

## OneGeology Linked Open Data Workshop report

### Context

The **OneGeology Linked Open Data Workshop** has been organised to address a request from the OneGeology Board (OB) to investigate implementing Linked Open Data principles on the current OneGeology architecture. The workshop was hosted by the Austrian Geological Survey (*Geologische Bundesanstalt*) in their Vienna office on Wednesday, May 24<sup>th</sup> 2017. The workshop was chaired by T. Duffy (BGS) and facilitated by E. Boisvert (GSC).

Participants from United Kingdom, Austria, New Zealand, Australia, Italy, France, United States of America and Canada were either physically or remotely present. The complete list is provided in Annex A. The workshop has been recorded through GotoMeeting.

During the OneGeology Board meeting in Gdańsk, Poland [1GMB], Canada representative suggested to leverage Linked Open Data principles to improve OneGeology web integration.

**Table 1: Excerpt from Gdańsk Management board meeting notes**

**ACTION 10.10:**

*François Robida will raise the OneGeology 3D project within the OGC/CGI meetings. BB (Boyan Brodaric) requested that OneGeology in 2017 should investigate the application of Linked data techniques to existing OneGeology infrastructure such that in the future users could 'type into Google find me the 1:50k geology map of Britain' and it returns a link to that data/web service/metadata'. He would arrange for colleague Eric Boisvert to attend and lead a workshop on this topic for OneGeology.*

**ACTION 10.11:**

*François (Robida) requested that Tim Duffy as co-chair should arrange a OneGeology TIG (Technical Implementation Group) meeting in late May/June around the time of the GIC in Vienna and add this Linked data item to the agenda, then report back to the Board meeting in June.*

During the workshop, the goal of the TIG was a) to unfold the vision expressed by the board ("*Google*" that name of a map and find map, service or metadata about this map) and b) frame it in a Linked Open Data perspective. Because of the explicit mention of Linked Open Data (LOD), it was concluded that the vision was not a mere keyword indexation by search engine, but also a series of best practices to expose data to the web and improves its integration to the web.

Two documents recently published by W3C and OGC were used to guide the TIG discussions.

- [DWBP] Data on the Web Best Practices a W3C recommendation published in January 2017
- [SDWBP] Spatial Data on the Web Best Practices W3C Working Group Note 11 May 2017, that extends [DWBP] with best practices relevant to spatial data.

The documents were used to assess how the current OneGeology architecture compares to the best practices and find opportunities of improvements. A subset of relevant best practices was initially selected by the facilitator to scope the discussion. It has been proposed to focus on “Quick wins” that were identified in the documents that required minimal adjustments to the existing architecture. It is expected that those Use Cases would be prepared and presented to TIG and OB. This document contains a high level description of those Use Cases.

This workshop looked mostly at the technical aspect on implementing Linked Open Data principles.

## Agenda

- Introduction
  - Goals and Motivations
  - LOD
- Review of W3C and OGC Best practices. BP are from [DWBP] while SBP are from [SDWBP]
  - BP1 Provide metadata
  - BP9, SBP1 : Persistent URI / Unique global id
  - BP10: Use Persistent URI within dataset
  - BP14: Multiple formats
  - BP15/ SBP10: Reuse vocabularies (Lexicons?)
  - BP17: Bulk download
  - BP18: Subset of large dataset (Hypermedia)
  - BP19: Content Negotiation
  - BP22: Missing data
  - SBP2: Make it indexable
  - SBP12: API
- Discussion and recommendation of proposed Quick wins
- Actions

## Workshop results

The main part of the workshop was dedicated to discussion of a relevant subset of [DWBP] and [SDWBP] best practices. Discussion often jumped from one best practice to the other because of the strong

interdependencies. Table 2 provides discussed item and how they apply to OneGeology. BP{n} match [DWBP] best practices identifier while SBP{n} match [SDWBP].

