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Newsletter for the Association of Applied Geochemists

President's Message

Paul Morris

Since publication of the March 2010 edition of **EXPLORE**, the Annual General Meeting of the AAG, and one of it's biennial Council meetings has been held by teleconference, involving members from North America, Europe, Asia, South America, Africa and Australasia. Coordinating a sufficient number of members or Councillors to achieve a quorum is not always easy, and I thank participants for taking the time and making the effort to contribute to these meetings.

Sponsorship is crucial to maintaining **EXPLORE** as a financially viable publication, and I am pleased that Innov-X Systems and Maxwell Geoservices have taken advantage of a sponsorship opportunity, which provides companies with a high level of exposure to the AAG membership. I would suggest that other companies should investigate the significant advantages afforded by taking out an **EXPLORE** sponsorship option — Beth McClenaghan (**EXPLORE**'s editor) is waiting for your email. The information from **EXPLORE**'s four-yearly editions is complemented by that on the AAG website (www.appliedgeochemists.org). The site has been undergoing some reorganisation and updating, and any information of interest to AAG members should be forwarded to Bob Eppinger (eppinger@usgs.gov), especially items that can be included in the *Upcoming Events* section.

For most AAG members, their use of applied geochemistry falls broadly in the mineral exploration or environmental fields. However, the position of applied geochemistry in relation to a volcanic event that is still unfolding, doesn't fit easily in either category, yet both geoscience in general and geochemistry in particular will be fundamentally important in understanding this event. At the time of writing, various airlines and aviation authorities are sufficiently confident about air safety that a number of airports have opened across Europe, offering some relief to the transportation chaos created by the eruption of the Eyjafjallajokull volcano in Iceland. I'm pretty sure that of the large numbers of the travelling public who had their travel plans disrupted, there would have been at least a few AAG members. Media reports have canvassed comments from geoscientists about the effects of volcanic ash on everything from aircraft safety and human health, through to longer term effects on agriculture and even the rate of global economic recovery. However, no single commentator could answer the simplest, yet probably most important question — when will the eruption stop. When the eruption eventually ceases and the air has cleared (in many ways), it's a fair bet that ensuing geological investigations will dissect eruption mechanisms, and the stratigraphy, mineralogy, chemistry and sedimentology of eruption products, in order to better understand how these types of eruptions take place, how the effects of future eruptions can be better handled, and what deposits from similar styles of volcanic eruption look like in the geologic record. Geochemistry will be fundamental to many of these studies. Apart from the application of a variety of analytical techniques to determine ash chemistry, geochemistry also has a place in other studies. For example, anecdotal evidence indicates that sulfur-bearing volcanic aerosols are converted to sulfuric acid, which is then ingested by aircraft engines — geochemistry clearly has a place in understanding this sort of process. In all of these studies, techniques such as inductively coupled plasma (ICP) spectrometry and the like will be commonly used. It's worth bearing in mind that the development and refinement of these techniques is in large part a response to the mineral exploration industry's requirement for rapid, (now) low cost analytical methods capable of accurate analysis of a wide variety of elements to low levels of detection at an acceptable level of precision.

By the time you are reading this, it will be slightly more than 12 months until the Rovaniemi IAGS meeting in Finland (www.iags2011.fi). The report to Council recently provided by Pertti Sarala and his group shows the development of a strong technical program, complemented by workshops, field excursions, and social events. I am hopeful that Eyjafjallajokull will have ceased eruption by the time we are all packing our bags and making our way to Finland in August next year.

Paul Morris
AAG President

Digital field data capture: the Geological Survey of Denmark and Greenland experiences in Greenland

Introduction

The Geological Survey of Denmark and Greenland (GEUS) is carrying out geological expeditions in Greenland during the short arctic summers. In the past, field diaries together with sample tag books were used to record field data, observations and information about samples collected. The field notes and the information from the sample tag books were then entered into spreadsheets or digitized after the field work. In order to record field data efficiently and consistently in a digital format and to reduce field based paper-work, GEUS recently decided to use a digital field data capture system. The system was tested in southern Greenland in the summers of 2008 and 2009 (Schlatter & Larsen 2010). Positive results were immediate as compared to the traditional method. A system for digital field data capture makes the release of geological data and maps faster. This paper aims to summarize the GEUS experiences of digital field data capture in Greenland and to describe the data flow from the data captured in the field to the central relational (Oracle®) GEUS master database and the reporting of the field data.

Personal digital assistant versus personal computer

Since early 2000, new technologies have been used to capture data directly in the field or to digitally make geological field maps using a personal computer (PC) or tablet PC. These new technologies have the advantage of avoiding data input errors into a computer system after the field season (Brimhall & Vanegas 2001; Gilbert et al. 2001; Buller 2002; Brodaric 2004; Colm et al. 2008; Curtis et al. 2008). The advantages and disadvantages of personal digital assistants (PDAs) versus tablet PCs are discussed in detail by Clegg et al. (2006). One of their conclusions is that PDAs are best used for field work involving mainly data collection from outcrops,but in cases where geological mapping is the purpose of the field work, a tablet PC is recommended. As GEUS is working in remote areas, often where access to the outcrops is only on foot, it became apparent that lightweight PDAs were more convenient to use than larger and weighty tablet PCs. Furthermore, Clegg et al. (2006) also state that PDAs are suitable for simple data collection tasks which were the main objective for the southern Greenland expeditions in 2008 and 2009. Following the recommendations of Clegg et al. (2006), GEUS chose PDAs for field data capture.

Equipment and Methodology

Hand held device

During field work, GEUS typically establishes a centrally located base camp for each expedition that supports, via helicopter, up to ten field teams. Each field team was comprised of two to four geologists who were equipped with an HP iPAQ 214 Entreprise Handheld PDA (Fig. 1a). Each PDA is wirelessly linked to a GPS via a Bluetooth® connection (Fig. 1b). The PDA and GPS are of a relatively small size and weight, for portability, but having a screen size of 8.5 x 6.5 cm, the PDA allows display of maps and data in a readable manner (Fig. 1a). The screen is pressure-sensitive and a stylus pen is used for input and writing of text and data. Following our field investigations, this type of PDA was found to be water resistant (not waterproof) and to be visible in strong sunlight, however, in severe working conditions such as snow and heavy rain it becomes difficult to read the screen. The unit needs to be recharged every day or second day. The digital field data capture system also includes a spare battery (Fig. 1c), replacement stylus pens (Fig. 1d) and a spare secure digital (SD) memory card (Fig. 1e). In order to prevent scratches on the screen, protector-films were applied. In total, a digital field data capture system costs about 450 € (exclusive of VAT; Fig. 1) which is about six times cheaper than a tablet PC. Power for the PDA and the GPS receiver were supplied by a solar energized power generator (Fig. 2) or a petrol engine generator.

"GanFeld" and ArcPad

Geological field work usually comprises a sequence of activities that are carried out in a similar way at each outcrop. Such a sequence normally starts by the determination of the geographic location commonly using a GPS receiver. Once the position is recorded, the rock type is determined and described, and then other information

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Notes from the Editor

The June 2010 issue of **EXPLORE** contains one technical article on the use of hand held digital data capture devices for field work written by Denis Martin Schlatter, Uffe Larsen and Bo Møller Stensgaard, Geological Survey of Denmark and Greenland, and Guy Buller, Geological Survey of Canada. Scientific and technical editing assistance for this **EXPLORE** issue was provided by Alain Plouffe and Wendy Spirito, Geological Survey of Canada and Scott Robinson, Queen's University.

Beth McClenaghan

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Figure 1. The digital field data capture system consists of: a) HP iPAQ PDA (310 €); b) wireless GPS receiver (48 €); c) HP extended battery (59 €); d) PDA stylus (7 € for each stylus); e) secure digital (SD memory card (15 €).

