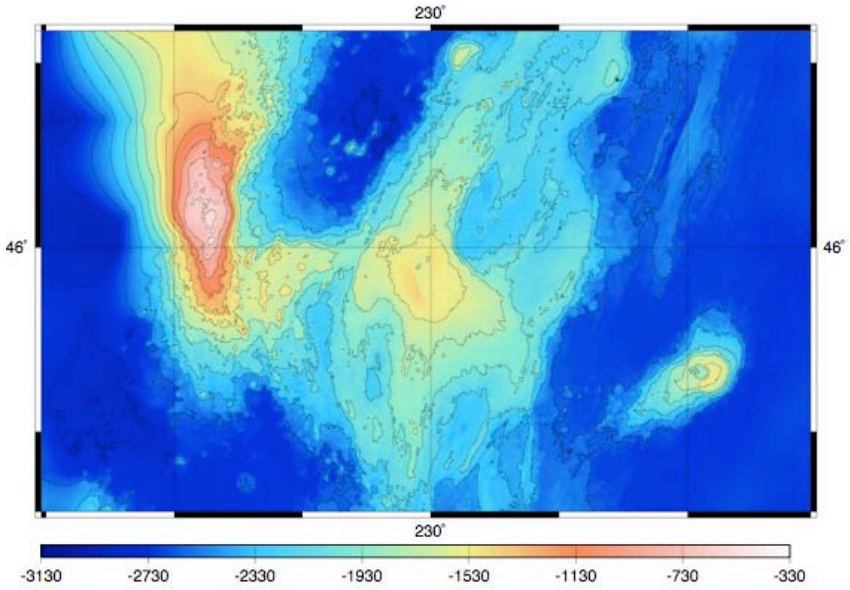
Limitations

• Although one could sub-sample grids and contour grids at selected intervals and scales using WEB page forms and buttons, the user's interaction was limited.

• For example, one could not superimpose other data types, such as track lines, sampling stations, ALVIN dives, etc.



North East Pacific Bathymetry



Lessons Learned

- Delivering pre-created maps did not meet user needs

- Users wanted to craft their own maps, explore data through visualization and superimpose data from other databases.

Initial Solution (2001)

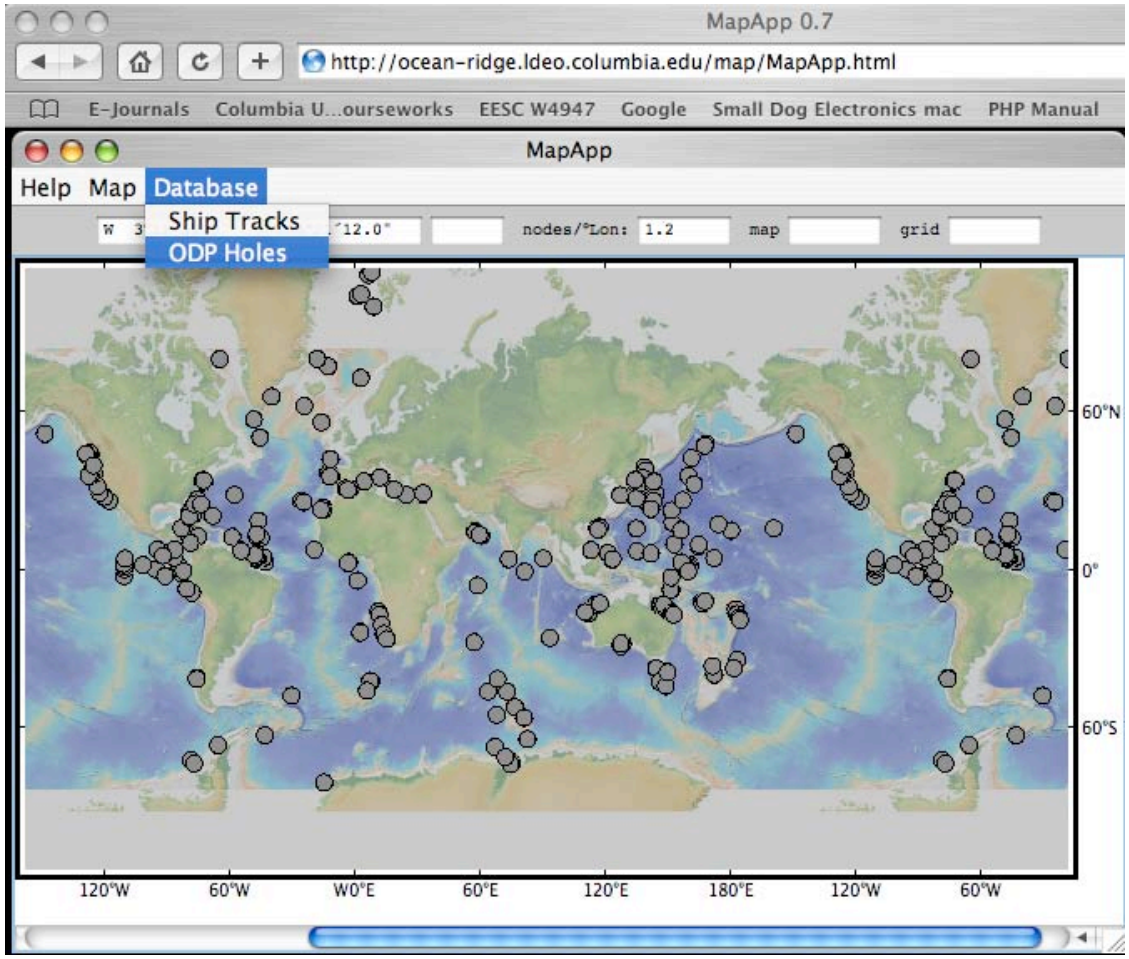
MapApp - a JAVA applet that opened from a WEB page

- It let users pan and zoom over the oceans and land though 512 levels of magnification

- Plot other data (such as ODP borehole locations)

- Draw ship tracks

- Contour grids



Innovations

- The bathymetry and elevations were stores as tiles,
    - A different set of tiles for each resolution
        - from zoom factor = 1 (4 tiles for the globe)
        - to zoom factor = 512 (100 meter grid node).
    - The images were each created and served as separate tiles (320 x 320)
    - The tiles were delivered via the WEB as called from the application
- These innovations have been advanced further by Google Maps and the Google Earth.

Issues

Java Applets could not read or write data from or to the user's computer (a security issue)

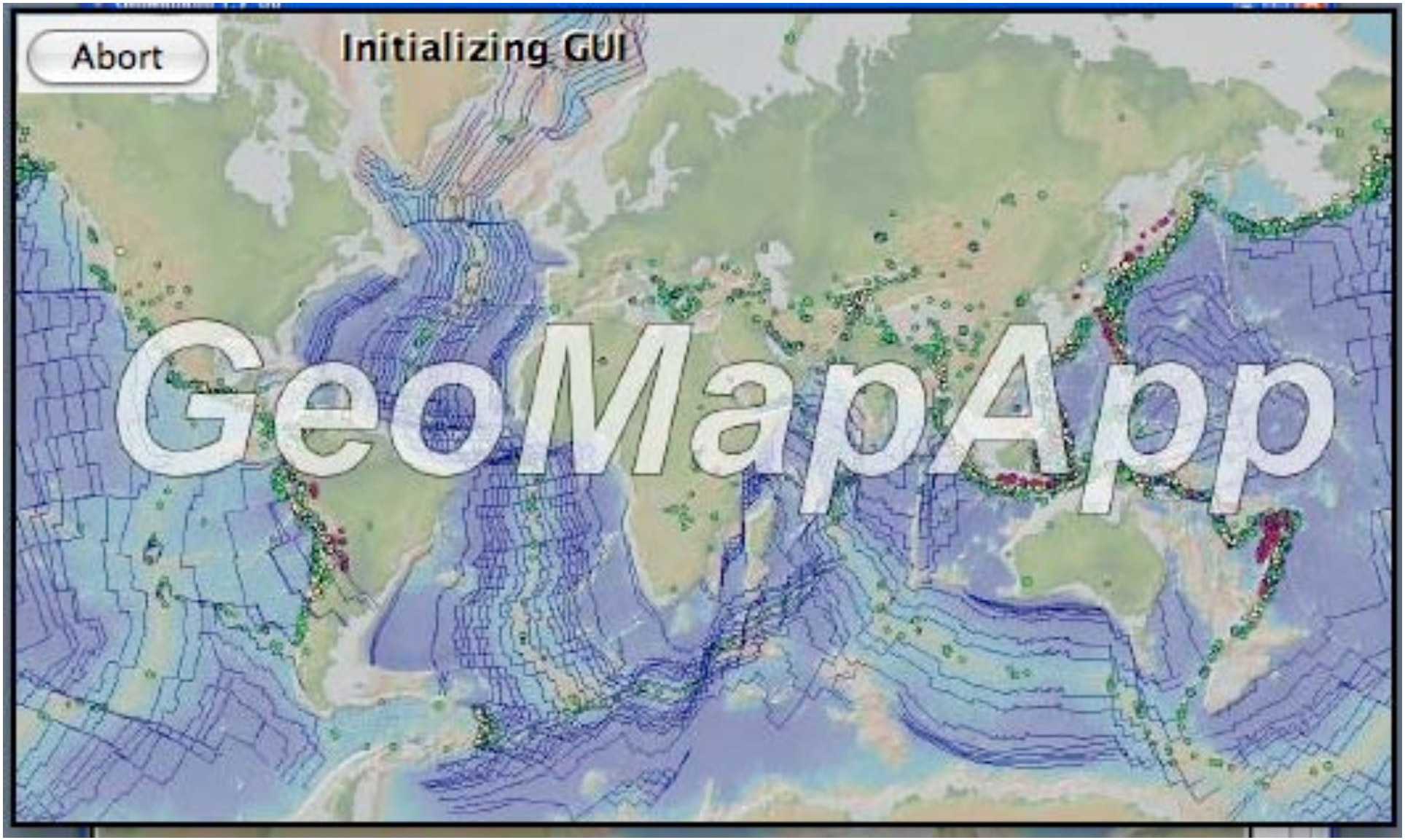
Thus the user could not visualize their own data on the global maps or stored products created

Solution (2002)

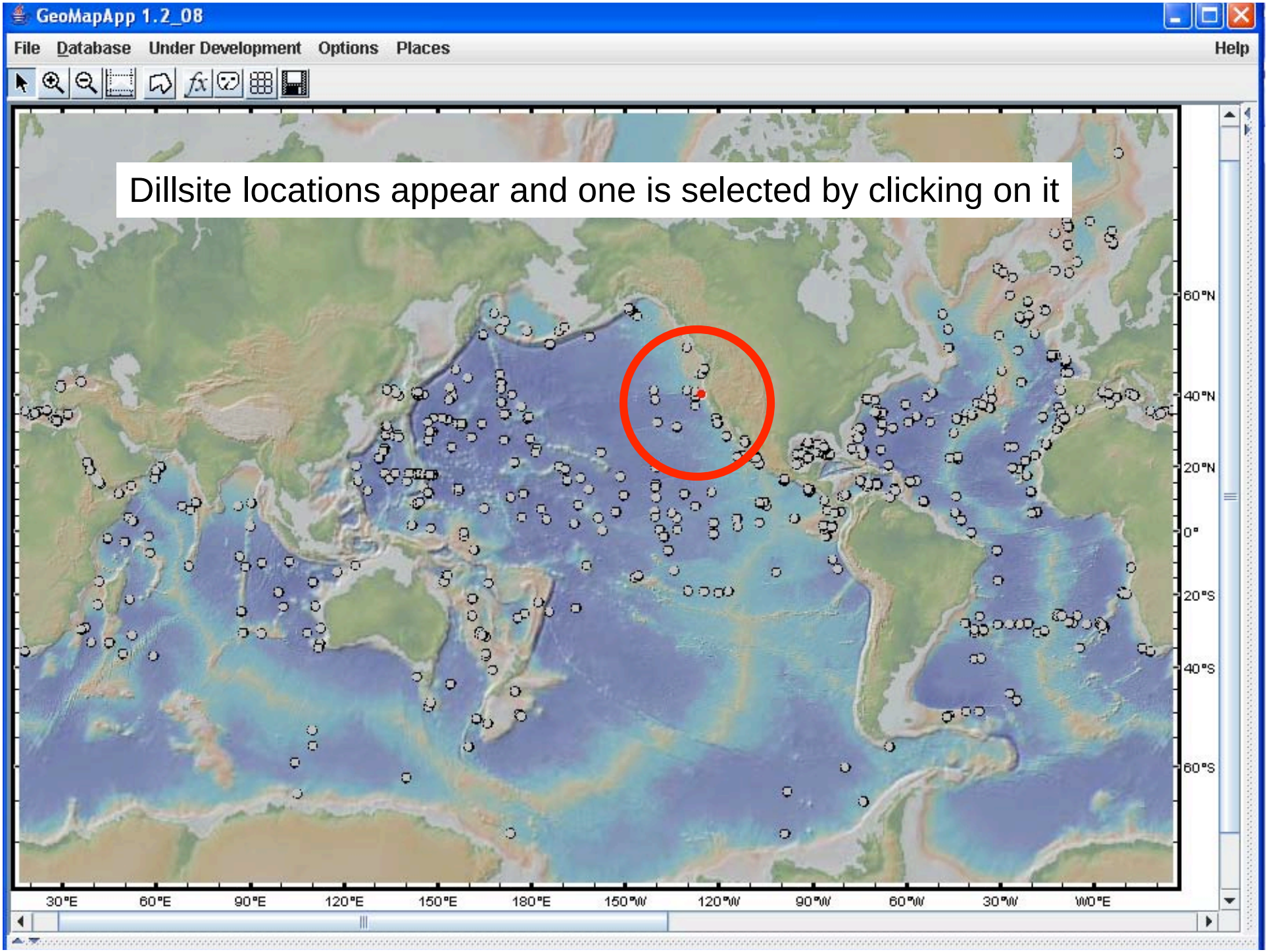
Convert the Applet into a full-blown JAVA application.

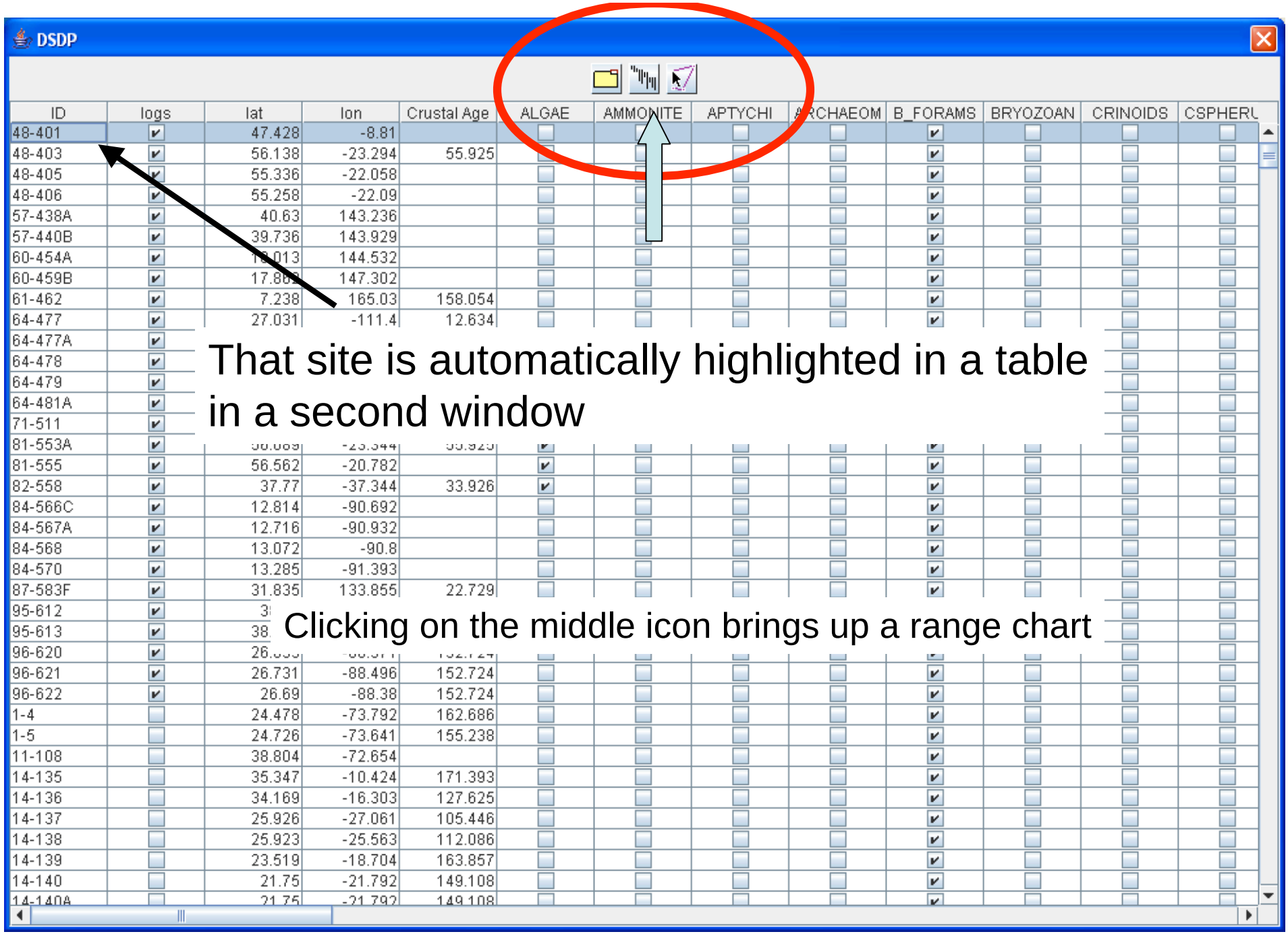
Require full inter-operability with Windows, Mac OS, Unix and Linux, each with its own JAVA differences