Best practice	Description	Applicability
<b>BP1 Provide metadata</b>	Provide metadata for both human users and computer applications.	OneGeology is essentially a metadata catalog, but metadata is not exposed to the web. Discussions were about how to expose metadata to search engines.
<b>BP9, SBP1 : Persistent URI / Unique global id</b>	Identify each dataset by a carefully chosen, persistent URI. Use stable HTTP URIs to identify Spatial Things, re-using commonly used URIs where they exist and it is appropriate to do so.	OneGeology does not assign a persistent URI to maps, or any other resources, but does use URI for vocabularies terms from IUGS or INSPIRE. Discussion on how OneGeology helps insure governance for some of those URI.
<b>BP10: Use Persistent URI within dataset</b>	Reuse other people's URIs as identifiers within datasets where possible.	One Geology "Five Star" WFS services do use URI for vocabularies. Except URI are not exposed to the web directly, but only as WFS response. (a search engine would need to construct a WFS request to get to them). Discussion about GeoSciML as a hypermedia.
<b>BP14: Multiple formats</b>	Make data available in multiple formats when more than one format suits its intended or potential use.	OneGeology only officially supports GML (GeoSciML) for maximum interoperability, but nothing prevents data provider to offer other formats. The group recognised that there is more and more people asking for GeoJSON (which is often provided by Out of the box WFS servers). There is also the option of linking directly to packaged datasets directly in the GetCapability or metadata. There are still technical details to sort out because of the many ways multiple formats can be offered.
<b>BP15/ SBP10: Reuse vocabularies (Lexicons?)</b>	Use terms from shared vocabularies, preferably standardized ones, to encode data and metadata.	OneGeology uses CGI (and if necessary exact match INSPIRE European vocabularies), but this best practice has a wider scope than GeoSciML. It actually refers to LOD vocabularies (often known as Ontologies) that can be understood by search engines. This topic has been discussed. There might be way to leverage this when adding microdata to HTML landing pages.
<b>BP17: Bulk download</b>	Enable consumers to retrieve the full dataset with a single request.	OneGeology does not provide this functionality directly (relates to BP14), although it can be argued that WFS can be used to download the whole dataset. This BP precisely discourages hiding a dataset behind a complex API (such as WFS). WFS might not be able to deliver large datasets. There is a way to provide direct links in ISO-19115 (TransferOptions) using the current metadata catalog. WMS also has a DataURL that could be leveraged.
<b>BP18: Subset of large dataset (Hypermedia)</b>	If your dataset is large, enable users and applications to readily work with useful subsets of your data.	Mostly discussed in the perspective of using GeoSciML as an Hypermedia because it can reference to move content (such as geometries, see SBP5, exemple 17) < <a href="https://www.w3.org/TR/sdw-bp/#ex-anne-frank-building-rdf">https://www.w3.org/TR/sdw-bp/#ex-anne-frank-building-rdf</a> > . This is likely a consideration for future work.
<b>BP19: Content Negotiation</b>	Use content negotiation in addition to file extensions for	Group considered having a persistent URI for the concept of a map, but it was not clear what representations it should have once dereferenced.

	<p>serving data available in multiple formats</p>	<p>Assuming 1 map = 1 layer = 1 metadata record, one can assume that the HTML representation can be the HTML rendering of metadata. Otherwise, it has been proposed that another representation of a map could be a "Context" (such as WMC or OWSContext).</p>
<b>BP22: Missing data</b>	<p>For data that is not available, provide an explanation about how the data can be accessed and who can access it.</p>	<p>In the new version of GeoSciML, the "nillable" are now optional, but INSPIRE as a community needs some of them compulsory (INSPIRE profile uses schematron to enforce community nillables). This BP has a wider application to whole dataset and there were discussion on how to deal with retired dataset. BP suggests maintaining a tombstone page and to never recycle a persistent URI.</p>
<b>SBP2: Make it indexable</b>	<p>Search engines should be able to crawl spatial data on the Web and index Spatial Things for direct discovery by users.</p>	<p>OneGeology does not directly expose metadata and data to the crawlers. Exposing metadata is definitively a quick win, because there is not much to do, except figuring out the persistent identifier issue. This does not make the spatial data content indexable, but just the metadata about the dataset. SBP12 could be explored to expose the data itself.</p>
<b>SBP12: API</b>	<p>If you have a specific type of application in mind for your data, tailor a spatial data access API to meet that goal.</p>	<p>[SDWBP] proposes adding an alternative link data friendly API over WFS service, which expose features normally accessible through WFS complex requests. This idea did raise interest for further investigation.</p>

Each BP had potential for improvements of current OneGeology architecture, but many would require significant modifications. Two potential quick wins were already identified and the group agreed they are implementable; one in a very short term and the other in medium term. Although two BP were highlighted for discussion, the identified quick wins do not target any particular BP.

- 1) UC-META: Improve indexability of OneGeology content by exposing its metadata catalog to search engine.
- 2) UC-MAP: Provide a persistent URI for each map in OneGeology

Those two use cases still need to be fully fleshed out. They leverage several concepts discussed in best practices documents.

## UC-METADA: Indexability

### Goal

Expose all metadata record to search engines, so user can "Google" and find a map (or a layer) and once the user clicks on the link, he/she is led to a representation of a layer, a service or a map.

### Current support

OneGeology metadata are held in GeoNetwork, which provides the content to power the OneGeology portal. GeoNetwork support CSW (OGC Catalog Service for the Web) interface but is not widely advertised. OneGeology portal actually passes through a wrapper <http://onegeology-geonetwork.brgm.fr/geonetwork3/srv/eng/catalog.search#/home> which does not use CSW, although the CSW service is publically accessible.