Digital field data capture... continued from page 3

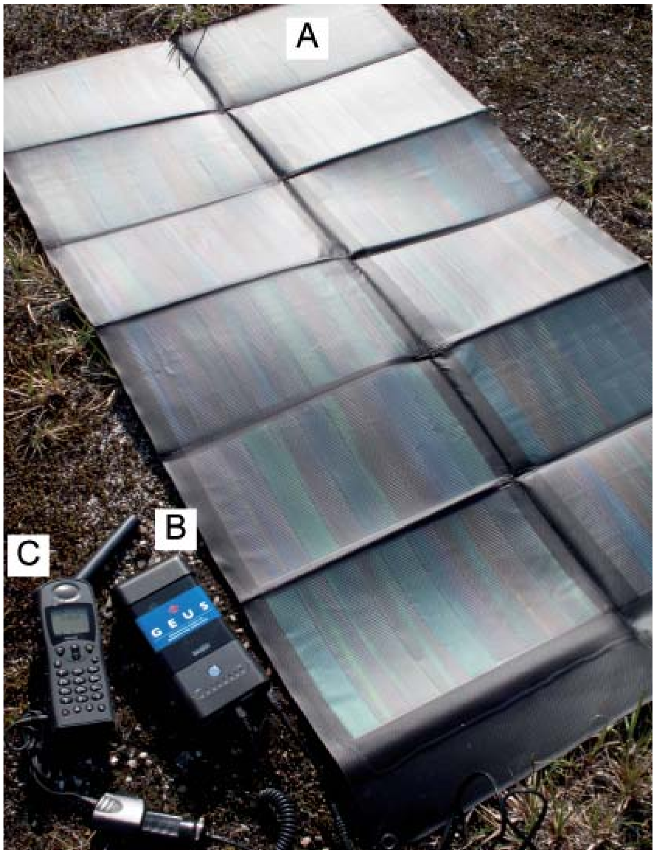

Figure 2. Equipment used for charging the digital field data capture system: a) solar panels (62W P3 Powerpack from Select Solar Ltd.) were used to generate power; b) an external battery (myPower ALL Plus MP3750 from Tekkeon, Inc.) was charged by the solar panel; c) charging an external device, in this example a satellite phone.

such as structural measurements on the outcrop are taken. Bedrock samples are collected and described and photographs are taken and annotated for documentation. Additionally, stream, soil, or scree sediment samples are collected. The "GanFeld" software developed by the Geological Survey of Canada (GSC) (Buller 2004, 2005) allows systematic capture of field data in an organized and modular manner. Table 1 summarizes the type of information that is digitally captured while performing field work. Although some of the data entry is compulsory and entered via predefined look-up tables (LUTs) as drop-down lists (e.g. "Station"; and "Earth Material"), other information is optional and consists of both LUTs and in some cases free-text description. The compulsory data entries ensure that all of the field data critical for GEUS are captured while keeping field work efficient. The predefined drop-down lists allow geologists to capture information in a consistent manner in which pre-defined classifications and descriptions

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Table 1. Field data are captured using the six "GanField" modules: "Station"' "Earth Material," "Rock Sample," "Structure," "Photo," and "Sediment sample" and each fo these modules consists of two to seven pages. (Note: "short notes" refer to text string up to 254 characters and "large notes" to text entry of unlimited length.)

Module:	Page number:	Pages:
"Station"	1	Coordinates (provided via GPS in three different coordinate systems)
	2	Elevation; observation type; team partner; camp ID
	3	Station "short note"; since last station "short note"; "large note"
"Earth Material"	1	Rock class; rock type; rock name; colour
	2	Minerals; abundance and size of minerals; metamorphic facies
	3	Alteration; ore minerals; abundance and size of minerals
	4	Textures (three different textures can be captured)
	5	Lithological map unit; "short notes" for material description; "large notes"
	6	Chronostratigraphy; era, period, epoch
	7	Fossils
"Rock Sample"	1	Sample type; purpose; GEUS sample number
	2	Sample orientation; sample depth, "short notes", "large notes"
"Structure"	1	Class; type; detail
	2	Method (right hand rule or dip dip direction); Azimuth and dip measurement
	3	"Short notes"; "large notes"
"Photo"	1	Category; File ID from digital camera; direction of picture; time of picture
	2	Photo caption (possibility to load previous caption); "large note"
"Sediment sample"	1	Stream Sediment (sub-module with 4 pages)
	2	Soil Sediment (sub-module with 3 pages)
	3	Scree Sediment (sub-module with 3 pages)

are used resulting in a consistent description of localities and geology amongst geologists. This last point is of particular interest to GEUS, as many of the field campaigns are carried out with external Danish and international collaborators with different backgrounds and expertise. Furthermore, because much of the data are selected from LUTs, GEUS has the ability to define these lists following international standards for describing rocks, minerals, textures and other geological information. Figures 3 and 4 demonstrate how the data are captured in the field: after capturing the location (Table 1, "Station"), the module "Earth Material" is activated by clicking on a hammer icon (Fig. 3a) and *page one* of the module "Earth Material"

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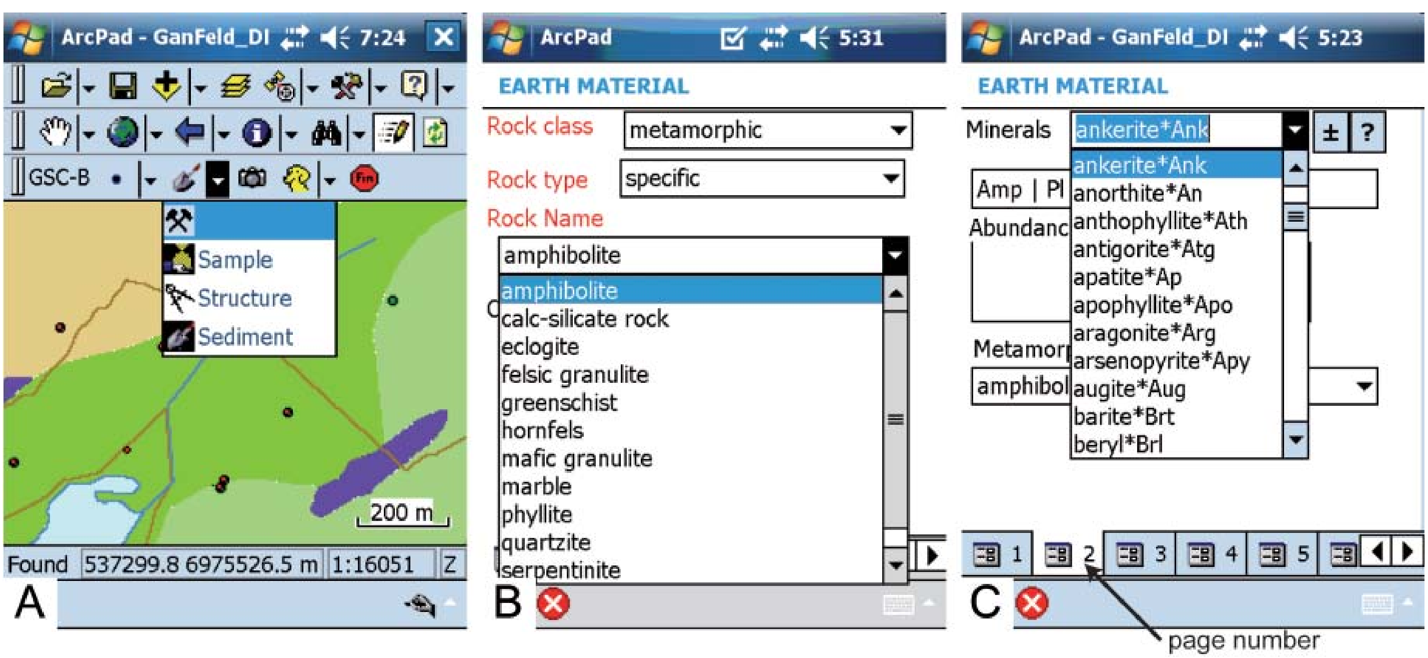

Figure 3. Sequence of digital field data capture for "Earth Material": a) a small hammer icon is activated to capture the field data seen at an outcrop. Other icons are sample bag (for samples), compasses (for structures) and shovel (for sediment samples). The location of the outcrop has already been captured previously and corresponds to one of the small dots on the geological map; b) the field data of the earth material is captured; c) the minerals identified at the outcrop are captured using the drop-down list with predefined minerals. Several minerals can be selected one by one and are concatenated into a series or string of words in a single box.

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opens in a new window (Fig. 3b; Table 1, "Earth Material"). *Page two* of the module "Earth Material" (Fig. 3c) includes the "Minerals" field populated with all minerals observed at the outcrop. Minerals are selected one after the other from a drop-down list (Fig. 3c). Subsequently, "GanFeld" guides the geologist through a step by step process to ensure that all necessary rock outcrop description information, following GEUS standards for Greenland, is captured. Figure 4 shows how the information for a sediment sample is captured. One of three sample types can be selected: stream sediment, soil sediment or scree sediment (Fig. 4a). Several drop-down lists within the sediment sample form (Figs 4b and 4c) facilitate the field data capture with little free-text being entered.

