DIGITAL MAPPING TECHNIQUES 2020

The following was presented at DMT’20
(June 8 - 10, 2020 - A Virtual Event)

The contents of this document are provisional

See Presentations and Proceedings from the DMT Meetings (1997-2020)

http://ngmdb.usgs.gov/info/dmt/
Modifications to Geologic Mapping Schema (GeMS) to support regional compilation: An example from the USGS Geologic Framework of the Intermountain West project

Project overview

- Transect along 37° (N) from Great Plains to Sierra Nevada
  - Equivalent to 14,1° X 2° (1:250K) quadrangles

- Assemble seamless, integrated geologic map database to support hazard and resource assessment and research objectives
- Provide regional framework for subsurface model interpretation
Multi-map, Multi-scale
• Strictly honors original source mapping

• Map units not necessarily integrated across boundaries

Seamless regional coverage
• New interpretive lines are generated from original source maps

• Features are continuous across map and administrative boundaries

From Muehlberger, 1967; Steven and others, 1976
Summary of GeMS modifications

• Feature-level documentation of compilation processes and data sources

• Independent surficial and bedrock datasets

• Partition descriptive information into fields

• Method for organizing and maintaining unique map units
Data model

- **ESRI environment**—SDE geodatabase (although shown here as a file geodatabase)
- Independent surficial and bedrock data structure—No topologic relationship between them
- **MapUnitLines**—feature class with both line and map unit attributes
- Drop use of GeologicLines in favor of thematically specific line feature classes
DataSources and CompilationMethod

DataSources

<table>
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<tr>
<th>Authors</th>
<th>Year</th>
<th>Title</th>
<th>Publisher</th>
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<tbody>
<tr>
<td>Maldonado, F., Miggins, D.P., Budahn, J.R., and Spell, T.</td>
<td>2013</td>
<td>Deformational and erosional history for the Abiquiu and contiguous area, New Mexico Geological Society of America Special Paper</td>
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<th>Pages</th>
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<td>155-168</td>
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CompilationMethod

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<td>COM1</td>
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<tr>
<td>Compiled unmodified from sources cited in DataSource field</td>
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<td>COM2</td>
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Feature-level attribution

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Partitioning descriptive attributes

• Process and Materials
  • DepositGeneral; DepositMaterial (3 fields); DepositType (3 fields)

• Age
  • ChronoStratAgeMin; ChronoStratAgeMax
  • NumAgeMin; NumAgeMax; NumAgeMethod; NumAgeSource
  • **Seamless database will eventually be integrated with the national geochronologic database**
Surficial vs bedrock units

Surficial

• Unconsolidated sediment

• Usually Quaternary (not a requirement)

• Generally undeformed
Surficial vs bedrock units

**Surficial**
- Unconsolidated sediment
- Usually Quaternary (not a requirement)
- Generally undeformed

**Bedrock**
- Sedimentary, igneous, metamorphic rocks
- All volcanic rocks (regardless of age) including sedimentary deposits directly associated with volcanic processes
Characterization of surficial deposits

From Maldonado, 2008 (Abiquiu, NM: 1:24K)

From Koning and others, 2004 (Medanales, NM: 1:24K)
Surficial deposits

Categorize by process: DepositGeneral

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>alluvium</td>
<td>groundwater / spring discharge deposits</td>
</tr>
<tr>
<td>alluvium / colluvium</td>
<td>playa, lake, wetland deposits</td>
</tr>
<tr>
<td>glacial deposits</td>
<td>water</td>
</tr>
<tr>
<td>eolian deposits</td>
<td>bedrock</td>
</tr>
<tr>
<td>mass wasting deposits</td>
<td>artificial fill</td>
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</table>
MapUnitPolys_Surficial

Doney, 1968
Bedrock units

**LIST OF MAP UNITS**

**VOLCANIC ROCKS**

- Qhd: Basaltic andesites Mačana cone (very Pleistocene)
- Tdan: Servite Basalt (Pleistocene)
- Toa: Olave andesite (Pleistocene)
- Tsb: Basaltic andesite of San Pedro Mesa (Miocene)
- Tact: Basaltic andesite and trachyandesite, undivided (Miocene)
- Tde: Andesite and dacite of San Pedro Mesa (Miocene)
- Thf: Hinsdale Formation (Oligocene)

