NADM Variant Fact Sheet

Variant Name : NGMDB Object-oriented Kentucky Prototype
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Abstract

Metadata

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Date : 2001
URL :

Intention

This variant of the NADM 4.3 data model was created in 2001 by Brodaric and Hastings, with contributions from Weisenfluh, Wahl, and Soller. It was developed for the National Geologic Map Database Project (NGMDB; http://ncgmp.usgs.gov/ngmdbproject/) using digital geologic map information generated by the Kentucky Geological Survey under the National Cooperative Geologic Mapping Program's STATEMAP Component.

Category

The NGMDB Object-oriented Kentucky Prototype (NOKP) is a logical model that was implemented in General Electric–Smallworld's object-oriented GIS technology.

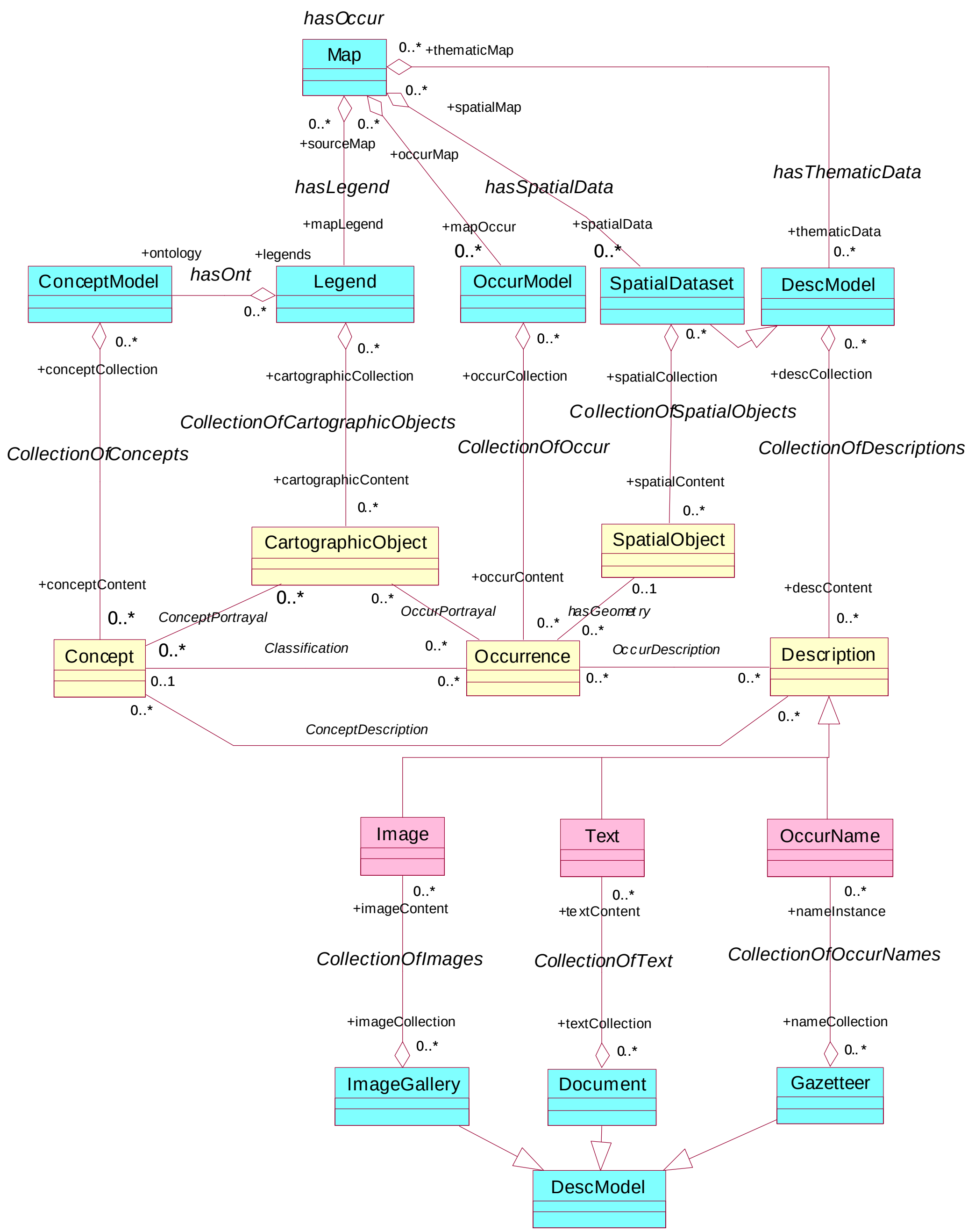
Summary

The NOKP project was undertaken to test the viability of creating a seamless map database consisting of a number of adjacent, edge-matched, 1:24,000-scale geologic maps. Project objectives were designed to evaluate an object-oriented data model implementation in GE Smallworld software for 1) storing large quantities of high-resolution vector data, 2) performing feature and concept generalization, 3) creating derivative classifications for spatial analysis, 4) integrating external databases, 5) exporting derived map views to external software, and 6) delivering this functionality through a Web interface.