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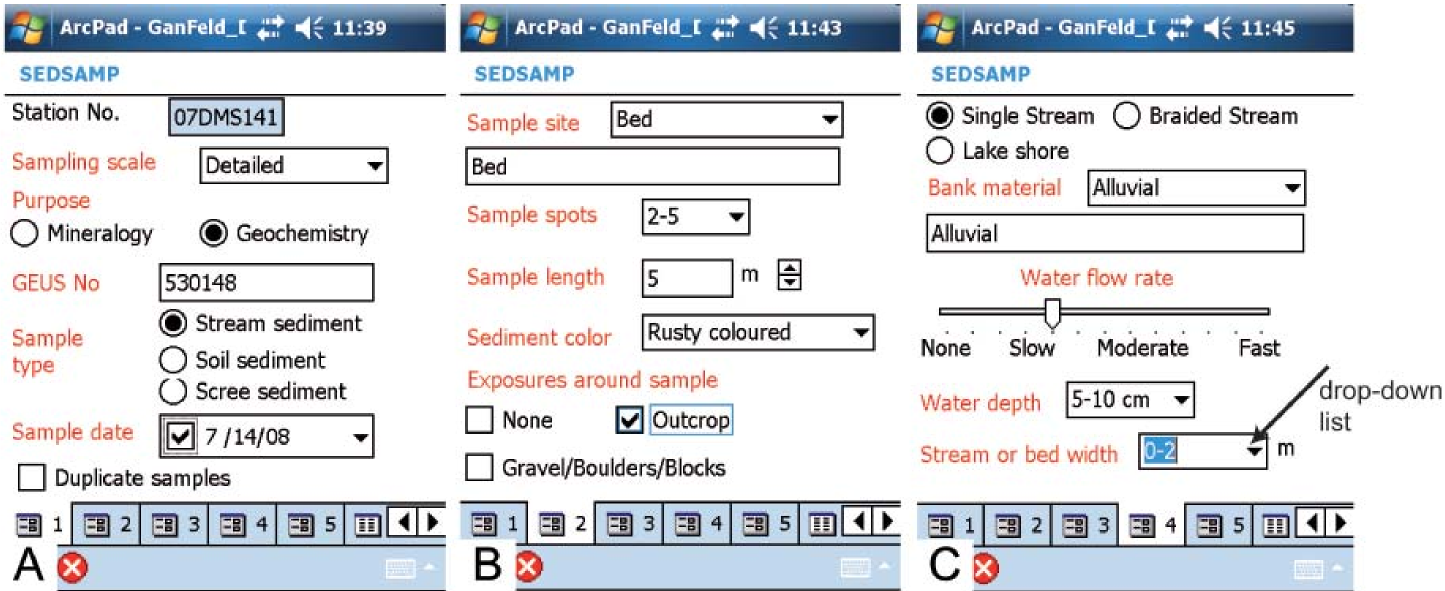

Figure 4. Sequence of digital field data capture for "Sediment sample": a) three types of sediment samples can be recorded: stream, soil and scree sediment samples; b) the sample site and sample collected are described using drop-down lists which are activated by clicking inside the small black arrows (on the right side of the combo boxes); c) the stream from which the sample is taken is described including water flow rate, which is characterized using a scale bar.

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"GanFeld" uses the ArcPad application, an Environmental Systems Research Institute Inc. (ESRI®) product that GEUS is already familiar with and thus has the necessary licenses. "GanFeld" leverages the geographic information system (GIS) capabilities of ArcPad by gathering information for a single point in an electronic format. The different groups of information (e.g. "Station", "Earth-Material", "Rock Sample", etc.; Table 1) are each recorded in separate shape files and therefore, have their own geographically referenced location that is plotted on the map when collecting data. The "GanFeld" software is simply a set of forms and menu items that are written in XML (Extensible Markup Language) which then use VBScript (Visual Basic Scripting Edition) code for producing a variety of functionality for each form. These forms and scripts simply act as an add-on to the existing ArcPad application. The captured data are stored in the database file (dbf file) of the shape files that makes it possible to directly access the data easily via spreadsheet or database applications. Furthermore, data can be plotted in the field directly into a GIS platform such as ArcMap, which is also an ESRI® product, or any other GIS software which can read shape files. The ability to produce maps based on captured field data while still in the field is a remarkable advantage recognized by other geological surveys such as the Geological Survey of Finland (Kauniskangas et al. 2008).

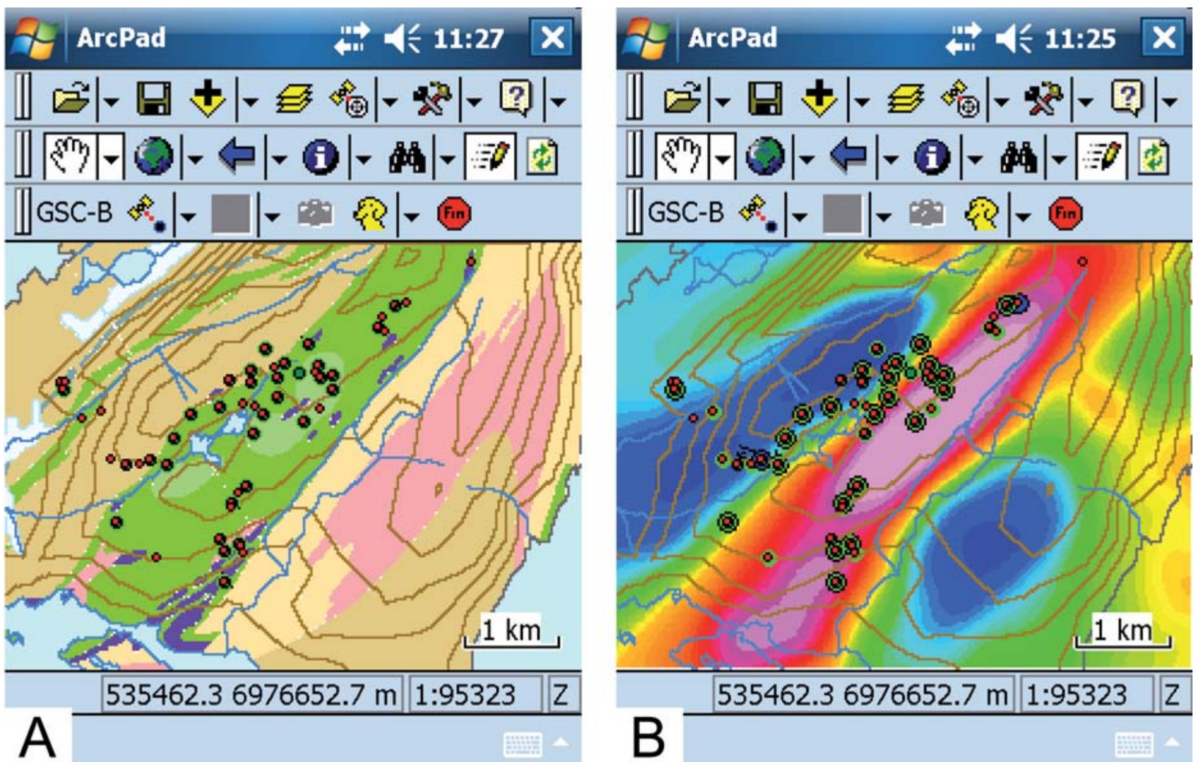

Figure 5. Geographically referenced base layers can be added by clicking the "plus" icon in the top row: a) the stations visited and the geological map from an area in southern West Greenland are superimposed. Circles of different colours indicate the type of data that was captured (Table 1 provides a list of the categories); b) same area as in (a) with the regional vertical gradient of the total magnetic intensity field (line spacing 500 m, draped 300 m) as a background base layer and position of the captured stations (small dots). The geographically referenced maps are stored on a SD memory card that is inserted in the PDA.

Base layers and examples from field work

Geographically referenced base maps such as bedrock geology maps (Fig. 5a) and geophysical maps (Fig. 5b) can be added as a layer in ArcPad ® and displayed directly on the screen of the PDA. This ability to display maps helps to provide a precise location in the field and to easily find areas of interest; for example, the edges of a geophysical anomaly (Fig. 5b). Furthermore, field work progress can be seen at a glance, because the stations visited, the samples taken and any other captured field data are directly displayed on the screen using different symbols for each activity (Figs. 5a and 5b). Individual geologists can add and remove maps by connecting the PDA to a computer or by simply storing map data files on the SD memory card which is part of the field capture system (Fig. 1e). If the maps are not available as shape files, georeferenced tiff-image files can be used. However, it is recommended that maps and images of small memory size are used because the memory available on a PDA is limited and the speed of the processor is slow compared to a desktop computer. Depicting a large map or image on a PDA in the field could be time consuming.

