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Introduction

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The Digital Mapping Techniques '09 (DMT'09) workshop was attended by 90 technical experts from 42 agencies, universities, and private companies, including representatives from 24 State geological surveys (see Appendix A). This workshop, hosted by the West Virginia Geological and Economic Survey, May 10-13, 2009, on the West Virginia University campus in Morgantown, West Virginia, was similar in nature to the previous 12 meetings (see Appendix B). The meeting was coordinated by the National Geologic Map Database project. As in the previous meetings, the objective was to foster informal discussion and exchange of technical information. It is with great pleasure that I note that the objective was again successfully met, as attendees continued to share and exchange knowledge and information, and renew friendships and collegial work begun at past DMT workshops.

At this meeting, oral and poster presentations and special discussion sessions emphasized (1) methods for creating and publishing map products (here, "publishing" includes Web-based release); (2) field data capture software and techniques, including the use of LiDAR; (3) digital cartographic techniques; (4) migration of digital maps into ArcGIS Geodatabase format; (5) analytical GIS techniques; and (6) continued development of the National Geologic Map Database.

Acknowledgments

I thank the West Virginia Geological and Economic Survey (WVGES) and the Director and State Geologist, Michael Hohn, for hosting this meeting. I especially wish to thank Scott and Jane McColloch for coordinating all of the events. Scott and Jane have been a part of the DMT meeting series for many years, their contributions to its success are great, and it's always a pleasure to work with them. Many other members of the WVGES and West Virginia University provided important assistance that ensured the meeting's success, I am indebted to them. They are John M. Bocan, John D. May, Michael A. Kirk, Susan C. Kite, Robert and Abraham Johnson, Gary W. Daft, Evan J. Moser, James M. Horner, Paula J. Hunt, Sarah E. Gooding, Jennifer L. Stump, Susan E. Pool, Jeanne M. Sutton, Keri L. Wilson, Gloria J. Rowan, Katherine L. Avary, Mary C. Behling, Thomas E. Repine, and Judith A. Sparks (WVGES), and Gregory A. Elmes, Timothy A. Warner, J. Steven Kite, Randy D. Crowe, Eric J. Hopkins, Frank LaFone, Tracye J. Tennant, and Hope M. Stewart (WVU Department of Geology and Geography).

Last, but not least, I thank all attendees for their participation; their enthusiasm and expertise were the primary reasons for the meeting's success.

Presentations and Posters

The workshop included 17 oral presentations, 3 discussion sessions, and 23 posters. Many are supported by a paper contained in these Proceedings. The papers describe technical and procedural approaches that currently meet some or all needs for digital mapping at the respective agency. There is not, of course, a single "solution" or approach to digital mapping that will work for each agency or for each program or group within an agency; personnel and funding levels, and the schedule, data format, and manner in which we must deliver our information to the public require that each agency design its own approach. However, the value of this workshop and other forums like it is through their roles in helping to design or refine these agency-specific approaches to digital mapping and to find applicable approaches used by other agencies.

In other words, communication helps us to avoid having to "reinvent the wheel."

During the course of the 13 annual DMT meetings, it has been my pleasure to meet, and work with, the many talented people who have authored papers in these Proceedings. As the subjects addressed by the DMT meetings have become even more essential to the Nation's geological surveys, the demands placed on them have risen to the point where many authors scarcely have time to address their work fully. Predictably, less time is then available to compose written summaries of their work; I'm sure the readers (or at least other editors) can sympathize with this predicament. Therefore, I include with this Introduction a list of all presentations and posters (Appendix C). If the reader finds an interesting title that isn't recorded in these Proceedings, I encourage the reader to contact the authors directly. Further, some presentations and related information are available for download at *http://ngmdb.usgs.gov/Info/dmt/DMT09presentations.html*.

The Next DMT Workshop

The 14th annual DMT meeting will be held in the spring of 2010 in Sacramento, California. Please consult the Web site (*http://ngmdb.usgs.gov/Info/dmt/*) for additional information about this and other DMT meetings.

