The MapPlace - An Internet-based Mineral Exploration Tool

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INTRODUCTION

The MapPlace, an Internet-based system operated by the British Columbia Geological Survey Branch, provides free interactive map access to data themes, covering a broad range of geospatial data in vector and attribute form. Themes include bedrock geology, surficial geology, metallic and industrial mineral potential ranking, regional silt and water geochemical surveys (RGS), mineral occurrences (MINFILE), exploration assessment reports (ARIS) and mineral title locations. These themes can be combined with other georeferenced datasets such as administrative boundaries, topographic features, aquifers and other related map-based information, including raster images such as digital elevation model (DEM) shaded relief, satellite (LandSat) and aeromagnetics to produce user-defined map views. Table 1 is summary of major datasets accessible through the MapPlace.

With the free Autodesk MapGuide Viewer, users can download data, interactively view, create, print and copy their own maps and reports. In addition to the creation of a map, many of the features that can be displayed on MapPlace are linked to supporting database tables, thus allowing users to access valuable attribute data that is linked to individual map objects. For some themes, clicking on an object links to a separate Internet site such as MINFILE, ARIS or Mineral Titles allowing further search and retrieval capabilities. Other options include buffering, selecting objects within polygons, and digitizing of polygons, points
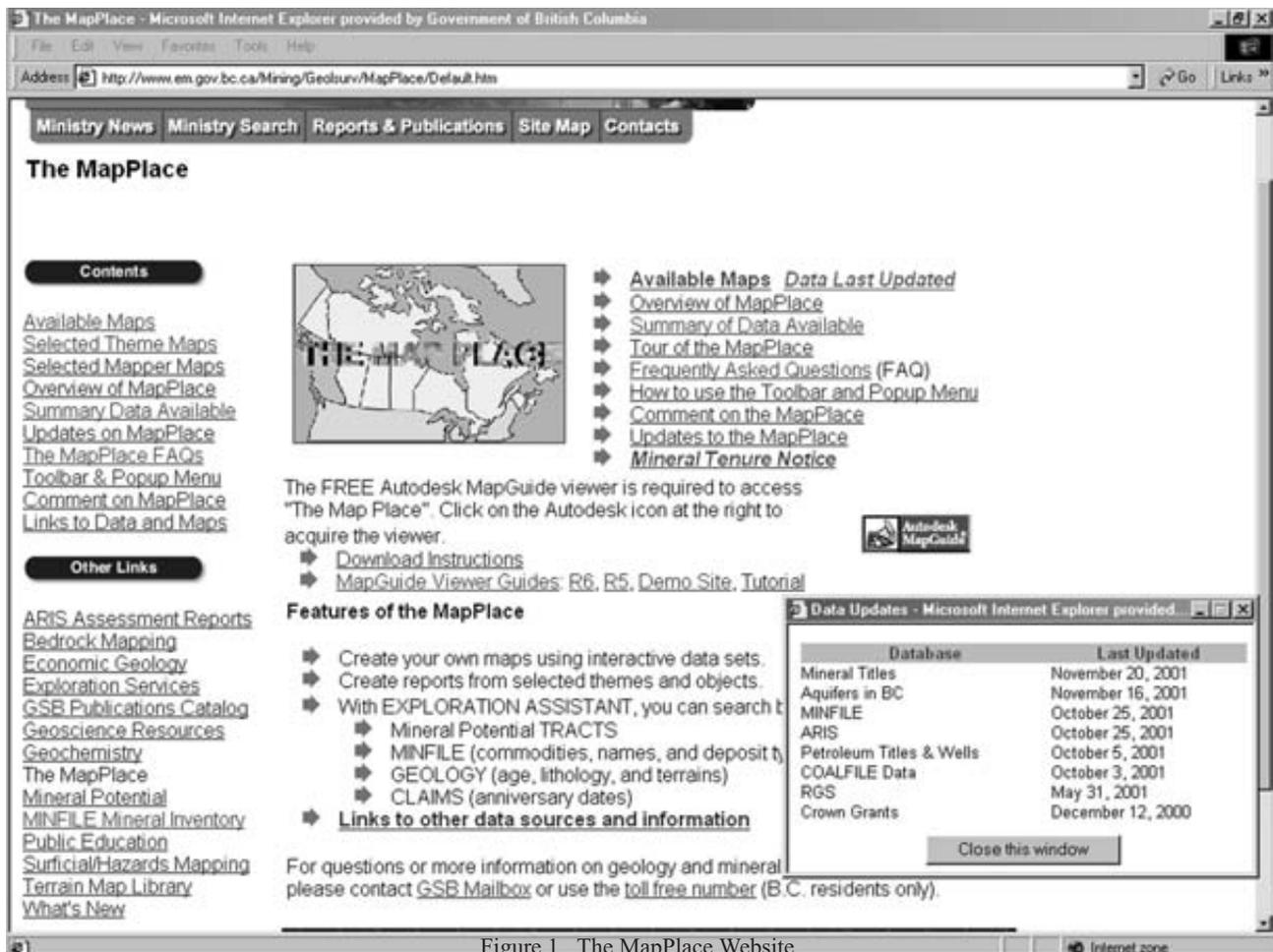

Figure 1. The MapPlace Website.

and lines on screen. Figure 1 shows the startup page for the MapPlace, showing links to more information; the web site is <www.em.gov.bc.ca/MapPlace>.

DEVELOPMENT OF THE MAPLACE

Ward Kilby began developing MapPlace in 1997 around several off-the-shelf software packages including Autodesk MapGuide, Allaire ColdFusion, Microsoft Access and the usual web server software. Databases handle all the tabular information associated with the site. ColdFusion is used as a web database manager, report writer and sophisticated web toolkit. MapGuide Server, Author and Viewer software provide the map displays, GIS func-

tionality and development environment for this style of web presentation.

Several of the datasets displayed on the MapPlace, including the tectonic assemblage map geology, reside on other MapGuide servers. This integration of data from different sources and custodianships is one of the most powerful features of distributed systems (Figure 2).