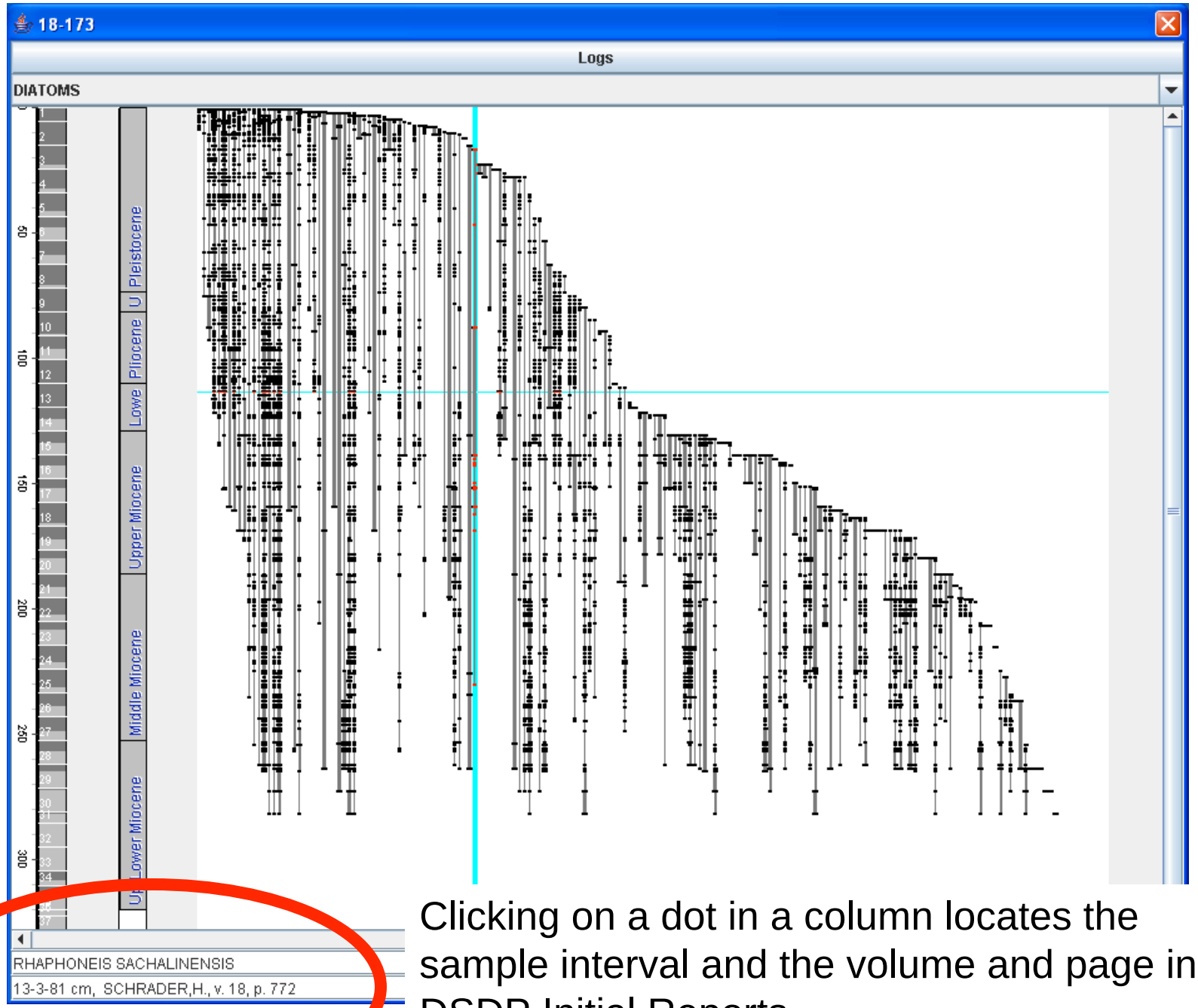
GeoMapApp screen as the application opens



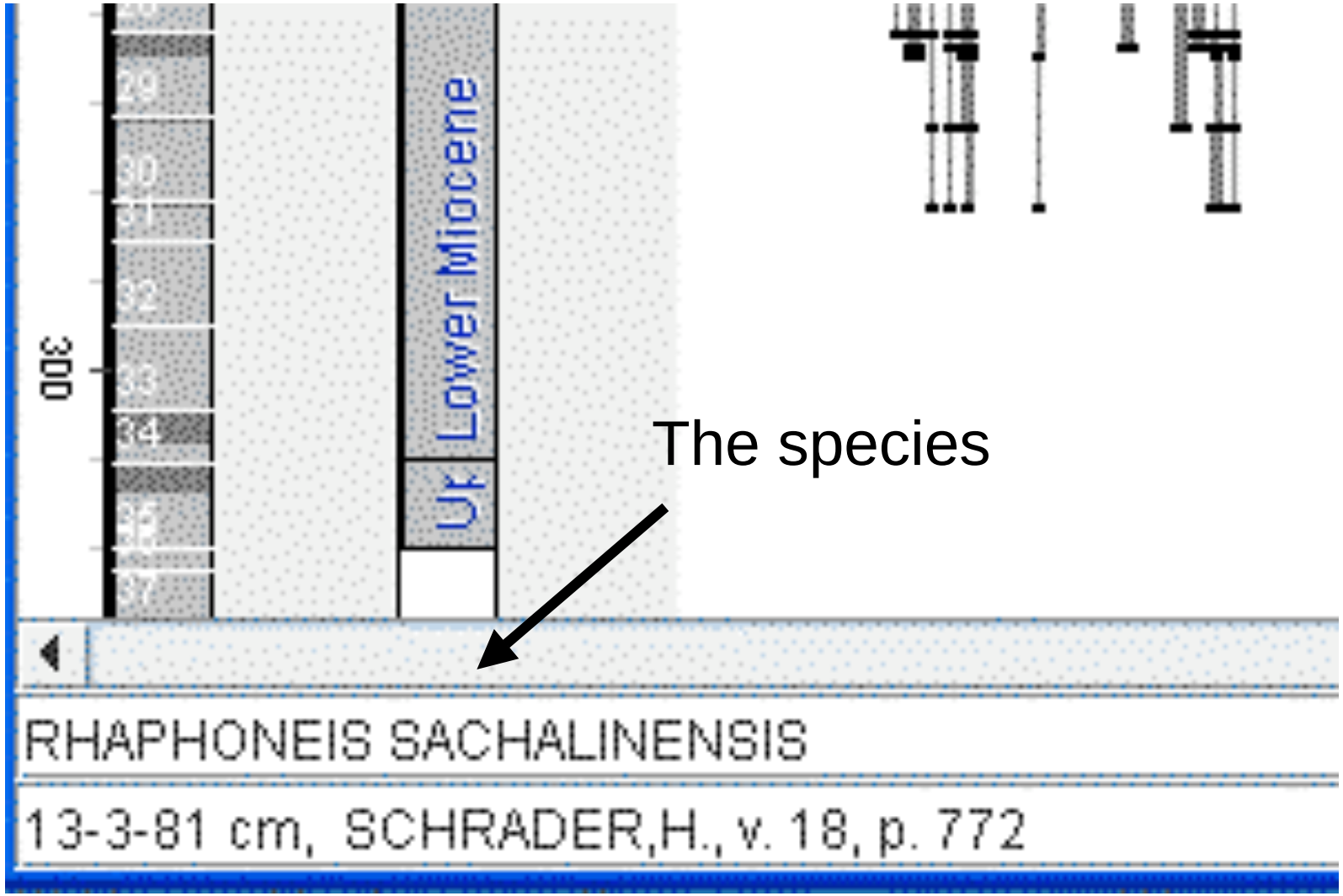

GeoMapApp 1.2_08
File
Database
Under Development
Options
Places
Drilling-DSDP/ODP/BRG
Bringing Ocean Drilling into GeoMapApp


GeoMapApp 1.2_08
File
Database
Under Development
Options
Places
Help
Dillsite locations appear and one is selected by clicking on it
60°N
40°N
20°N
0°
20°S
40°S
60°S
30°E
60°E
90°E
120°E
150°E
180°E
150°W
120°W
90°W
60°W
30°W
0°E

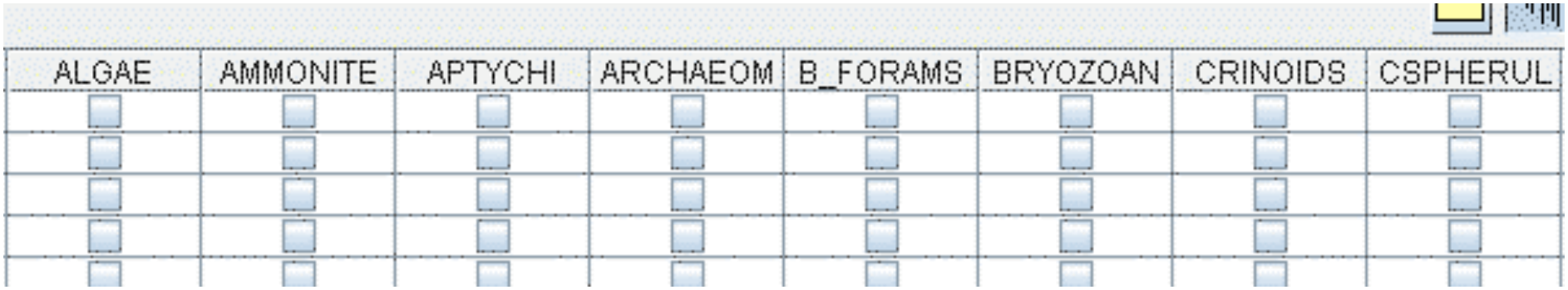

DSDP
That site is automatically highlighted in a table in a second window
Clicking on the middle icon brings up a range chart



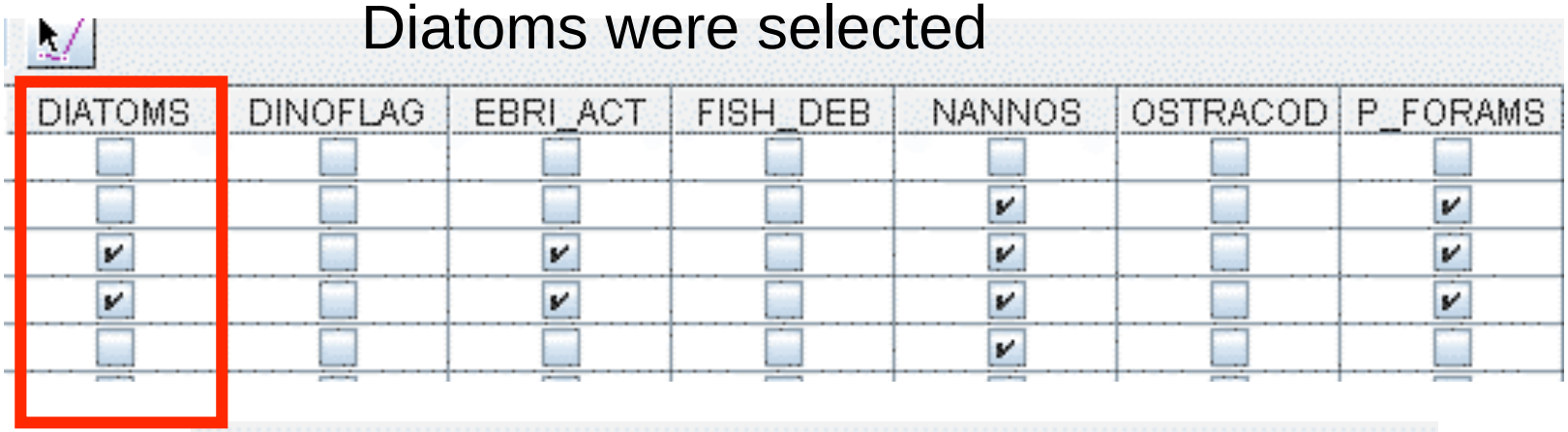
Clicking on a dot in a column locates the sample interval and the volume and page in the DSDP Initial Reports

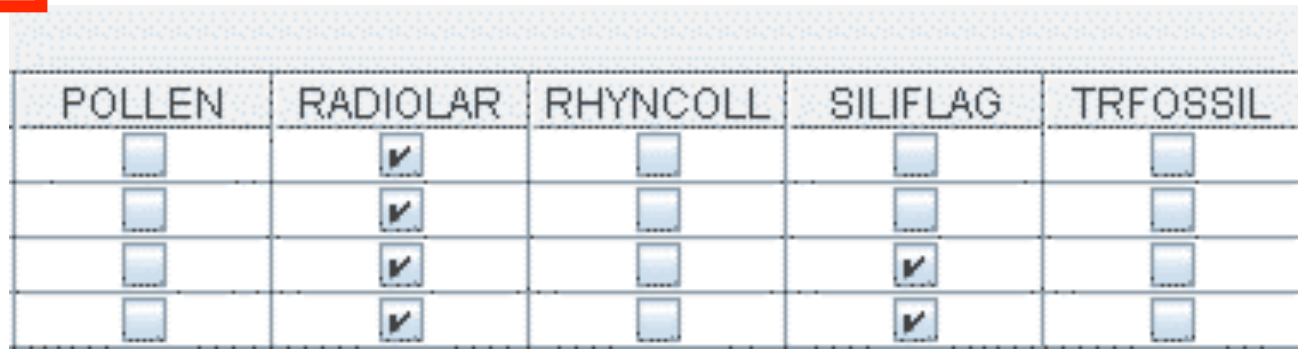

300
Lower Miocene
Uf
The species
RHAPHONEIS SACHALINENSIS
13-3-81 cm, SCHRADER,H., v. 18, p. 772
Core, section, sample interval

