Regional Geology Interactive Web Based Mapping Application

Milestone Report

Fuel Cycle Research & Development

SUMMARY

This is a milestone report for the FY2015 development of the Used Fuels and Research program development of the Regional Geology Web Mapping Application by the Idaho National Laboratory Geospatial Science and Engineering group. This tool was developed for general public use and is an interactive web based application to visualize, reference, and analyze geological features of the US pertinent to the Used Fuel Disposal program. This tool is designed to facilitate capability and understanding of regional geology of the US.

CONTENTS

FIGURES

ACRONYMS

AOI – Area of Interest
ArcGIS – Suite of Esri's GIS software
DMZ – Demilitarized Zone
Esri - Environmental Systems Research Institute
FLEX – open source application framework for building and maintaining expressive web applications
FY2016 – Fiscal Year 2016
IE – Internet Explorer
INL – Idaho National Laboratory
RGWM - Regional Geology Web Map
GeoSE – Geospatial Science and Engineering Group
GIS – Geographic Information System
LANL – Los Alamos National Laboratory
NE - Office of Nuclear Energy
UFD – Used Fuel Disposal
URL – Uniform Resource Locator
US – United States
USGS – United States Geological Survey
UTM – Universal Transverse Mercator

REGIONAL GEOLOGY INTERACTIVE WEB BASED MAPPING APPLICATION MILESTONE REPORT

1.   INTRODUCTION

Los Alamos National Laboratory (LANL) is developing GIS (geographic information system) data for understanding the relationships between potential geologic host rocks for a high-level nuclear waste repository and potential siting guidelines that could influence the eventual siting of a repository. The US Department of Energy's Office of Nuclear Energy (NE) has employed Idaho National Laboratory (INL) to provide this information to the public through a web-based interactive GIS application. This application will allow users to better understand potential siting issues for certain regions of the country including the presence or lack of potential host rocks, natural hazards, potential for future drilling of natural resources, and proximity to population centers.

This document serves as the first year progress report for development of the Regional Geology Web Map (RGWM) application. At a high level, INL project requirements were to develop, maintain, and host this application, which resides on INL's external GIS server and will take advantage of current GIS application hosting software licenses (ArcGIS Server). It can be accessed at https://gis.inl.gov/RegionalGeology. The application has been built using FLEX, an open source Esri ArcGIS Viewer for Flex platform for web development, which provided a significant reduction in development costs for this application because INL's Geospatial Science and Engineering Group (GeoSE) has developed many other web application using Flex. Flex is a common web based software application language used to develop rich mapping experiences in a web browser environment. The application is a server side application that does not require uses to download software, rather the application is provided on a web-enabled server to users via an internet browser such as Internet Explorer (IE), Google Chrome, Mozilla Firefox, or Safari. The initial interface of RGWM can be viewed in Figure 1.

1.1   Spatial Data

The Deep Borehole Application includes various spatial base reference and geological layers specifically identified by LANL. The data are organized in five mapservices, or published ArcGIS map documents. Below is a list of those mapservices, associated layers and some descriptions of layers:

- **Base Reference Layers**
  - US Population Density - Only areas of greater than 1000 people per mile^2
  - State Boundaries and Labels
  - Major Lakes of the US
  - Sedimentary Basins of the US - Outlines of the basins in the continental US and extending in the Gulf of Mexico
  - Smoothed Topographic Slope in Degrees
- **Alternative Disposal Media**
  - Bedded Salt Formations
    - Raster layer(s) for 25 salt formation (depth only)
    - Vector layer (polygon) showing extents of areas of interest (AOI)