Differences in the logical model compared to NADM 4.3 are, in most respects, similar to those of Cordlink (NADM 5.2). Metadata usage was expanded to all objects. Singular Object Archive (**SOA**) and Compound Object Archive (**COA**) are implemented as **Occurrences** of spatial objects and **Concept** classes, respectively, each having associated descriptions and metadata. Description classes are shared between both occurrences and concepts.

Diagram

(see associated PDF for full diagram)



Comparison

Conceptual differences

1. **Metadata**: Whereas version 4.3 restricted metadata to source maps, NOKP supports, via object-orientation, metadata for all database components, describing their authorship, lineage, spatial and temporal particulars (datums, projections, etc.), and quality indicators (error, resolution, uncertainty, variability, completeness, etc.). Every object in the data model possesses a metadata *role* which links the object to metadata *descriptions*, enabling metadata to be specified for any object in the meta-model.
2. **Occurrences and Classifications**: Version 4.3 (as well as all other variants) distinguishes between single spatial objects (SOA) and groups of objects with similar characteristics (COA). NOKP generalizes the notions of COA and SOA to that of *Concepts* and *Occurrences*. *Concepts* are definitional and *Occurrences* are instances of concepts, such as a formation and its map polygon instances. Occurrences need not be spatial objects, but may be related to a single spatial object; spatial objects may be associated with multiple occurrences to facilitate association of the spatial object with more than one classification (concept). Classifications are stored in *concept* classes that contain a simple set of descriptive attributes. The concept classes centralize the database vocabulary, and are therefore the repository for science language. Full attribution of concepts (and occurrences) is achieved through related descriptions, relationships, and metadata.
3. **Descriptions**: Version 4.3 provided for independent descriptions of singular objects and classifications. In the NOKP model, description classes are centralized for use with by both *concepts* and *occurrences*. Hence, the lithologic description of an outcrop location and for a geologic formation are managed by the same tables. Description classes are extensible in that new types can be easily added. Unlike NADM 4.3, descriptions can be related in NOKP, allowing for example, lithologies to be sequenced and proportioned.
4. **Cartography**: In version 4.3 a 'map' is a source document, whereas in NOKP a map is explicitly and indepently represented. Also, the notion of a legend in NOKP is simplified in that it consists of a set of symbolized concepts and uniquely symbolized instances; in contrast, a 4.3 legend also encompassed all the spatial objects being classified.
5. **Models**: In order to model a variety of collections of core data model objects (i.e. collections of concepts, occurrences, symbols, descriptions, and their relations) model objects are explicitly identified (i.e. models such as concept models, occurrence models, legends, spatial models, etc.)

Physical Differences

1. **Data Normalization**: Unlike relational data models that use foreign keys in tables to relate entities, NOKP relies on underlying system linkages, constructed during data loading, that are not visible to the user.

2. **Inheritance:** the GE SmallWorld implementation required custom programming to enable the physical implementation of subclasses wherever they occurred in the logical model.

Example

The example is based on a legend description extracted from:

Harald Drewes. 1998,. ARIZONA. Geologic map of the Bartlett Mountain Quadrangle, Pima and Santa Cruz counties, Arizona, I-2624**. Lat 31 deg 22'30" to 31 deg 30', long 111 deg 15' to 111 deg 22'30". Scale 1:24,000 (1 inch = 2,000 feet). Sheet 43 by 39 1/2 inches.**

***Dacitic Vent Breccia (Miocene)** —Light-medium-gray, finely porphyritic dacitic rock containing inclusions of Jurassic or Proterozoic granite and Jurassic rhyolite (welded tuff?) as much as 20 m in diameter. The subcircular outcrop mass of breccia probably is a volcanic vent or throat. A halo of strongly saussuritized rock 0.3 –0.5 km wide (delineated on map) surrounds this vent. The dacitic matrix consists of phenocrysts (25-35%, as much as 2 mm in length) set in a cryptocrystalline granular groundmass. Phenocrysts included albitized(?) plagioclase (12-18%), chloritized biotite (2-5%), uralized amphibole (2-10%), magnetite (trace to 2%), and apatite (trace). Quartz is present as a secondary mineral, filling vugs.*

*Magenta highlights in above paragraph not treated below
*Blue items not yet implemented in conceptual or logical model

Metadata

Map.metadata.meta_agency	USGS
Map.metadata.meta_authors	Drewes
Map.metadata.meta_pubdate	1998
Map.metadata.meta_pubissue	I-2624
Map.metadata.meta_title	Geologic map of the Bartlett Mountain Quadrangle, Pima & Santa Cruz counties, AZ

CartographicObjects

CartographicObject.cart_label	Mdv (example)
CartographicObject.cart_name	Dacitic Vent Breccia
CartographicObject.cart_id	100001 (example)