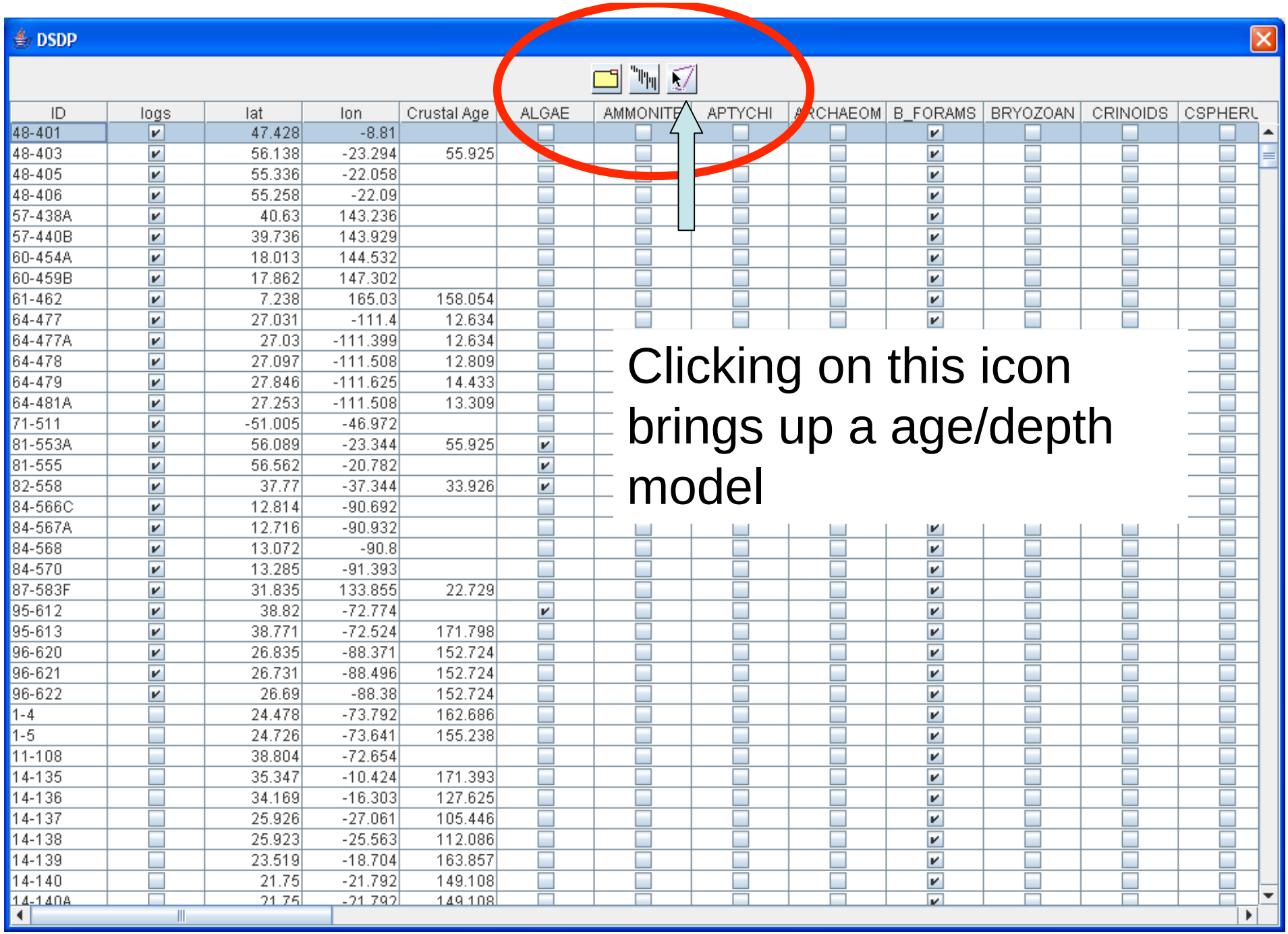
20 faunal/floral types to select

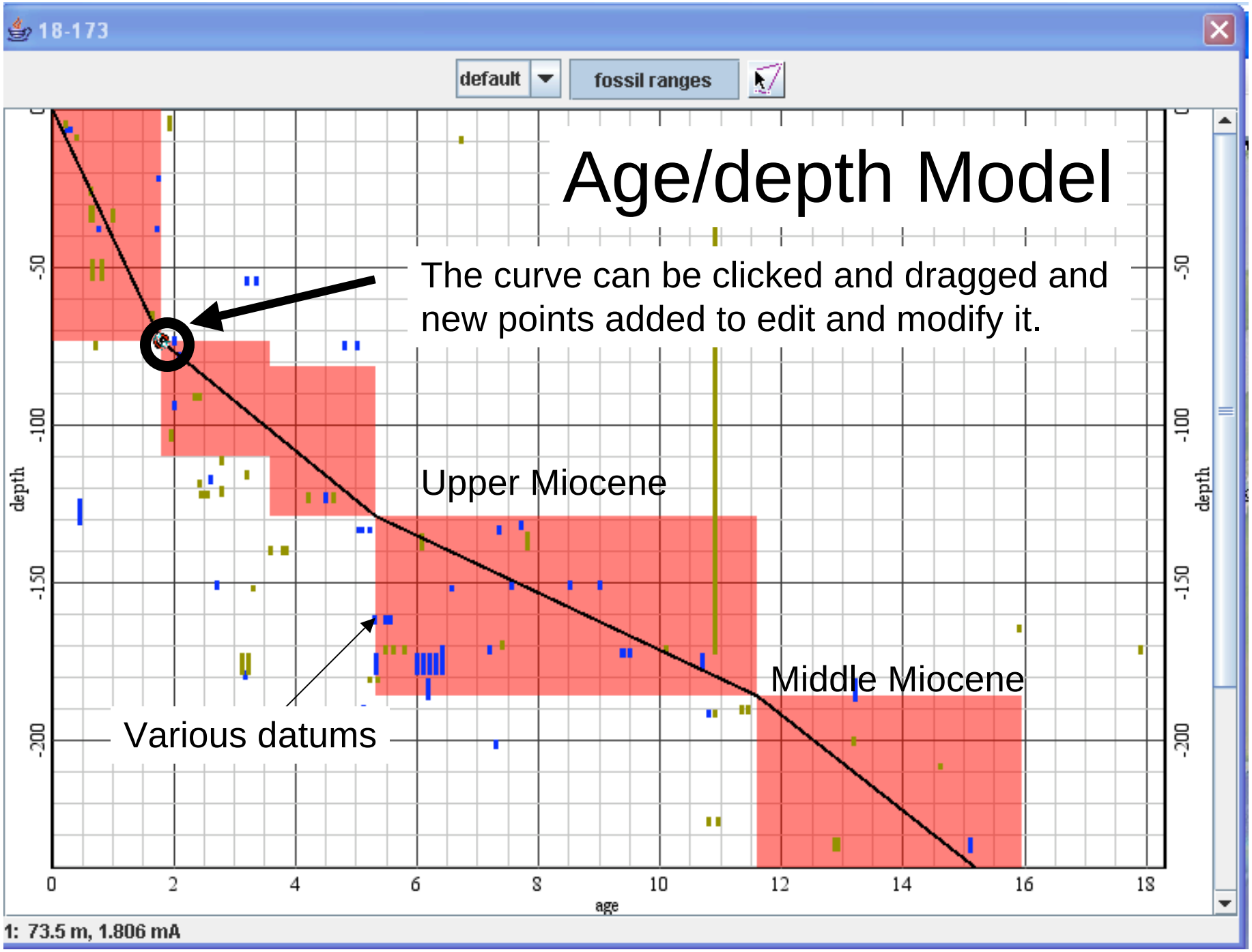


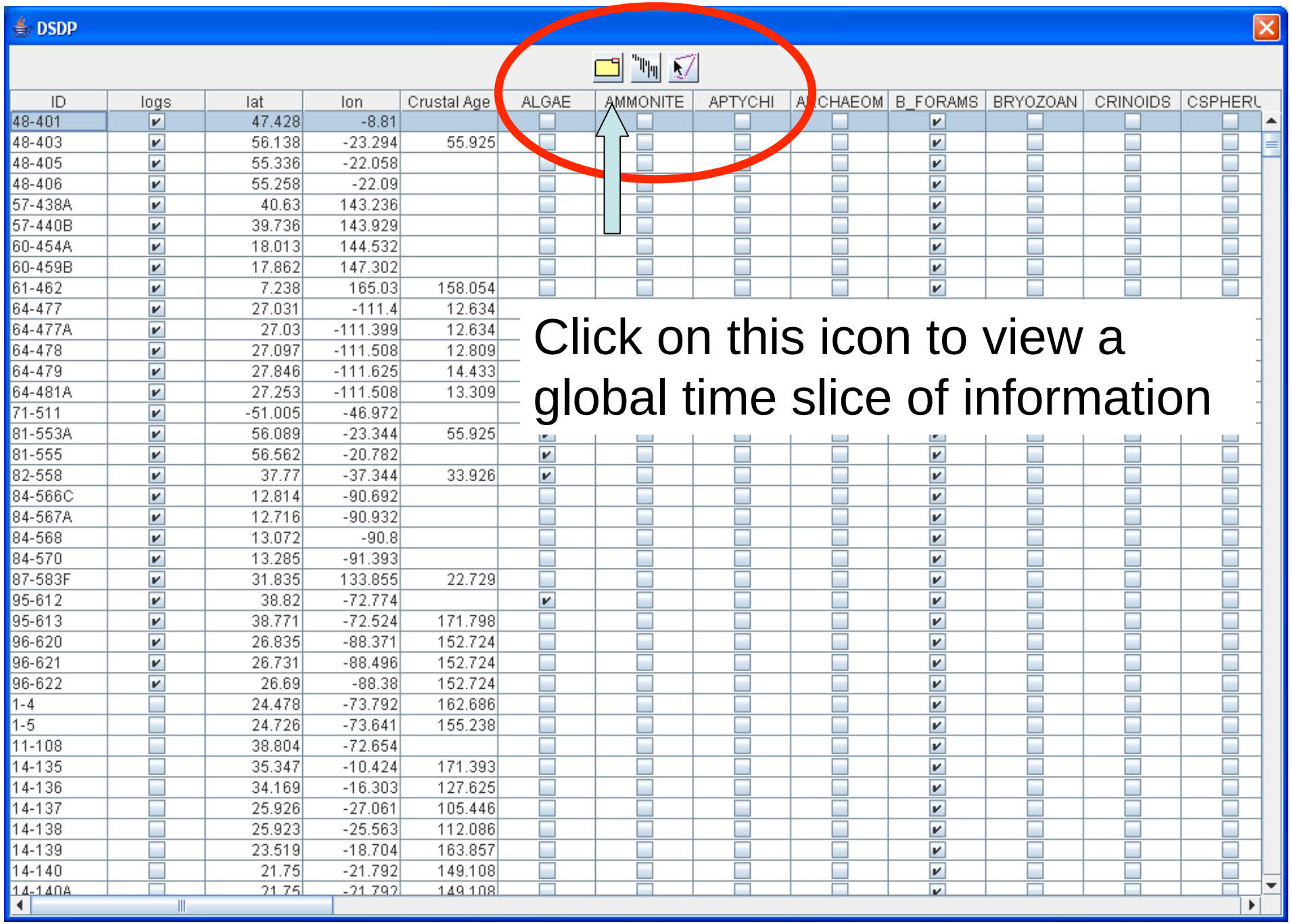
Diatoms were selected






DSDP
ID
logs
lat
lon
Crustal Age
ALGAE
AMMONITE
APTYCHI
ARCHAEOM
B_FORAMS
BRYOZOAN
CRINOIDS
CSPHERU
48-401 47.428 -8.81
48-403 56.138 -23.294 55.925
48-405 55.336 -22.058
48-406 55.258 -22.09
57-438A 40.63 143.236
57-440B 39.736 143.929
60-454A 18.013 144.532
60-459B 17.862 147.302
61-462 7.238 165.03 158.054
64-477 27.031 -111.4 12.634
64-477A 27.03 -111.399 12.634
64-478 27.097 -111.508 12.809
64-479 27.846 -111.625 14.433
64-481A 27.253 -111.508 13.309
71-511 -51.005 -46.972
81-553A 56.089 -23.344 55.925
81-555 56.562 -20.782
82-558 37.77 -37.344 33.926
84-566C 12.814 -90.692
84-567A 12.716 -90.932
84-568 13.072 -90.8
84-570 13.285 -91.393
87-583F 31.835 133.855 22.729
95-612 38.82 -72.774
95-613 38.771 -72.524 171.798
96-620 26.835 -88.371 152.724
96-621 26.731 -88.496 152.724
96-622 26.69 -88.38 152.724
1-4 24.478 -73.792 162.686
1-5 24.726 -73.641 155.238
11-108 38.804 -72.654
14-135 35.347 -10.424 171.393
14-136 34.169 -16.303 127.625
14-137 25.926 -27.061 105.446
14-138 25.923 -25.563 112.086
14-139 23.519 -18.704 163.857
14-140 21.75 -21.792 149.108
Clicking on this icon brings up a age/depth model


18-173
default
fossil ranges
Age/depth Model
The curve can be clicked and dragged and new points added to edit and modify it.
Upper Miocene
Middle Miocene
Various datums
depth
age
0
2
4
6
8
10
12
14
16
18
-50
-100
-150
-200
1: 73.5 m, 1.806 mA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AMMONITE
APTYCHI
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64-481A 27.253 -111.508 13.309
71-511 -51.005 -46.972
81-553A 56.089 -23.344 55.925
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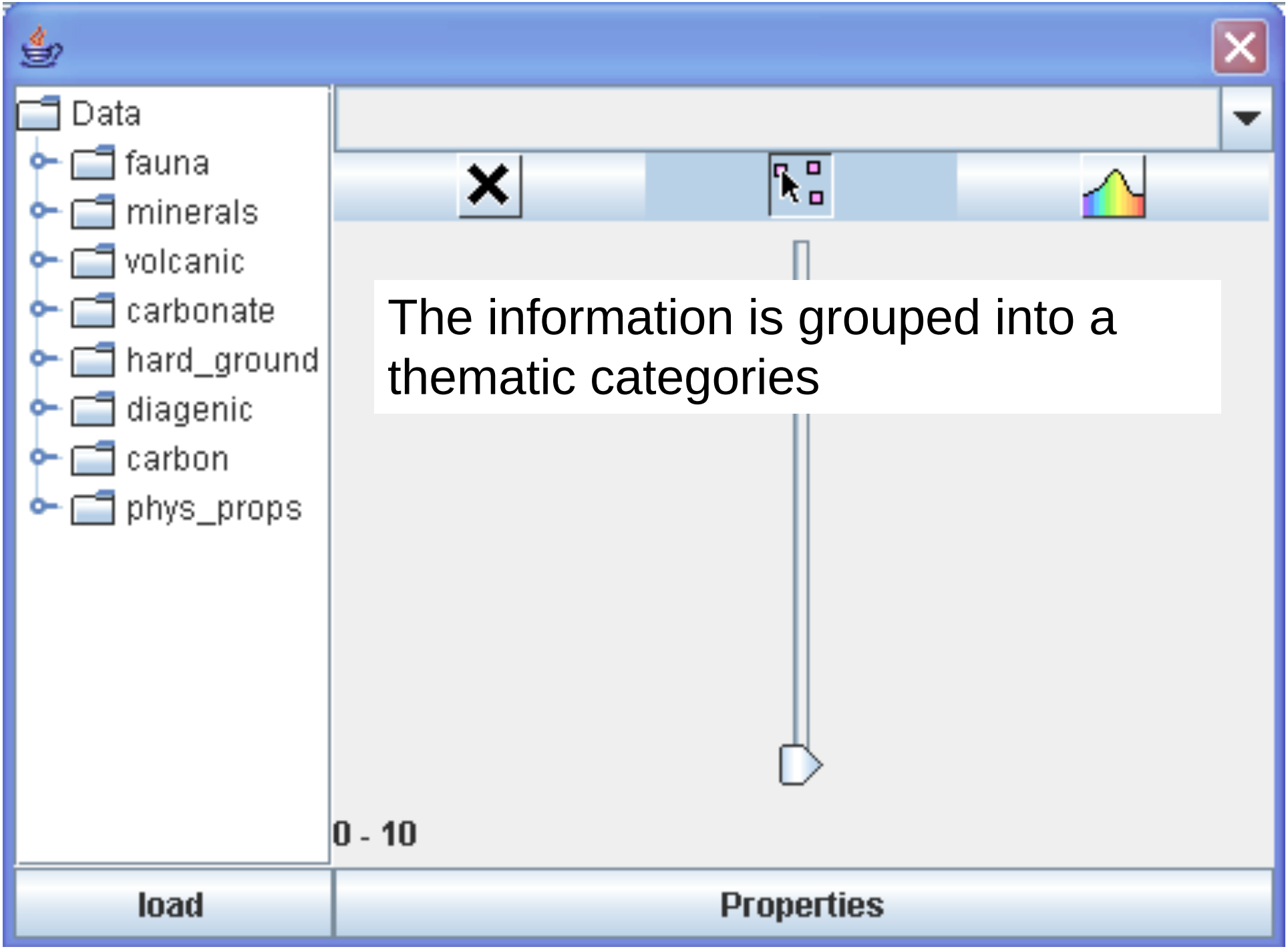
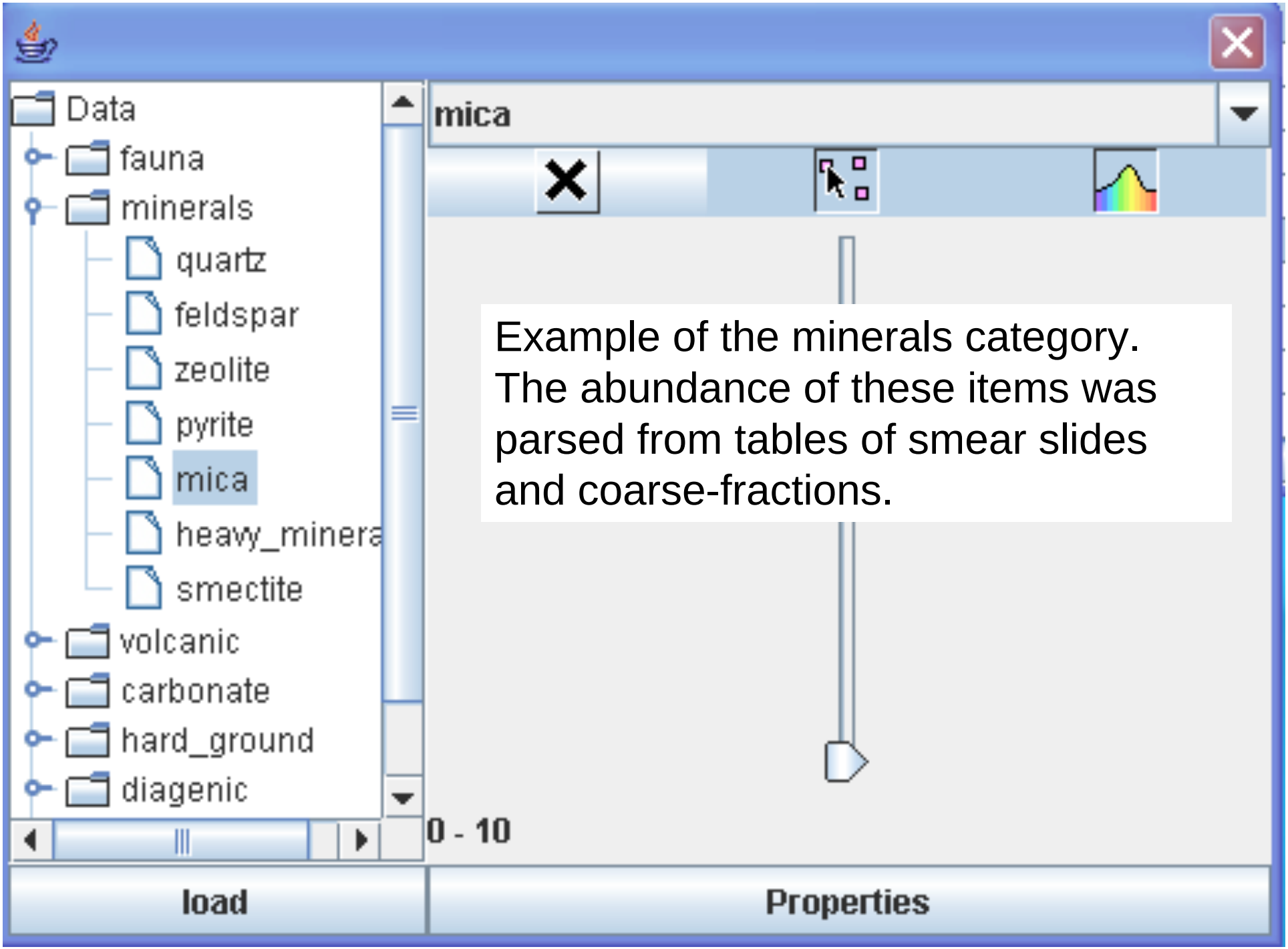
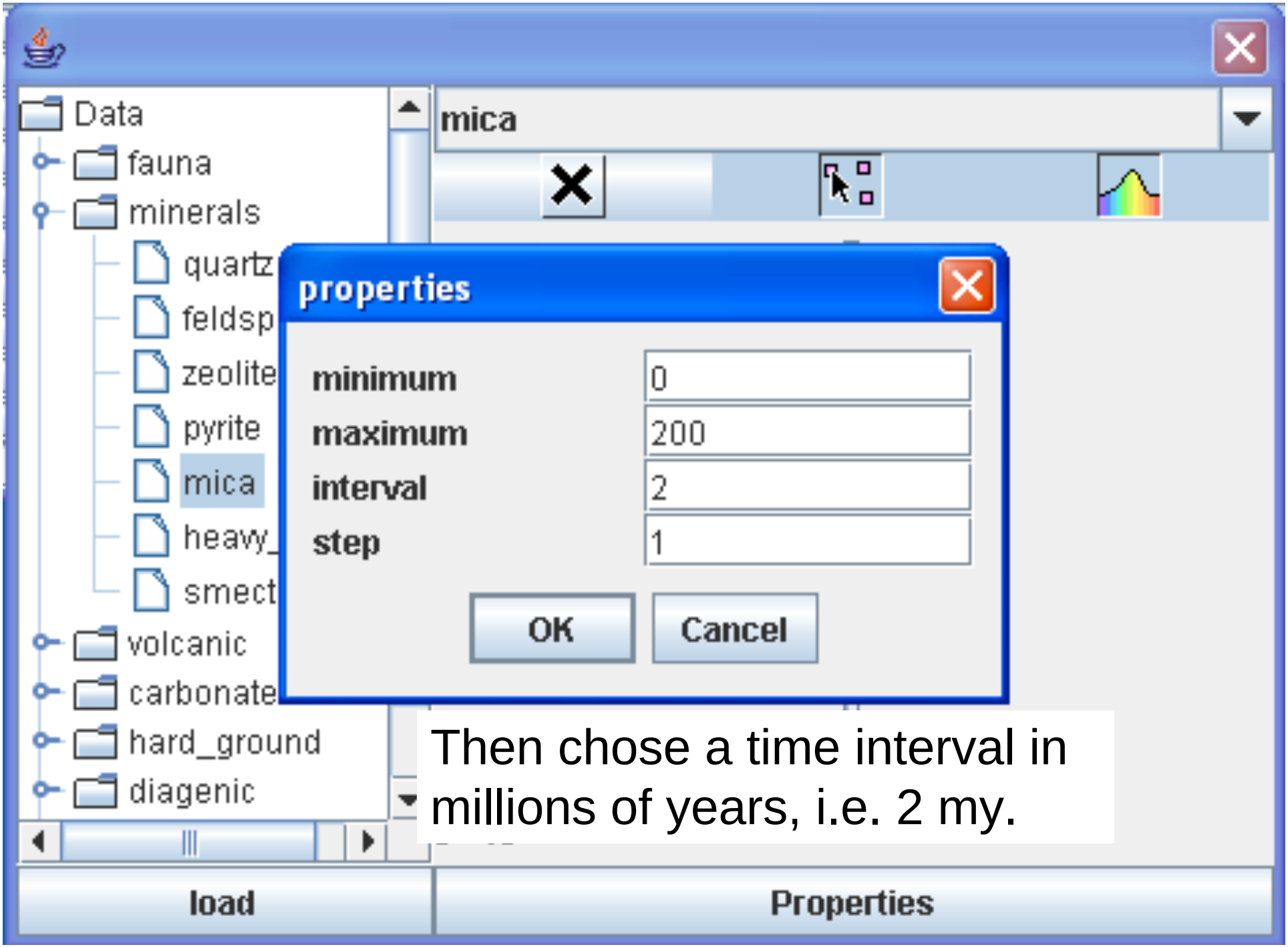
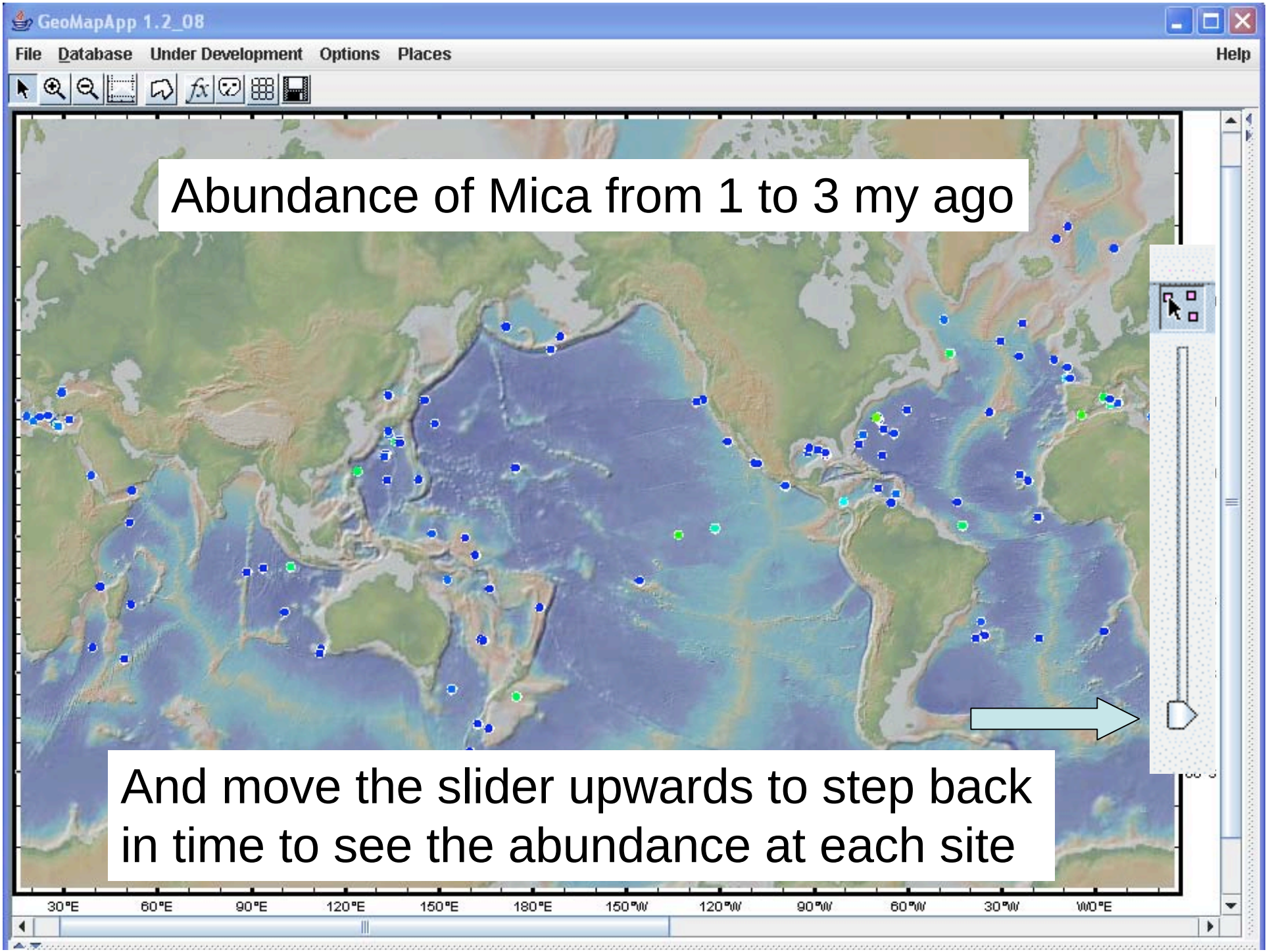
14-135 35.347 -10.424 171.393
14-136 34.169 -16.303 127.625
14-137 25.926 -27.061 105.446
14-138 25.923 -25.563 112.086
14-139 23.519 -18.704 163.857
14-140 21.75 -21.792 149.108
Click on this icon to view a global time slice of information