GeoNetwork has a mechanism to expose a “sitemap”, which is a series of files listing all metadata record and provide a link for indexation engine to index each metadata document. This could be leveraged for search engine crawlers and improve discoverability. It was noted that this sitemap was not currently available from the current BRGM OneGeology Geonetwork 3 instance <http://onegeology-geonetwork.brgm.fr/geonetwork3/srv/eng/portal.sitemap?type=rdf> But only because of a firewall blocking issue that BRGM could easily solve? The sitemap was seen to be available from other global Geonetwork 3 instances including BGS’ <http://metadata.bgs.ac.uk/mica/srv/eng/portal.sitemap>.

In OneGeology, multiple representations of the metadata are available:

HTML: <http://onegeology-geonetwork.brgm.fr/geonetwork3/srv/eng/catalog.search#/metadata/e39920d6-7284-4c5f-aadc-97daaef37c5e>

XML: <http://onegeology-geonetwork.brgm.fr/geonetwork3/srv/eng/xml.metadata.get?uuid=e39920d6-7284-4c5f-aadc-97daaef37c5e>

GeoNetwork plugins can add more representations (JSON?)

The HTML probably needs some work, because the “add to map” button launches a Geonetwork map viewer (that does not work). It should instead launch the portal and load the layer (or even, display the map directly in the HTML page with the option of launching the full portal).

Note that metadata records do not exclusively documents layers, they can be technically anything (such as WFS service, or even documents). We should not make the assumption that each record represents a layer.

The best practices suggest that spatial data shall be indexed also, but so far this quick win will only concern metadata (and “map”) because the data composing the map itself must be exposed through WFS. SBP 12 could be used to extend to the data itself, but this would require significant more work from each data providers (or the portal itself). This functionality might be revisited on later time.

## *Recommendations*

UC-META.1 Create a single persistent URI for each metadata record

A single persistent URI shall link to a GeoNetwork entry through content negotiation to a (mandatory) HTML and (optionally) XML representation. The persistent URI shall represent a real world or abstract objects (a.k.a Non Information Resource) such as maps, layers, services or dataset. This will allow management of multiple representations (structures and formats) accessible through the same persistent URI.

E.G.:

Persistent URI

<http://onegeology.org/id/dataset/{uuid}>

HTML representation:

<http://onegeology-geonetwork.brgm.fr/geonetwork3/srv/eng/catalog.search#/metadata/{uuid}>

XML representation:

<http://onegeology-geonetwork.brgm.fr/geonetwork3/srv/eng/xml.metadata.get?uuid={uuid}>

Several organisations (or governances) propose a URL pattern for each resources type. Although this is not a technical requirement for LOD to work, it is often a convenience to help humans guessing the type of resource or to help the generation of unique URIs (the path structure acting as a namespace).

This recommendation implies that OneGeology must host some sort of content negotiation application to redirect client to the right representation.

#### UC-META.2 Expose persistent URI in sitemap

The GeoNetwork sitemap should expose the persistent URI, to make sure users discovering a resource access it through it's persistent URI.

GeoNetwork normally creates a list of URI using this syntax:

<http://onegeology-geonetwork.brgm.fr/geonetwork3/srv/eng/catalog.search#/metadata/{uuid}>

This is what search engines will catalog and it will register this URL instead of the persistent URL. Making sure the persistent URLs are indexed will allow addition of more representation without concerns about what the URI will eventually resolve. Note that search engine crawler will request the HTML version (will invoke content negotiation to get HTML). To expose persistent URL instead of the Geonetwork generated URL, the sitemap will need to be transformed (XSLT?).

### UC-META.3 Add relevant metadata into the HTML representation

Best practices suggest that every non information resource shall have a HTML “landing page” with special microdata and links to other resources representations. The HTML representation of the resource should content relevant metadata elements using a vocabulary well known to search engines, such as schema.org, RDFa or JSON-LD – or a combination of them (to be determined). Search engine can use this information to improve indexing. The data to fill those microdata field is expected to be already available from metadata records.

### UC-META.4 Make sure a link to service and/or dataset if provided in metadata record

ISO 19115 has a TransferOption property linking to various distribution of the dataset itself (including the wms layer). There are different ways to do this and the group did not come to an agreement on the details. This will fulfill BP17 and BP18.

### UC-MAP : Provide a persistent URI for each map in OneGeology

#### *Goal*

Create a new resource type in OneGeology called “maps” that combines a set of 1 to many WMS layers. Expose these maps as web resources under a persistent URI and provide useful representations.

#### *Current support*

The group discussed what a “map” meant in the context of OneGeology. OneGeology is a collection of services and layers and nothing prevents it to document other kind of resources. It has been suggested that the best representation of a “Map” is a collection of resources, including layers, legends, metadata and other document.