- Vector layer (line) of contours within AOI showing depth intervals
  - o Shale Formations
    - Raster layer(s) for 25 salt formation (depth only)
    - Vector layer (polygon) showing extents of areas of interest (AOI)
    - Vector layer (line) of contours within AOI showing depth intervals
  - o Crystalline Rock Outcrops
    - Vector Layer (polygon) – Attributes include (age, rock type, area, etc.)
  - o Crystalline Basement
    - Raster layer of depth to crystalline basement
  - o Sedimentary Basins
    - Vector layer (polygon) of sedimentary basins (USGS)
- **Potential Siting Guideline Data Layer**
  - o Quaternary Faulting
    - Vector layer (line) showing the distribution of quaternary faults (USGS)
    - Vector polygon layer showing areas of Quaternary Faulting
  - o Plio-Quaternary Volcanic Rocks
    - Vector layer (polygon) showing the distribution of Pleistocene and Quaternary volcanic rocks (USGS)
  - o Sedimentary Rock Thickness (2000 meter contours)
  - o Oil and Gas Production
    - Vector layer (polygon) 0.5 km polygons showing location of oil and gas drilling (USGS)
  - o Crystalline Basement Structures from Sims 2005
    - Magnetic Derived Structures
      - Thrust Faults associated with suture zones
    - Structure Types
      - High Angle Faulting
      - Ductile Shear Zone
      - Boundary of Major Rift Zones
  - o Heat Flow
    - Raster layer from Southern Methodist University (SMU)
  - o Seismic Hazard
    - Raster layer showing peak ground acceleration
    - GeoRSS Feed – USGS Earthquake map service showing active earthquakes at various magnitudes
- **Federal Lands**
  - o Map Service showing land administration for the US – (USGS Protected Areas Database map service)
- **ArcGIS Online Base Layers**
  - o Aerial Imagery
  - o Streets
  - o USGS Topographic
  - o Shaded Relief
    - This is the default background.

1.2   Tools

RGWM application provides users with a robust set of tools for referencing pertinent geolgical features and siting potential. The specialized tools are designed to allow for greater usability and specific layer targeting. Below is the list of tools provided in the application:

- **Navigation** – This standard map tool provides navigation of the map by zooming to scale, panning, front and back zoom, directional pan, and return to last or original extent.
- **Base Layer Toggling Tool** – Gives users the option to switch between base layers of imagery, streets layer, shaded relief, and topographic layer depending on user background layer preference.
- **Scale Bar and Latitude/Longitude Coordinates** – Another standard map tool giving the user location and scale distance information. Tool automatically updates information while user interacts with application.
- **Overview Map** –Provides users with an overview map of the location of the current extent in the main map window.
- **Layer List** – This tool provides the user with the ability to interact with the data layers by turning them on and off, adjusting layer transparency, moving layers up and down in the table of contents, and provides descriptions of the data layers.
- **Identify** – This tool allows the user to identify specific features of visible layers. Users can identify on all layers visible or select a single visible layer.
- **Geological Unit Query Tool** – A suite of tools designed to provide the user with name of and depths of subsurface formations.
    - **Query by Location** – Allows a user to find out the name and depth of a location on specific features of salt and shale unit formations.
- **Analyze Tools**
    - **Viewshed** – This can be used to identify a topographic view shed (the area in the field that can be seen) of a specific location selected by the user.
    - **Elevation Profile** – This tool allows the user to see the elevation profile of a line that is drawn on the map by the user.
    - **Draw and Measure Tool** – This tool allows for a user to draw graphics on the map and get specific units of measure (area, distance) of those graphics.
    - **Add Excel Data** – If a user chooses to do so, they can add Excel data with coordinate attributes to the map and the RGWM will project them on the map.
- **Navigate Tools** – This suite of tools is designed to help user with some basic navigation of the RGWM.
    - **Locate Tool** – Allows the user to input Latitude and Longitude coordinates (decimal degrees, degrees – minutes – seconds, and Universal Transverse Mercator (UTM)). Also allows the user to specify an address of a location in the US (Street number, name, city, state). The tool will give the user ranked options depending on the specificity the address input.
    - **Map Extents** – Map Extents allows the user to select default map extents across the US as well as add custom extents. These extents allow for quick zoom navigation to places that are of interest to the user.
- **Print Tool** - Allows a user to save or print the current visible map within RGWM.

- **Help and Feedback Tool** – This tool provides the users with the ability to provide the developers with feedback (bug reporting, comments, suggestions) and allow the user to utilize the help documentation for navigating and utilizing RGWM.

1.3   Export Control

For the software to meet functionality and policy standards, an overview was performed with Dennis Raunig of the Scientific & Technical Information Management Systems (STIMS) team and review for Export Compliance was performed by Rai Nims to gain approval for release to public use of the RGWM application.   Review of the application found to have no security or functionality issues to address.

1.4   Software Development Testing and Migration

Using INL's GeoSE development workstations, the GeoSE developed the RGWM and tested functionality of layers and tools. The application was compiled and migrated to an application beta testing server within the INL internal network. The testing environment allowed for members of the GeoSE group to test functionality.   Once functionality was considered satisfactory by testing, the application was migrated to the INL external ArcGIS for Server on the INL DMZ (demilitarized zone) for use by the public. The RGWM can be access by the following Uniform Resource Locator (URL):

https://gis.inl.gov/regionalgeology.