Data
fauna
minerals
volcanic
carbonate
hard_ground
diagenic
carbon
phys_props
The information is grouped into a thematic categories
0 - 10
load
Properties

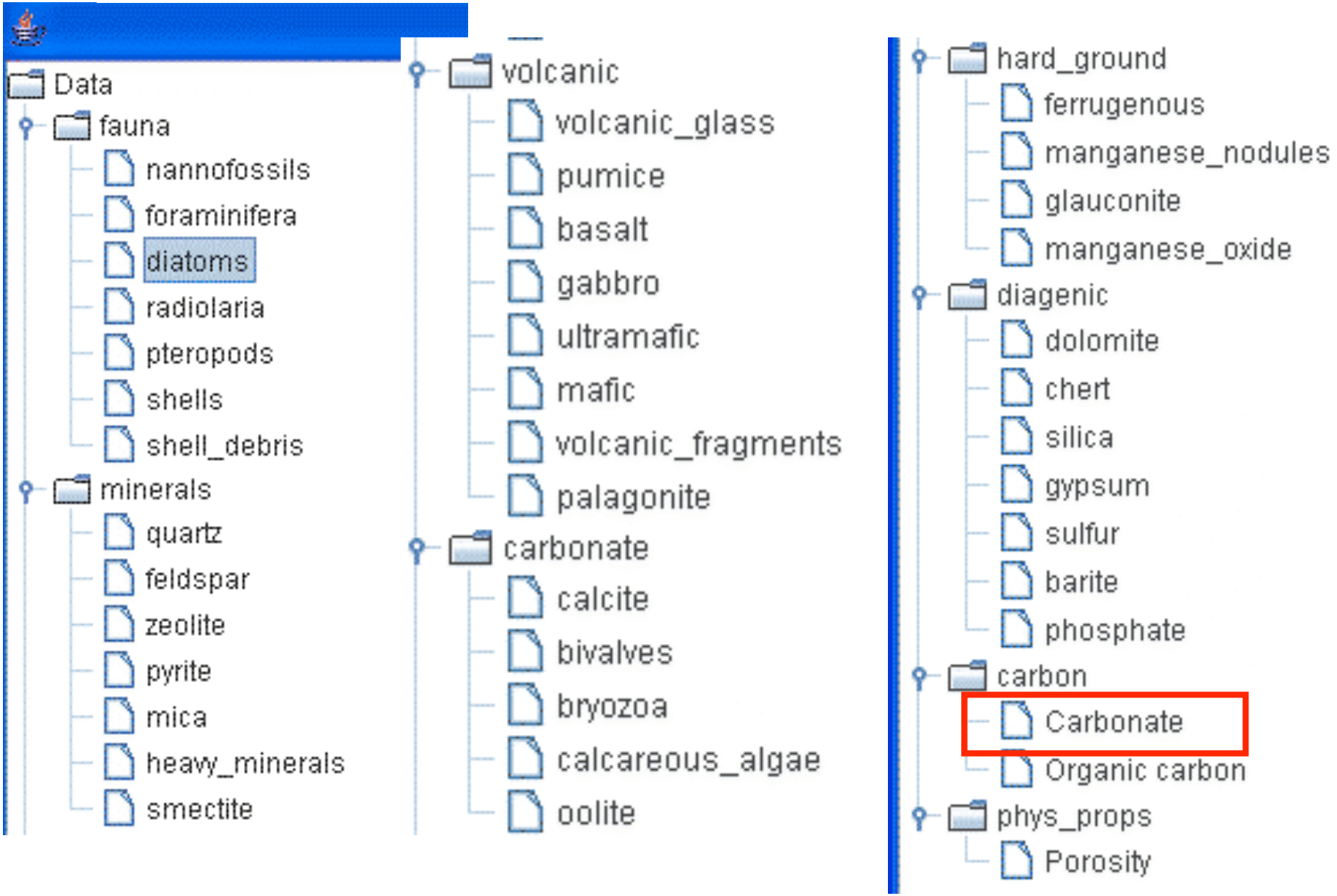

Data
fauna
minerals
quartz
feldspar
zeolite
pyrite
mica
heavy_minera
smectite
volcanic
carbonate
hard_ground
diagenic
mica
Example of the minerals category. The abundance of these items was parsed from tables of smear slides and coarse-fractions.
0 - 10
load
Properties

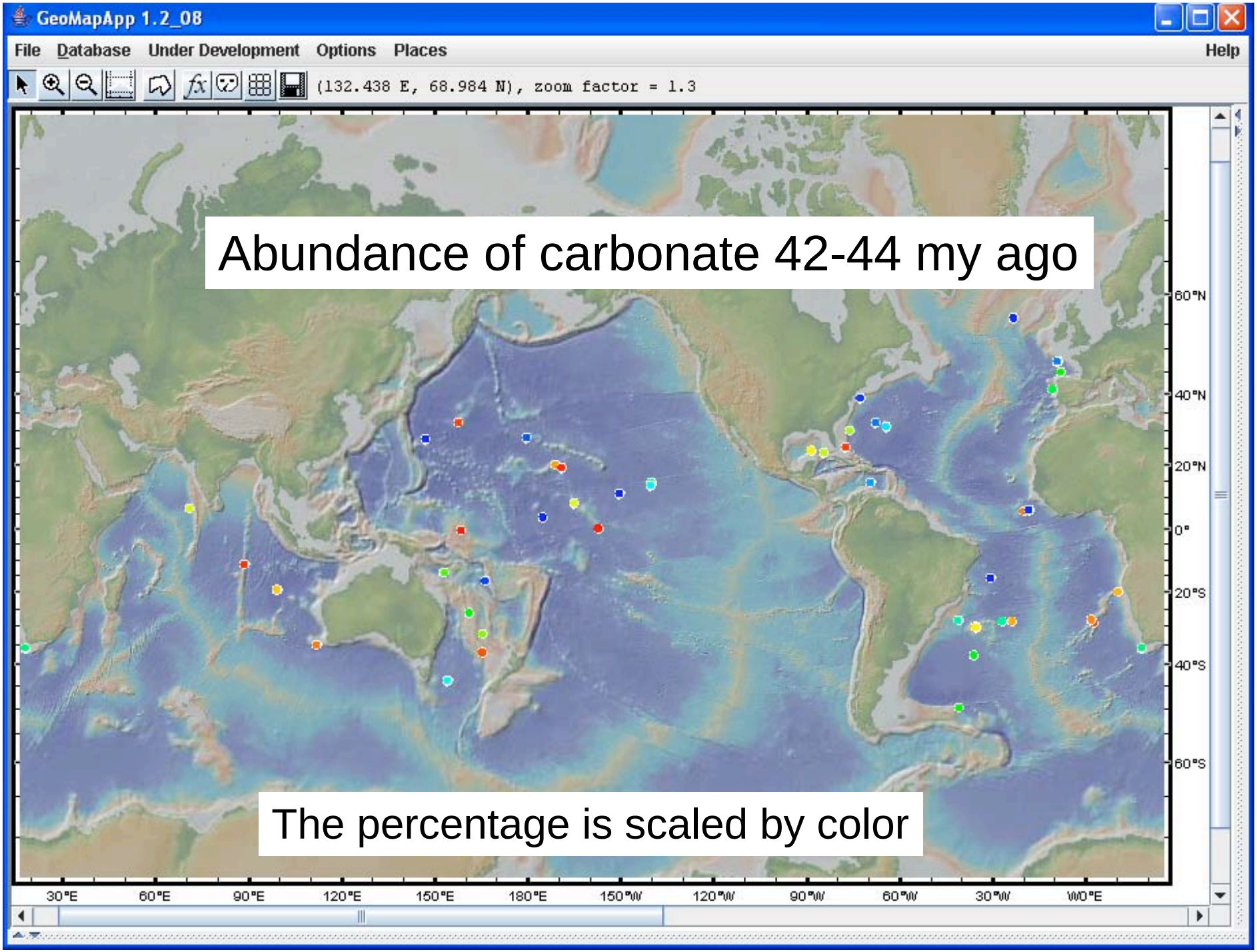


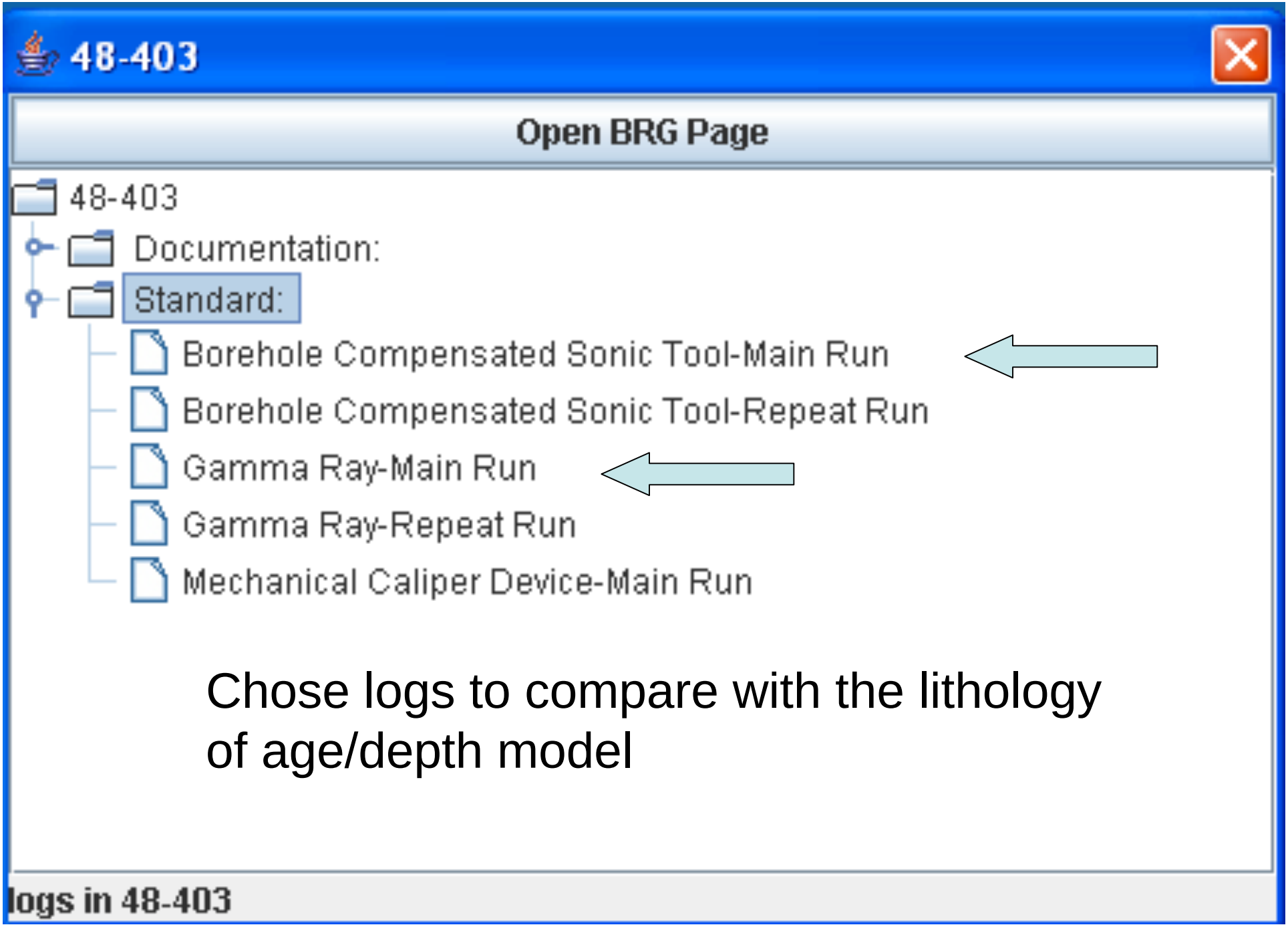
Then chose a time interval in millions of years, i.e. 2 my.


GeoMapApp 1.2_08
File
Database
Under Development
Options
Places
Help
Abundance of Mica from 1 to 3 my ago
And move the slider upwards to step back in time to see the abundance at each site
30°E
60°E
90°E
120°E
150°E
180°E
150°W
120°W
90°W
60°W
30°W
0°E

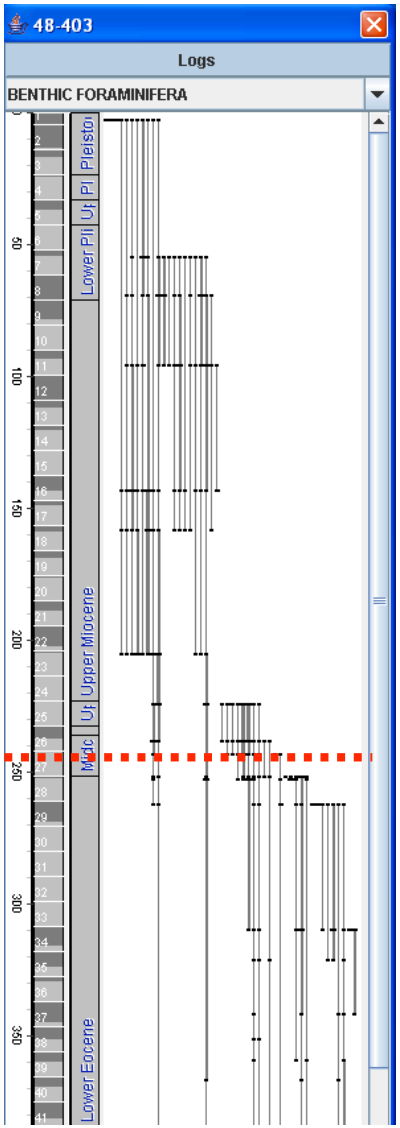
>40 components to examine through time



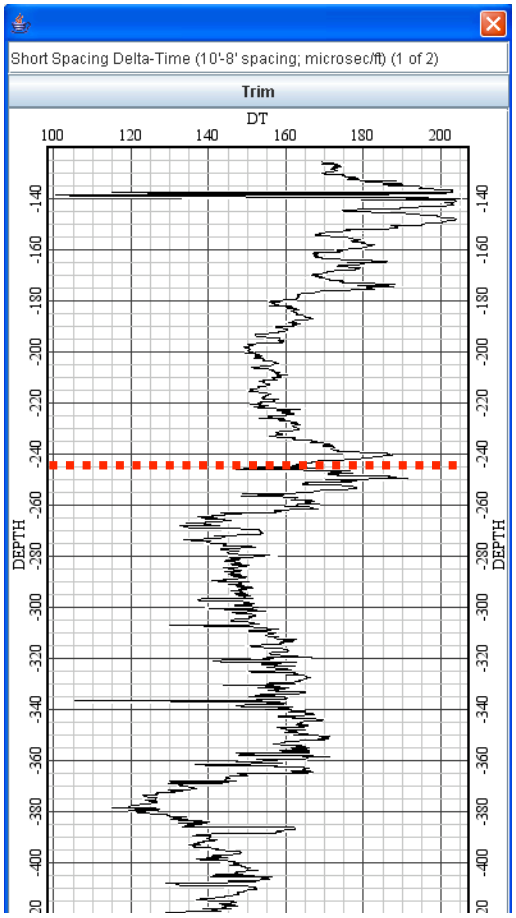

GeoMapApp 1.2_08
File
Database
Under Development
Options
Places
Help
(132.438 E, 68.984 N), zoom factor = 1.3
Abundance of carbonate 42-44 my ago
The percentage is scaled by color
60°N
40°N
20°N
0°
20°S
40°S
60°S
30°E
60°E
90°E
120°E
150°E
180°E
150°W
120°W
90°W
60°W
30°W
0°E


48-403
Open BRG Page
48-403
Documentation:
Standard:
Borehole Compensated Sonic Tool-Main Run
Borehole Compensated Sonic Tool-Repeat Run
Gamma Ray-Main Run
Gamma Ray-Repeat Run
Mechanical Caliper Device-Main Run
Chose logs to compare with the lithology of age/depth model
logs in 48-403

