## GS-4 Comprehensive geological and geochemical database for the sub-Phanerozoic Flin Flon Belt, west-central Manitoba (parts of NTS 63J3–6, 11–12, 14, 63K1–2, 7–10)
by S.K.Y. Lee, M. Lenton and R-L. Simard
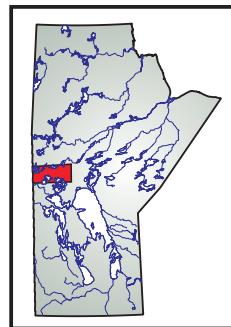
Summary
Remapping of the sub-Phanerozoic Flin Flon Belt was initiated in 2009 by the Manitoba Geological Survey with the main objective of producing revised geological maps of the area. Whereas successful mineral exploration in the sub-Phanerozoic Flin Flon Belt is still viable by applying standard geophysical techniques and diamond drilling, a better understanding of the regional distribution of the various tectonostratigraphic assemblages and geological domains, in particular the location of favourable host rocks within juvenile-arc assemblages, will provide valuable guidance for new exploration programs. A key portion of the remapping effort consists of building a comprehensive database of historical data (drillcore logs, geochemistry, etc.) for the sub-Phanerozoic Flin Flon Belt, using a Microsoft® Access® database. Data compilation has become necessary in order to manipulate the vast amount of existing data for use in a Geographic Information Systems (GIS) environment.

This report describes 1) GeoCapture, a Microsoft® Access® database developed by the Manitoba Geological Survey, which can be used as logging software to manually enter drillcore logs, and 2) a 'Format Tool', which allows the user to reformat existing digital data, namely geochemistry, into a standardized format that can then be imported directly into GeoCapture. The export features of GeoCapture allow the user to quickly export information contained in the GeoCapture database (geology, collar, geochemistry, etc.) into Excel® and/or other software such as GIS or geochemistry software.

Introduction
The Flin Flon Belt is one of the largest Paleoproterozoic volcanogenic massive sulphide (VMS) districts in the world. It is composed of a series of tectonostratigraphic assemblages (juvenile arc, juvenile ocean-floor back-arc, ocean plateau, ocean-island basalt, evolved plutonic arc) flanked to the north by gneisses of the Kisseynew Domain and extending south under the Phanerozoic rocks of the Western Canadian Sedimentary Basin (Figure GS-4-1). All VMS deposits found to date are located within the juvenile-arc volcanic rocks.

Extensive mineral exploration spanning almost a century in the exposed parts of the Flin Flon Belt have led to the discovery of more than 25 ore deposits (as well as 40 subeconomic deposits; Syme et al., 1999), the most recent being the Lalor Lake deposit (2007) in the Snow Lake area. Whereas successful mineral exploration in the sub-Phanerozoic Flin Flon Belt is still viable by applying standard geophysical techniques and diamond drilling, a better understanding of the regional distribution of the various tectonostratigraphic assemblages and geological domains, in particular the location of favourable host rocks within juvenile-arc assemblages, will provide valuable guidance for new exploration programs.

Remapping of the sub-Phanerozoic Flin Flon Belt was initiated in 2009 by the Manitoba Geological Survey (MGS) with the main objective of producing revised geological maps for the area (Simard and McGregor, 2009; Simard et al., 2010). Concurrent investigations in the Saskatchewan extension of the Flin Flon Belt (Flin Flon and Glennie domains) are being conducted by the Saskatchewan Geological Survey (Morelli and MacLachlan, 2008; Morelli, 2009, 2010a, b; Morelli et al., 2010).

A key portion of the remapping effort consists of building a comprehensive database of historical data (drillcore logs, geochemistry, etc.) for the sub-Phanerozoic Flin Flon Belt. Data compilation has become necessary so that the amount of available data (>2000 drillholes, >9000 geochemistry samples), which exist in different formats and media, can be manipulated for use in a Geographic Information Systems (GIS) environment. Once compiled, these data will be used for revising geological maps and for producing 3-D models of areas of interest (exploration targets, deposits, etc.).

