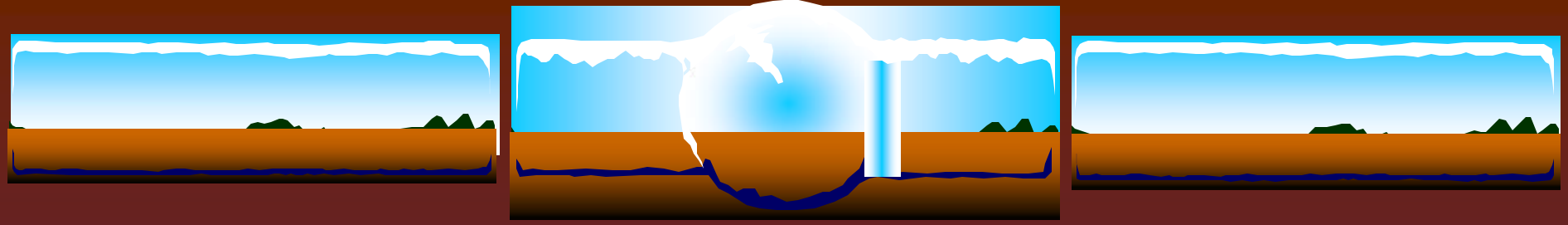

DOE's EGS Program Review

EGS Database Development

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Black Mountain Technology

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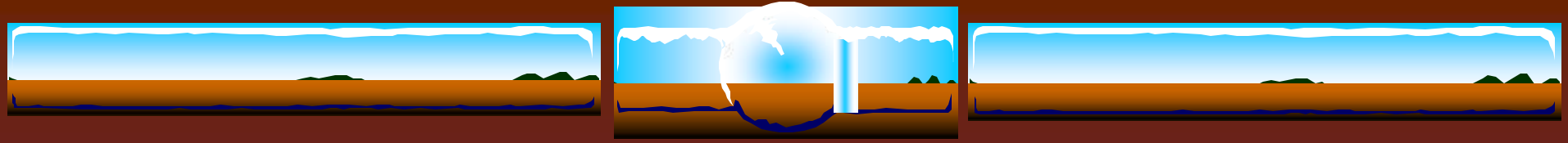
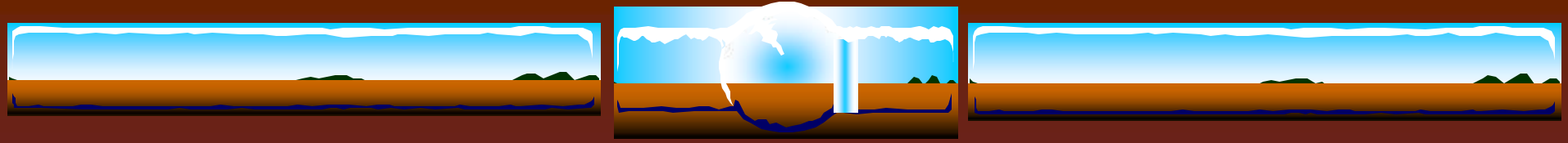
July 18, 2006

Marriott Hotel
Golden, CO



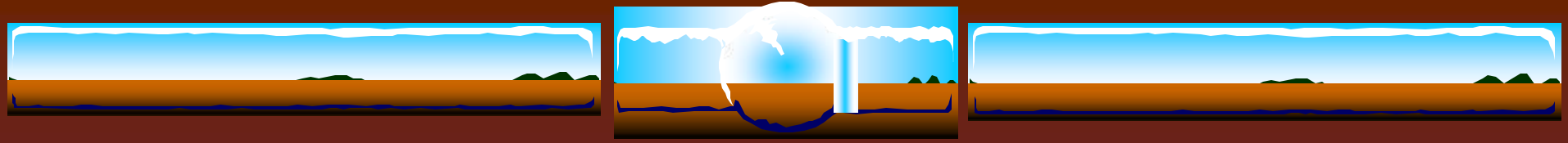
Project Objective

- Original objective: Develop database information on Enhanced Geothermal Systems projects worldwide.
- Expanded objective: Make data available interactively through Google Earth. Include EGS projects worldwide, sites with EGS potential in the US and data on temperature with depth developed by Dave Blackwell and Maria Richards, SMU.