At the end of each field day, geologists can download and back-up the PDA data onto a laptop computer to avoid the data loss. Digital field data from the field teams are sent

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to base camp on SD memory cards on a regular basis to allow base camp staff to compile and analyse all captured data (Fig. 6). The outcrops visited are plotted on a geological map (Fig 6a) which allows the quality of the information and the progress of the field work to be verified. Geologists at base camp can interpret the data while in the field and plan field activities accordingly. The activities carried out by a given field team can be plotted on an even more detailed map (Fig. 6b).

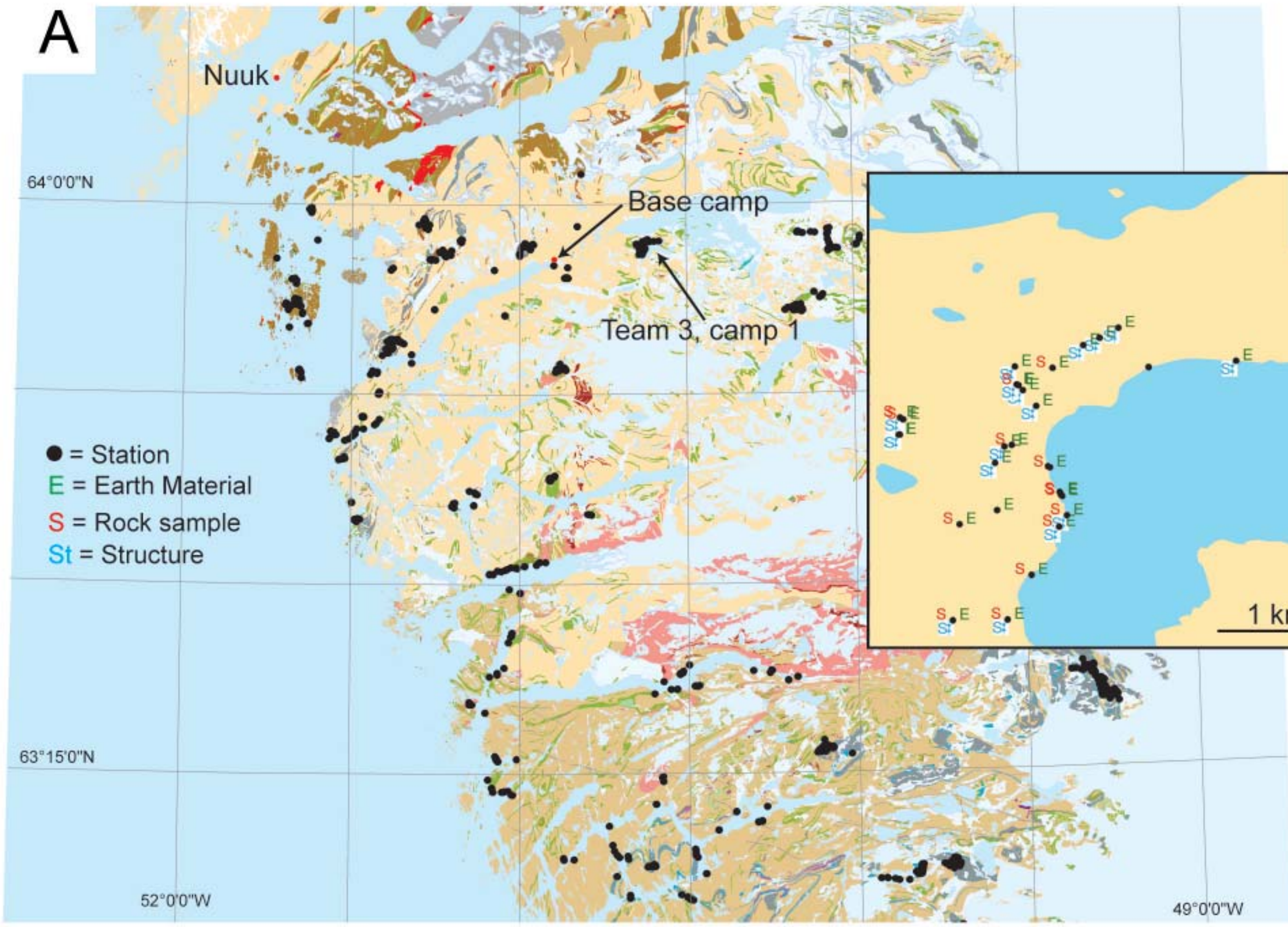

Figure 6. Maps produced at the base camp: a) Field activities carried out in southern West Greenland. Locations of the base camp in 2008 and of the first camp of field team number 3 (Team 3, camp 1) are shown. Distance from Nuuk to base camp is about 50 km; b) the field activities carried out by team 3 at their camp location 1 are listed (E="Earth Material", S="Rock Sample", St="Structure").

Data processing after the field season

Data flow in the office

Immediately after the field season, the digital field data will be verified by a software routine that cross checks the "GanFeld" field data with the reference database containing the permitted entries. This routine generates an error list (Fig. 7) which facilitates the detection of mistakes and omissions and the necessary corrections within the field data to be made efficiently. Often, these minor typographical errors occur because text was entered directly in the text boxes instead of using the predefined drop-down lists. Such errors can be corrected easily. After corrections are made, the reviewed data will be cross-checked once more with the routine in order to have an error-free data set. Subsequently the field data are transferred into the central relational master database and a preliminary data report is generated via Crystal Reports which is also an ESRI product (Schjøth 2009). In detail, six dbf files ("Station", "Earth Material" etc., see Table 1) are linked to the station number and a report with all the field data from a given station is generated (Table 2).

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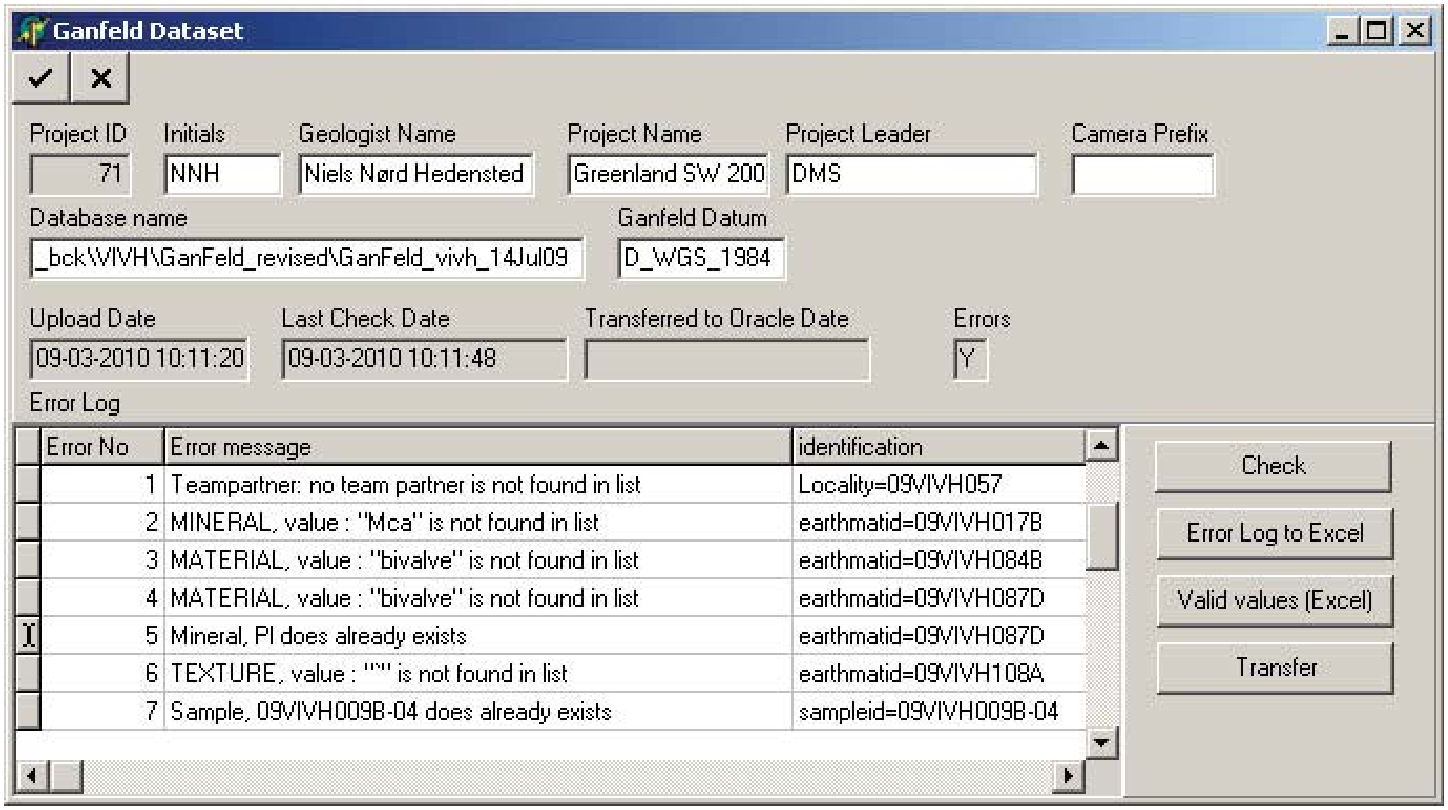

Figure 7. A software routine cross checks the field data with the database and detects inaccuracies which are then listed in an error report. This list helps the geologist to revise and edit the field data.