Before the migration to the DMZ, INL's Export Compliance reviewed and approved the applications usage, data and tools to be made available publicly.

1.5   Maintenance

Maintenance of the RGWM is anticipated to continue through FY2016 and performed by the developers of the INL's GeoSE group. The RGWM is deployed with a Help and Feedback tool that allows users to give feedback and report software bugs. This tool sends the development group an email with the users' comments. As part of the maintenance, the RGWM administrators and developers are expected to respond to the user feedback and resolve issues in a timely manner.

2.   REFERENCES

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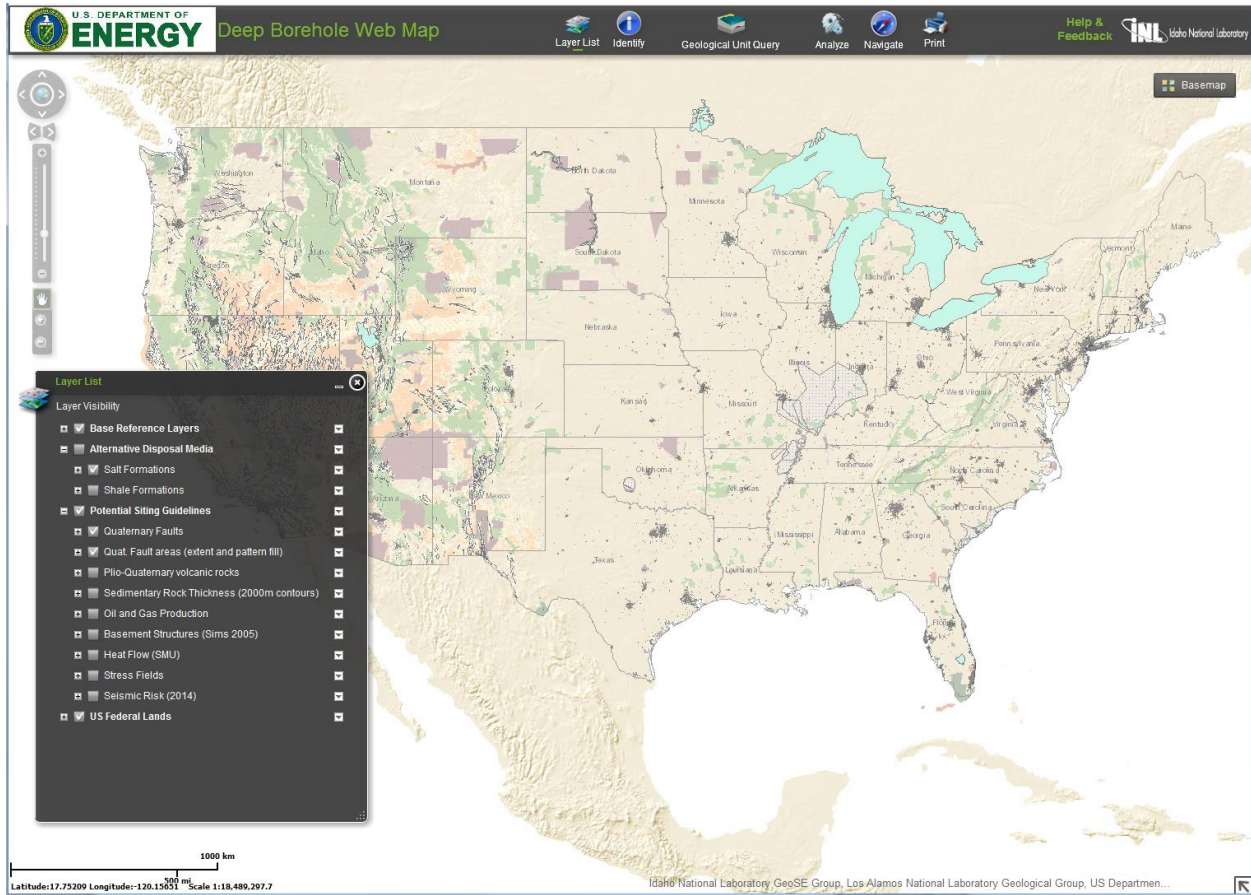
Figure 1. Regional Geology Web Mapping Application.