EGS Problem

- Importance to program
  - Allows researchers access to information on current status of EGS technology
  - Provides data for researchers to test new technology
  - Assists DOE in mapping out future research
  - Documents advances in technology and areas of needed research
- Technical issues
  - Understanding of current status of EGS technology
  - Dissemination of EGS information to a wide range of users and the public

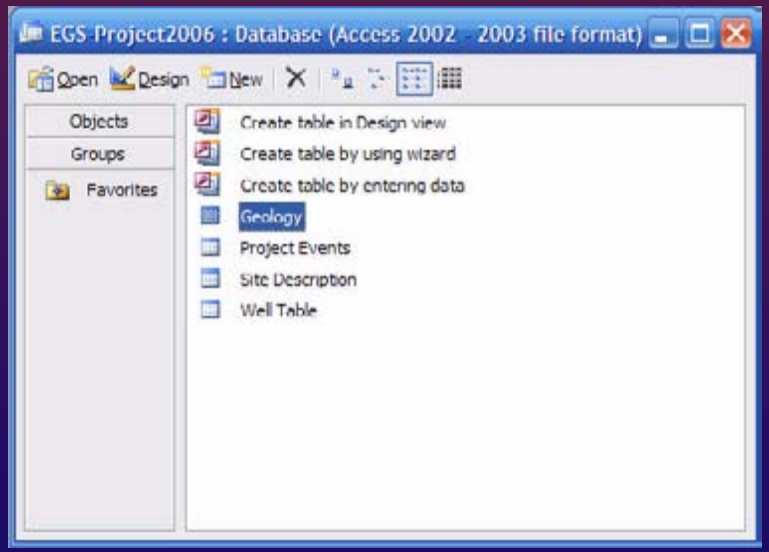


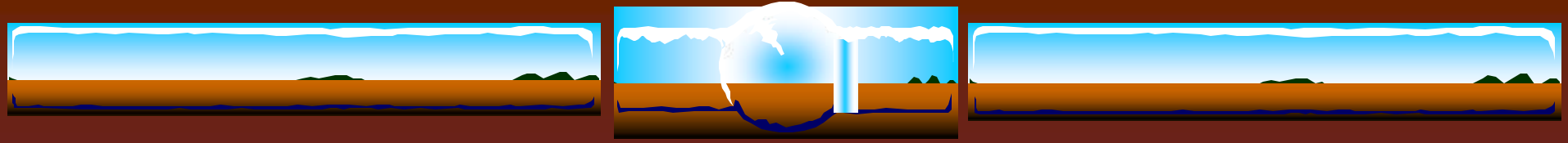
EGS Problem

- Barriers and Challenges
  - Lack of understanding of status of EGS technology
  - Need to improve EGS information access for researchers, industry, government and the public
- Achievement of DOE goals:
  - Allows potential users access to information on: size of resource, location of potential resources, data from past projects and status of current projects

Background/Approach

- Database structure developed
- Published data used
- Four linked database tables
  - Site Description
  - Project Events
  - Well Data
  - Geology



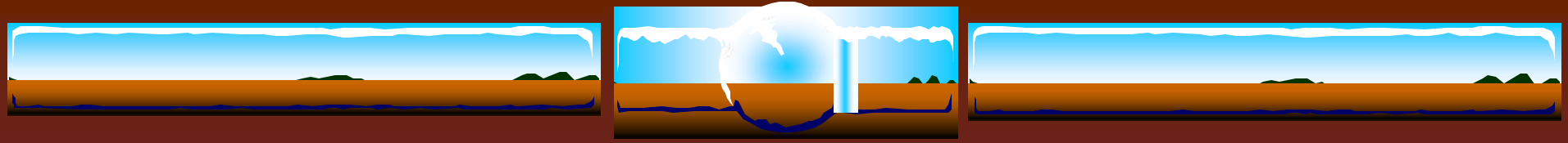


Background/Approach

- Site Description
  - EGS projects world wide
  - Sites with EGS potential in the USA
- 221 specific sites in USA
  - Current EGS projects at Coso and Desert Peak
  - Past EGS project at Fenton Hill
  - Hydrothermal associated EGS
  - High temperature oil and gas reservoirs with EGS potential
- Variables tracked for each site in the database
  - Location
  - Area of thermal anomaly
  - Depth
  - Temperature at depth
  - Wells drilled
  - Flow per producer from tests
  - Fractured volume if stimulated
  - Well spacing
  - Heat exchange area