Appendix A. List of Workshop Attendees

[Grouped by affiliation]

American Association of Petroleum Geologists
Jingyao Gong

Alaska Division of Geological and Geophysical Surveys
Jennifer E. Athey

Arizona Geological Survey
Ryan Clark
Steven M. Richard

Auburn University
Bart Davis

British Geological Survey
Jeremy Giles
Colm J. Jordan

Canaan Valley Institute
Paul Kinder
Janette McNeer

Colorado Geological Survey
Dave Noe

Colorado State University (National Park Service Cooperator)
Ronald D. Karpilo
Stephanie A. O'Meara

Delaware Geological Survey
John A. Callahan
William S. Schenck

ESRI
Janel Day
Charlie Frye
Willy Lynch

Fugro-William Lettis & Associates, Inc.
Mark Zellman

Georgia DNR - Environmental Protection Division
John Costello

Geological Survey of Alabama
Philip Dinterman

Geological Survey of Canada
Parm Dhesi
Vic Dohar
Phil O'Regan

Government of Newfoundland and Labrador
Larry Nolan

Idaho Geological Survey
Jane Freed
Loudon Stanford

Illinois State Geological Survey
Don McKay

Kansas Geological Survey
Bill Harrison

Kentucky Geological Survey
Gerald A. Weisenfluh

Louisiana Geological Survey
Robert Paulsell

Maine Geological Survey
Bob Marvinney

Michigan Office of Geological Survey
John Esch

Missouri Division of Geology and Land Survey
Cheryl Seeger

National Park Service, Geologic Resources Division
Andrea Croskrey
Georgia Hybels

Ohio Geological Survey
Paul Hoeffler
James McDonald
Donovan Powers

Oregon State Department of Geology and Minerals Industries
Jed T. Roberts
Sarah Robinson
Mathew Tilman

Pennsylvania Geological Survey
Jaime Kostelnik
Victoria Neboga
Tom Whitfield

South Carolina Geological Survey
Scott Howard

Techna-Graphics, Inc.
David Mecklenburg

University of Tennessee, Knoxville
Andrew W. Wunderlich

The University of Alabama
Doug Behm

U.S. Geological Survey
Stafford Binder
Pete Chirico
Mary DiGiacomo-Cohen
Dan Doctor
Joe East
Tracey Felger
Christopher P. Garrity
Linda Gundersen
Rich Harrison
Ralph Haugerud
Linda Jacobsen
Peter Lyttle
Tim Miller
Craig Neidig
Randall Orndorff
Frances Pierce
David R. Soller
Nancy R. Stamm
Byron Stone
Dave Weary

Minnesota Geological Survey
Richard Lively

USDA Forest Service--Minerals and Geology Management
Courtney Cloyd

Utah Geological Survey
Kent Brown

Vincennes University
Adam M. Davis

Virginia Division of Geology and Mineral Resources
Amy Gilmer

West Virginia Geological and Economic Survey
John Bocan
Gary Daft
Sarah Gooding
Jamie Horner
Paula Hunt
Bob Johnson
Susan Kite
Jane McColloch
Scott McColloch, Jr.
Evan Moser
Susan Pool
Jenny Stump
Keri Wilson

West Virginia GIS Technical Center
Eric Hopkins

West Virginia University Department of Geology and Geography
Greg Elmes

Wisconsin Geological Survey
Kathy Roushar

Appendix B. Previous Digital Mapping Techniques workshops

1997:
Hosted by the Kansas Geological Survey, Lawrence, Kansas, June 2-5. 73 technical experts attended, from 30 State geological surveys, the USGS, and the Geological Survey of Canada.

Soller, D.R., ed., 1997, Proceedings of a workshop on digital mapping techniques: Methods for geologic map data capture, management, and publication: U.S. Geological Survey Open-File Report 97-269, 120 p., *http://pubs.usgs.gov/of/of97-269/*.

1998:
Hosted by the Illinois State Geological Survey in Champaign, Illinois, May 27-30. More than 80 technical experts attended, mostly from the State geological surveys and the USGS.