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**Dakota Sandstone (Upper Cretaceous, Cenomanian)**

- **Kdt**: Twin Wells Tongue—Yellowish-gray (SY7/2-5/SY7/4), very fine grained to fine-grained sandstone, conglomeratic sandstone, and conglomerate. Thickness 10-30 ft (0-9 m). PINNEDALE AREA, PINNEDALE: 608109N 1061620W to 608129N 1061645W, and as much as 10 ft (3 m) south.
- **Kd**: Main body—Mostly light-grayish-yellow and very pale orange (10YR8/2) siliciclastic sandstone in cliff-forming beds as thick as 10 m and commonly bedded as much as 10 ft (3 m).

(Robertson, 2006: Pinedale, 1:24k)

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**National Geologic Map Database**

**Search Count: 3,662 Units**

(Ferguson and Osburn, 2012: Luera Mtns, 1:24k)

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**Basalt flows (Pliocene and Miocene)**

- **Tby**: Basalt (Pleistocene and Pliocene, 0.9–2.5 Ma)

(Ratte, 2001: Tularosa, 1:100k)

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**Basalt (Oligocene): Phenocryst-poor basaltic lava containing <5%, <2.5mm phenocrysts of olivine (typically altered to iddingsite), pyroxene, and sparse plagioclase. Matrix ranges from vitric to strongly crystalline with abundant plagioclase microlites. Thickness up to 300m.**

(Ulrich and others, 1984: Flagstaff, 1:250K)

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**Basalt flow (Upper Tertiary):** Medium- to dark-gray or black, holocrystalline, hard, vuggy, noritic, olivine basalt. Commonly has

(Scott, 1986: Springer, 1:100K)

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**VS.**

(Ulrich and others, 1984: Flagstaff, 1:250K)

(Rwucke and others, 2004: San Carlos, 1:125k)
Concept of geologic province

Tectonic, magmatic, or stratigraphic associations

Spatial and temporal characteristics

No fixed spatial boundaries

Include 3 GeolProvince fields

Ranked GeolProvince1

Cenozoic extension

Magmatism of uncertain association

Southern Rocky Mountains volcanic field

Cordilleran orogenic system
Hierarchy of GeolProvince fields

Cordilleran orogenic system
  └── Laramide province
      ├── Laramide province: Sevier foreland
      │    └── Sevier foreland
      │         └── Sevier foreland: Mesozoic back arc
      └── Mesozoic back arc
Hierarchy of GeoProvince fields

Cordilleran orogenic system

- Laramide province
  - Sevier foreland
    - Sevier foreland:
      - Mesozoic back arc
    - Mesozoic back arc
  - Laramide province:
    - Sevier foreland
    - Laramide subduction-related magmatism

GeoProvince1

GeoProvince2

GeoProvince3

- Raton Basin
  - El-Rito-Galisteo Basin
  - San Juan Sag
  - San Juan Sag: San Juan Basin
  - San Juan Basin
- Laramide subduction-related magmatism
  - Raton Basin: Western interior seaway
    - San Juan Basin: Western interior seaway
    - Western interior seaway
  - Late Jurassic epeirogenic uplift
    - Late Jurassic epeirogenic uplift:
      - Sundance Sea shoreline
      - Sundance Sea shoreline
      - Chinle depositional system
Map units and GeolProvince association

• Map unit **names** only need to be unique within a particular GeolProvince

• An individual **map unit** can only be associated with a single GeolProvince regardless of location
  • Like the Lava Creek B example
Map units and GeolProvince association

Unit is unique based on combination:
GeolProvince1-GeolProvince2-GeolProvince3-MapUnitName

<table>
<thead>
<tr>
<th>GeolProvince1</th>
<th>GeolProvince2</th>
<th>GeolProvince3</th>
<th>MapUnitName</th>
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<td>Bridgetimber Gravel</td>
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NonUnique MapUnitNames

- Informal unit names referring to lithology, color, or type of deposit (ex. basalt lava flow) can be nonunique within database, BUT must be unique with a GeolProvince

- Using hypothetical example of MapUnitName = basalt lava flow

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<th>GeolProvince1</th>
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<th>GeolProvince3</th>
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### Bedrock attributes

**MapUnitPolys_Bedrock**

**DescriptionOfMapUnits_Bedrock**

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Surficial, bedrock, and combined