EGS Site Database Fields

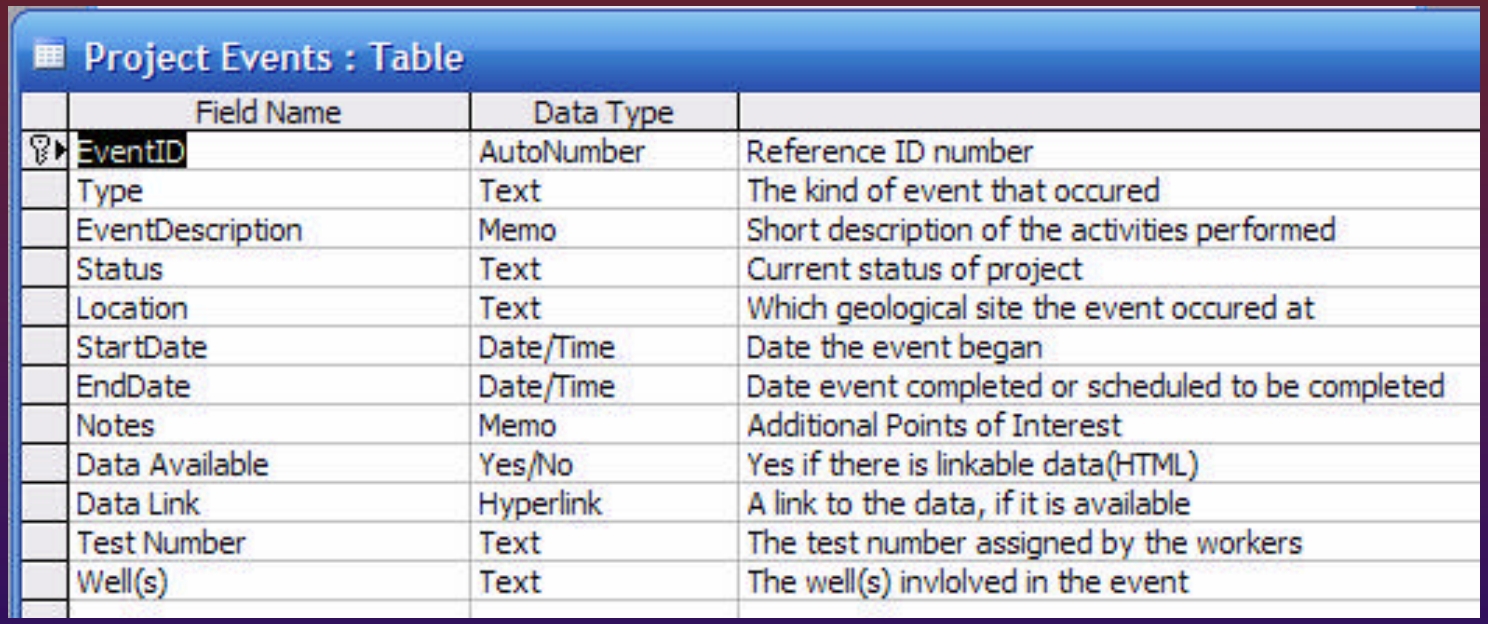
Field Name	Data Type	
Name	Text	Name of the site/area
Country	Text	Name of the country the site is located in
State/Area	Text	Name of the state/region the site is located in
Region	Text	Region for sites in the US
Geological Province	Text	Geological province the site is located in
Latitude	Number	Latitude of the site
Longitude	Number	Longitude of the site
Target Temperature	Number	The heat goal for fluid in the resevoir
Actual Temperature	Number	The actual temperture of the fluid in the resevoir in Farenheit
Temp Accuracy	Number	Accuracy of target vs actual temperature
Temp Gradient	Number	Temperature gradient in degrees celsius per kilometer
Area	Number	Total area of the resource in
Depth	Number	True vertical depth of the well in m
Mass Flow Rate	Number	Flow rate of the entire site in kg/s
MW t Measured Output	Number	The output of thermal energy in MW
Calculated Net MW e Output	Number	The net output of electrical energy in MW
Plant Type	Text	Type of power plant used at the site
Power Type	Text	Type of power, EGSor HYDRO
Rock Type	Text	The kind of rock(lithography) of the area
Stress Regime	Text	The direction that the rock pushing
Total Fractured Volume	Number	Total volume of fractured rock at the site in km3
Post-Stim Frac Spacing	Number	Measure of the average distnce between fractures after stimulation in m
Heat Exchange Area	Number	
Tectonic Stress	Text	A general measurement of tectonic stress for the site
Porosity	Number	Percentage of solid rock that has holes in it
Permeability	Number	Permeability of rock, measured in millidarcies
Pressure Drop	Number	Amount of pressure drop in the system in Mpa
H2S	Yes/No	Indicates the presence of H2S
CO2	Yes/No	Indicates the presence of CO2
Salinity	Yes/No	Indicates the presence of Salt
Silica	Yes/No	Indicates the presence of Silica
CACO3	Yes/No	Indicates the presence of CACO3
Toxic	Yes/No	Indicates whether or not the site is toxic
Water Loss Percentage	Number	Percentage of the water that is lost duriong circulation
Short Circuit Factor	Number	A measure of how quickly the water travels through the system
Productivity Index	Number	A measure of well productivity in l/sec/Mpa
Exploration	Text	Describes exploration of the site
Status	Text	Current Status of any projects at this site
Owner	Text	The owner of the site
Utility	Text	Utility company with the contract for the site
Environmental Impact	Text	Notes on acquiring the land for geothermal purposes and the effects on local environment
Political Climate	Text	Notes on the current political climate at the site
Power Market	Text	Availability of markets for power from site
Notes	Text	Any notes on the site
GETEM Base Cost	Number	Cost in cents per kW/hr generated by GETEM
GETEM Incremental	Number	Cost in cents per kW/hr generated by GETEM
GETEM Future Tech	Number	Cost in cents per kW/hr generated by GETEM