USING THE AUTODESK MAPGUIDE VIEWER

The free Autodesk MapGuide Viewer transforms your browser (e.g. Microsoft Internet Explorer or Netscape) into a map viewer that works over the Internet. As a type of geo-
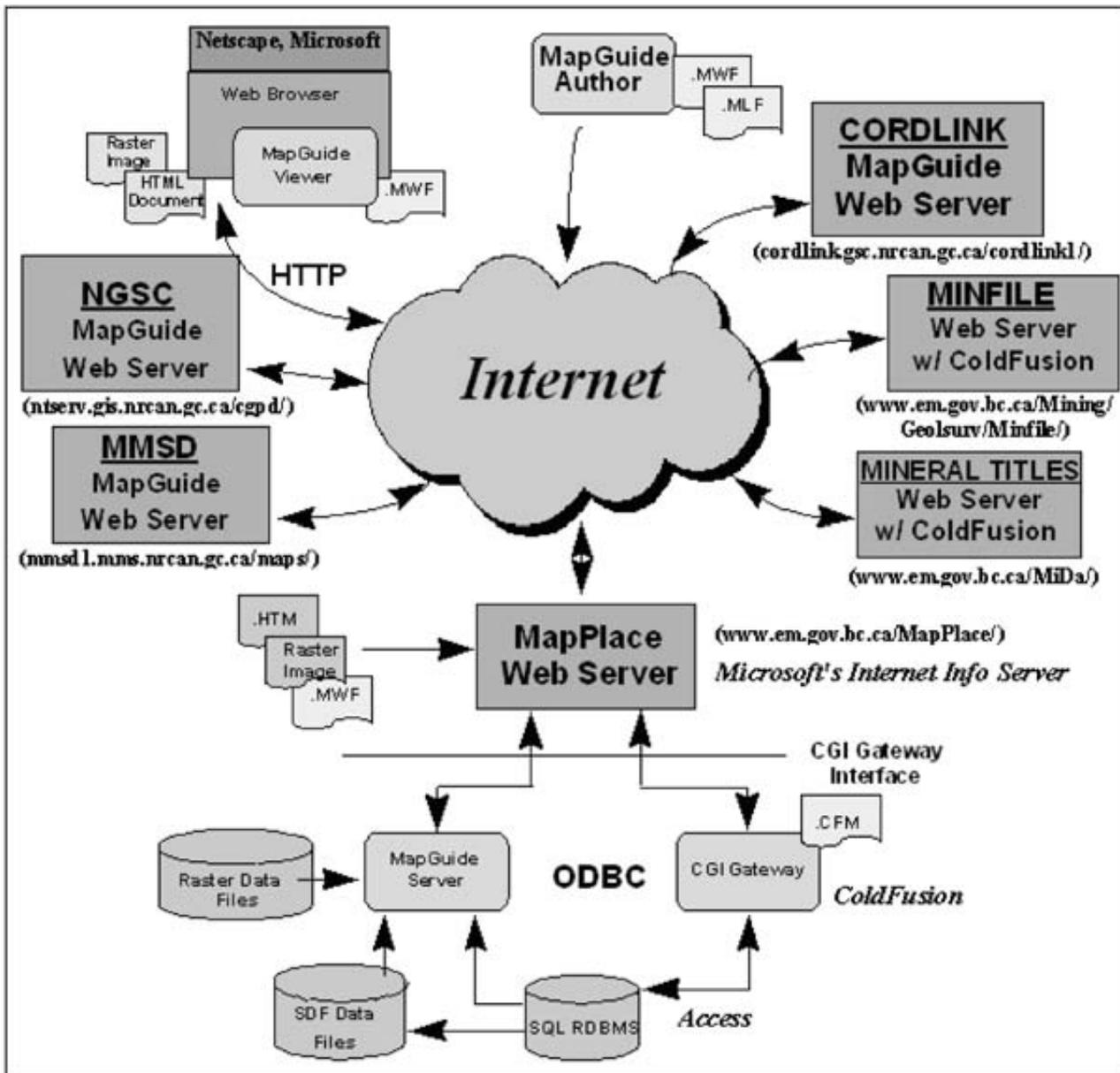

Figure 2. Diagrammatic view of the MapPlace configuration in relation to the Internet, geographic data, attribute databases, other websites and other MapGuide sites.

graphic information system (GIS), the Viewer enables non-technical users to zoom in and out on a map; find, select and display information about specific features; collapse or expand layer groups; make queries; create buffers; print to scale, and much more. The efficient Viewer only downloads the information required or selected to display a map. The Viewer can be downloaded by going to x or through the link at the MapPlace. The MapPlace also contains a link to instructions on how to download and install the Viewer, as well as links to user guides, on-line tutorials, interactive demos, help functions and FAQs.

Organization Of Data Into Layers

Available data in the MapGuide Viewer is presented in the form of layers. Each layer represents one entity, such as rivers, coal boreholes, or BC Mining Divisions (Figure 3a), and performs a function similar to a transparency. The types of data that are available for each map are listed in the legend on the left hand side of the Viewer (Figure 3b). When one or more layers are selected, they appear like stacked transparencies and are displayed as a single map (Figure 3b).

The order in which the layers are 'stacked' or appear on the map, is determined by their position in the legend. Those
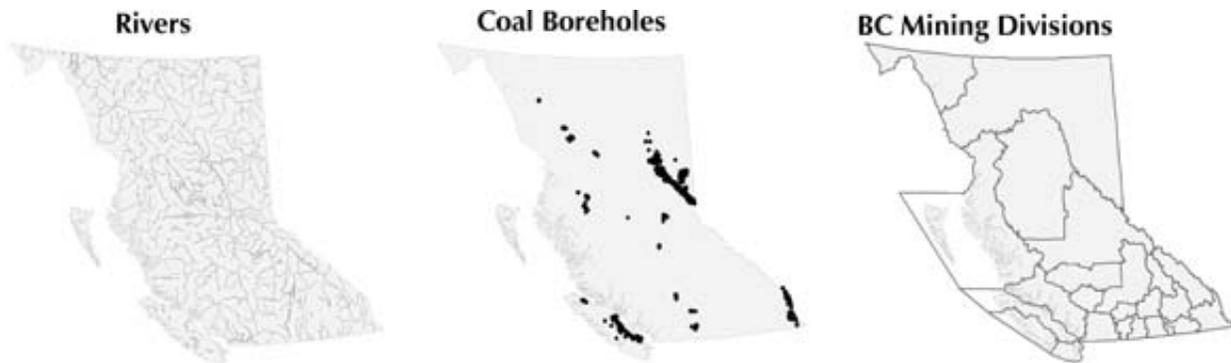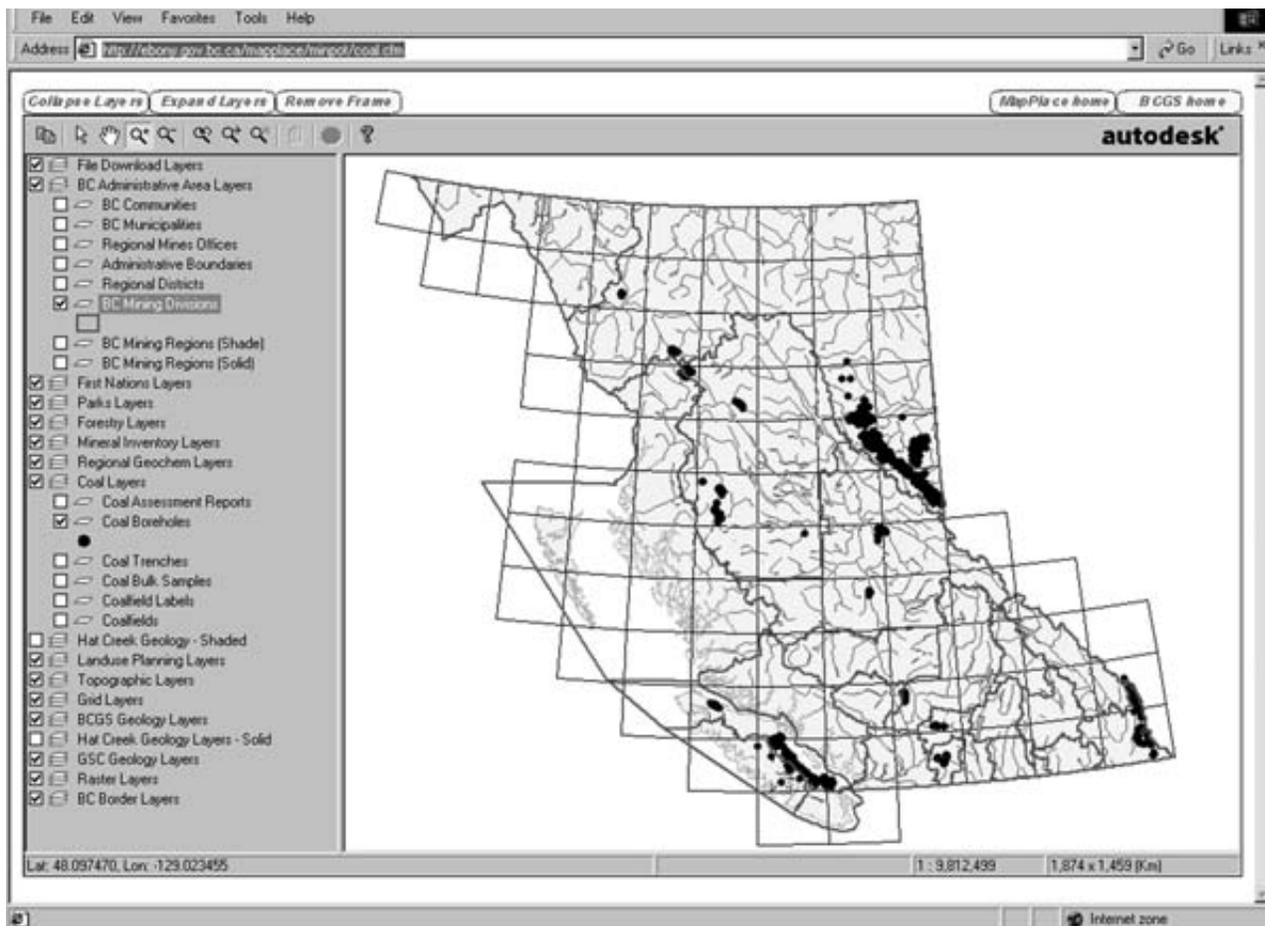