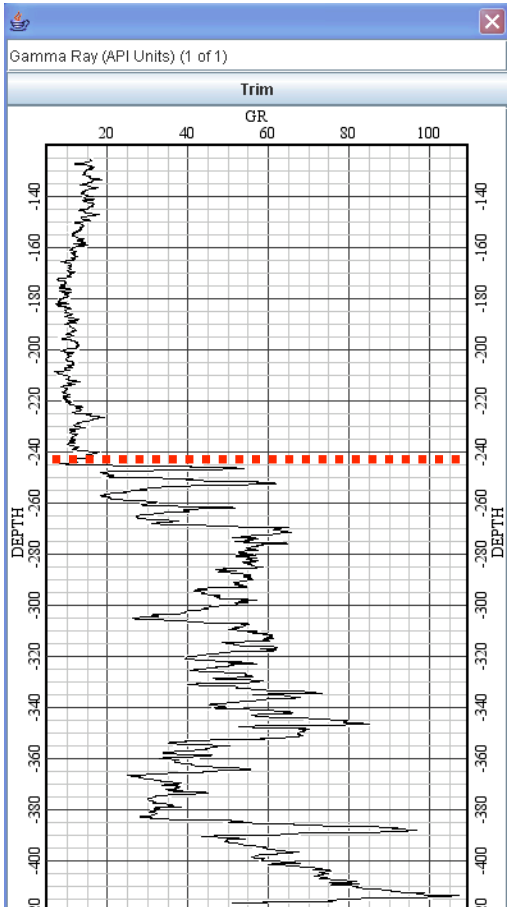
48-403

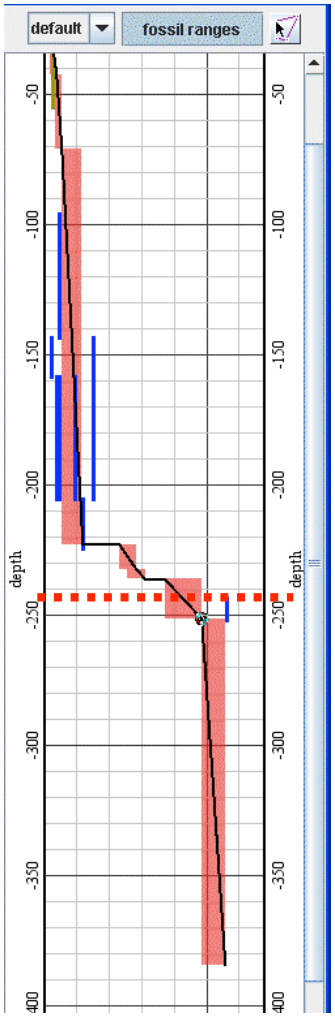


Sonic tool

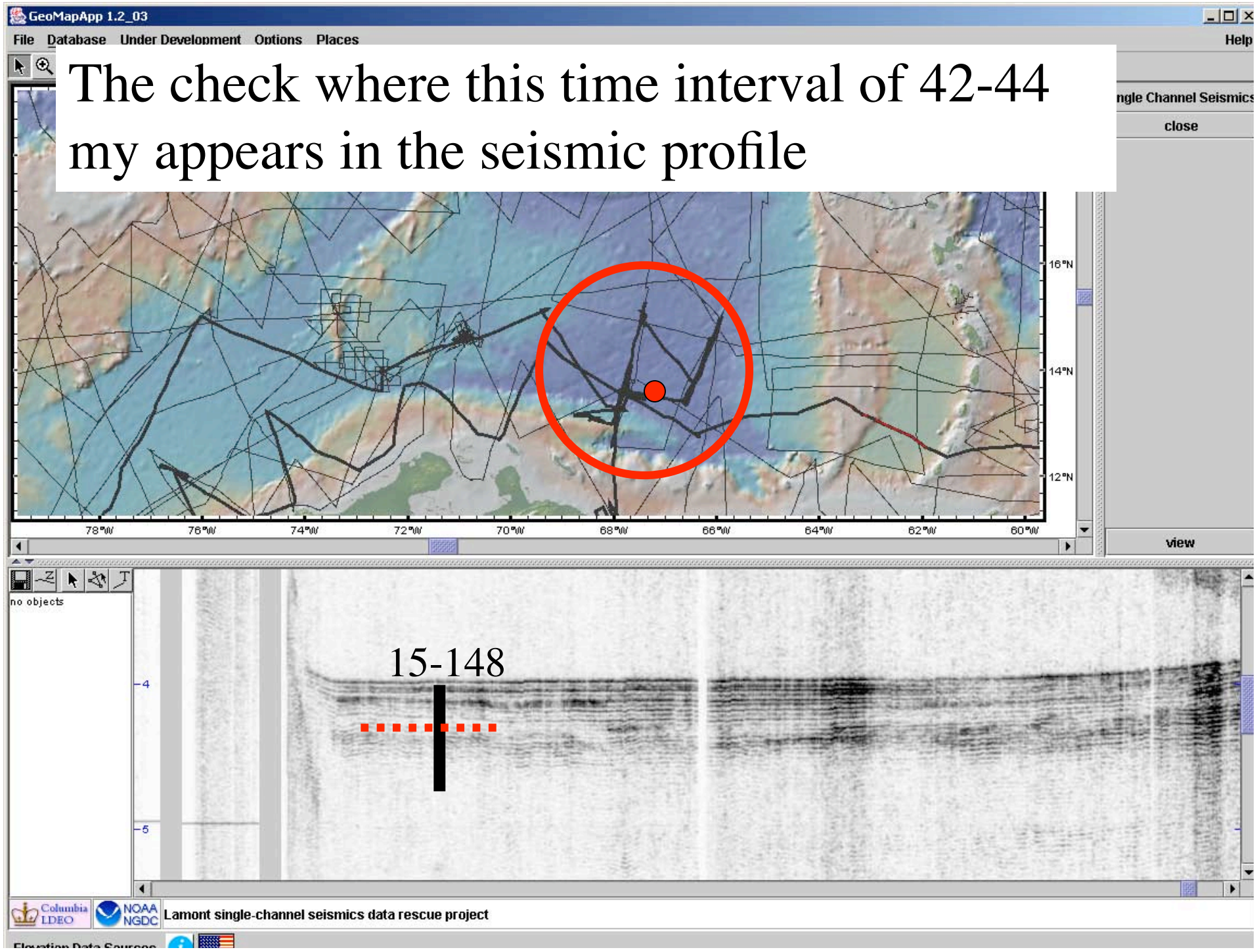


Gamma Ray



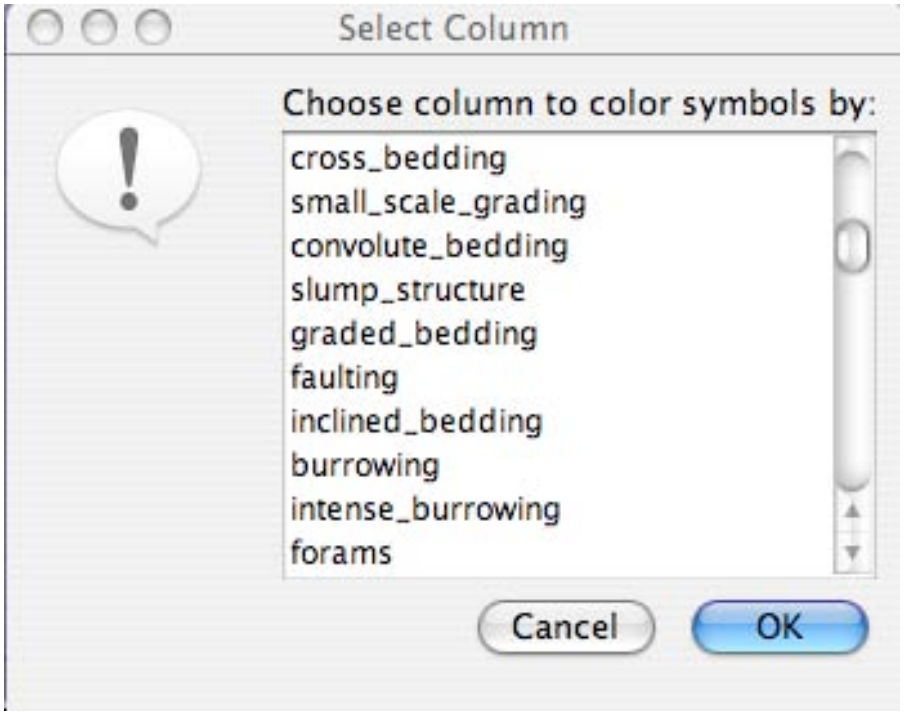


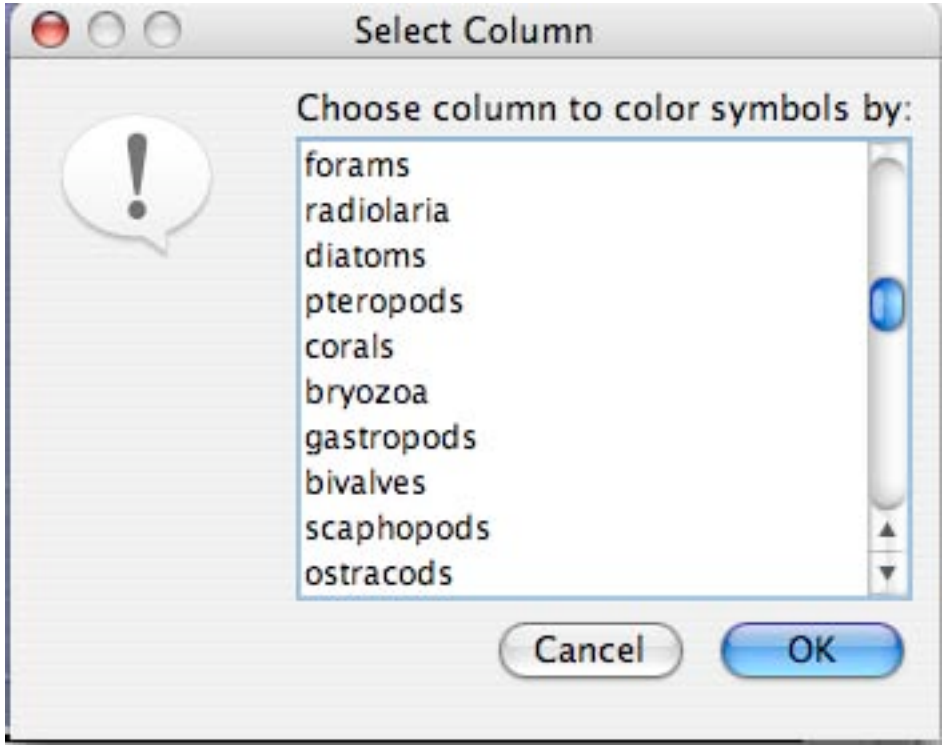
Discover a major change in formation properties associated the a slowing of the accumulation rate

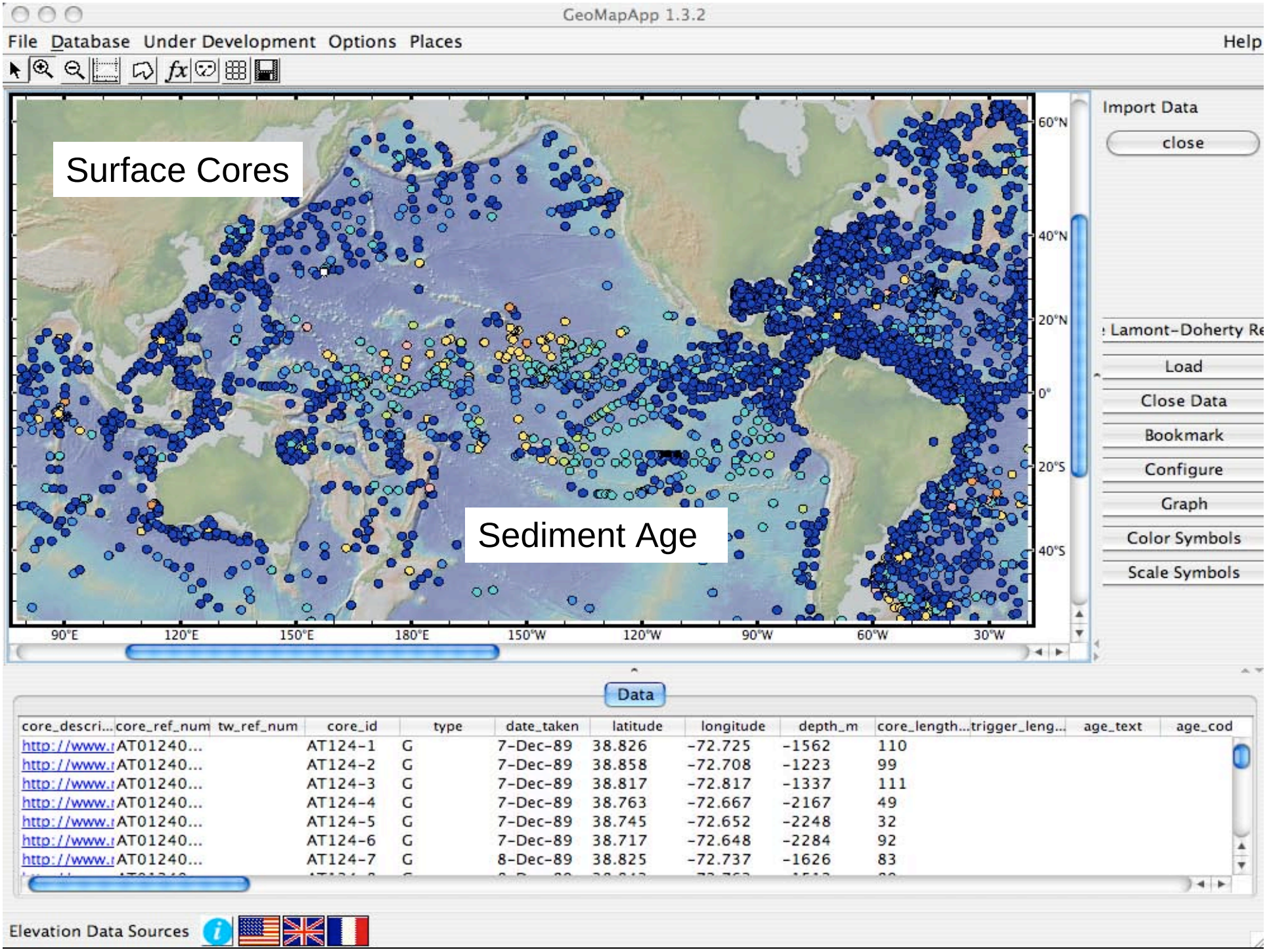

GeoMapApp 1.2_03
File Database Under Development Options Places Help
The check where this time interval of 42-44 my appears in the seismic profile
ngle Channel Seismics
close
16°N
14°N
12°N
78°W 76°W 74°W 72°W 70°W 68°W 66°W 64°W 62°W 60°W
view
no objects
15-148
4
5
Columbia LDEO
NOAA NGDC
Lamont single-channel seismics data rescue project

Parallel efforts with the ~9000 cores in the Lamont-Doherty repository

- Relational database exists
- Core descriptions have been parsed for >40 descriptors such as forams, glauconite..
- Photographs are all digital






GeoMapApp 1.3.2
File Database Under Development Options Places Help
Surface Cores
Sediment Age
60°N
40°N
20°N
0°
20°S
40°S
90°E
120°E
150°E
180°E
150°W
120°W
90°W
60°W
30°W
Import Data
close
Lamont-Doherty Re
Load
Close Data
Bookmark
Configure
Graph
Color Symbols
Scale Symbols
Data
core_descri... core_ref_num tw_ref_num core_id type date_taken latitude longitude depth_m core_length... trigger_leng... age_text age_cod
http://www.r AT01240... AT124-1 G 7-Dec-89 38.826 -72.725 -1562 110
http://www.r AT01240... AT124-2 G 7-Dec-89 38.858 -72.708 -1223 99
http://www.r AT01240... AT124-3 G 7-Dec-89 38.817 -72.817 -1337 111
http://www.r AT01240... AT124-4 G 7-Dec-89 38.763 -72.667 -2167 49
http://www.r AT01240... AT124-5 G 7-Dec-89 38.745 -72.652 -2248 32
http://www.r AT01240... AT124-6 G 7-Dec-89 38.717 -72.648 -2284 92
http://www.r AT01240... AT124-7 G 8-Dec-89 38.825 -72.737 -1626 83
Elevation Data Sources

Deep Sea Core Repository

Lamont-Doherty Earth Observatory of Columbia University

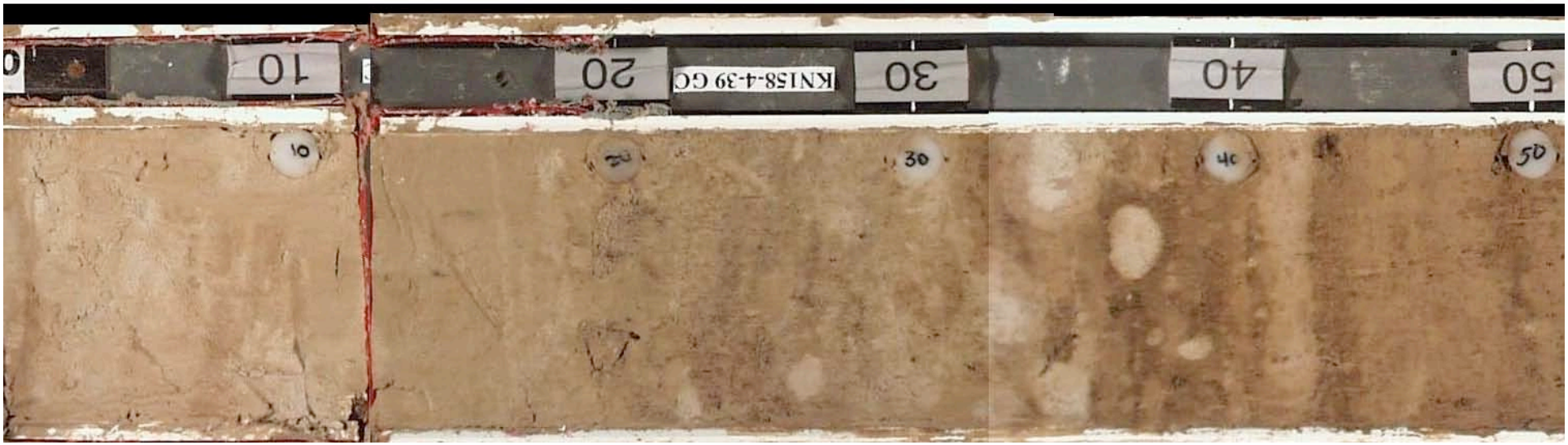
Links: home --- search

Visual Core Description for RC12-76

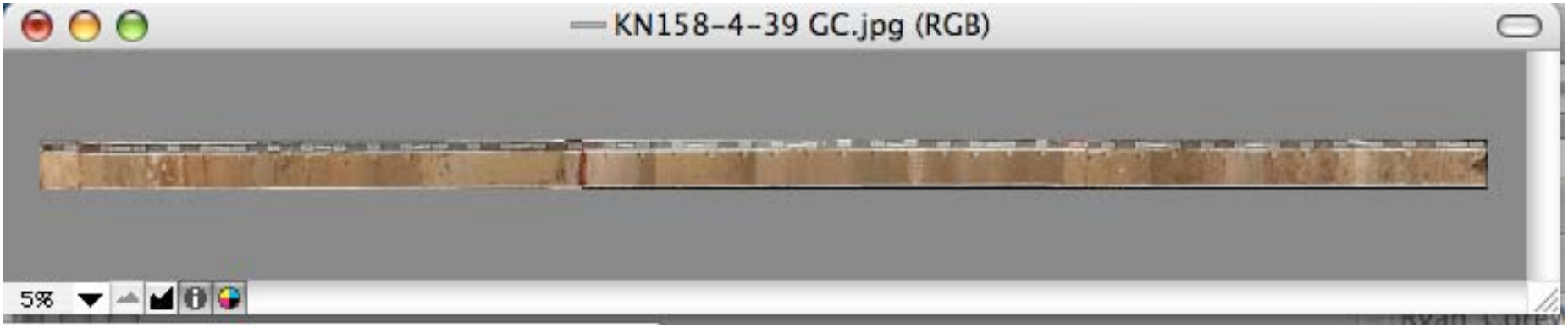
Date described: 13 February 1969 Described by: J. Zauderer 0-70 cm: Chalk, moist, firm and plastic, with pyroclastic and manganese debris; matrix very light gray (N8). Manganese and pyroclastic nodules occur. Pieces of palagonitized basalt and vesicular basalt with zeolite fillings occur from 30 cm to 38 cm, covered by pyrolusite. The carbonate is confined to a chalk matrix and carbonate content of sediment is about 60%. Coarse fraction (total about 25%) consists of scattered planktonic and benthonic foraminifera (10%) and non-bioclastic material (15%), consisting of palagonite, basalt, psilomelane and pyrolusite. Bottom contact a change of matrix percentage and content. 70-140 cm: Pyroclastic and manganese debris, with a chalky matrix, olive gray (5 Y 4/1), moist, loosely consolidated and crumbly. Carbonate content 30%, confined to matrix. Coarse fraction from 30% at top to 75% from 80 cm and below, consisting of scarce benthonic and planktonic foraminifera, palagonite, amygdaloidal black glass, manganese nodules, pyrolusite, quartz and shark teeth. The coarse fraction is unsorted; generally the largest pieces are of pebble size.