Background/Approach

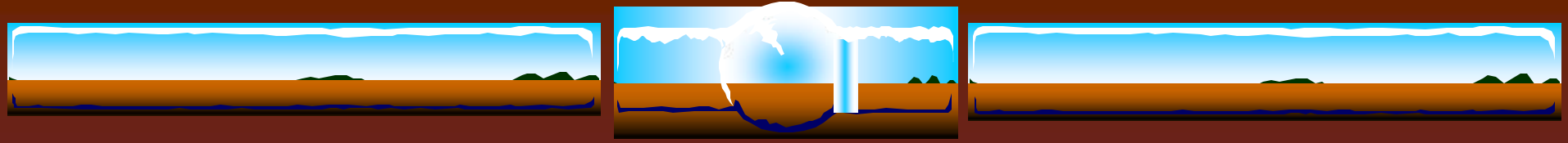
- Event database
- Event history for established EGS sites
  - Well drilling
  - Stimulation events and results
  - Acoustic emissions mapping
  - Well testing
  - Geochemistry

Project Events



Project Events : Table

Field Name	Data Type	
EventID	AutoNumber	Reference ID number
Type	Text	The kind of event that occured
EventDescription	Memo	Short description of the activities performed
Status	Text	Current status of project
Location	Text	Which geological site the event occured at
StartDate	Date/Time	Date the event began
EndDate	Date/Time	Date event completed or scheduled to be completed
Notes	Memo	Additional Points of Interest
Data Available	Yes/No	Yes if there is linkable data(HTML)
Data Link	Hyperlink	A link to the data, if it is available
Test Number	Text	The test number assigned by the workers
Well(s)	Text	The well(s) invlolved in the event



Background/Approach

- Well database
  - Well profile
  - Drilling data – Depth w. time
  - Rate of penetration
  - Bit records
  - Costs if available

Project Events

Project Events : Table

Field Name	Data Type	
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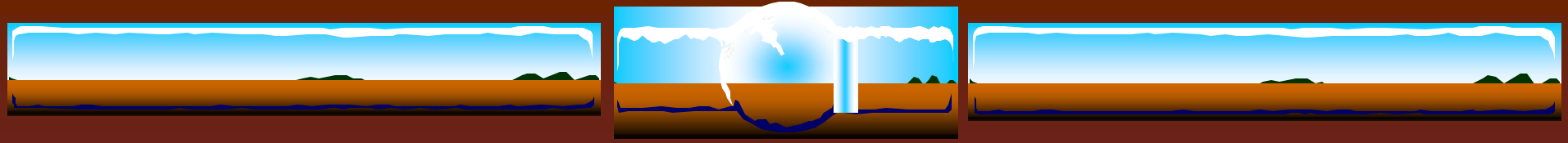