Soller, D.R., ed., 1998, Digital Mapping Techniques ‘98—Workshop Proceedings: U.S. Geological Survey Open-File Report 98-487, 134 p., *http://pubs.usgs.gov/of/of98-487*/.

1999:
Hosted by the Wisconsin Geological and Natural History Survey in Madison, Wisconsin, May 19-22. 91 selected technical experts from 42 agencies, universities, and private companies attended, including representatives from 30 State geological surveys.

Soller, D.R., ed., 1999, Digital Mapping Techniques ‘99—Workshop Proceedings: U.S. Geological Survey Open-File Report 99-386, 216 p., *http://pubs.usgs.gov/of/of99-386/front.html*.

2000:
Hosted by the Kentucky Geological Survey in Lexington, Kentucky, May 17-20. 99 technical experts from 42 agencies, universities, and private companies attended, including representatives from 28 State geological surveys.

Soller, D.R., ed., 2000, Digital Mapping Techniques ‘00—Workshop Proceedings: U.S. Geological Survey Open-File Report 00-325, 209 p., *http://pubs.usgs.gov/of/of00-325*/.

2001:
Hosted by the Geological Survey of Alabama, in Tuscaloosa, Alabama, May 20-23. 108 technical experts from 48 agencies, universities, and private companies attended, including representatives from 31 State geological surveys.

Soller, D.R., ed., 2001, Digital Mapping Techniques ‘01—Workshop Proceedings: U.S. Geological Survey Open-File Report 01-223, 248 p., *http://pubs.usgs.gov/of/2001/of01-223/*.

2002:
Hosted by the Utah Geological Survey, in Salt Lake City, Utah, May 19-22. More than 100 technical experts from 40 agencies, universities, and private companies attended, including representatives from 30 State geological surveys.

Soller, D.R., ed., 2002, Digital Mapping Techniques ‘02—Workshop Proceedings: U.S. Geological Survey Open-File Report 02-370, 214 p., *http://pubs.usgs.gov/of/2002/of02-370/*.

2003:
Hosted by the Pennsylvania Geological Survey, in Millersville, Pennsylvania, June 1-4. Nearly 90 technical experts from 36 agencies, universities, and private companies attended, including representatives from 22 State geological surveys.

Soller, D.R., ed., 2003, Digital Mapping Techniques ‘03—Workshop Proceedings: U.S. Geological Survey Open-File Report 03-471, 262 p., *http://pubs.usgs.gov/of/2003/of03-471/*.

2004:
Hosted by the Oregon Department of Geology and Mineral Industries, in Portland, Oregon, May 16-19. Nearly 100 technical experts from 40 agencies, universities, and private companies attended, including representatives from 22 State geological surveys.

Soller, D.R., ed., 2004, Digital Mapping Techniques ‘04—Workshop Proceedings: U.S. Geological Survey Open-File Report 2004-1451, 220 p., *http://pubs.usgs.gov/of/2004/1451/*.

2005:
Hosted by the Louisiana Geological Survey, in Baton Rouge, Louisiana, April 24-27. More than 100 technical experts from 47 agencies, universities, and private companies attended, including representatives from 25 State geological surveys.

Soller, D.R., ed., 2005, Digital Mapping Techniques ‘05—Workshop Proceedings: U.S. Geological Survey Open-File Report 2005-1428, 268 p., *http://pubs.usgs.gov/of/2005/1428*/.

2006:
Hosted by the Ohio Geological Survey, in Columbus, Ohio, June 11-14. More than 115 technical experts from 51 agencies, universities, and private companies attended, including representatives from 27 State geological surveys.

Soller, D.R., ed., 2007, Digital Mapping Techniques ‘06—Workshop Proceedings: U.S. Geological Survey Open-File Report 2007-1285, 217 p., *http://pubs.usgs.gov/of/2007/1285/*.

2007:
Hosted by the South Carolina Geological Survey, in Columbia, South Carolina, May 20-23. More than 85 technical experts from 49 agencies, universities, and private companies attended, including representatives from 27 State geological surveys.