OWSContext [OWSC] seems to provide an ideal container for a Map. OneGeology already has support for WMC (Web Map Context) [OWMC] which precedes the more recent OWSContext. WMC is more limited in scope (restricted to a list of WMS layers or WFS’, although layers can have links to data and metadata). OneGeology portal can load WMC and recreate a map (see figure 1) – even if the layers are not registered in OneGeology catalog. OneGeology can also save the current set of layers into a WMC which can be reused later or shared with other users (WMC is an XML file). It has been proposed to leverage this existing capability to implement the concept of a map. Because implementing OWSContext will require some significant work, the group proposed to first implement a WMC only



version and consider a OWSContext on a later phase. Nothing prevents OneGeology to provide both WMC and OWSContext as alternative representation. This also allows OneGeology to progressively implement the representations, starting with WMC which is already supported by the portal.

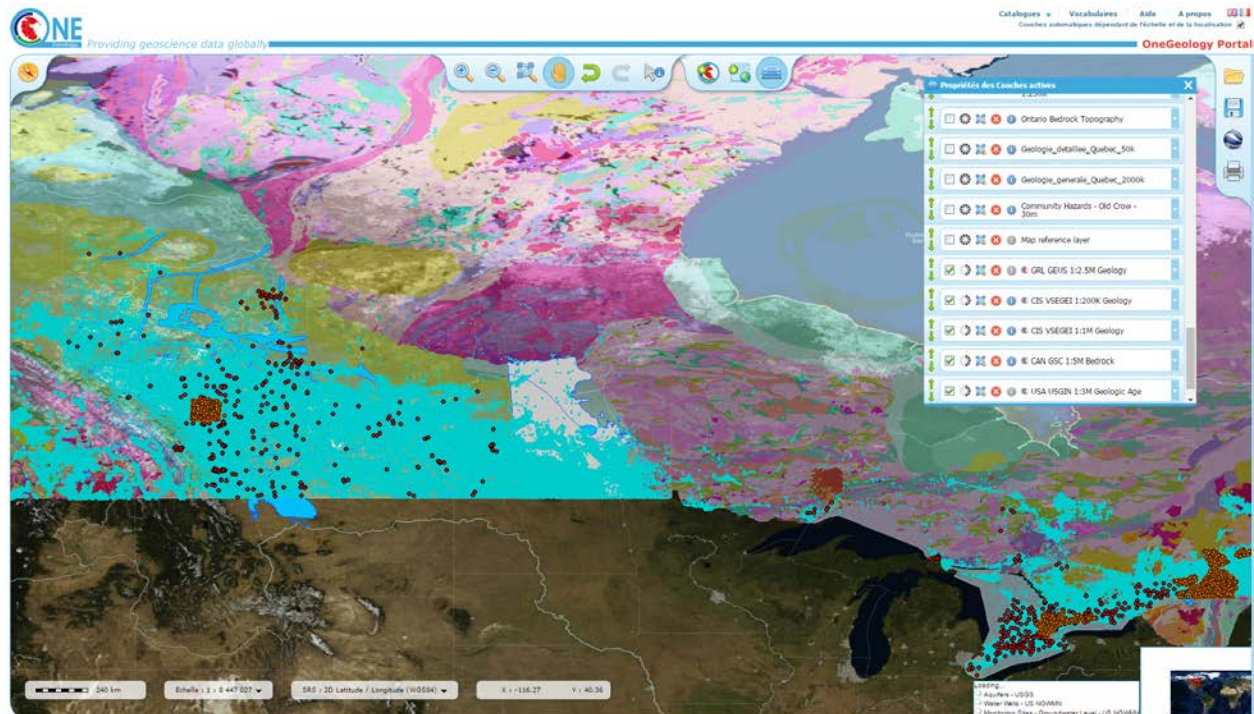


Figure 1: Map created one OneGeology portal by loading GIN WMC (provided by GIN service)

## Recommendations

UC-MAP.1 Expose each layer in the metadata catalog as a single layer WMC

A default 1 layer map can automatically be generated from the catalog. The content of the metadata catalog is probably sufficient to generate all elements required in single layer WMC. This means that from the catalog at least two kinds of resources can be generated: a) layer/service/other and b) maps. If the uuid of the metadata record can be reused is debatable.

For instance, we could consider a URI

<http://onegeology.org/id/map/e39920d6-7284-4c5f-aadc-97daaef37c5e>



and

<http://onegeology.org/id/layer/e39920d6-7284-4c5f-aadc-97daaef37c5e>

to be different identifiers (they are) or two different things which lead to different representations. But sharing the same uuid might generate confusion as user might consider both URI to be the same thing (they are not). In this particular situation, single layer map happen to share the same uuid. It won't be the case for multiple layer maps, which will have their own uuid from their own metadata record.

The counter argument is, URI are supposed to be opaque and one should not try to infer anything from them. Whatever outcome of this debate won't make any change to the resulting architecture (content negotiation will return the right representation).

#### UC-MAP.2 Expose each WMC as a persistent URI

By leverage the work on the previous component, a persistent URI can be generated and exposed to search engines

E.G. :

<http://onegeology.org/map/{uuid}>

The content negotiation will provide various representations. Note that both WMC and OWSContext have XML representations, but they have distinct mime-types. OWSContext XML (amongst other encoding) representation uses Atom [Atom] *application/atom+xml* while WMC uses *application/vnd.ogc.context+xml* ([OWMC, clause 6.1).