Maintenance of drop-down lists and system

In the "GanFeld" software, drop-down lists are populated directly from pre-defined LUTs in the form of dbf files. Table 3 shows a part of the LUT which is used to describe the mineral assemblage of an earth material. Because the LUTs are stored as dbf files, the content can easily be modified by geologists in DBF viewer which is a free software utility (HiBase Group USA) that allows minor modifications to a dbf file. After modification, the altered file can be copied back into the "GanFeld" software. The next time that "GanFeld" is turned on, the updated mineral list will be used to populate the mineral drop-down list (Fig. 3c). Typically after each field season, it becomes apparent that certain datafields or types are missing from the lists (e.g. a mineral or rock texture not contained in the list). Consequently, the content of these lists needs to be updated before the next field season. The process of the modification of these lists is overseen by a panel of geoscientists who are appointed by GEUS. Modification of LUTs, even in the field, provides a certain flexibility to "GanFeld" reflecting the complexity and variability of the geological information. Another advantage of using ArcPad is that new pages can be easily added and existing pages can be easily modified via the ESRI ArcPad Application Builder. The sizes and appearances of the combo boxes and the text of the combo boxes can also be changed easily with the ArcPad Application Builder.

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Table 2. Example of a Crystal report which was generated directly from the "GanFeld" data. At station 09DMS011, one rock was described ("Earthmat"), a sample was taken ("Sample"), a measurement of a structure was carried out ("Structure") and a photo was taken ("Photo"). (Station 09DMS011 is located in southern West Greenland and corresponds to one of the dots on Figure 5).

Station

09DMS011	Latitude=	62,90738	Entry type=	GPS
	Longitude=	-50,27065	Pdop=	2
	Easting=	537060	Sat used=	10
	Northing=	6975480	Visit date=	01-07-2009
	Elevation=	555 Elevation method= altimeter	Visit time=	11:16:07 AM
	Altimeter=		Partner=	Yong Chen
	Obs type=	outcrop		
	Profile id=			
	Camp id=	Camp 2		
	Station note:			
	same large shear zone as seen in station 09DMS009			

Earthmat	Earthmat letter=	A
09DMS011	Material:	metamorphic specific amphibolite
09DMS011A	Colour:	yellow brownish
	Map unit:	
	Mineral assemblage:	Qtz
	Metamorphic grade:	amphibolite
	Alteration:	Qtz | Phl
	Notes:	amphibolite hosts 50 cm zone with veinlets of qtz carbonate, rusty

Sample		
09DMS011	Sample number:	1
09DMS011A	Sample type:	rock hand RS
09DMS011A-01	Sample orientation:	
GGUno =	Sample dep:	0
511907	Purpose:	geochem WR | geochem assay
	Notes:	composite sample

Structure	Structure number:	1
09DMS011	Class:	planar
09DMS011A	Structure type:	shear zone
09DMS011A-01	Detail:	
	Method & readings:	Dip azimuth / Dip 151 / 80
	Sym ang:	61
	Relative age:	0
	Notes:	same shear zone is sampled as in station 09DMS010
	Symbol:	0
	Intensity:	strong

Photo	Photo number:	1
09DMS011	Category:	outcrop
09DMS011P01	File number:	536
	File name:	IMG0536.jpg
	Direction:	0
	Caption:	picture of outcrop
	Photo date:	01-07-2009

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Table 3: The "minerals list" is stored as a dbf file and can easily be altered and modified by using the free software "DBF viewer" from HiBase Group USA.

EARTH MATERIAL		carbonate	
Page 2		(undifferentiated)	Cb
Minerals		cassiterite	Cst
other minerels are listed above		celestite	Cls
ankerite	Ank	chalcocite	Cc
anorthite	An	chalcopyrite	Ccp
anorthoclase	Ano	chlorite	Chl
anthophyllite	Ath	chloritoid	Cld
antigorite	Atg	chromite	Chr
apatite	Ap	chrysotile	Ctl
apophyllite	Apo	clay (undifferentiated)	Clay
aragonite	Arg	clinopyroxene	Cpx
arsenopyrite	Apy	clinozoisite	Czo
augite	Aug	cordierite	Crd
barite	Brt	corundum	Crn
beryl	Brl	covellite	Cv
biotite	Bt	cummingtonite	Cum
boehmite	Bhm	diaspore	Dsp
bornite	Bn	dickite	Dick
Ca-clinoamphibole	Cam	diopside	Di
Ca-clinopyroxene	Cpx	dolomite	Dol
calcite	Cal	enstatite	En
cancrinite	Ccn	other minerels are listed below	

The way forward

A central relational (Oracle®) master database is used to store all captured data from all the expedition members. About half of the Greenland expedition members are Danish or international collaborators and are not permanently based at GEUS. Because an application was needed that enables the geologists to quickly assess the quality of captured data, generate data reports and plot data, an application that is accessible via the Web was developed. This allows "GanFeld" users to review and to edit their data after the field season. Figure 8 shows how this application is structured. The field data can be accessed with a password. By searching for a given station number, any other set of information attached to that field station can be edited (Fig. 8). After completing the review and edits, the master database is updated and the "GanFeld" data can then be linked to other data sets (e.g. geochemical data which are stored in the GEUSGREEN database; Tukiainen & Christensen 2001).

Discussion and conclusions

The past two GEUS field seasons have shown that PDAs are suitable devices for capturing digital data during field work in Greenland. Although a tablet PC is more powerful and has a larger screen than a PDA, the latter fits into a vest or a pocket and is thus more suitable for field work in remote arctic alpine terrain with variable field conditions (Figure 9) and when no detailed mapping is involved. For industry and/or government organizations, the use of these devices facilitates the monitoring of field work progress, some quality control in base camps and efficient and fast post-field work data treatment. Also, it allows the field geologist to review the data on a daily basis, as the generated dbf files can be easily transferred and backed-up onto a laptop at the end of each day in the field. Avoiding loss of digital field data is critical. Therefore, a very strict backup procedure must be established. The field data must be downloaded daily to a laptop computer and/or onto a SD memory card (Fig. 1e) by the individual field team. In addition, base camp should store the field data of all the teams centrally and keep track of the reporting of these data (Fig. 6).

Future PDA development will include the ability to add point data information from already existing GEUS databases onto the PDAs (e.g. previously analysed rock

