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Remote Predictive Mapping (RPM):
A not so New Paradigm for Mapping Canada's North

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NEW SERIES

Remote Predictive Mapping (RPM): A not so New Paradigm for Mapping Canada's North

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Due to its vast territory and world-class mineral and energy potential, Canada's North needs efficient technologies and analytical techniques for upgrading its geoscience knowledge base. An important part of this endeavour involves updating the geological map coverage. Whereas in the past, the coverage and publication of traditional geological maps (of a limited region) demanded many years of fieldwork, more time-efficient approaches of mapping larger regions within shorter time spans are now required. As a result, an approach termed Remote Predictive Mapping (RPM) has been implemented since 2004 in pilot projects undertaken by the Geological Survey of Canada. Remote Predictive Mapping is an integrated geological mapping approach, in which existing geological map data are re-compiled on the basis of the interpretation of various types of remotely sensed geoscience data as well as legacy field data before, and during, fieldwork.

These data may include sensing devices that measure a variety of properties of the Earth's surface and sub-surface. The properties can include magnetic total field (from which magnetic susceptibility can be derived) measured by a magnetometer, radio-element emission measured by a gamma-ray spectrometer, density variations measured by a gravimeter, visible and infrared spectral reflectance measured by various optical and infrared sensors, emitted heat measured by a thermal radiometer, microwave backscatter by radar, and terrain height measured by an altimeter or extracted from air photos. These parameters can be useful alone, or in combination, for producing a remote predictive geologic map or a series of predictive maps. Field data, if available, can be incorporated into the RPM process to aid, verify and geologically calibrate the interpretations made from the geoscience data.

The method of information extraction may involve photogeologic interpretation of enhanced and/or fused images derived from the various data types or computer-assisted techniques that are useful for the identification of spectral and spatial patterns in the data. The output is most commonly a map showing predicted lithologic units, structures and suggested field traverses or a series of maps that show predicted units (bedrock, surficial, tectonic, etc.), various geological structures (faults, lineaments, contacts, fold axes, glacial flow indicators, etc.), bedrock outcrop and areas in which to focus field mapping. These maps can comprise a series of layers within a GIS and be integrated with field mapping to assist in constructing a traditional geologic map. In some cases, depending on the method(s) used to generate the map, a measure of uncertainty (or confidence) in the interpretation is also included. The predictive map or series of maps are by no means "end products" but are intended to help assist, guide and plan field mapping campaigns, as well as assist in the production of the "final" geologic map. In cases where no existing geological information (or very minimal) exists, RPM maps serve as a first-order source for basic geological information on which to base future mapping or exploration programs. In areas where basic geological information exists, these maps may show areas where the predicted geology agrees and/or disagrees with the existing information. Both of these scenarios are important as areas of agreement confirm what has been mapped traditionally and areas of disagreement point to areas that may require further field mapping and study. These maps can be used in conjunction with field observations to build a geological map interactively (i.e., "on the fly") while in the field. These predictive maps can also be useful for planning a field campaign by providing information on areas where more detailed mapping is required, areas of bedrock outcrop, wetlands, and areas where detailed traverses could be undertaken.

The RPM method differs from current methods for mapping the North, which traditionally relied on a homogeneous grid of traverses spaced 1 to 5 km apart over the area of interest regardless of the complexity of geology and supplemented with the interpretation of air photos. The advantage of RPM maps is that they can show areas of both geologically homogeneous and heterogeneous areas allowing more field emphasis to be placed on the complex areas. In addition, the signatures that have been extracted from various geoscience datasets over an area that has been verified (mapped), can be used to help predict areas of similar geology where mapping is not possible.

The RPM philosophy is nothing new! It follows the "light-table" approach that has always been used by geologists The RPM process involves compiling all available data from existing sources, studying the relationships between the data, and selection of target areas for mapping and/or exploration from the integrated data. The difference is that more high-resolution digital (spectral and spatial) data and processing tools (GIS, image analysis, etc.) are now available to facilitate the compilation, integration and analysis process.

The new RPM theme for Geoscience Canada will include a number of papers on basic types of geoscience data useful for remote predictive mapping such as airborne magnetic and radiometric data as well as optical and radar imagery. A number of case studies illustrating how these RPM methods can be used to assist in bedrock and surficial mapping will also be presented later in this series. We welcome other papers dealing with RPM topics. For further information or to discuss ideas for papers, please contact series editor J.R. Harris, Geological Survey of Canada. 613-947-0790, harris@nrcan.gc.ca.