Figure 3a. Layer example selected individually.

Figure 3b. All 3 layers in Figure 3a were selected together and are displayed on one map.
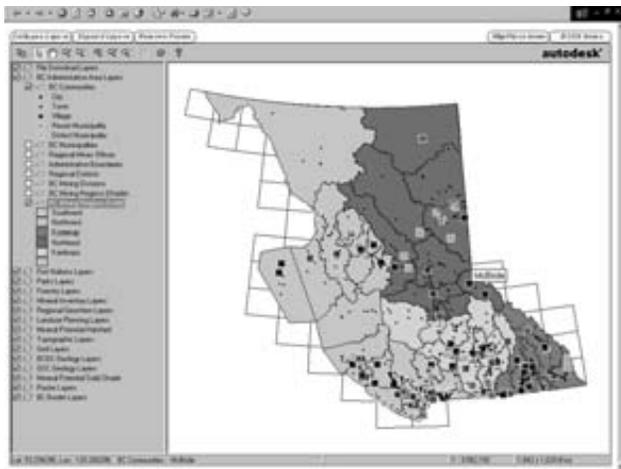
Figure 4a. BCGS Geology Map, viewed at full size. BC Communities and BC Mining Regions (Solid) are selected layers within the BC Administration Layer Group.

layers that are located at the bottom are stacked first, followed consecutively by selected layers above. This means that the layer located at the top most part of the legend will be the last layer stacked and it may appear to overlap or cover up some of the data from the lower positioned layers.
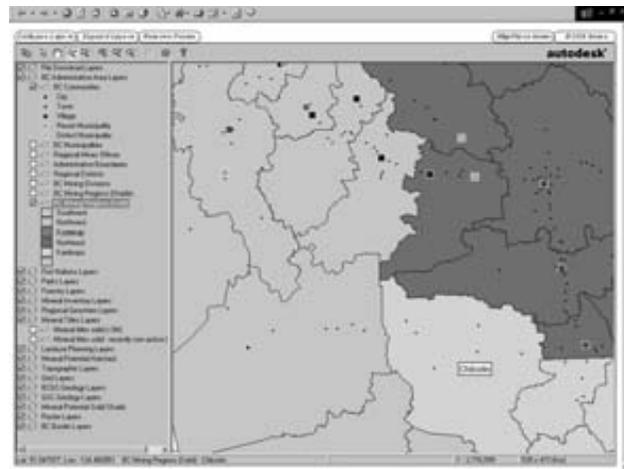

Figure 4b. The ZOOM IN feature used on the map in Figure 4a was used to display a more detailed view. With more detail displayed on the map, another layer 'BC Localities' becomes available and has been selected.

In general the maps are 'authored' to place raster layers at the bottom, vector layers in the middle and point layers at the top.

To further organize the data, layers have been grouped by themes. For example, Figure 4a contains the BC Com-

TABLE 1
SUMMARY OF MAJOR DATASETS ACCESSIBLE THROUGH THE MAPPLACE

Layer Group or Name	Object Type	No. of Objects / Coverage	Date Updated	Reports, Downloads and Links	Visible Scales (M=million, K=thousand)	Sources of Data*
Bedrock Geology (1:5M, 1M, 250K resolution)	Polygon, Line	60,000; 180,570	1994	legend reports	<1M, 2M incremental to 10M	MEM/GSB; NRCan
Geology Map Index	Polygon	298	1998	data report and download	all scales	MEM/GSB
Geology Download	Arcview files (e00)	100% (1:250K maps)	1998	E00 file downloads	all scales	MEM/GSB
Mineral Potential	Polygon	788	1998	data report and download	all scales	MEM/GSB
Aggregate	Point, Polygon	725 pts / Nanaimo, Okanagan, Prince George, Sea-to-Sky	periodically	table download	all scales	MEM/GSB
COAL Assessment Reports, Boreholes, Trenches, Bulk Samples	Point, PDF files	827 reports; 8350 boreholes; 3324 trenches; 459 bulk samples	1990	Reports and table download	all scales	MEM/GSB
Mineral Occurrences - MINFILE	Point	12,091	monthly	data reports and downloads; links to MINFILE	all scales	MEM/GSB
Assessment Reports - ARIS	Point, PDF files	25,941	monthly	data reports and downloads; links to ARIS	all scales	MEM/GSB
Regional Geochemistry - RGS	Point, Polygon	44,428	annually	complete data download	<1M	MEM/GSB
Mineral Tenure	Polygon	41,862	monthly	data report and links to MIDA	<1M	MEM/MTB
Crown Grants	Raster image	100%	periodically	TIFF file downloads	<200K	MEM/MTB
Petroleum Tenure and Wells	Point, Polygon	11,917 titles; 14,405 wells	2001	Reports and table download	all scales	MEM/PLB/OGC
Topography (6M, 2M, 1M, 250K, 50K, 20K resolution; Colour Contours, TRIM Contours, Roads, Rail, Rivers, Lakes, Glaciers, Coast, Bathymetry, Aquifers)	Points, Polygon, Line	very large; 7000 TRIM maps; 1122 aquifers	variable; TRIM 1996	none	variable scales for different resolutions	MSRM; WLAP; NRCan
Geographic Locations (Map Grids, Gazetteer)	Point, Polygon	41,500	1998	none	all scales	MSRM
Administration Areas (First Nations, Parks, Forestry, LRMP areas)	Polygon	multiple	variable	none	all scales	MSRM, MOF
DEM Shaded Relief	Raster image	100%	1999	none	all scales	MSRM; NRCan
LandSat	Raster image	95%	1999	none	all scales	MSRM; NRCan
Aeromagnetics	Raster image	85%	2000	none	all scales	NRCan
Gravity	Raster image	100%	1999	none	all scales	NRCan