This report describes GeoCapture, a Microsoft® Access® database developed by the MGS, which can be used as logging software to manually enter drillcore logs, as well as a 'Format Tool', which allows the user to reformat existing digital data, primarily geochemistry, into a standardized format that can then be imported directly into GeoCapture. Both of these products will be released to the public as freeware in due course.

GeoCapture
GeoCapture was built in Microsoft® Access® 2007, which is a relational database management system (RDBMS) that stores data in several related, two-dimensional tables. A RDBMS was chosen because tables can be 'normalized' so that the vast amount of data are not
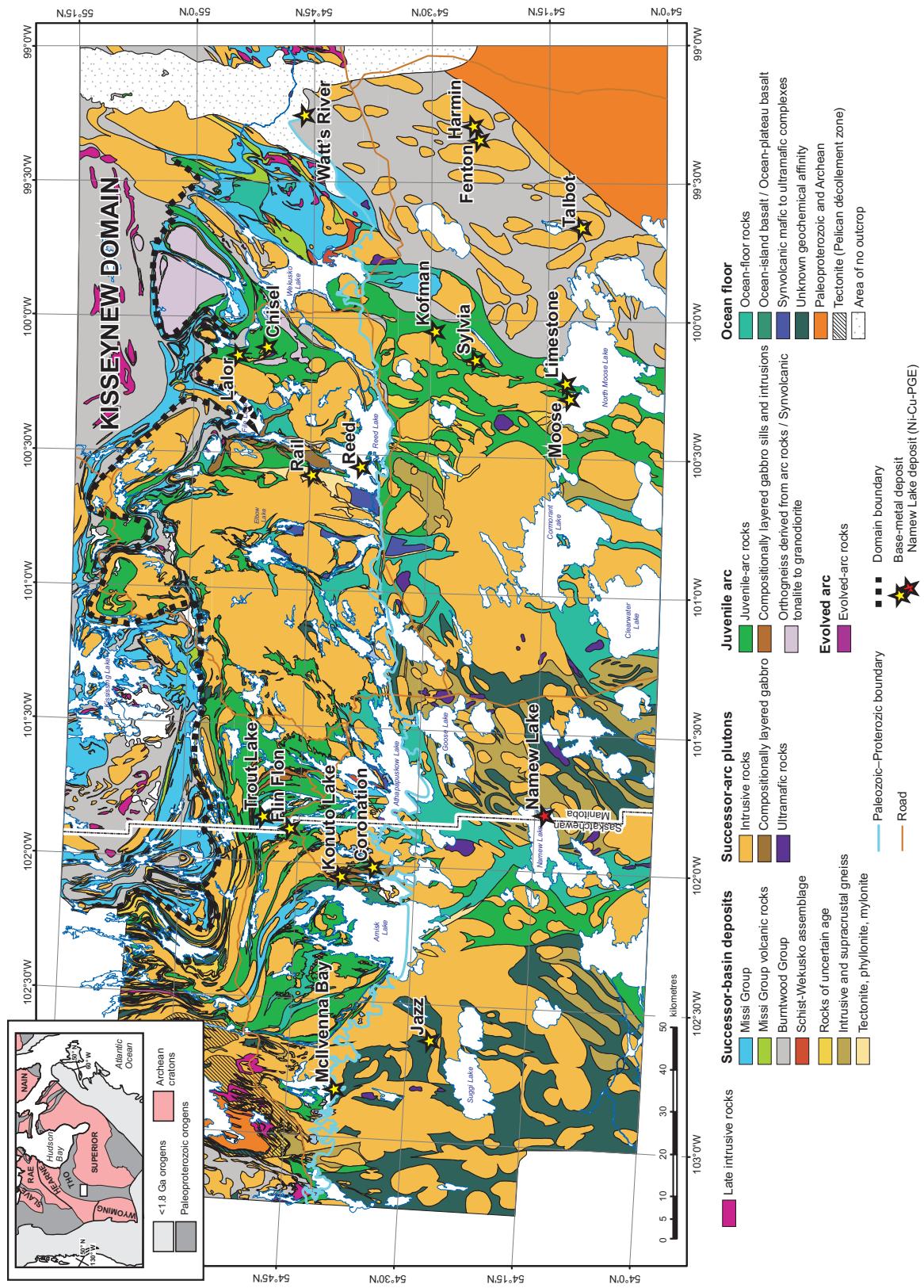
Figure GS-4-1: *Generalized geological map of the Flin Flon Belt with emphasis on its sub-Phanerozoic southern extension (modified from NATMAP Shield Margin Project Working Group, 1998). Stars show the location of some of the deposits in the belt.*