Funded by the National Science Foundation

Similar Core Photo requirements as CoreWall



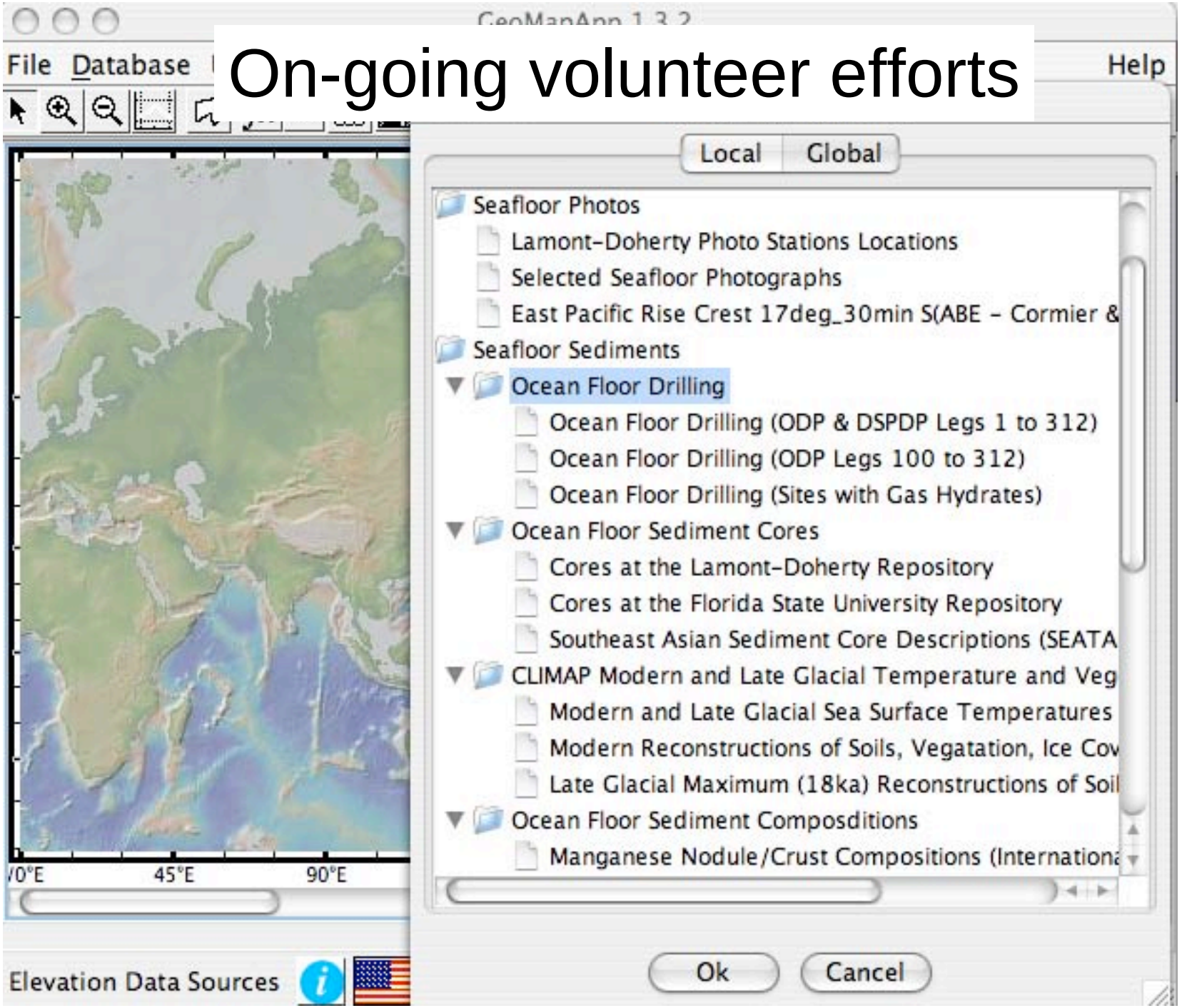
Treat the composite as a map. Serve the imagery as tiles like bathymetry

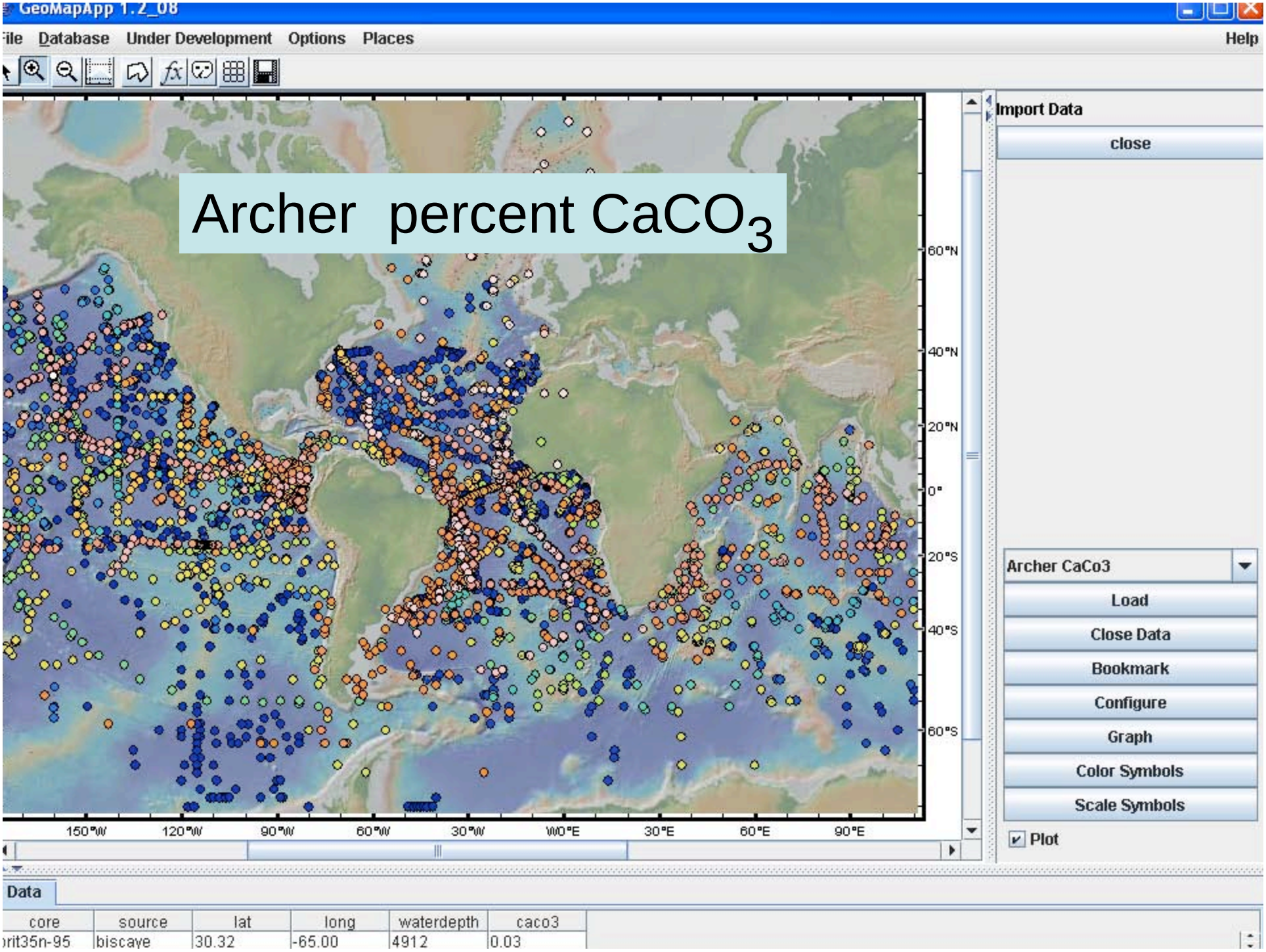


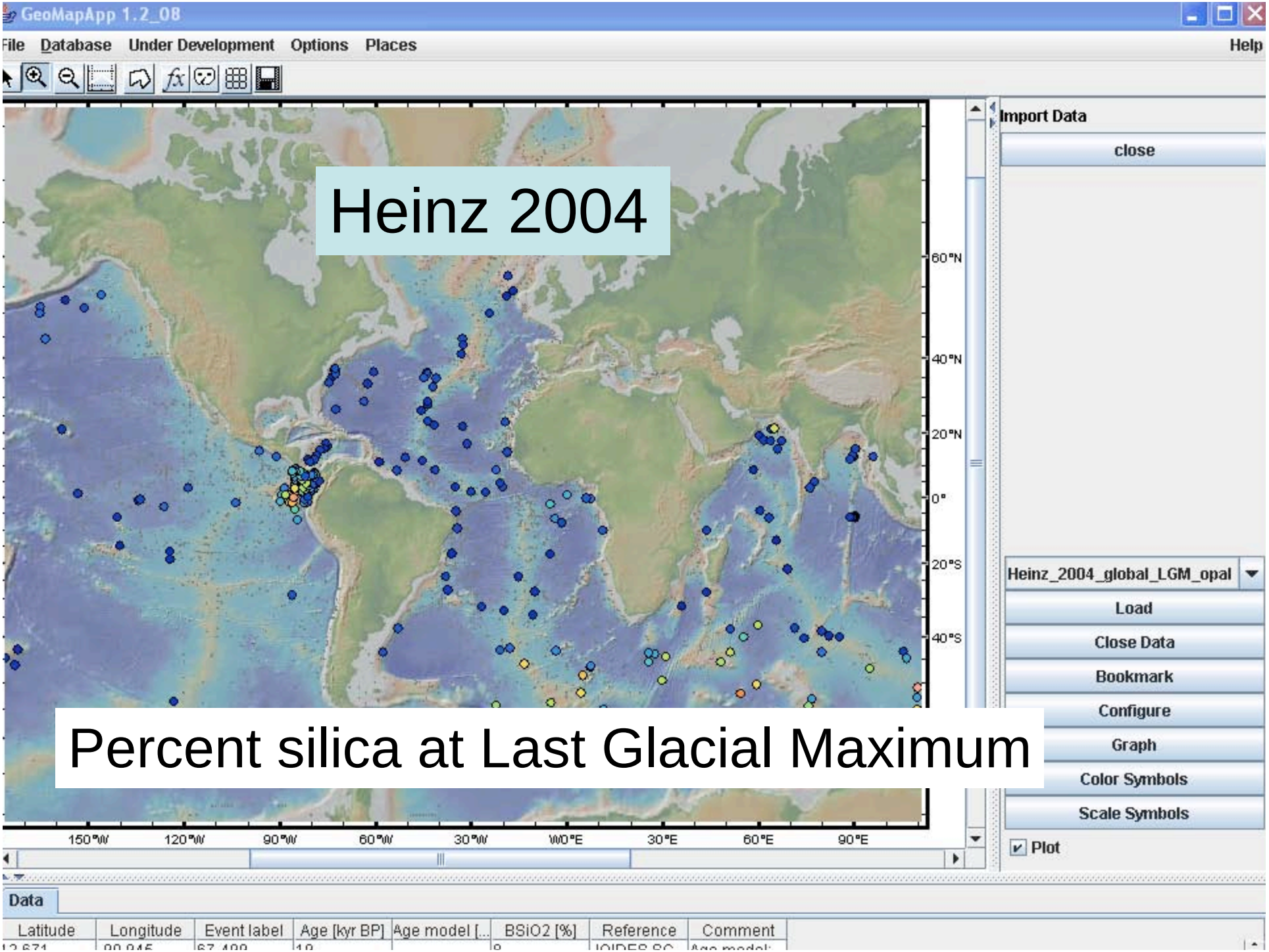
Next Steps

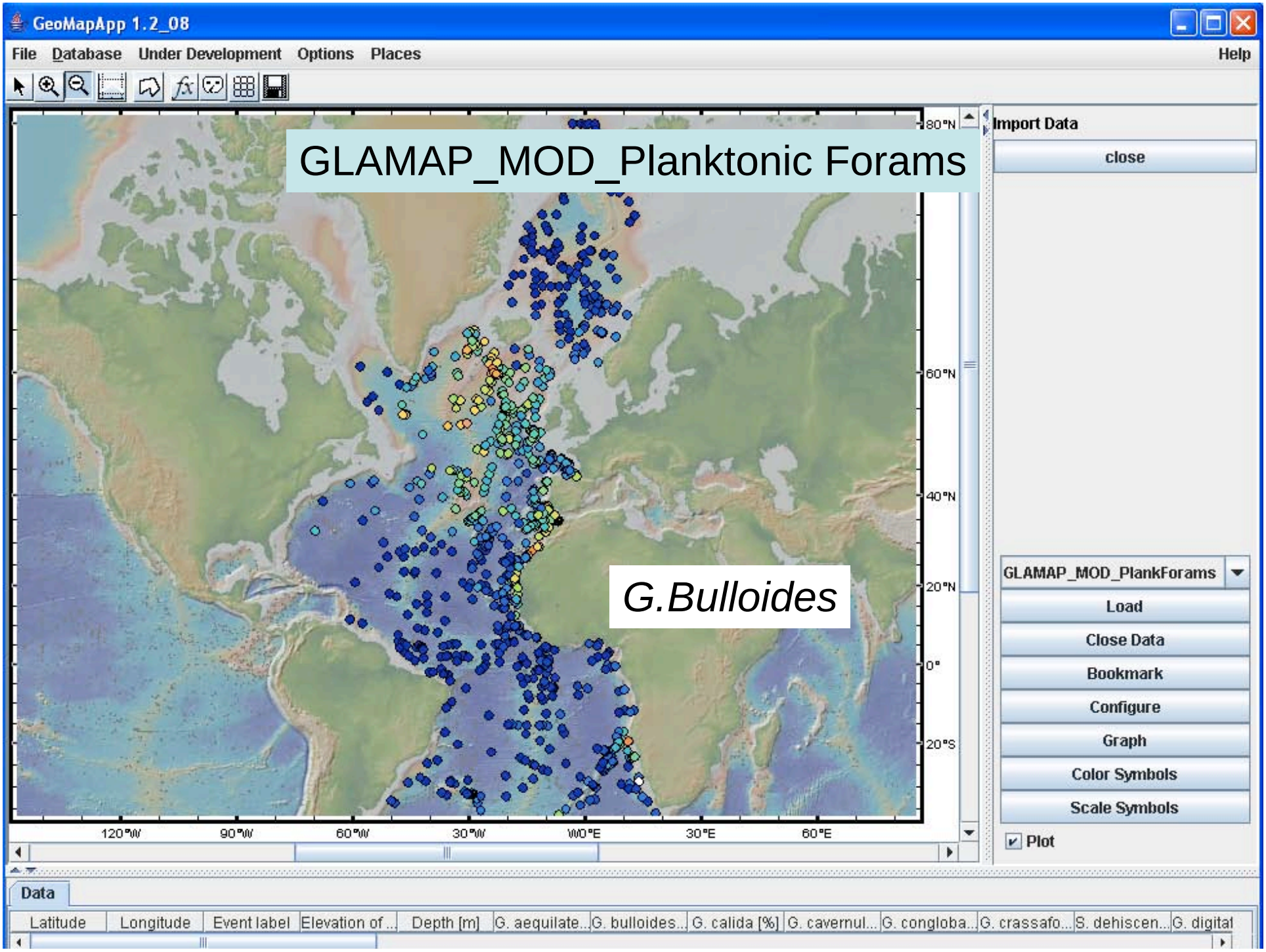
- Add the ODP and IODP data to complete the database
- ~$30K of funds needed for TAMU (JANUS) and INSTARR
- Funds exist in legacy projects
- 3 months to complete the effort
- A standalone version to take to sea on the drill ship
- A standalone version is at sea right now on the *R/V Atlantis*

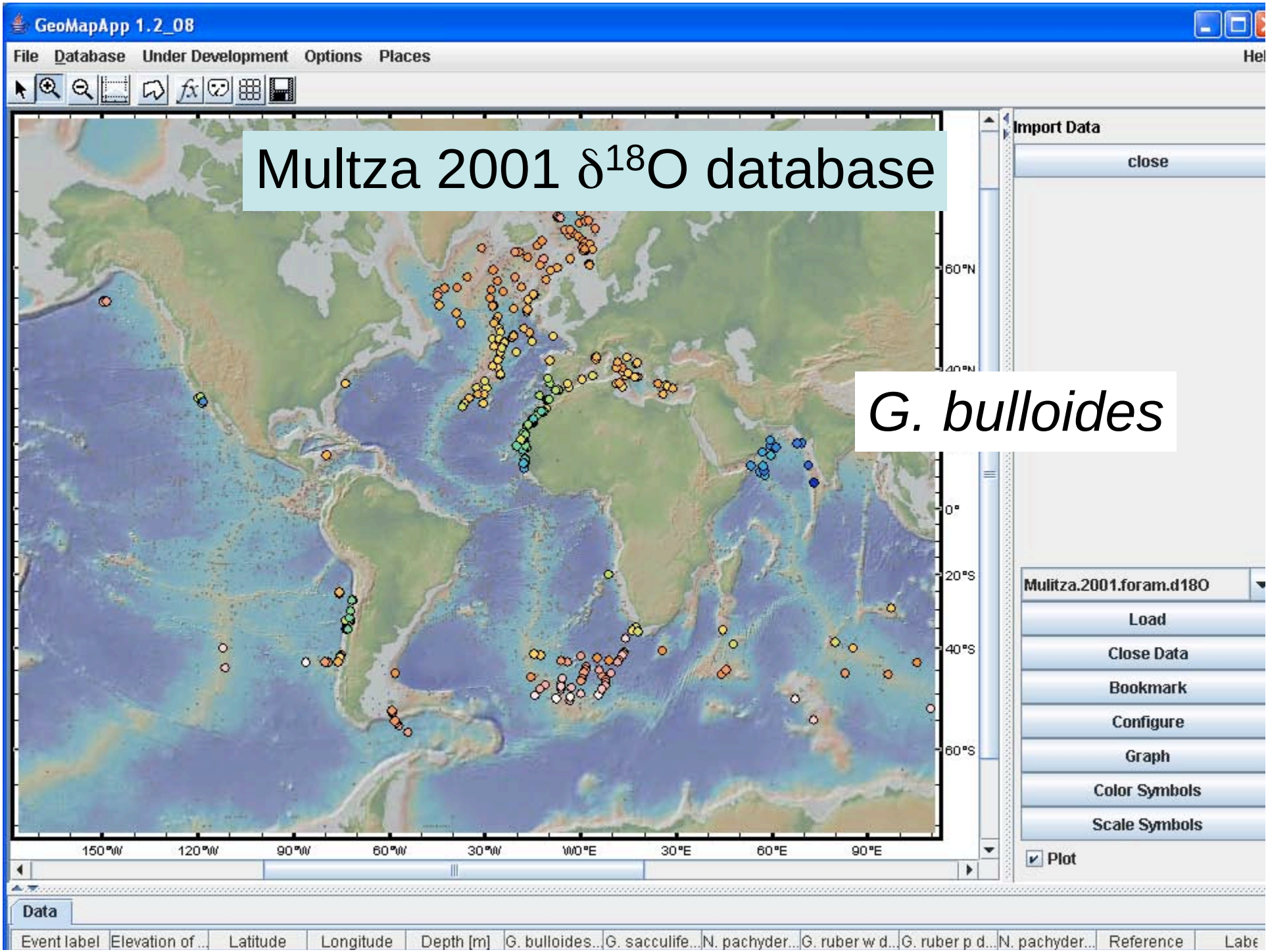
On-going volunteer efforts




GeoMapApp 1.2_08
File Database Under Development Options Places Help
Archer percent $CaCO_3$
Import Data
close
60°N
40°N
20°N
0°
20°S
40°S
60°S
150°W
120°W
90°W
60°W
30°W
0°E
30°E
60°E
90°E
Archer CaCo3
Load
Close Data
Bookmark
Configure
Graph
Color Symbols
Scale Symbols
Plot
Data
core source lat long waterdepth caco3
orit35n-95 biscaye 30.32 -65.00 4912 0.03


