An overview of semantic models in the geosciences: what do we have, and where are we going?

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What can we say about a “thing”?

In the geosciences:

• What descriptions have been published?
• Which languages are used?
• Which semantic technologies are prevalent?

i.e. What ontologies semantic models are available?
Affordance

Ontology

Logical Theory

Disjoint Subclass; Transitivity property

OWL Full Description Logics
OWL 2 DL
OWL 2 Profiles

UML

Higher-order Modal Logic
First-order Logic

Semantic Interoperability

Controlled Vocabularies (term-based)

Thesauri

ER

Narrower/Broader Than

Conceptual Model

Relational model; XML Schema

Extended ER

Synonyms,
Enhanced Search (recall),
cross indexing

Enterprise Modelling (system, service, data),
question-answering (improved precision),
Querying, SW Services

Domain Modelling,
Semantic Search,
Machine interoperability, Automated Reasoning, SW services

Syntactic Interoperability

Structural Interoperability

Ontology (weak)

Ontology (strong)

Expressivity

Semantic Expressivity

Controlled Vocabularies

RDF/S

Microdata; RDFa

Schema.org; RDFa-lite

OWL Full

OWL 2 Profiles

(weak)

(strong)

Domain Modelling,
Semantic Search,
Machine interoperability, Automated Reasoning, SW services

Adapted from Obrst, 2010
questions / concerns

• Where do we put Earth science ontologies once they have been created?
• Who owns the ontology once it is published?
• Do ontologies need a license?
• Who maintains the ontology once it's released into the wild; i.e. published or... portaled?
questions / concerns

• What is the process (or mechanism) by which geoscience ontologies are verified and validated (ontology efficacy)?

• Search, recovery, and "semantic awareness"

• How do we keep track of conceptual drift?
Overall, how is the geoscience semantics community governed?
What mechanisms are in place? What is needed?
a case for *deep* semantics

In the geosciences, it is not only important to capture and formalise *what* is known, but *how* it is known.

*deep*- as in deeply examining the conceptual structure and complexities of the domain in order to provide enough specificity in the concepts and relations that they are useful terms to differentiate complex but real situations (as they are found in research artefacts).
Ontologies are used to identify semantic connections in research artefacts (i.e., document collections).
Can we combine multiple layers for effective seismic amplitude modeling?
Geographical neighbourhood of an artefact, or set of artefacts

Looking for a location mentioned in a document? And the resources near it?
The geographic extent of an artefact coordinated with the highlighting of recognised concepts.
THE USE OF COMPLEX SEISMO REFLECTION ATTRIBUTES TO DELINEATE SUBSURFACE FRACTURE NETWORKS: AN EXAMPLE FROM TEPORO, WYOMING

References

Regional Reservoir Compartmentalization within offlapping.

References

Frequency

Powder River

Basin

Tectonics

References

Controls on gas and methane potential in coals of Indiana (Illinois Basin)

References

Perspectives and Queries

Potential Settings

Settings

Ontology Navigator

Web Browser
The Powder River Basin is a geologic region in southeast Montana and northeast Wyoming, about 120 miles (190 km) east to west and 200 miles (300 km) north to south, known for its coal deposits. The region supplies about 40 percent of the coal in the United States. It is also a topographic drainage and geomorphic structural basin. The basin is so named because it is drained by the Powder River, although it is also drained in part by the Cheyenne River, Tongue River, Big Horn River, Little Missouri River, Platte River, and their tributaries.

While the Powder River Basin is unified geologically, residents of areas distant from the Powder-River proper do not think of themselves as living in a single geographic region. For example, residents of the Crow Reservation in the Big Horn River watershed, or of Sheridan in the Tongue River watershed, would locate the Powder-River Basin as the region east of the Big Horn Mountains, using a definition based on watershed and topography.

Major cities in the area include Gillette and Sheridan, Wyoming, and Mills City, Montana. Outside of these main towns, the area is very sparsely populated and is known for its rolling grasslands and semiarid climate.