repeated more often than necessary. The database consists of 23 related data tables (Figure GS-4-2) and 45 lookup tables and lists. The tables are related using composite keys—two or more fields in combination used to create a unique value for each record stored in the table—which are hard-coded in GeoCapture. These composite keys (e.g., DDH_No_unique, Litho_No_unique, Sample_No_ unique), also referred to as primary keys, cannot be edited by the user, which would result in loss of referential integrity. Referential integrity ensures internal references are synchronized so that no record refers to other records that no longer exist.

Two sets of 'entry forms' were developed to allow manual entry of data by the user; one capturing project information (Figure GS-4-3a) and the other drillhole information (Figure GS-4-3b). Because this database is intended to capture data that can later be manipulated in a GIS, some fields are mandatory (DDH_ID, Easting, Northing). Data are systematically stored in metric units in the database, but can be entered using imperial units.

Although GeoCapture was primarily designed to capture drillhole information, one can also capture surface data. This feature is still a work in progress.

An 'export form' (Figure GS-4-4) has been developed to allow data, such as geology and/or geochemistry, to be exported into Excel® and shared with others and/or imported into other software (e.g., GIS or geochemistry software).

An 'import form' for GeoCapture is currently being developed to support batch importing of digital data (e.g., collar information, geology and geochemistry).