*Abbreviations: MEM=BC Ministry of Energy and Mines; GSB=Geological Survey Branch; MTB=Mineral Titles Branch; PLB=Petroleum Lands Branch; OGC=Oil and Gas Commission; MSRM=BC Ministry of Sustainable Resource Management; WLAP=BC Ministry of Water, Land & Air Protection; MOF=BC Ministry of Forests; NRCan=Natural Resources Canada

munities layer, which is a layer within the BC Administrative Layers group. Layer Groups can either be collapsed or expanded by double clicking on the layer group title. To select a layer group or a layer, use your mouse to click on the box adjacent to the layer or layer group. Selection will be indicated by a checkmark in the box. Layers will only be displayed in the map Viewer if the Layer Group has been selected first. As each layer group is selected, different layers become available and can be selected and deselected with the user's needs. Zooming in on a map area also produces more layer choices and the detail of the map increases. This is demonstrated by comparing the available layers in Figure 4a with Figure 4b. The ZOOM IN feature used to produce the map in Figure 4b allows for the BC Localities layer to be available and selected.

Accessing Commands

The MapGuide Viewer uses either **toolbar buttons** or the **popup menu** to carry out various commands (Figure 5). The toolbar buttons are situated across the top left side of the Viewer window. The popup menu is a menu that appears by clicking the right-hand button on the mouse (referred to as 'right clicking') anywhere in the map window. Right clicking displays the popup menu, and a command can be selected by clicking one of the items in the menu. Those commands that have a right arrow next to them (such as ZOOM) display a secondary popup menu when selected (Figure 5).

The **toolbar buttons** allow the user to COPY the current map view to the clipboard; SELECT features; PAN or slide the map around to display areas that are outside of the current view; ZOOM to an area that is user defined either with a center point or a rectangle; ZOOM OUT from the area defined by a center point; ZOOM PREVIOUS view that was displayed; ZOOM GOTO a specified location; UNZOOM to display the full extents of the map; VIEW REPORTS associated with the selected map objects; STOP or interrupt the updating of the map display; and HELP to link to the Autodesk MapGuide Viewer Help Website.

The **popup menu** provides additional features to the toolbar buttons, such as the PAGE SETUP dialogue box, where map size can be specified by scale; PRINT the current map displayed; RELOAD the viewer to display the original map layout; ZOOM WIDTH dialog box, where map width can be specified at the place of the curser; ZOOM SCALE dialog box, where the scale of the map can be defined; ZOOM SELECTED to selected object(s); BOOKMARKS to add and delete bookmark names for displayed map views; SELECT criteria such as OBJECTS, RADIUS, POLYGON, and WITHIN specified map objects; VIEW DISTANCE between two points; VIEW BUFFER to create buffers around selected areas; and ABOUT which links you to Autodesk MapGuide Viewer Help website and allows you to change PROPERTIES such as viewing scale and map coordinates.
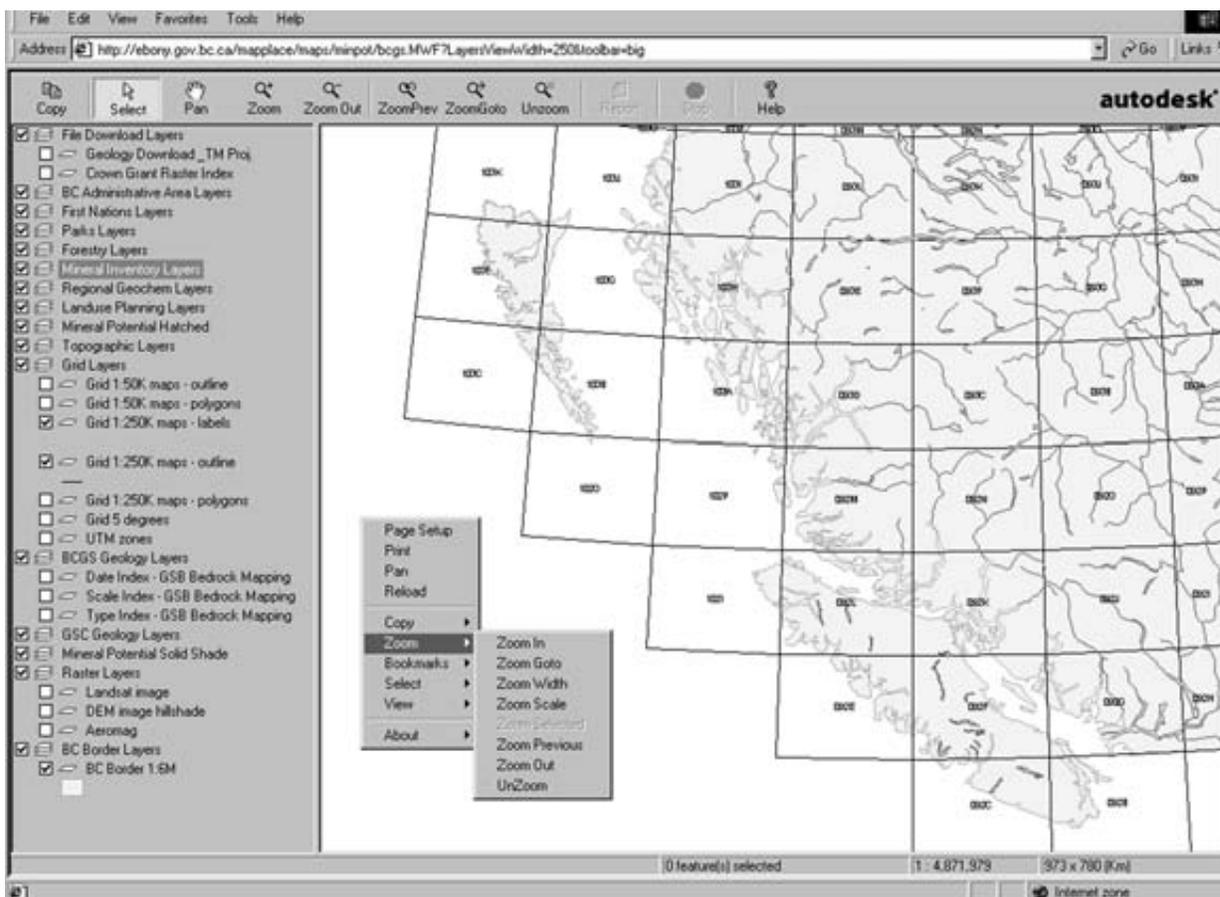

Figure 5.   Toolbar Buttons and Popup Menu.

AVAILABLE MAPS

The MapPlace has 21 theme-based maps. The BCGS Geology Map can access all available provincial datasets, whereas the other maps focus on particular areas or themes, such as detailed and surficial geology, geophysics, and geology map indexes. Other maps such as the Exploration Assistant allow users to search and display elements of 4 main databases. Each map has a 'more details' link to provide further information, such as unique layers, special instructions to view certain features, type of projection used, etc. Descriptions of these maps, with examples of their use, are presented here.