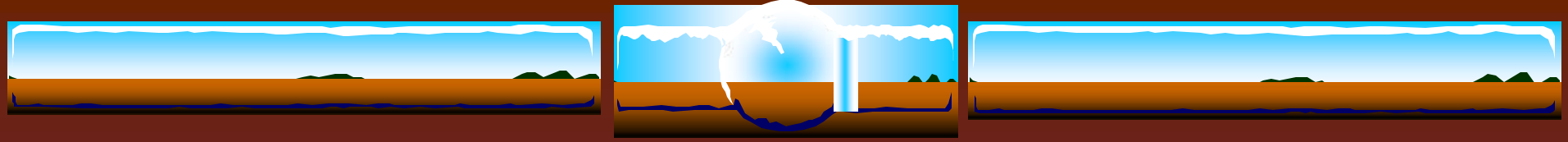
Background/Approach

- Geology Database
  - Stratigraphic column
  - Completion formation
  - Thermal properties
  - Stress data-scans
  - Mechanical properties
  - Core photos
  - Fracture ID logs-scans
  - Geophysical logs-scans

Geology

Geology : Table

Field Name	Data Type	Descri
ID	AutoNumber	Basic ID number of Geology Reference
Site Name	Text	Name of site
Lithological Column	Hyperlink	Lithology data for section/entirity of wellbore
Other Lithology	Hyperlink	A link to any other lithological data
Stress Field	Hyperlink	Graphical representation of the stress field fomr cutaway of wellbore
Geological Map	Hyperlink	A link to a map of the area in which the site is located
Geological Cross Section	Hyperlink	A link to a picture of the cross section of the area
Core Photos	Hyperlink	A link to a picture of the core photos taken
Fracture Imaging Logs	Hyperlink	A link to a picture of image logs from a borehole televiewer or FMS, EMS, EMI, FMI, or others
Geophysical Logs	Hyperlink	A link to a picture of the well log
Bit Life	Number	Length of time bit was used in hours
Rate of Penetration	Number	(ROP) in meters per hour
Drilling Difficulties	Hyperlink	A link to data on mud losses, altered zones, and borehole stability problems
Lost Circulation	Number	A percentage of the total flow in circulation that is lost
MT Survey Map	Hyperlink	Link to a MT survey image
MT Cross Section	Hyperlink	Link to images of MT cross sections
Gravity Map	Hyperlink	Link to a map of the gravity anomalies at the site
Additional Data	Hyperlink	Any additional data that is relevant to the geology of the site



Results/Accomplishments

Completed and linked:

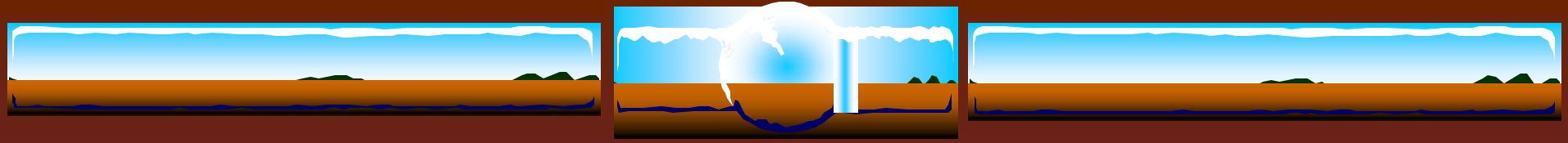
- Geology Data Table.
- Data in all tables for all major sites.
- Basic reports and data entry forms.
- Enhanced and simplified usability
- Compiled version usable without Microsoft Access.
- User's Guide – in progress

Completed and distributed:

April 5, 2006

Data Update:

Sept 30, 2006

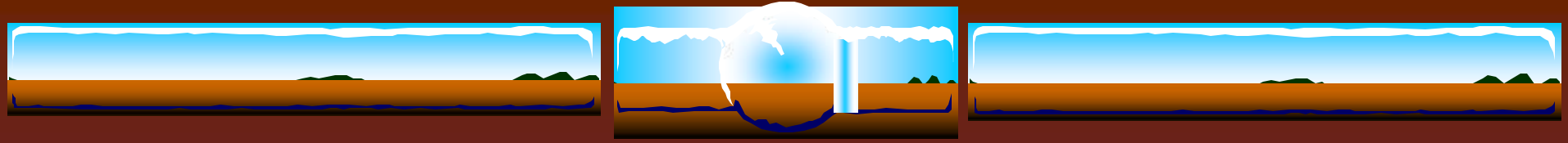


Results/Accomplishments

- Added geographic interface – allows user to click on Google Earth world map to access site data
- Add temperature at depth layers
- Improve user interface and usability, compile and install on website
- Update user guide

Due for completion:

Sept 30, 2006



Conclusion

- Milestone 1 – Database with scanned data on disk
  - Completed and distributed April 5, 2006
- Milestone 2 – Improved user interface
  - To be completed July 31, 2006
- Milestone 3 – Google Earth interactive database
  - To be completed August 31, 2006