GeoMapApp 1.2_08
File Database Under Development Options Places Help
Heinz 2004
Percent silica at Last Glacial Maximum
Import Data
close
Heinz_2004_global_LGM_opal
Load
Close Data
Bookmark
Configure
Graph
Color Symbols
Scale Symbols
Plot
60°N
40°N
20°N
0°
20°S
40°S
150°W
120°W
90°W
60°W
30°W
0°E
30°E
60°E
90°E
Data
Latitude
Longitude
Event label
Age [kyr BP]
Age model [...
BSiO2 [%]
Reference
Comment


GeoMapApp 1.2_08
File
Database
Under Development
Options
Places
Help
GLAMAP_MOD_Planktonic Forams
G.Bulloides
80°N
60°N
40°N
20°N
0°
20°S
120°W
90°W
60°W
30°W
0°E
30°E
60°E
Import Data
close
GLAMAP_MOD_PlankForams
Load
Close Data
Bookmark
Configure
Graph
Color Symbols
Scale Symbols
Plot
Data
Latitude
Longitude
Event label
Elevation of ...
Depth [m]
G. aequilate...
G. bulloides...
G. calida [%]
G. cavernul...
G. congloba...
G. crassafo...
S. dehiscen...
G. digital


GeoMapApp 1.2_08
File Database Under Development Options Places
Multza 2001 δ18O database
G. bulloides
Import Data
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60°N
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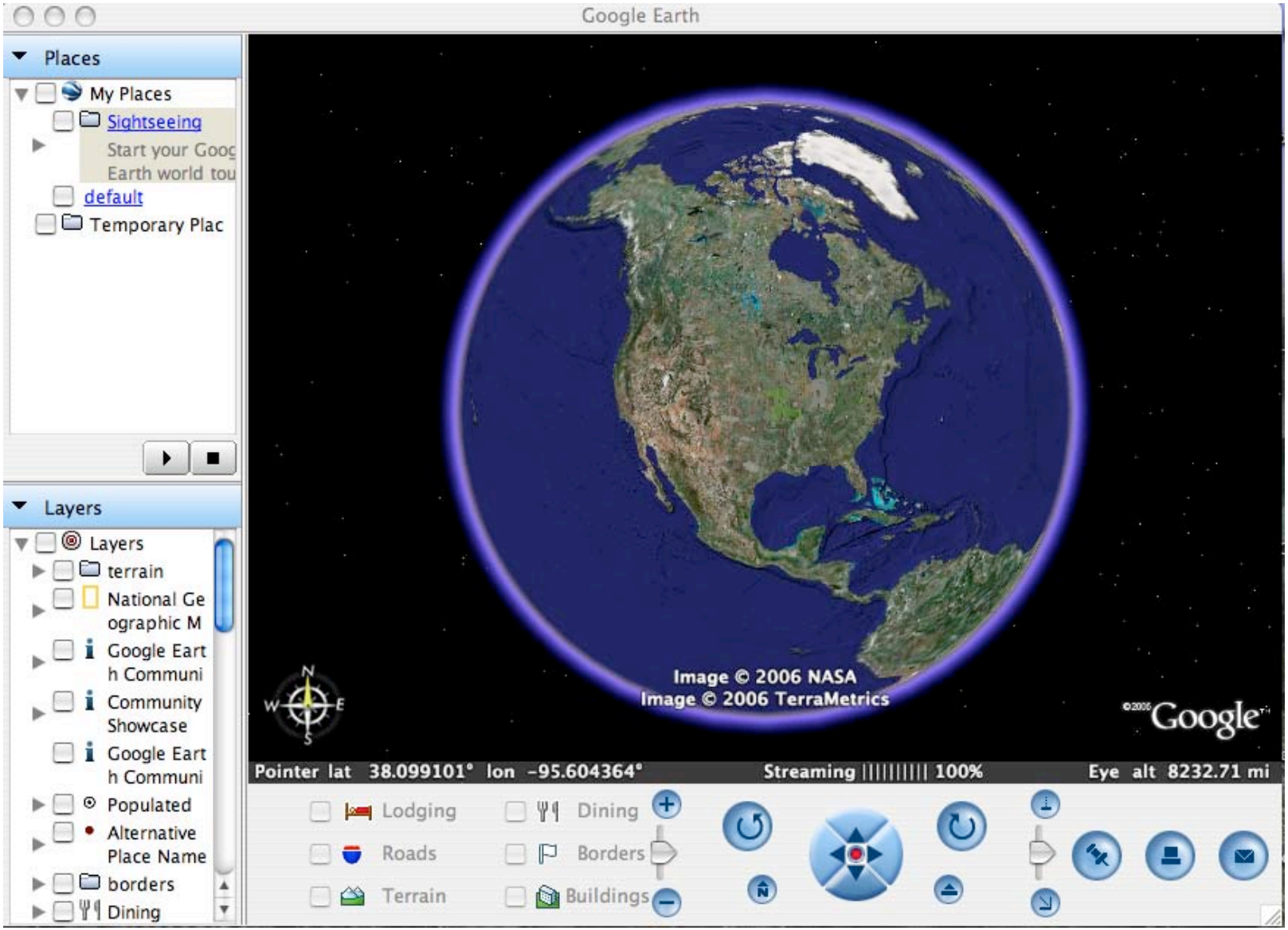
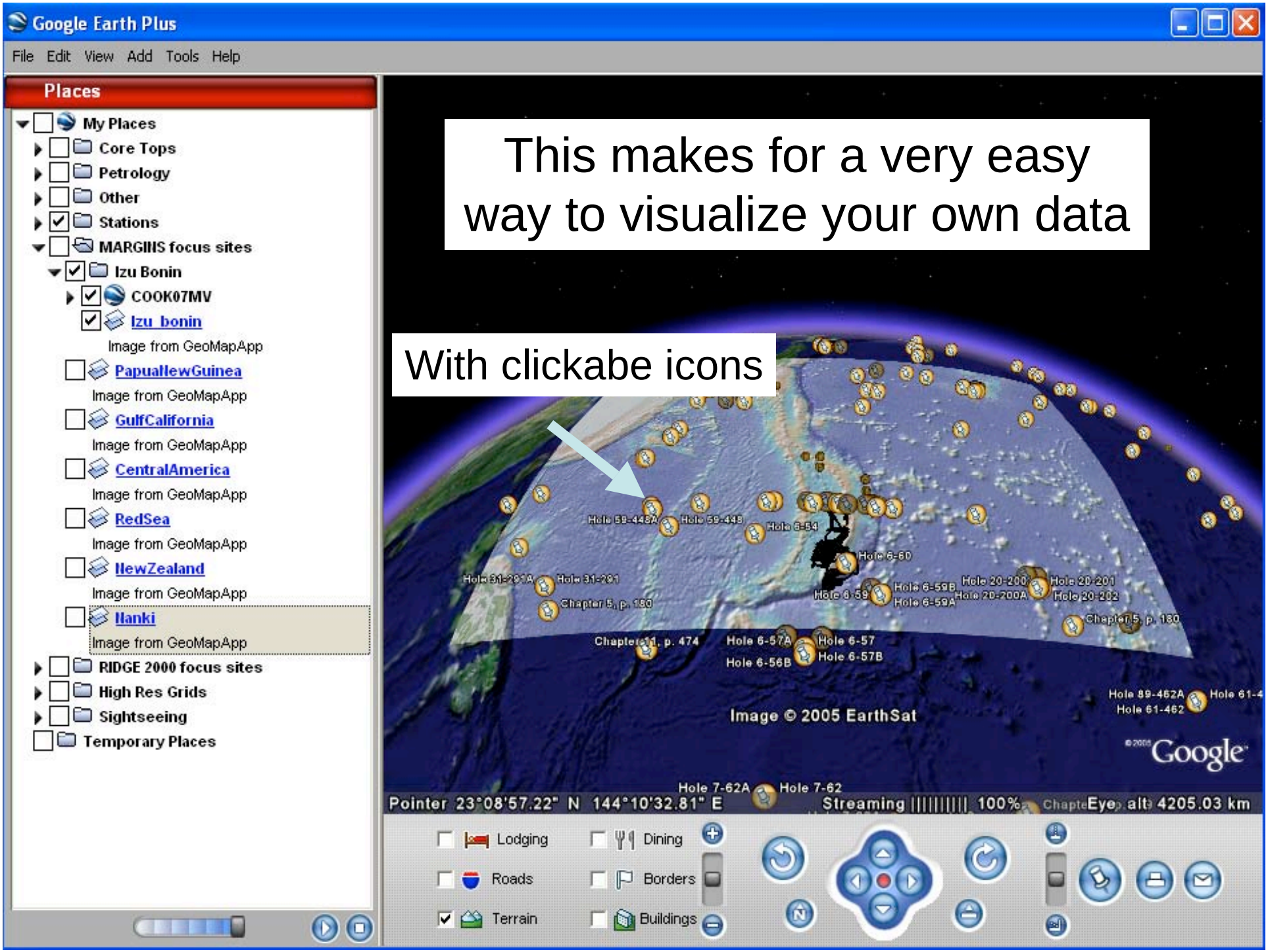
60°S
150°W 120°W 90°W 60°W 30°W 0°E 30°E 60°E 90°E
Mulitza.2001.foram.d18O
Load
Close Data
Bookmark
Configure
Graph
Color Symbols
Scale Symbols
Plot
Data
Event label Elevation of .. Latitude Longitude Depth [m] G. bulloides.. G. sacculife.. N. pachyder.. G. ruber w d.. G. ruber p d.. N. pachyder.. Reference

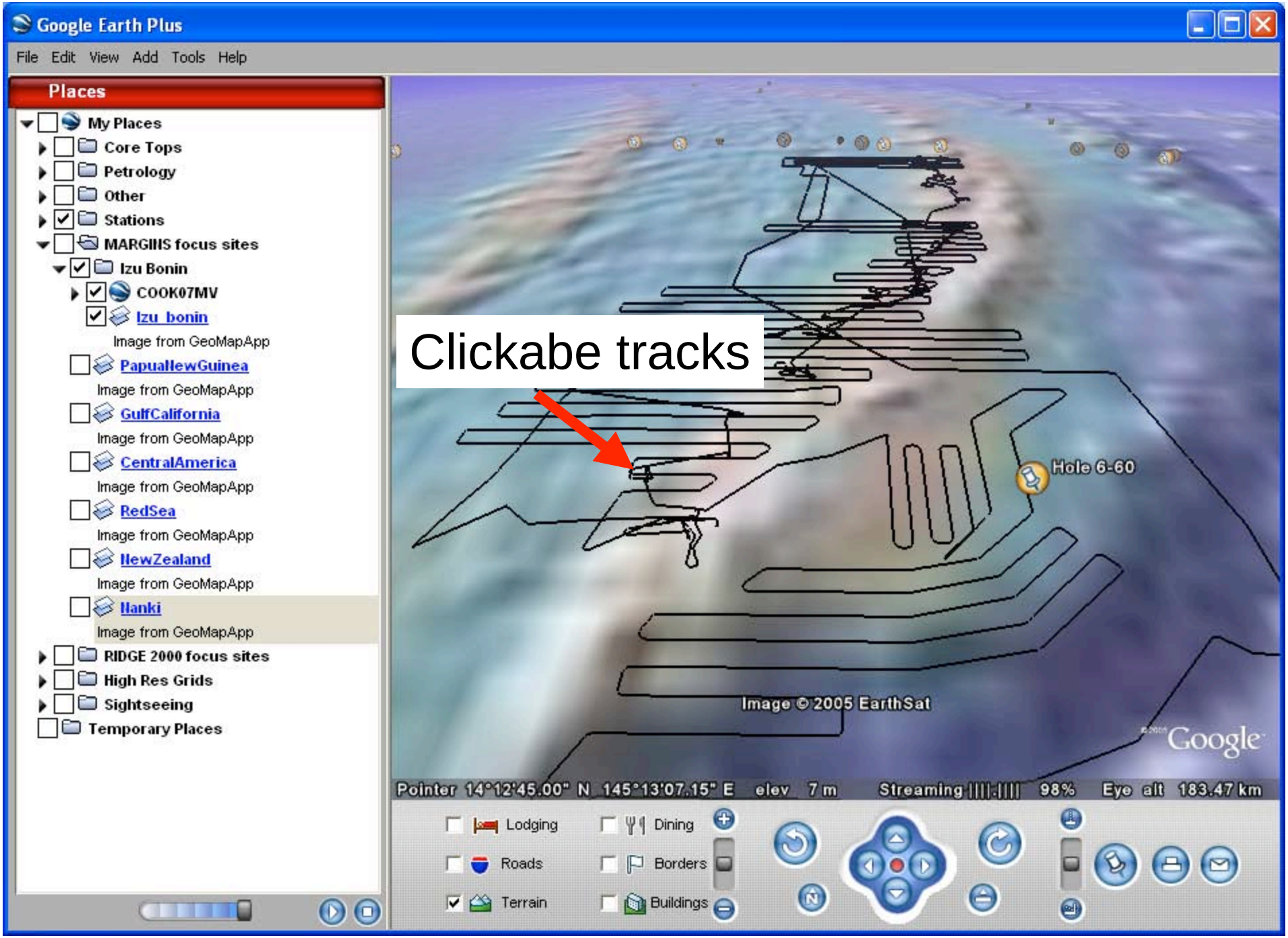
New Paradigm - Google Earth



Innovation

- Data are described with XML tags (using the Keyhole Markup Language extensions)


Google Earth Plus
File Edit View Add Tools Help
Places
My Places
Core Tops
Petrology
Other
Stations
MARGINS focus sites
Izu Bonin
COOK07MV
Izu_bonin
Image from GeoMapApp
PapuaNewGuinea
Image from GeoMapApp
GulfCalifornia
Image from GeoMapApp
CentralAmerica
Image from GeoMapApp
RedSea
Image from GeoMapApp
NewZealand
Image from GeoMapApp
Nanki
Image from GeoMapApp
RIDGE 2000 focus sites
High Res Grids
Sightseeing
Temporary Places
This makes for a very easy way to visualize your own data
With clickabe icons
Image © 2005 EarthSat
Google
Pointer 23°08'57.22" N 144°10'32.81" E
Streaming 100%
Eye alt 4205.03 km
Lodging
Dining
Roads
Borders
Terrain
Buildings


Google Earth Plus
File Edit View Add Tools Help
Places
My Places
Core Tops
Petrology
Other
Stations
MARGINS focus sites
Izu Bonin
COOK07MV
Izu_bonin
Image from GeoMapApp
PapuaNewGuinea
Image from GeoMapApp
GulfCalifornia
Image from GeoMapApp
CentralAmerica
Image from GeoMapApp
RedSea
Image from GeoMapApp
NewZealand
Image from GeoMapApp
Hanki
Image from GeoMapApp
RIDGE 2000 focus sites
High Res Grids
Sightseeing
Temporary Places
Clickabe tracks
Hole 6-60
Image © 2005 EarthSat
Google
Pointer 14°12'45.00" N 145°13'07.15" E elev 7 m Streaming 98% Eye alt 183.47 km
Lodging
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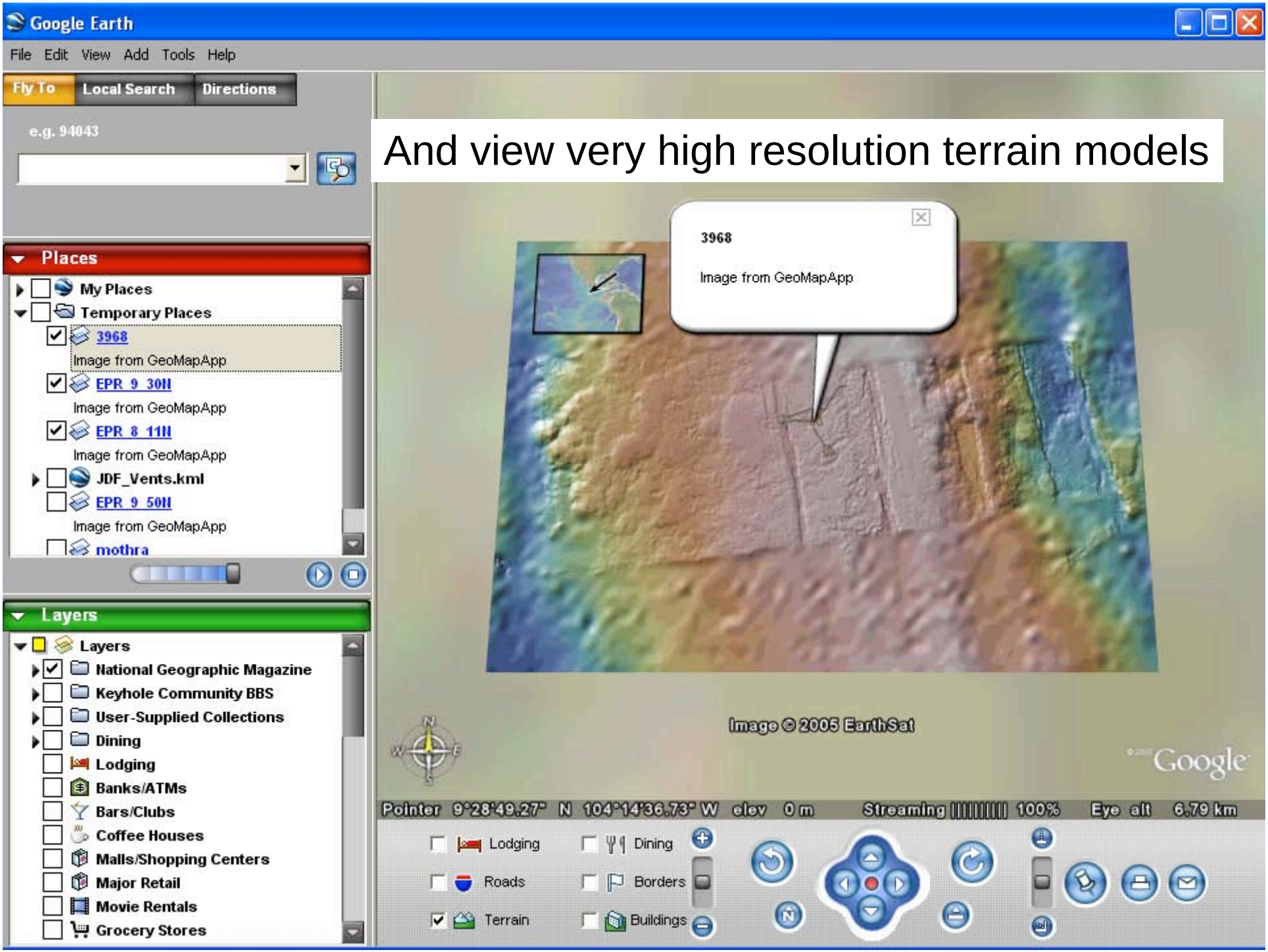
Roads
Borders
Terrain
Buildings