Maps Currently Available:

- BCGS Geology Map
- Exploration Assistant
- Mineral Titles Map
- World Map
- Canada Map
- USA Map
- Jennings River Geology Map
- Barkerville Geology Map
- Lillooet LRMP Map
- Guichon Batholith

- Vernon Geology Map
- Aggregate Potential Map
- Terrain Map Index
- Regional Geophysics Map
- Relief and Radar Map
- Southeast BC Geophysics Map
- Petroleum Tenure and Wells Map
- Coal Map
- BC Geology Map Index
- GSC & GSB Geology Map Indexes
- Mineral Statistics Maps: Coal Operations, Metal Operations, Refining & Smelting, Industrial Minerals

BCGS Geology Map

This map is projected in Albers Equal Area for BC. It provides access to all provincial datasets and geology layers. Figure 6 displays the available layer groups (collapsed). The Legend Window is organized into themes. Look for the expanded geology, mineral occurrence, ARIS and mineral title layers at the bottom of the legend window. Administrative layers are at the top. Topographic layers, including TRIM, are in the middle of the legend window. Two sets of Mineral Potential layers are available, a shaded version above the geology layers and a solid version below the geol-
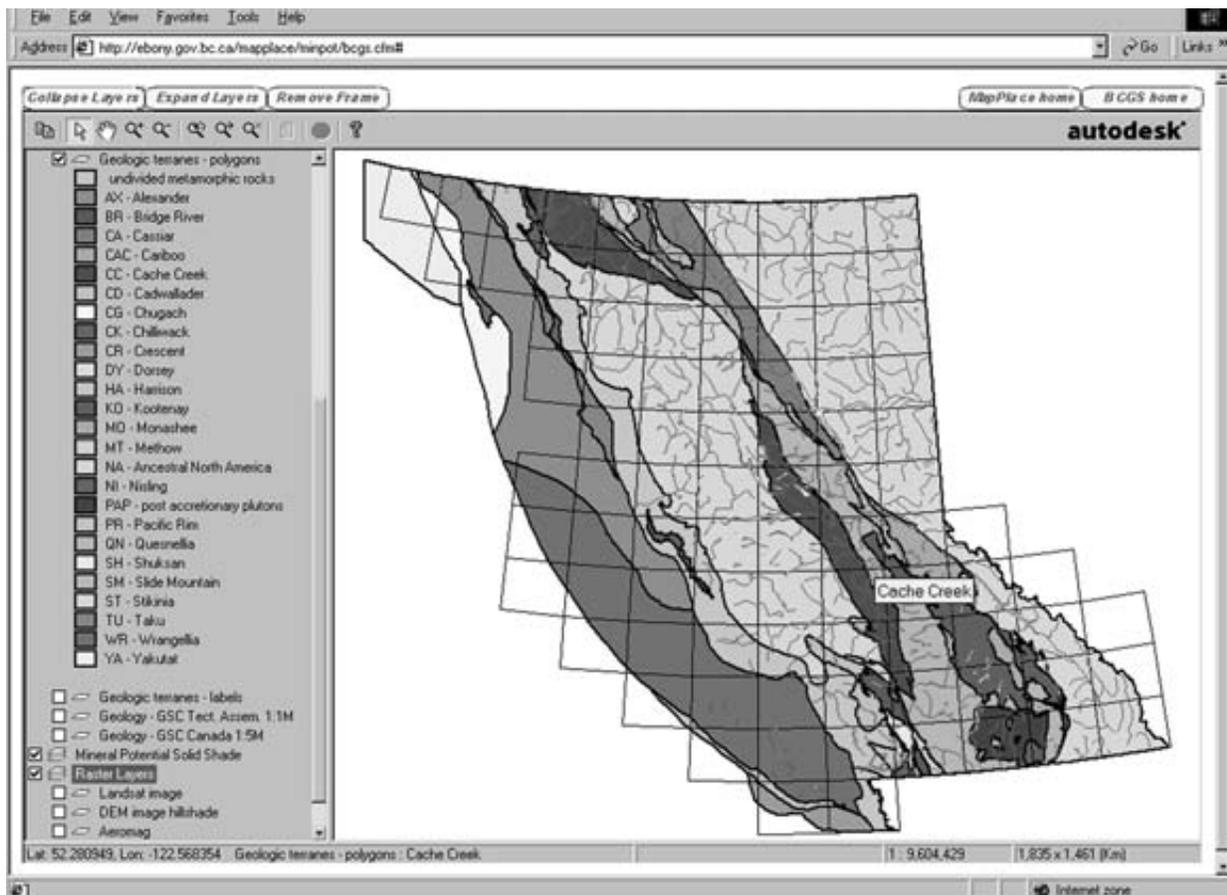

Figure 6. Available layer groups (collapsed) for the BCGS Geology Map are shown in the left hand of the window frame.

ogy layers. This map provides the most flexibility for the combination of available datasets. This is the best map to start with as it allows you to see all the datasets in their most generic form.

Bedrock geology layers are visible under 1:1.5 million scale. Legend reports are attached to the layers which included Faults and Contacts; Geology polygons coloured by age and rock class (sedimentary, intrusive etc.); Geology polygons hatched by rock type (this hatch pattern is transparent and can be superimposed on raster images); Geology labels based on the lithostratigraphic map unit. The cursor flyout also has information on the map unit represented by each polygon, plus it gives the poly-id and previous keycode so that geologic revisions can be done for specific polygons.

To access the Geology Downloads click on the appropriate theme at the top of the legend and double click on the map area of interest. The resultant page display will provide access to the digital files in ArcInfo EXPORT (E00) format in either Albers Equal Area Polyconic or Geographic (decimal degrees) projections. The datum is NAD83. Click on the item you require to download the zipped files. To use the files as shape files they can be translated using the Import71 utility that comes with Arcview. Metadata for the geology of the whole province is also available on this page as a downloadable file (). A describes the download files. To interactively view the bedrock geology with MapPlace, select

the Interactive View of the map sheet in either projection and the NTS area will be displayed.

The TRIM (Terrain Resource Information Management) layers are visible at a zoomed scale of 1:100,000, include Transport Structures, Rail, Roads, Rivers, Lakes, Land Cover and Contours in two layers. Aquifers in British Columbia, from Ministry of Water, Land and Air Protection, are available in two layers (above 1:2 million and below 1:2 million scale). Some of the aquifers are directly linked (double click) to the Aquifer Image Portfolio.

Exploration Assistant

This theme map offers 5 different features to perform detailed queries that are displayed on the map. These features include: Gazetteer to find a location; Discovery Potential where Mineral Resource Assessment program predicted new deposits of specific types will be found; MINFILE by commodity or deposit type or name; Regional Geochemistry by provincial or mapsheet statistical threshold for 37 elements; Geology by age, lithology and terrane; and Mineral Titles by claim name and anniversary date. This map has access to other databases such as BC Localities and Communities, Regional Districts, Regional Geochemical Surveys, Assessment Reports, Road, Railways, Rivers, Parks, and many others.