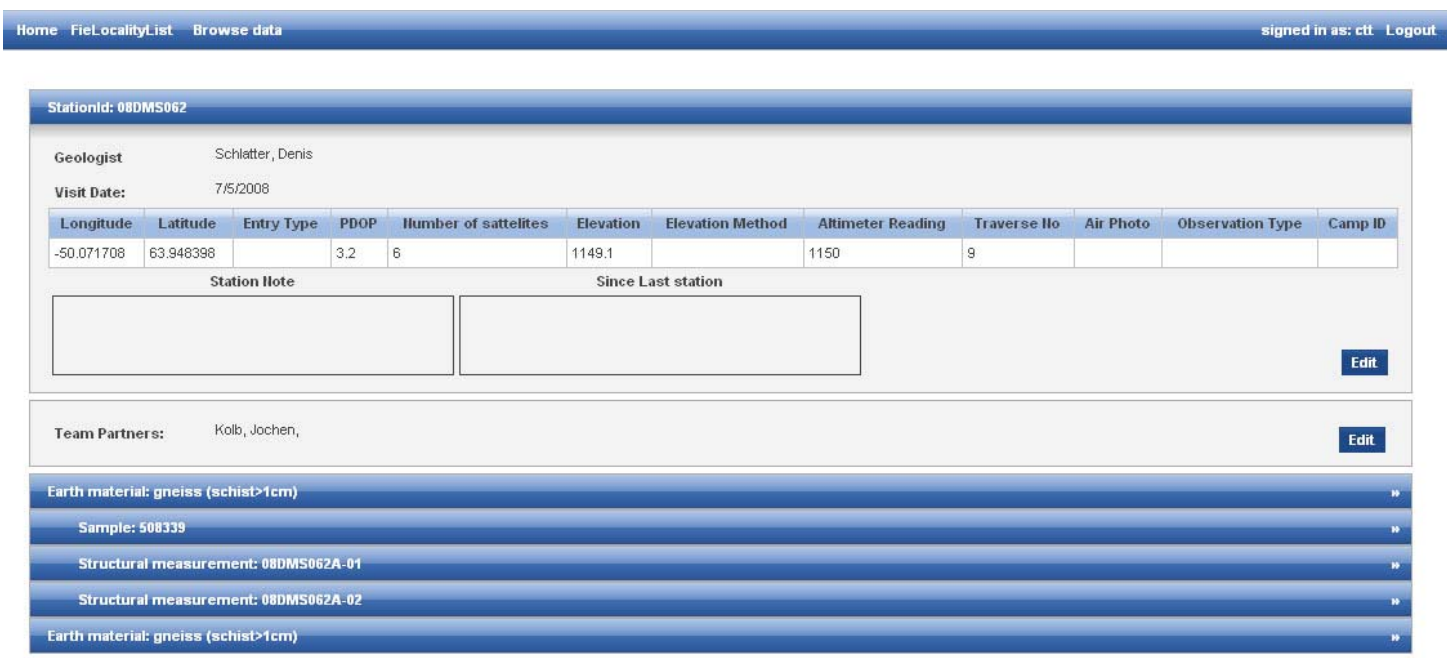

Figure 8. A web based application allows the user to browse and edit the "GanFeld" data. The GEUS master database is updated after edits are completed.

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Figure 9. Field work is performed by the first author in steep and rough terrain in southern West Greenland. GEUS is now using the digital field data capture system on many of their expeditions. The wireless GPS can be seen on the rock outcrop (Photo: Jochen Kolb).

samples, locality descriptions, remote sensing anomalies, etc). Furthermore, the web application for editing and reviewing data can be developed to allow plotting and analysis of data on existing maps or on web applications such as Google Earth®. Digital mapping carried out with a tablet PC might be developed and used by GEUS in the future in cases where extensive geological mapping will be carried out. It might be possible to add the "GanFeld" component as a function directly into a digital mapping system of a PC tablet. Handheld portable X-ray fluorescence (XRF) analyzers are improving rapidly and can potentially be used in the field with the PDAs in order to capture not only all the relevant field data, but also the analysis provided by the handheld XRF analyzers.

In order for GEUS to use a digital field data capture system, comprehensive and complete instructions for the system and how to use the "GanFeld" software have to be supplied to all users prior to the field season (Schlatter & Larsen 2009). As part of standard field preparation, "GanFeld" training exercises should be completed by all users. It was also necessary to convince geologists to use the digital field data capture system in the field.

Advantages of the use of digital field data capture for GEUS include faster reporting of the field season because the field data are already digitally available and geologists do not need to spend time entering data manually into spreadsheets from field diaries which is not only time consuming but can introduce errors. Furthermore, digital field data can easily be shared at the end of the field season. In summary, since digital field data capture using PDAs and "Ganfeld" has been introduced at GEUS, field data are neatly organized and reporting and sharing of data has become easier.

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Acknowledgements

Frands Schjøth (GEUS) is thanked for his help with assistance at the base camp and creating Crystal reports from "GanFeld" data. Leif Thorning (GEUS) is thanked for his help building the data model. John Schumacher (University of Bristol), Anders Scherstén (Lund University) and Jochen Kolb (GEUS) are thanked for their help with the accurate naming of minerals, rocks and structures. Agnete Steenfelt (GEUS) is thanked for her help with the organizing of the sediment sample module. Finally Jan Peter from the Geological Survey of Canada (GSC) is thanked for having connected the GEUS "GanFeld" team together with the "GanFeld" experts at the GSC, Ottawa, Canada. Our thanks to the GSC for helping GEUS to implement the digital field data capture at GEUS and for allowing GEUS to use the "GanFeld" software. This article is published with permission from GEUS. Alain Plouffe, GSC is thanked for his detailed review and Beth McClenaghan, GSC is thanked for her editorial help; the reviews of Alain and Beth have substantially improved the article.

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Denis Martin Schlatter, Uffe Larsen and Bo Møller Stensgaard
Geological Survey of Denmark and Greenland,
Øster Voldgade 10, DK-1350
Copenhagen K, Denmark
E-mail: dms@geus.dk

Guy Buller
Geological Survey of Canada
601 Booth Street
Ottawa, ON
K1A 0E8 CANADA

Obituary-Robert Jackson

The geochemistry community lost a colleague and a friend with the passing of Robert Jackson (58) last July after more than a year battling ALS. Robert graduated with a B.Sc. in Geology from Queen's University in 1973 and immediately entered into a graduate program at Queen's, under the supervision of Dr. Ian Nichol. Robert's research on lake-bottom sediments as an exploration medium in the Canadian Shield began his long career as an exploration geochemist. These were the early-days of lake-bottom sediments applied to mineral exploration, so Robert and his co-workers made significant contributions to the technique.

Robert received his M.Sc. from Queen's in 1975 and then took a position as a geochemist with Saint Joseph Explorations Ltd. Although he was based in Toronto, much of his time was spent in Northern Canada applying and developing geochemical techniques applicable to that environment. After working with Saint Joe's, Robert was a private consultant from 1987 to 1993, but he jumped at the opportunity to work for the Ontario Geological Survey (OGS), preferring scientific pursuits to routine surveys. While at the OGS, Robert trialed some of the early experimental techniques to geochemically detect mineralization buried beneath transported (glacial) overburden.

In 1995 Robert was offered the opportunity to work in the word-class gold districts of Nevada as a geochemist for Newmont Mining. There, he applied some of the same techniques he had tested in Ontario, but now for buried mineralization in the Basin and Range region of Nevada. While in Nevada, Robert began experimenting with 3D display and interpretation of geochemical multi-element zoning patterns surrounding gold mineralization. This work lead to the development of an integrated 3D model for element zoning around Carlin-style mineralization.

This work provided Robert with a niche skill and in 2002 he struck out on his own, as a consultant. His consulting work came from many diverse regions in the world so he and his wife, Daphne, decided to be based in Dartmouth, Nova Scotia moving there in 2004. In addition to his involvement with 3D deposit alteration modeling, he continued to work and conduct research in surficial methods of mineral exploration.

Robert served as an Association of Exploration Geochemists council member from 2002-2004 and was author of many professional articles, papers and presentations.

Robert enjoyed interpreting geochemical results most of all. If a particular survey generated data for 50 elements, in three size fractions, you could bet he would generate 150 maps, each with a carefully-reasoned interpretation. To the best of this writer's knowledge, Robert holds the record for the spreadsheet with the most tabs.

In 2007 Robert designed a comprehensive multi-media surficial geochemical study for uranium in the Athabasca Basin, on behalf of companies participating in a Camiro study. Regrettably, his illness precluded his field involvement in this significant study, but he managed the program from his home office and proceeded to produce a remarkably comprehensive report in spite of his steadily debilitating condition. He passed away within just a few weeks of submitting his report - a testimony to his passion for the discipline of exploration geochemistry.

Robert was equally passionate about things outside the world of mineral exploration, including entertaining, fine food and wine. While at graduate school, he turned many of his colleagues on to peanut butter and banana sandwiches as the perfect field lunch. During his adult life, he and Daphne tag-team cooked to serve up sumptuous meals to vagabond geochemists passing through. Robert was also an avid and skilled tennis player for much of his life and participated in many tennis club activities and competitive tournaments. He was also a keen bridge player, with several trophies to his name.

Robert is survived by his wife, Daphne Cruikshanks of Dartmouth; brother, Terrence of Plymouth, England; stepmother, Jean Jackson; stepsister, Gayle Bates; stepbrothers, Greg (Bev) and David Jackson, all of Vancouver Island, B.C.; stepsister, Catherine (Bill) Knox of Kelowna, B.C.; sister-in-law, Robin Jackson of Ottawa, Ont.; sister-in-law, Margaret (Joe) of Maghergall, Northern Ireland, and many friends and extended family members. He was predeceased by his father, George Melrose Jackson of Vancouver Island, and mother, Eileen (Greenlaw).

Owen Lavin
with help from **Daphne Cruikshanks, Lynda Bloom**, and **Colin Dunn**

The AAG Needs You as a Councilor

Each year the Association of Applied Geochemists needs motivated and energetic AAG Fellows to stand for election to the position of “Ordinary Councilor”. Fortunately, each year some of our most outstanding Fellows are ready, willing, and able to meet this challenge. This is the annual article in **EXPLORE** summarizing the job and describing how one goes about getting on the ballot. It is our sincere hope that this might entice more Fellows to step forward for election to this most important position.