Google Earth
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Places
My Places
Temporary Places
3968
Image from GeoMapApp
EPR_9_30N
Image from GeoMapApp
EPR_8_11N
Image from GeoMapApp
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EPR_9_50N
Image from GeoMapApp
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Layers
Layers
National Geographic Magazine
Keyhole Community BBS
User-Supplied Collections
Dining
Lodging
Banks/ATMs
Bars/Clubs
Coffee Houses
Malls/Shopping Centers
Major Retail
Movie Rentals
Grocery Stores
And view very high resolution terrain models
3968
Image from GeoMapApp
Image © 2005 EarthSat
Google
Pointer 9°28'49.27" N 104°14'36.73" W elev 0 m Streaming 100% Eye alt 6.79 km
Lodging
Dining
Roads
Borders
Terrain
Buildings

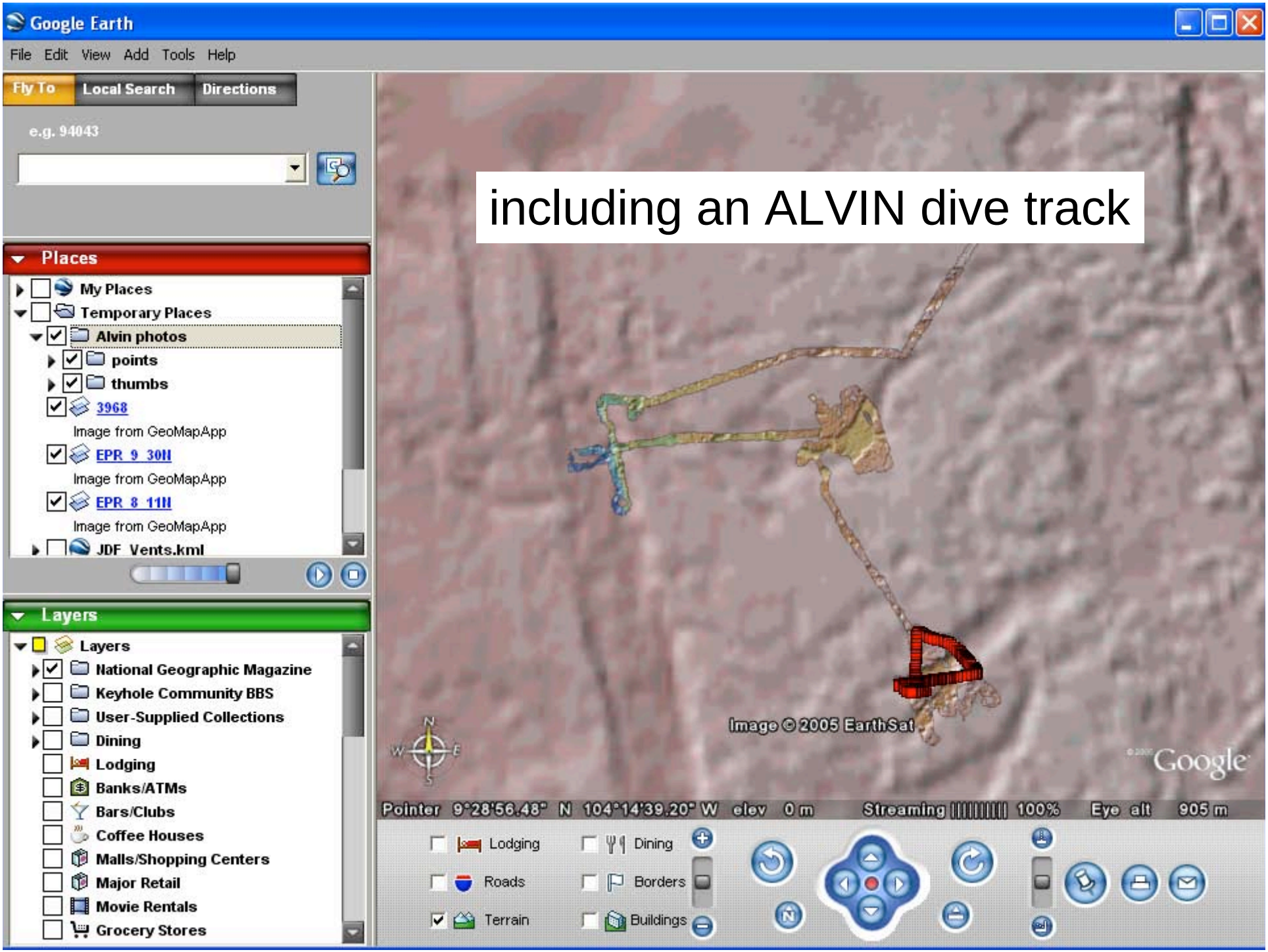
Google Earth
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Image from GeoMapApp
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National Geographic Magazine
Keyhole Community BBS
User-Supplied Collections
Dining
Lodging
Banks/ATMs
Bars/Clubs
Coffee Houses
Malls/Shopping Centers
Major Retail
Movie Rentals
Grocery Stores
including an ALVIN dive track
Image © 2005 EarthSat
Google
Pointer 9°28'56.48" N 104°14'39.20" W elev 0 m
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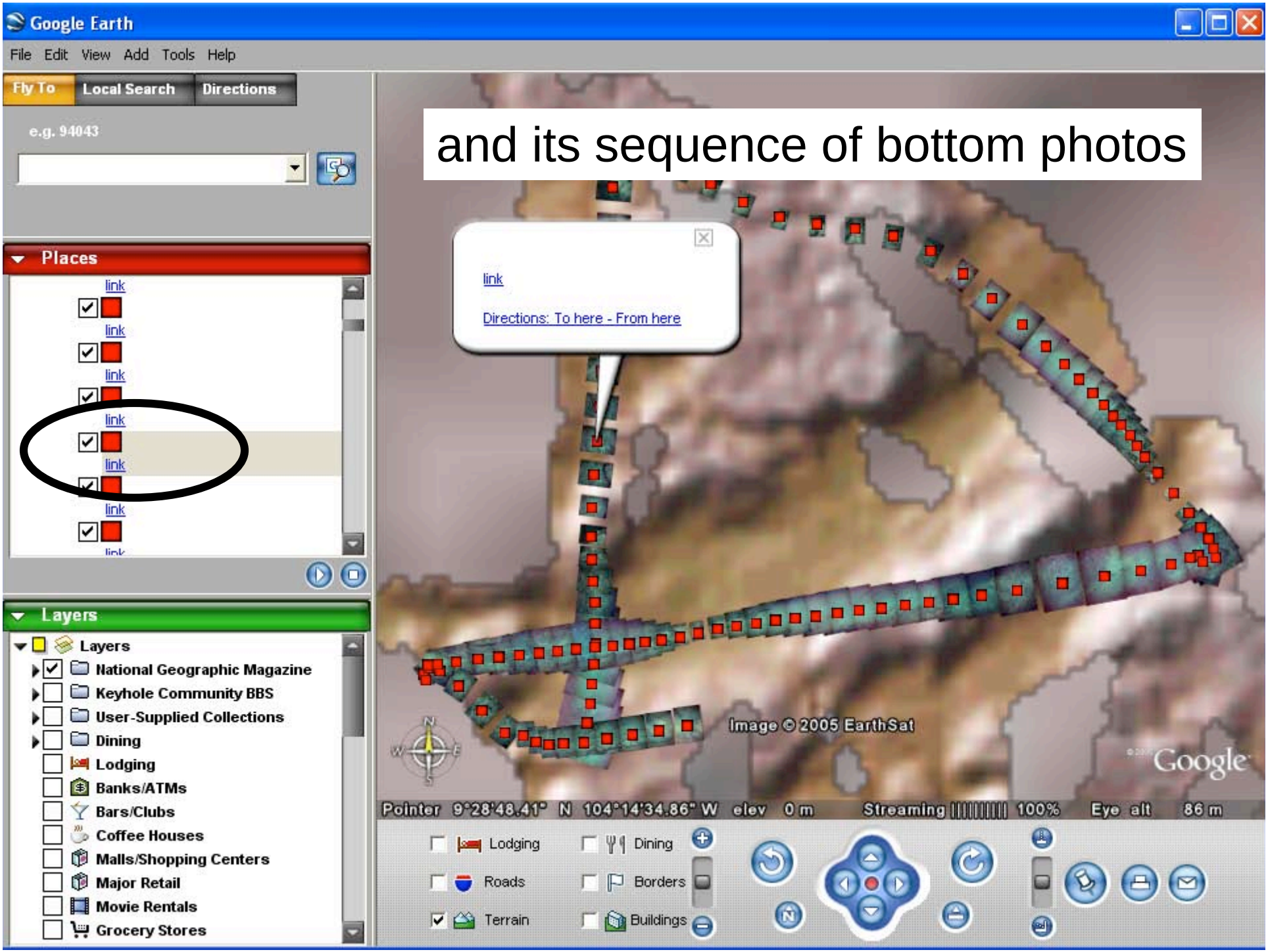
Dining
Roads
Borders
Terrain
Buildings


Google Earth
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Directions
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National Geographic Magazine
Keyhole Community BBS
User-Supplied Collections
Dining
Lodging
Banks/ATMs
Bars/Clubs
Coffee Houses
Malls/Shopping Centers
Major Retail
Movie Rentals
Grocery Stores
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Image © 2005 EarthSat
Google
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Dining
Roads
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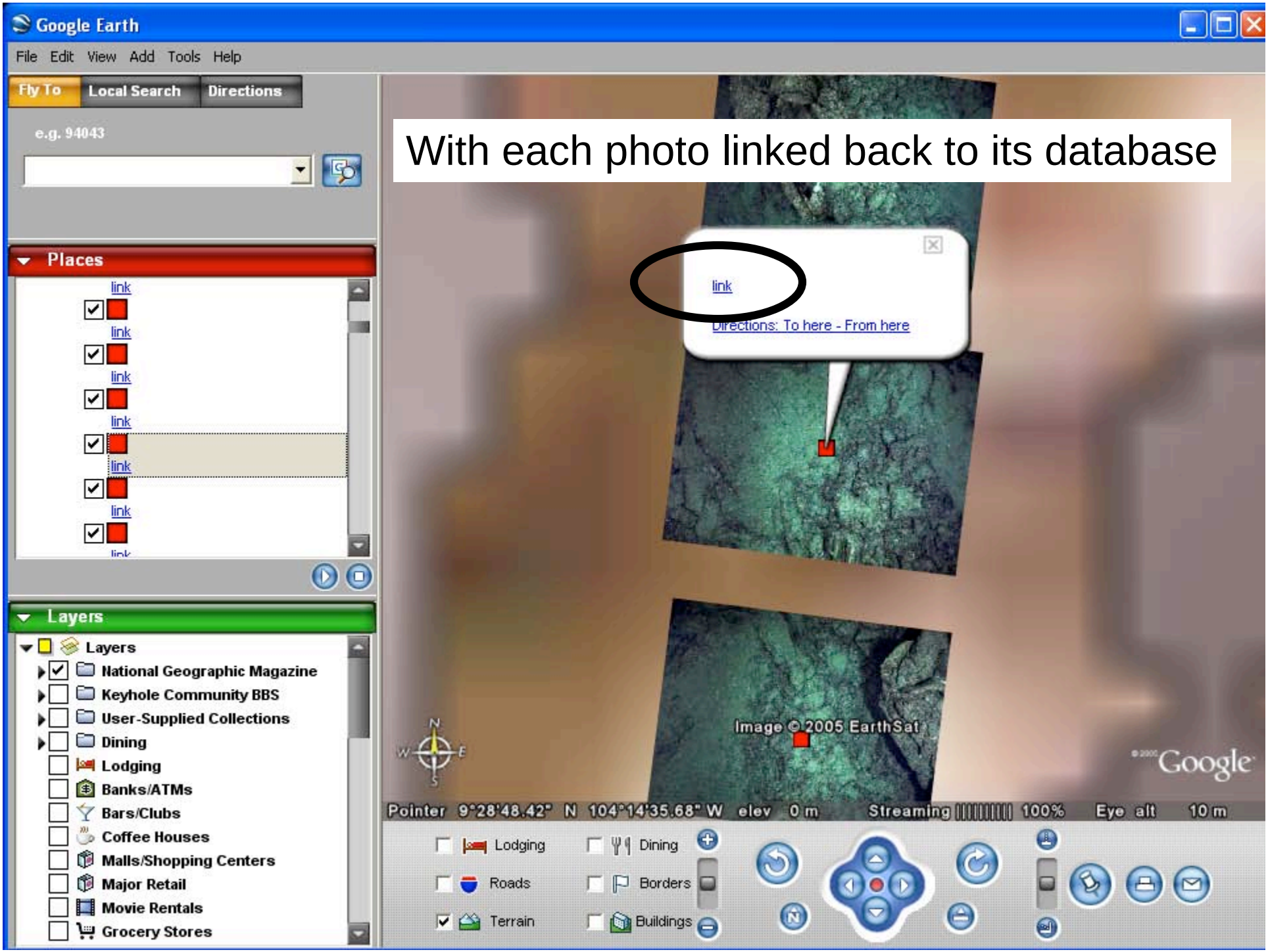
Terrain
Buildings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Keyhole Community BBS
User-Supplied Collections
Dining
Lodging
Banks/ATMs
Bars/Clubs
Coffee Houses
Malls/Shopping Centers
Major Retail
Movie Rentals
Grocery Stores
With each photo linked back to its database
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Directions: To here - From here
Image © 2005 EarthSat
Google
Pointer 9°28'48.42" N 104°14'35.68" W elev 0 m
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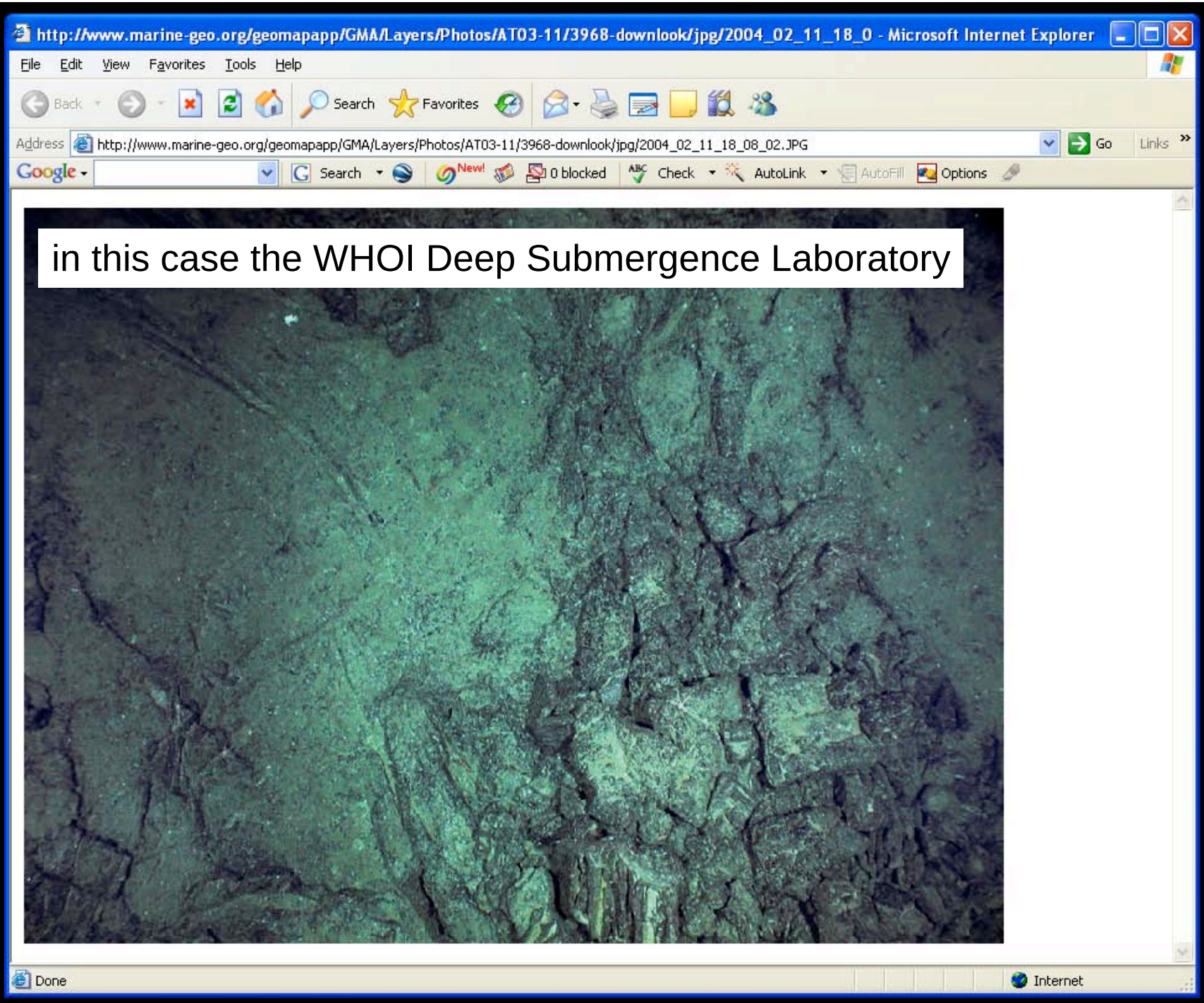
Roads
Borders
Terrain
Buildings


http://www.marine-geo.org/geomapapp/GMA/Layers/Photos/AT03-11/3968-downlook/jpg/2004_02_11_18_0 - Microsoft Internet Explorer
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Back Search Favorites
Address http://www.marine-geo.org/geomapapp/GMA/Layers/Photos/AT03-11/3968-downlook/jpg/2004_02_11_18_08_02.JPG
Go Links
Google Search 0 blocked Check AutoLink AutoFill Options
in this case the WHOI Deep Submergence Laboratory
Done
Internet

Suggestions for CoreWall

• Build on the visualization paradigm of Google Earth and GeoMapApp using tiles. Is a video wall truly necessary?

• Consider reaching out to a very broad audience equipped with PCs

• Think of your core imagery as maps, served from an Internet Map Server

• Think of you data as described by XML and served from an internet Feature Server

• Think of your application as being as innovative as iTunes.

continued

- No longer does one download data to the desktop.
- Your application discovers the data where ever they reside.
- Data arrive from servers invisible to the user.
- Like sharing song lists in iTunes, users work in collaboration at separate sites.
- Think of your goal not as delivering images, graphs and tables, but kernels of knowledge and catalysts for new ideas.

Acknowledgements

Bill Haxby