The following are examples of queries that can be performed through the Exploration Assistant: find a particular
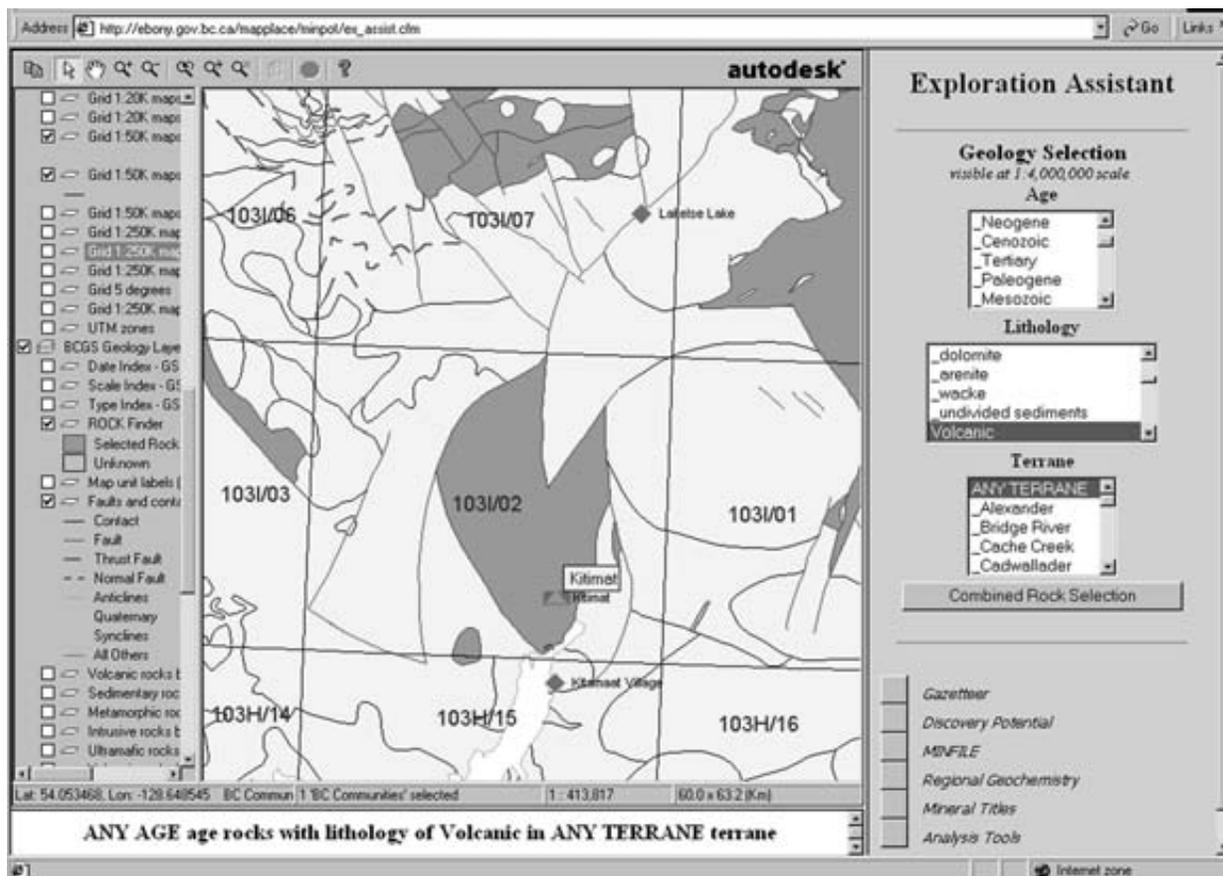

Figure 7. Exploration Assistant Map, displaying geology with the criteria of any age, volcanic lithology, and any terrain in the Kitimat area.

settlement, such as Gold Creek; display areas favourable for garnet skarns; show the location of the Eskay Creek deposit; plot all Jade occurrences; plot the Placer deposits; zoom into an area and display Cretaceous age sedimentary rocks within any terrane; find the Flan claim; display all claims in an area with an anniversary date in the next 40 days. An example of a geology query for the following criteria: any age, volcanic lithology, and any terrain, within the Kitimat area is displayed in Figure 7.

Mineral Titles Map

This map is viewed along with an additional window frame to allow users to conduct a number of Mineral Title related searches:

- **Tenure searches** by number, claim name, tag number, tenures staked by a person, and tenure owned by a person or company
- **Free Miner** searches
- **Maps** searches for a list of all tenures on a specific map and Mineral Title Maps on the web
- **Lot** searches by number and Land District
- **Form** searches for Mineral Tenure Act Forms and Applications
- **Other searches:** Map Index, Tenure Statistics, Links to Mineral Titles Information, and Search Tips

Mineral, Placer and Coal tenures layers are unique to this map and can be viewed at scale of 1:3,000,000 or less. Once these layers have been selected, users can use the SELECTION function on the toolbar buttons, and double-click on any map tenure area to search the database for that particular tenure number (Figure 8). The lower window frame will display related information about the selected tenure as well as provide links to gain access to further information.

A **ZOOM GOTO Mineral Tenure Number** is also available to locate tenures on the map (Figure 9). Right click on the map to display the Popup Menu, select ZOOM, then from the submenu select ZOOM GOTO. A ZOOM GOTO window will appear and in Category use the pull down menu to choose Mineral Tenure Number. Enter the tenure number in Location and click OK. Due to the large size of the Tenure data source, the ZOOM GOTO may take up to a minute to display the tenure map area. Turn on the Mineral Title Layer and the tenure number specified in the GOTO dialogue box will be displayed on the map. Double clicking on the tenure will link to Mineral Titles Registry System (MIDA) for a report on the tenure.

Crown granted two post claims are available in raster format for downloading or viewing Figure 10. To access this layer turn on the Crown Grant Raster Index Layer and double click on the map area of interest. The lower frame win-
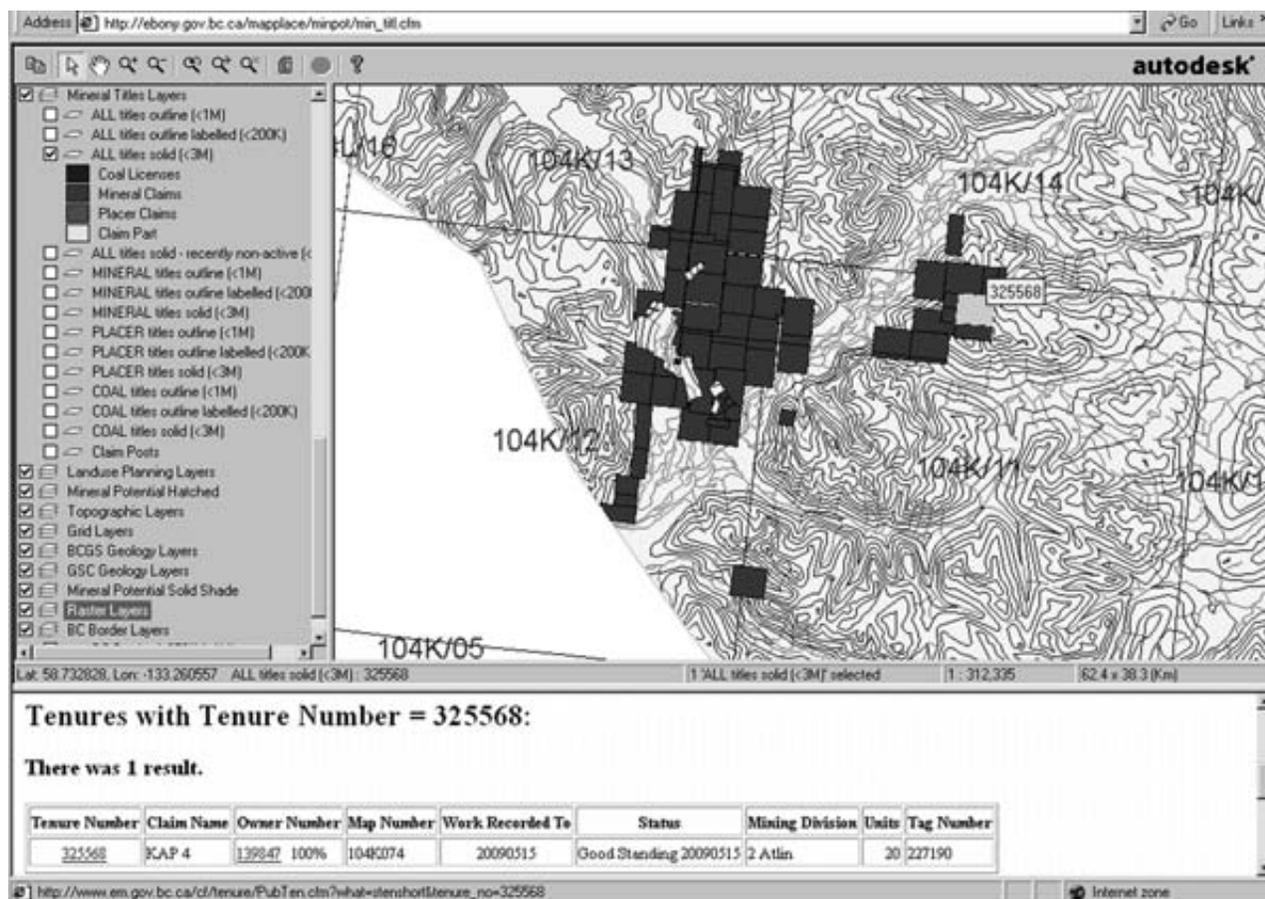