Job Description

The AAG By Laws state that “the affairs of the Association shall be managed by its board of directors, to be known as its Council”. The affairs managed by Council vary from reviewing and ranking proposals to host our biennial Symposium to approving application for new membership to developing marketing strategies for sustaining and growing our membership. These affairs are discussed and decisions made at Council teleconferences usually held 3-4 times per year. Each teleconference lasts about 90 minutes. In addition, there is often a running email discussion about a selected issue or two between each teleconference. So for a commitment of about 8 hours of your time per year, you can help influence the future of your Association. If you want to spend more than the minimum time required, there is plenty of opportunity to do so through committee assignments and voluntary efforts that greatly benefit the Association.

Qualifications and length of term

The only qualification for serving as Councilor is to be a Fellow in good standing with the Association. Please note the difference between being a Member of AAG and being a Fellow. A Fellow is required to have more training and professional experience than a Member. Consult the AAG web site, Membership section, for further details. If you are not currently a Fellow and have an interest in serving on Council, please go through the relatively painless process of converting to Fellowship status in AAG.

Each Councilor serves a term of two years and can then stand for election to a second two-year term. The By Laws forbid serving more than two consecutive terms, although someone who has served two consecutive terms can stand for election again after sitting out for at least one year. Elections are usually held in the fall of the year for a term covering the following two years. Our next election will be in the fall of 2010 for the term of 2011-2012.

How to get on the ballot

If you are interested in placing your name into consideration for election to AAG Council, simply express your interest to the AAG Secretary Dave Smith, (dsmith@usgs.gov) by August 31, 2010 and include a short (no more than 250 words) summary of your career experience. All that is asked is that you bring energy and ideas to Council and are willing to share in making decisions that will carry the Association forward into a successful future. We look forward to hearing from you.

David B. Smith
Secretary, Association of Applied Geochemists

The Association of Applied Geochemists

announces the

2010 AAG SGS Student Paper Competition

The AAG announces the 8th biennial Student Paper Competition. The paper must address an aspect of exploration geochemistry or environmental geochemistry related to mineral exploration and be based on research performed as a student. The student must be the principal author and the paper must have been published in ***Geochemistry: Exploration, Environment, Analysis*** no more than three years after completion of the degree, All eligible papers in 2009 and 2010 volumes of GEEA will be reviewed by the selection panel.

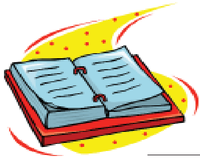
The winner will receive:

A cash prize of **$1000**CAD generously donated by **SGS Minerals Services.**

A 2-year membership of AAG, including the society's journal (GEEA), **EXPLORE** newsletter, publication of an abstract and CV of the winner, a certificate of recognition and **$500**US towards expenses to attend an AAG-sponsored meeting, courtesy of **AAG**.

The results of the 2010 competition will be announced at the 25th IAGS in mid 2011. Details are available from the chair of the committee or the AAG Students' page (http://www.applied geochemists.org/).

David Cohen
Chair, Student Paper Competition
Schools of BEES
The University of New South Wales
UNSW, NSW 2052 Australia
Email: d.cohen@unsw.edu.au



CALENDAR OF EVENTS

International, national, and regional meetings of interest to colleagues working in exploration, environmental and other areas of applied geochemistry. These events also appear on the AAG web page at: www.appliedgeochemists.org

2010

13-18-June 2010. Goldschmidt 2010, Knoxville TN USA. Website: www.goldschmidt2010.org

16-17-June 2010. International Uranium Conference (AusIMM), Adelaide Australia. Website: www.ausimm.com.au/uranium2010

21-24-June 2010. 11th International Platinum Symposium, Sudbury ON Canada. Website: http://11ips.laurentian.ca

27 Jun-2 July 2010. 27th Society for Environmental Geochemistry and Health, European Conference, Galway Ireland. Website: www.nuigalway.ie/segh2010

4-8 July 2010. Australian Earth Sciences Convention (AESC) 2010, Canberra Australia. Website: http://www.gsa.org.au/

7-11 July 2010. EMU School: High-resolution electron microscopy of minerals, Nancy France. Website: http://www.lcm3b.uhp-nancy.fr/emu10/ **Note: Link broken at press time**

25-30 July 2010. Gordon Research Conference — Green Chemistry , Davidson NC USA. Website: http://tinyurl.com/y4v4ot2

1-6 August 2010. Gordon Research Conference: Organic Geochemistry , Holderness NH USA. Website: http://tinyurl.com/yzgvra9

8-13 August 2010. Gordon Research Conference: Water & Aqueous Solutions, Holderness NH USA. Website: http://tinyurl.com/ygzed8g

15-18 August 2010. Uranium 2010, Saskatoon SK Canada. Website: http://www.metsoc.org/u2010

15-20 August 2010. Gordon Research Conference: Biomineralization, New London NH USA. Website: http://tinyurl.com/y7qzech

16-20 August 2010. Water-Rock Interaction XIII Symposium, Guanajuato, Mexico. Website: http://wril3.cicese.mx/

21-27 August 2010. International Mineralogical Association 20th General Meeting, Budapest Hungary. Website: http://www.ima2010.hu/

22-26 August 2010. 240th American Chemical Society National Meeting & Exposition, Boston MA USA. Website: http://tinyurl.com/y599cqy

1-4 September 2010. International Symposium: Geology of Natural Systems, Iasi, Romania. Website: http://tinyurl.com/yl7ap3d

5-10 September 2010 September 2010. 11th IAEG (International Assn. for Engineering Geology and the Environment) Congress, Auckland New Zealand. Website: http://www.iaeg2010.com

15-17 September 2010. 11th International Symposium on Environmental Radiochemical Analysis, Chester, UK. Website: http://tinyurl.com/yghqp3o

19-23 September 2010. Conference on Heavy Metals in the Environment, Gdansk, Poland. Website: www.pg.gda.pl/chem/ichmet/

19-24 September 2010. IWA World Water Congress and Exhibition, Montreal Canada. Website: http://www.iwa2010montreal.org

23-26 September 2010. Carpathian Balkan Geological Association XIX Congress , Thessaloniki, Greece. Website: http://www.cbga2010.org/

20-26 September 2010. Association of Environmental and Engineering Geologists 53rd Annual Meeting, Charleston SC USA. Website: http://tinyurl.com/y6dzelm

30 September-5 October 2010. SEG 2010 Conference, Keystone CO USA. Website: http://seg2010.org

31-October-3 November 2010. Geological Society of America Annual Meeting, Denver CO USA. Website: http://www.geosociety.org/meetings/2010/

5-9 November 2010. 36th International Symposium on Environmental Analytical Chemistry , Rome, Italy. Website: http://www.iseac36.it

5-10 December 2010. Northwest Mining Association 115th Annual Meeting, Exposition and Short Courses, Spokane WA USA. Website: http://tinyurl.com/y7loy9x

8-11 December 2010. 11th European meeting on Environmental Chemistry, Portorož, Slovenia. Website: http://www.ung.si/~emec11

2011

24-27 January 2011. Mineral Exploration Roundup 2011, Vancouver BC Canada. Website: http://www.amebc.ca/roundup/Roundup-2011.aspx

6-9 March 2011. Prospectors and Developers Association of Canada Annual Convention, Toronto ON Canada. Website: http://www.pdac.ca/pdac/conv/index.html

25-27-May 2011. GAC/MAC Annual Meeting , Ottawa ON Canada. Website: http://gacmacottawa2011.co/

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CALENDAR OF EVENTS

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20-24-June 2011. Frontiers in Environmental Geoscience 2011, Aberystwyth Wales UK. Website: http://tinyurl.com/yhyxllj

28 June-7 July 2011. XXV IUGG General Assembly: Earth on the Edge: Science for a Sustainable Planet, Melbourne, Australia. Website: http://www.iugg2011.com/

24-29 July 2011. 10th International Conference on Mercury as a Global Pollutant, Halifax NS Canada. Website: http://mercury2011.org/

14-19 August 2011. Goldschmidt 2011, Prague Czech Republic. Website: http://www.goldschmidt2011.org/index

22-26 August 2011. 25th International Applied Geochemistry Symposium, Rovaniemi Finland. Website: http://www.iags2011.fi/

1-8 August 2011. 10th International Congress for Applied Mineralogy, Trondheim Norway. Website: www.icam2011.org

9-12 October 2011. GSA 2011 Annual Meeting, Minneapolis MN USA. Website: http://www.geosociety.org/meetings/2011/index.htm

1-3 November 2011. 8th Fennoscandian Exploration and Mining , Levi Finland. Website: http://fem.lappi.fi/en