`Text/xml`: provide the OneGeology portal loaded will all the layers (and other resources) provided in the WMC. This is an existing functionality in the portal. Improvement can be considered when moving to OWSContext.

`application/vnd.ogc.context+xml` : will provide the WMC in XML. It is suggested that "plain" XML (`text/xml`) also return WMC.

`application/atom+xml` : will return OWSContext (when supported) in Atom/XML format [OWSC-E] Clause 6.2

`application/vnd.geo+json` : will return OWSContext in GeoJSON (when supported) [OWSC-J] Clause 7.1

#### UC-MAP.3 Allow creation and storage of "map" on OneGeology identified by persistent URI

This feature will allow OneGeology with edition roles to create map composition and save them as WMC as a public resource (as opposed to a local file as it is the case right now). This will

- Assign a persistent URI to the map (likely based on the guid of the metadata record)
- Provide to opportunity to fill metadata record for the map
- Expose the resource to search engines
- Eventually add more resources (stories, images, links to publications, etc..) as OWSContext is implemented

#### UC-MAP.4 Provide a sitemap of all maps on one geology

Similar to metadata, provide a crawlable sitemap of all maps as an HTML page. This page should provide a list of all map persistent URI.

#### UC-MAP.5 Add microdata and/or schema.org or RDFa to HTML representation

Add search index friendly microdata in the page (HTML) representation to improve discoverability (see UC-META.3). The nature or content of microdata need to be discussed. It is likely that some of the content will come from the metadata document.

## Actions

We did not have enough time to define a precise work plan but agreed on some task that needs to be done

- Develop fully documented Use Cases
- Implement PID on OneGeology for Metadata and Map
- Expose Metadata list to crawlers
- Implement the ability to save a WMC/OWSContext in OneGeology and provide a persistent URI linking to it.
- Create WMC/OWSContext for each layer in the metadata catalog
- Create a sitemap for all maps in OneGeology

Further discussions amongst the TIG will be required to come up with concrete work plan. The group also showed interest to push further, especially for their own infrastructure, into Linked Open Data and there is an opportunity to work beyond those two use cases.

## Acknowledgment

We wish to express our gratitude to Geologische Bundesanstalt for hosting this meeting and grant us access to their network and technical support. Special thanks too for coffee and refreshments provided during our enjoyable stay. **Danke schön !**

## Annex A : Attendees

Name	Organisation
Christine Hörfarter	Geologische Bundesanstalt
Martin Scheigl	Geologische Bundesanstalt
Tim Duffy	British Geological Survey
Marcus Sen	British Geological Survey
James Passmore	British Geological Survey
Chris Schubert	Vienna University
Mark Rattenbury	GNS Science, New Zealand
Oliver Raymond	Geoscience Australia
Carlo Cipolloni	Servizio Geologico d'Italia, ISPRA
Sylvain Grellet (remote)	Bureau de recherches géologiques et minières
Steve Richard (remote)	Columbia University
Rachel Heaven (remote)	British Geological Survey
Eric Boisvert	Commission géologique du Canada / Geological Survey of Canada



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## Annex B : OWSContext example

### Annotated Example of OWSContext in ATOM/XML

```

<?xml version="1.0" encoding="UTF-8"?>
<feed xml:lang="en" xmlns="http://www.w3.org/2005/Atom"
xmlns:georss="http://www.georss.org/georss" xmlns:gml="http://www.opengis.net/gml"
xmlns:owc="http://www.opengis.net/owc/1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:dc="http://purl.org/dc/elements/1.1/">
  <!-- Required Root Element and Namespaces. One Mandatory Language Attribute.
  Ex: xml:lang="en" or xml:lang="fr" -->
  <link rel="profile" href="http://www.opengis.net/spec/owc-atom/1.0/req/core"
  title="This file is compliant with version 1.0 of OWS Context"/>
  <!-- Required as is-->
  <id>http://www.nrcan.gc.ca/earth-sciences/science/geology/geology-
  canada/10868/</id>
  <!-- One Mandatory ID in IRI Format. Must be Unique. Not Necessarily
  Dereferenceable. -->
  <title>GSC EN Geological Formations</title>
  <!-- One MandatoryTitle. Content may be of type "text", "HTML" or "XHTML" -->
  <subtitle type="text">
    <em>Geological Survey of Canada (GSC) - Geological Map Data</em>
  </subtitle>
  <!-- Optional Abstract. Content may be of type "text", "HTML" or "XHTML" -->
  <updated>2017-06-01T16:18:20Z</updated>
  <!-- One MandatoryDate of OWC Creation or Significante Update -->
  <author>
    <!-- Zero or More Optional OWC Author. If Author Contains No Child Nodes,
    It Should Not Be Serialized -->
    <name>Héryk Julien</name>
    <!-- One Optional Name -->
    <email>heryk.julien@canada.ca</email>
    <!-- One Optional Email-->
    <uri>http://sage-
    geds.gc.ca/en/GEDS?pgid=015&dn=cn%3DJulien%5C%2C+Heryk%2Cou%3DGI-GI%2Cou%3DGSCQUE-
    CGCQC%2Cou%3DGSCNCB-CGDCNC%2Cou%3DESS-SST%2Cou%3DDMO-CSM%2Cou%3DNRCan-
    RNCan%2Co%3Dgc%2Cc%3Dca</uri>
    <!-- One Optional URI-->
  </author>
  <dc:publisher>Geological Survey of Canada - Natural Resources Canada -
  Government of Canada</dc:publisher>
  <!-- ZERO or More Entity Responsible for the OWC - Person, Organisation or
  Service-->
  <!--<rights></rights>-->
  <!-- ZERO or More Human Readable Rights Over the OWC -->
  <georss:where>
    <gml:Polygon>
      <gml:exterior>
        <gml:LinearRing>
          <gml:posList srsDimension="2"
  srsName="EPSG:4326">40.0 -141.0 86.5 -141.0 86.5 -47.5 40.0 -47.5 40.0-
  141.0</gml:posList>
          <!--<gml:posList srsDimension="2"
  srsName="EPSG:4326">ymin xmin ymax xmin ymax xmax ymin xmax ymin xmin</gml:posList>-->
        </gml:LinearRing>
      </gml:exterior>
    </gml:Polygon>
  </georss:where>