Figure 8. All (mineral) Titles Solid layer was selected. Tenure number 325568 was selected by double-clicking with the SELECT feature on that particular tenure in the map viewer. The lower window frame provides information and links to this tenure.
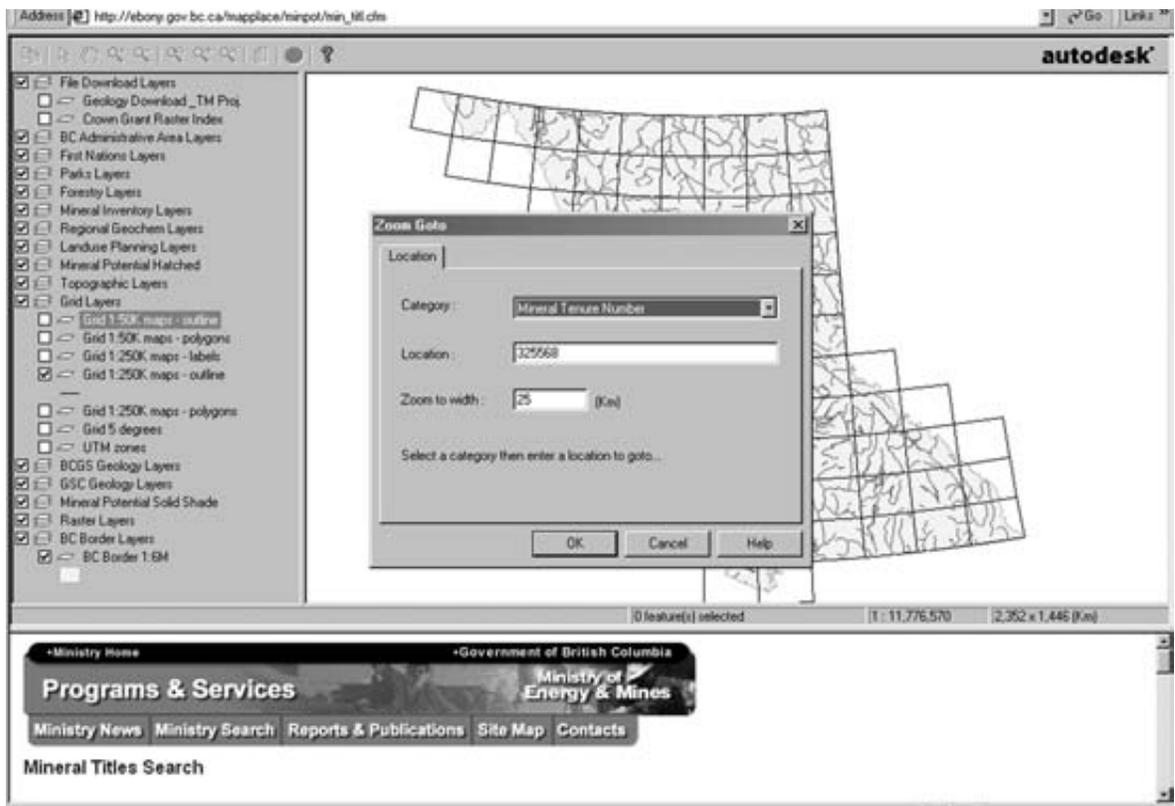
Figure 9. ZOOM GOTO window displayed with an example of information required to view a particular Mineral Tenure Number on the map.
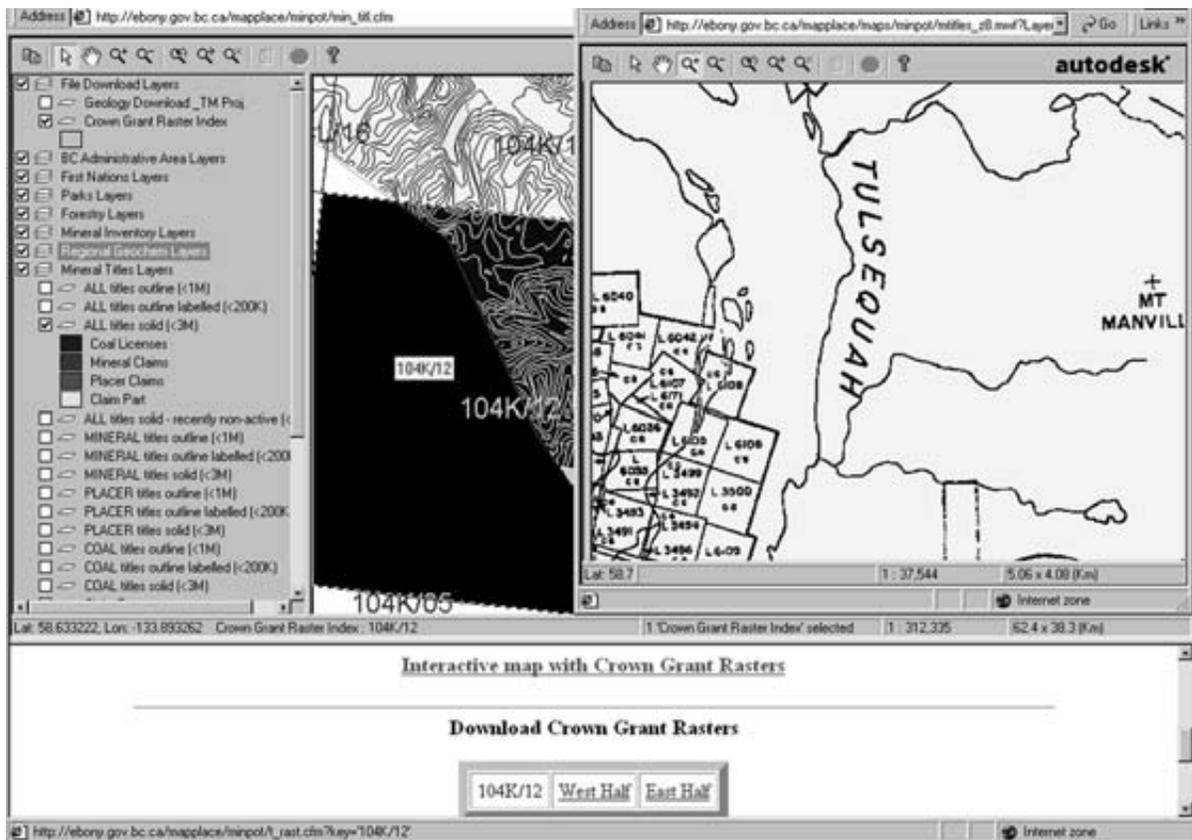