Format Tool

Due to the vast amount of existing digital data (e.g., geochemistry) and wide range of available file formats and storage media, a user-friendly and reliable 'Format Tool' was needed to efficiently import data into Geo-Capture. The Format Tool was created to minimize the need for users to manipulate the original data file, thereby reducing the possibility of user-introduced errors.
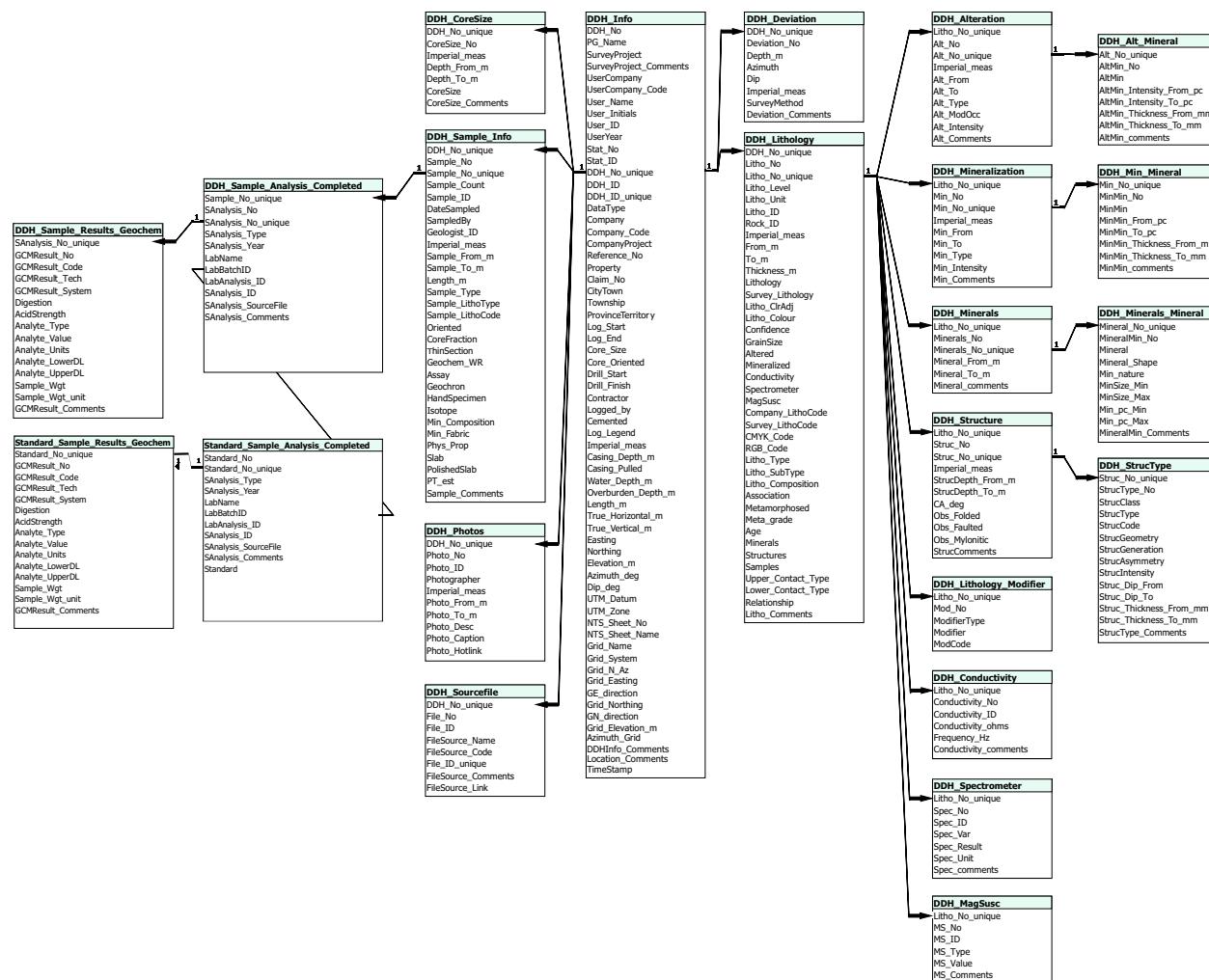
***Figure GS-4-2:** GeoCapture database structure (one-to-many table relationships).*