```

```

</georss:where>
<!-- Optional Suggested Viewer Area of Interest (Bounding Box Coordinates) -->
<!-- <dc:date>2009-01-23T09:08:56.000Z/2009-01-23T09:14:08.000Z</dc:date>Zero
or more Relevant Context Document Date or Range of Dates -->
<entry>
  <!-- Zero or More Ressources. The First Entry is the Topmost Layer -->

  <id>http://canada3d.gcgeo.gc.ca/ows/wms/getcapabilities/onegeology/GSC\_EN\_Geological\_Formation/#CAN\_GSC\_EN\_5M\_Bedrock\_Geology</id>
  <!-- One Mandatory ID in IRI Format. Must be Unique. Not Necessarily
  Dereferenceable. Mandatory reference to the Context Resource -->
  <title>CAN GSC EN 1:5M Bedrock Geology</title>
  <!-- Mandatory human-readable title of the resource. Content may be of
  type "text", "HTML" or "XHTML" -->
  <content type="html">
    <h1>CAN GSC EN 1:5M Bedrock Geology</h1>
    <p>Geological map of the Arctic - 2011 - Arctic Circumpolar
    bedrock - Geological Survey of Canada - Natural Resources Canada. Geological Survey of
    Canada, "A" Series Map 2159A, 2011; 9 sheets; 1 DVD, doi:10.4095/287868. Harrison, J
    C; St-Onge, M R; Petrov, O V; Strelnikov, S I; Lopatin, B G; Wilson, F H; Tella, S;
    Paul, D; Lynds, T; Shokalsky, S P; Hults, C K; Bergman, S; Jepsen, H F; Solli, A</p>
  </content>
  <!-- Mandatory Description of the Resource Purpose or Content Unless the
  parent Atom Feeds Contains at Least One Author. Content May Be Of Type "text", "HTML"
  or "XHTML". Type "HTML" Recommended. -->
  <updated>2017-06-01T16:18:20Z</updated>
  <!-- One Optional Date of Resource Creation or Significant Update -->
  <author>
    <name>Héryk Julien</name>
    <!-- One Optional Name -->
    <email>heryk.julien@canada.ca</email>
    <!-- One Optional Email-->
    <uri>http://sage-geds.gc.ca/en/GEDS?pgid=015&dn=cn%3DJulien%5C%2C+Heryk%2C%3DGI-GI%2C%3DGCQUE-CGCQC%2C%3DGSCNCB-CGDCNC%2C%3DESS-SST%2C%3DDMO-CSM%2C%3DNRCan-RNCan%2C%3Dgc%2C%3Dca</uri>
    <!-- One Optional URI-->
  </author>
  <!-- Zero or More Optional OWC Author. If Author Contains No Child Nodes,
  It Should Not Be Serialized. Should Contain a Least One Child Node -->
  <dc:publisher>Geological Survey of Canada - Natural Resources Canada -
  Government of Canada</dc:publisher>
  <!-- ZERO or More Entity Responsible for Making the Resource Available -
  Person, Organisation or Service-->
  <!--<rights></rights>-->
  <!-- ZERO or More Human Readable Rights Over the Resource -->
  <georss:where>
    <gml:Polygon>
      <gml:exterior>
        <gml:LinearRing>
          <gml:posList srsDimension="2"
srsName="EPSG:4326">32.8080677701495 -143.4193835023 83.774951119695 -143.4193835023
83.774951119695 -10.308359664933 32.8080677701495 -10.308359664933 32.8080677701495 -
143.4193835023</gml:posList>
          <!--<gml:posList srsDimension="2"
srsName="EPSG:4326">ymin xmin ymax xmin ymax xmax ymin xmin</gml:posList>-->
        </gml:LinearRing>
      </gml:exterior>
    </gml:Polygon>
  </georss:where>