Figure 10. Crown Grant Raster Index layer selected and displayed, NTS map sheet selected by using the SELECT feature on the Toolbar Buttons. Lower window displays link to download or view the NTS map sheet.

dow provides the user with the option to download one of the two possible half sheets for use in some graphics program OR to view the maps interactively and integrated with other MapPlace data. When choosing to interactively view 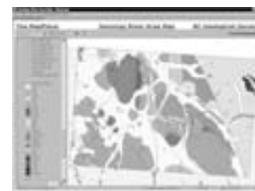the Crown Grant Raster Index Layer, a new Viewer window will open up allowing further data to be added. The Crown Grant Raster maps are displayed with a UTM83 projection, so caution must be exercised as one nears the UTM zone boundary.

Selected Theme Maps

There are 15 Selected Theme Maps and they contain most of the layers found in the BCGS Geology Map, but also contain layers unique to their theme. Some of these maps when opened will already be zoomed into an associated geographical area.

Jennings River Geology Map

This map is displayed in Albers Equal Area projection and includes the Jennings River area (NTS 104O/14E and 15) geology. The detailed map features: Station Points, Features and Labels; Geology Lines, Polygons (stippled and solid) and Labels; Outcrops; and Eskers. Geology is from of Open File 2001-6 by J. Nelson, T. Harms, C. Roots, M. Mihalynuk and M. de Keijzer.

Barkerville Geology Map

This map covers the Barkerville area (NTS maps 093A and H) and unique layers include the Barkerville Cariboo and Kootenay terranes.

Lillooet LRMP Map

This map covers NTS maps, 092IW, 092J and 092O (south) and is displayed in the Universal Transverse Mercator projection. In addition to the standard data sets, this map has a Lillooet LRMP layer, DEM image hillshade layer, a magnetics map layer, and a magnetics raster map with legend.

Guichon Batholith Map

This map covers NTS map 92I and is displayed in BC-Albers projection. Unique data layers include the Guichon Magnetic Linears, Guichon Geology Transparent, and Guichon Geology. Mapping was done by W. J. McMillan, J. D. Blanch-Flower, P. McAndless, D. Coombes, P. Garvin; 1969-1974 and linework was digitally captured by Cominco Ltd.
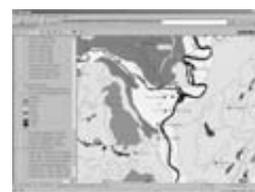

Vernon Geology Map

This map covers NTS maps 082L03, 06, 11, 13, 14 and is displayed in the Universal Transverse Mercator projection. Unique layers to this map are Geology Unit, Lines, Structures, Mapping Stations, and Ages in the Vernon Area.

Aggregate Potential Map

This map displays the results of four aggregate potential study areas: Prince George, Okanagan, Nanaimo and Sea-to-Sky. Each of these four study sites are organized into four layers under the Aggregate Potential layer Group. Photos of aggregate pits are available mainly in the north part of the Sea-to-Sky study area. To view the photos, use the select tool and double click if a hand shows while on the pit symbol. Links to the Aggregate Projects and downloads are available in the PopUp Menu on the Map.
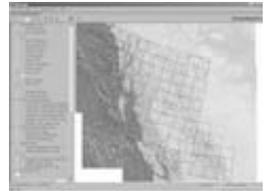
Terrain Map Index (Open File 1992-13)

This published index provides a compilation of data for about 2000 surficial geology/terrain maps of British Columbia. The database is presented both as a tabulated listing, and graphically in a series of provincial base maps. The tabulated database presents the location in relation to the National Topographic System, scale and agency involved. This hardcopy report is available from Crown Publications. A link to the Terrain Map Library provides terrain and slope stability related maps in digital format. The digital maps may be constructed and viewed on-line or downloaded for use in a GIS or Desktop Mapping package.

Regional Geophysics Map

This map is projected in Lambert Conformal Conic, NAD 27. Unique layers to this map are Gravity, Aeromagnetics, Landsat and DEM Shaded Relief. These images come directly from the CORDLINK, a collaborative knowledge network initiative between the Geological Survey of Canada and its provincial/territorial and academic partners in western Canada.
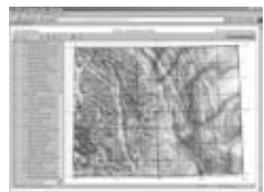

Relief and Radar Map

The Relief and Radar Map contains a colour shaded relief map based on the GTOPO30 data set and a radar mosaic for the southern portion of the province. More detailed colour relief, radar mosaic and digital elevation model (DEM) layers are available for Vancouver Island. These raster layers are from GeoGratis (National Resources of Canada), a web site and FTP site that distribute geospatial data of Canada free of charge.
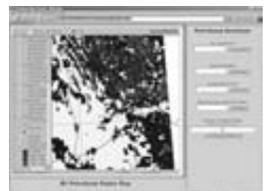

Southeast BC Geophysics Map

The Southeast BC Geophysics map is displayed in UTM-NAD 83 projection and contains three unique layers geophysical layers: Kootmag, Magnetics and Thorium ratios. These layers are from the Geological Survey of Canada Pacific Geoscience Centre. A sample detailed orthophoto (1 metre pixels) is available for area 082F.099 at scale of 1:35,000.

Petroleum Tenure and Wells Map

This map displays northeastern BC Petroleum and Natural Gas well locations, tenure and major pipelines. Tools allow users to query tenure owner, tenure number, range of tenure numbers or BC Gazetteer locations in the right window frame. This queried information can be displayed on the map.

Coal Map

This map features Coal Geology layers, databases from COALFILE and links to Coal Assessment Reports in PDF format on the map.

BC Geology Map Index

This map is displayed in Albers Equal Area Projection. This map contains most of the layers found in the BCGS Geology map, as well as the following Index Map layers: Surficial Mapping Index, Regional Geochemical Survey Index, MINFILE Index, and B.C. Geological Survey of Bedrock by Date, Scale and Type.

GSC & GSB Geology Map Indexes

This map of the World, is zoomed into Canada and is displayed in Mercator projection. This map contains map index layers from the Geological Survey of Canada (GSC) and B.C. Geological Survey (GSB), as well as a volcano, world countries, major cities layer, U.S. Cities, States and Interstates layers.

Mineral Statistics

These maps display locations of mining, coal, industrial mineral, refining and smelting operations.

CONCLUSION

The MapPlace has been operational for over five years, providing free Internet access to mineral exploration-related information to the mineral exploration industry, land use planners, government agencies and the general public. It has proven to be an efficient and effective way to disseminate map-based information and its flexibility gives users a powerful tool for building their own custom maps. Visit the MapPlace at http://www.em.gov.bc.ca/MapPlace.