21-24 November 2011. Conference on Arsenic in Groundwater in Southern Asia, Hanoi, Vietnam. Website: http://tinyurl.com/y3jf9vh

2012

6-11 February 2012. 10th International Kimberlite Conference, Bangalore India. Website: http://10ikcbangalore.com/

28-30-May 2012. GAC/MAC Annual Meeting , St. Johns NL Canada. Website: www.stjohns2012.ca

5-15 August 2012. 34th International Geological Congress, Brisbane Australia. Website: http://www.34igc.org/

17-20 September 2012. Geoanalysis 2012, Buzios Brazil. Website: http://www.ige.unicamp.br/geoanalysis2012/

Please let us know of your events by sending details to:
Steve Amor
Geological Survey of Newfoundland and Labrador
P.O. Box 8700, St. John's NL Canada A1B 4J6
Email: StephenAmor@gov.nl.ca
709-729-1161

RECENT PAPERS

This list comprises titles that have appeared in major publications since the compilation in **EXPLORE** Number 147, June 2010. Journals routinely covered and abbreviations used are as follows: Economic Geology (EG); Geochimica et Cosmochimica Acta (GCA); the USGS Circular (USGS Cir); and Open File Report (USGS OFR); Geological Survey of Canada papers (GSC paper) and Open File Report (GSC OFR); Bulletin of the Canadian Institute of Mining and Metallurgy (CIM Bull.): Transactions of Institute of Mining and Metallurgy, Section B: Applied Earth Sciences (Trans. IMM). Publications less frequently cited are identified in full. Compiled by L. Graham Closs, Department of Geology and Geological Engineering, Colorado School of Mines, Golden, CO 80401-1887, Chairman AEG Bibliography Committee. Please send new references to Dr. Closs, not to **EXPLORE.**

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GAC® SCN 18: $80.00

This volume is a companion to a drift exploration short course conducted at the Geological *Association* of Canada (GAC) 2007 Meeting in Yellowknife. The short course and this publication was sponsored by the Mineral Deposits Division of the GAC with additional sponsorship from the Alberta Geological Survey, Geological Survey of Canada, Overburden Drilling Management Limited, Apex Geoscience Limited and Shear Minerals Limited. The authors represent a wide range of specialties and possess many years of experience in their particular fields of interest. Federal and provincial geological surveys as well as academia and the exploration industry have all contributed to this volume.

Senior Authors (Alphabetical)

Stu A. Averill (Overburden Drilling Management Limited)

Janet E. Campbell (Saskatchewan Northern Geological Survey)

Travis Ferbey (British Columbia Geological Survey)

David Hozjan (Overburden Drilling Management Limited)

Ray E. Lett (British Columbia Geological Survey)

Isabelle McMartin (Geological Survey of Canada)

Roger C. Paulen (Alberta Geological Survey/Geological Survey of Canada)

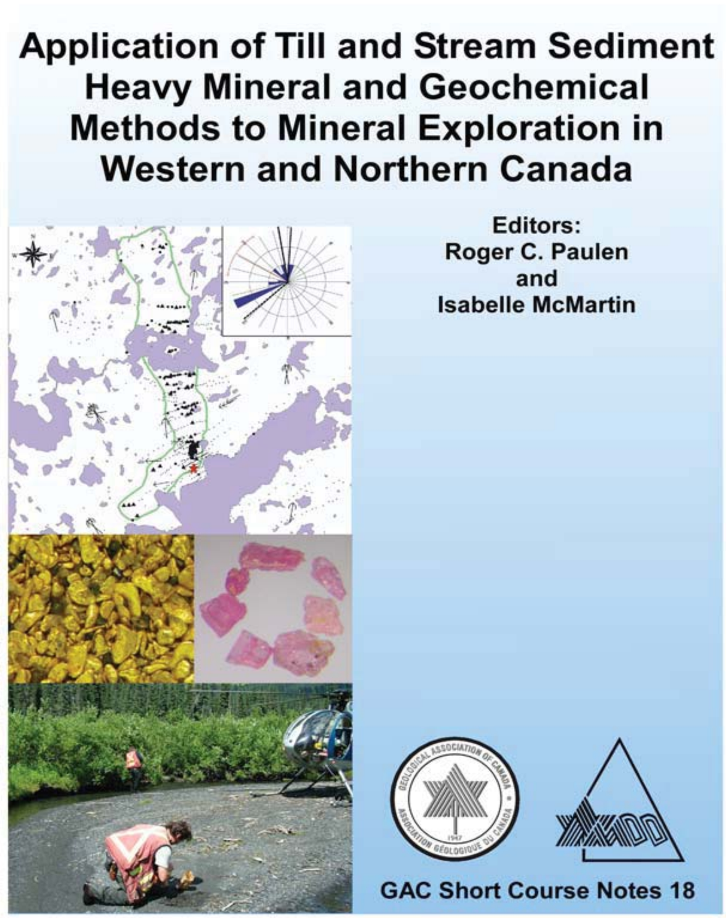
Glen Prior (Alberta Geological Survey)

Cliff R. Stanley (Acadia University)

Ralph R. Stea (Quaternary Consultant)

Pamela Strand (Shear Minerals Limited)

L. Harvey Thorleifson (Minnesota Geological Survey)



Editors:
Roger C. Paulen, Northern Canada Division, Geological Survey of Canada
601 Booth Street, Ottawa, Ontario K1A 0E8

Isabelle McMartin, Northern Canada Division, Geological Survey of Canada
601 Booth Street, Ottawa, Ontario K1A 0E8

Full Reference:
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continued on page 22

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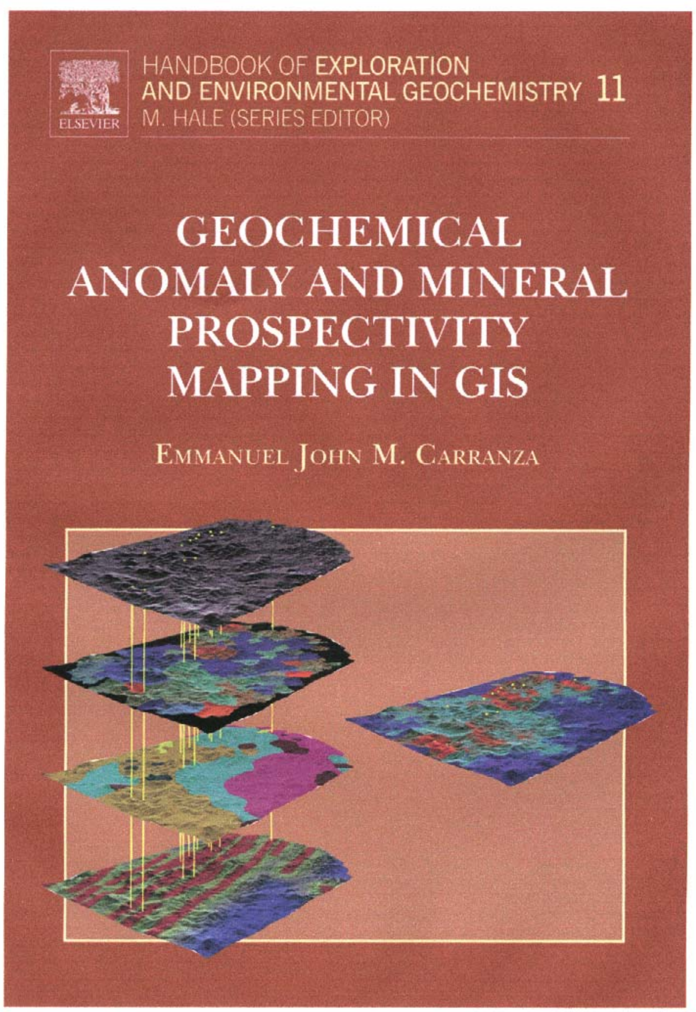

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AAG Website Update

Proceedings from the 24th International Applied Geochemistry Symposium in Fredericton, New Brunswick, Canada on June 1-4, 2009 are now posted on the AAG Website main page and are available for download as pdf files.

The AAG website is always in need of new items for the 'What's News' webpage that describes AAG member activities. Just provide a photograph in JPG format, a short description of the activity, or who is in the photo, and a date to Bob Eppinger (eppinger@usgs.gov) or Dave Lentz (dlentz@unb.ca).

Bob Eppinger
AAG Website Chair

Association of
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Editor: Beth McClenaghan (bmcclena@nrcan.gc.ca)
Business Manager:
Sarah Lincoln, (604) 615-8629 (explorenewsletter@gmail.com)
Back Issues contact: Betty Arseneault (office@appliedgeochemists.org)

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