```



```

<!-- Optional Area of Interest of the Resource (Bounding Box Coordinates)
-->
<!-- <dc:date>2009-01-23T09:08:56.000Z/2009-01-
23T09:14:08.000Z</dc:date>Zero or more Relevant Context Document Date or Range of
Dates -->
<link rel="icon" type="image/png" title="Canadian Bedrock Geology"
href="http://canada3d.gcgeo.gc.ca/geoserver/GSC_EN_Geological_Formations/ows?REQUEST=G
etMap&SERVICE=WMS&TRANSPARENT=true&LAYERS=CAN_GSC_EN_5M_Bedrock_Geology&am
p;FORMAT=image/png&VERSION=1.1.1&STYLES=&SRS=EPSG:4326&WIDTH=25&HE
IGHT=25&BBOX=-143.4193835023,32.8080677701495,-10.308359664933,83.774951119695"/>
<!-- Zero or More Reference to a Quick-Look or Browse Image Representing
the Context resource. The Attributes Length and Type SHOULD be Provided -->
<link rel="alternate" type="text/html" title="Metadata & Download"
href="http://dx.doi.org/10.4095/208175"/>
<!-- Zero or More reference to a description of the Context resource in
alternative format-->
<link rel="enclosure" type="image/png" title="Canadian Bedrock Geology"
href="http://canada3d.gcgeo.gc.ca/geoserver/GSC_EN_Geological_Formations/ows?REQUEST=G
etMap&SERVICE=WMS&TRANSPARENT=true&LAYERS=CAN_GSC_EN_5M_Bedrock_Geology&am
p;FORMAT=image/png&VERSION=1.1.1&STYLES=&SRS=EPSG:4326&WIDTH=1680&
HEIGHT=934&BBOX=-143.4193835023,32.8080677701495,-
10.308359664933,83.774951119695"/>
<!-- Zero or More reference to the location of the data resource
described in the Context resource. Length and type attributes SHOULD be provided-->
<link rel="enclosure" type="application/pdf" title="Canadian Bedrock
Geology Map"
href="http://ftp.maps.canada.ca/pub/nrcan_rncan/publications/ess_sst/208/208175/gscmap
-a_1860a_e_1996_mn01.pdf"/>
<link rel="enclosure" type="image/jp2" title="Canadian Bedrock Geology
Map"
href="http://ftp.maps.canada.ca/pub/nrcan_rncan/publications/ess_sst/208/208175/gscmap
-a_1860a_e_1996_mn01.jp2"/>
<link rel="enclosure" type="application/x-compressed-zip" title="Canadian
Bedrock Geology Map"
href="http://ftp.maps.canada.ca/pub/nrcan_rncan/publications/ess_sst/208/208175/as_186
0.zip"/>
<owc:offering code="http://www.opengis.net/spec/owc-atom/1.0/req/wms">
  <owc:operation code="GetCapabilities" method="GET"
href="http://canada3d.gcgeo.gc.ca/ows/wms/getcapabilities/onegeology/GSC_EN_Geological
_Formation.xml?service=wms&version=1.3.0&request=getcapabilities"/>
  <!-- Zero or more. Defines an operation within an offering. Each
Operation has One mandatory "@code" indicating the type of offering. Each Operation
has One mandatory "@methode". Zero or more MIME-type of the content class. Zero or One
"@href". For HTTP GET the serviceURL item is used to capture the entire request. For
POST (and SOAP) requests, the serviceURL is used to capture the address, and in
addition a payload
is required.-->
  <owc:operation code="GetMap" method="GET"
href="http://canada3d.gcgeo.gc.ca/geoserver/GSC_EN_Geological_Formations/ows?REQUEST=G
etMap&SERVICE=WMS&TRANSPARENT=true&LAYERS=CAN_GSC_EN_5M_Bedrock_Geology&am
p;FORMAT=image/png&VERSION=1.1.1&STYLES=&SRS=EPSG:4326&WIDTH=1680&
HEIGHT=934&BBOX=-143.4193835023,32.8080677701495,-
10.308359664933,83.774951119695"/>
</owc:offering>
<!-- Zero or More offerings defined by the class OWC:Offering. No
significance to the order of appearance of the owc:offering elements in an atom:entry.
Each Offering has One mandatory "@code" indicating the type of offering. -->
<!-- IMPORTANT: See OGC OWS Context Atom Encoding Standard for examples
of integration of various OGC standards (ex: WFS, WPS, KML, GeoTIFF, etc) as well as
for POST and SOAP and inline results examples (ex: GML) -->
<category term="true" scheme="http://www.opengis.net/owc/active"/>