Figure GS-4-3: *Examples of entry forms from the GeoCapture database:* **a)** *project forms, which allow the user to create a new project or edit an existing project and its drill-holes, and* **b)** *drillhole information form, which is used to capture information about a given drillhole (location, deviation survey, lithological log, samples, photographs, etc.).*
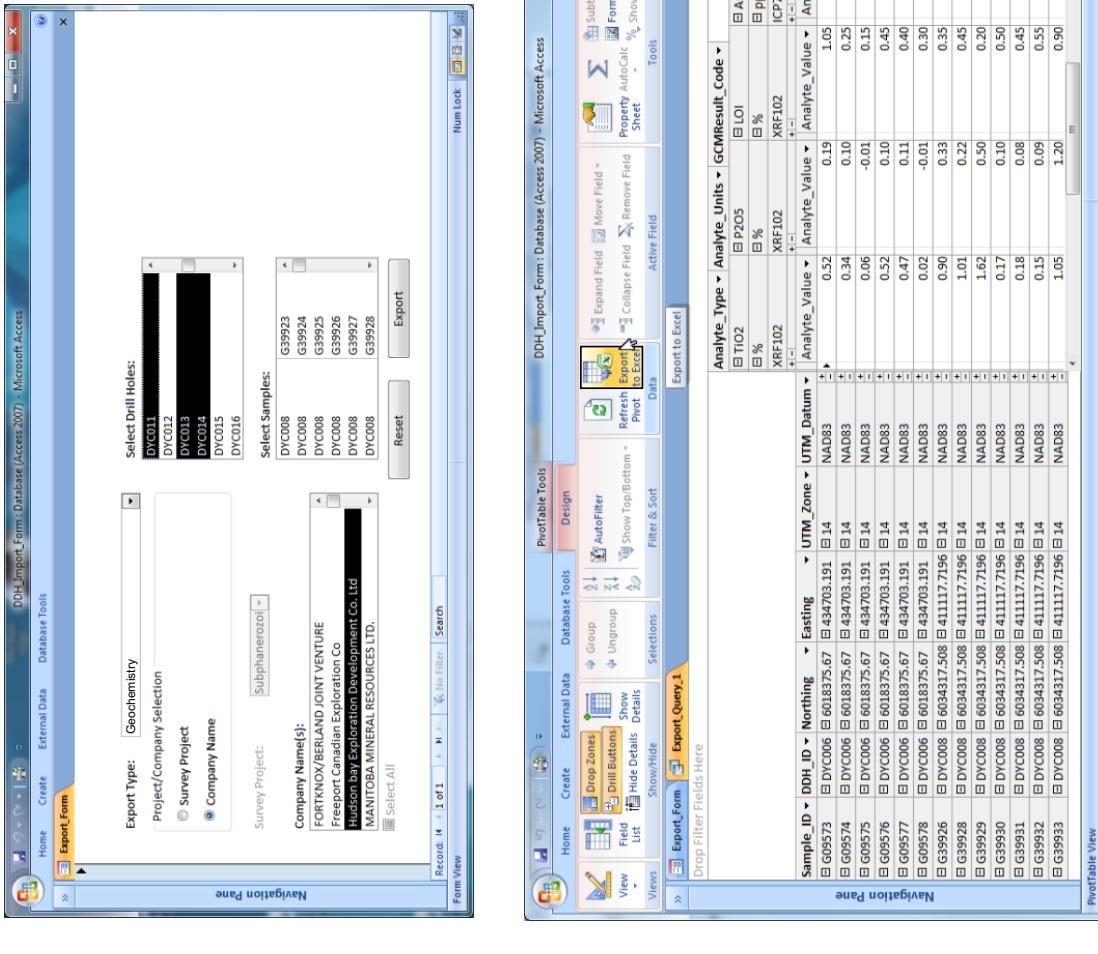
Figure GS-4-4: *Example of the Export Form for the GeoCapture database: a) the export tool allows the user to choose the type of data to be exported (geochemistry, geology, collar, etc.) for a selection of drillholes/samples, and b) example of a pivot table generated for the data (e.g., geochemistry) using the Export Form (N.B.: if an analyte, e.g., Ba, was analyzed using two different methods, both set of results will be exported). To save the results of this pivot table, the user clicks on the 'Export to Excel' button in the Ribbon at the top of the screen. The pivot table will re-appear in Excel® where the user may save the data in their preferred file format (e.g., .xls or .csv).*

Using Visual Basic® in Visual Studio® 2010 Express, the Format Tool transforms data from any Excel® (or comma-space delimited text, .csv) file into a standardized format and outputs it to a comma-space delimited text (.txt) file. These .txt files can be imported directly into GeoCapture, the Microsoft® Access® database, using a simple 'append query' or 'import form'. The program can be run on any Windows system that is running the Microsoft® .NET Framework 3.5 and up.

In the case of geochemical data, the Format Tool was specifically designed to capture the metadata associated with each 'Analyte Value' for all samples (e.g., units, analytical methods, detection limits, laboratory, source file, etc.) and import these data into GeoCapture for future references. The Format Tool also separates the 'Standards' sample analyses from the others (based on the pre-existing pick-list of suffix/prefix/template provided by the user) and allows users to reformat some of the field information (e.g., field names) of the output file, if needed.