Symbol

CartographicObject.cart_id	100001
CMYK.color_C	56
CMYK.color_M	0
CMYK.color_Y	47
CMYK.color_K	34

Concepts

RockUnit.con_name	Dacitic Vent Breccia
StratTimeScale.con_name	Miocene
StratTimeScale.con_name	Proterozic
StratTimeScale.con_name	Jurassic
Lith_Class.con_name	Aphanitic.Felsic.Dacite
Lith_Class.con_name	Phaneritic.Felsic.Granite
Lith_Class.con_name	Aphanitic.Felsic.Rhyolite
Lith_Texture.con_name	porphyritic
Llith_Fabric.con_name	brecciated
Mineral.con_name	plagioclase
Mineral.con_name	biotite
Mineral.con_name	amphibole
Mineral.con_name	magnetite
Mineral.con_name	apatite
Mineral.con_name	quartz
Mineral.con_name	groundmass
etc.— for remaining blue items	

*Note : we are moving to storing all concepts within a single Concept object in further work.

Descriptions (for Dacitic Vent Breccia)

StratigraphicAge

StratigraphicAge.max_strat_name	Miocene
StratigraphicAge.min_strat_name	Miocene

LithDescription (Dacite)

LithDescription.rock_name	Dacite
LithDescription.lith_class	Aphanitic.Felsic.Dacite
LithDescription.lith_texture	porphyritic
LithDescription.lith_fabric	brecciated
LithDescription.lith_color	light gray
LithDescription.lith_color	medium grey

LithDescription (Granite)

LithDescription.rock_name	Granite
LithDescription.lith_class	Phaneritic.Felsic.Granite
LithDescription.max_size	20
LithDescription.size_unit	meters
LithDescription.lith_habit	inclusion
StratigraphicAge.max_strat_name	Proterozic
StratigraphicAge.min_strat_nam	Jurassic
StratigraphicAge.metaData.meta_certainty	low

LithDescription (Rhyolite)

LithDescription.rock_name	rhyolite
LithDescription.lith_class	Aphanitic.Felsic.Rhyolite
LithDescription.lith_genesis	welded tuff
LithDescription.max_size	20
LithDescription.size_unit	meters
LithDescription.lith_habit	inclusion
LithDescription.meta_certainty	low
StratigraphicAge.max_strat_name	Jurassic
StratigraphicAge.min_strat_name	Jurassic

MineralDescription (Plagioclase)

MineralDescription.mineral_name	plagioclase
MineralDescription.min_percent	12
MineralDescription.max_percent	18
MineralDescription.max_size	2
MineralDescription.size_unit	mm
MineralDescription.alteration	albitized
MineralDescription.meta_certainty	low

MineralDescription (Biotite)

MineralDescription.mineral_name	biotite
MineralDescription.min_percent	2
MineralDescription.max_percent	5
MineralDescription.max_size	2
MineralDescription.size_unit	mm
MineralDescription.alteration	chloritized

MineralDescription (Amphibole)

MineralDescription.mineral_name	amphibole
MineralDescription.min_percent	2
MineralDescription.max_percent	10
MineralDescription.max_size	2
MineralDescription.size_unit	mm
MineralDescription.alteration	uralized

MineralDescription (Magnetite)

MineralDescription.mineral_name	magnetite
MineralDescription.min_percent	trace
MineralDescription.max_percent	2
MineralDescription.max_size	2
MineralDescription.size_unit	mm

MineralDescription (Apatite)

MineralDescription.mineral_name	apatite
MineralDescription.min_percent	trace
MineralDescription.max_percent	2
MineralDescription.max_size	2
MineralDescription.size_unit	mm

MineralDescription (Quartz)

MineralDescription.mineral_name	quartz
MineralDescription.mineral_habit	vug filling

MineralDescription (Groundmass)

MineralDescription.mineral_name	groundmass
MineralDescription.max_size	cryptocrystalline
MineralDescription.size_unit	relative
MineralDescription.mineral_texture	granular

Relations

(MineralDescription—LithDescription)

Relation(Child)	**rel_role1**	**rel_type**	**rel_role2**	Relation(Parent)
MineralDescription(Plagioclase)	mineral	IsPartof	lithology	LithDescription (Dacite)
MineralDescription(Biotite)	mineral	IsPartof	lithology	LithDescription (Dacite)
MineralDescription(Amphibole)	mineral	IsPartof	lithology	LithDescription (Dacite)
MineralDescription(Magnitite)	mineral	IsPartof	lithology	LithDescription (Dacite)
MineralDescription(Apatite)	mineral	IsPartof	lithology	LithDescription (Dacite)
MineralDescription(Quartz)	mineral	IsPartof	lithology	LithDescription (Dacite)
MineralDescription(Groundmass)	mineral	IsPartof	lithology	LithDescription (Dacite)