Soller, D.R., ed., 2008, Digital Mapping Techniques ‘07—Workshop Proceedings: U.S. Geological Survey Open-File Report 2008-1385, 140 p., *http://pubs.usgs.gov/of/2008/1385/*.

2008:
Hosted by the Idaho Geological Survey, in Moscow, Idaho, May 18-21, 2008. More than 100 technical experts from 39 agencies, universities, and private companies attended, including representatives from 19 State geological surveys.

Soller, D.R., ed., 2009, Digital Mapping Techniques ‘08—Workshop Proceedings: U.S. Geological Survey Open-File Report 2009–1298, 217 p., *http://pubs.usgs.gov/of/2009/1298/*.

Appendix C. List of Oral and Poster Presentations, and Discussion Sessions

Oral Presentations

Overview of West Virginia's Geology
By Scott McColloch, Jr. (West Virginia Geological and Economic Survey)

Building a National Archive – Standards Development and the U.S. National Geologic Map Database
By David R. Soller and Nancy R. Stamm (U.S. Geological Survey)

A Practitioner's Guide to Managing Geoscience Information
By Jeremy Giles (British Geological Survey)

Building an Enterprise Geotechnical Database to Support Geologic Mapping Activities
By Gerald A. Weisenfluh (Kentucky Geological Survey)

Semi-automated mapping of surficial geologic deposits from digital elevation models (DEMs) and hydrologic network data
By Peter G. Chirico (U.S. Geological Survey)

ESRI Cartographic Representations for the FGDC Digital Cartographic Standard for Geologic Map Symbolization
By Charlie Frye and Janel Day (ESRI)

USGS Topographic Maps from The National Map
By Stafford Binder, Greg Allord, and Michael J. Cooley

A New Delaware DataMIL and Delaware DataMIL topographic maps that replace USGS topo maps for Delaware
By William S. Schenck (Delaware Geological Survey)

Lidar based DEM slope-shapes – seeing through the canopy
By Thomas G. Whitfield (Pennsylvania Geological Survey)

Discussion Session: "Acquiring high-quality digital base maps"
Geologic mapping projects now depend on digital base maps rather than the standard paper (or Mylar) base map of the past, and significantly more effort is now needed to acquire the base map. There are many sources for digital base maps, many methods of creating them, and their quality is uneven. Easy access to standardized, high-quality digital base map layers (perhaps including, but not limited to, LIDAR) is desirable; this session addressed the technical issues and attempted to provide guidance to management.

SIGMAmobile, the British Geological Survey digital field mapping system in action
By Colm J. Jordan (British Geological Survey)

A Desktop Analysis of Proposed Wind Farm Sites; Southeastern and Coastal California
By Mark Zellman, Chris Hitchcock, Ranon Dulberg, and David Slayter (William Lettis & Associates)

Using Google tools to aid geologic mapping in a low-relief karst terrain, northern Virginia
By Daniel Doctor (U.S. Geological Survey) and Katarina Doctor (George Mason University)

Credit where credit's due: developing authorship strategies at the Journal of Maps
By Mike J. Smith (Kingston University, U.K.), and Colm J. Jordan and Jenny C. Walsby (British Geological Survey)

Improving ArcGIS workflow through automation using VBA
By Andrew L. Wunderlich (University of Tennessee, Knoxville)

Mapping Exercises for Freshmen and Sophomore College Students
By Adam M. Davis (Vincennes University)

Web Map Services and Catalog Services in the U.S. Geoscience Information Network
By Stephen M. Richard (Arizona Geological Survey / U.S. Geological Survey)

Why doesn't your model pass information to mine?
By Jeremy Giles and Holger Kessler (British Geological Survey)

Discussion Session: "NCGMP09 – a proposed standard format for publication of geologic maps"
This database design addresses the critical need to produce simple yet useful GIS products for individual geologic maps. The design was released at this meeting, with request for evaluation and refinement. This session was one outcome of the DMT'08 Discussion Session "Can we develop national standards and guidelines for geologic map databases?"

Discussion Session: "Cartographic Design and Map Production"
An informal time to show maps and to discuss map design and preparation techniques. This session included a GSA-style "Map Blast" (an informal display of posters) and a group discussion.