The Format Tool is very simple to use. The open Excel® (or .csv) data file is displayed in a grid viewer window (Figure GS-4-5). The subwindow to the left of the grid viewer window lists the fields to be populated. For each field choice, the user selects the starting cell of the row or column of data that the program will begin processing from to populate the field (blue cells, Figure GS-4-5). Once all fields are chosen, that is populated from the grid viewer window (red text) or ignored (grey

text), the user clicks 'Finish' and the program retrieves and reformats the data from the Excel® or .csv file.

The program outputs three .txt files: 1) an 'Analyses' file containing the valid data that was collected from the Excel® (or .csv) file, 2) a 'Standards' file containing all of the valid standards data from the Excel® (or .csv) file, and 3) an 'Errors' file containing all records in error due to missing required data. Each row in the outputted files is a record of an Analyte Value with all of its metadata. For example in a geochemical file, each row contains one Analyte Value for a specific sample and all of its metadata, such as Analyte Type, Detection Limits, Analytical Methods and so forth.

Economic considerations

The development of a user-friendly but comprehensive database of all existing geoscientific data in the sub-Phanerozoic Flin Flon Belt will be of great assistance in revising the geological maps of the area, as well as in producing 3-D models of areas of interest (exploration targets, deposits, etc.). The newly acquired ability to bring such historical data into a GIS environment will also help achieve a better understanding of the regional distribution of the various tectonostratigraphic assemblages and geological domains, in particular the location of favourable host rocks within juvenile-arc assemblages, and thus provide valuable guidance for current and future mineral exploration programs.
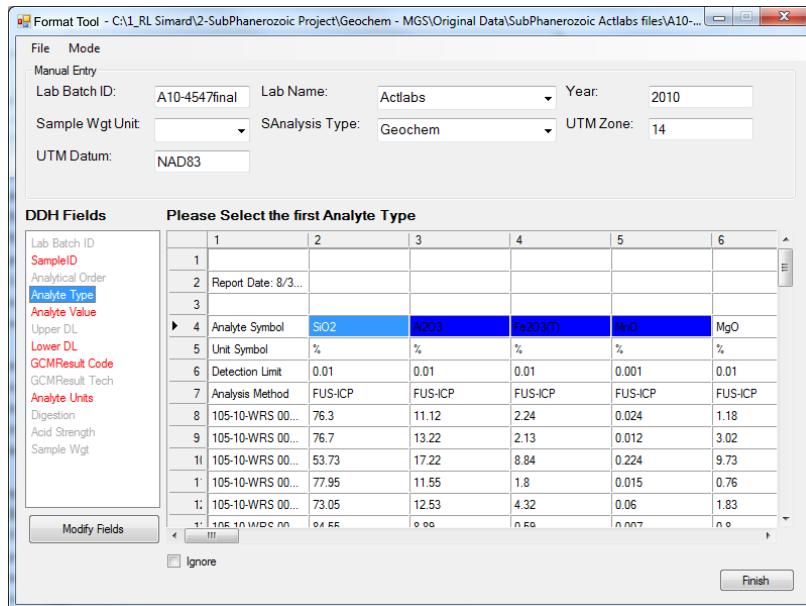
Figure GS-4-5: *View of the main screen of the Format Tool. The upper portion of the screen shows fields that can be manually filled or left blank, the subwindow on the left contains the list of fields to be populated, and the grid viewer window to the right displays the Excel® or .csv data. The light blue cell is the 'data retrieval' start point followed by dark blue cells to highlight the direction in which the data will be processed, as selected by the user. If a field that is listed in the subwindow on the left side of the screen is not contained in the open Excel® (or .csv) file, then the field must be omitted by checking the 'Ignore' box. Otherwise, the field is highlighted red when data are present. The user can add or delete a field using the 'Modify Fields' button.*

Acknowledgments

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