```

```

<!-- Zero or One Flag value "active" indicating to the client if the
Context resource should be displayed by default. Possible values are 'true' or 'false'
and the values are case-sensitive. Default value is 'true' -->
  <link rel="via" type="application/vnd.ogc.wms_xml" title="Original
GetCapabilities document"
href="http://canada3d.gcgeo.gc.ca/ows/wms/getcapabilities/onegeology/GSC_EN_Geological
_Formation.xml?service=wms&version=1.3.0&request=getcapabilities"/>
  <!-- Zero or More reference to a resource from which the present resource
is derived-->
  <category scheme="http://www.onegeology.org/wmsCookbook/appendixI.html"
term="Bedrock" label="Bedrock"/>
  <!-- Zero or More Keywords. It MAY have a related code-list that is
identified by the scheme attribute. The category element has one required attribute,
term (identifies the category), and two optional attributes, scheme (identifies the
categorization scheme via a URI) and label (provides a human-readable label for
display). This specification assigns no significance to the order of atom:category
elements within the atom:entry.-->
  <!--<owc:minScaleSenominator>100</owc:minScaleSenominator> Zero or One.
Defines the minimum scale for the display of the resource -->
  <!--<owc:maxScaleSenominator>100</owc:maxScaleSenominator> Zero or One.
Defines the maximum scale for the display of the resource -->
  <category terme="BEDROCK" label="Bedrock Geology"
schema="http://www.opengis.net/spec/owc/folder"/>
  <!-- Zero or one. Defines the folder name in
which the resource is placed. If this atom:category element has a title attribute it
MAY be used to represent a human-readable caption.-->
  </entry>
  <link rel="via" type="application/vnd.ogc.wms_xml" title="Original
GetCapabilities document"
href="http://canada3d.gcgeo.gc.ca/ows/wms/getcapabilities/onegeology/GSC_EN_Geological
_Formation.xml?service=wms&version=1.3.0&request=getcapabilities"/>
  <link rel="via" type="text/html" title="Geology of Canada"
href="http://www.nrcan.gc.ca/earth-sciences/science/geology/geology-canada/10868"/>
  <!-- ZERO or More References to Resources from Which the OWC is Derived. Ex:
Metadata link -->
  <category scheme="http://www.onegeology.org/wmsCookbook/appendixI.html"
term="OneGeology" label="OneGeology"/>
  <category scheme="http://www.eionet.europa.eu/gemet/concept" term="Earth
Science" label="Earth Science"/>
  <category scheme="http://www.eionet.europa.eu/gemet/concept" term="Geology"
label="Geology"/>
  <category scheme="https://unstats.un.org/unsd/methodology/m49/" term="Canada"
label="Canada"/>
  <category scheme="https://unstats.un.org/unsd/methodology/m49/" term="Northern
America" label="Northern America"/>
  <!-- ZERO or More Keywords that May Have a Related Code-list. Scheme and Label
Attributes are Optional -->
</feed>

```

## References

[1GMB]

OneGeology Board Meeting #10 , March 2017,

[http://www.onegeology.org/docs/meetings/OneGeology\\_Board\\_Meeting\\_10\\_Final\\_Minutes.pdf](http://www.onegeology.org/docs/meetings/OneGeology_Board_Meeting_10_Final_Minutes.pdf). Last accessed May 25, 2017

[Atom] Gregorio, J., ed. 2007, The Atom Publishing Protocol, <http://www.rfc-editor.org/rfc/rfc5023.txt>

[DWBP]

Data on the Web Best Practices. Bernadette Farias Loscio; Caroline Burle; Newton Calegari. W3C. 31 January 2017. W3C Recommendation. URL: <https://www.w3.org/TR/dwbp/>

[OWSC]

OGC OWS Context Conceptual Model OGC Web Services Context Document (OWS Context), OGC 12-080r2, [https://portal.opengeospatial.org/files/?artifact\\_id=55182](https://portal.opengeospatial.org/files/?artifact_id=55182)

[OWSC-E]

Brackin, R., Gonçalves, P., 2014, OGC OWS Context Atom Encoding Standard, OGC 12-084r2  
<[https://portal.opengeospatial.org/files/?artifact\\_id=55183](https://portal.opengeospatial.org/files/?artifact_id=55183)>

[OWSC-J]

Brackin, R., Gonçalves, P., 2016, OGC OWS Context GeoJSON Encoding Standard, OGC 14-055r2  
<http://docs.opengeospatial.org/is/14-055r2/14-055r2.html>

[SDWBP]

Spatial Data on the Web Best Practices, Jeremy Tandy; Linda van den Brink ; Payam Barnaghi. W3C/OGC , May 2017, W3C Working Group Note, URL: <https://www.w3.org/TR/sdw-bp/>

[OWMC]