Poster Presentations (listed alphabetically, by author):

Shepherding geologic data from the outcrop to publication (and beyond?)
By Jennifer E. Athey and DGGS staff (Alaska Division of Geological & Geophysical Surveys)

Approaches to Implementing OGC Web Map Services
By Ryan Clark (Arizona Geological Survey)

Creation of Digital Geologic Data for Pecos National Historical Park
By Andrea Croskrey and Georgia Hybels (National Park Service, Geologic Resources Division)

Converting Geologic Maps from Paper to Vector Format
By Richard B. Davis, Mark Steltenpohl, and Luke J. Marzen (Auburn University)

BeeGIS – a new open source and multiplatform mobile GIS
By Mauro De Donatis and Andrea Antonello (University of Urbino), Luca Lanteri (ARPA Piemonte), and Sara Susini (University of Urbino)

Demonstration of the Alluring Experience of Interactive Pen-On-Screen Mapping
By Mary DiGiacomo-Cohen (U.S. Geological Survey)

An Atlas of Unconventional Petroleum Resources in the Continental United States
By Evan Fedorko, Eric Hopkins, Frank Lafone, Denyse Wyskup, Kurt Donaldson, and Xiannian Chen (West Virginia University)

Database of the Geologic Map of North America
By Christopher P. Garrity and David R. Soller (U.S. Geological Survey)

Overcoming Cartographic and Technical Challenges in Developing an Interactive Mapping System for the Appalachian Basin Tight Gas Reserviors Project
By Sarah Gooding, Susan Pool, John Bocan (West Virginia Geological and Economic Survey)

Ohio Underground Mine Map Georeferencing Project
By Paul D. Hoeffler and Christopher P. Gordon (Ohio Division of Geological Survey)

A Geologic Resources Inventory of Our National Parks
By Ronald D. Karpilo, Stephanie A. O'Meara, Trista L. Thornberry-Ehrlich, Heather I. Stanton, and James R. happell (Colorado State University)

Minnesota Geological Survey information systems
By Richard Lively and Harvey Thorleifson (Minnesota Geological Survey)

New GIS tools for mapping Ohio Lake Erie Coastal Erosion Areas
By James McDonald, Paul Harbulak (Ohio Division of Geological Survey), and Scudder D. Mackey (Habitat Solutions NA)

Landscape Visualization through Lidar for Natural Stream Design
By Janette McNeer (Canaan Valley Institute)

Legacy Maps to GIS Vector Data -- Enabling Printing and Other Digital Applications
By David Mecklenburg (Techna-Graphics, Inc.)

Development of an ArcGIS map template to support standard geologic map production in Kentucky
By Mike Murphy (Kentucky Geological Survey)

NCGMP09 – a proposed standard format for digital publication of geologic maps
By National Geologic Map Database Project and Pacific Northwest Geologic Mapping Project (U.S. Geological Survey)

The OGC Catalog Service for the Web – what is it and how can we use it?
By Stephen M. Richard (Arizona Geological Survey)

Feature Extraction from High-Resolution Lidar – The Next Generation of Base Maps
By Jed Roberts, Sarah Robinson, Mathew Tilman, John English, Ian Madin, Rudie Watzig, and Bill Burns (Oregon Department of Geology and Mineral Industries)

The Cookie Cutter: a method for obtaining a quantitative 3D description of glacial bedforms
By Mike J. Smith (Kingston University, U.K.), James Rose (University of London), and Michael B. Gousie (Wheaton College, USA)

Map Database for Surficial Materials in the Conterminous United States
By David R. Soller, Marth C. Reheis, Christopher P. Garrity, and Darren R. Van Sistine

The National Geologic Map Database
By David R. Soller and Nancy R. Stamm (U.S. Geological Survey)

Surficial Material and Bedrock Geologic Mapping at the Missouri Department of Natural Resources, Division of Geology and Land Survey
By Edith Starbuck (Missouri Department of Natural Resources, Division of Geology and Land Survey)